Program Concept of Operations

Version 3.1

December 7, 2021

Revision History

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3.0	TAC-ConOps Working Group Distribution	11/23/2021	WSP; VL
3.1	Minor revisions to address comments from TAC-ConOps Working Group (CHP)	12/21/2021	WSP; VL

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Acronyms & Abbreviations

Innovate 680 Project Names

- ADS – Automated Driving System
- AT – Advanced Technologies
- ELC – Express Lane Completion
- PTTL – Part Time Transit Lane
- MOD – Mobility on Demand
- SMH – Shared Mobility Hub

Agency Names

- BAIFA – Bay Area Infrastructure Financing Authority
- BART – Bay Area Rapid Transit
- BATA – Bay Area Toll Authority
- Caltrans – California Department of Transportation
- CCTA – Contra Costa Transportation Authority
- CHP – California Highway Patrol
- County Connection – Central Contra Costa Transit Authority
- FAST – Fairfield and Suisun Transit'
- FHWA – Federal Highway Administration
- LAVTA – Livermore Amador Valley Transit Authority
- MTC – Metropolitan Transportation Commission
- SolTrans – Solano County Transit
- Tri-Delta Transit – Eastern Contra Costa Transit Authority
- USDOT – United States Department of Transportation

Stakeholder Committees

- CMT – Corridor Management Team
- ESC – Executive Streeting Committee
- PAC – Policy Advisory Committee
- PLT – Program Leadership Team
- SDT – Strategic Development Team
- TAC – Technical Advisory Committee

Other Terminology

- APC – Automatic Passenger Counters
- ATCMTD – Advanced Transportation and Congestion Management Technologies Deployment
- ATSPM – Automated Traffic Signal Performance Measures
- AVL – Automatic Vehicle Location
- CAD – Computer Aided Dispatch
- CATS – Coordinated Adaptive Traffic Signals
- CARM – Coordinated Adaptive Ramp Metering
- CBPP – Countywide Bicycle and Pedestrian Plan
- CCD – Countywide Connected Data Center
- CCTV – Closed Circuit Television
- CMA – Congestion Management Agency
- CMS – Changeable Message Sign
- ConOps – Concept of Operations
- DSRC – Dedicated Short Range Communications
- DSS – Decision Support System
- eBART – East Contra Costa County BART
- EL – Express Lanes
- EMT – Emergency Medical Transportation
- FSP – Freeway Service Patrol
- GHG – Green House Gasses
- GPL – General Purpose Lane
- HOV – High Occupancy Vehicle
- IDEA – Innovate Deployments to Enhance Arterials
- I-680 – Interstate 680
- ITS – Intelligent Transportation System
- KPI – Key Performance Indicators
- LUMS – Lane Use Management Systems

Other Terminology (continued)

- MOU – Memorandum of Understanding
- O&M – Operations and Maintenance
- PA/ED – Project Approval/Environmental Document
- PHD – Person Hours of Delay
- PHT – Person Hours Traveled
- PMT – Person Miles Traveled
- PTI – Planning Time Index
- RCSC – Regional Customer Service Center
- ROC – Regional Operations Center
- ROW- Right-of-Way
- SAV – Shared Automated Vehicle
- SHOPP – State Highway Operation and Protection Program
- SOP – Standard Operating Procedures
- SOV – Single Occupant Vehicle
- SR – State Route
- SWITRS – Statewide Integrated Traffic Records System
- TDM – Transportation Demand Management
- TMC – Transportation Management Center
- TNC – Transportation Network Company
- TOS – Traffic Operations System
- TSP – Traffic Signal Priority
- VHD – Vehicle Hours of Delay
- VHT – Vehicle Hours Traveled
- VMT – Vehicle Miles Traveled
- VSL – Variable Speed Limits
- V2I – Vehicle to Infrastructure
- V2V – Vehicle to Vehicle
- V2X – Vehicle to Everything

1.0 Introduction

The Innovate 680 Program (Program) originated with one simple concept: a connected corridor that could move people more efficiently and effectively. As the congestion management agency for the county, the Contra Costa Transportation Authority (CCTA) embraced this challenge by studying congestion relief tools in development locally, nationally, and globally. After careful review of countless innovative solutions from every corner of the world, CCTA selected several strategies that, when combined to function as an integrated solution, will smooth traffic on Interstate 680 (I-680) and its surrounding communities, providing greener, more efficient transportation choices for all travelers. From these strategies, CCTA developed the six projects that make up the Program today. This Program Concept of Operations (ConOps) brings those six projects - as well as future projects that may be added to the program such as transit improvements - together and shows how they will build from the existing conditions, as described in Section 5.0.

The proposed concept comes to life in Section 6.0 as the ConOps describes how the six projects and existing regional systems will work together to support consistently smooth-flowing traffic, increased travel speeds, and innovative options for travelers to get where they need to go without having to drive a car. The full deployment of the program will also improve travel reliability on the road and transit networks alike to allow both business and the public to prosper. Ultimately, the Program is designed to provide options and tools that will improve mobility for all. Furthermore, these improvements will be measured in order to show the progress of the program's activities.

Please keep in mind that a ConOps is a user-oriented document that describes but does not define system characteristics for a proposed system. This document does not have all of the answers needed for a successful deployment; instead, it sets the path and the vision for full program-level integration that shows how the proposed concept will emerge and change the corridor as we know it today. The program's operational scenarios, presented in Section 7.0, demonstrate this change from both a traveler and operator perspective, further illustrating the vision of the Program.

The program is grateful for the support of its partner agencies throughout the development of this Program ConOps, including:

- California Department of Transportation (Caltrans)
- Metropolitan Transportation Commission (MTC)
- California Highway Patrol (CHP)
- Federal Highway Administration (FHWA)
- Bay Area Rapid Transit (BART)
- Central Contra Costa Transit Authority (County Connection)
- Livermore Amador Valley Transit Authority (LAVTA)
- City of Concord
- City of Walnut Creek
- City of San Ramon
- City of Pleasant Hill
- City of Martinez
- Town of Danville
- Contra Costa County

Working together, the Program will be a national model for success in partnership and innovative operations and maintenance best practices. Its impacts will be measurable, both operationally and organizationally, to define our successes as we conquer the toughest challenges our transportation network faces.

2.0 Purpose of Document

The Program aims to address increased population and economic growth in the county, which has resulted in increased congestion along I-680 and its surrounding communities. While physical, financial, and environmental constraints don't allow for a significant expansion in infrastructure to address this increased demand, CCTA has developed the Program to improve, integrate, and ultimately encourage the use of the full suite of transportation options made available to travelers of the corridor. To accomplish this goal, the Program ConOps describes the proposed operational concept for a program that aims to integrate the full suite of transportation solutions within the Program. From this, the program seeks to optimize the effectiveness of demand management strategies deployed on the I-680 corridor and its surrounding communities.

The Program ConOps includes operational features that have been developed through a collaborative process with key stakeholders led by CCTA. The development of this ConOps is intended to document a shared understanding among stakeholders of how the Program will ultimately be developed and operated. This sets a foundation that can be built upon in future phases of program development to ensure that the ultimate deployment conforms to its initial concept.

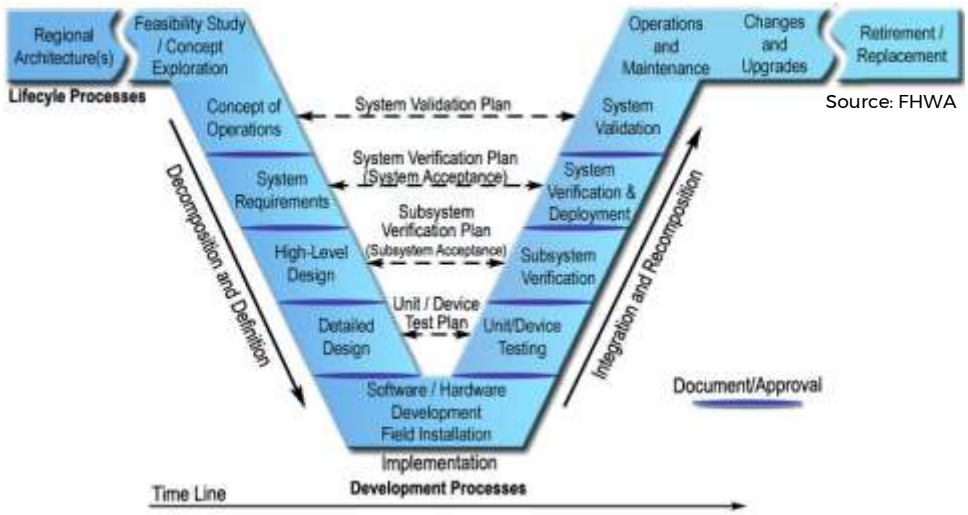
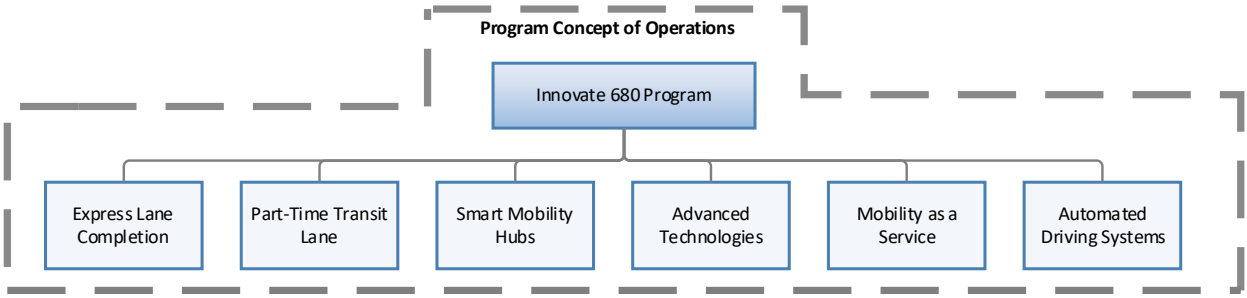


Figure 1 – FHWA Systems Engineering Process

As defined by the Federal Highway Administration (FHWA) Systems Engineering Process shown in Figure 1 above, a ConOps is typically developed to document the desired system concept from the viewpoint of stakeholders in a non-technical way. This ultimately serves as a foundation for developing the system in the future by providing an overview of the existing conditions, the system concept, and operational scenarios that begin to outline future considerations for system design. While the Program ConOps intends to accomplish this goal, it should be noted that this document is a program-level assessment of existing conditions and needs, encompassing various components work at both the program level and project level. For this reason, several projects within the Program will also develop project-level

ConOps documents to support their unique project goals and objectives, as shown in Figure 2 below. As such, the Program ConOps will also serve to guide the strategic direction of both program and project-related efforts in the future.



Source: WSP, 2021

Figure 2 – Program and Project ConOps Development

The development of this Program ConOps report was informed by extensive stakeholder engagement, achieved through several Technical Advisory Committee (TAC) - ConOps Working Group meetings. At these meetings, aspects of the Program and Innovate 680 projects were reviewed and discussed with stakeholders. This document is intended to describe the outcomes of a collaborative stakeholder engagement process in a way that is easily understood and widely accessible by stakeholder groups. This Program ConOps is also intended to be a living document with the flexibility to allow for updates, and changes as the Program evolves. As the development of the program matures and individual projects are implemented, this document may be updated to reflect final consensus related to the physical and operational aspects of the corridor.

3.0 Reference Documents

The following documents were used to support the development of the Program ConOps. Each document noted below can be found on the Program E-Builder website, linked **here**.

Reference Documents:

- Alameda CTC I-80 ICM System Integration ConOps (2017)
- BART Station Access Policy (2016)
- BART Multimodal Access Design Guidelines (2017)
- BART Short Range Transit Plan (2018)
- Caltrans I-680 Ramp Metering/TOS Project Initiation Document (2020)
- Caltrans Deputy Directive 35-R1 – Ramp Metering (2011)
- Caltrans Ramp Metering Design Manual (2016)
- Caltrans District 4 Bike Plan (2018)
- CCTA I-680 Transit Investment/Congestion Relief Options Study (2015)
- CCTA I-680 Design Alternatives Analysis: Adaptive Ramp Metering (2017)
- CCTA I-680 Concept Exploration for Integrated Corridor Management (2018)
- CCTA Northbound Express Lanes Design Alternatives Analysis (2016)
- CCTA Innovate 680 Corridor Management Plan (2020)
- CCTA Coordinated Adaptive Ramp Metering Feasibility Study (2020)
- CCTA Coordinated Adaptive Ramp Metering Concept Plans & Estimate (2020)
- CCTA Countywide Bicycle and Pedestrian Plan (2018)
- CCTA Part Time Transit Lane Draft ConOps (2020)
- CCTA Mobility on Demand Draft ConOps (2020)
- CCTA Shared Mobility Hub Vision White Paper (2020)
- CCTA Accessible Transportation Strategic Plan (2021)
- City of Concord Fiber Deployment Plan Schematic (2020)
- City of San Ramon ITS Master Plan (2018)
- City of Walnut Creek Fiber Optic Communications Network Master Plan (2018)
- Contra Costa County Iron Horse Corridor Active Transportation Study (2020)
- County Connection Short Range Transit Plan (2016)
- LAVTA Short Range Transit Plan (2016)
- LAVTA Tri-Valley Hub Network Integration Study (ongoing)
- MTC Bay Area ITS Architecture (On-Going)
- MTC Regional Communications Strategic Investment Plan (2019)
- MTC Regional Express Lanes ConOps (2016)
- MTC Innovative Deployments for Enhanced Arterials (IDEA) CCTA ConOps (2020)
- Victoria Department of Transport (Australia) Managed Motorways Reference Documentation, including:
    - Managed Freeways: Freeway Ramp Signals Handbook (2013)
    - Managed Freeway Guidelines (2015)
    - Guide to Smart Motorways (2016)
    - Managed Motorways Framework (2017)
    - Managed Motorways Design Guide (2019)

4.0 Scope of the Program

The Program, developed and initiated by CCTA, aims to create a comprehensive traffic management solution for the I-680 corridor in Contra Costa County. Over the years, this corridor has seen increased congestion, prompting numerous studies and evaluations to be undertaken by both CCTA and neighboring agencies. Unlike past regional efforts, CCTA recognizes the need to develop a comprehensive, corridor-wide solution along I-680. This approach will ensure that past, present and future work is integrated, and that collaborative progress is being made towards developing a multimodal transportation network of the future. This network will be centered around addressing the needs of travelers who utilize the I-680 corridor, with the aim of creating a seamless traveler experience for all.

To achieve this vision, CCTA partnered with program stakeholders to develop a regional partnership. This partnership will allow the program to leverage the collective resources of the region and ensure all solutions extend beyond jurisdictional boundaries. As such, the program seeks to integrate the full suite of transportation demand management solutions along the corridor. This connected corridor will move travelers more reliably and efficiently, providing a new set of easy-to-use options and tools that will improve mobility and encourage travelers to move toward shared modes. Ultimately, the aim of the program is to improve quality of life and accessibility to the transportation network while also providing better air, safer roads, shorter travel times, and less congestion in the county.

4.1 Program Goals and Metrics

The Program will be a performance-based program that is guided by ongoing, system-wide performance monitoring, allowing stakeholders to strategically review, modify, and implement varying operational strategies and projects across the corridor. The Program worked with stakeholders to develop programmatic goals and corresponding performance metrics that both encapsulate the vision of the program and outline the necessary steps to accomplishing it to establish the strategic direction of the Program.

To guide the strategic direction of the Program, CCTA, with the support of stakeholders of the program, developed a list of program goals. The goals of the Program are to:

- **Improve safety, efficiency, and reliability** on I-680;
- Develop and integrate advanced transportation technologies to **prepare the corridor for the future** and maximize the productivity of the transportation infrastructure;
- Enhance the ability for people to **shift travel modes** from single-occupant vehicles (SOV) to active transportation and shared mobility options;
- **Improve connectivity and services** among the suite of mobility options along the corridor to facilitate seamless end-to-end journeys;
- **Provide mobility options** that are accessible, convenient, and personalized to commuters;
- **Improve air quality** through shared mobility and reduced vehicle emissions along the corridor; and
- **Promote equity and provide access to transportation services** for residents who have limited or no access to vehicles through on-demand mobility and affordable transportation options.

To track the progress and success of the program in relation to the program goals, with the support of program stakeholders, CCTA also developed a list of program performance metrics. These metrics are shown in Table 1 below.

Table 1 – Program Performance Metrics

Program Goals	**Program Performance Metrics**
Improve Safety, Efficiency, and Reliability	• Vehicle Hours Traveled (VHT), Vehicle Hours of Delay (VHD), Vehicle Miles Traveled (VMT) • Person Hours Traveled (PHT), Person Hours of Delay (PHD), Person Miles Traveled (PMT) • Travel Time for Express Lane (EL), SOV, and Transit • Travel Time Reliability for EL, SOV and Transit • Number of Incidents • Incident Clearance Time • Crash Rate • Crash Severity
Prepare for Future and Maximize Productivity of Infrastructure	
Shift Travel Modes	• Average Vehicle Occupancy • Transit Ridership by Route • Mode Share • Number of People Using Shared Mobility Options
Improve Connectivity and Services	
Provide Mobility Options	
Improve Air Quality	• VMT • Green House Gasses (GHG)
Promote Equity and Provide Access to Transportation Services	• Transit and Paratransit Ridership • Number of People Being Served in Communities of Concern • Number of People Using Shared Mobility Options

Together, the program goals and metrics outline the goals, strategies, and future performance monitoring needs for the Program. It should be noted, however, that the development of the program goals and metrics is an ongoing process and may require review and/or amendments in the future as the landscape of potential transportation technologies, funding, and regional mandates evolve. If such action is required, it is recommended to reconvene the appropriate stakeholder committees to review, evaluate, and communicate changes to the program goals and metrics, while also updating this document to reflect the rationale and corresponding changes.

For additional information on the development of the Program goals and metrics, please see Appendix A – Program Goals & Metrics Development.

4.2 Innovate 680 Projects

Guided by the Program goals, CCTA is actively engaged in six Innovate 680 project efforts to implement various aspects of the Program. These initial six project efforts are summarized below in the Current Innovate 680 Projects section. The projects within the Program are geographically constrained to be within Contra Costa Country with impacts to travel patterns of the I-680 travel shed. Additionally, several other regional projects that have links to the program and/or may be incorporated into the Program in the future are listed in the Related Projects section. For additional information on the schedules for these projects, including considerations for future implementation, please see Section 8.0 Program Implementation.

4.2.1 Current Innovate 680 Projects

Advanced Technologies Project – The Advanced Technologies (AT) project will explore the development of an overarching system of systems capable of managing the suite of advanced traffic management and transportation demand management solutions deployed on the corridor. The term "system of systems" refers to a collection of dedicated systems that pool their resources and capabilities together to create a new, more complex system that offers more functionality and performance than simply the sum of the constituent systems. This project will develop a corridor-wide Decision Support System (DSS) to support an increased highway, arterial, and transit management, as well as a Countywide Connected Datacenter (CCD) to support data management and system-wide performance monitoring. The AT project will also explore a managed freeways approach to freeway traffic management and support the deployment of emerging technologies on the corridor, including the potential for utilizing coordinated adaptive ramp metering (CARM), lane use management signs (LUMS), variable speed limit signing (VSL), dynamic arterial messaging signs and coordinated adaptive traffic signals (CATS).

Currently, the AT project has evaluated the feasibility of a CARM solution on the I-680 corridor. Findings, concept-level plans, cost estimates for this deployment for the southern segment, between the CC/Alameda County Line and SR-24 can be found **here**. These findings were utilized to assess the synergies between the CARM strategy and the existing Caltrans Traffic Operations System (TOS)/Fiber/Ramp Metering State Highway Operation and Protection Program (SHOPP) project, which is described in more detail in the Related Projects section below. They will also be used to prepare an implementation plan to cover the entire I-680 corridor within Contra Costa County.

Caltrans and CCTA have executed a team integration charter for the delivery of CARM within the scope of the SHOPP TOS/Fiber/Ramp Metering project. This charter supports the project development activities and integration of the two projects. In November 2021, a Project Study Report that proposes an initial phase of CARM implementation, from Alcosta Boulevard to Olympic Boulevard in the northbound direction, was completed. The corresponding Project Approval/Environmental Document will begin in December 2021, which will include a project-level ConOps document outlining the necessary intelligent transportation systems and software systems envisioned for CARM.

Mobility on Demand Project – The Mobility on Demand (MOD) project will deploy a traveler-oriented mobility-as-a-service platform. This platform will combine traveler information and services provided by both public and private entities, allowing travelers to access personalized mobility options. This platform will ultimately enable end-to-end journeys that aim to optimize the use of the transportation system while also allowing users to plan, schedule and pay for trips. In addition, travelers will be incentivized and rewarded for multimodal trips that support transportation demand management (TDM) programs within the county.

The MOD project was borne from the Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) grant program administered by FHWA. Currently, the project is scoped to deliver Phase I of a mobility-as-a-service phone application. Phase I is intended to be a proof-of-concept deployment on the I-680 corridor leveraging the existing technology of the BART Trip Planner application. Future phases of MOD include a county-wide deployment (Phase II) and eventually a deployment across the greater Bay Area (Phase III). For more information on the initial operational concept of the MOD platform, please see the Draft MOD ConOps document, linked **here**.

Shared Mobility Hub Project – The Shared Mobility Hub (SMH) project will explore the development of multimodal transportation nodes within the program area. This includes improvements that support enhanced bus services, shared-use and demand-responsive mobility options, as well as active transportation. The project aims to upgrade existing transit hubs and/or construct new facilities that complement these services while also providing integrated, real-time traveler information to make it easier for users to access and/or request services for other modes of transportation. This includes micro-mobility options (i.e., shared electric scooters), carpools, vanpools, transportation network companies (i.e., Uber & Lyft), and bicycle and pedestrian facilities.

The SMH Project is in the planning stages of project development. Currently, the project is in the process of identifying potential shared mobility hub locations, as well as defining the amenities and typologies of shared mobility hub sites for future consideration. Additional information on these efforts can be found in the Shared Mobility Hub Vision White Paper, linked **here**.

Part Time Transit Lane Project – In cooperation with local public transit services, the Part Time Transit Lane (PTTL) project aims to allow bus operation on the right shoulder of I-680 during peak congestion hours. The project plans to enable buses to travel on dedicated shoulder lanes, bypassing heavy traffic congestion and further reducing traffic congestion in the general-purpose lanes (GPL). The project aims to increase the reliability of transit services and connectivity to other modes of transportation, providing an attractive travel option that addresses accessibility needs.

To date, the PTTL Project has developed a Draft PTTL ConOps document that describes the operational concept of a pilot PTTL demonstration. This report, which can be found **here**, outlines the use of a static roadside signing system for PTTL operations on the southern segment of the corridor. Both the ConOps and the project, however, have been put on pause due to a variety of factors. These include impacts to project funding from the COVID-19 pandemic, statewide efforts to establish bus-on-shoulder guidance, the need for legislation to

support bus-on-shoulder use on the state highway system, as well as enforcement and logistical concerns from corridor partners.

Automated Driving Systems Project – The Automated Driving Systems (ADS) project intends to implement a pilot program consisting of three different projects that utilize safety data, vehicle-to-infrastructure (V2I) communications, and the creation of more accessible transit options for older adults and persons with disabilities. The three projects in the pilot program include the Rossmoor First Mile/Last Mile Shared Automated Vehicles, the County Hospital Accessible Transportation in Martinez for an on-demand wheelchair-accessible shuttle service, and Personal Mobility on I-680 Corridor for the preparation of future automated vehicles and related technology by installing new and upgraded V2I and vehicle-to-vehicle (V2V) technologies to accommodate both connected and/or highly automated vehicle technology and the implementation of other innovative operational strategies.

The Automated Driving Systems project kicked off in 2021, with testing at GoMentum Station starting in 2022. Implementation of the three projects will begin in 2023 and run through 2024. The project is scheduled to wrap up by 2025. The project will be completed at that time, but the lessons learned from the project will support the program as it continues to develop beyond that timeline.

GoMentum Station is a 2,100-acre facility in Concord that that offers a collaborative space dedicated to the safe development of automated vehicles. The facility is used by private sector and public agency partnerships to advance connected and automated vehicle safety. Learn more at http://gomentumstation.net/

Source: GoMentum Sta. & AAA NorCal/NV/UT

Express Lane Completion Project – The Express Lane Completion (ELC) project proposes to construct a northbound Express Lane from Livorna Road to State Route (SR) 242 and would further include the conversion of the existing northbound high occupancy vehicle (HOV) lane to an express lane from SR-242 to the Benicia-Martinez Bridge toll plaza. The project alternatives are also considering a braided ramp operational improvement for the North Main Street, Lawrence Way, and Treat Boulevard northbound on and off ramps. The project would provide a continuous express lane network through the corridor and would further increase travel speeds for buses, carpools, vanpools, and motorcycles, relieving congestion and providing operational improvements by reducing bottleneck impacts and addressing weaving issues in areas that normally cause traffic congestion. Project alternatives are on the table that would either close the current HOV/Express lane gap or shorten the gap to be only between the Olympic and N Main I/Cs rather than Livorna to SR-242.

The ELC project is currently analyzing and refining build alternatives for the PA/ED phase of project delivery. The project team has prepared geometric drawings and preliminary traffic analysis and working with Caltrans to define the final build alternatives for PA/ED. Technical studies are underway, and the project schedule identifies the public circulation of the draft environmental document milestone in early 2023 and completion of the PA/ED in early 2024.

While the project will follow the design process to outline the placement of toll systems infrastructure, the project is expected to follow the operational concept for the MTC Express Lanes system. The document describing this concept, the MTC Express Lanes ConOps, can be found **here**.

4.2.2 Related Projects

Caltrans TOS/Fiber/Ramp Metering SHOPP Project – Caltrans has initiated a TOS/Fiber/Ramp Metering SHOPP project that overlaps the program area. This project intends to install fiber-optic communications, ramp metering, and other supporting ITS elements on the entirety of the I-680 corridor, as well as neighboring I-580 and I-780 corridors. The project is also scoped to upgrade the existing traffic management system for Caltrans District 4. For additional information on this project, please see the Project Initiation Document, linked **here**.

As noted earlier, CCTA and Caltrans are preparing a charter to link the TOS/Fiber/Ramp Metering Project goals with the Program and the Advanced Technologies Project. This effort will support the deployment of CARM on I-680 utilizing the managed freeways approach to traffic management.

MTC Innovative Deployments for Enhanced Arterials Projects – While not part of the Program, MTC, in partnership with CCTA, County Connection, the City of Walnut Creek, the City of Concord, and the City of San Ramon have initiated Innovative Deployments for Enhanced Arterials (IDEA) projects within the program area. These efforts intend to deploy traffic signal priority (TSP) and automated traffic signal performance measure (ATSPM) technologies along key arterial corridors neighboring I-680.

One such effort has been developed as a joint, collaborative partnership between CCTA, County Connection, the City of Walnut Creek, and the City of Concord. This project will deliver TSP systems in the northern portion of the program area. This effort has two main deployments focused around improving transit travel time reliability in the downtown Concord and Walnut Creek areas. In addition, the project will also support the development of a system that will support real-time traffic monitoring and signal timing changes for several City of Concord intersections. For more information on the operational concept of these deployments, please see the IDEA Project ConOps document, linked **here**.

Additionally, the City of San Ramon was awarded an IDEA grant from MTC and will be deploying an ATSPM program along the Bollinger Canyon and Crow Canyon corridors near the southern segment of the I-680 corridor.

4.3 Program Area

The Program encompasses an area within Contra Costa County extending from the Benicia-Martinez Bridge in the north to the Alameda County line in the south. As shown in Figure 3, a key feature of this area is the I-680 highway facility. In the region, this corridor serves as a key commuter route for travelers commuting to Silicon Valley, Bishop Ranch and various employment centers in downtown urban centers. Locally, this corridor also serves as the primary travel route into and out of the central and tri-valley regions of Contra Costa County. In addition to the I-680 highway facility, this area also encompasses:

- Three state route system interchanges (SR-24, SR-242 and SR-4);
- Twenty-four local service interchanges;
- Two regionally significant multi-use paths (Iron Horse and Contra Costa Canal trail);
- Eight park and ride facilities with connectivity to transit routes;
- Several BART stations along the Antioch-San Francisco International Airport (SFO)/Millbrae BART line;
- The Martinez Amtrak station with connectivity to the Capital Corridor and San Joaquins Amtrak lines;
- The Benicia-Martinez bridge serving regional Bay Area travel;
- Several notable transit centers for regional and local transit routes;
- Several regionally significant arterial corridors; and
- Several notable locations of significance to the residents of Contra Costa County.

Collectively, the transportation features listed above and illustrated in Figure 3 below define what is referred to as the "program area." The program area, which is evaluated further in this Program ConOps, ultimately offers services to travelers who both live and travel within Contra Costa County and those who travel through the corridor to neighboring regions. Therefore, while the program focuses on infrastructure improvements and transportation services offered within this specific geographical area, future program efforts will ensure that external trip origins and destinations are also considered.

For additional information on the program area, including a review of the existing infrastructure, services, operations, systems, support environment, regional policies, and user groups who interact with the transportation system outlined above, please see Section 5, Existing Conditions.

As noted, this assessment focuses primarily on the program area outlined in Figure 3. However, the program team recognizes the need for project-level efforts to incorporate the unique needs of local communities and regionally significant transportation features that are not presented in this report. These additional areas will likely increase the limits of the program to a greater "study area" that extends beyond the program area outlined here. As the program matures, this larger "study area" will be coordinated with program-level efforts to ensure consistency and conformity to the goals of the Program presented in Section 4.1.

Furthermore, throughout the planning and implementation of the various Innovate 680 projects, it is expected that project teams will likely require coordination with neighboring agencies and other regional efforts, including coordination with transit providers and nearby counties that serve neighboring communities. In order to support these efforts, CCTA has also developed the I-680 Corridor Partnership. This committee, comprised of regional transit, transportation and congestion management agencies, is tasked with evaluating mobility on the entirety of the I-680 corridor through Solano, Contra Costa, Alameda and Santa Clara counties. While the Program may require coordination with the I-680 Corridor Partnership in the future, it should be noted that the Program and the I-680 Corridor Partnership are different regional efforts with unique regional goals. While CCTA leads both, the agency is approaching each with the unique needs of the stakeholders involved.

Source: WSP, 2021

Figure 3 – Innovate 680 Program Area

4.4 Program Governance Structure

In order to support the Program, CCTA developed a collaborative regional partnership with stakeholders of the I-680 corridor. This partnership allows the program to leverage the collective resources of the region, with the hopes of developing a corridor-wide solution that sees beyond jurisdictional boundaries. In order to support these efforts, CCTA developed a robust, program governance structure comprised of various stakeholder committees aimed at providing strategic guidance and decision-making authority across the program. This governance structure is intended to develop a lasting partnership between agency stakeholders that can be sustained beyond eventual changes in leadership, staffing, and internal re-organizations. The following is an overview of each Innovate 680 stakeholder committee.

- **Corridor Management Team (CMT)** – Comprised of consultants/contractors and internal CCTA staff. This committee performs the day-to-day program and project-level work. This committee meets on a bi-monthly basis.
- **Strategic Development Team (SDT)** – Comprised of technical staff at CCTA, Caltrans, Metropolitan Transportation Commission (MTC), California Highway Patrol (CHP) and FHWA. This committee performs most of the detailed program and project-level coordination work. This committee meets on a monthly basis.
- **Program Leadership Team (PLT)** – Comprised of deputy-executive level staff at CCTA, Caltrans, MTC, CHP and FHWA. This committee serves as the primary decision-making authority for program providing as-needed direction and oversight. This committee meets quarterly.
- **Executive Steering Committee (ESC)** – Comprised of executive level staff at CCTA, Caltrans, MTC, CHP and FHWA. This committee approves scope, schedule, and funding changes, while also providing direction to the Program Leadership Team as needed. This committee meets on an as-needed basis.
- **Technical Advisory Committee (TAC)** – Comprised of technical staff from local cities, Contra Costa County and transit agencies. This committee advises the program on technical and project-specific matters. This committee meets ad-hoc, often prior to Policy Advisory Committee meetings.
    - **TAC-ConOps Working Group** – Comprised of members of the TAC, SDT and PLT. This committee was utilized to support the development of the Program ConOps. This committee meets ad-hoc.
- **Policy Advisory Committee (PAC)** – Comprised of elected officials of local cities, Contra Costa County and transit agencies. This committee advises the program on policy and overall program matters. This committee meets ad-hoc, often quarterly.

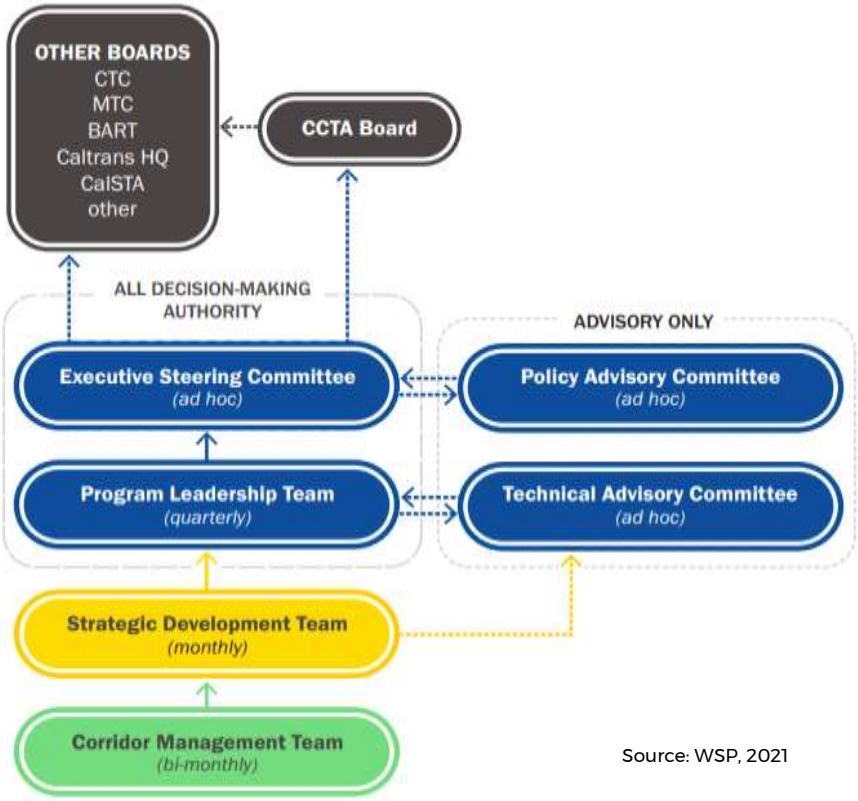


Figure 4 – Innovate 680 Program Governance Structure

4.5 Stakeholder Roles and Responsibilities

The following section outlines the existing roles and responsibilities of the Program stakeholders.

4.5.1 CCTA

CCTA is Contra Costa County's designated Congestion Management Agency (CMA), responsible for preparing and implementing congestion management programs and maintaining and improving the county's transportation system. CCTA does this by planning, funding, and delivering critical transportation infrastructure projects and programs across the county. This includes serving as the implementing agency for the county's transportation sales taxes from Measures C and Measure J funds. As the founding agency of the Program, CCTA serves as the Program Manager. CCTA's current role on the program is to oversee the strategic delivery of the program and projects, guiding the various committees that provide oversight and decision-making for the program. Staff at various levels within CCTA are members of the Corridor Management Team, SDT, Program Leadership Team, and Executive Steering Committee.

4.5.2 Caltrans

Caltrans District 4 is the lead state agency in the San Francisco Bay Area. Caltrans is responsible for coordinating with regional and local partners to plan, design, and construct transportation projects on the state highway system. As an owner, Caltrans District 4 operates and maintains more than 1,400 miles of the state highway system – of which 27 miles reside within the program area on the I-680 corridor. As a member of the Program, several District 4 staff members sit on the Strategic Development Team, supporting the delivery of the Innovate 680 Projects and overseeing the development of the overall program. In addition, deputy-executive and executive-level staff support the Program Leadership Team and Executive Steering Committee through guidance and oversight of the program.

4.5.3 MTC

MTC is the metropolitan planning organization of the San Francisco Bay Area, responsible for planning, financing, and coordinating transportation for the nine-county San Francisco Bay Area. In addition, MTC operates, maintains, and oversees a wide range of systems that support real-time operations in the Bay Area, including:

- The Bay Area Infrastructure Financing Authority (BAIFA), who is responsible for the operations of the Bay Area express lanes network;
- The Bay Area Toll Authority (BATA), who manages, invests, and distributes the revenues from the region's seven state-owned toll bridges and manages the Bay Area's FasTrak® electronic toll payment system and the FasTrak® Regional Customer Service Center (RCSC);
- The Freeway Service Patrol (FSP) program, which detects and clears incidents, picks up dangerous debris from freeways, and makes the roadways safer with its roving tow truck service;
- The Clipper® program, which oversees regionally integrated fare payment within the greater San Francisco Bay Area; and
- The 511 SF Bay traveler information program.

Each of these regional systems interface with the program in some capacity. In addition, as a stakeholder of the Program, several MTC technical, deputy-executive, and executive-level staff support the program's Strategic Development Team, Program Leadership Team, and Executive Steering Committee, helping guide and oversee the strategic direction of the program.

4.5.4 CHP

CHP is the state law enforcement agency with jurisdiction over all California highways. CHP also provides traffic enforcement and accident response on unincorporated County Roads. CHP supports the safety, enforcement, and security of the state highway system. CHP is also partnered with various Innovate 680 stakeholders for various support elements, including dispatch services supporting incident management on state highways and FSP program support in partnership with MTC and Caltrans. The CHP Golden Gate Division currently supports the Program with staff that serves on the SDT, Program Leadership Team, and Executive Steering Committee. These committee members help guide and oversee safety and law enforcement matters for the program.

4.5.5 FHWA

FHWA is the federal organization with the United States Department of Transportation (USDOT) that supports the planning and funding of improvements to the national highway system. FHWA initiates and oversees several federal funding programs. This includes the ATCMTD program. As such, FHWA is currently overseeing the delivery of both the Mobility on Demand and Automated Driving Systems projects within the Program. In addition to these efforts, FHWA offers a wealth of knowledge and expertise in systems engineering, supporting the program at the SDT, Program Leadership Team, and Executive Steering Committee level.

4.5.6 Transit Providers

4.5.6.1 BART

BART is a heavy rail provider that provides service between Alameda, Contra Costa, San Francisco, San Mateo, and Santa Clara Counties. Customers traveling to and from the Innovate 680 corridor have direct service to/from Oakland, San Francisco, San Mateo, Central Contra Costa, and Eastern Contra Costa on the Antioch-SFO Line and can transfer in Oakland to travel to/from northern, southern and eastern Alameda County, Milpitas, and San Jose. The stations located within the Innovate 680 corridor are the Concord, Pleasant Hill/Contra Costa Centre, North Concord/Martinez, and Walnut Creek stations. In addition to providing transit service on the corridor, BART staff currently support the Program by serving on both the Technical and Policy Advisory Committees, helping support both project-level and program-level efforts for the Program.

4.5.6.2 County Connection

County Connection is a motor bus and demand response operator that operates primarily in Central Contra Costa County. County Connection provides a variety of local, commuter, and school-based service throughout its service area. County Connection also operates paratransit bus service within the service limits of County Connection so long as the destination is within at least 3/4-miles of the fixed-route service and in most cases up to 1-1/2-miles from the fixed-route service. County Connection operates eight express routes that provide service primarily in the morning and afternoon that connects customers to important destination like BART stations, train stations, transit centers, and major employment areas. In addition to providing transit service on the corridor, County Connection staff currently support the Program by serving on both the Technical and Policy Advisory Committees, helping support both project-level and program-level efforts for the Program.

4.5.6.3 LAVTA

LAVTA, also known as Wheels, operates primarily in the Tri-Valley area that serves Dublin, Livermore, Pleasanton, and unincorporated parts of Alameda County. Wheels has one express route that provides service to the Pleasant Hill and Walnut Creek BART Stations, Route 70X, which operates in the morning and afternoon provides commuter service between the Dublin and Walnut Creek/Pleasant Hill BART Stations. Wheels also is responsible for paratransit services in the Tri-Valley. In addition to providing transit service on the corridor, Wheels staff currently support the Program by serving on both the Technical and Policy Advisory Committees, helping support both project-level and program-level efforts for the Program.

4.5.7 Local Agencies

There are several local agencies that support the Program. For the purposes of the program, these agency stakeholders are the owners of transportation network system elements within their jurisdictional boundaries, including arterial roads, parking facilities, bike/ped facilities, and city/countywide signal systems. As members of the Innovate 680 stakeholder group, technical staff and elected officials serve on both the Technical Advisory Committee and Policy Advisory Committee. Collectively, these local agency representatives support the program by providing strategic guidance in both technical, project matters, as well as broader, city and countywide policy decision making. There are seven local agency stakeholders within the Program, including:

- City of Concord
- City of Martinez
- City of Pleasant Hill
- City of Walnut Creek
- City of San Ramon
- Town of Danville
- Contra Costa County

Regional Transportation Planning Committees (RTPC) within Contra Costa County also play a role in the Program. TRANSPAC (Transportation Partnership and Cooperation) is the central Contra Costa County RTPC, which is under the jurisdiction of five cities and the County. The Southwest Area Transportation Committee ("SWAT") represents the South County sub-region including the Cities of Lafayette, Orinda, and San Ramon; the Towns of Danville and Moraga; and the unincorporated area of Southern Contra Costa County. These committee are responsible for the development of transportation plans, programs, and policies throughout the sub-region as well as the appointment of two representatives to the CCTA Board of Directors. The goals of these committees are typically to relieve congestion generated by past land use development through roadway and transit improvements to be funded by the sales tax increase, and to prevent future land use development decisions from resulting in a deterioration of public services throughout the County. The Local Agency representation for Program's TAC and PAC are appointed by the RTPCs.

4.6 Key Challenges for the Program

To implement the Program and achieve its stated goals, stakeholder partners will need to recognize, track and actively navigate a wide range of project and program-level challenges. The following section outlines several key challenges that were identified throughout the development of the Program ConOps that have the potential to significantly impact the program's ability to deliver its intended outcomes. While these do not capture all of the challenges of the program, these attempt to highlight key issues that will require significant consideration from all stakeholders moving forward.

4.6.1 Stakeholder Involvement

One of the primary challenges for the Program is uniting a wide range of program stakeholders who are unlikely to all have identical needs, goals, and priorities. If accomplished successfully,

the program will benefit from sharing information, resources, and funding to deliver Innovate 680 Projects effectively and efficiently. Conversely, if a collaborative partnership is not formed, future Innovate 680 efforts will be met with challenges that will result in cost, schedule, and quality impacts that will negatively affect the traveler experience on I-680. For these reasons, CCTA developed several Innovate 680 stakeholder committees to ensure all agency partners remain informed and actively involved in guiding the strategic direction of the program. In recognizing these needs, the program team utilized the Innovate 680 governance structure to develop this Program ConOps document. In doing so, the Program ConOps attempts to touch on all issues and concerns voiced by program stakeholders during the ConOps development process. And, while the Program ConOps was developed in this way, it will be equally important that all future program efforts, including those at the project level, utilize this committee structure to guide, develop and implement future solutions on the corridor.

4.6.2 Operations and Maintenance

In order to achieve the vision of the Program, all stakeholders must understand the wide range of roles, responsibilities, needs, and overarching implications of developing the various infrastructure and system elements proposed within the program. A clear understanding of the needs for ongoing operations and maintenance (O&M) is critically important to ensure the program has lasting support beyond the current leadership and internal governance of program stakeholders; the needs must extend to include broader regional, state, and national needs, and have longevity in order to have continued support by leadership at all levels in the future. The need for permanent, active management of the program and its supporting systems cannot be overemphasized. This will require a long-term commitment from all of the agencies involved and a collective understanding of the future roles and responsibilities on the corridor. This includes the operational decision-making and authority for the overarching system envisioned for the program. Furthermore, decision-making and authority are likely to require delegated and automated control of systems that program stakeholders typically control. This Program ConOps explores these challenges, outlining the need for future policy discussions and potential agreements.

4.6.3 System Integration

The Program will undoubtedly be challenged by the need to integrate the future slate of Innovate 680 Projects, their accompanying systems, and all other external systems owned by stakeholders and private entities serving the corridor. These challenges are likely to manifest throughout the development of public and private agreements, especially as they relate to legal and liability concerns surrounding data sharing and data security/privacy. Furthermore, there are likely to be several technical challenges as the program attempts to integrate existing and planned systems in the region. The intent of the Program ConOps will be to identify these challenges, highlighting both the risks and opportunities relating to these issues, helping guide the development of the program, and the eventual design of an overarching system.

4.6.4 Program Funding

All Innovate 680 Projects will require funding beyond their current phase of development. Furthermore, future Innovate 680 efforts that have been considered but not yet programmed

will require funding that has yet to be identified. This includes the long-term, permanent, and active nature of operating and maintaining the overarching system envisioned for the corridor. This will undoubtedly require future, long-term funding commitments; long-term funding of operations and maintenance, with no undue burden on local agencies, is critical for the success of the program. This Program ConOps highlights this issue, illustrating the potential need to pursue regional sales tax measures, federal grants, and other funding mechanisms to support the long-term financial obligations of the program.

4.6.5 COVID-19 Impacts on Travel Demand

The COVID-19 pandemic is likely to leave a lasting impact on the travel characteristics of the Innovate 680 corridor. While there are signs pointing to a slow recovery of vehicular traffic to pre-pandemic levels, transit ridership has seen a significant, sustained drop since March 2020. While this has proven challenging for transit providers on the corridor, the program remains steadfast in its commitment to improving transit travel and transit reliability in the future. This commitment is ultimately backed by information obtained from travelers of the corridor. Of over 1,500 recently surveyed individuals, 68% of respondents said they were either very interested or somewhat interested in driving less on the I-680 corridor.

In addition to the significant transit ridership decline, carpool and vanpool ridership has declined significantly. In fact, it should be noted that the 511 Contra Costa Carpool and Vanpool Programs have seen a significant reduction in ridership as well as the elimination of vanpools traveling to/from Contra Costa County, specifically to the San Ramon Valley, including Bishop Ranch Business Park, located in the City of San Ramon. This is very concerning to San Ramon as pre-COVID-19 there were approximately 30-50 vanpools on the road, carrying on average 10 passengers per van.

Collectively, these findings show a direct alignment between the wants of corridor travelers and the goals of the Program. This Program ConOps explores these considerations, evaluating both the existing conditions of the corridor prior to the start of the COVID-19 pandemic and the solutions that can be safely and efficiently offered to travelers in the future.

See Section 8.1 - Key Policy and Technical Considerations for additional discussion on each of these key challenges for the Program.

5.0 Existing Conditions

The following existing conditions assessment was completed to document an initial review of the program area in support of future program and project-level efforts. Furthermore, this section outlines the considerations, challenges, and needs for the proposed operational concept outlined in Section 6.0. This section provides an overview of:

- The existing infrastructure and services that enable travel in the program area;
- The existing operations of highway, arterial, transit, parking, and mobility services offered along the corridor prior to the COVID-19 pandemic;
- The impacts to existing operations due to the COVID-19 pandemic;
- The existing systems that provide services and/or support operators in managing services offered in the program area;
- The existing operational policies that are likely to impact the development of the proposed operational concept; and
- The existing user groups who interact with the transportation system and are evaluated further in the proposed operational concept and operational scenarios for the program.

5.1 Existing Infrastructure and Services

The Program covers an area positioned within the central and tri-valley region of Contra Costa County, centered around a 27-mile segment of the I-680 highway. This corridor is bound by the Benicia-Martinez Bridge to the north and the Contra Costa – Alameda County Line (Alcosta Blvd) to the south. This program area is illustrated in Figure 3 in Section 4.3 Program Area. Within the program area, there are several, key multimodal transportation features, including:

- The I-680 highway facility with general-purpose and HOV/EL;
- Three state route system interchanges (SR-24, SR-242 and SR-4);
- Twenty-four local service interchanges;
- Two regionally significant multi-use paths (Iron Horse and Contra Costa Canal trail);
- Eight park and ride facilities with connectivity to transit routes;
- Two truck scales;
- Several BART stations along the Antioch-SFO/Millbrae BART Line;
- The Martinez Amtrak station with connectivity to the Capital Corridor and San Joaquins Amtrak lines;
- The Benicia-Martinez bridge serving regional Bay Area travel;
- Several notable transit centers for regional and local transit routes;
- Several regionally significant arterial corridors; and
- Several notable locations of significance to the residents of Contra Costa County.

Collectively, the features noted above and illustrated in Figure 3 outline the key infrastructure elements of the program area. The following sections describe these existing features and the transportation services they provide to travelers in more detail.

5.1.1 Highway and Arterial Facilities

While the I-680 highway facility is a central component of the program area, the limits of the program encompass a much larger area inclusive of segments of neighboring highway

corridors as well as key arterial corridors. This area, however, is an expansive roadway network that is not possible to evaluate and study in detail at the program-level. Therefore, it is necessary for the program to establish bounds for a detailed review of the existing highway and arterial corridors within the program area. The following map, Figure 5, illustrates which corridors were evaluated as part of this program-level existing conditions assessment. This includes:

- The I-680 highway;
- The I-680 HOV/express lane facility;
- Segments of the neighboring SR-24, SR-242, and SR-4 highway facilities; and
- Key arterial corridors were identified as regionally significant based on discussions with stakeholders of the program.

It should be noted, however, that the highway and arterial facilities outlined in this program-level existing conditions assessment are not meant to be final. As the program progresses, stakeholders will continue to identify highway and arterial segments that will be required to be studied further. This includes work at the project level, which will likely identify and study arterial corridors and neighboring highway segments that may not be highlighted in Figure 5.

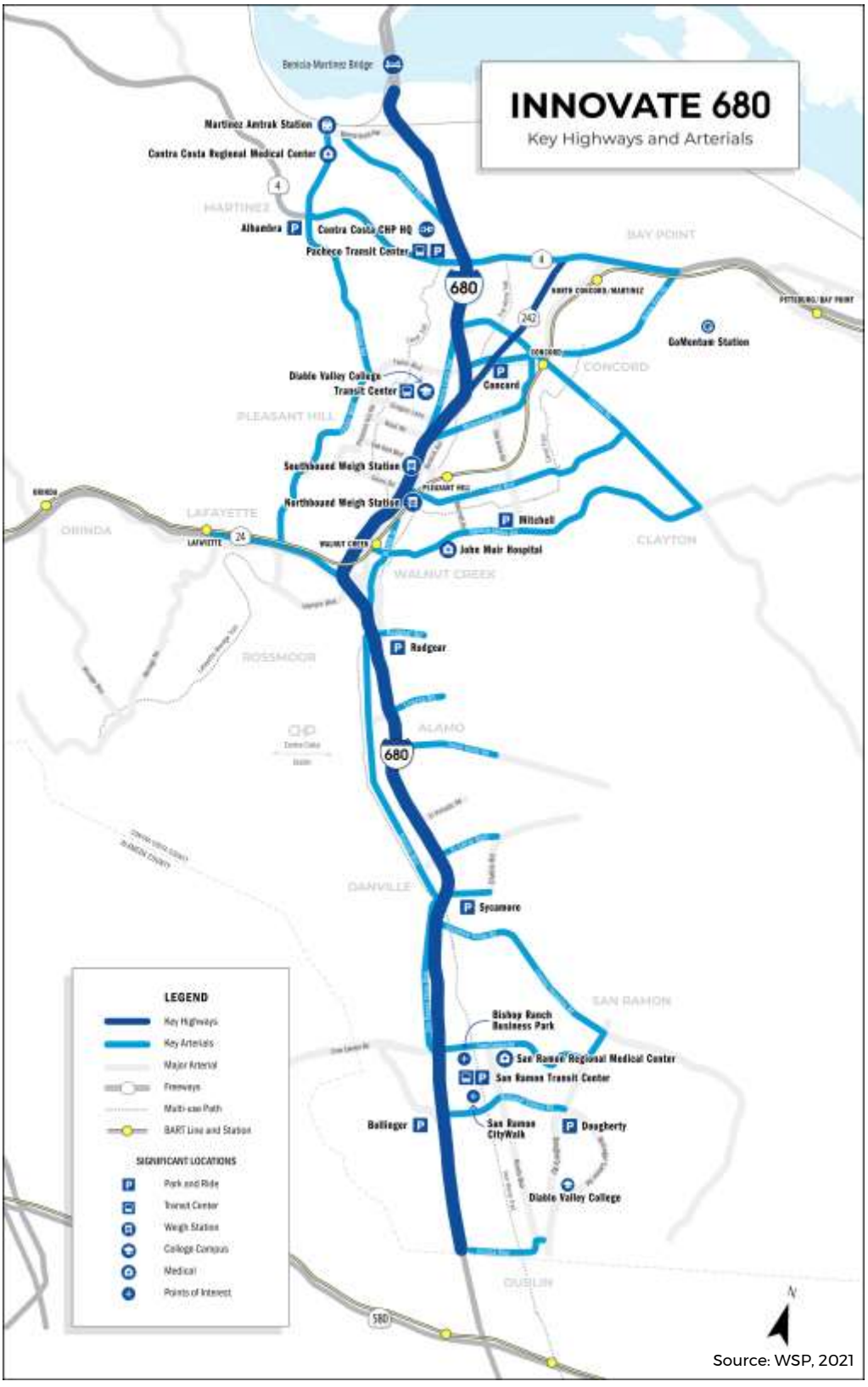


Figure 5 – Corridors Evaluated for Existing Conditions Assessment

The following is a brief description of these highway and arterial segments:

- **I-680 Highway** – I-680 is a north-south highway that provides a total of six to 10 lanes for approximately 27 miles through central Contra Costa County. The highway is classified as an urban principle arterial interstate and is owned and operated by Caltrans. At the north end of the corridor, I-680 interfaces with the Benicia-Martinez Bridge and toll plaza. The Benicia-Martinez Bridge is owned and operated by Caltrans and provides five and four travel lanes in the northbound and southbound directions, respectively, across the Carquinez Strait. The Benicia-Martinez Bridge toll plaza, located on the south side of the bridge in Contra Costa County, is owned and operated by MTC/BATA. The toll plaza charges northbound I-680 travelers as they enter into Solano County. In addition to these features, CHP also owns and operates a truck weigh station along I-680 in Walnut Creek. This truck scale facility supports CHP with the enforcement and safety of goods movement within the region.

- **I-680 HOV/EL** – The I-680 express lane currently provides one express lane northbound and southbound from the southern Contra Costa County line to approximately Rudgear Rd/Livorna Rd. The southbound express lane from just south of the Benicia-Martinez bridge from Marina Vista Ave to Rudgear Rd, which had been operating as an HOV lane since August 2020, opened to traffic as an express lane in August 2021. The northbound segment from Livorna Rd to the SR-242 interchange does not have an existing HOV or express lane, however, an HOV lane begins around SR-242 and ends just south of the Benicia-Martinez bridge at Marina Vista Ave. The entire northbound section from Livorna Rd to the Benicia-Martinez bridge is currently being evaluated as a potential express lane under the Innovate 680 Express Lane Completion project. The express lane facilities are currently owned and operated by MTC/BAIFA. On the express lane, buses, as well as HOV 2+, vanpools, and motorcycles with a switchable FasTrak® transponder, travel toll-free, while solo-driver CAVs pay half-priced tolls. Discounts are also available to travelers with eligible clean-air vehicles. Other vehicles pay a toll to use the facility.

- **Neighboring Highway Facilities** – In addition to I-680, several highway facilities in Contra Costa County provide significant connectivity within the program area. These include the SR-24, SR-242, SR-4, and II-580 facilities which are owned and operated by Caltrans. All of these highways intersect with I-680, creating three significant highway interchanges in the program area. As shown in Figure 5, while these facilities will be partly evaluated at the program-level, the extent of the evaluations will be limited by the scope and budget of the Program and will need to be evaluated when congestion on these routes impacts the operations of I-680.

- **Arterial Corridors** – Arterial corridors in the program area serve as key connections for local vehicle traffic, local transit routes, and other multimodal travel. Several arterial corridors were identified as regionally significant in discussions with stakeholders of the program. These arterials are highlighted in Figure 5, including:
    - the Pacheco Blvd-Contra Costa Blvd and Danville Blvd-San Ramon Valley Blvd corridors that run parallel to I-680 the entire length of the corridor,
    - the Monument Blvd-Concord Ave corridor in the downtown Concord area,

- the Treat Blvd and Ygnacio Valley Rd corridors in Walnut Creek,
- segments of other key arterial corridors in the program area that intersect with the I-680 highway and/or were deemed locally significant to stakeholders of the program.

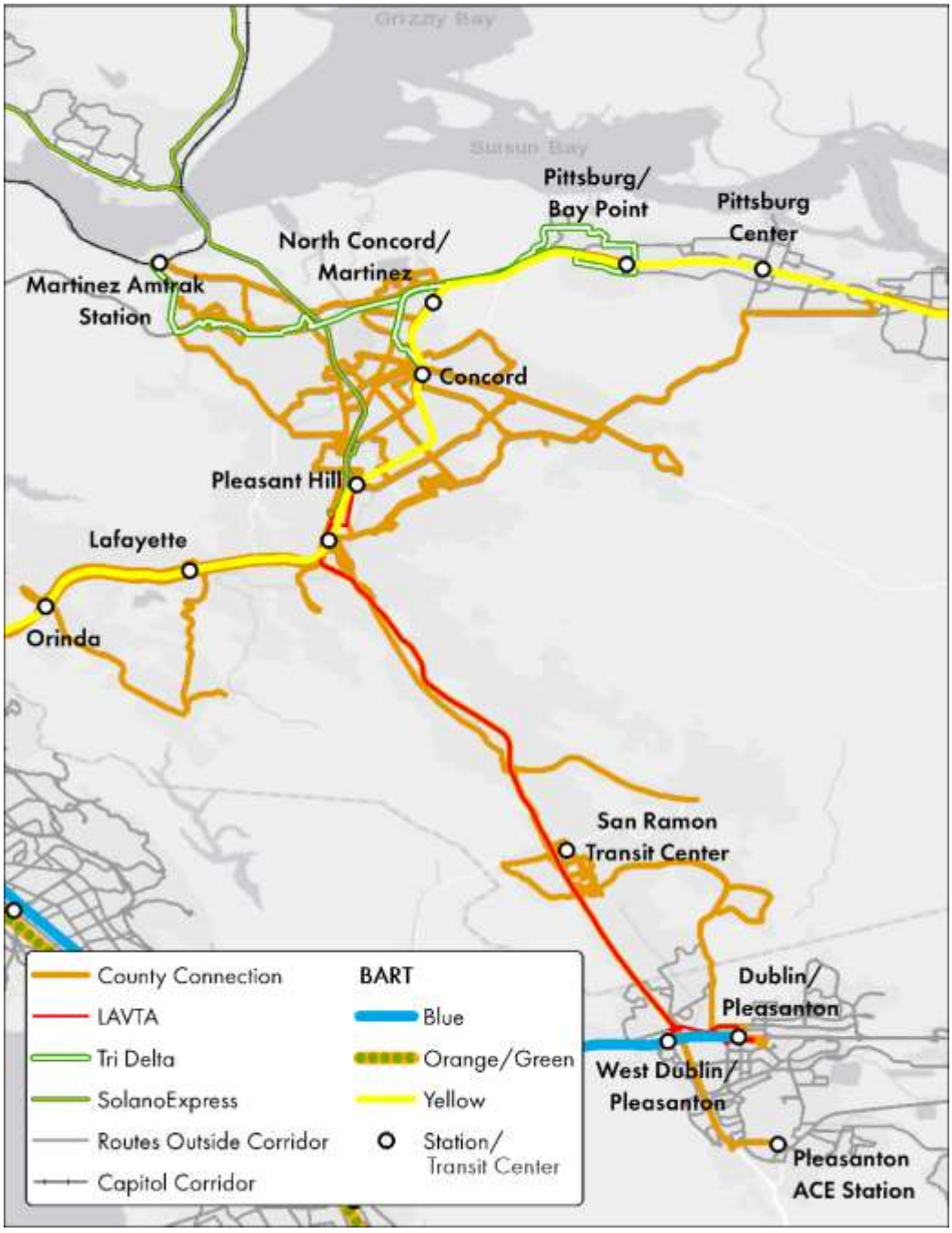
5.1.2 Transit Service

Several transit operators offer varying levels of transit service in the program area. This section details the existing transit service along or near the I-680 corridor and includes information primarily on the public transit providers that are part of the Innovate 680 TAC but also includes information on public and private transit providers that serve the corridor. The public transit information is based on pre-COVID-19 service information and could be different from what is currently operating or what will be planned to be operated as transit operators recover from the impacts of the pandemic. Figure 13 provides details of public transit routes within the Innovate 680 Corridor. Table 1 provides a summary of the public transit providers' service in the program area.

The information presented below is based on the most recent public timetables implemented prior to the COVID-19 pandemic. The trips indicated in Table 2 are representative of all one-way scheduled trips in the program area.

As shown in the figures below, Amtrak, Fairfield and Suisun Transit (FAST), Solano County Transit (SolTrans) and Eastern Contra Costa Transit Authority (Tri-Delta Transit) operate service within the Innovate 680 Corridor. While these agencies do not currently serve on the Innovate 680 TAC, future efforts within the program are likely to require coordination with them. The following is a brief description of each:

- FAST and SolTrans operate the Solano Express that provides service between Solano County and the Walnut Creek and Pleasant Hill BART Station;
- Tri-Delta provides service to the Martinez Amtrak, North Concord/Martinez BART and Concord BART Stations; and
- Amtrak operates both the Capitol Corridor and San Joaquin's inter-city rail service with each stopping at the Martinez Amtrak Station and additional connecting bus service to and from the area. These services are managed by the Capital Corridor Joint Powers Authority and San Joaquin Joint Powers Authority.



Source: WSP, 2021

Figure 6 – Program Area Transit Service Map

Table 2 – Program Area Transit Services Provided

Transit Operator	Type of Service	Routes	Trips	Span
County Connection	All Day Motor Bus Service	20	864	3:50a – 11:06p
County Connection	Peak/Express Motor Bus Service	8	141	3:50a – 7:59p
Tri-Delta Transit	Local Motor Bus Service	2	59	6:10a – 7:20p
LAVTA	Express Motor Bus Service	1	19	5:43a – 7:13p
SolanoExpress (SolTrans and FAST)	Commuter Motor Bus Service	2	96	4:19a – 10:17p
BART	Heavy Rail	1	168	4:56a – 1:56a
Amtrak Capitol Corridor	Inter-City Rail	1	30	4:34a – 12:27a
Amtrak San Joaquins	Inter-City Rail	1	10	8:25a – 9:30p

5.1.2.1 Private Operators

There are also numerous private shuttles provided by employers that serve specific areas along the corridor, such as park and rides along I-680 and BART Stations within community centers. These private operators often offer pick-up and drop off for employees between these community hubs and their assigned workplaces. While these entities do not serve in a formal partnership role on the Program, future efforts within the program are likely to require partnerships and/or coordination with them. It should also be noted that, currently, these fleets are not considered "public transit" vehicles, and thus are not permitted to use lanes (HOV/PTTL/HOT) lanes unless granted legal exceptions in the future.

Bishop Ranch Business Park, located in San Ramon, is one of largest private operators in the corridor. All programs, projects and/or infrastructure planned, as part of Innovate 680 to and/or from Bishop Ranch are coordinated in concert with the city. It is unclear what services will be provided after the pandemic, but the business park previously provided a plethora of transportation options to the employees of its tenants. Some of the options include:

- Commuter benefits including transportation on Contra Costa County services;

- Privately operated express bus service between San Francisco-Bishop Ranch;
- Privately operated luxury express bus service between San Francisco-Bishop Ranch;
- Circulator bus service that operates in Bishop Ranch;
- The BriteBikes Bike Share program; and
- A portal that matches travelers with vanpools and carpools.

Bishop Ranch is also an example of private and public agency collaboration with the coordination of transit service through fare cards and operation planning. Employees at Bishop Ranch, the largest mixed-use business community in Northern California, are eligible for transit benefits that are a result of an agreement between the business park and public agencies. The Business Park has also implemented a circulator shuttle that has allowed County Connection to operate its commuter service efficiently by dropping customers off at a central location. In 2018 Bishop Ranch began a partnership with CCTA, GoMentum Station, and the City of San Ramon to test a shared automated vehicles (SAV) on public roads at Bishop Ranch. This was the first time the California Department of Motor Vehicles allowed a shared automated vehicle to travel on public roads in the state. It was the City of San Ramon which ultimately approved the route to operate the SAV pilot project on public roadways, and the city's police department worked with DMV to accelerate the issuance of the SAV license plates so that the SAV could operate on a public roadway and the testing of the SAV on a public roadway. The innovative pilot project at Bishop Ranch has ended, but lessons learned and local passion for the project remain.

5.1.2.2 Other Regional Efforts

The following is a listing of other regionally significant transit efforts that may provide additional infrastructure and/or services in or near the program area.

- Link 21 – BART and the Capital Corridor Joint Powers Authority, in coordination with multiple public agencies of the Program, are proposing improvements to create a faster and more integrated rail system in Northern California. This includes the proposed second Transbay crossing, which could allow for additional service in the East Bay, greatly enhancing mobility options for customers along the Innovate 680 corridor.
- eBART Extension – The east Contra Costa County BART (eBART) extension is a regional effort that extended the existing eBART system into Brentwood, Byron, and/or Oakley. Additional BART service into east Contra Costa County may provide enhanced mobility options to travelers of the program area.
- Zero Emission Bus Programs – Transit agencies in the program area are currently evaluating the impacts of developing zero emission bus programs. County Connection is currently operating some battery electric buses, while LAVTA/Wheels is currently procuring several battery electric buses. These changes have the potential to impact transit service in the program area, as well as air quality and vehicle emissions corridor wide.
- Accessible Transportation Strategic Plan - The Accessible Transportation Strategic Plan provides a coordination structure with strategies to improve accessible transportation services, based on an examination of transportation challenges facing seniors, people with disabilities, and veterans in Contra Costa County.

5.1.3 Parking Facilities

Currently, several agencies supporting the Program own and operate park and ride lots across the program area. Typically, these park and ride lots are free of charge to travelers of the corridor, offering connectivity to transit service providers along the corridor. The following table is a listing of these facilities. These park and ride lots can also be found on Figure 3 in Section 4.3.

Table 3 – Program Area Park and Ride Lots

Owner	Location	Parking Spaces	Bike Lockers/Racks?
City of San Ramon	Dougherty Park and Ride (Stoneleaf & Bollinger Canyon)	56	Y
City of San Ramon	San Ramon Transit Center (Executive Parkway & Camino Ramon)	52	Y
Town of Danville	Sycamore Park and Ride (I-680 & Sycamore Valley)	230	Y
Caltrans *	Bollinger Park and Ride (I-680 & Bollinger Canyon)	108	-
Caltrans *	Pacheco Park and Ride (I-680 & SR4)	57	-
Caltrans	Rudgear Park and Ride (I-680 & Rudgear)	64	-
Caltrans	Concord Park and Ride (SR 242 & Willow Pass)	45	-
City of Walnut Creek	Mitchell Drive Park and Ride (Wiget & Mitchell)	92	Y
* Caltrans owned, maintained by local agencies (Bollinger – City of San Ramon; Pacheco – City of Martinez)			

As noted in the table above, several local agencies own and operate local park and ride facilities with varying levels of parking availability and bike storage facilities. Caltrans also owns and operates several park and rides along I-680. In two instances however, while Caltrans owns the park and ride lot, they have an agreement in place with local agencies to maintain the existing facility.

5.1.3.1 Parking Garage and Lot Facilities

In addition to free park and ride lots, several agencies also own other parking amenities along the corridor such as parking garages and/or parking lots for travelers commuting to local downtown areas, community/business centers, or heavily trafficked transit stations. The following tables summarizes this information.

Table 4 – Program Area Parking Garage/Lot Facilities

Owner	Parking Garages/Lots?
City of Concord	Y
City of Martinez	Y
City of Pleasant Hill	Y
City of Walnut Creek	Y
City of San Ramon	Y
Town of Danville	Y
Contra Costa County	-
BART	Y
County Connection	-
LAVTA	-

A brief summary of some of the parking facilities listed in Table 4 is provided below. For further information on these facilities and the parking management systems that support their operations, please see Section 5.4 Existing Systems.

- BART – The agency currently owns paid parking facilities at local BART stations, such as paid parking garages and parking lots with both permit and day-use parking. BART also has a well-developed parking program with set parking polices/business rules, as well as online resources to assess parking alternatives by station.
- The City of Martinez – The city currently utilizes several parking lots and a downtown parking zone strategy to support travel into their downtown corridor. This is particularly unique because the city is home to the Contra Costa County court system. From this, the city experiences a regular influx of daily visitors traveling for jury duty. In addition, the City of Martinez also utilizes a parking management system for the Pacheco Transit Hub.
- City of Walnut Creek – The city currently offers a robust parking program with numerous facilities. The city currently utilizes an outside vendor to support the management of agency-owned parking garages across the city. In addition, the agency

has installed embedded sensors at over 85% of metered parking spaces across the city, utilizing an advanced analytics platform to manage pricing and demand.

While not noted above, several local agencies also offer local parking permit programs and day-use parking meters for local street parking in residential and high-use areas.

5.1.3.2 Other Parking Facilities

It should be noted that many private organizations own and operate parking facilities along the I-680 corridor, such as pay-for-parking lots, garage facilities or private parking meters. While it is outside the scope of the program to evaluate and document each of these facility types, opportunities may exist for Innovate 680 Projects to partner with key business and/or community partners during the project development process. In doing so, consideration should be taken to evaluate the local significance of:

- Business centers;
- Transit stations;
- Schools;
- Churches; and
- Other heavily trafficked community centers.

5.1.4 Bike and Pedestrian Facilities

To further ongoing efforts within the county, CCTA adopted the July 2018 update to the Countywide Bicycle and Pedestrian Plan (CBPP), shared **here**. Pictured in Figure 7 below are the priority areas identified in the CBPP for both the pedestrian and bicycle network. As shown, several pedestrian priority areas exist within the limits of the Program, including:

- The greater San Ramon downtown area between Crow Canyon and Bollinger Canyon;
- The local Danville downtown area along Danville Blvd near I-680;
- The greater Walnut Creek downtown area near the I-680 and SR-24 interchange;
- The Contra Costa Centre area centered around Pleasant Hill BART station;
- The greater Concord downtown area neighboring both I-680 and SR-242; and
- The Martinez waterfront near the Amtrak station;
- The proposed San Ramon Walking District.

In addition to these areas, this map also identifies the proximity of these pedestrian priority areas to public schools as well as BART and Amtrak stations.

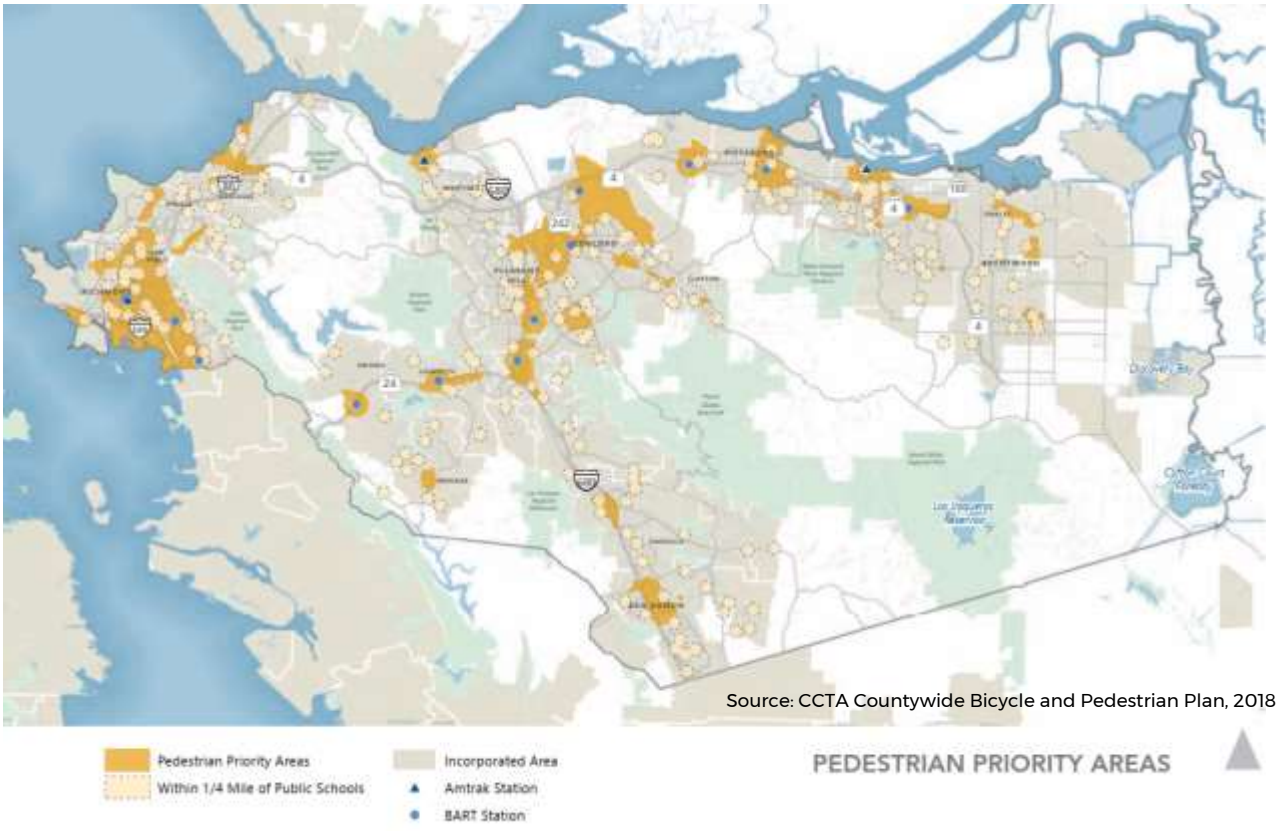


Figure 7 – Countywide Pedestrian Priority Areas

The CBPP also outlines the existing and planned countywide bikeway network, of which are several key bikeways that are encompassed within the program area, including two notable regional multi-use paths:

- The Iron Horse Trail, which runs parallel to the I-680 corridor; and
- The Contra Costa Canal Trail (Canal Trail), which runs from the City of Martinez, through the City of Pleasant Hill and City of Concord.

This network is shown below in Figure 8 and Figure 9, from the 2018 County Bicycle and Pedestrian Plan. As shown, the map also identifies additional existing and proposed low stress bikeway networks for future consideration in the county.

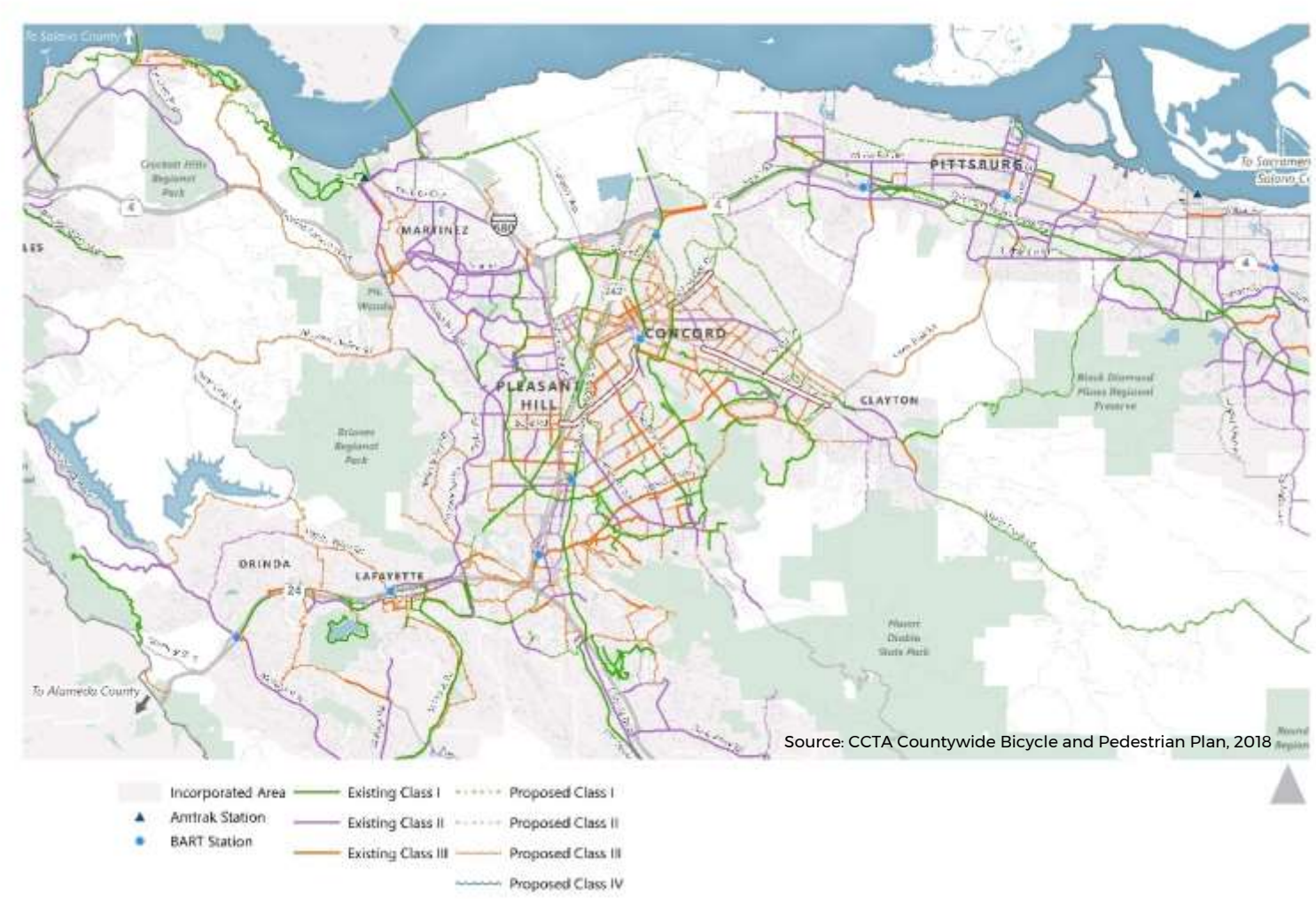
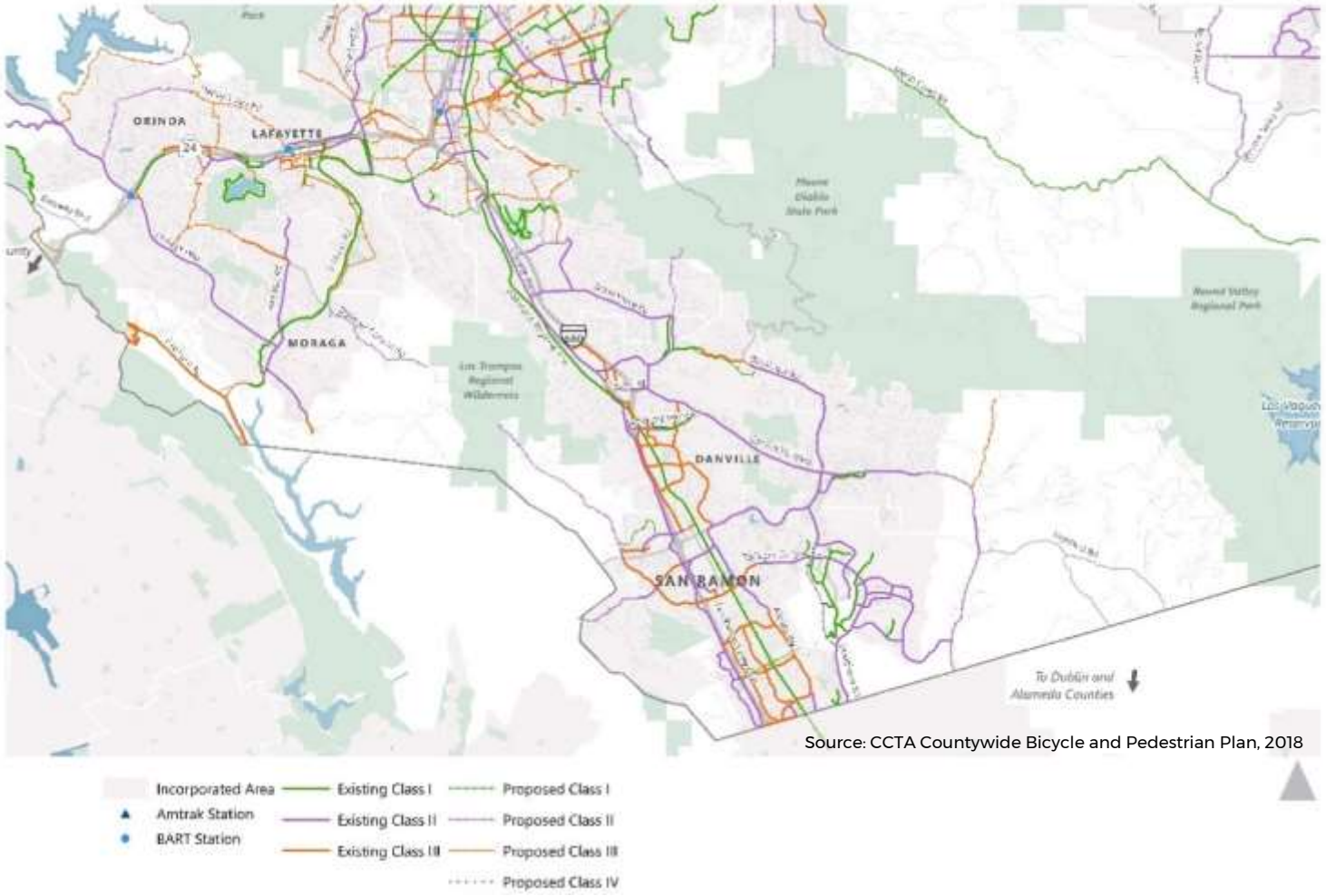


Figure 8 – Countywide Bikeway Network (Part 1)



Source: CCTA Countywide Bicycle and Pedestrian Plan, 2018

Figure 9 – Countywide Bikeway Network (Part 2)

5.1.4.1 Iron Horse Trail

As noted in the prior section, Iron Horse Trail is a multi-use path of regional significance in Contra Costa County and the program area. In June 2020, Contra Costa County released the Iron Horse Trail – Active Transportation Corridor Study. The study provides an overview of existing corridor conditions and a vision for the corridor in the future. The study evaluates how the regional trail can better accommodate pedestrians and bicyclists of all ages and abilities, as well as users of other emerging mobility options, such as e-bikes and e-scooters. The study also envisions a corridor that would not preclude the use of shared automated vehicles (SAVs) in the future. This study is shared **here**.

5.1.4.2 Future BART Station Improvements

In order to support the design of BART station improvements across the region, BART developed Multimodal Access Design Guidelines and region-wide Station Access Policy, shared **here**. This policy is designed to reinforce sustainable communities and support the advancement of pedestrian and bicycle use in the region. The design guidelines provide information on the unique stations access typologies and the strategic investment framework for future station improvements in the program area.

5.1.4.3 Other Bike and Pedestrian Facilities and Services

In order to support multimodal travel and first & last mile connectivity, CCTA has also established several TDM programs countywide to encourage bike and pedestrian travel. For additional information on this and the 511 Contra Costa Program which encompasses these efforts, please see Section 5.4.1 Regional Systems. In addition to the information provided in this section, project-level efforts with the program seeking to improve first/last mile connectivity should also utilize local agency bike-pedestrian plans and policies to identify the unique needs of specific communities along the corridor. Many local agencies offer the following information online, or can be reached for additional information on:

- Local bike and pedestrian master plans;
- Local bike and pedestrian access studies;
- Local bike, pedestrian and trail maps; and
- Other local bike-pedestrian resources.

5.1.5 Carpool, Shared Vehicle, and Micro-mobility services

5.1.5.1 Carpool and Vanpool Services

In the county, travelers can access region-wide carpool and vanpool services offered by the 511 SF Bay and 511 Contra Costa program. These systems offer easily accessible information and robust trip planning resources for travelers seeking multimodal alternatives. For additional information on these systems, please see Section 5.4.1 Regional Systems.

5.1.5.2 Carshare Services

Carsharing companies allow users to benefit from right-sized, on-demand vehicle ownership without the sunk cost of purchasing a vehicle, the need to store it, or any maintenance. Each trip the user takes includes the total cost of the vehicle for the time it is used, such as

insurance, fuel, and wear-and-tear. Three carshare companies have operated in Contra Costa County, each on a limited basis.

- Zipcar, a subsidiary of Avis Budget Group, operates on a membership model, with members paying an annual or monthly fee, as well as an hourly fee based on the vehicle chosen. Membership and fees cover insurance, gas, and maintenance of the car. Zipcar also uses a round trip model, with vehicles in designated parking spots in residential and commercial zones. While the carsharing page of the 511 Contra Costa website notes Zipcars are available in Walnut Creek and other Contra Costa cities, the Zipcar site does not show any active vehicles in the region. This may be due to temporary changes from COVID-19.
- Gig carshare currently uses an hourly charge model. Gig requires no membership or fees to join and vehicles operate on a one-way model. Gig vehicles also include racks, enabling multimodality for modes such as bicycles. The vehicles can be picked up and dropped off anywhere in the "home zone," which includes much of the Bay Area but does not currently include Contra Costa County. However, current efforts under the MOD project are evaluating deployments within the county.
- Turo operates a peer-to-peer carshare program, providing a platform for private owners to lend out their vehicles by the hour. Turo vehicles must be returned to their owners, creating a round trip model for usage. Vehicle prices and availability varies, but allows for longer rentals, similar to traditional car rental services. Turo recently received the first permit to operate at an airport from the Buchanan airport in Concord, allowing visitors to pick up and drop off Turo vehicles on airport grounds.

5.1.5.3 Ride Hailing Services

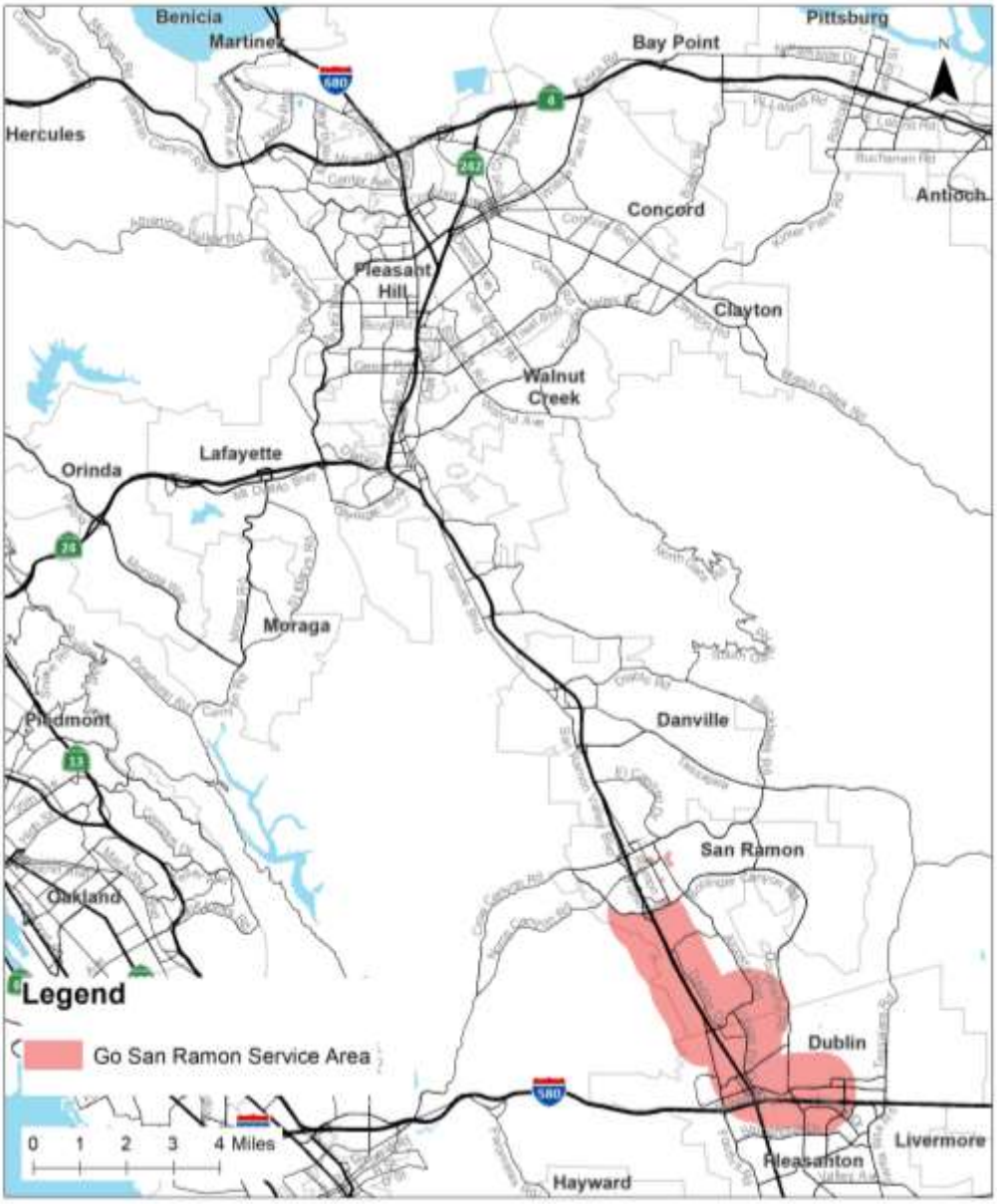
Ride hailing and Transportation Network Companies (TNCs) are often considered shared vehicles since users do not need to own the vehicle to utilize the service. Both major TNC companies, Lyft and Uber, offer service in the program area. Both companies offer shared rides on their platforms, allowing users heading on similar routes to carpool for a reduced fee. However, these services are used less frequently than the single user single ride model and have been suspended during the COVID-19 pandemic.

In Contra Costa County, the City of Walnut Creek has partnered with Lyft to provide free rides for seniors through the Transportation Expansion Program. It should be noted, however, that this program requires reservations 24 hours in advance. Additionally, several transit agencies have partnered with TNCs to support micro transit services offered in the county. These services are described in more detail in the section below.

5.1.5.4 Micro Transit Services

Micro transit services are increasingly serving local communities to enhance or replace traditional transit in various use cases. Micro transit platforms are popular as their model creates dynamic, on-demand service for communities with limited transit availability. In the program area, the Go San Ramon and Go Dublin micro transit programs are offered by County Connection and LAVTA. Both provide transit service to less-populated areas near the southern segment of the I-680 corridor. The programs are currently partnered with Uber and Lyft and

offer to pay part of travel fares if a user's travel destination starts or ends in San Ramon or Dublin.



Source: WSP, 2021

Figure 10 – Go San Ramon Program Service Area

5.1.5.5 Micro-Mobility Services

Docked bikeshare and scooter programs have proven popular over the last decade, increasing active transportation usage and enhancing access to transit. While bikes and scooters cannot serve the same purpose as many other vehicles, they can serve as first & last-mile solutions for moderately dense areas, especially for those who are outside of the catchment zone of transit stops. In the program area, the City of Walnut Creek began a micro-mobility pilot in 2018, partnering with Lime for scooters and bikes. Unfortunately, Lime's rapidly shifting business model resulted in the pilot terminating without a renewal. While Lyft's Bay Wheels (the greater

Bay Area's docked bikeshare program) does offer service along the corridor, they currently have limited stations and vehicles in the region. The county has also adopted provisions within its TDM ordinance to allow for micro-mobility services in County Ordinance. 2003-02 § 2, 92-31 § 3. There have been no applicants for county permits at this time, although Lime Bikes was the unpermitted operator in the Contra Costa Centre area for a time. Additionally, the City of San Ramon also approved a bikeshare program for use in their local jurisdiction.

5.2 Existing Operations

To document existing conditions in the program area, an assessment of the current operations of key multimodal elements along the corridor was completed. This assessment was completed based on information obtained prior to the start of the COVID-19 pandemic. The intent of this assessment is to highlight the:

- Existing travel patterns, including observed mode share for the I-680 corridor;
- Existing highway and arterial operations within the program area;
- Existing transit operations of high-capacity transit routes;
- Existing operations of vehicle and bike parking facilities; and
- Existing operations of shared vehicle programs offered to travelers of the corridor.

In conducting this operational assessment, the program team utilized the performance metrics developed and outlined in Section 4.1 Program Goals and Metrics. In doing so, the program team aimed to develop a baseline existing conditions assessment to support program performance monitoring in the future. The data sources that were utilized to conduct this initial assessment are provided in Appendix B – Data Sources for Existing Conditions Evaluation. It should be noted, however, that the identified data sources are for an initial existing conditions assessment. In the future, new or supplemental data sources may be utilized to support these efforts. Additionally, as the program matures, this baseline existing conditions assessment may be modified to incorporate new or alternative facilities/services that stakeholders choose to monitor for the program. For additional information on future performance monitoring, please see Section 6.3 System Performance Monitoring

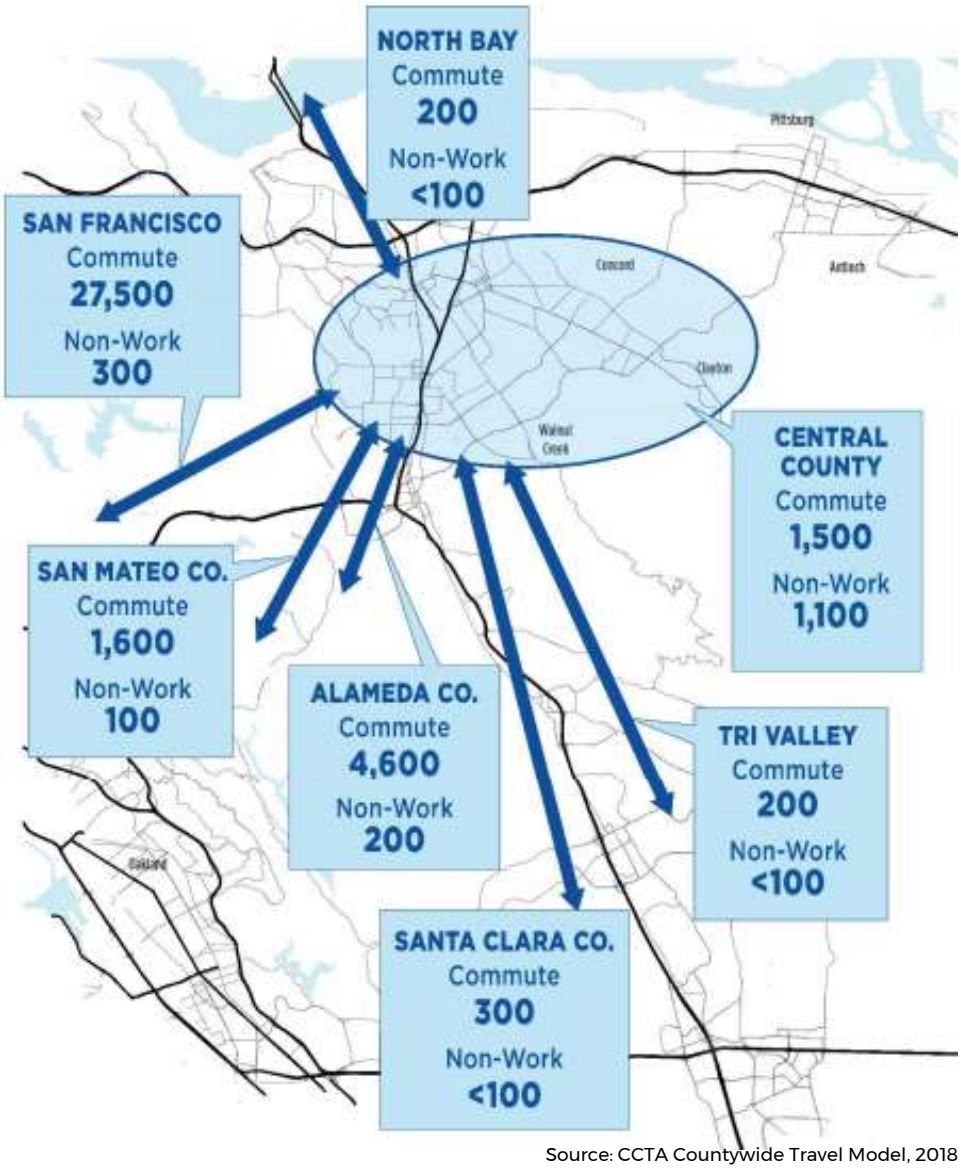
Furthermore, to support an initial step towards addressing equity within the program area, socioeconomic data was used to map where sensitive communities are located in proximity to the program. These maps emphasize the importance for the program to consider future impacts to key community groups and travelers. The following equity maps were developed:

- Low-income households (less than 80% of U.S. Department of Housing and Urban Development Area Median Income);
- Non-white and/or Hispanic population;
- Youth (18 years old and younger);
- Elderly (65 years old and older); and
- Zero vehicle households.

These maps are provided in Appendix C – Equity Overlay Maps, and were developed utilizing census tract data. In addition to being utilized throughout this initial program-level existing conditions assessment, this data will also be utilized to support the development of future Program efforts.

5.2.1 Travel Patterns

To further understand the travel characteristics of the corridor and broader program area, the following maps detail the modeled travel patterns for both central Contra Costa County and the tri-valley region. This modeled data is based on average weekday trips and is estimated from the Contra Costa Countywide Travel Model 2018 scenario. As shown, the largest share of commuters for the two areas travel to San Francisco, followed by Alameda County. Central Contra Costa County has almost equal commute and non-commute transit trips occurring on a typical day. The central county also has the larger number of commuters compared to the tri-valley area. Although a transit service is provided from the Stockton area to the Dublin/Pleasanton BART Station, there is very minimal commuting between the central valley and the tri-valley areas, indicating that there could be a lack of supply of transit service for customers that wish to take transit.



Source: CCTA Countywide Travel Model, 2018

Figure 11 – I-680 Central County Travel Patterns

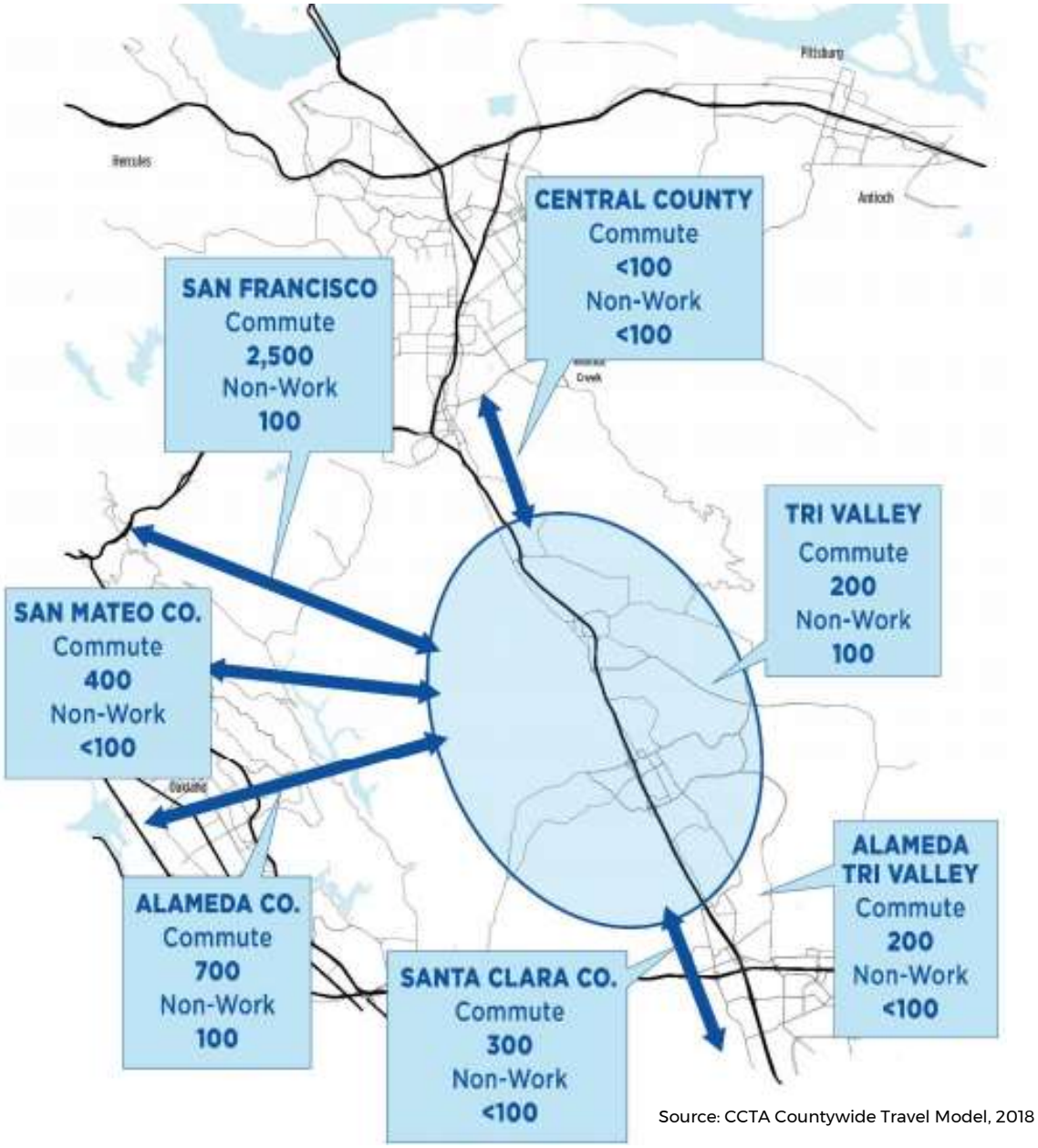
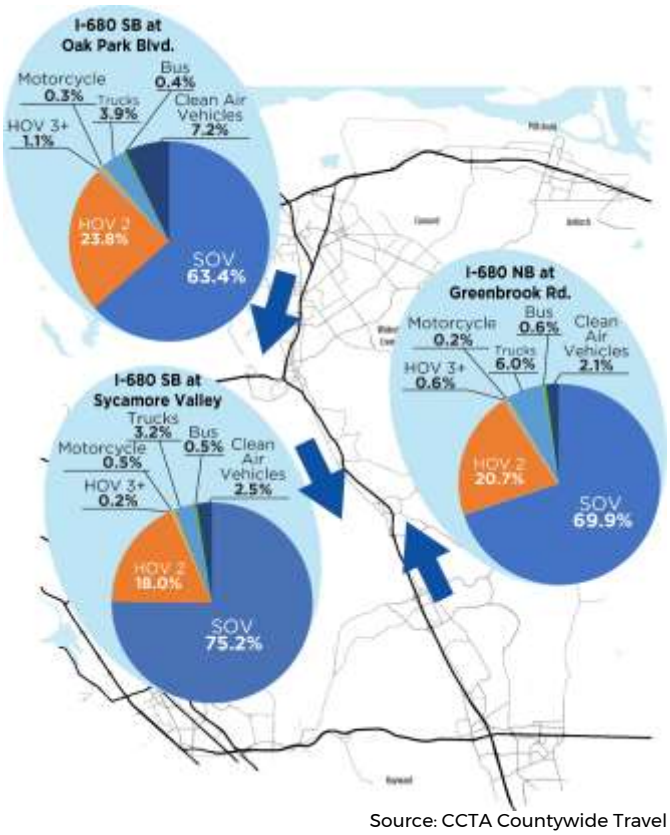


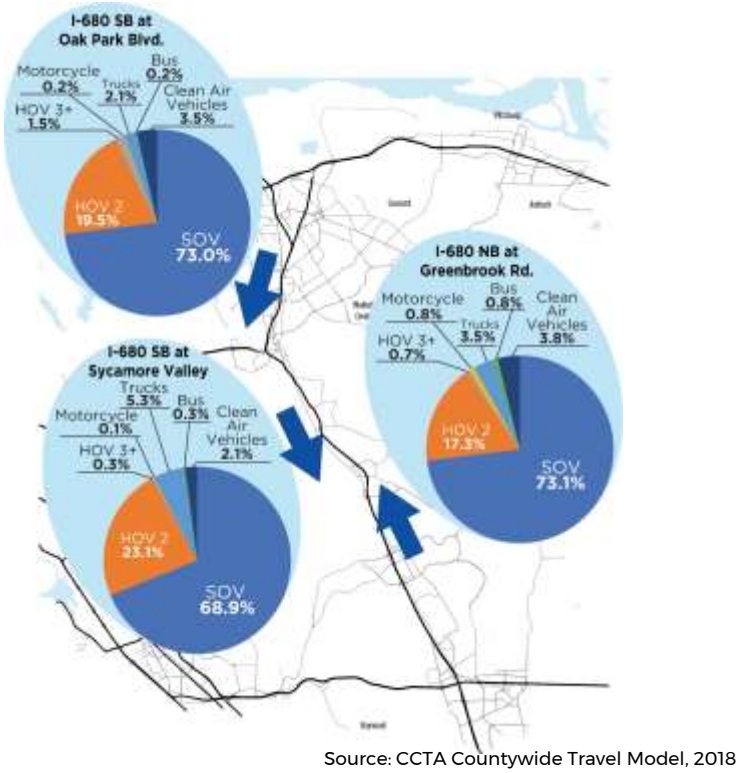
Figure 12 – I-680 Tri-Valley County Travel Patterns

Figure 13 and Figure 14 below showcase the primary mode of travel vehicle classifications along the corridor. This data is borne from manual occupancy surveys completed in calendar year 2018. In the AM and PM periods the primary mode of travel is SOV, with 63% to 75% of the travel vehicles on the identified segments. This is followed by high occupancy vehicles (HOV) with 17% to 23%. Lastly, transit accounts for less than 1% of the vehicle's occupancy in both periods.



Source: CCTA Countywide Travel Model, 2018

Figure 13 – I-680 AM Peak Vehicle Occupancy



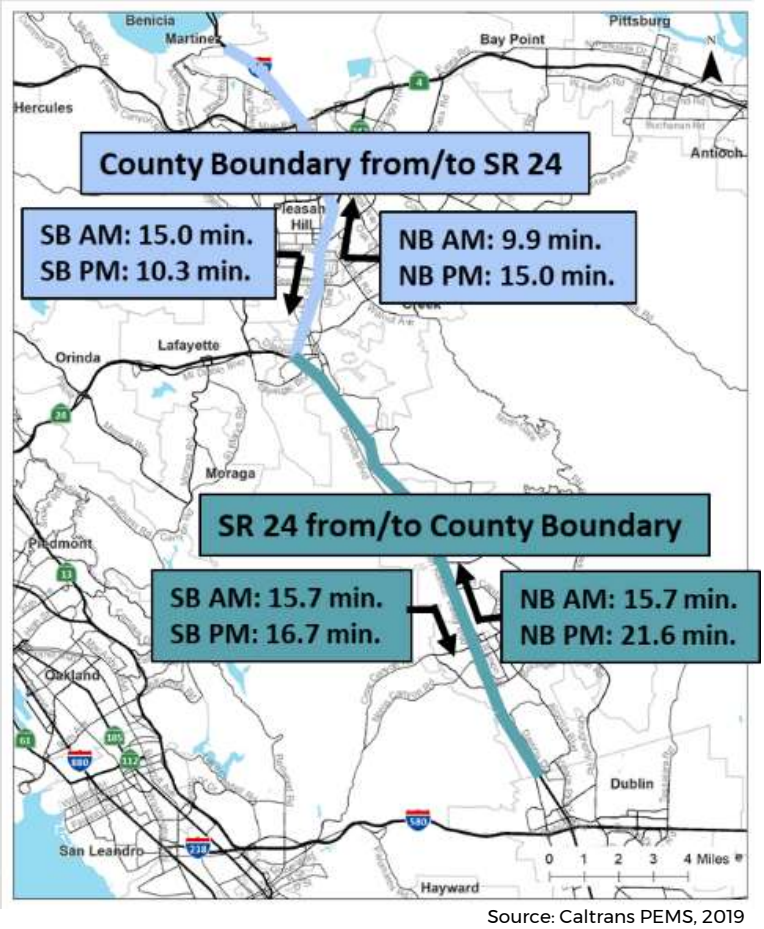
Source: CCTA Countywide Travel Model, 2018

Figure 14 – I-680 PM Peak Vehicle Occupancy

5.2.2 Highway and Arterial Operations

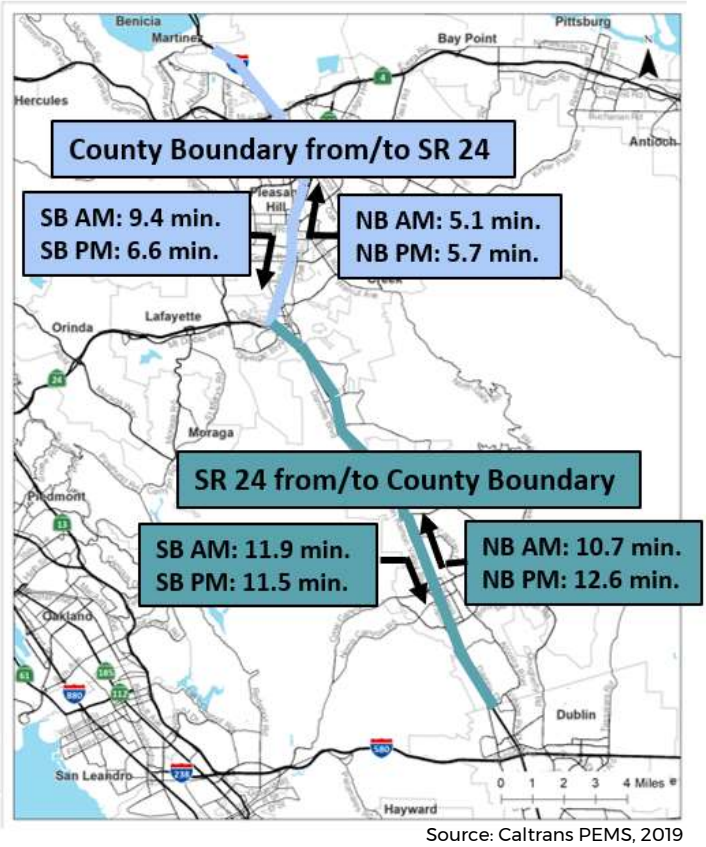
5.2.2.1 Vehicle Travel

The following figures outline the current average travel times for I-680 for both the GPL and HOV/EL. For both, AM peak is defined as 6AM to 9AM and PM peak is defined as 3PM to 6PM. Both also utilize PeMs data from calendar year 2019. Travel time along the arterial routes utilize data from INRIX for the same time period. As shown, southbound travel through Contra Costa County is the predominant morning travel pattern with travel times averaging 15 minutes from the Benicia-Martinez bridge to SR-24 and 15.7 minutes from SR-24 to the Contra Costa County – Alameda County line. In the evening, the reverse commute is the predominant travel pattern with an average of 21.6 minutes from the Contra Costa County – Alameda County line to SR-24 and 15 minutes from SR-24 to the Benicia-Martinez Bridge. The HOV/EL facility exhibits the same travel patterns with slightly shorter travel times, as shown in the figures below.



Source: Caltrans PEMS, 2019

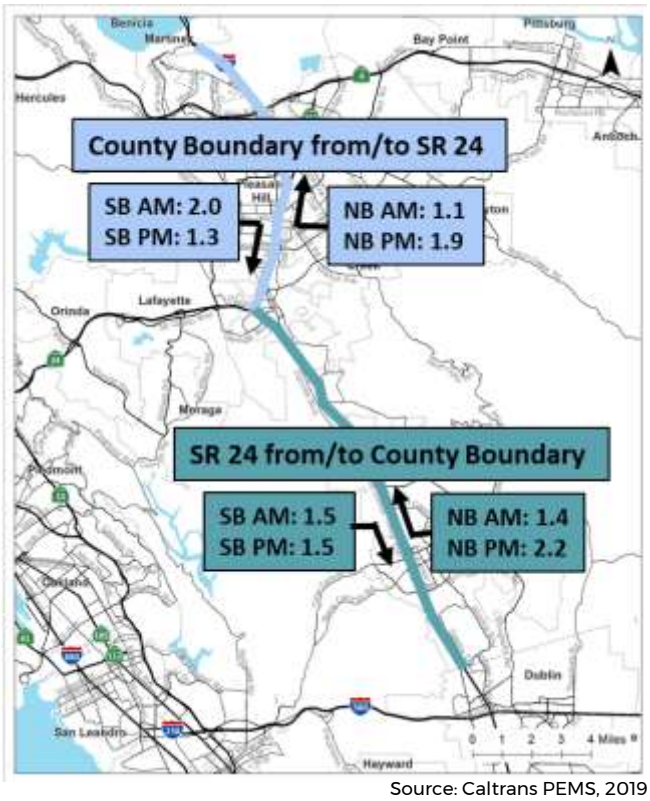
Figure 15 – I-680 GPL Average Travel Times



Source: Caltrans PEMS, 2019

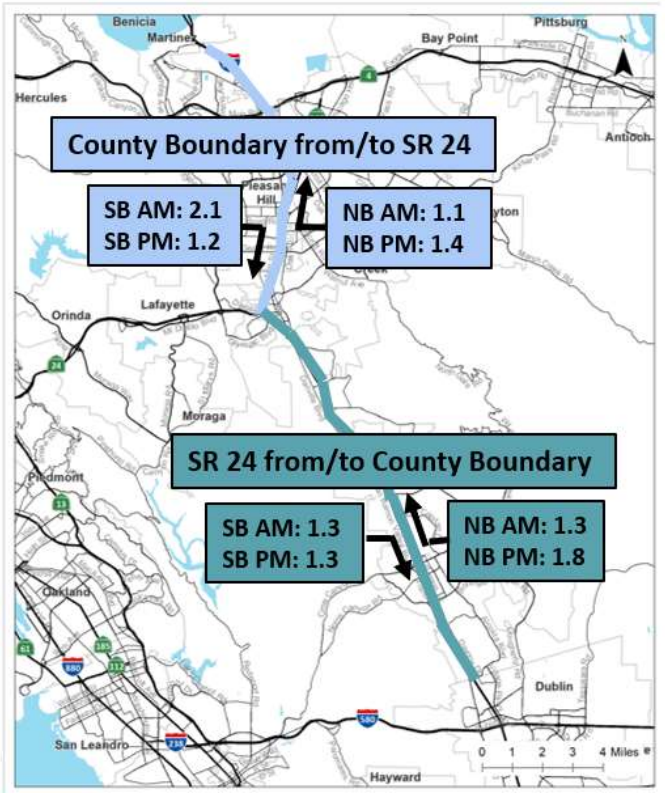
Figure 16 – I-680 HOV/EL Average Travel Times

To measure travel time reliability, the following planning time index (PTI) measurements were also developed for both the GPL and HOV/EL. These measurements seek to measure the ratio of 95th percentile travel time to free flow travel times. For this reason, a higher PTI equates to a less reliable travel time. As shown in the following figures, the PTI is highest, meaning travel time reliability is lowest, in both the southbound AM and northbound PM peak. This largely speaks to the variability of travel times during peak congestion hours. This variability can be attributed to a number of factors that ultimately stem from both recurrent and non-recurrent congestion on the corridor.



Source: Caltrans PEMS, 2019

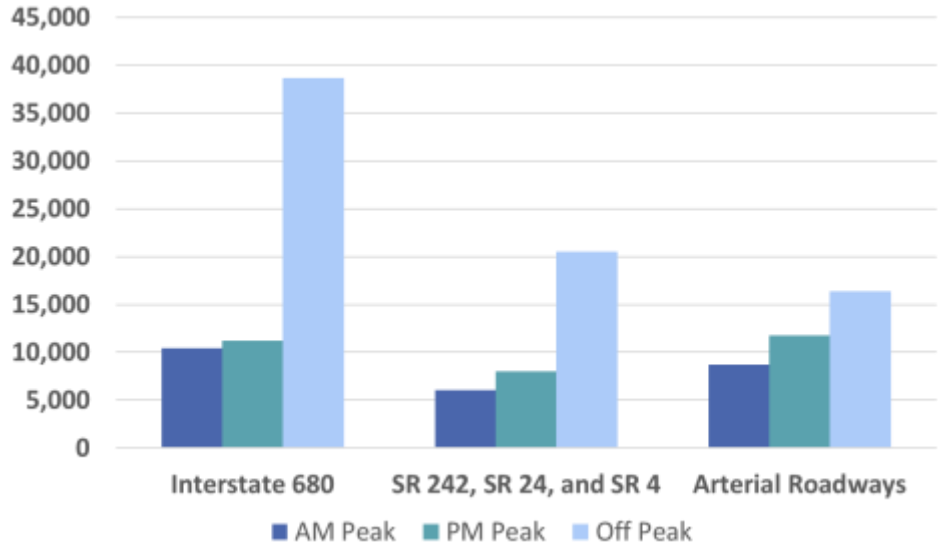
Figure 17 – I-680 General Purpose Lane Planning Time Index



Source: Caltrans PEMS, 2019

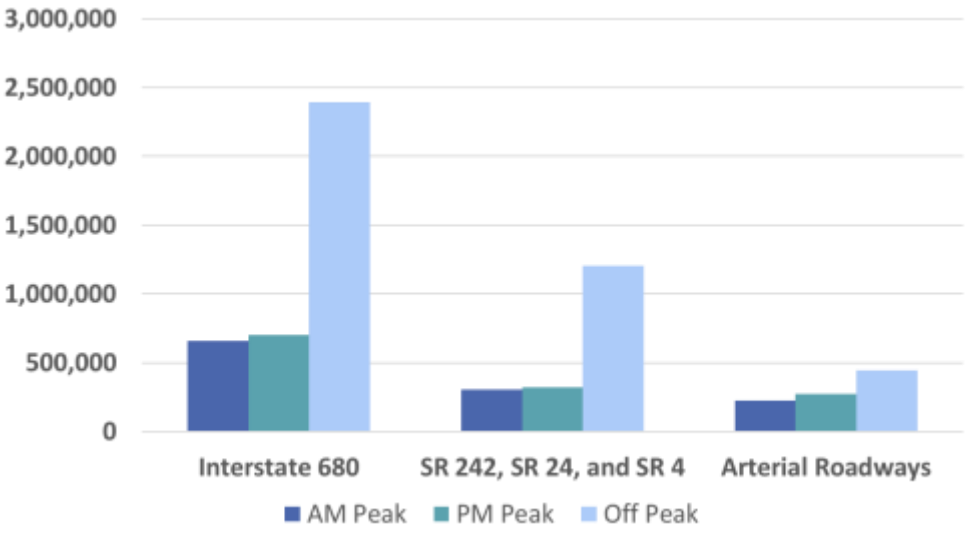
Figure 18 – I-680 HOV/Express Lane Planning Time Index

In addition to travel time, the following figures illustrate Vehicle Hours Traveled (VHT), Vehicle Miles Traveled (VMT), and Vehicle Hours Delay (VHD) for the program area. These measurements include analysis for the I-680 highway facility as well as segments of neighboring highway and arterial corridors in the program area, as shown previously in Figure 5. This information was developed from INRIX and Streetlight data from calendar year 2019, with AM peak being 6AM to 9AM and PM peak being 3PM to 6PM. As shown in the following graphs, while the I-680 highway facility exhibits the highest aggregate VHT and VMT totals for the program area, neighboring segments of the SR-242, SR-24, and SR-4 exhibit comparatively high hours of vehicle delay. The same can also be said for neighboring arterial roadways. These trends speak to a larger issue of congestion that appears to impact operations well beyond the limits of the I-680 freeway facility in the program area.



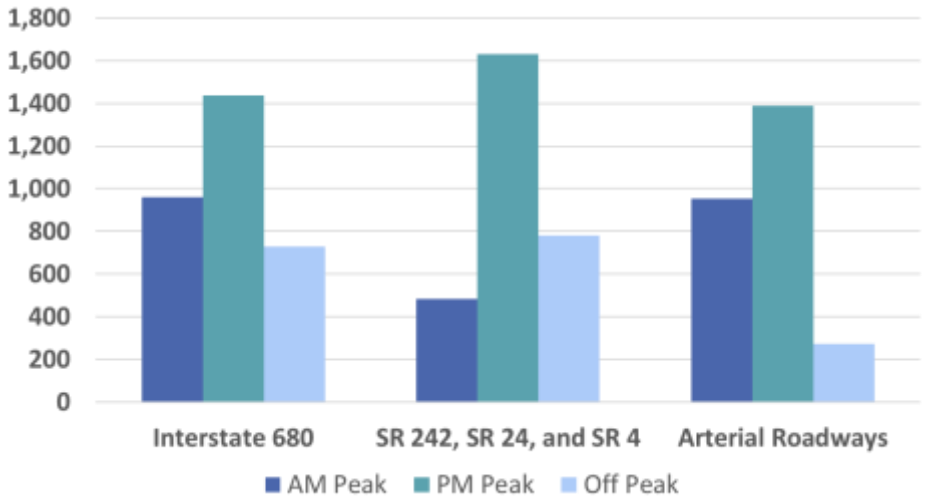
Source: INRIX & Streetlight Data, 2019

Figure 19 – Program Area VHT



Source: INRIX & Streetlight Data, 2019

Figure 20 – Program Area VMT



Source: INRIX & Streetlight Data, 2019

Figure 21 – Program Area VHD

5.2.2.2 Road Safety

The safety of vehicle travel in the program area was also studied in this program-level existing conditions assessment. The information provided below is based on the calendar year 2019 UC Berkeley Transportation Injury Mapping System data. As shown in the table below, of the 114.5 centerline miles of highway and arterial roadways assessed, the percentage of injury (52%) and severe/fatal (59%) crashes were highest on the arterial roadway network. This, however, is expected because the majority of centerline miles evaluated in the Program area were arterial roads (65%). Conversely, while I-680 only represented about a quarter (22%) of the total centerline miles studied, its total for injury-related crashes (32%) was fairly high.

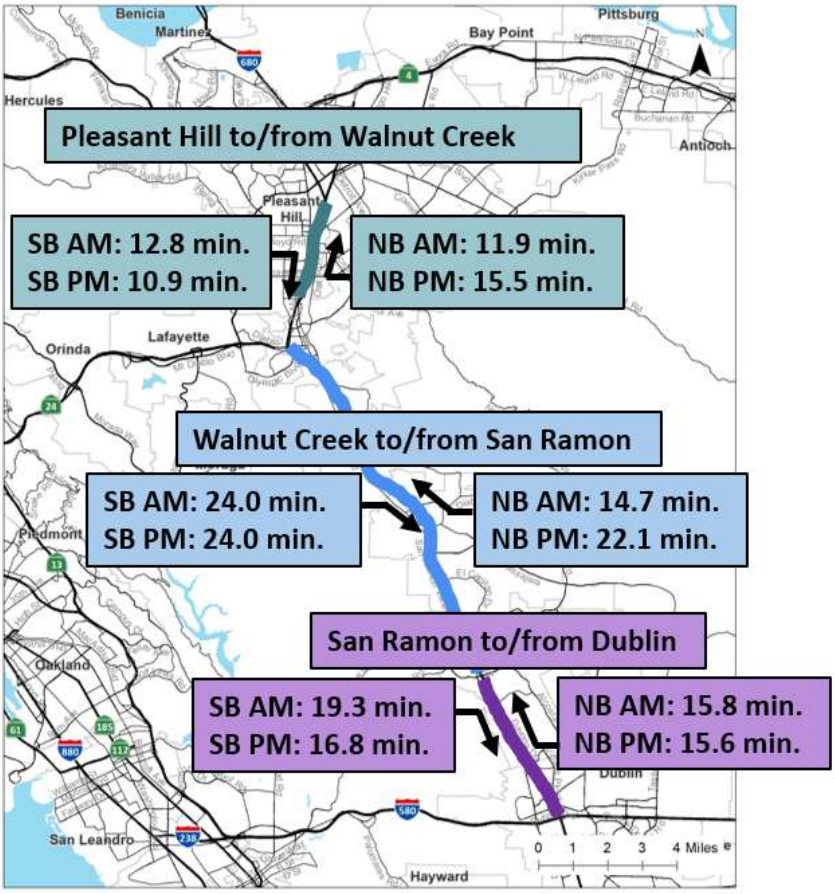
Table 5 – Program Area Crashes

Facility	Centerline Miles	All Injury Crashes	Severe Injury or Fatal
Interstate 680	24.7 (22%)	293 (32%)	12 (18%)
SR 24, SR 242, and SR 4	15.0 (13%)	146 (16%)	15 (23%)
Arterial Roadways	74.8 (65%)	468 (52%)	39 (59%)
Total	**114.5 (100%)**	**907 (100%)**	**66 (100%)**

5.2.3 Transit Operations

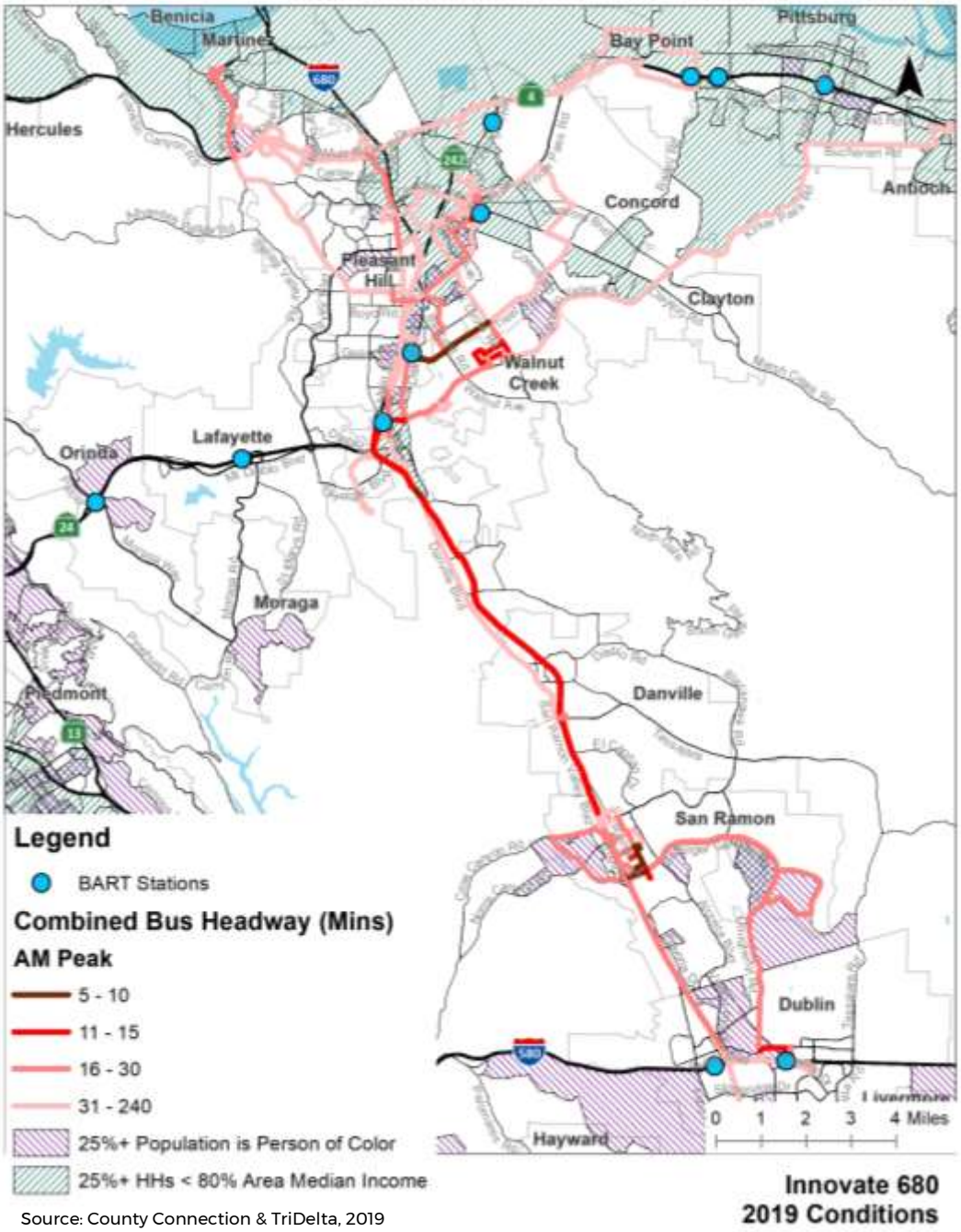
To evaluate transit operations, County Connection automated passenger count data from the calendar year 2019 was utilized to evaluate transit travel time. Figure 22 below illustrates that transit travel time on I-680 in the southbound direction is primarily consistent in both the AM and PM periods, with only a 2.5-minute difference between the AM and PM travel times. Northbound transit travel time is more variable, with the Walnut Creek/San Ramon area incurring seven minutes of additional travel time in the PM peak and the Pleasant Hill/Walnut Creek area incurring 3.6 minutes of additional travel time in the PM peak.

Also shown below in Figure 23 and Figure 24 are bus headways in the program area. This information is based on County Connection and Tri-Delta automated passenger count data from calendar year 2019. As shown, bus service is most frequent along the I-680 corridor between Walnut Creek and San Ramon, with approximately 11 – 15 minutes headways in both AM and PM peak. Most of the arterial bus headways are between 31 – 240 minutes in the northern portion of the program area. Portions of the arterial corridors between San Ramon and Dublin have headways of 16 – 30 minutes in both periods. Lastly, BART operates with the shortest headways in the program area at approximately five – 10 minutes.



Source: County Connection, 2019

Figure 22 – I-680 Bus Travel Times



Source: County Connection & TriDelta, 2019

Figure 23 – Program Area AM Peak Combined Bus Headway

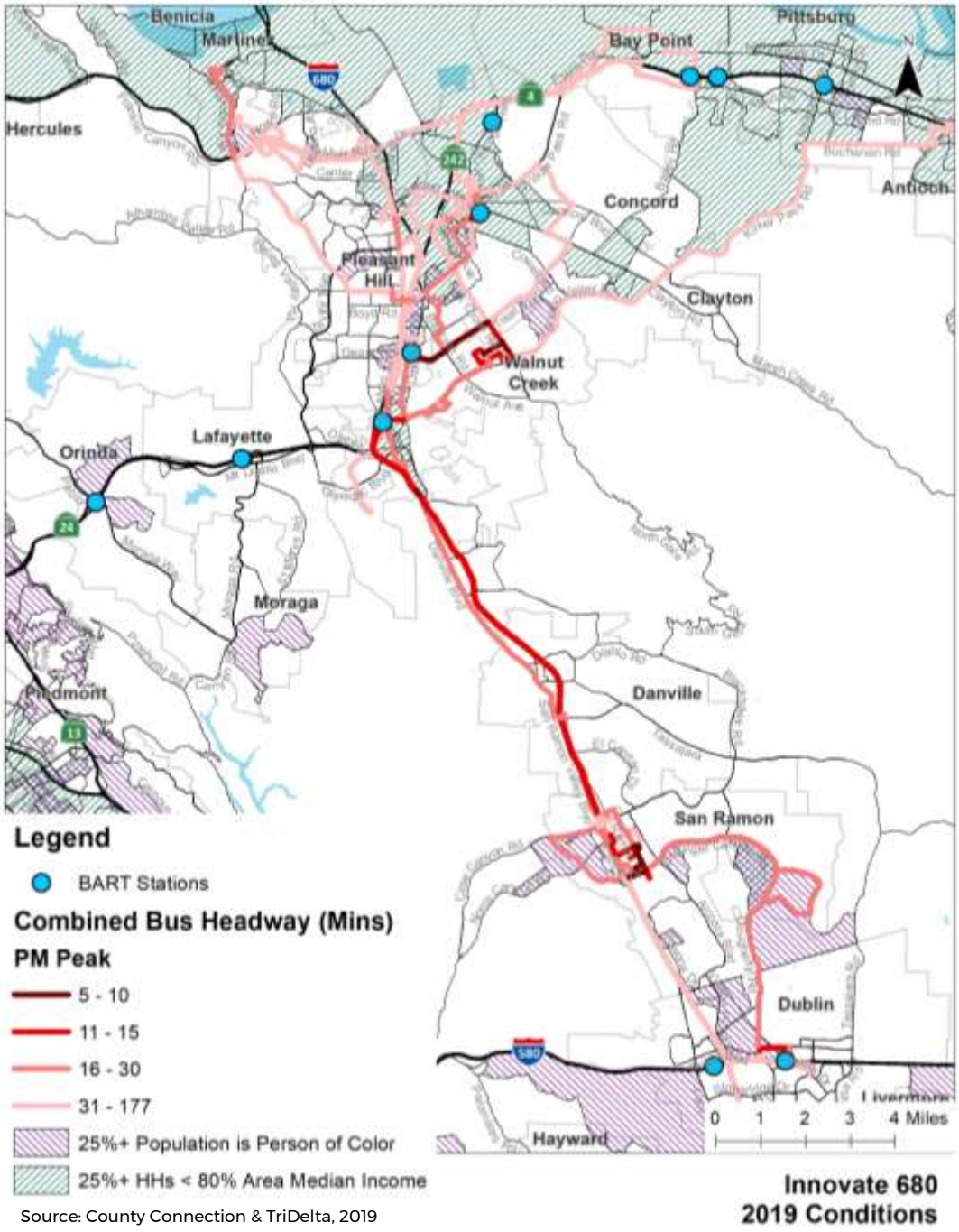


Figure 24 – Program Area PM Peak Combined Bus Headway

5.2.4 Parking Operations

To evaluate existing parking operations in the program area, the program team evaluated the use of parking facilities offered at BART stations within the program area by sending out an observer to record the information. This includes the Walnut Creek, Pleasant Hill/Contra Costa

Centre, Concord, and North Concord/Martinez stations. Each of these stations was evaluated based on existing parking availability for both vehicle and bicycle users. As shown in the figures below, the Walnut Creek, Pleasant Hill/Contra Costa Centre, and Concord stations experience nearly 100% vehicle parking occupancy during the midday period. Currently, the North Concord/Martinez station reaches about 73% vehicle parking occupancy midday. For bike parking, the Walnut Creek, Pleasant Hill/Contra Costa Centre, and Concord stations experience between 40% and 50% bike parking occupancy mid-day. The North Concord/Martinez station experiences approximately 9% bike parking occupancy midday.

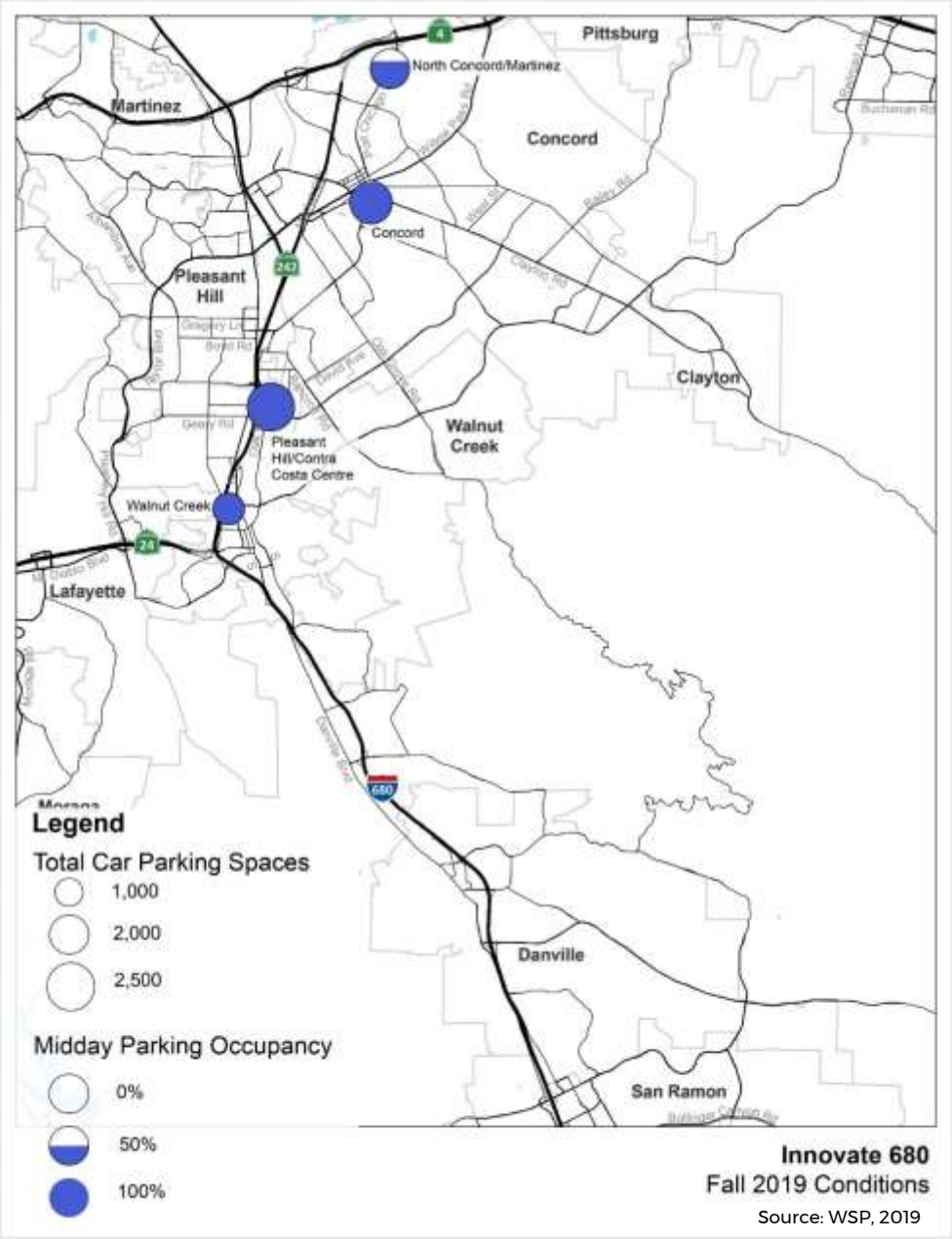


Figure 25 – BART Station Vehicle Parking and Occupancy

Figure 26 – BART Station Bike Parking and Occupancy

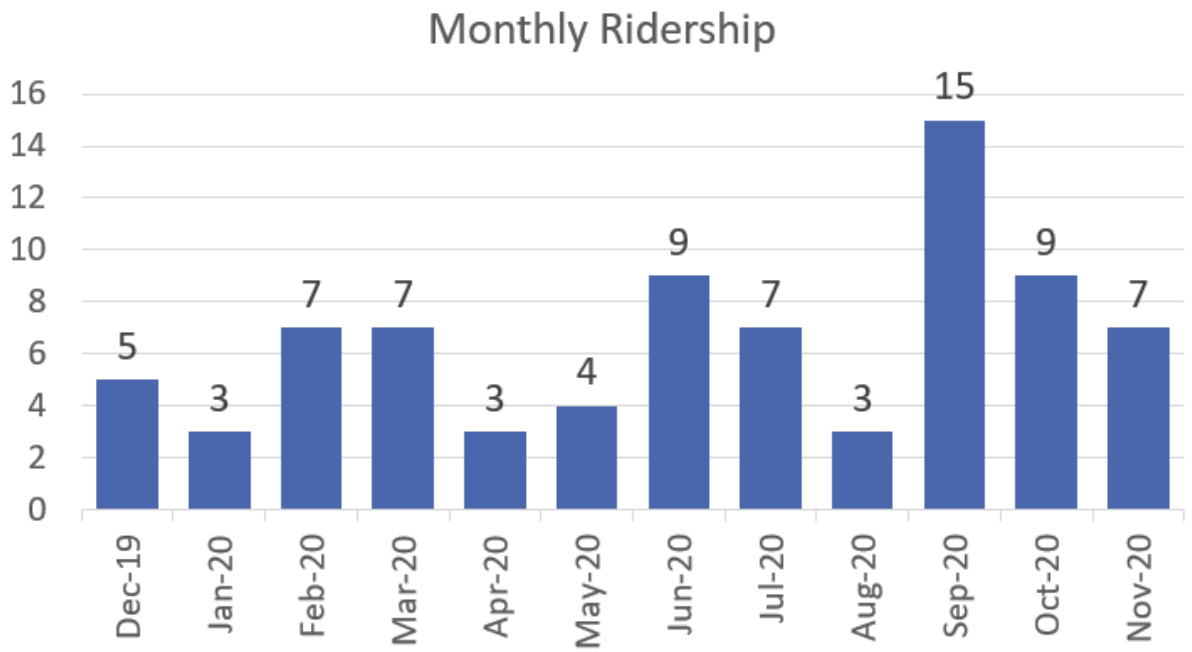
Additionally, there are agency owned parking spaces by location along the corridor in Table 6. The largest agency owned parking site is at the Martinez Amtrak station with over 500 spaces. The total parking space at park and ride locations ranges between 50 and 100 spaces.

Table 6 - Agency Owned Parking Spaces by Location Type

Location	Total Parking Spaces	Handicap Parking	Vanpool/ Carpool Parking	EV Charging Stations	Motorcycle Parking
Martinez Amtrak Station	561	12	0	2	0
Concord Park and Ride	45	3	0	0	0
Mitchell Dr Park and Ride	92	4	0	0	0
Danville Sycamore Valley Park and Ride	240	8	0	0	8
San Ramon Transit Center	52	3	0	7	8
Downtown Pleasant Hill	43	2	2	2	0
Bollinger Park and Ride	109	3	0	0	0

5.2.5 Shared Vehicle Operations

To evaluate the existing conditions of shared vehicle operations on the corridor, the program team evaluated the monthly ridership of the Go San Ramon program offered by the City of San Ramon and its partners, County Connection and Uber/Lyft. The monthly ridership of the program is illustrated in Figure 27 below. As shown, the program has seen fairly limited use by travelers since its soft launch in December 2019 and subsequent full launch in March 2020. Since then, the program has seen a steady average of between 3-10 monthly riders, with a small spike in September 2020.



Source: City of San Ramon, 2020

Figure 27 – Go San Ramon Program Monthly Ridership

5.3 Existing Operational Impacts Due to COVID-19

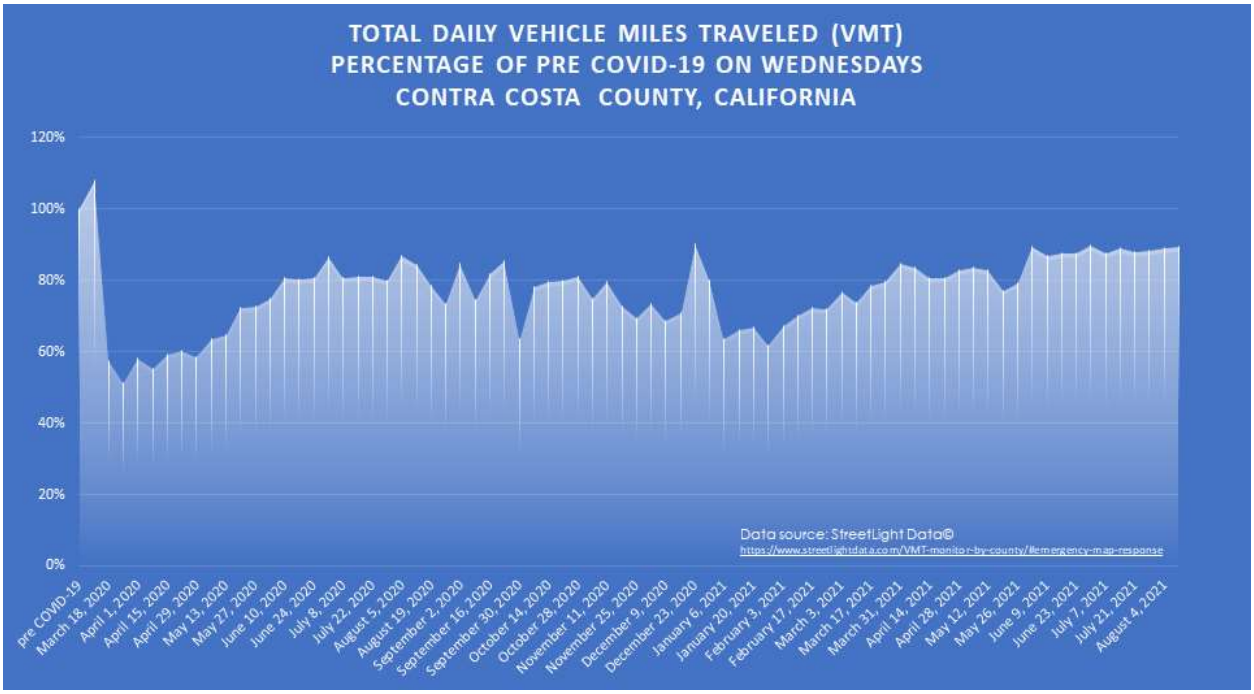
While it is impossible to know the lasting impact of the COVID-19 pandemic, the program team has actively tracked and monitored the travel characteristics of the program area post-COVID-19. This includes an evaluation of vehicle travel, road safety, transit ridership, and traveler behaviors.

It should be noted, however, that the amount of person-travel in the corridor may be the most relevant indicator of pre- and post-pandemic travel. With increased telecommuting, many former commuters may remain working at home. And, due to COVID-19 concerns, transit riders may choose to drive instead. While these impacts offset each other to a degree, merely looking at vehicle volumes and transit ridership may not tell the whole story or be an accurate estimator of what the future holds for the corridor. Nonetheless, these efforts were ultimately undertaken to provide context on the challenges, needs, and opportunities for future program efforts, while also providing information on the direct impacts to operations in the program area.

5.3.1 Vehicle Travel

While vehicle travel was impacted within the program area, there are signs pointing to a recovery of vehicular traffic to pre-pandemic levels. Figure 28 below shows VMT across Contra Costa County, with the graph illustrating VMT as a percentage of total VMT prior to the Bay Area countywide stay-at-home orders enacted in March 2020. As shown below, countywide VMT reached around 70% of pre-COVID-19 levels in December 2020, prior to an anticipated

slow-down for the 2020 holiday season and the new stay-at-home orders put in place during the winter.



Source: WSP, 2021

Figure 28 – COVID-19 Impacts to Countywide VMT

As shown in the figures below, I-680 has also seen a steady rise in vehicle traffic over the year. Figure 29 shows average northbound PM peak-hour volumes and Figure 30 illustrates average southbound AM peak-hour volumes. Both figures divide the corridor into northern and southern segments. In the northern segment of the corridor, northbound traffic has seen a rather substantial recovery in traffic volumes since the beginning of the COVID-19 pandemic. This is likely due to a number of factors, including the possibility of increased personal vehicle use as travelers shifted from high-capacity transit routes such as BART, as well as improved productivity in the northbound direction as a result of higher traffic flows being sustained during peak periods in the absence of chronic congestion. In the southbound direction, while traffic volumes have recovered, there is still less vehicle traffic than had previously been recorded on the corridor in 2019.

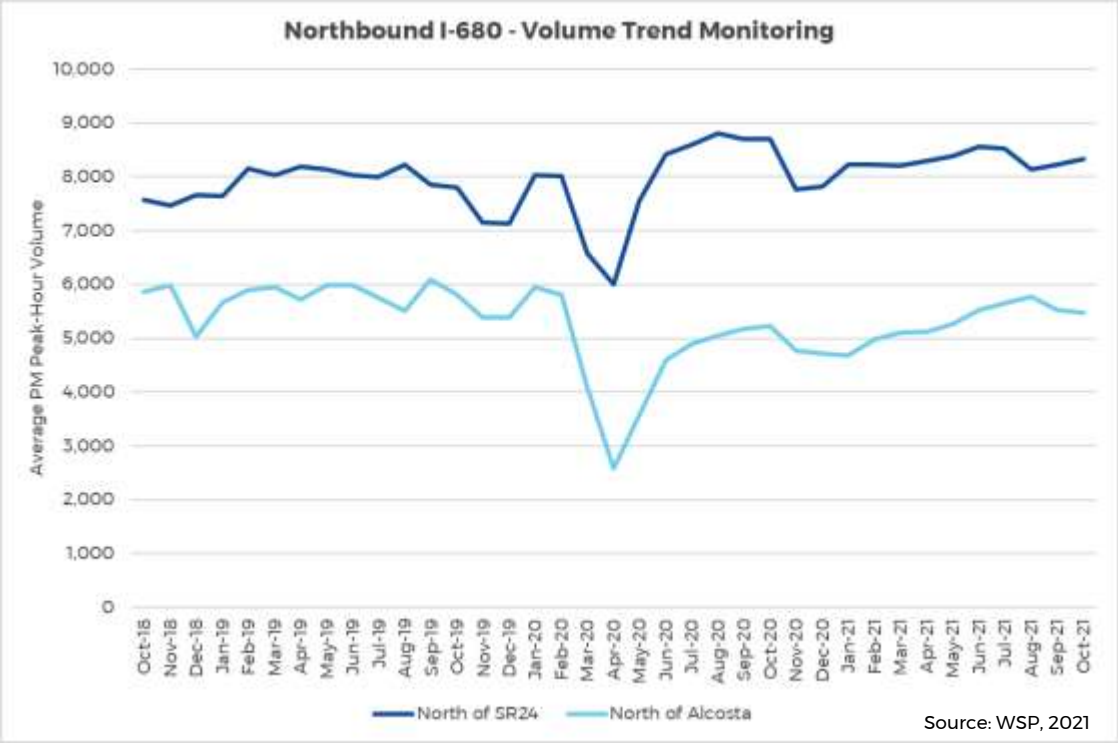


Figure 29 – COVID-19 Impacts to NB I-680 Travel

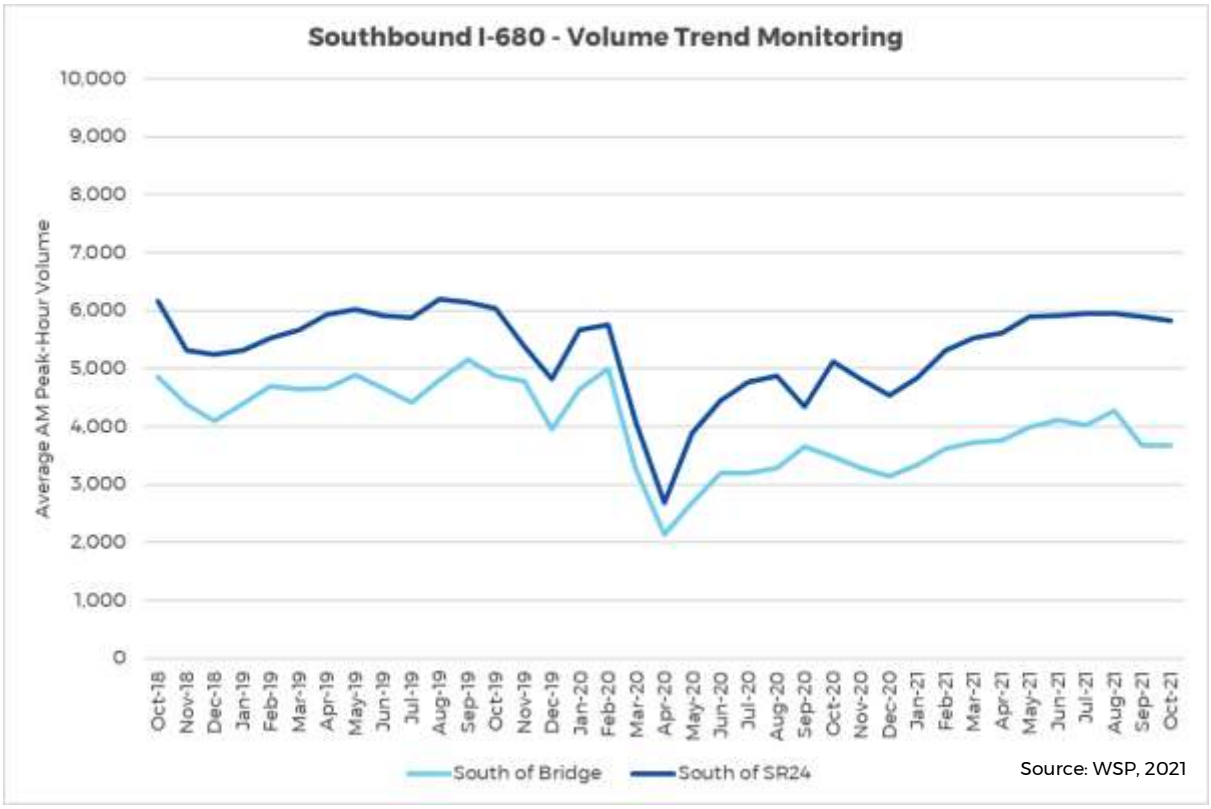


Figure 30 – COVID-19 Impacts to SB I-680 Travel

5.3.2 Road Safety

With the above-mentioned changes in vehicle traffic, there have also been observed changes to highway safety on the I-680 corridor. As compared to 2019, CHP has seen a decrease in calls for service by approximately 14% in 2020. Furthermore, in the Contra Costa area, CHP has seen a 3% reduction in citations in 2020. As shown in Figure 31 below, while there has been a decrease in citations for carpool/express lanes violations in 2020, total citations for speeding have significantly increased.

Please note that the statistics shows in Figure 30 and Figure 31 are not considered final until approximately 18 months after the end of the year, which is when Statewide Integrated Traffic Records System (*SWITRS) data is considered complete.*

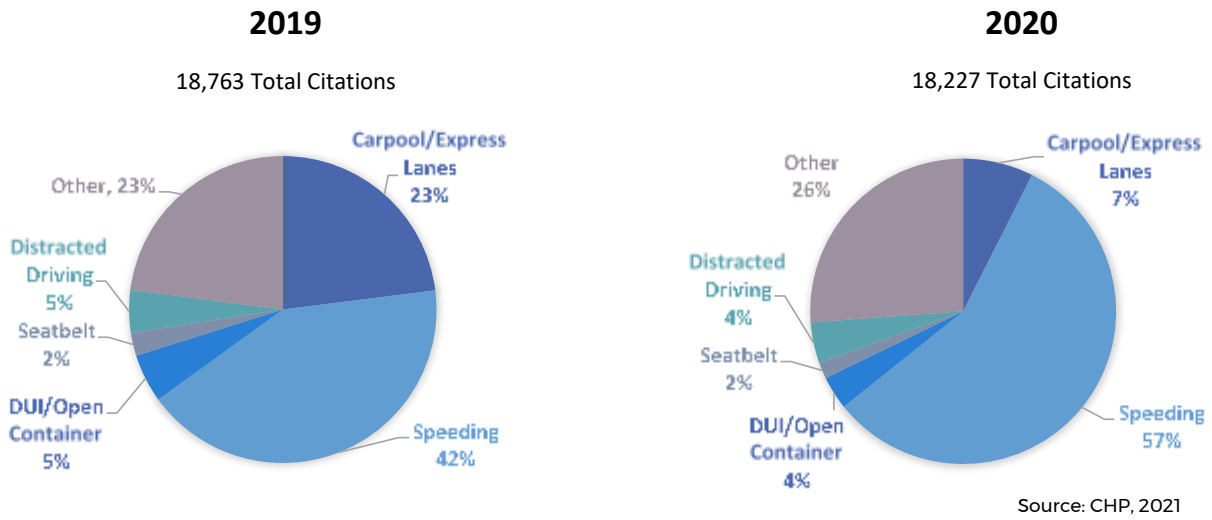


Figure 31 – COVID-19 Impacts to Vehicle Citations in Contra Costa

As shown in the figure below, CHP has also seen a 26% reduction in total vehicle crashes in the Contra Costa area. While not evident in the figure below, an increase in fatal crashes was observed in 2020, rising to 69% from 2019. CHP believes that this change is likely due to a number of factors, including increased vehicle speeds due to reduced vehicle traffic volumes.

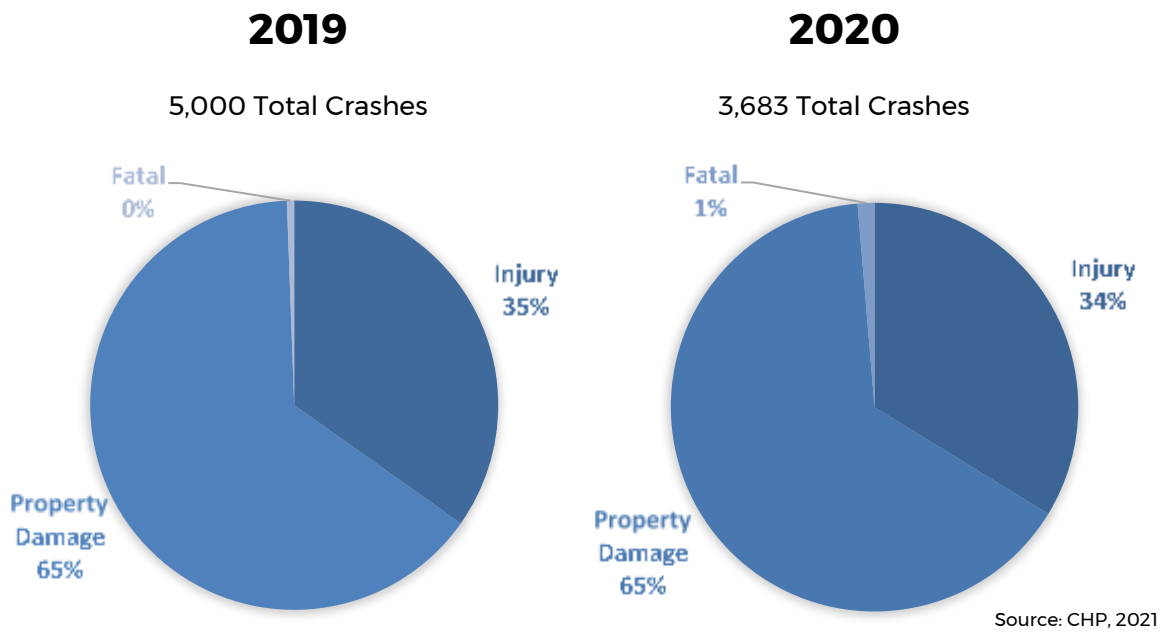


Figure 32 – COVID-19 Impacts to Vehicle Crashes in Contra Costa

5.3.3 Transit Ridership

Transit ridership has seen a significant, sustained drop since the start of the COVID-19 pandemic in March 2020 and shelter-in-place orders went into effect. The following graph - gathered from average weekday ridership data for BART stations and commuter bus service on I-680 - illustrates the fall in transit ridership in the program area. While this has proven challenging for transit providers on the corridor, stakeholders remain steadfast in their commitment to improve transit travel and transit reliability in the future.

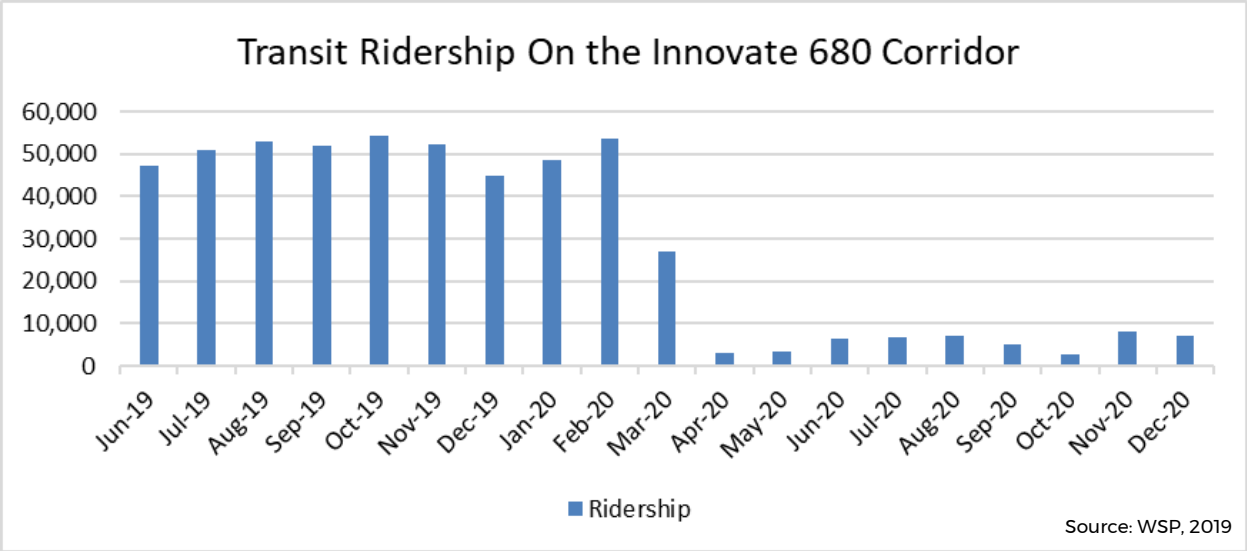


Figure 33 – COVID-19 Impacts to Transit Ridership

5.3.4 Traveler Behavior

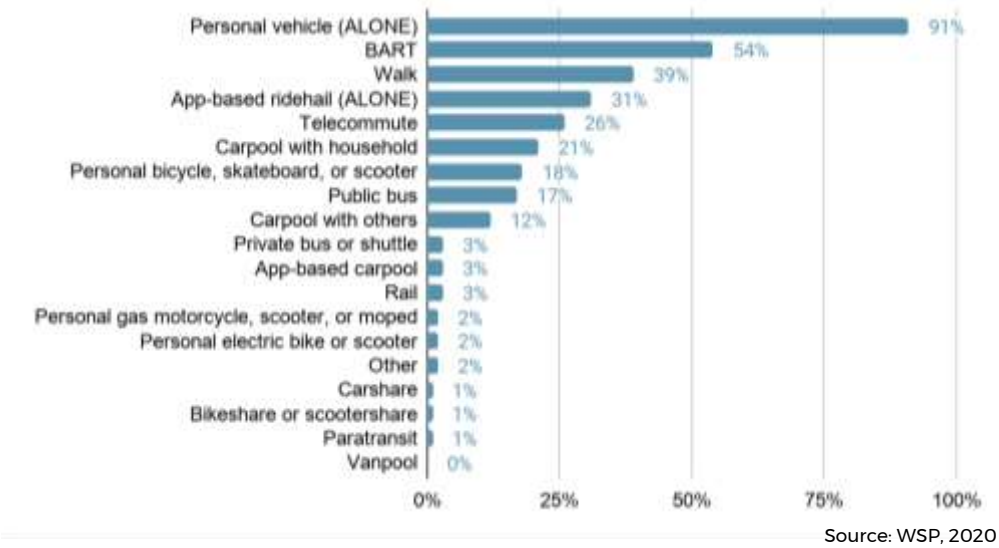
To better understand travel behaviors in the I-680 corridor, the program team conducted a user analysis survey in late 2020 of a random selection of corridor residents. In total, the team surveyed over 1,500 individuals. From this work, several key takeaways were identified:

- 91% of respondents, when presented with a list of potential commute options, chose personal vehicle as one of their preferred mode choices pre-COVID-19;
- 84% of respondents say they are very likely or somewhat likely to return to pre-COVID-19 travel habits; and
- 68% of drivers say they are either very interested or somewhat interested in driving less – 69% cited lessening environmental impacts as a reason; 63% cited not wanting to sit in traffic as a reason (please note: respondents were prompted to select all reasons that applied).

Collectively, these findings illustrate two main points:

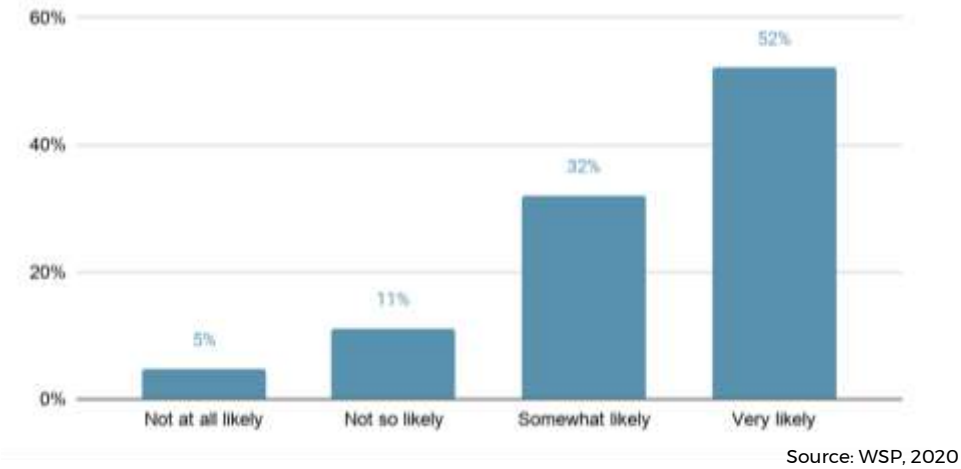
1. Prior to the COVID-19 pandemic, travelers of the corridor preferred utilizing their personal vehicle; and
2. Many travelers of the I-680 corridor are interested in driving less to accommodate varying personal and environmental concerns.

Both of these points offer a unique opportunity for the Program to position itself as a solution to the challenges and concerns felt by travelers of the corridor.



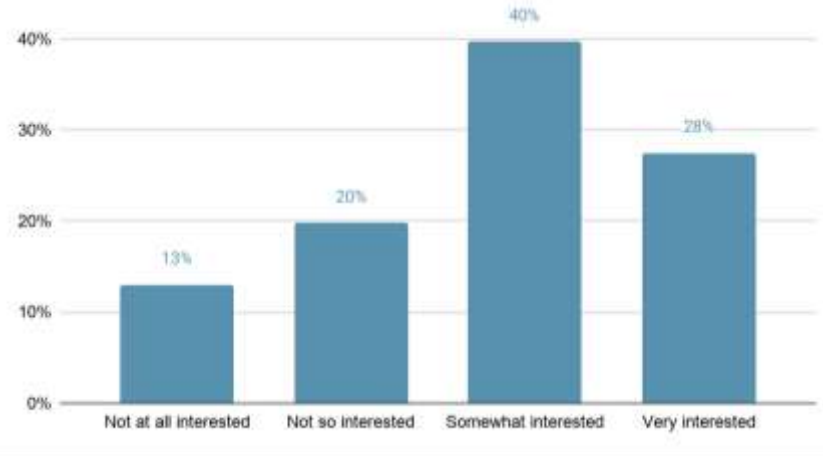
Source: WSP, 2020

Figure 34 – Pre-COVID-19 Preferred Mode Choice



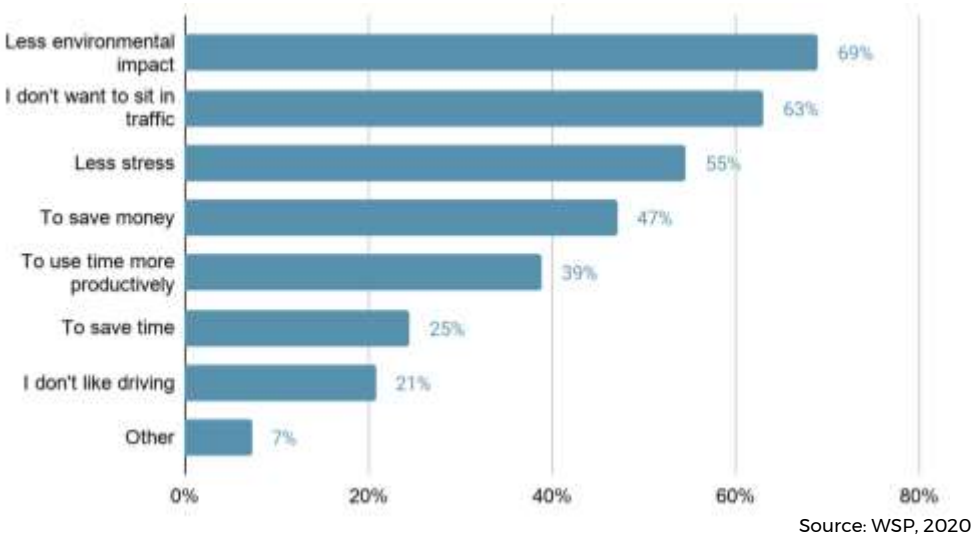
Source: WSP, 2020

Figure 35 – Likelihood of Returning to Prior Travel Habits



Source: WSP, 2020

Figure 36 – Interest in Driving Less



Source: WSP, 2020

Figure 37 – Reasons for Wanting to Drive Less

5.4 Existing Systems

To manage, operate and maintain the transportation network outlined in the previous sections, public and private entities utilize a wide range of transportation management systems. Many of these systems act independently of, and potentially in conflict with, one another, highlighting a key challenge for the Program – there currently is no single system that can be leveraged to achieve the vision of the Program. This means the Program will ultimately be tasked with integrating existing and proposed systems into a comprehensive, holistic, overarching system-of-systems that meets the needs of the Program. This section outlines the real-time operating systems that are most likely to require integration with the program in the future. In addition to identifying these systems, this section aims to provide a brief overview of their key components and capabilities.

5.4.1 Regional Systems

The following sections provide a brief summary of the key regional systems that provide transportation services and/or operational support to owners, operators and travelers of the program area. For additional information on these regional systems, including their existing interconnectivity, please see the MTC Bay Area ITS Architecture website, linked **here**.

5.4.1.1 Caltrans District 4 – State Highway System Operations

Caltrans currently owns and operates 1,400 miles of the state highway system in the San Francisco Bay area. To manage this system, Caltrans utilizes a real-time operations center, the District 4 Transportation Management Center (TMC), located in Oakland, California. This TMC has connectivity to highway system elements, such as ramp metering systems, closed circuit television (CCTV) monitoring, vehicle detection, and changeable message signs. As shown in Table 6, Caltrans owns and maintains in-pavement inductive loops for detecting vehicle traffic on the corridor. In addition to mainline loops for monitoring general purpose, express and HOV lane traffic, the agency also utilizes ramp loops for on-ramp detection. They also utilize seven changeable message signs on the corridor, providing real-time information to travelers, such as travel time estimates and travel alerts. Caltrans also operates a small network of CCTV cameras on the corridor, providing coverage for both TMC operators and CHP support staff. Caltrans does not currently utilize ramp metering on the I-680 corridor in Contra Costa County.

Table 7 – Caltrans I-680 ITS Field Assets

Owner	Detection	Variable Signs	Video	Ramp Metering
Caltrans	Yes - Inductive loop detection on mainline and on-ramps	Yes - Changeable Message Signs (CMS)	Yes - CCTV	None

Ultimately, these ITS field assets are managed through an Advanced Transportation Management System (ATMS) that leverages the available information to provide real-time data to operators at the District 4 TMC. Also present within the State Highway System operations is connectivity to CHP Dispatch. This allows Caltrans to coordinate incident and emergency response on the state highway system with local CHP officers.

Source: Caltrans

Figure 38 – Caltrans District 4 Transportation Management Center

Currently, Caltrans is exploring the procurement of an advanced transportation management system (ATMS) for use at both the state level and within Caltrans District 4. This system, known as CATMS (California ATMS), is intending to increase the capabilities of the existing transportation management system. This would include the ability to integrate additional real-time operational elements with external systems, as well as provide more robust performance monitoring of the state highway system. At this time, Caltrans is still working through the planning and design stages of this effort in coordination with the Program.

5.4.1.2 MTC/BAIFA – Express Lanes Operations

To monitor operations on the regional express lanes network, MTC/BAIFA currently utilizes the Regional Operations Center (ROC) located in San Francisco, California. This center allows in-person operators the ability to oversee real-time operations on the express lane corridor on I-680 in Contra Costa County. In the field, MTC owns a wide array of toll lane equipment for the Express Lanes System, such as toll tag readers, variable toll message signs, and traffic monitoring stations.

Table 8 – MTC/BAIFA I-680 ITS Field Assets

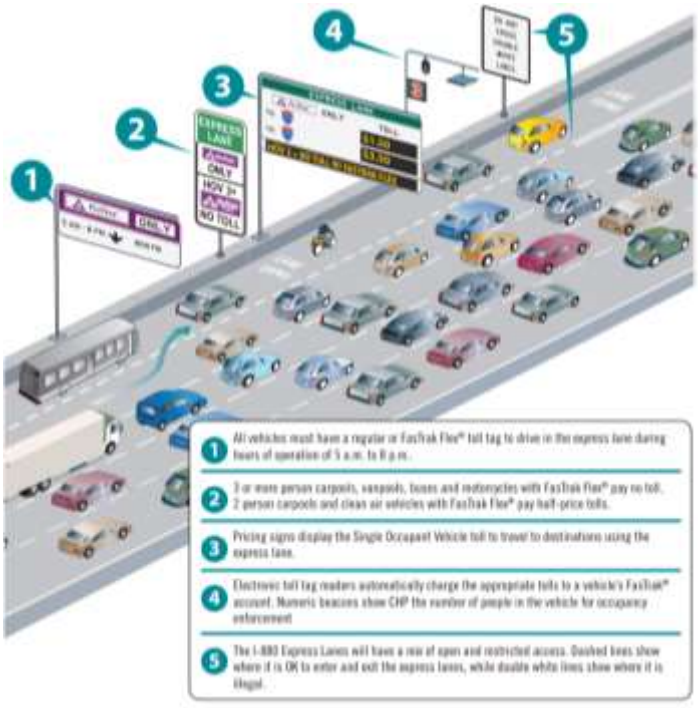
Owner	Detection	Variable Signs	Video	Ramp Metering
MTC *	Yes - Microwave Radar Detection, Toll Tag Readers	Yes - Variable Toll Message Signs	Yes - CCTV	n/a
* MTC currently operates express lanes from approximately Rudgear Rd/Livorna Rd to Alcosta Blvd.				

As shown in Table 7, MTC owns several traffic monitoring stations that utilize microwave radar devices to track both express lanes and general-purpose lanes traffic on the corridor. In addition, the express lanes system utilizes toll tag readers and automated license plate readers to provide travel and customer data to the BATA FasTrak® RCSC. MTC also owns several

variable toll message signs that provide travelers with dynamic toll rates and express lane usage information. The system also utilizes its own CCTV cameras which are separate from the Caltrans CCTV network. It should be noted, however, that MTC currently only operates express lanes from approximately Alcosta Blvd. to Rudgear Rd. in both the northbound and southbound directions. The southbound extension of the express lane, from south of the Marina Vista/Waterfront Interchange to Rudgear Rd., is anticipated to be operational by summer 2021. The remainder of the express lanes network, northbound from Livorna Rd to just south of the Marina Vista/Waterfront Interchange is proposed under the Express Lane Completion project.

A backend traffic management system ultimately provides connectivity to these system elements that MTC operates, allowing in-person operators to monitor operations on the regional express lanes, such as opening or closing toll lanes, or providing real-time adjustments to tolling rates. MTC's Regional Express Lanes System is illustrated in Figure 38. In addition, the ROC offers connectivity to the Caltrans District 4 TMC, allowing operators to coordinate as needed with highway system operators during incident and emergency scenarios.

MTC/BAIFA and Caltrans have entered into operations and maintenance agreements with an express lanes toll system integrator who is responsible for overseeing the existing 680 express lanes network. This agreement contains stringent KPIs to ensure the toll system is operating at an agreed upon level.



Source: MTC

Figure 39 – MTC's Regional Express Lanes System

5.4.1.3 MTC/CHP – Freeway Service Patrol

In order to support real-time operations on Bay Area highways and express lanes, the MTC Service Authority for Freeways and Expressways, in partnership with CHP and Caltrans, operates a regional FSP program. This program utilizes service patrol vehicles that travel the highways during hours of peak congestion, providing quick and efficient response to incidents. As shown in the figure below, FSP currently has an active beat covering the entire segment of I-680 in Contra Costa County. It should be noted, however, that this service is active only during weekday AM and PM commute periods.

Source: MTC, 2019

Figure 40 – MTC's FSP Service Area

5.4.1.4 MTC – Clipper®

MTC also owns and operates the Clipper® system. Clipper® offers an integrated fare payment system for over 20 different transit agencies, making it easier for travelers to commute across varying transit systems in the Bay Area. This includes connectivity to the three public transit agencies that serve as partners to the Program: BART, County Connection and LAVTA. Clipper® also offers fare integration with BART Parking Services, Bay Wheels, and BikeLink; all of which offer varying levels of service along the I-680 corridor. Clipper® is currently available on iOS and will eventually be available on Android devices.

Source: MTC

Figure 41 – MTC's Clipper® Card

In addition to these existing services, the Next Generation Clipper® Fare Payment System, often referred to as C2, is currently under development. C2 is envisioned as the future of Clipper®, encompassing the development a centralized account management phone application, smartphone fare payment services, as well as integration with additional transit providers. Mobile application-based fare integration is available for iOS devices now and will be available for Android devices soon.

5.4.1.5 MTC/BATA – FasTrak® RCSC

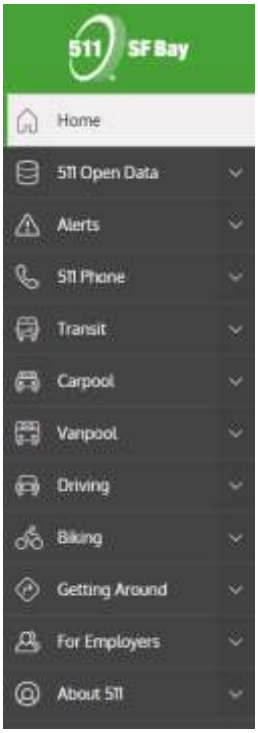
MTC also operates the BATA RCSC for FasTrak®, the Bay Area's electronic toll collection system that allows travelers to pay tolls using a regionally integrated toll payment service. To use this service, travelers must purchase and mount a FasTrak® toll tag on the interior of their vehicle or sign up for a license plate or one-time use account. On the I-680 corridor, the BATA FasTrak® RCSC primarily interfaces with the express lanes system and the Benicia-Martinez bridge and toll plaza. Travelers of the I-680 express lanes can travel toll free if traveling by motorcycle or with 2+ vehicle occupancy. Additionally, 50% discounts for single-occupant clean air vehicles are also available to corridor travelers.

Source: MTC

Figure 42 – FasTrak® Flex Switchable Transponder

5.4.1.6 MTC – 511 SF Bay

MTC operates the Bay Area 511 program, also known as 511 SF Bay, which is a comprehensive phone and web resource for traffic, transit, carpool, vanpool, and bicycling information. The system offers a wide range of real-time traveler information to commuters, such as critical traffic, transit and emergency alerts, a phone service with a state-of-the-art speech recognition system, as well as helpful connections to transit, carpool, vanpool, driving and biking services. In addition, the system also offers an open data portal for all external users to access available traffic and transit data compiled by MTC. Collectively, 511 SF Bay hosts the most robust and comprehensive traveler resources for Bay Area commuters. Bay Area Commuter Benefits Program can be accessed through the 511 SF Bay site. MTC's 511 SF Bay Services are shown in Figure 42.



Source: MTC

Figure 43 – MTC's 511 SF Bay Services

As noted above, the 511 SF Bay program operates a carpool and vanpool program that is utilized daily by travelers across the San Francisco Bay Area The program includes access to services such as:

- Merge Carpool – A carpool service that seeks to connect carpoolers with long-term carpool partners;
- Casual Carpool – Designated Bay Area pick-up and drop locations for travel over the Bay Bridge into San Francisco;
- Waze Carpool – Carpool and carpool driver services utilizing the Waze app;
- Scoop Carpool – Automated trip matching for morning and evening work commutes;
- BART Carpool – Connection to the BART carpool service provided via the BART app. This service also allows travelers to coordinate with BART's existing parking program; and
- Vanpool – Access to available regional vanpool seats and incentives for groups of travelers to start their own commuter vanpool.

In addition to connecting travelers to these services, 511 SF Bay also offers an array of incentives and monthly subsidies.

511 SF Bay also offers connectivity to CCTA's 511 Contra Costa program. This program is described in more detail below.

5.4.1.7 CCTA – 511 Contra Costa

CCTA currently oversees the implementation of the 511 Contra Costa program. 511 Contra Costa serves as an online resource to connect travelers to existing TDM programs in Contra Costa County, including those for biking, transit, walking, micro mobility, carpool, vanpool, and driving. The countywide 511 Contra Costa program offers robust and easily accessible information, resources and tools that promote alternative mobility options for travelers of the corridor. This includes information and services such as:

- The Guaranteed Ride Home Program offered to travelers who live and/or work or attend college in Contra Costa County;
- The Vanpool Driver/Passenger Incentive/Bonus Program offered to select vanpool users with a Contra Costa County origin or destination;
- An E-Bike Rebate Program for travelers who purchase an e-bike, conversation kit, or electric moped;
- The Drive Less Commuter Incentive for qualified commuters who switch to walking, biking, or transit;
- Access to BikeLink cards allowing travelers to utilize bike parking across the county;
- The Bike Mapper application to plan travel on the countywide bicycle network;
- Information on EV charging stations across the greater San Francisco Bay Area;
- The Miles partnership allows 511 Contra Costa to offer meaningful incentives to encourage travelers to try environmentally friendly modes of transportation while also providing useful data to CCTA's engineers and planners from the Miles application. The application also offers connectivity to the 511 SF Bay program for regional carpool and vanpool services; and
- The Scoop Technologies partnership provides carpool incentives to Scoop passengers who carpool from locations in Contra Costa.

5.4.1.8 Transit Providers – Transit Operating Systems

Currently, the transit providers of the I-680 corridor oversee real-time operating systems, known as Transit Operating Systems, that allow transit dispatchers to coordinate with buses and trains in real-time. In order to support these systems, transit agencies use a wide variety of system elements, such as Computer Aided Dispatch (CAD), Automatic Vehicle Location (AVL) systems, Automatic Passenger Counters (APC) or automatic fare collection systems to support real-time operations on the I-680 corridor. The following provides a brief description of these systems, with the subsequent table identifying which transit operators currently utilize these systems.

- CAD/AVL System: Provides live vehicle locations for dispatchers and communication between dispatchers and operators. The vehicle locations can be pushed to different platforms to provide real-time arrival information to customers.
- APC System: Records passenger boardings and alightings by stop/station on vehicles. The information can be transmitted live to provide customers with live information on

seating capacity or can be recorded and then uploaded when the vehicle returns to the yard for analysis and reporting by agency staff.

- TSP Transponders: Provides the ability for a transit vehicle to communicate with a traffic signal that has been set-up for TSP to affect the signal phasing by either prolonging, shortening, or changing a signal phase. This can improve the speed and/or reliability of the transit service.

Table 9 – Transit ITS Field Assets

Owner	CAD/AVL	APC	TSP Transponders
BART	CAD	No (uses faregate data to estimate)	n/a
County Connection	Yes	Yes (Clever Devices)	Yes (currently piloting)
LAVTA	Yes	Yes (Trapeze)	Yes
Acronyms: APC – Automatic Passenger Counters; AVL – Automatic Vehicle Location System; CAD – Computer Aided Dispatch; TSP – Transit Signal Priority.			

County Connection uses Clever Devices for both CAD/AVL and APC data. The CAD/AVL is real-time and feeds various third-party and internal systems while the APC data is retrieved from the vehicles when they return to the yard and transferred to a database for analysis. The Trapeze device also records on-board vehicle systems and their respective health to improve service reliability. The AVL system would most likely be able to communicate with other systems like ramp meters or traffic signals. These systems also enable Wi-Fi availability to passengers on Country Connection buses.

Transit service providers also provide varying levels of traveler information systems, informing travelers through web services, online platforms and messaging systems. This includes the BART, County Connection, and LAVTA trip planner applications that allow users to enter origin and destination information to plan their travel route. Additionally, some agencies also provide real-time transit information at local transit stops with static or dynamic message signs. Collectively, these systems are connected and integrated with 511 Contra Costa, 511 SF Bay and the Clipper® systems, supporting travelers who are searching for information and utilizing multiple transit services.

Furthermore, transit agencies also utilize physical operations centers for real-time coordination and operational support. A prime example is BART, which operates their Bay Area system out of a large, transit operations center. BART's facility, known as the Operations Control Center, is located in Oakland, California. County Connection and LAVTA also have similar operations centers that ultimately support local operations on a smaller scale. While these operations centers are not currently connected to local arterial signal systems, future TSP programs are planned along the I-680 corridor that are likely to require connectivity in the future.

Source: BART

Figure 44 – BART's Operations Control Center

5.4.1.9 Local Agencies – Traffic Operations Systems

Most local agencies on the corridor provide real-time operational support for arterial signal systems in the county. These agencies utilize traffic operations systems to monitor and control various system elements, such as signal timing, vehicle/bike/pedestrian detectors, emergency vehicle preemption devices, and CCTV cameras. A primary component of these systems is the traffic signal controller, which is located on-site at arterial intersections. In some instances, agencies have yet to upgrade traffic signal controllers to current, state-of-the-practice controller devices. Some agencies still utilize legacy dialup systems to communicate with older signal controller types. Many of the older signal controllers, however, are in the process of being upgraded and integrated into centralized control systems. As such, several agencies are limited in their abilities to support real-time operations on their facilities.

In addition to signal controllers, there are several other key elements to existing signal systems, including:

- Detection devices, which are used to monitor vehicle, pedestrian, and bicycle movements. In some cases, some agencies are utilizing video detection devices for enhanced vehicle detection and data collection.
- CCTV cameras, which are used to monitor real-time operations on arterial corridors.
- Emergency vehicle preemption devices, which are used to prompt changes in signal timing to prioritize emergency service vehicles.

Table 9 summarizes the state of existing signal systems for the seven local agencies on the corridor. In addition to this information, several agencies have ITS master plans that provide additional detail on the state of ITS infrastructure at a more granular level, by agency. For additional information, please see these reports, located **here**. For additional information on backbone communications systems and future fiber deployments, please see Section 5.5 Existing Support Environment.

Table 10 – Arterial ITS Field Assets

Owner	Upgraded Controllers?	Video Vehicle Detection?	CCTV?	Bike/Ped Detection?	Emergency Preemption?
City of Concord	No	Yes – some use cases	Yes – limited use cases	Yes – limited use cases	Yes
City of Martinez	No	No	No	No	Yes
City of Pleasant Hill	Yes – limited use cases	Yes – several use cases	No	No	Yes
City of Walnut Creek	Yes – several use cases	Yes – several use cases	Yes – several use cases	No	Yes
City of San Ramon	Yes – several use cases	Yes – several use cases	No	Yes – limited use cases	Yes
Town of Danville	Yes – limited use cases	Yes – several use cases	No	Yes – limited use cases	Yes
Contra Costa County	No	No	No	No	Yes – several use cases

Limited Use Cases – very few devices deployed at intersections

Some Use Cases – some devices deployed, however not utilized at the majority of intersections

Several Use Cases – several devices deployed at the majority of intersections

Currently, most agencies on the I-680 corridor have some level of control and monitoring capabilities of their existing signal systems, often accessible virtually to staff members who are assigned personal computers. Contra Costa County and the City of Martinez are two exceptions to this, as they currently do not have remote connectivity to their existing signal systems. With the exception of the City of Walnut Creek, most agencies do not have connectivity to incident, emergency, or event management systems that support local coordination. The City of Walnut Creek, however, owns and operates a local traffic operations center for real-time operational support. This facility is housed at the city hall building in Walnut Creek. Many agencies also have existing agreements with Caltrans to either oversee or control ramp termini signals that neighbor and/or cross their local jurisdictions. One example is the adaptive signal system that the City of San Ramon currently operates on Crow Canyon and Bollinger Canyon Rd. At both ramp termini, the city has an MOU with Caltrans that provides the city the ability to control signal operations at the highway intersection, pending approval by Caltrans. While some agencies have developed time-of-day plans or have implemented signal coordination across corridors, none of the local agencies coordinate signal timing across jurisdictional boundaries. Additionally, none of the existing local agency traffic operations systems connect to transit operating systems.

However, to help improve arterial operations, several local agencies applied for federal grants through the MTC IDEA program. This grant program utilized $13 million in federal funds to help cities, counties and transit agencies improve operations of major arterial roadways in the region. Grant proposals were submitted from many agencies across the San Francisco Bay Area region; five grants were awarded within the Program area. Of these five grant awards, four were combined into a regional, multi-agency partnership led by CCTA and supported by County Connection, the City of Walnut Creek and the City of Concord. This regional project seeks to deploy innovative arterial improvement technologies in the downtown Walnut Creek and Concord areas, including the use of transit signal priority and adaptive signal systems. Additional ConOps for this region-wide IDEA project can be found **here**. The City of San Ramon was also awarded its own IDEA grant to further improve operations on Bollinger Canyon and Crow Canyon Rd with the deployment of an Automated Traffic Signal Performance Measures program. Each of these projects offer opportunities to pilot and test innovative operational strategies aimed at improving arterial operations in the program area. The Program will benefit from looking for opportunities to connect to these systems in the future, while also prioritizing future investments to support their long-term operations and maintenance.

5.4.1.10 Various – Parking Management Systems

Several agencies also utilize parking management systems to manage parking demand at local community centers and transportation facilities.

- BART has a rather robust parking system, offering travelers daily, monthly, carpool and electric vehicle parking programs and permits, all with connectivity to Clipper® payment services. The agency is also continuing to enhance its system, evaluating potential automatic license plate recognition deployments in the future. In addition, some private developers have installed dynamic parking availability signs at nearby privately-owned garages.

- The City of Martinez manages the Pacheco Transit Hub with a parking management system that is installed and currently operational. This system has over 100 parking sensors and several still cameras for parking validation.
- The City of Pleasant Hill currently owns a downtown parking garage and recently upgraded the system to a video camera-based parking management system.
- The City of Concord owns two downtown parking garages and is looking into developing a parking management system.
- The City of Walnut Creek currently utilizes embedded sensors across the city to manage metered spaces and commercial loading zones through an online cloud dashboard. The city also utilizes Smarking for dynamic garage management and uses some digital signs to provide parking information availability to travelers in real-time.
- The Town of Danville utilizes iPARK, an online permit service available to downtown merchants and employees. There is interest within the agency to install a parking management system for existing facilities, including the Sycamore park and ride lot which is owned by the Town of Danville. The Danville Police Department also owns and maintains a robust automated license plate readers (ALPR) and situational awareness cameras (Sitcams) surveillance system.

5.4.1.11 Local Law Enforcement – First Responder Systems

In addition to the law enforcement services provided by CHP, local law enforcement groups such as local police departments, Contra Costa County's Sheriff Department, and BART Police Department also support the safety and enforcement of non-state highway facilities in the program area. In order to support these services, most agencies utilize emergency dispatch systems accessible via phone. These first responder systems support coordination in incident and emergency scenarios and, in rare cases, are connected to existing operations centers. Traffic patterns on both freeways and arterials are constantly changing; these changes require regular monitoring and ongoing coordination between local law enforcement agencies

5.4.2 Private Systems

In addition to the key regional systems discussed above, several private entities support real-time operations on the I-680 corridor as well. These include both private mobility providers and private data providers who manage private fleet management systems and private traveler information systems. Private fleet management systems are systems operated by carshare, ride hailing and micro mobility providers that support the management of fleet assets that are deployed to users traveling the corridor. Private traveler information systems are information systems, such as those provided by Google/Waze, that provide real-time travel information to commuters, while also offering connectivity to other services, such as transit routes and first/last mile solutions. Many of these systems have connectivity to existing regional systems. The MOD/MaaS project currently has partnership is place with private systems and more are likely to connect to some aspect of the future Innovate 680 system in the future. These connections ultimately offer travelers access to additional traveler information and a growing number of first/last mile mobility options.

5.5 Existing Support Environment

Each of the systems listed in the previous section require a robust support environment to enable ongoing operations and maintenance. This section outlines these supporting elements, including:

- The operations centers and staffing that support real-time system operations;
- The software assets that support highway, arterial and transit systems;
- The overarching communications network that supports real-time operations;
- The existing data sharing and data management practices among stakeholders; and
- The current maintenance protocol and regimes that support existing operations.

5.5.1 Operations Centers and Staffing

As described in the prior section, several stakeholders of the program own and operate physical operations centers that support real-time operations in the program area. The following table summarizes these facility types, noting the facility owner and location of the facility.

As noted in the table below, the City of Martinez and Contra Costa County do not have connectivity to their existing signal systems. While all other agencies do have connectivity to their systems in varying capacities, some agencies take part in more regular, day-to day operations, such as Caltrans, MTC, and BART. These agencies utilize physical operations centers and employ in-person, on-site staff who regularly oversee system operations. In addition, while the City of Walnut Creek does have a physical operations center, on-site staff is only provided on an intermittent basis.

While the remaining agencies do not have physical operations centers, they do have the ability to connect to virtual servers that allow agency staff to monitor traffic conditions remotely. Several agencies, including the City of San Ramon, City of Concord, City of Pleasant Hill and Town of Danville, are evaluating the need for developing centralized control systems. For some of these cities, this also includes the potential for developing local, centralized operations centers for their citywide signal systems.

Table 11 – Existing Operations Facilities

Owner	Facility	Location
Caltrans District 4	Transportation Management Center	Oakland, CA
MTC	Regional Operations Center	San Francisco, CA
CHP	Golden Gate Communications Center (GGCC)	Vallejo, CA
City of Concord	**	-
City of Martinez	+	-
City of Pleasant Hill	**	-

City of Walnut Creek	Traffic Operations Center	Walnut Creek, CA
City of San Ramon	**	-
Town of Danville	**	-
Contra Costa County	+	-
BART	Operations Control Center	Oakland, CA
County Connection	Administrative Office	Concord, CA
LAVTA	Maintenance, Operations, and Administration Facility	Livermore, CA

* CHP Officers are currently co-located at the Caltrans District 4 TMC, supporting real-time incident management and other TMC functions on the state highway system.

** While these agencies do not have physical, real-time operations centers, most connect to a virtual private network to monitor traffic conditions remotely.

+ These agencies do not have remote operational control of existing signal systems.

5.5.2 Software

In order to support ongoing operations, program stakeholders utilize a wide variety of backend software systems. This includes traffic management systems that support highway and arterial operations. This section provides a brief summary of these key elements that are utilized in the program area.

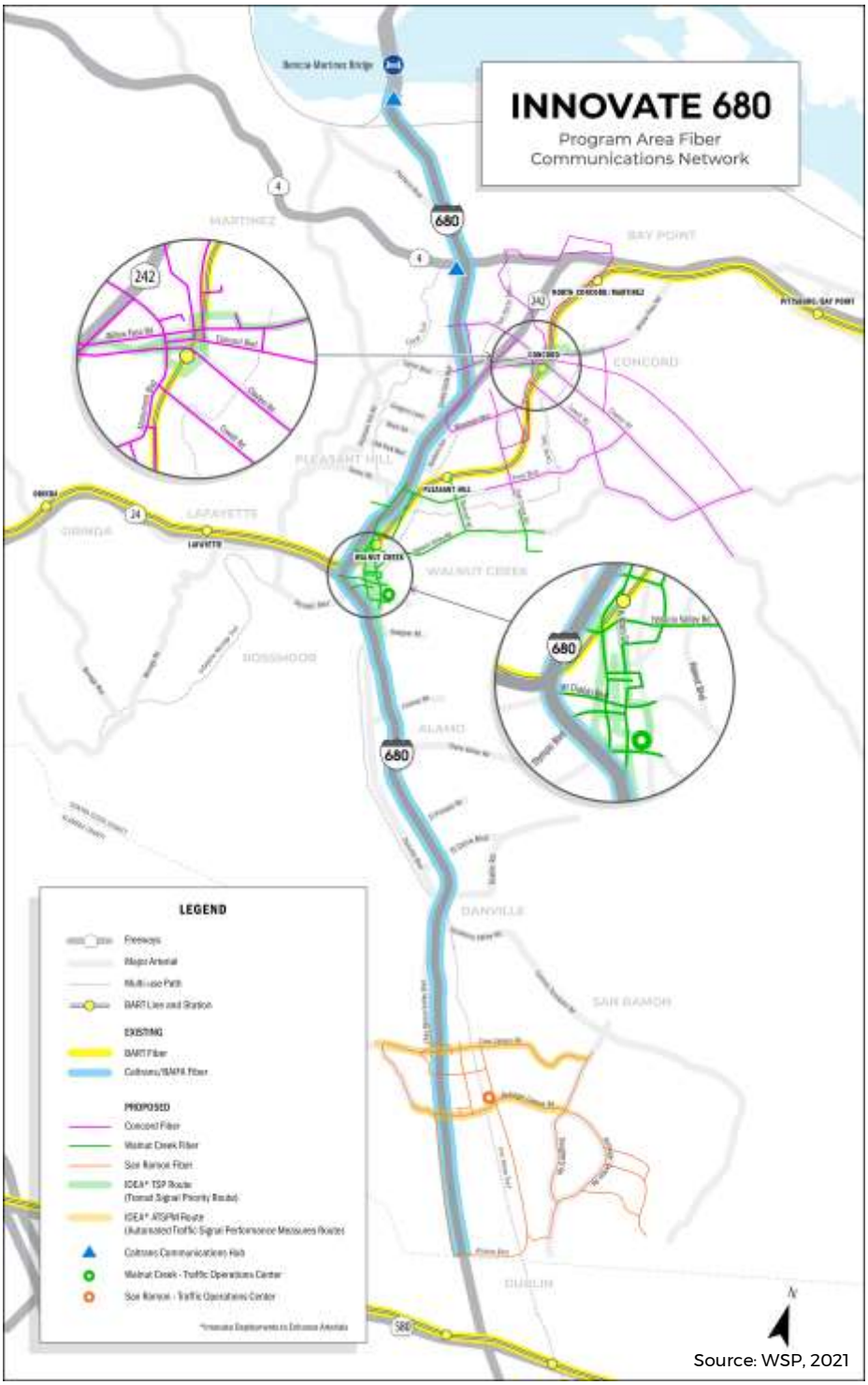
Regionally, Caltrans D4 TMC utilizes an ATMS (Parsons Company) system and KITS advanced traffic management system (Kimley Horn) to support traffic operations on the state highway system. MTC utilizes a TransSuite (TransCore) system to support operations at the ROC. Locally, the cities along the corridor use a variety of systems to manage their arterial signal systems. The following is a listing of these systems:

- Contra Costa County utilizes a Quick Net (McCain) system;
- The City of Concord utilizes a Cubic (Traffic Ware) system;
- The City of Pleasant Hill utilizes a Quick Net (McCain) system;
- The City of Martinez does not utilize a centralized signal management system;
- The City of San Ramon utilizes a MaxView (Intelight) system;
- The City of Walnut Creek utilizes a Cubic (Traffic Ware) system; and
- The Town of Danville is phasing out of their Quick Net (McCain) system and utilizing a Centracs (Econolite) system for new deployments.

5.5.3 Network Communications

In order to support ongoing operations in the program area, several agencies utilize a wide range of communications infrastructure within the program area, including dial-up, radio, and other wireless communications systems, of particular importance to the program is the existing use of high bandwidth, low-latency solutions such as fiber-optic cabling. Ultimately, these communications systems are most able to support future technology deployments on the corridor, and, if accessible and available, can be leveraged to support the Program in the

near term. In addition, these systems are the preferred alternative for the build-out of a robust, backbone communications system that can support ancillary communications systems in the future. The Figure 45 illustrates both the existing and planned fiber communications network in the program area. This information is described in more detail in the following sections.



Source: WSP, 2021

Figure 45 – Program Area Existing & Planned Communications Network

5.5.3.1 Regional Fiber Optic Communications

As described in the MTC Regional Communications Strategic Investment Plan, linked **here**, Caltrans, MTC/BAIFA and BART all own existing fiber optic communications infrastructure either on or near the I-680 corridor. BAIFA, which is the agency within MTC that owns and operates the regional express lanes system, currently owns the existing fiber optic cabling along the I-680 corridor. This fiber cabling is a 144-strand single mode fiber optic cable. This cabling was ultimately installed as the communications backbone network for the I-680 express lanes system and is installed within the Caltrans right-of-way (ROW). Caltrans supports maintenance of the conduit infrastructure that houses the fiber cable and also owns 72 of the above-mentioned 144-strand fiber optic cable. Additionally, BART owns fiber optic cabling along their ROW throughout the program area.

5.5.3.2 Local Fiber Optics Communications

In addition to the regional fiber network, several local agencies are in the process of developing local fiber communication networks. It should be noted that, currently, local signal systems are connected via copper traffic signal interconnect cabling. To develop more robust backbone communications systems, several agencies have developed fiber deployment plans, which are shared **here**. These are shown in Figure 45 as proposed improvements and are summarized below:

- City of San Ramon – The agency has developed an ITS Master Plan. This plan outlines the future trunk line and fiber branch cabling needs for the city, including a recommended corridor deployment plan. The current priority for the city is the development of the Bollinger Canyon Road corridor and downtown San Ramon area, followed by the Crow Canyon Road corridor.
- City of Walnut Creek – The agency has developed a Fiber Optic Communications Network Master Plan. This plan outlines the future trunk line and fiber branch cabling needs for the city, including a recommended corridor deployment plan. The current priority for the city is the development of the downtown Walnut Creek area, followed by the Ygnacio Valley Road corridor.
- City of Concord – The agency has developed a preliminary fiber deployment plan. The current priority for the agency is the buildout of the fiber communications network in the downtown Concord area, including the Monument Blvd-Concord Ave corridor.

5.5.4 Data Sharing and Management

Stakeholders within the program area have varying needs for sharing and managing data as it relates to their transportation programs. This is especially important for traffic engineering and planning purposes, measuring the performance of the transportation network, real-time monitoring of conditions, and to evaluate safety needs.

For example, traffic and bicycle/pedestrian counts and other historical data for traffic engineering and transportation planning use is collected manually by some and in an automated fashion by others. Stakeholders typically access crash and safety data using CHP's Statewide Integrated Traffic Records System (SWITRS) and also keep records in local databases.

Traffic signals are another type of data that is shared and managed along the corridor. Furthermore, several local agencies are collecting data in order to support ATSPM programs.

Real-time data is also shared throughout the program area. This is done mostly through regional systems, such as 511 SF Bay which is operated by MTC. Local agencies have also collected travel times using Bluetooth-based technologies in select corridors to spot check travel times as needed. Furthermore, existing data-sharing agreements are described in additional detail in Section 5.6.2, Existing Agreements.

Security measures to protect devices in the field, back-office systems, and the ITS and IT networks that support devices and systems in each agency are in place. Robust data security systems are currently in place to support Clipper® and FasTrak® systems.

5.5.5 Maintenance

The various systems operating along the I-680 corridor are typically maintained by the individual owner/operators. This section intends to briefly outline these differences for key system owners on the corridor, highlighting the need for uniform and consistent maintenance protocol under the operational concept that is proposed.

- Caltrans District 4 – Caltrans currently maintains their existing state highway system with internally hired Caltrans maintenance staff. These staff members are responsible for overseeing both civil infrastructure elements as well as ITS equipment on the state highway system. Infrastructure maintenance is a high priority for the agency. As such, it is challenging for Caltrans maintenance staff to provide preventative and proactive maintenance support for the unique needs of ITS assets deployed on the corridor. Similarly, given the breadth of technology deployments that are serviced across the district, it is often difficult for Caltrans maintenance staff to support the implementation and maintenance of new, innovative technology deployments on highway corridors. Caltrans also maintains park and ride facilities.
- MTC – Currently, MTC operates, maintains, and oversees a wide range of systems within the region, including 511 SF Bay, Clipper®, FasTrak® RCSC, and the regional express lanes. While each of these systems are maintained differently, MTC has largely been more progressive in their approach to on-going O&M, developing unique O&M agreements that often utilize outside contractors/consultants. For example, the express lanes and toll bridge system use O&M agreements with toll system integrators who are responsible for maintaining the toll system and its physical infrastructure assets. The agency utilizes KPIs to monitor system performance and ensure contractors are supporting the needs of the system 24/7. Similarly, MTC utilizes outside contractors to support the maintenance of the Clipper® and 511 SF Bay programs as well as traditional civil and backhaul maintenance. While this progressive approach has its benefits, it would require an additional interface (to the system maintainer) in the ultimate integration of the various system elements providing operational support on the I-680 corridor. In addition to coordinating with MTC on future system integration needs, the program will also be required to work with the multitude of contractors/consultants who provide on-going support to the organization.

- Local Agencies – Currently, local agency traffic signal maintenance responsibilities vary. Within the county, Contra Costa County serves as the primary signal maintenance provider for several local agencies, including the Town of Danville, City of Martinez, and City of Pleasant Hill. In some cases, however, local agencies maintain some, but not all, of their own signal systems, including those operated by the City of Walnut Creek, City of Concord, and City of San Ramon. Furthermore, some local agencies maintain neighboring Caltrans ramp terminal signals. As it currently exists, local signals are not known to utilize robust asset management databases or on-going performance monitoring to support maintenance regimes.
- Transit Providers – The transit providers' system equipment is primarily on vehicles and includes the APC, CAD/AVL, cameras, TSP equipment, and fareboxes and the travel information that is relayed to customers at stations and stops or through customer technology. The equipment that relays information real-time (like the CAD/AVL) is transmitted to a server and then may be made public from there. Transit providers all have their own unique systems that provide the real-time information, but they can be combined in third-party systems like Google Maps, Transit, or other applications. Day-to-day maintenance of the vehicles and minor defects with the equipment are done by transit providers' own maintenance staff. Problems with the software and larger defects to the equipment require the software vendors or vendor-approved contractors to perform maintenance. Some transit providers are also responsible for maintaining park and ride facilities.

5.6 Existing Operational Policies

Several existing regional policy and legislative efforts are likely to impact the development of the Program and its projects in the future. While it is not possible to note all existing regional policy discussions, this section identifies high priority issues that are most likely to impact the development of the Program in the future. Moreover, to operate and maintain the various transportation services and systems outlined in the prior sections, program stakeholders have a multitude of existing operations and maintenance agreements among one-another. This section also outlines these agreements types, highlighting those that are most likely to impact the development of the Program in the future.

5.6.1 Existing Policy and Legislation

The following is a listing of key policy and legislative efforts that have the greatest potential to impact the development of the Program in the future.

- Regional Transit Planning – Accelerated by impacts felt from the COVID-19 pandemic, MTC has placed a renewed emphasis on improving coordination among regional transit providers. This has resulted in the formation of the Blue-Ribbon Task Force. This task force is leading region-wide efforts to recover from impacts to ridership and transit performance, as well as support the distribution of federal funds provided by the federal Coronavirus Aid, Relief and Economic Security Act. Various transit operators across the nine Bay Area counties are part of this regional task force, and it is currently unclear what lasting changes may occur. Under consideration is the development of a regional transit network manager who would be responsible for overseeing transit operations region-wide. The task force will submit a Bay Area Public Transit

Transformation Action Plan to the MTC commission by mid-2021 for consideration and possible adoption.

- SB743 – Senate Bill 743 changes the way in which transportation projects will be assessed throughout their development statewide. These changes ultimately support statewide efforts to achieve climate commitments, preserve the environment, and support transportation mode shift. This change has been implemented at both the project and program-level with VMT mitigation being a central discussion among program stakeholders. As these changes are evaluated at the statewide level, the program will encompass these considerations into the delivery of projects within the program.
- Part Time Shoulder Use – Currently, Caltrans is in the process of developing guidance for part time shoulder use on the state highway system. Concurrently, CCTA is evaluating the challenges and opportunities of sponsoring legislation to support part time shoulder use on I-680. These discussions will be tracked at the program-level to support the development of the PTTL Project in the future.
- HOV 2+/+/HOV 3+ – On-going regional discussions regarding a change from HOV 2+ to HOV 3+ policy have the potential to impact traffic flow and congestion, HOV/express lane operations, transit operations, shared vehicle operations, and existing TDM programs. While these discussions are preliminary, future outcomes need to be tracked and accounted for in the planning, design and implementation of Innovate 680 projects.
- Clipper® and FasTrak® START Program – To address transportation equity disparities in the region, MTC has developed both the Clipper® and FasTrak® START programs. Both programs offer discounts for Bay Area travel to residents who meet income eligibility requirements. While both programs are currently in the pilot stage, they illustrate a regional shift in evaluating future transportation infrastructure and services. This highlights the need for the Program to consider equity in its future implementation. This consideration is captured as one of the several goals of the Program.

5.6.2 Existing Agreements

Currently, program stakeholders have a multitude of existing agreements shared among one another to operate and maintain the services and systems provided in the program area. Ultimately, these agreements point to the complexities of the existing roles and responsibilities for operations and maintenance among stakeholders. While it is not possible to outline all existing agreements, Table 11 outlines the types of agreements that are most likely to impact the development of the Program and its operational concept outlined in the following section. It should also be noted that, while not listed in Table 11, there are several existing O&M and memorandum of understanding (MOU) agreements that have been developed across the region that can be leveraged by the Program in the future. This includes those developed for the I-80 ICM Project, as well as other agreements developed by both regional and local agency stakeholders of the program.

Table 12 – Existing Agreement Types

Stakeholder	Existing Agreement Types
CCTA	• Agreements with contractors/private companies to support the operations and maintenance of 511 Contra Costa.
Caltrans District 4	• Agreements with MTC/BATA/BAIFA to support maintenance of civil infrastructure assets on the regional express lanes system, including the fiber trunk line. • Agreements with MTC and CHP to support the operations of the FSP program. • Agreements with CHP to support emergency and incident management on the state highway system. • Agreements with local agencies to allow delegated control and/or oversight of local ramp termini signal systems. • Agreements with local agencies to operate and maintain local Park and Ride facilities. • Agreements with contractors/private companies to support the operations and maintenance of the Caltrans District 4 TMC system.
MTC/BATA/BAIFA	• Agreements with toll system integrators to support maintenance of toll system assets on the regional express lanes and toll bridges. • Agreements with Caltrans to support maintenance of civil infrastructure assets on the regional express lanes system. • Agreements with Caltrans and CHP to support the operations of the FSP program. • Agreements with CHP to support emergency and incident management on the regional express lanes system. • Agreements with contractors/private companies to support the operations and maintenance of the ROC, Clipper®, FasTrak® RCSC, and 511 SF Bay systems.
CHP	• Agreements with Caltrans and MTC to support emergency and incident management on the state highway and regional express lanes systems. • Agreements with Caltrans and MTC to support the operations of the FSP program. • Agreements with Caltrans to support the operations of Caltrans for COZEEP (construction), MAZEEP (maintenance), PDZEEP (project development) and encampment cleanups/removals.
Local Agencies	• Agreements with Caltrans to allow delegated control and/or oversight of local ramp termini signal systems. • Agreements with Caltrans to operate and maintain local Park and Ride facilities. • Agreements with Contra Costa County for maintenance of existing signal systems. • Agreements with other local agencies for operations and maintenance of existing signals on/near jurisdictional boundaries. • Agreements with contractors/private companies to maintain local traffic management software systems. • Agreements with contractors/private companies to operate and maintain local micro mobility programs. • Agreements with contractors/private companies to operate and maintain parking systems.
Transit Providers	• Agreements with Caltrans for maintenance of joint-use facilities. • Agreements with contractors/private companies to support operations and maintenance of transit operating systems and transit assets (LAVTA). • Collective bargaining agreements with operations and maintenance staff unions (BART and County Connection). • Mutual aid agreements between transit providers (BART and County Connection) • Agreements with vendors for maintenance of transit equipment and software. • Agreements with contractors/private companies to operate and maintain local micro transit programs. • Agreements with contractors/private companies to operate and maintain parking systems. • Agreements with contractors/private companies to operate and maintain transit-oriented developments (TOD).

5.7 Existing User Groups

As it currently exists, the I-680 corridor is utilized by a diverse set of users across Contra Costa County and the greater San Francisco Bay Area. These users regularly interface and interact with the corridor and its various multimodal elements and systems. As such, several stakeholders outlined in the previous section operate the corridor within the program area as there is currently no centralized system operator. These include:

- CCTA
- Caltrans District 4
- MTC
- CHP
- Local agencies
- Transit providers

In addition to the agencies noted above, this Program ConOps also explores the wider impacts of the program to the traveling public, private industry partners, and emergency responders. In doing so, the program will center its future needs around all travelers, owners and operators who are critical in supporting the overall operational concept and the operational scenarios presented in Section 7.0. For this reason, the following additional user groups were developed for this Program ConOps:

- Travelers
- Mobility providers
- Data providers
- Local law enforcement
- Emergency services

The following section is a brief description of the additional user groups outlined above. It should be noted, however, that these user groups are not intended to capture all potential users of the I-680 corridor. There are other known users of the corridor, such as business owners, local schools, and freight, trucking and regional logistics providers. However, in evaluating the scope of the program, the key elements of the corridor, and the potential for two-way information exchange, these users were not included in this Program ConOps. However, there may be a need to evaluate these users on future Innovate 680 projects. In the future, considerations should be taken based on proximity to local schools and businesses in project-level ConOps documents.

5.7.1 Travelers

Travelers are the end users of the infrastructure and services provided in the program area. Currently, travelers utilize this area to begin, pass through, or complete their trip, interacting with most other user groups of the program. Sub-classes of travelers are also referenced throughout the Program ConOps to identify the needs of key community groups along the corridor. These groups were developed based on a review of the equity overlay recommendations provided in the prior section, as well as additional information that is known of key community groups in the program area. These groups are:

- Youth – Travelers who are under the age of 18;
- Elderly – Travelers who are over the age of 65;
- ADA – Travelers who have a physical and/or mental impairment that limits personal mobility;
- Non-English Speaking – Travelers who do not utilize English as their first language;
- Car Free – Travelers who do not have access to a personal vehicle;

- Unbanked – Travelers who do not have access to banking services; and
- No Phone – Travelers who do not own a phone, are not carrying their phone, or are unconnected to wireless or cellular communications due to a technical failure, such as a loss of power or cellular service.

5.7.2 Mobility Providers

Mobility providers are private businesses, nonprofits, and quasi-governmental agencies that offer one or more modes of transportation for use by travelers in exchange for payment. These include car-sharing services, ride-sharing services, ride hailing companies, bike sharing services, and private car/van pools from ride matching services. In some cases, private mobility providers may also operate and maintain infrastructure along the corridor, such as a bike-sharing services that maintain a physical space where travelers can pick up or drop off a bicycle when transitioning to or from transit. While these entities are not formal partners at the program-level, it is expected that several projects within the program will develop partnerships with private mobility providers to support the development of first & last-mile solutions along the corridor.

5.7.3 Data Providers

Data providers are private businesses, nonprofits, and quasi-governmental agencies that track, store, and manage transportation data along the corridor. This includes, but is not limited to, entities such as Google/Waze, etc. that offer real-time traveler information to users of the I-680 corridor. While these entities are not formal partners of the program, it is possible that the program will develop partnerships with these groups to transmit and/or receive data to support both real-time operations and future performance monitoring needs.

5.7.4 Local Law Enforcement

Local law enforcement primarily consists of local sheriff and police departments responsible for the enforcement and safety of local transportation facilities on arterial streets and BART Police Department that patrol BART stations, ROW, and vehicles. This includes providing services related to construction/work zone management, emergency response and incident management, to name a few. While these law enforcement departments are part of larger, local city, county, and transit provider organizations, they currently do not serve as formal partners of the Program. However, it is expected that local law enforcement departments will become involved in future phases of program and project work to support the specific enforcement, incident and emergency management needs along local arterial corridors within the program area.

5.7.5 Emergency Services

Emergency services are the fire, medical service, and law enforcement first responders that interact with travelers and transportation system operators in emergency response scenarios. For example, CHP is the Incident Commander for all emergency response services on the freeways and is supported by the other agencies depending on the nature of the call. While these groups may not currently serve as formal partners of the Program, it is expected that they will be involved in future phases of program and project work to support the specific emergency management needs encompassed within the program.

6.0 Proposed Concept

The Program is an expansive set of multimodal projects, containing a wide variety of system and infrastructure improvements on the I-680 corridor. These improvements, if delivered in isolation, would ultimately be limited in their ability to impact the travel characteristics of the corridor. In recognizing this, CCTA developed the Program to create a holistic, corridor-wide vision, focused on creating a seamless traveler experience for all I-680 users. The following scenario illustrates this operational concept from a traveler's perspective.

Innovate 680 – Envisioning A Seamless Traveler Experience:

A traveler opens the **Mobility on Demand** phone application and sees robust traveler information, including multiple mode choices, and the costs associated with each. The traveler decides that transit is their preferred mode choice, and commutes to a local **Shared Mobility Hub** by personal bike to catch the next bus.

At the mobility hub, the traveler stores their bike and awaits the arrival of the next bus. At the mobility hub, other travelers of the corridor have access to electric vehicle charging stations, **Automated Driving Systems** such as shared automated vehicle shuttles, and a suite of other, easily accessible travel options and amenities.

After boarding their bus, the traveler is taken through local city streets and onto I-680. Together, these facilities leverage **Advanced Technologies** to support the use of coordinated signal timing, coordinated adaptive ramp metering, and other operational strategies that seek to optimize travel in the program area.

On the I-680, the bus operator utilizes the **Part Time Transit Lanes**, which allows the bus to travel on the highway shoulder during peak congestion periods. On the highway, other travelers of the corridor, including those on regional transit routes, utilize the **Express Lanes** to expedite travel for HOVs and SOVs that choose to pay during congested periods.

Upon reaching their final destination, the traveler is notified of their trip summary and the total cost of the trip. The traveler is able to pay for their trip via the MOD application and is also provided incentives and rewards for their travel.

It should be noted that the traveler experience referenced above is a high-level summary of the operational concept for the program. While not noted above, the operational concept for the program also envisions region-wide coordination for incident and emergency management scenarios, innovative arterial, highway and transit management use cases, as well as other, wide ranging use cases for both travelers and operators. These use cases are further described in the operational scenarios for the program, outlined in Section 7.0 Operational Scenarios.

To make this operational concept a reality, the program will be responsible for:

- Leveraging existing and planned regional investments to further improve the transportation network in the program area; and

- Integrating these elements with proposed project-level elements that will enable the program to deliver a seamless traveler experience.

The program will ultimately seek to leverage all of the tools made available to it through collaborative, regional partnerships. If successful, these partnerships will allow the program to usher in a new, innovative era of transportation system management and operations, aimed at providing a first-rate customer experience for travelers. To outline the operational concept of the program, this section provides:

- An overview of existing and future systems, including the anticipated needs from each to support the operational concept for the program;
- The proposed, high-level Innovate 680 system architecture, illustrating the need for existing and future systems integration;
- An overview of the proposed performance monitoring that will link the operations of the program to its stated goals;
- The support environment required for the program, including considerations for facilities, software, network communications, data sharing and data management, and on-going maintenance;
- The new roles and responsibilities anticipated for user groups of the program; and
- The key policy assumptions that support the operational concept for the program and are assumed throughout the operational scenarios presented in Section 7.0.

6.1 System Components

Interoperable system components from projects within the program, as well as throughout the region, are critical to the overall operational concept for the program. This, in addition to the physical infrastructure improvements that projects within the Program will deploy, will enable the operational concept to become realized. Each of these disparate systems, including those that are already existing and utilized by user groups of the corridor, will serve a specific purpose to help the program meet its goals and objectives. This section provides a brief overview of each of these systems and describes the key functions of each that are required to support the operational concept of the program.

It should be noted, however, that this section presents an idealized version of systems and sub-system components that support the operational concept for the program. As such, this section encompasses project elements that may not currently be considered and/or budgeted in existing Innovate 680 project-level efforts. Additional projects may be developed through the continued work of the program. This section ultimately provides guidance for the development of these projects in the future to support the operational concept envisioned for the program.

6.1.1 Advanced Technologies Project

The AT project currently encompasses a wide range of efforts that are aimed at improving operational efficiency across the program area. For this reason, the AT project is envisioned as the overarching project-level effort that will be responsible for linking the capabilities of existing and future systems together. This effort, seen as the development of an overarching "system-of-systems" for the Program, seeks to enable real-time, centralized operational control

of the program area, while also supporting continuous data sharing among existing and future systems, as well as corridor wide performance monitoring. In order to support this concept, two central components are envisioned – a Decision Support System and a Countywide Connected Datacenter. These components are described in more detail below.

In addition, the AT project also explores the use of advanced highway and arterial management strategies to support ongoing operations. This includes exploring the development of managed freeways and CATS systems to support the deployment of the Program's operational strategies, such as CARM, LUMS, VSL, coordinated signal timing, TSP systems, and arterial messaging systems. These are described in more detail below.

6.1.1.1 Decision Support System

The Decision Support System (DSS) will provide centralized, real-time operational control of the Program. Much of this system will be automated, requiring little to no operator intervention.

In order to provide proactive, responsive, and real-time operational support for the program and its operational concept, a centralized DSS is recommended. This system will serve as the primary control system for the corridor, controlling the various highway, arterial, and multimodal systems typically operated by Caltrans, MTC, and local agencies. This system will ultimately seek to manage demand among the suite of existing and proposed mobility systems. The DSS will be automated, allowing the system to react in real-time to bypass potential latency from in-person operators and minimizing the number of resources to staff the DSS at an operations center. However, there will be in-person operators who will oversee the real-time operations of the system, allowing for system override or support during failure scenarios.

The DSS is envisioned to be operated by an overarching system operator. The agency and/or entity that will serve as system operator has yet to be determined. Ideally, system will be co-located to leverage existing resources and maximize efficiency of resources. Ultimately, this system is intended to be active 24/7, allowing the system operator to provide operational support for both recurrent and non-recurrent congestion scenarios, including incident and emergency management scenarios.

6.1.1.2 Countywide Connected Datacenter

The CCD is the central data sharing and data repository for the Program. This information will be utilized to inform the DSS as well as support ongoing performance monitoring for the program.

The CCD will serve as the central data system for corridor operations. This will operate most effectively with a constant feed of real-time data from Caltrans, MTC, transit providers, local agencies, and other external systems connected to corridor operations. The information gathered from this system will ultimately support the real-time operations of the DSS, while also providing a robust data repository for ongoing system performance monitoring. The system will be required to be both scalable and flexible, supporting connectivity to additional external systems in the future. Furthermore, the CCD will need to be capable of sharing information to existing stakeholder systems, supporting broader, region-wide data sharing and

coordination. The CCD would potentially be a hybrid data center both being a cloud based and on-site system.

6.1.1.3 Managed Freeways System

The Managed Freeways system is the primary highway management system for the program. This system will connect the suite of highway technologies on the corridor, including CARM, LUMS, and VSL.

The Managed Freeways system is the primary highway management tool for the I-680 corridor, allowing operators to manage ITS deployments on the state highway system. The Managed Freeways system is likely to be a module that is integrated with the larger DSS envisioned for the program, although the Managed Freeway system could potentially serve as a foundational element of a broader DSS. For Managed Freeways, CARM is expected to be a core strategy encompassing enhanced monitoring of the highway facility as well as next-generation ramp metering algorithms to proactively balance demand among all ramps within the program area, which will allow for the freeway system to be managed more efficiently. In addition to CARM, the Managed Freeways system will also offer the ability to manage future LUMS and VSL systems deployed on I-680. LUMS is anticipated to be a future deployment of overhead gantry installations providing real-time lane use signage to inform travelers of incidents, lane closures, and other use cases. In support of this deployment, VSL may also be deployed to enable adjustments to highway speeds in real-time to support speed harmonization.

6.1.1.4 Coordinated Adaptive Traffic Signals System

The CATS system is the primary arterial management system for the program, providing connectivity to arterial elements such as coordinated signal timing, emergency vehicle preemption, TSP, and arterial messaging systems.

The CATS system is envisioned as the primary arterial management tool for the program. The CATS system is likely to be a module within the larger DSS envisioned for the program. This system will support signal timing coordination across the program area, including key arterial corridors operated by local agencies, as well as ramp terminal signals operated by Caltrans. In order to accomplish this, the system will require connectivity to existing traffic operations centers and systems to support corridor-wide traffic signal and emergency vehicle preemption coordination. This system will also provide an interface between the signal operations of local agencies and the eventual operations of TSP with transit providers. Future evaluations will be required to consider the circumstances in which this system provides operational control in support of these functions. Furthermore, this system will provide connectivity to advanced traveler messaging systems, such as roadside travel time sign deployments near highway on-ramps, key arterial corridors, and parking facilities.

6.1.2 Mobility on Demand Project

The MOD project will be responsible for developing an overarching mobility as a service platform for travelers of the corridor. In order to support this platform, the project will develop a backend MOD system that will support seamless travel in the program area.

The MOD system is the primary trip planning and traveler information system for the I-680 corridor.

The MOD system will be the primary interface between system operators and travelers of the I-680 corridor. This includes serving as the go-to trip planning, travel information, and payment system for the program. This system will interface with travelers as a user-friendly smartphone and/or web application, connecting people to the various transit, micro mobility, and multimodal travel alternatives offered in the program area. The system will collect a wealth of data from both existing and proposed systems within the program area, including those operated by Caltrans, MTC, transit providers, and mobility providers. The system will also communicate travel rewards/incentives in support of TDM programs offered across the program.

This is a demonstration project and further evaluation will be required at the conclusion of the demonstration as to full implementation in the corridor.

6.1.3 Shared Mobility Hubs Project

In addition to the infrastructure needs for each mobility hub, the SMH project will also be responsible for developing a backend Smart Mobility Hub system that supports the various traveler amenities, travel information, and travel services provided at local mobility hubs.

The SMH system will provide in-person traveler information and on-site trip planning services at local shared mobility hubs.

The SMH system will be critical to the operations of first & last-mile services offered on the I-680 corridor. This includes connectivity to public transit, micro-mobility, and shared-ride services, as well as other traveler amenities, such as bike/car parking and information kiosks for on-site trip planning. In order to support these services, a SMH system will be required to transmit and receive real-time traveler information and offer travelers in-person trip planning, trip matching, and trip payment services. Electric vehicle charging and potential charging or hydrogen refueling for transit are also being considered in this project. Future evaluations will be required to assess whether some or all of these functions will be supported by the MOD system described previously. The system may also be required to manage parking services offered on-site, as well as curbside use for transit and shared vehicle loading and unloading. Ultimately, these efforts will require coordination and connectivity to almost all other sub-systems within the Program.

6.1.4 Part Time Transit Lanes Project

In addition to the infrastructure improvements needed to support bus-on-shoulder operations, the PTTL project will also be responsible for developing a coordinated system that supports the use and safety of shoulder travel on the corridor. In order to support this concept, a dynamic lane use management system would likely be required in the future.

The PTTL system is a dynamic lane use management system that will allow buses to travel safely on the shoulder of the I-680 corridor.

The PTTL system will utilize lane use management systems and infrastructure to allow buses to travel on the I-680 shoulder during periods of heavy congestion. The system would permit

buses to utilize the shoulder when general-purpose lane speeds fall below 35 mph and alert buses to yield to other shoulder usages, such as incidents, stalled vehicles, debris, and enforcement activity. In order to support these use cases, the system will likely require dynamic signs that can alert travelers, law enforcement, and bus operators of real-time shoulder use, as well as connectivity to ramp metering systems and HOV by-pass lanes to accommodate priority ramp entrance onto I-680. The system may also require new CCTV cameras to provide operators additional coverage of ramp and shoulder areas.

6.1.5 Automated Driving Systems Project

In order to support the Rossmoor, county hospital, and I-680 personal mobility demonstrations that are encompassed within the ADS Project, the project is expected to develop a backend data warehouse and mobility platform.

The ADS system is based on a mobility platform to support the operations of shared automated vehicles.

This system is expected to connect on-board vehicle devices, field equipment supporting vehicle-to-everything (V2X) technologies, a backend data storage/warehouse, and other supporting elements to support the ongoing operations of automated vehicles utilized in the program area.

This is a demonstration project and further evaluation will be required at the conclusion of the demonstration as to full implementation in the corridor.

6.1.6 Express Lane Completion Project

In addition to the infrastructure improvements needed for express lanes operations, the ELC project will also be responsible for ensuring that the design of the express lanes conforms to the operational concept of the MTC Regional Express Lanes. The ConOps describing this operational concept can be found **here**. Because this system already exists within the region, the express lane system is described in the Existing Regional Systems section below.

6.1.7 Existing Regional Systems

As discussed in the existing conditions section, there are various regional systems that support operations in the program area. This section highlights the key functions that may be required of each regional system to support the operational concept for the program. It should be noted, however, that these functions assume an idealized operational concept. Each of these functions will require additional discussion, consideration and evaluation as the program matures.

6.1.7.1 Caltrans District 4 – Transportation Management Center

The District 4 TMC may provide operational support for the I-680 and neighboring highway facilities. The TMC may also delegate control of I-680 highway system elements to the DSS.

Caltrans District 4 TMC may support operational coordination on both I-680 and neighboring highway corridors. This would likely be done via a communications link between TMC operators and the system operator of the Program. In addition, to allow for centralized control

of the I-680 corridor, the District 4 TMC may also allow the DSS to have operational control of I-680 system elements within Contra Costa County. Lastly, in failure scenarios where the DSS is not functional, the District 4 TMC may also serve the role of backup system operator for the program.

6.1.7.2 Caltrans District 4 – Highway System

Highway system elements may be integrated with the DSS.

The DSS may be integrated with existing and proposed I-680 highway system elements within Contra Costa County. This would provide the program and its system operational control of ramp metering, vehicle detection, CCTV cameras, changeable message signs, and other ITS deployments that support the programs operational concept within the highway system. The protocol and scenarios under which this is done will require future coordination with program stakeholders.

6.1.7.3 CHP – Dispatch

CHP Dispatch may support real-time emergency and incident response.

In order to support real-time operations of the I-680 corridor, the DSS may require connectivity to CHP Dispatch. This connection may allow the DSS to alert CHP of the various incident and emergency management scenarios taking place on the corridor. In addition, with the potential for the future integration of predictive safety analytics, this support will be key to ensuring the corridor can provide proactive safety and enforcement support. The California Department of Justice (DOJ) requirements must be met to ensure confidentiality and other requirements for the CAD system.

6.1.7.4 MTC/BAIFA – Regional Operations Center (ROC)

The ROC may provide operational support for the I-680 express lane facility. The ROC may also delegate control of I-680 Express Lanes System elements to the DSS.

The MTC ROC may support operational coordination on the I-680 express lanes. This would likely be done via a communications link between ROC operators and the system operator of the Program. Additionally, to allow for centralized control of the I-680 corridor, the DSS may also require operational control over I-680 Express Lanes System elements. Scalability of both physical space and resources will be considered as coordination plans are developed.

6.1.7.5 MTC/BAIFA – Express Lanes System

Express Lanes System elements may be integrated with the DSS.

The DSS may be integrated with I-680 Express Lanes System elements. This will provide the program and its system operational control of dynamic toll rate signs, CCTV cameras, and the ability to open or close the express lanes. The protocol and scenarios under which this is done will require future coordination with program stakeholders, including toll policy considerations to ensure consistency with toll ordinances and financial sustainability.

6.1.7.6 MTC/FSP – Freeway Service Patrol

FSP may support real-time emergency, incident and debris clearance.

In order to support operations on the I-680 corridor, FSP may require connectivity to the DSS. This connection would allow the DSS to alert FSP crew of the various incident, emergency, and debris clearance needs for the corridor. FSP responsibilities, including call volumes, could increase as a result of alerts, which may lead to the need to expand the FSP program. Future PTTL operations on the corridor make this service critically important, ensuring I-680 can support bus-on-shoulder use in a safe and efficient manner.

6.1.7.7 MTC – Clipper®

Clipper® may continue providing payment services for I-680 transit and multi-modal travel.

In order to support the program, Clipper® may continue providing payment services for existing transit and multi-modal travel on the corridor. As the Program matures, there may be future opportunities for Clipper® to integrate with proposed Innovate 680 systems that offer payment services to travelers, such as the MOD and SMH systems.

6.1.7.8 MTC/BATA – FasTrak® RCSC

The FasTrak® RCSC may continue providing toll collection services on I-680 facilities.

In order to support the program, the FasTrak® RCSC may continue providing toll collection services on the corridor. As the program matures, new TDM programs may be developed to encourage shared vehicle use on the corridor. These programs may require integration and/or coordination with FasTrak® in the future.

6.1.7.9 MTC – 511 SF Bay

511 SF Bay may provide real-time traveler information and continue providing carpool and vanpool services to travelers.

511 SF Bay may allow the CCD to access the data-rich 511 SF Bay platform in real-time. This data would be used to inform the DSS and other system components, such as the MOD platform, in real-time operational decision making. This link will also support data sharing and performance monitoring across the program. The system will also continue offering carpool and vanpool services across the program, coordinating and integrating these services with the MOD platform.

6.1.7.10 CCTA – 511 Contra Costa

511 Contra Costa will maintain its connectivity to the 511 SF Bay system and support the integration of future TDM programs.

The primary, real-time operational component of 511 Contra Costa is supported through its connectivity to carpool/vanpool services offered by 511 SF Bay. As such, 511 Contra Costa should continue offering and incentivizing the use of these services. In addition, the system will be responsible for integrating existing and future TDM programs within the Program to support the goal of encouraging multi-modal transportation use on the corridor.

6.1.7.11 Transit Providers – Transit Operating Systems

Transit operating systems will provide operational support for I-680 transit services, including those for PTTL, TSP and Connection Protection systems.

While the program does not propose exercising operational control over existing transit systems (i.e., operating BART trains or CCTA/LAVTA buses), there are technology deployments on the corridor that will interface directly with existing transit operating systems. This includes the operations of transit signal priority, part-time transit lanes, and connection protection systems. For these deployments, the DSS would likely communicate directly with transit operating systems to ensure dispatchers are informed of system activation, changes in system operations, as well as any potential route impacts due to emergency or incident scenarios. This would likely be done via a communications link between transit operating system operators and the system operator of the Program.

6.1.7.12 Local Agencies – Traffic Operations Systems

Local Agencies may provide operational support for local arterial corridors. Local traffic signal systems may be controlled by the DSS.

Local agencies will support operational coordination on local arterials. This is would likely be done via a communications link between traffic operations system operators and the system operator of the Program. In order to support operational efficiency along the corridor, the program may also require operational control of local traffic signal systems, as agreed to by the local jurisdictions. This includes real-time operational control of signalized intersections and future ITS deployments that support the operational concept for the program. Transit operators can also request vehicle operators to be additional eyes and ears for the Program and report to the transit operators' dispatch center or data center, which can then relay information to the Program. The protocol and scenarios under which this is done will require future coordination with Program stakeholders.

6.1.7.13 Various – Parking Management Systems

Parking management systems may provide real-time data on existing parking facilities.

Existing parking management systems will support operations by providing available parking data to the CDD. This will allow the CCD to provide travel data to the DSS and other supporting sub-systems, such as the MOD, ADS, and SMH systems to support ongoing operations.

6.1.7.14 Local Law Enforcement – First Responder Systems

First responder systems may support real time emergency and incident response on highways and local roadways.

First responder systems utilized by local law enforcement will be evaluated to determine opportunities to provide connectivity to the DSS. This will allow first responders to support incident and emergency scenarios on both the highway system and key arterial roadways in real-time. DOJ requirements must be met to ensure confidentiality and other requirements for the CAD system.

6.1.8 Private Systems

6.1.8.1 Mobility Providers – Fleet Management Systems

Fleet management systems may provide real-time data on existing fleet operations.

Private fleet management systems that provide multimodal transportation options to I-680 travelers will connect to the CDD. This will allow the CCD to provide data to the DSS and other supporting sub-systems, such as the MOD, ADS, and SMH systems to support ongoing operations.

6.1.8.2 Data Providers – Traveler Information Systems

Traveler information systems may provide real-time data on existing highway and arterial operations.

Private traveler information systems that provide real-time travel information to I-680 users may be evaluated to determine opportunities to provide connectivity to the CDD. This will allow the CCD to provide travel data to the DSS and other supporting sub-systems, such as the MOD, ADS, and SMH systems to support ongoing operations.

6.2 System Architecture

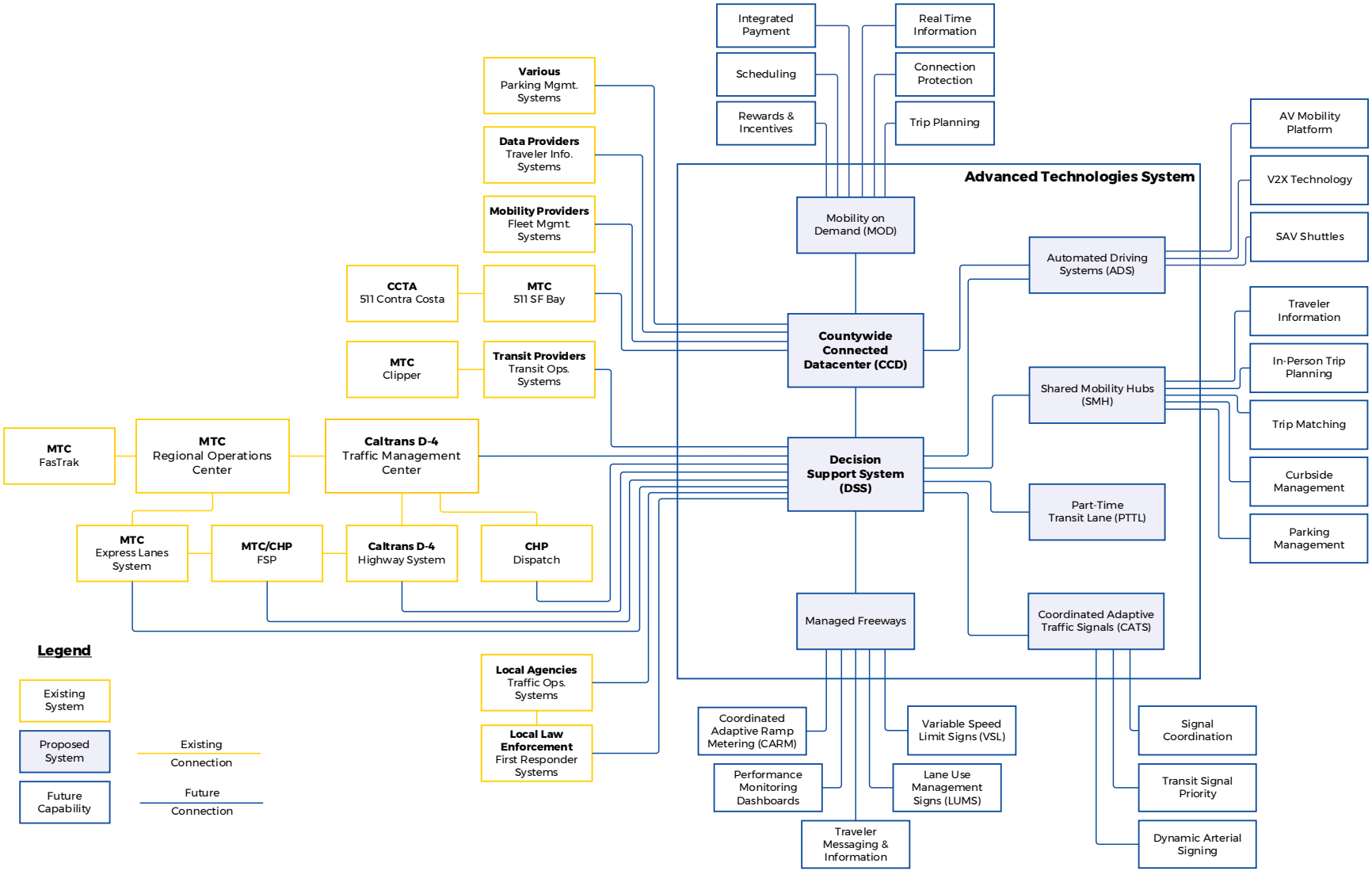
To tie the system components discussed in the prior section together, the Program envisions an overarching "system-of-systems" that links together the capabilities of the disparate transportation management systems that exist today and are proposed as part of the program with the primary Innovate 680 subsystems. The planning-level architecture of this system, also referred to as the Advanced Technologies System, is shown below in Figure 46. Ultimately, the various system components encompassed within the program are outlined in this diagram to ensure the Program's operational concept fits within and integrates with the existing architecture of the region and does not create any duplicative systems or services. In addition to outlining these various system components, Figure 46 illustrates the complexities and future challenges that await the future development of the Program.

The intent of this diagram is to highlight, at a high-level, the need for connectivity between existing regional systems and proposed Innovate 680 elements. Therefore, the following items need to be considered upon review of the diagram:

- This diagram illustrates a simplified and idealized version of future systems architecture and connectivity for the program. This diagram is not intended to be utilized for design or implementation in the near future. Instead, this diagram is utilized to provide a simple graphical representation of the overall Innovate 680 system, support the development of the operational concept defined in this section, the operational scenarios outlined in Section 7.0, and to support discussions regarding future program implementation outlined in Section 8.0.
- While not currently shown in this diagram, what cannot be understated is the need to ensure individual system components have communications links built among one-another. This built-in redundancy will add robustness to the overarching system in the case of system failure or damage to any of its central components. This is especially

important for systems that are reliant on operational support or data exchange from external systems.

- Data sharing challenges are expected as the Program seeks to integrate existing legacy systems that do not include a common Application Program Interface (API) interface to share data with modern systems. Such a challenge may require system replacement. On the other hand, some modern systems actively deployed (i.e., Cubic – Walnut Creek, Econolite – Danville) do not easily allow data sharing since they are closed network systems or add-on modules that do not allow for data sharing.
- Furthermore, this diagram does not show all existing connections between existing regional system components. For additional information on existing regional systems, please see the Bay Area ITS Architecture website, linked **here**.



Source: WSP, 2021

Figure 46 – Innovate 680 System Architecture Diagram

6.3 System Performance Monitoring

A cornerstone of the Program is to ensure the program is performance-based in its approach, implementation, and eventual operation. Utilizing the program goals and performance metrics defined in Section 4.1, the Program seeks to create a performance-based program by developing on-going performance monitoring. This effort is initiated in the existing conditions assessment, provided in Section 5, with respect to the operational analysis of the various highway, arterial, transit, shared vehicle, and micro-mobility services offered in the program area. While the analysis provided in Section 5 is preliminary, future efforts can leverage this work to develop more robust performance monitoring as the program matures. In the interim, the data available to the program team will be utilized to continue to track program performance with respect to the goals and metrics outlined for the program.

In an idealized scenario, the future functions of the CCD outlined in the operational concept will support on-going performance monitoring for the program. This would include pulling from the various system components (such as the DSS) to aggregate travel data that can be tracked and monitored on a continual basis. As such, these functions should be considered with respect to the buildout of a future CCD. However, it should be noted that the various Innovate 680 projects will likely be completed and brought into operation at different times. Thus, the benefits of the entire program may not be realized immediately and there may only be incremental performance improvements initially. This also means that it may be difficult to isolate the performance benefits of any individual project. For this reason, the program will need to take careful consideration of the future methodologies utilized to develop performance monitoring for the program.

This effort is anticipated to continue after the completion of this Program ConOps and throughout the lifecycle of the program. As future projects, systems and data sources are introduced in the program, stakeholders will work collaboratively with the program team to establish best practices for on-going performance monitoring. And, as this practice continues to assess the operations of the various facilities and services provided on the corridor, the program team will continue to share its findings with the Program Leadership Team (PLT), the Executive Steering Committee (ESC), the Policy Advisory Committee (PAC), and the various governing boards to help guide the strategic direction of the program and to garner support for regional collaboration, policy and funding needs. Ultimately, performance monitoring will also help inform necessary adjustments and refinements that are needed for the program and its projects after implementation.

6.4 Support Environment

To enable ongoing operations and maintenance, a robust support environment will be required for the program. This section focuses on outlining the needs, opportunities, and challenges in key areas, such as:

- the operations center and support staff required for real-time operations,
- considerations for software assets, such as APIs and software development kits (SDKs) needed for system integration,
- the communications network needed to support program wide operations,
- future data sharing and data management practices of agencies; and

- the on-going maintenance needs of future system components.

6.4.1 Operations Centers and Staffing

6.4.1.1 Operations Facility

To operate the Program effectively, decision-making and control of system components are recommended to be hosted at a centralized location. In addition, this operational facility will require coordination with existing regional efforts. As noted previously, both MTC and Caltrans currently own and operate regional operations centers that serve these functions (the MTC ROC and Caltrans District 4 TMC). While both of these regional operations centers may be capable of hosting a system operator for the I-680 corridor, the use of either would need to be evaluated to see if modifications and/or enhancements would be required to support the Program. For example, the MTC ROC may have physical constraints that limit the size of the operations. MTC's leadership may also require changes to be regional in nature in order to be considered at all. Given that these investments have already been made in the region, stakeholders should consider evaluating the risks and benefits of utilizing each location.

While there may be benefits to developing a separate operation center for the Program, facilities of this type require rather significant investments in both physical infrastructure and network equipment, as well as regular maintenance, inspection, and upgrades to support their prolonged use. It should be noted however, that with the recent advances in cloud computing and cloud services, some agencies are utilizing cloud service providers to develop operations centers without the need for a significant investment in infrastructure or hardware. If it is deemed necessary to provide a separate operations center for Innovate 680, program stakeholders should strongly consider leveraging services of this type.

6.4.1.2 Staffing

While the program will utilize automated system components, there will still be a need for in-person staff to oversee the real-time operations of Program and its overarching system components. Additionally, on-going training will also be necessary to instruct staff on the responsibilities for managing the various system elements, including asset management, performance monitoring and on-going system maintenance.

While several agency stakeholders have existing staff, who are trained in these areas, there are significant challenges when considering what can reasonably be expected of stakeholders, given the level of commitment that will be required for operation and maintenance of the program. For example, while Caltrans does serve as owner-operator of the I-680 highway system, the district as a whole is responsible for over 1,400 miles of state highways in the Bay Area. The I-680 corridor only represents approximately 30 miles, or 2% of their overall system. Similarly, MTC staff support a wide range of efforts across the region, including the real-time operations of the I-680, I-880, and future US-101 and I-80 express corridors. MTC also supports the real-time operations and maintenance of the FasTrak® RCSC and Clipper® systems region-wide. And, while CCTA has delivered large-scale transportation projects, they currently do not own or operate any transportation facilities and lack trained staff that could be leveraged to oversee ongoing operations and maintenance of the program. CCTA understands that its role

may evolve over time as the Program is implemented and it may need to consider an operational role in the future.

These considerations point to concerns regarding whether existing agency staff have the ability to both support the operations and maintenance of the program. This will require stakeholders to evaluate the nature of staffing the program in the future. This includes evaluating which responsibilities will be undertaken by existing agency staff, supplemented through the hiring of additional agency staff, or, furthermore, augmented through the hiring of outside consultants and/or contractors.

6.4.2 Software

Program stakeholders will be responsible for the procurement, licensing, and warranty of the software systems required to support the overarching systems elements. These systems will enable the program to integrate transportation management systems into a centralized corridor control system, while also providing the capabilities to transfer and receive data from various agencies to support real-time operational decision making and corridor wide performance monitoring. These future systems will ultimately require integration with existing systems operated by local agencies and regional partners. For example, Traffic Signal Performance Measure software may be integrated in a coordinated way across local agency networks to better manage traffic flow on arterial roadways when incidents occur on I-680. A few notable items on existing efforts are provided below:

- Caltrans – District 4 is in the process of procuring a new, statewide advanced traffic management system, CATMS. CATMS is likely to interface with the program in the future and will need to be considered when designing the DSS for the program. Furthermore, there may be opportunities for the program to leverage the future capabilities of CATMS to support Innovate 680. These benefits and risks should be evaluated by program stakeholders as both systems continue through the planning and design stages.
- Local Agencies – As shown in the existing conditions section, most local agencies utilize unique traffic management systems. These systems are owned by different private companies and will likely complicate future integration efforts. This points to a potential need to develop corridor-wide minimum system requirements for future technology deployments in the program area. This effort should actively be discussed with stakeholders of the program to ensure future system elements are compatible with the operational concept of the program.
- Existing Operations Centers – If intended to be used, it is anticipated that the current capabilities of the software systems that support the MTC ROC and Caltrans District 4 TMC will not meet the system requirements needed for the program. Program stakeholders should evaluate the challenges and opportunities of designing, testing and implementing new software systems and/or new software system elements to support the proposed capabilities of the program.

While these notes do not categorize the full breadth of future challenges and concerns related to future software systems, they highlight key issues that have already been identified and flagged for discussion with program stakeholders. As stakeholders continue discussions regarding the future buildout of DSS, CDD, Managed Freeways, CATS, PTTL, SMH, ADS and MOD system components, the needs and challenges related to software system elements will likely expand over time. These discussions would benefit by using the operational concept outlined in this Program ConOps, as well as subsequent program-level system engineering efforts, to support the development and procurement of software systems in the future.

The Program will develop an Implementation Plan that will focus on defining the requirements of the various systems in the program so that all stakeholders can make decisions to upgrade systems so that there is compatibility between systems in the various agencies along the corridor.

6.4.3 Network Communications

6.4.3.1 Fiber Optic Communications

In order to support real-time communications among system components, it will be important that a robust communications network is developed for the Program; gaps in communications will also introduce risk and cost escalation. It is recommended that the backbone of this system leverage fiber optic communications where possible. A few notable items on existing efforts are provided below:

- I-680 Fiber – As stated in the existing conditions section, MTC and Caltrans own 144-strand fiber optic cabling on the entirety of the I-680 corridor in Contra Costa County, installed as part of the I-680 Express Lanes project. The program would benefit from leveraging these regional fiber assets to support the development of a fiber optic network for the program. Future technology deployments on the I-680 corridor, such as ramp metering, part time transit lane systems, and arterial signal systems will all benefit from utilizing this infrastructure. As such, agreements between agencies will likely be required to support the shared use of these fiber assets in the future.
- Local Fiber – As stated in the existing conditions section, several local agencies have developed strategic fiber deployment plans for key arterial corridors in the program area. Collectively, these improvements are aimed at supporting improved arterial operations in the program area and are also aligned with future IDEA project deployments along the corridor. In order to support the overarching vision coordinated adaptive traffic signals in the program area, stakeholders should evaluate how to support funding the capital improvements and the eventual operations and maintenance of these fiber deployments in the future.

While these notes do not categorize the full breadth of future challenges and concerns related to fiber communications systems in the region, they highlight key issues that have already been identified and flagged for discussion with program stakeholders in the near term. Additionally, stakeholders will likely be required to evaluate bandwidth needs for future technology deployments, as well as how to provide redundancy among fiber optic communications systems in the case of fiber damage and/or failure.

6.4.3.2 Other Communication Systems

In addition to fiber communications, cellular communications and short-range wireless radio infrastructure will be utilized to support ancillary functions of the program. This includes the operations of nearby systems communicating at a local level, as well as the deployment technology to support V2X. As these communications elements come online, it will be critically important that they are coordinated with the program to ensure they are part of the larger communications framework. Where possible, these systems should utilize the fiber backbone network for the program to connect to key regional communications hubs.

6.4.4 Data Sharing and Management

Data sharing and management is critical to the success of the program.

Systems that manage/monitor traffic signal operations or performance can collect massive amounts of data. As such, servers required for such systems need to significant capacity and processing power. Since this program is intended to coordinate such systems from multiple agencies, a critical element of the support system will be server capacity.

Access to data is an enabler for the safe, efficient, and accessible integration of interoperable systems along the corridor and throughout the region more broadly. Lack of access to data could impede the integration of systems in the proposed operational concept. The following figure illustrates several guiding principles developed by USDOT that can support future data management efforts within the program.

Data management plans will be developed for both the Program and projects within the Program. The ADS project currently has a data management plan in place.

Figure 47 – USDOT Guiding Principles for Data Management

6.4.5 Data Security and Privacy

Security of the system must also be considered, as well as data privacy. Details surrounding data sharing and management will be clarified in project-level data management plans and coordinated at the program and regional levels.

Cyber-security will be a consideration as the proposed concept matures. Striking a balance between the Program's open architecture and cooperative management of ITS assets with the maintenance of resilient systems that protect data and control systems will be a challenge. Many transportation field devices are not well secured, agency password management standards vary, and phishing/social hacking are common. Creating additional interfaces creates more attack surfaces, which could lead to attacks.

Maintaining the desired levels of security will require ongoing monitoring, clear standards for vendors and detailed conversations between partner agencies about security practices on their networks.

6.4.6 Maintenance

It will be critically important that both back-end software systems and in-the-field devices have proper maintenance regimens to ensure their uptime during future operations. Since the Program envisions a future where real-time operations and data sharing is uninterrupted, preventative and responsive maintenance will be necessary. Because the program will be performance-based by nature, there will also likely be KPIs that stipulate high device up-time requirements for various system elements. This only furthers the need for a robust

maintenance program, which may require utilizing a robust asset management system and/or data inventory to track the needs for both short and long-term maintenance.

Furthermore, it is expected that new ITS devices will be procured and deployed across the program area. This includes the multitude of ITS device deployments envisioned for future Managed Freeways, PTTL, and CATS systems, as well as supporting infrastructure for the ADS and SMH systems. Many of these field devices are likely to leverage the support environment for the program and should be considered when developing future maintenance needs. While these assets will largely be deployed as part of project-level efforts, their future operations will be critical in supporting the operational concept and will need to be considered under the larger O&M umbrella for the program.

Ultimately, the approach stakeholders take to program wide maintenance will require a significant change from the status quo. A focus on resiliency and consideration of lifecycle costs is essential. Stakeholders will be required to make significant investments in on-going maintenance, as well as work collaboratively to ensure on-going maintenance remains a priority for as long as the program is active. This includes the potential to hire outside contractors to handle certain maintenance responsibilities on the corridor. It should be noted, however, that there are existing labor laws that may prevent some maintenance responsibilities from being contracted out on the state highway system. These issues will need to be discussed in the future as the program begins preparing for the operations of any particular system component.

6.5 Proposed Roles and Responsibilities

In this section, the user groups defined in the existing conditions sections are utilized to outline the proposed roles and responsibilities to support the operational concept for the program. It should be noted, however, that one additional user group is included in this section that was not included in the existing conditions section – a System Operator for the corridor. This user group is intended to represent the agency and/or entity who will be responsible for the real-time operations and maintenance of the program and its overarching system in the future. At this time, the agency and/or entity to hold this role is undetermined. Our approach is to identify what the role and responsibilities would be for the system operator and then seek to determine the best agency or combination of agencies to serve as the system operator.

6.5.1 System Operator

The System Operator will be responsible for the real-time operations and maintenance of the operational concept for the program.

The System Operator will be the agency and/or entity responsible for O&M of the overarching Advanced Technologies System envisioned for the program. This includes daily ongoing operations of the DSS and CCD, as well as maintenance of software and in-the-field assets that support operational efficiency within the program area. The System Operator will serve as the lead between all other existing and project-level systems that support the program, allowing for centralized decision-making, operational control, data sharing and corridor wide performance monitoring. As such, the System Operator will be responsible for systems integration of the overall program, leading the design, testing and implementation of the

overarching Advanced Technologies System that supports the operational concept for the program.

6.5.2 CCTA

CCTA will manage the System Operator contract and continue to champion the Program. In addition, CCTA will be responsible for TDM coordination across the program.

As the founding agency of the Program, CCTA will manage the System Operator contract, which will include establishing and monitor system wide performance monitoring. CCTA will inform the development of KPIs to measure the impact of the proposed concept, which will leverage the program goals and performance metrics established for the Program. In addition, as the county CMA, CCTA will be responsible for linking the implementation and integration of TDM programs across the Program.

6.5.3 Caltrans District 4

Caltrans District 4 will define protocols that enable the System Operator to operate and maintain highway system elements.

Caltrans District 4 will provide input to CCTA on how the System Operator contract is managed. Caltrans will coordinate with the System Operator to support of the Program goals, including defining protocols and business procedures that allow the System Operator to have responsibility for operational control and provide maintenance for highway system elements on the I-680 corridor in Contra Costa County. Caltrans District 4 will champion the program within Caltrans and with FHWA.

6.5.4 MTC

MTC will coordinate with the System Operator to share data and information related to regional programs that MTC manages and support regional integration of operations.

MTC program leads from each regional program that MTC manages that touches the Advanced Technologies System will coordinate closely with the System Operator in support of the Program. This will include defining protocols and business procedures that also allow the System Operator to have responsibility for operational control on express lane system elements on I-680 in Contra Costa County. In addition, MTC will support the integration of regional services provided by FSP and 511 SF Bay to support highway clearance/monitoring, traveler information/data sharing, and carpool/vanpool services.

6.5.5 CHP

CHP will lead enforcement on I-680 and coordinate with the System Operator for enforcement, emergency and incident management, work zone traffic control and maintenance along the corridor.

CHP will lead enforcement activities to support the Program. CHP will also coordinate with the System Operator, providing real-time support for emergency and incident management scenarios in the program area, building from agreements in place with Caltrans for COZEEP,

MAZEEP, and PDZEEP. CHP will also support work zone and highway maintenance use cases to support safety and operational efficiency on the state highway system.

CHP requests changes to highway technology via dispatch to the TMC. For example, when express lane (EL) status changes are needed, field units go through the TMC and do not directly contact MTC or another EL operator. Additional steps may be required if the DSS is not at the TMC.

6.5.6 Local Agencies

Local agencies support the System Operator by allowing the System Operator to operate and maintain local arterial system elements and sharing data.

Local agencies will coordinate with the System Operator in support of the Program. This will include local agencies participating to defining protocols and business procedures that will allow the System Operator to have responsibility for operational control and maintenance over arterial management systems, including local signal systems on key arterial corridors identified in the program area.

6.5.7 Transit Providers

Transit providers will coordinate with the System Operator for various transit management use-cases.

Transit providers will coordinate with the System Operator in support of the Program. Transit providers will also coordinate with the System Operator on connection protection, transit signal priority, and bus-on-shoulder use cases in the program area.

6.5.8 Travelers

Travelers will be responsible for interacting with the transportation network and its various system components.

Travelers will interact with existing and proposed transportation systems, utilizing the capabilities of the operational concept of the program to embark on seamless, end-to-end journeys from their origin to their destination. Travelers have the option to opt-in to share their travel data with the system operator.

6.5.9 Mobility Providers

Mobility providers will be responsible for providing data and are expected to consume data to enhance their services.

Mobility providers will provide real-time data on services offered within the program area, supporting traveler information provided to and utilized by regional travelers. They will also be expected to consume data made available through the proposed concept in order to provide enhanced services to travelers.

6.5.10 Data Providers

Data providers will share real-time data to the System Operator.

Data providers will share real-time data gathered within the program area with the System Operator, supporting traveler information provided to and utilized by I-680 travelers.

6.5.11 Local Law Enforcement

Local law enforcement will be responsible for coordinating with the System Operator for enforcement and emergency/incident management scenarios.

Local law enforcement will coordinate with the System Operator in real-time to support emergency and incident management scenarios resulting in impacts to the safety of travelers within the program area. This also includes coordinating with CHP and emergency service providers as needed. Local law enforcement will coordinate any requests to alter conditions to the state highway through CHP for approval.

6.5.12 Emergency Services

Emergency services will be responsible for coordinating with the System Operator for emergency/incident management scenarios.

Emergency services will coordinate with the system operator in real-time to support emergency and incident management scenarios that may impact the safety of travelers within the program area. This also includes coordinating with CHP and local law enforcement providers as needed.

6.6 Key Policy Assumptions

In order to support the development of the operational scenarios presented in the following section, the program team was required to develop a listing of key policy assumptions that highlight key needs for the operational concept of the program. All stakeholders will have a voice and are expected to be involved with critical decisions related to these policy decisions. These items are assumed throughout the operational scenarios presented in Section 7.0 and also summarize several key takeaways from prior sections regarding key system components and proposed stakeholder roles and responsibilities. They include the following:

- **A DSS provides centralized, real-time operational control for the program.** While the owner and operator of the DSS is currently unknown, highway and arterial systems within the program, typically operated by Caltrans, MTC, and local agencies, are assumed to be operated via the DSS. The DSS also supports various use cases involving CHP, transit providers, mobility providers, data providers, local law enforcement, and emergency services. This system is assumed to be operated out of a centralized operations center and is also assumed to have automated system components that require minimal operator intervention.
- **A CCD serves as the central data sharing and data repository for the program.** While the owner and operator of this CDD is currently unknown, the CCD will require a constant feed of real-time data from Caltrans, MTC, local agencies, transit providers, mobility providers, and data providers. The CCD is also envisioned to support the real-time operational capabilities of the DSS, while also supporting performance monitoring for the program.

In addition to the key policy assumptions outlined above, there are several considerations that will inevitably require future discussion among stakeholders. While it is not possible for this Program ConOps to address all of these issues, after the presentation of the operational scenarios in Section 7.0, Section 8.0 outlines key policy and technical challenges that will require future coordination with program stakeholders. The assumptions noted above, as well as key items noted throughout Section 6.0, are revisited in Section 8.0 to develop the next steps for furthering the development of the operational concept.

6.7 Additional System Components

Several additional systems components came up as the proposed concept was being developed that are not, at this time, included in the proposed concept. These items are on the radar of both the Program and project teams for inclusion as the Program continues to develop. Some of these are detailed in Section 8.1 as they relate to policy consideration for the Program. The additional system components considered but not included are listed below.

- **Utilities.** While utilities, including power and communications, are not necessarily system components, they are fundamental to the underlying infrastructure. Sharing of network communication infrastructure will be crucial to reducing capital costs. Other considerations may include sharing of power resources, including upgrades for electrification.

- **Integration with Smart Cities initiatives**. Innovate 680 is largely focused on transportation, but it would be a miss to not look at how the transportation system fits within the larger built environment. Considerations could be had for how Innovate 680 fits with other advanced and smart technologies, including:
    - Smart sensors
    - Weather systems
    - Smart buildings

- **Traffic incident management dashboards.** Tool to share data and trends that can be utilized to track real-time traffic incidents along state highway corridors. These are under development and could be a helpful tool that may be leveraged by in-person operators to monitor incidents in real-time, with the potential to provide predictive analytics on incident hot spots and areas of concern.

7.0 Operational Scenarios

A variety of operational scenarios were devised to illustrate the operational concept for the Program, demonstrate how the diverse types of travelers in the corridor would utilize the Program, and how the various projects would interact. These operation scenarios were developed to:

- illustrate how various system components communicate with one another,
- ensure all major use-cases are accounted for,
- describe potential impacts to both travelers and owners/operators,
- outline key policy and technical issues that will need to be considered to guide the development of the program in the future.

The first set of scenarios, referred to as **"Traveler Focused Scenarios"**, illustrate common travel scenarios. These scenarios detail the corresponding traveler and operator responsibilities, with possible failure modes for each. The following scenarios are provided:

- 1 – Commuting to Work via Personal Bike, Bus and BART
  - (Failure – The transit connection is not made)
- 2 – Commuting to Work via Personal Vehicle with Carpoolers
  - (Failure – An incident occurs on the highway)
- 3 – Traveling via Shared Automated Vehicle
  - (Failure – A medical emergency occurs during trip)
- 4 – Traveling to a Destination Outside of Contra Costa County
  - (Failure – A local incident blocks entry onto I-680)
- 5 – Traveling Back Home from Outside Contra Costa County
  - (Failure – The carpool driver never shows up)

The second set of scenarios, referred to as **"Operator Focused Scenarios"**, illustrate scenarios that are inherently challenging for operators and highlight the need for additional project, policy and procedural considerations. The following scenarios are provided:

- 6 – Unplanned Obstruction of the Part Time Transit Lane
- 7 – Transit System Shutdown
- 8 – Regional Emergency
- 9 – Loss of Communications with System Operator
- 10 – MOD Application Failure
- 11 – Fleets of Automated Vehicles Operating Along Corridor

To ensure each scenario showcases a unique need/consideration for the program's operational concept, the following matrices were developed to outline how each scenario interacts with user groups and the various projects. As shown in Table 12 and Table 13, the operational scenarios presented in this section showcase a wide array of user group and project interactions. There are, however, some areas where interactions do not occur. These were reviewed to confirm that these interactions are not currently required for consideration in the operational concept of the program.

Table 13 – Operational Scenario Impacts to User Groups

Scenarios: / User Groups:	1	1F	2	2F	3	3F	4	4F	5	5F	6	7	8	9	10	11
System Operator	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Caltrans	X		X	X			X	X			X	X	X	X	X	X
MTC			X	X			X		X	X	X	X	X	X		X
CHP				X							X		X			X
Local Agencies	X		X	X	X			X				X	X	X	X	
Transit Providers	X	X			X	X	X	X			X	X	X		X	
Mobility Providers		X								X		X	X			X
Data Providers											X		X			
Local Law Enforcement						X		X					X	X	X	
Emergency Services				X		X		X					X	X	X	
Travelers	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 14 – Operational Scenario Impacts to Innovate 680 Projects

Scenarios: / Projects:	1	1F	2	2F	3	3F	4	4F	5	5F	6	7	8	9	10	11
Advanced Technologies	X	X	X	X		X	X	X			X	X	X		X	X
Mobility on Demand	X	X	X	X	X	X			X	X	X	X	X			
Shared Mobility Hubs	X		X	X		X	X	X	X	X	X	X	X		X	
Part Time Transit Lanes	X			X			X				X	X		X		
Automated Driving Systems					X	X										X
Express Lane Completion			X	X			X		X	X		X	X	X		X

7.1 Traveler Focused Scenarios

7.1.1 Scenario 1 – Commuting to Work via Personal Bike, Bus and BART

This scenario envisions a traveler trip that is anticipated to be a regular occurrence on the corridor – a multimodal trip involving the use of a personal bike and transit services offered by stakeholders of the corridor. The transit leg of the trip is envisioned to be a utilization of both local bus services as well as the BART system involving a scheduled transfer. Along the way, the traveler interfaces with a variety of program elements, touching on a several aspects of the transportation network.

Scenario Title:	1 – Commuting to Work via Personal Bike, Bus and BART			
Scenario Description:	A Traveler uses the MOD application to book a trip from home to work utilizing personal bike, local bus, and BART service.			
Users Involved:	**User:**	**Role:**		
	Traveler	End user of the system		
	System Operator	Overall Innovate 680 system operator		
	Caltrans	Ramp metering and highway facility owner		
	Local Agency	Local signalized intersection owner		
	Transit Providers	Bus operator, BART operator		
Key Assumptions:	• All system owners, including MTC, Caltrans, local agencies, and transit providers will proactively share all available travel-time/bus/route data. • Recurrent congestion triggers the DSS to activate local TSP, as well as ramp metering and PTTL use on the highway.			
Key Actions/Events:	**User:**	**Step:**	**Key Action:**	**Project Interactions:**
	Traveler	1	Opens MOD application, provides origin and destination.	MOD
	System Operator	2	Receives travel-time and cost information via CCD, displays options via MOD to traveler.	AT, MOD
	Traveler	3	Traveler chooses to commute by personal bike and transit.	MOD
	System Operator	4	Saves trip details, reserves bike storage at mobility hub.	MOD, SMH
	Traveler	5	Traveler stores bike at mobility hub, awaits bus.	SMH

	Traveler	6	Pays for ticket, boards bus, uses e-ticket via MOD application for bus entry.	MOD
	Transit Providers	7	Bus receives priority at signalized intersections. Bus also receives priority at ramp meters for PTTL use or On-ramp provides HOV bypass lane and transit priority metering.	AT, PTTL
	System Operator	8	System monitors arrival times for the bus-BART trip connection, relays trip connection details to Traveler via MOD.	AT, MOD
	Traveler	9	Transfers from bus to BART at local station, scans e-ticket via MOD application for BART station entry.	MOD
	System Operator	10	Relays final price and payment summary via MOD.	MOD
	Traveler	11	Exits BART station and completes trip by walking two blocks to work.	
Key Policy/Technical Considerations:	• Delegated control of TSP, ramp metering and PTTL activated by the automated DSS • Data sharing, data transfer of real-time travel data/information to the CCD and MOD • On-board/in-station ticketing confirmation for MOD users of bus/BART routes • Considerations for bike storage at local mobility hubs • Connection protection expectations and integration with Transit Providers • Bus operator confirmation and communications protocol for PTTL use • Considerations for HOV-bypass lanes and transit priority ramp metering			

7.1.2 Scenario 1F –Transit Connection is Missed

This scenario is a failure mode of the previous scenario. In it, rather than having a successful transfer between the local bus route and BART, the traveler is unsuccessful in making the transfer. This prompts a change in their travel itinerary to ensure their trip is made in a reasonable time.

Scenario Title:	1F – Transit Connection is Not Made	
Scenario Description:	The traveler is unable to make the connection from the bus to BART in time. The traveler must seek alternative options to make a timely arrival to work.	
Users Involved:	**User:**	**Role:**
	Traveler	End user of the system

	System Operator	Overall Innovate 680 system operator		
	Transit Provider	Operator of BART		
	Mobility Providers	TNC operator		
Key Assumptions:	• All system owners, including mobility providers, provide available travel-time data.			
Key Actions/Events:	**User:**	**Step:**	**Key Action:**	**Comments:**
	System Operator	1	System determines connection may be missed.	AT, MOD
	Traveler	2	Traveler is notified via MOD application that connection may not be possible.	MOD
	System Operator	3	Receives travel and cost options via CCD, displays alternatives via MOD application.	AT, MOD
	Traveler	4	Traveler chooses to travel by TNC.	MOD
	System Operator	5	Confirms trip with matched TNC.	MOD
	Mobility Providers	6	TNC receives travel query, confirms request, dispatches vehicle.	MOD
	System Operator	7	Communicates to Traveler via MOD that TNC trip is matched.	MOD
	Traveler	8	Boards TNC vehicle, travels to final destination.	MOD
	System Operator	9	Relays final price and payment summary via MOD application.	MOD
Key Policy/Technical Considerations:	• Connectivity, data sharing, and application integration with TNCs (mobility providers) • Accuracy in connection protection assessment • Connection protection cost implications for Traveler, System Operator, Transit Providers			

7.1.3 Scenario 2 – Commuting to Work via Personal Vehicle with Carpoolers

This scenario envisions a traveler trip that is anticipated to be a regular occurrence on the corridor – a traveler utilizes their personal vehicle to travel to work. To help get to work quicker, the traveler sees that they can pick up nearby carpoolers. This allows the traveler and his passengers the opportunity to utilize systems that are aimed at providing enhanced service for shared-vehicle use.

Scenario Title:	2 – Commuting to Work via Personal Vehicle with Carpoolers

Scenario Description:	Traveler uses the MOD application to plan a trip to work with their personal vehicle, matching with local carpoolers for travel in the Express Lane and parking services downtown.			
Users Involved:	**User:**	**Role:**		
	Traveler	End user of the system		
	System Operator	Overall Innovate 680 system operator		
	Caltrans	Ramp metering and highway facility owner		
	MTC	Express lanes facility owner		
	Local Agency	Local signalized intersection owner, parking service provider		
Key Assumptions:	• All system owners, including Caltrans, MTC, and local agencies will provide available travel-time, costs, and parking availability data via the CCD. • Recurrent congestion triggers the DSS to activate local coordinated signal timing and ramp metering. • Parking reservation service is offered at a local downtown parking facility, operated by a local agency.			
Key Actions/Events:	**User:**	**Step:**	**Key Action:**	**Project Interactions:**
	Traveler	1	Traveler opens MOD app, provides origin and destination. Additional travelers at mobility hub provide similar destination via MOD.	MOD, SMH
	System Operator	2	Receives travel-time, cost and nearby trip data via CCD, displays options to all travelers via MOD.	AT, MOD
	Traveler	3	Traveler chooses personal vehicle, local carpool pick-up, and downtown parking.	MOD
	System Operator	4	Saves trip details, provides potential carpool option to MOD users, arranges curbside pick-up time/location, reserves downtown parking space	AT, MOD
	Local Agency	5	Confirms parking space availability and reservation downtown.	AT, MOD
	Traveler	6	Traveler 1 arrives at mobility hub, picks up carpool passengers in designated pick-up location.	SMH, MOD
	Traveler	7	Continues onto I-680 highway, activates 3+ on toll tag and travels in the EL.	ELC

	MTC	8	Bills trip as carpool (free).	
	Traveler	9	Arrives at downtown parking facility, scans e-ticket via MOD application for entry.	MOD
	System Operator	10	Relays price, payment summary via MOD application to all travelers.	MOD
Key Policy/Technical Considerations:	• Delegated control of signal timing and HOV-bypass metering activated by automated DSS • Data sharing, data transfer of real-time travel data to the CCD • Trip-matching for carpool travelers at local shared mobility hubs • Handshake between carpool drivers and travelers to ensure safety • Integration with local parking facility systems for confirmation and entry • Curbside management integration at local shared mobility hubs			

7.1.4 Scenario 2F – An Incident Occurs on the Highway

This scenario is a failure mode of the previous scenario. In it, the traveler and their passengers are confronted with an incident on the highway. This ultimately highlights key incident and emergency management needs for the program, showcasing interactions between owner/operators and emergency response personnel on the corridor.

Scenario Title:	2F – An Incident Occurs on the Highway	
Scenario Description:	After picking up carpoolers, a traffic incident occurs (vehicle overturned) in the Express Lane, causing activation of an incident response plan, utilizing lane use management signs, ramp metering, and incident signal timing. Emergency response crews arrive on scene to clear incident.	
Users Involved:	**User:**	**Role:**
	Traveler	End user of the system
	System Operator	Overall Innovate 680 system operator
	Caltrans	Lane use management and ramp metering system owner
	MTC	Express lanes owner, FSP operator
	Local Agency	Local signalized intersection owner
	CHP	Incident response, on-site traffic handling
	Emergency Services	Fire and emergency medical transportation (EMT) response
Key Assumptions:	• All system owners, including Caltrans, MTC, and local agencies will provide available travel-time data via the CCD. • Emergency Services respond as appropriate within their policies and law.	

<table>
<tr><td></td><td colspan="4">• FSP response assumes incident occurs during hours that FSP operates.</td></tr>
<tr><td>Key Actions/Events:</td><td>User:</td><td>Step:</td><td>Key Action:</td><td>Project Interactions:</td></tr>
<tr><td></td><td>System Operator</td><td>1</td><td>DSS confirms incident, activates incident response plan, coordinates with first responders.</td><td>AT, ELC</td></tr>
<tr><td></td><td>System Operator</td><td>2</td><td>Notifies emergency services, Caltrans, MTC, CHP, local agencies.</td><td>AT</td></tr>
<tr><td></td><td>System Operator</td><td>3</td><td>The incident plan activates lane use/speed signage, ramp metering adjustments, EL and PTTL closure, local signal timing adjustments.</td><td>AT, ELC, PTTL</td></tr>
<tr><td></td><td>System Operator</td><td>4</td><td>Traveler information messaging is pushed to both MOD application and message signs at mobility hubs.</td><td>AT, SMH, MOD</td></tr>
<tr><td></td><td>Emergency Services</td><td>5</td><td>Fire/EMT crews dispatched to the site.</td><td>PTTL</td></tr>
<tr><td></td><td>CHP</td><td>6</td><td>CHP dispatched to the site.</td><td>PTTL</td></tr>
<tr><td></td><td>System Operator</td><td>7</td><td>Confirms FSP dispatch with MTC for tow service.</td><td>AT</td></tr>
<tr><td></td><td>Transit Provider</td><td>8</td><td>Dispatch relays PTTL closure if necessary, reroutes transit vehicles if necessary.</td><td>PTTL</td></tr>
<tr><td></td><td>System Operator</td><td>9</td><td>Confirms incident is cleared, DSS reverts to normal operations.</td><td>AT</td></tr>
<tr><td>Key Policy/Technical Considerations:</td><td colspan="4">• Delegated control of local signal timing, metering and EL closure activated by the DSS
• DSS autonomy during incident scenarios; need/protocol for incident confirmation and incident clearance
• Collaboration to determine incident response plan, overall protocol for incident scenarios, and PTTL, EL usage
• Collaboration to determine alternative route planning and messaging/communications to travelers
• Use of PTTL during express lane closure scenarios.
• Data sharing, data transfer of real-time travel data/information to the CCD
• Assessing the need for a centralized TMC for a system operator to facilitate more direct communication with partners.</td></tr>
</table>

7.1.5 Scenario 3 – Traveling via Shared Automated Vehicle

This scenario envisions a traveler trip that is anticipated to be a regular occurrence on the corridor – a traveler utilizes an SAV to travel to a destination within the program area. In particular, this scenario envisions an elderly traveler who is utilizing SAV service to travel from home to the county hospital. Along the way, the SAV picks up nearby passengers and interacts with various systems that support enhanced arterial operations.

Scenario Title:	3 – Traveling via Shared Automated Vehicle			
Scenario Description:	Traveler uses the MOD application to plan a trip a day in advance to a local county hospital. On the day of the trip, an SAV picks up the traveler as well as additional passengers at a local mobility hub. The group travels together to the local county hospital.			
Users Involved:	**User:**	**Role:**		
	Traveler	End user of the system		
	System Operator	Overall Innovate 680 system operator		
	Local Agency	Local signal timing owner		
	Transit Provider	SAV operator		
Key Assumptions:	• All system owners, including local agencies and transit providers, will provide available travel-time/bus/route data, and cost info, via the CCD. • A transit provider is the assumed operator of the SAV. • SAV is traveling on public roads.			
Key Actions/Events:	**User:**	**Step:**	**Key Action:**	**Project Interactions:**
	Traveler	1	Traveler 1 opens MOD app, provides origin-destination for future date.	MOD
	Traveler	2	On the day of the scheduled travel, addl. travelers at mobility hub provide similar destinations via MOD.	MOD
	System Operator	3	System receives trip itineraries from MOD users, supports trip matching. Relays trip information to all Travelers.	MOD
	System Operator	4	Transmits SAV request.	ADS
	Transit Provider	5	Confirms SAV is dispatched.	ADS
	System Operator	6	Relays information for pick-up time/location to all travelers via MOD.	ADS, MOD
	Traveler	7	Traveler 1 boards SAV from home, confirms pick-up via MOD.	ADS, MOD

	Traveler	8	Additional travelers board SAV at a local mobility hub. All travelers confirm pick-up via MOD.	ADS, MOD
	Traveler	9	SAV completes trip to local county hospital.	ADS
	System Operator	10	Relays price and payment info via MOD application to all travelers.	MOD
Key Policy/Technical Considerations:	• Data sharing, transfer of travel-time data to the CCD • Owner/operator of SAVs • Ticketing for SAV travel • Trip planning/scheduling in advance of travel • Considerations for ADA and/or elderly travelers who may require assistance or support • Trip matching for carpool travelers at local shared mobility hubs • Curbside management integration at local shared mobility hubs			

7.1.6 Scenario 3F – A Medical Emergency Occurs During Trip in Shared Automated Vehicle

This scenario is a failure mode of the previous scenario. In it, a traveler aboard the SAV faces a medical emergency. This scenario ultimately highlights emergency/incident response and coordination with SAVs operating on the local arterial street system, as well as the various system elements that support the safety of travelers during incidents of this type.

Scenario Title:	3F – Medical Emergency Occurs During Trip in Shared Automated Vehicle			
Scenario Description:	On the SAV trip to the county hospital, a traveler faces a medical emergency. Law enforcement and emergency response crews are dispatched for on-site support.			
Users Involved:	**User:**	**Role:**		
	Traveler	End user of the system		
	System Operator	Overall Innovate 680 system operator		
	Transit Provider	SAV operator		
	Local Law Enforcement / CHP	Local sheriff/police department incident response services. If the medical emergency occurred on the freeway, CHP would be the Incident Commander.		
	Emergency Services	Fire and EMT emergency response services		
Key Assumptions:	• A transit provider is the assumed operator of the SAV.			
Key Actions/Events:	**User:**	**Step:**	**Key Action:**	**Project Interactions:**

	Traveler	1	SAV operator and/or additional travelers activate the emergency SAV button.	ADS
	Transit Provider	2	Operator speaks to passengers, logs incident information.	ADS
	Transit Provider	3	Activates SAV emergency plan. Notifies local law enforcement, emergency services.	ADS
	Transit Provider	4	Navigates vehicle to safe location.	ADS
	Emergency Services	5	Follows emergency response plan, dispatches Fire/EMT crews.	ADS
	Local Law Enforcement / CHP	6	Follows emergency response plan, dispatches sheriff/police department.	ADS
	System Operator	7	Coordinated emergency vehicle preemption supports emergency response time.	AT
	Transit Provider	8	Sends additional SAV vehicle for continued service.	ADS
	System Operator	9	Provides alternative route choices for impacted travelers via MOD app.	AT, MOD
	System Operator	10	Alerts other, nearby travelers via MOD application and messaging at mobility hubs.	AT, MOD, SMH
Key Policy/Technical Considerations:	• Owner/operator of SAVs • Emergency stop functionality in SAV; operator protocol for pulling vehicle over • Collaboration to determine emergency response plans and overall protocol for SAV emergency scenarios • Considerations for non-English speaking travelers • Technical/system requirements for coordinated emergency vehicle preemption • Assessing the need for a centralized TMC for a system operator			

7.1.7 Scenario 4 – Traveling to a Destination Outside of Contra Costa County

Given that the Innovate 680 corridor is largely used as a link between traveler trips in and out of the county, this scenario envisions a recreational trip that begins in the program area but ends outside of the county. In it, a youth traveler without a banking service is traveling to Pleasanton to visit friends at the Alameda County Fair. The traveler walks to a nearby shared mobility hub to plan and embark on their trip, taking a regional express bus route to the neighboring county.

Scenario Title:	4 – Traveling to a Destination Outside of Contra Costa County			
Scenario Description:	A youth traveler in Contra Costa County wants to travel to Pleasanton to visit the Alameda County Fair. The traveler loses power on their phone and walks to a nearby mobility hub. There, the traveler plans their trip at a hub kiosk, taking an express bus route to a transit stop near the fairgrounds.			
Users Involved:	**User:**	**Role:**		
	Traveler	End user of the system		
	System Operator	Overall Innovate 680 system operator		
	Caltrans	Ramp metering and highway facility owner		
	MTC	Express lanes owner		
	Transit Provider	Express bus operator		
Key Assumptions:	• The traveler's phone loses power. • All system owners, including Caltrans, MTC and transit providers, will provide available travel-time/bus/route data, and cost data, via the CCD. • Recurrent congestion triggers the DSS to activate ramp metering			
Key Actions/Events:	**User:**	**Step:**	**Key Action:**	**Project Interactions:**
	Traveler	1	Walks to local mobility hub.	SMH
	System Operator	2	Receives travel-time and cost data via CCD, displays options via traveler info boards at the mobility hub.	AT, SMH
	System Operator	3	Provides on-site kiosk for trip booking and payment.	SMH
	Traveler	4	Traveler chooses to travel by Express Bus. Traveler books, pays via cash, receives ticket. Awaits arrival, boards bus with ticket.	SMH
	Transit Provider	5	Express bus utilizes HOV bypass on-ramp lane, and express lane. The onramp provides HOV bypass lane and transit priority metering.	AT, ELC, PTTL
	MTC	6	Recognizes express lane trip through Contra Costa County as transit and assesses as non-revenue. Similarly, Alameda CTC recognizes trip as transit and also assess as non-revenue.	ELC
	Traveler	7	Arrives at transit station.	

Key Policy/Technical Considerations:	• Data sharing, data transfer of real-time travel data/information to the CCD • Traveling back into the county without a phone/connectivity to MOD platform • Coordination/integration with agencies (Alameda CTC) outside of the county • On-site kiosk for in-person trip planning at shared mobility hubs • Considerations for HOV-bypass lanes and transit priority ramp metering • Considerations for travelers without a phone or banking service (cash payment services) • Considerations for youth travelers

7.1.8 Scenario 4F – A Local Incident Blocks Entry onto I-680

This scenario is a failure mode of the previous scenario. In it, prior to entering the I-680 highway facility, the express bus encounters a local incident on the arterial road near the shared mobility hub. This ultimately highlights coordination needs between arterial operations, local emergency response crews, regional transit providers and state highway system operations.

Scenario Title:	4F – A Local Incident Blocks Entry onto I-680			
Scenario Description:	Prior to entering I-680, the Express Bus encounters an incident on a local arterial within Contra Costa County, blocking entrance onto the highway.			
Users Involved:	**User:**	**Role:**		
	Traveler	End user of the system		
	System Operator	Overall Innovate 680 system operator		
	Caltrans	Ramp metering and highway facility owner		
	Transit Provider	Express bus operator		
	Local Agency	Local signalized intersection owner		
	Emergency Services	Fire and EMT emergency response services		
	Local Law Enforcement	Local sheriff/police department incident response services		
Key Assumptions:	• The incident triggers the DSS to activate incident response signal timing and ramp metering.			
Key Actions/Events:	**User:**	**Step:**	**Key Action:**	**Project Interactions:**
	System Operator	1	DSS receives incident confirmation, provides details to first responders.	AT

	System Operator	2	Notifies local agency, Caltrans, transit provider, emergency service, local law enforcement.	AT
	Emergency Services	3	Dispatches fire/EMT for incident response.	AT
	Local Law Enforcement	4	Sheriff/police department dispatched for incident/traffic handling at ramp termini/arterials.	AT
	System Operator	5	DSS coordinates incident response plan, activating ramp metering signal timing and message information signs at mobility hubs.	AT, SMH
	System Operator	6	Communicates alternative route for entering the I-680 highway to the Express Bus operator.	AT
	Transit Provider	7	Re-routes express bus to alternative ramp entry point.	AT
	Transit Provider	8	Bus operators inform non-phone travelers of impacts to route.	
Key Policy/Technical Considerations:	• Delegated control of signal timing and ramp metering activated by the DSS • DSS autonomy during incident scenarios; need/protocol for incident confirmation and incident clearance • Collaboration to determine incident response plans and overall protocol for incident scenarios • Collaboration to determine alternative route planning and communications to no-phone travelers • Assessing the need for a centralized TMC for a system operator			

7.1.9 Scenario 5 – Traveling Back Home from Outside of Contra Costa County

In the same fashion of the previous scenario, it is equally important to consider travelers who are utilizing the Innovate 680 corridor to return back to the program area from outside of the county. This scenario presents a car-less traveler who utilizes a regional carpool service to return back to a mobility hub near their home.

Scenario Title:	5 – Traveling Back Home from Outside of Contra Costa County	
Scenario Description:	A traveler is traveling back to Contra Costa County from a trip to San Francisco. The traveler uses the MOD application to plan a 511-carpool ride to a mobility hub near their home.	
Users Involved:	**User:**	**Role:**
	Traveler	End user of the system

	System Operator	Overall Innovate 680 system operator		
	MTC	511 operator, toll bridge operator		
Key Assumptions:	• All system owners, including MTC, will provide available travel data via the CCD.			
Key Actions/Events:	**User:**	**Step:**	**Key Action:**	**Project Interactions:**
	Traveler	1	Opens MOD app, provides origin and destination several hours in advance of traveling.	MOD
	System Operator	2	Receives real-time travel and cost data, displays options via MOD app.	MOD
	Traveler	3	Traveler chooses carpool services offered via 511 SF Bay.	MOD
	MTC	4	Receives query from system, confirms match, transmits trip details	MOD
	System Operator	5	Displays pick-up details to Traveler via MOD application for later that evening. Traveler confirms trip details.	MOD
	Traveler	6	Boards vehicle and begins trip across bridge. Carpool driver has toll tag set to 2+ for express lane use.	MOD, ELC
	Traveler	7	Arrives at local mobility hub, walks home.	SMH
Key Policy/Technical Considerations:	• Data sharing, data transfer of real-time travel data/information to the CCD • MOD integration with outside platforms, such as 511 carpool system • Trip planning/scheduling in advance of travel			

7.1.10 Scenario 5F – Traveler's Carpool Driver Never Shows Up

This scenario is a failure mode of the previous scenario. In it, the scenario considers the potential for the traveler's carpool driver to not show up. As such, this scenario explores the needs for integrating the TDM strategies of the program with the existing TDM and guaranteed ride home programs for the county.

Scenario Title:	5F – Traveler's Carpool Driver Never Shows Up	
Scenario Description:	While waiting in San Francisco, the traveler's carpool driver never arrives. The traveler revisits the MOD application for alternatives. A guaranteed ride home program ensures the traveler finds a trip back to Contra Costa County.	
Users Involved:	**User:**	**Role:**

<table>
<tr><td rowspan="4"></td><td>Traveler</td><td colspan="3">End user of the system</td></tr>
<tr><td>System Operator</td><td colspan="3">Overall Innovate 680 system operator</td></tr>
<tr><td>MTC</td><td colspan="3">511 operator, express lane and bridge operator</td></tr>
<tr><td>Mobility Provider</td><td colspan="3">TNC operator</td></tr>
<tr><td>Key Assumptions:</td><td colspan="4">• All system owners, including MTC and mobility providers, will provide available travel data via the CCD.</td></tr>
<tr><td rowspan="9">Key Actions/Events:</td><td>User:</td><td>Step:</td><td>Key Action:</td><td>Project Interactions:</td></tr>
<tr><td>Traveler</td><td>1</td><td>Opens MOD app, marks that carpool driver has not arrived.</td><td>MOD</td></tr>
<tr><td>System Operator</td><td>2</td><td>Cancels carpool trip, alerts MTC, receives travel-time and cost data for alternatives.</td><td>MOD</td></tr>
<tr><td>Traveler</td><td>3</td><td>Chooses TNC alternative.</td><td>MOD</td></tr>
<tr><td>Mobility Provider</td><td>4</td><td>Receives query from system, confirms trip, dispatches TNC driver.</td><td>MOD</td></tr>
<tr><td>System Operator</td><td>5</td><td>Relays TNC pick-up/arrival time to traveler via MOD app. Traveler confirms trip details.</td><td>MOD</td></tr>
<tr><td>Traveler</td><td>6</td><td>Boards TNC vehicle, confirms boarding. TNC driver has toll tag set to 2+</td><td>MOD, ELC</td></tr>
<tr><td>MTC</td><td>7</td><td>Confirms travel on bridge and EL, assigns discount.</td><td>MOD, ELC</td></tr>
<tr><td>Traveler</td><td>8</td><td>Arrives at shared mobility hub near home.</td><td>MOD, SMH</td></tr>
<tr><td>Key Policy/Technical Considerations:</td><td colspan="4">• Data sharing, data transfer of real-time travel data/information to the CCD
• Policy for a guaranteed ride home program and cost share between public agencies and traveler
• Wait times/limit protocol for carpool services that are delayed
• MOD integration with outside platforms, such as TNC and 511 carpool system
• Connectivity, data sharing, and application integration with Mobility Providers</td></tr>
</table>

7.2 Operator Focused Scenarios

7.2.1 Scenario 6 – Unplanned Obstruction of the PTTL

To highlight additional considerations needed for system operators, this scenario outlines the coordination and protocol needs for an unplanned obstruction of the part time transit lane. In

it, the system operator is required to interface with services offered by the FSP program to support debris clearance and facilitate an expedited return to normal PTTL operations.

Scenario Title:	6 – Unplanned Obstruction of the PTTL			
Scenario Description:	A parked vehicle is reported on the shoulder of the highway. The system operator informs MTC's FSP, Caltrans, and transit providers of obstruction. FSP is dispatched to secure the site.			
Users Involved:	**User:**	**Role:**		
	Traveler	End user of the system		
	System Operator	Overall Innovate 680 system operator		
	MTC/CHP	FSP partner		
	Caltrans	PTTL and highway facility owner		
	Transit Provider	Local bus operator		
	Data Provider	Waze operator		
Key Assumptions:	• All system owners, including MTC and mobility providers, will provide available travel data via the CCD. • The DSS will operate the PTTL and accompanying maintenance coordination needs with FSP. • FSP hours of operation are aligned to match PTTL hours of operation. • When an unplanned obstruction such as an abandoned vehicle is in the PTTL, FSP cannot tow the vehicle to clear the lane. 22651(f) VC.			
Key Actions/Events:	**User:**	**Step:**	**Key Action:**	**Project Interactions:**
	Traveler	1	Uses Waze to report a vehicle obstruction on the highway shoulder.	MOD
	Data Provider	2	Provides alert/information to the system operator.	AT
	System Operator	3	Receives notification, DSS confirms obstruction via CCTV.	AT
	System Operator	4	DSS updates the PTTL signage to reflect impacted shoulder.	AT, PTTL
	System Operator	5	Confirms FSP dispatch with MTC, communicates PTTL impact to Caltrans and Transit Provider.	AT, PTTL
	MTC	6	Dispatches FSP to secure the site.	AT
	Transit Provider	7	Relays potential impacts to bus operators via dispatch.	AT

	System Operator	8	Monitors real-time travel data, alerts impacted travelers via MOD application and mobility hub messaging.	AT, MOD, SMH
	System Operator	9	DSS confirms site status, resumes normal operations as soon as possible.	AT, PTTL
Key Policy/Technical Considerations:	• MOD integration with outside platforms, such as Waze. • Delegated control of PTTL and maintenance coordination for DSS • Protocol for confirming obstruction and obstruction clearance on the roadway. • PTTL operations and signage for incident/maintenance/closure scenarios • Current FSP operating hours, potential needs to extend existing operating hours			

7.2.2 Scenario 7 – Transit System Shutdown

This scenario explores the various system-wide coordination needs in the event of a transit system shutdown. In particular, this scenario envisions an incident that causes a BART shutdown with no known timetable for its restored operations. This requires he system operator to coordinate with all other systems, highlighting the opportunities for the program to leverage all operational components to support the movement of travelers on the corridor.

Scenario Title:	7 – Transit System Shutdown			
Scenario Description:	An incident causes a system-wide shutdown of BART service in the Bay Area. The MOD application is used to alert travelers of this incident. The system operator also informs travelers at all local mobility hubs, while also leveraging operational strategies to support traveler movement. This includes encouraging travelers to utilize shared mobility options offered by mobility providers.			
Users Involved:	**User:**	**Role:**		
	Traveler	End user of the system		
	System Operator	Overall Innovate 680 system operator		
	Caltrans	Highway facility owner		
	MTC	Express lane facility owner		
	Local Agencies	Arterial facility owner		
	Transit Providers	Local bus and BART operator		
	Mobility Providers	TNC Operator		
Key Assumptions:	• All system owners, including mobility providers, will provide available travel data via the CCD.			
Key Actions/Events:	**User:**	**Step:**	**Key Action:**	**Project Interactions:**

	Transit Provider	1	Informs the system operator of the shutdown of the BART system.	AT
	System Operator	2	Supports communications among transit providers to provide "bus bridges" for travelers utilizing transit services.	AT
	System Operator	3	Provides an alert to travelers via the MOD application and in-person at SMH sites via traveler information signs.	AT, MOD, SMH
	System Operator	4	Provides addl. messaging to travelers via dynamic message signs on the highway and arterial corridors.	AT
	System Operator	5	Activates PTTL use and increases express lane pricing to encourage shared-use vehicle travel.	AT, PTTL, ELC
	System Operator	6	Requests an increase in shared-use travel options offered by TNCs.	AT, MOD
	Mobility Provider	7	Receives request, increases fleet presence in the program area and encourages shared-use services.	AT, MOD
Key Policy/Technical Considerations:	• Policy for enacting changes to express lane pricing on I-680 • Connectivity, data sharing, and application integration with Mobility Providers • Agreements with Mobility Providers to support TDM strategies during unique failure scenarios • Responsiveness of MOD application during high-use scenarios • Express lanes may require lane operation mode override, may require regional coordination with ROC.			

7.2.3 Scenario 8 – Regional Emergency

This scenario explores the potential for a regional emergency to impact operations in the program area. In particular, this scenario envisions a regional fire emergency that has the potential to impact the safety of travelers and the electrification of the transportation network. This scenario highlights the need for system-wide incident/emergency messaging, as well as disaster planning in the event that everyday services beyond the transportation network are impacted.

Scenario Title:	8 – Regional Emergency
Scenario Description:	A regional fire near Contra Costa County threatens the safety of travelers and the electrification of various systems elements. The DSS and CCD, still operational at this time,

	allow the system operator to inform travelers and owners/operators of this regional event to support disaster planning and readiness.			
Users Involved:	**User:**	**Role:**		
	Traveler	End user of the system		
	System Operator	Overall Innovate 680 system operator		
	Caltrans	Highway facility owner		
	MTC	Express lane facility owner		
	CHP	Statewide safety and law enforcement		
	Local Agencies	Arterial facility owner		
	Transit Providers	Local bus and BART operators		
	Mobility Providers	TNC Operators		
	Data Providers	Google/Waze operators		
	Local Law Enforcement	Local sheriff/PD		
	Emergency Services	Fire and EMT providers		
Key Assumptions:	• The overarching system is still operable. • All system owners provide available travel data via the CCD.			
Key Actions/Events:	**User:**	**Step:**	**Key Action:**	**Project Interactions:**
	Emergency Services	1	Provides a notice to the system operator regarding the regional fire event.	AT
	System Operator	2	Coordinates with CHP and Local Law Enforcement to enact disaster protocol.	AT
	System Operator	3	Coordinates with Caltrans, MTC, and Local Agencies for as-needed highway, express lane and local road closures.	AT, ELC
	System Operator	4	Coordinates with Transit Providers on impacts to local bus and BART operations.	AT
	System Operator	5	Informs Mobility and Data Providers of system-wide impacts.	AT
	System Operator	6	Provides an alert to travelers via the MOD application and in-person at mobility hub sites via traveler information signs.	AT, MOD, SMH

	System Operator	7	Provides addl. messaging to travelers via dynamic message signs on the highway and arterial corridors.	AT
	System Operator	8	Monitors ongoing operations and regional fire to support as-needed emergency evacuation support.	AT
	System Operator	9	If necessary, coordinates with transit providers to utilize buses for local evacuation (e.g.: senior living communities, residential areas with low vehicle ownership).	AT
Key Policy/Technical Considerations:	• Protocol and agreements for regional disaster planning, response and recovery • Disaster traveler information dissemination and evacuation support • Protocol for early warning and wide area alerts			

7.2.4 Scenario 9 – Loss of Communications with the System Operator during Freeway Incident

This scenario outlines a use case where the system operator losing communications with all other external systems during an incident on the I-680. Ultimately, this scenario highlights the need for a deputy system operator who can assume regional control and support the operational concept in a failure event.

Scenario Title:	9 – Loss of Communications with the System Operator	
Scenario Description:	Partner agencies lose communications with the overall system operator during a highway incident impacting three (3) lanes. Caltrans assumes control of highway operations, communicating impacts to MTC, transit providers, law enforcement, emergency services and local agencies directly.	
Users Involved:	**User:**	**Role:**
	Traveler	End user of the system
	System Operator	Overall Innovate 680 system operator
	Caltrans	Deputy system operator
	MTC	Express lane owner
	Local Agencies	Local signalized intersection owner
	Law Enforcement	Local sheriff/police department
	Emergency Services	Local fire/EMT response
Key Assumptions:	• The DSS loses communications with all other external systems.	

Key Actions/Events:	User:	Step:	Key Action:	Project Interactions:
	System Operator	1	Incident occurs, DSS comms is lost with partner agencies.	
	Caltrans	2	Recognizes incident and comms loss, confirms incident via CCTV. Contacts System Operator by phone to confirm situation and assess extent of failure.	
	Caltrans	3	Activates incident response plan, activates lane use management and variable speed signs, ramp metering adjustments, PTTL closure.	PTTL
	Caltrans	4	Informs MTC, transit providers, law enforcement, emergency services, local agencies.	ELC, PTTL
	Caltrans	5	Adjust local signal timing for key arterials, updates traveler information signing per response plan	
	Emergency Services	6	Organize staff and resources to meet the needs of the incident.	PTTL
	Law Enforcement	7	CHP is the Incident Commander. Direct traffic handling to minimize delays and expedite incident clearance.	PTTL
	MTC	8	Opens express lane to all to support incident clearance	ELC
	Transit Providers	9	Communicates PTTL closure to bus operators via dispatch	PTTL
	Caltrans	10	Confirms site clearance, resumes standard operations	
Key Policy/Technical Considerations:	• Protocol/handoff and prior system integration to allow Caltrans TMC to assume delegated control is in place; Caltrans staffing requirements for assuming control. • Delegated control includes integration with Caltrans TMC • Collaboration to determine incident response plans and overall protocol for incident scenarios • Collaboration to determine alternative route planning and communications to travelers during system outages			

	• Bus operator confirmation and communications protocol for PTTL use • Policy/protocol for express lane open to all during incident scenarios

7.2.5 Scenario 10 – MOD Application Failure

This scenario outlines a use case where the MOD application loses communications with all other external systems during an incident on a local arterial corridor. Ultimately, this scenario highlights the need for in-person traveler information systems that can provide phoneless and unbanked travelers trip planning resources. Additionally, this scenario showcases the ways in which operators can continue to provide travel information and travel planning resources to travelers with field systems and devices.

Scenario Title:	10 – MOD Application Failure			
Scenario Description:	During an accident on a major arterial corridor, the MOD application crashes. Nearby arterial wayfinding signs, highway CMS, and mobility hub information signs inform drivers of incident rerouting. Emergency crews are dispatched for on-site response.			
Users Involved:	**User:**	**Role:**		
	Traveler	End user of the system		
	System Operator	Overall Innovate 680 system operator		
	Caltrans	Ramp metering and highway CMS owner		
	Local Agencies	Local signalized intersection owner		
	Transit Providers	Local bus operator		
	Law Enforcement	Local sheriff/police department		
	Emergency Services	Local fire/EMT response		
Key Assumptions:	• The MOD application crashes and/or loses communications. • The DSS and CCD remain functional.			
Key Actions/Events:	**User:**	**Step:**	**Key Action:**	**Project Interactions:**
	System Operator	1	DSS activates incident response plan, activating metering and local signal timing	AT
	System Operator	2	Informs Caltrans, transit providers, law enforcement, emergency services, local agencies	AT
	Transit Providers	3	Dispatch communicates incident to impacted bus routes	AT
	System Operator	4	Relays traveler information via local wayfinding signs,	AT, SMH

			highway CMS, mobility hub info signage.	
	Traveler	5	Travelers driving on local arterials see arterial DMS messaging for alt routes; highway drivers see updated CMS travel times	AT
	Traveler	6	Travelers at local mobility hubs see traveler information signs with incident notices and impacted travel times	AT, SMH
	System Operator	7	CCD continues to receive and transmit frequent real-time travel info to infrastructure in the field	AT
	System Operator	8	Continues to provide on-site kiosk for trip booking and payment at mobility hubs	AT, SMH
Key Policy/Technical Considerations:	• Delegated control of traveler information signage by the automated DSS • Collaboration to determine incident response plans and overall protocol for incident scenarios • Collaboration to determine alternative route planning and communications to travelers			

7.2.6 Scenario 11 – Fleets of Automated Vehicles Operating Along Corridor

This scenario outlines a use case where the system operator is able to leverage information from automated fleet vehicles traveling along the corridor. Ultimately, this scenario highlights how AVs could gather data to improve operations.

Scenario Title:	11 – Fleets of Automated Vehicles Operating Along Corridor	
Scenario Description:	Collecting data from vehicles traveling along the corridor is expected to become easier as the V2I and V2V technologies demonstrated in the ADS project are scaled up. In this scenario fleet vehicles traveling along I-680 share information with the system operator including speed, heavy braking, road temperatures, wiper status, and other data in order to calculate travel times, identify incidents, or weather events, or determine pavement conditions (e.g. potholes). Integration with payment systems is also possible. The scenario also reveals needs for security and privacy.	
Users Involved:	**User:**	**Role:**
	Traveler	End user of the system
	System Operator	Overall Innovate 680 system operator
	Caltrans	Highway facility owner
	MTC	Express lane facility
	Mobility Provider	TNC owner

	CHP	Incident notification		
Key Assumptions:	Vehicle data will be shared through a device in the vehicle that connects with the network to the system operator.			
Key Actions/Events:	**User:**	**Step:**	**Key Action:**	**Project Interactions:**
	Mobility Provider	1	Receives and accepts ride request though TNC app. Picks up passenger in the Rossmoor Retirement Community. Trip destination is the Amtrak Station in Martinez.	ADS
	System Operator	2	Receives automated notification of a pothole on Olympic Blvd. Alerts maintenance.	ADS, AT
	Caltrans	3	Alerts maintenance crews in the area to the pothole.	ADS, AT
	Mobility Provider / Traveler	4	Experiences delay due to the ramp meter to enter I-680.	AT
	System Operator	5	Automated system responds to queue increases at ramp meter to prevent backups into the arterial.	ADS, AT
	Mobility Provider	6	Vehicle enters I-680 Express Lanes. Payment is processed through V2X enabled device.	ADS, ELC
	Mobility Provider	7	Slows due to vehicle on the side of the road. System operator and CHP are notified of the slowdown.	ADS, AT
	CHP / System Ops	8	Vehicle causing the slowdown is verified on CCTV, dispatch sends a unit to assist.	ADS, AT
	Mobility Provider	9	Vehicle sensors detect low visibility conditions and wipers being used. Weather info is shared with system operator.	ADS, AT
	Mobility Provider / Traveler	10	Arrives at destination ahead of schedule	ADS
Key Policy/Technical Considerations:	• Data sharing agreements need between agencies • Privacy concerns of data shared with system operators			

8.0 Program Implementation

This section outlines the key considerations for furthering the program into its next stage of development. It is not intended to be a formal program implementation plan. In order to support this future effort, this section outlines:

- Key policy and technical considerations that will support the next phase of program development;
- Current program funding, including considerations for future anticipated program needs; and
- The current program schedule, including considerations for the prioritizations of projects in the future.

8.1 Key Policy and Technical Considerations

Several key policy and technical considerations need to be evaluated further to support the development of the program and its operational concept in the future. The following section outlines these key issues, which fall into six main categories:

- Roles and responsibilities;
- Systems integration;
- Transit prioritization;
- TDM strategies;
- Technology deployments; and
- First and Last Mile Connections.

Each issue is described and prioritized in order to tie together the key challenges, opportunities, and needs that have been outlined in Section 6.0 Proposed Concept and Section 7.0 Operational Scenarios. It should also be noted that the Program Goals outlined in Section 4.1 also point to several key policy overlays, such as equity and accessibility, for each of the considerations that are listed in this section. These issues are cross-cutting, with several elements potentially falling under multiple categories.

The following considerations are highlighted:

- **Potential actions** that will be needed, such as establishing policy, legislation, inter-agency agreements, and/or technology/system requirements;
- The **priority** of each issue, ranging from high, medium to low based on its potential to impact the development of the program and its operational concept; and
- The recommended **timeframe for starting discussions** with stakeholders to address each issue, ranging from those that would benefit from being discussed in the short term (0-12 months) to those that may be discussed in the long term (12+ months).

8.1.1 Roles and Responsibilities

Several key issues relating to **roles and responsibilities** need to be discussed further with program stakeholders.

Table 15 – Roles and Responsibilities Considerations

Program Element	Issue	Potential Actions	Priority	Timeframe for Starting Discussion
Delegated & Automated Control	Owner/operators will be required to allow delegated control of their system components, as well as agree to system automation to support real-time operations.	• MOUs for delegated control • Standard Operating Procedures (SOPs) for automated operation	High	Short-Term
Operations Center	The need for, location, and ownership of a physical operations center to support real-time operational needs to be determined.	• O&M agreements for shared use operations centers	High	Short-Term
Incident, Emergency & Disaster Response	Protocols and priorities for the various program elements need to be established for non-recurrent operational scenarios.	• SOPs for incident management • SOPs for emergency and disaster response	Medium	Long-Term
Maintenance	Enhanced maintenance protocol, potentially involving inter-agency partnerships, will be required to support device up-time and infrastructure readiness requirements.	• MOUs for delegated/ shared maintenance • KPIs for device up-time requirements	Medium	Long-Term
Staffing & Training	Staffing and on-going training will be required for operating and maintaining the performance-based program envisioned in the operational scenarios.	• MOUs for shared staffing costs • Agency staffing needs	Medium	Long-Term

The following is a brief summary of each of these items, including outcomes from early discussions with program stakeholders.

- **Delegated & Automated Control** – Further discussion is needed to garner support for delegated control. This includes establishing the conditions upon which operational control will be requested and relinquished, who will exercise control, the specific system elements that will be controlled, the agency/entity who will serve as system operator, and the manner in which the agreements are formalized (most likely through an MOU). If conceptual agreement on delegated control is reached in the future, stakeholders have expressed an interest in developing an initial focused, limited-duration pilot to test and demonstrate this arrangement. Such a pilot could ultimately serve as a proof of concept for expanded longer-term deployments. As the operational concept matures, automated control will likely be necessary to support accelerated, real-time operational response that is envisioned in the operational scenarios. Stakeholders will need to agree on the extent of the automation and how such a system will be tested. Interest has been expressed in having a regional agency, such as CCTA, MTC or Caltrans, serve as the system operator. Should MTC take on the role, MTC's role as system operator would require an approach that can be scaled regionally; in a similar fashion, if Caltrans would take on the role, the operations would likely scale up

to operate throughout D4 over time. Whether the day-to-day staff-level responsibilities can then be contracted to a private entity will also need to be evaluated.

- **Operations Center** – The need for a centralized Innovate 680 operations center will need to be evaluated. This includes supporting the future, real time operations of highway and arterial systems, mobility hub sites, automated driving systems, and other elements noted in the operational concept, as well as maintaining functional compatibility with the existing systems described in Section 5.4. The potential to partner with agencies like MTC or Caltrans to leverage existing regional investments will be considered. While these discussions have been initiated with program stakeholders, future evaluations will be required to assess the risks, benefits and challenges of the various alternatives.

- **Incident, Emergency and Disaster Response** – The protocols of the various Program elements under non-recurrent operational scenarios will need to be evaluated, which will also need to acknowledge established incident command procedures. How the express lanes, part time transit lanes, and other lane use management systems will be operated and prioritized during various incident scenarios will need to be agreed upon, particularly if a delegated and automated control system is to be employed. How emergency responders will be effectively supported with coordinated, consistent incident management protocols will also be evaluated. Ultimately, these discussions are likely to evolve into SOPs for the program.

- **Maintenance** – An evaluation of existing and future maintenance regimens will be required in order to support ongoing operations. This includes identifying opportunities to develop interagency partnerships for shared maintenance, the potential to utilize private contractors for ongoing maintenance, and an evaluation of device up-time requirements that are likely to stipulate future maintenance needs. To implement this change, stakeholders will need to determine consistency with existing labor contracts.

- **Staffing and Training** – In order to support the operational concept, program stakeholders will be required to evaluate staffing and training needs. This includes staff that can support the development of the program, staff who can integrate and implement the proposed system, as well as operations center staff and future maintenance staff. This is likely to require an evaluation of which responsibilities are undertaken by existing agency staff, supplemented through the hiring of additional agency staff, or augmented through the hiring of outside consultants and/or contractors. Decisions will also need to be made on specialized training needs that are specific to the program, including who will provide the training and how the training will be funded. Inter-agency MOUs may be required for shared staff and shared costs.

8.1.2 System Integration

Several key issues relating to **system integration** need to be discussed further with program stakeholders.

Table 16 – System Integration Considerations

Program Element	Issue	Potential Actions	Priority	Timeframe for Starting Discussion
Data Sharing	Public and private partners will need to agree to share data in real-time and with the system operator to support ongoing operations.	• Data sharing agreements w/ public and private partners • Data management platforms	High	Short-Term
Shared Network Communications	A shared backbone communication system is needed to support system connectivity, which may require an agreement to use the existing regional fiber network.	• Fiber sharing agreements • Corridor wide technology standards • Leveraging broadband initiatives	High	Short-Term
System Security and Data Privacy	The system must be secure from external disruptions and attacks and must be able to maintain the security and privacy of data.	• Security standards and agreements for agencies and contractors	High	Short-Term
Future Bay Area Regional Integration	A modular, scalable overarching system will need to be developed for the program to support integration with system elements and components beyond the program area in the future.	• System requirements to support modularity and scalability	Medium	Long-Term

The following is a brief overview of each of these items, including a summary of early discussions with program stakeholders.

- **Data Sharing** – To provide an integrated system for travelers in the corridor, continuous data sharing between public and private partners across all program elements is needed. Stakeholders will be required to evaluate whether existing data-sharing agreements need to be expanded or to establish new agreements. These agreements will also provide an all-encompassing data repository for program performance monitoring.

- **Shared Network Communications** – A complete and consistent backbone communications network will be required to implement the proposed operational concept, which may require the adoption of corridor-wide technology standards. The willingness, risks, and benefits of sharing the existing regional fiber network will need to be evaluated, and the need and opportunities for expanding local fiber systems. Network communications may also pair well with larger-scale broadband initiatives happening within the region or state.

- **System Security and Data Privacy** — Given the shared operation and open architecture concept for the entire system, a comprehensive plan and agreements to maximize system and data security will be required. Security and privacy policies and standards will need to be established for both the participating agencies, as well as contractors and vendors involved.

- **Future Bay Area Regional Integration** – In order to support future implementation of the program concept beyond the initial program area, the overarching system that is developed for the program will need to be scalable and modular, and also have the ability to integrate with regional pricing, technology, communication and system architecture standards. The degree of scalability needed and the required level of conformity and consistency with existing systems will be memorialized in future system requirements that will be developed in future phases of the program. Transit Prioritization

8.1.3 Transit Prioritization

Several key issues relating to **transit prioritization** that need to be discussed further with program stakeholders.

Table 17 – Transit Prioritization Considerations

Program Element	Issue	Potential Actions	Priority	Timeframe for Starting Discussion
Shoulder Use	Bus on shoulder use in the program area will require a regional policy and/or legislation. Considerations for private bus operators also need to be evaluated.	• Legislation for transit shoulder use • SOPs for shoulder use cases • Private bus use of part time transit lanes	High	Short-Term
Transit Signal Priority	As part of the Coordinated Signal System strategy, TSP will require technology standards and maintenance agreements for transit vehicles and related field infrastructure.	• Technology standards for transit in-vehicle equipment • Maintenance agreements	High	Short-Term
Express Bus Lanes	As part of a larger regional effort to expand the use of express busses, Innovate 680 would benefit from 680 having an express bus on the corridor that used and had priority to the Express Lane	• The Regional Express Bus program was included in PBA 2050 • Work with the Express Bus Sponsor to further understand the next steps and how 680 can become a priority corridor for implementation	High	Short-Term
Connection Protection	The impacts and policy surrounding the development of connection protection technologies need to be discussed with transit providers of the corridor.	• Technical/system requirements needed • SOPs for connection protection use cases	Medium	Long-Term
Fare Integration	Fare integration is an assumed feature of the operational concept for the program. This will require coordination with Clipper®, FasTrak® and transit agencies to support seamless travel among transit providers on the corridor.	• MTC Clipper® C2 efforts • FasTrak® Title 21 efforts • O&M agreements for future payment/ticket kiosks	Medium	Long-Term

Regional Transit Network Operator	A regional transit network operator would result in a significant change in the implementation of all transit-related recommendations that support the operational concept of the program.	• MTC Blue Ribbon Task Force recommendations	Low	Long-Term

The following is a brief overview of each of these items, including a summary of early discussions with program stakeholders.

- **Shoulder Use** – The PTTL Project is predicated on legislation to allow transit bus use of freeway shoulders. This will require coordination and support by program stakeholders to reinforce the importance of PTTL use on the corridor. Consideration for the use of the PTTL by private bus operators who also provide service to travelers of the corridor will need to be discussed by stakeholders and may need to be incorporated into legislation. Furthermore, the various use cases and safety requirements that will support PTTL operations will need to be established and coordinated.

- **Transit Signal Priority** – TSP systems are already being pursued in the northern portion of the program area and other parts of the region. The potential for improving transit travel times and reliability with TSP will be analyzed in partnership with local agencies. Preferential treatment for transit vehicles at freeway ramp meters will also be explored. TSP will require technology standards and maintenance agreements for transit vehicles and related field infrastructure.

- **Express Bus Lanes** – The Regional Express Bus (i.e. REX) was a larger concept first presented by local nonprofit public policy organization SPUR. As part of Plan Bay Area 2050, a subset of the original express bus routes were put forward. These were routes on corridors with an existing or planned express lane that also did not have a parallel rail corridor. 680 emerged as a good candidate corridor. The concept being that the express buses could have easy access and guaranteed travel times by using the express lanes. This concept will require further discussion with the project sponsor, MTC.

- **Connection Protection** – The concept and potential impacts related to connection protection need to be further discussed and understood by stakeholders of the program. This includes the technical requirements and potential operational adjustments needed from the various transit operator systems to support the concept and the development of operational scenarios and use cases for connection protection services.

- **Fare Integration** – To support seamless travel, integrated payment and ticketing services will be provided to travelers of the program area. This will require coordination with regional efforts such as Clipper® C2, FasTrak® Title 21 discussions, as well as discussions with the various transit and mobility providers who offer transportation services on the corridor. Additionally, payment and ticketing services

that are offered on-site at future mobility hubs are likely to require agreements with transit providers for future operations and maintenance.

- **Regional Transit Network Operator** – As discussed previously, the development of a regional network operator currently being discussed by the MTC Blue Ribbon Task Force has the potential to affect the approach to transit integration within the program. While the findings and subsequent recommendation of the Task Force will be outside of the control of the Program, the resulting changes will need to be considered in its future operational concept and technical requirements.

8.1.4 Transportation Demand Management (TDM) Strategies

Several key issues relating to **TDM strategies** need to be discussed further with program stakeholders.

Table 18 – TDM Strategy Considerations

Program Element	Issue	Potential Actions	Priority	Timeframe for Starting Discussion
TDM Program Coordination	The program will require coordination between various TDM programs offered in the region, including those offered through 511 Contra Costa and 511 SF Bay. This includes considerations for discounts and/or incentives offered to program travelers.	• Expansion of the Guaranteed Ride Home Program. • Expansion of discounts and incentive programs • Integration with regional carpool/ vanpool services	High	Short-Term
Mode Shift	The DSS will provide recommendations to travelers regarding the use of transit services, shared vehicles, and active transportation. Stakeholders will be required to strategize how multimodal services will be both encouraged and leveraged in recurrent and non-recurrent congestion scenarios.	• DSS recommendations for recurrent and non-recurrent congestion scenarios • Cost-per-mile calculations for personal vehicle use • Investigate pricing integration and incentives	High	Short-Term
Parking Management	The program will leverage parking services provided by both public and private owners, requiring system-wide coordination, as well as considerations for a parking pricing policy.	• Parking pricing policy • Parking management system integration	Medium	Long-Term
Curbside Management	Future shared mobility hubs may require local and/or regional policy to develop consistent curbside management protocols. This includes access for both private and public transportation service operators.	• Implementation and refinement of regional guidance for curbside management • MOUs with private/ public operators for pick-up/drop-off at local mobility hubs	Medium	Long-Term

The following is a brief overview of each of these items, including a summary of early discussions with program stakeholders.

- **TDM Program Coordination** – Several existing TDM programs already serve travelers in the program area. An analysis will need to be conducted of the level of coordination of these services necessary to support the overall approach to encouraging mode shift and providing fail-safe services like guaranteed rides home, as well as whether the existing services should be (or can be) modified or expanded, or whether a new TDM program should be developed. Additionally, carpool and vanpool services already provided by regional partners may require expansion and/or integration into the proposed operational concept (or vice-versa). Opportunities to enhance coordination with employer-based TDM efforts and employee benefits programs will need to be explored.

- **Mode Shift** – In relation to mode shift, the program will be required to evaluate the priority and balance between the future services that are offered to both vehicle and non-vehicle travelers. Consistent pricing/tolling policies and practices will need to be developed. This may require providing cost-per-mile calculations to drivers to illustrate sunk costs, as well as encouraging shared use and multimodal travel through the MOD platform.

- **Parking Management** – Integration with existing and future parking services provided by both private and public partners on the corridor will likely be required. This may also require the program to evaluate parking policies across the program area to ensure there is consistency in the services that are provided, which may include establishing pricing and business rules for parking demand management corridorwide.

- **Curbside Management** – Consistent pick-up and drop-off procedures at local mobility hubs located across the program area to support bus and shared vehicle operations will be needed. This will require coordination with transit and mobility providers and potentially the establishment of a policy for curbside use and curbside management across all jurisdictional boundaries in the program area. Guidelines on curb use allocation and prioritization are currently under development in the region. These guidelines seek to address curb zone types, signage, bus and shuttle bay allocation, passenger loading zones, waiting areas, taxi and ride application zones.

8.1.5 Technology Deployments

Several key issues relating to **technology deployments** need to be discussed further with program stakeholders.

Table 19 – Technology Deployments Considerations

Program Element	Issue	Potential Actions	Priority	Timeframe for Starting Discussion
Ramp Metering	Ramp metering is a key operational component of the program. Currently, the I-680 corridor is not metered. Agreements will be needed on control algorithms and mitigation of local impacts.	• MOUs for ramp metering implementation • Implementation of new control algorithms and ITS field assets	High	Short-Term
Coordinated Signal Timing	Coordinated adaptive traffic signals are proposed in the program. This will require the deployment of ITS elements such as updated controller cabinets, vehicle/bike/ped detectors, TSP, and coordinated emergency vehicle preemption.	• Maintenance agreements for intersection ITS assets • Funding agreements for O&M • Minimum technology standards	High	Short-Term
Lane Use Management and Variable Speeds	How and where these strategies will be deployed will need to be agreed upon, and authorization to implement VSL in an enforceable manner will require legislative approval.	• SOPs for system activation • VSL legislation	High	Short-Term
Vehicle Electrification	Charging infrastructure needed to support electric vehicles	• Integrate charging infrastructure into design of the system	High	Short-Term
Automated Vehicles	The evolution of automated vehicles is emerging rapidly during this time and holds a large amount of inherent risk. Integration with On Demand Transit/ Microtransit efforts is critical.	• Availability of Shared Automated Vehicles • Public acceptable of highly automated vehicles on public roads • Coordination with On Demand Transit/ Microtransit efforts	Medium	Long-Term
New and Emerging Communications	Several new and emerging communications technologies are on the horizon such as those that enable V2X technologies.	• Infrastructure needs • Costs associated with V2X communications • Ability to bring vehicle data in to support system operations	Medium	Long-Term

The following is a brief overview of each of these items, including a summary of early discussions with program stakeholders.

- **Ramp Metering** – Consistent with past regional efforts, ramp metering implementation will require a comprehensive evaluation of the impacts on freeway and local street operation and potential infrastructure improvements needed at ramps to mitigate local queuing. This includes evaluating the various control algorithms that can be implemented to support coordinated adaptive ramp metering and the changes in device types and device placement to support enhanced operations. The required level of consistency with existing regional or statewide metering practices will need to be determined. How the metering will be operated in coordination with the ELC and PTTL Projects will also need to be considered.

- **Coordinated Signal Timing** – In order to support coordinated operation across multi-jurisdictional arterial corridors, program stakeholders may be required to develop funding and O&M agreements, as well as minimum technology standards to support integration. This may be essential to the concept of delegated and automated control envisioned in the overall system. Additional ITS deployments may be required across the program area, including enhancements to existing signal controllers, upgraded detection, transit signal priority, and coordinated emergency vehicle preemption. This solution has mature technology options that are low in cost and risk.

- **Lane Use Management and Variable Speeds** – In order to support both recurrent and non-recurrent operational scenarios, lane use management systems and variable speed limit signing are envisioned. Where these management strategies are best suited along the corridor and the scenarios in which they will be activated will need to be determined. Furthermore, whether these system elements will be enforceable or advisory-only requires future discussion with program stakeholders, as well as the need for enabling legislation to authorize enforcement of these strategies.

- **Vehicle Electrification –** California is expected to turn over its vehicle fleet to mostly electric during the timeframe of the Program. This includes not only private, light vehicles but also transit buses, trucks, shuttles, delivery vehicles, shared vehicles, and more. This transition will likely introduce the need for additional charging infrastructure.

- **Automated Vehicles –** Automated vehicles will interface directly with the public and their success or issues related to deployment will impact multiple projects within the program. Strong coordination with related efforts in On Demand Transit/ Microtransit will be critical.

- **New and Emerging Communications** – Low latency communications will benefit the program at many levels by enabling real-time data sharing among and between devices along the corridor. This technology is emerging quickly, and the program will need to be flexible as it moves forward to be able to take advantage of the latest advances in communications technology available. The program should advocate at the national level to ensure public sector needs are represented to minimize ongoing operations costs while maximizing and leveraging industry participation.

8.1.6 First & Last Mile Connection Options

Several key issues relating to First and Last Mile Connection options need to be discussed further with program stakeholders. Many of these elements and issues are closely tied with those that are listed in Table 19 – TDM Strategy Considerations.

Table 20 – First & Last Mile Connections Considerations

Program Element	Issue	Potential Actions	Priority	Timeframe for Starting Discussion
Regional Rideshare Program	How can Innovate leverage the existing Regional to find first/last mile solutions? Are travelers willing to carpool for portions of their trip? How will users be presented with options for carpooling in the app?	• Look for examples of how this is done elsewhere • Work with MTC to define their vision for the future of rideshare	Medium	Short-Term
Micro mobility and Active Transportation	Need to determine whether certain modes (such as walking, biking & bike share, and E-Scooters and other micro mobility options) should be incentivized more strongly. Need consistent policies and practices for working with third-party vendors.	• Work with localities to determine ideal locations for services. • Integration at shared mobility hubs • Policies for third-party vendors.	Medium	Long-Term
On Demand Transit/ Microtransit	There is interest in microtransit, but it is unclear what the impacts to travel will be. Travelers have concerns about wait times, safety, and cost of on demand options. Consistent policies and practices for working with vendors, including shared automated vehicle vendors, is needed.	• Training for passengers • Coordinated testing for providers • Policies for vendors. • Coordination with shared automated vehicle and electric vehicle activities	Medium	Long-Term
Car Share	Need to determine how to incentivize car sharing. Across the Program area, there is an overall need to raise awareness of carsharing services available to travelers.	• Work with localities to determine ideal locations for car share stations • Integration at shared mobility hubs	Low	Long-Term

The following is a brief overview of each of these items, including a summary of early discussions with program stakeholders.

- **Regional Rideshare Program** – MTC has had a Carpool/Rideshare program going back 20 years. The program has evolved from an employer-focused program with an in-house ride-matching system and database to an individual market program that relies on both a traditional ride-matching program and partnerships with third parties, such as Scoop, Waze, or Lyft. This program and future iterations have the potential to match drivers for first & last-mile connections. An example of this was the successful carpool to BART program that gave free parking to verified carpoolers. Rideshare programs have

been proven to be a low-cost and highly effective solution to address first & last-mile needs.

- **Micro mobility and Active Transportation** — Micro mobility options are ideal for short-distance trips too close to drive but too far to walk. Options such as shared bikes and E-Scooters may be essential to addressing the "last mile" portion of trips. Decisions to be made include the types of services that are best suited to each shared mobility hub, how best to coordinate those services with the MOD and other TDM strategies, which options (if any) should be prioritized, and what policies are needed when working with third-party vendors.

- **On Demand Transit / Microtransit–** Microtransit solutions that improve the rider's experience by operating small-scale, on-demand public transit services that can offer fixed routes and schedules in some service areas or flexible routes and on-demand scheduling in other service areas. This is an emerging area for transit; it is unclear what the long-term impacts on transit ridership may entail. These services are often provided between zones or low-density areas to a node with high-frequency transit service. Contract mechanisms that ease the burden on stakeholders and support consistency along the corridor will support the Program goals. On-going marketing must be done for the service to increase passenger awareness, encourage the service, and gather public feedback.

- **Car Share** – Carsharing has been a mobility option in the Bay Area for over 20 years and continues to be part of the region's transportation fabric. The Program would like to see car sharing integrated at shared mobility hubs and will work with stakeholders and those providing car sharing services along the corridor to determine the ideal location to support the Program's goals. Carsharing reduces the burden of car ownership to families, but travelers may be reluctant to use it because of price sensitivities and overall unfamiliarity with the services. Car sharing may also support business needs and employee benefits programs.

8.2 Program Funding Overview

The following tables outline an overview of the current funding status of the Program. However, it should be noted that this information is based on the current scope for program and project development. In addition, several operational features outlined in the operational concept and operational scenarios section of this document have yet to be estimated and included in this program cost assessment. These considerations are discussed in more detail below.

Table 21 outlines the current Program funding sources and the current estimated budget for the program. As shown, several federal, state, regional, local, and partner fund sources are being utilized to support the development and delivery of Program and projects. There are a number of project-specific funding sources that may apply to specific projects in the overall program. For example, MTC's Mobility Hub program is providing grant funding to implement pilots at several locations, including some in the program area. The remaining total that is not currently funded is identified in the table below as the "unfunded" program amount, totaling $358M.

Table 21 – Current Program Funding Sources

INNOVATE 680 PROGRAM COST BY FUND SOURCE			
Authority	**Fund Source**	**$M**	**Subtotal (M)**
Federal	Surface Transportation Program (STP)	$14	**$30**
	ATCMTD Grant	$8	
	ADS Grant	$8	
State	SHOPP*	$75	**$75**
Regional	Regional Measure 3 - I-680 Transit	$10	**$86**
	Regional Measure 3 - Express Lane Category	$60	
	BAIFA	$15	
	IDEA Grant	$1	
Local	Measure J	$19	**$70**
	State Transportation Improvement Program - STIP (RIP)	$40	
	Tri Valley Developer Fees	$2	
	SB1 Local Partnership Program (Formulaic) - CCTA	$9	
Partner	In-Kind Contributions (ADS and ATCMTD Grants)	$25	**$25**
	INNOVATE 680 PROGRAM FUNDED SUB-TOTAL		**$286**
Unfunded	TBD	$358	**$358**
	INNOVATE 680 PROGRAM TOTAL		**$644**

*Current estimate for project portion on I-680 and may change as design is completed.

Table 22 outlines planned funding sources that may be leveraged in the future to support the $358M unfunded amount for the program. As shown, several federal, state, regional and local funding sources have been identified.

Table 22 – Potential Additional Program Fund Sources

INNOVATE 680 PROGRAM PLANNED FUNDING			
Authority	**Planned Fund Source**	**$M**	**Subtotal (M)**
Federal	RAISE Grant	$25	**$25**
State	SB1 Local Partnership Program (Competitive)	$33	**$153**
	SB1 Solutions for Congested Corridors	$100	
	Transit and Intercity Rail Capital Program (TIRCP)*	$20	
Regional	SB1 Local Partnership Program (Formulaic) - MTC	$10	**$40**
	Future Surface Transportation Program (STP) Funds	$30	
Local	SB1 Local Partnership Program (Formulaic) - CCTA	$15	**$25**
	Tri Valley Developer Fees	$10	
Unfunded	Remaining Unfunded	$115	**$115**
	INNOVATE 680 PROGRAM PLANNED FUNDING		**$358**

*Total TIRCP application is planned for $75M and includes elements not yet incorporated in Innovate 680 Program budget, including Express Bus service and hydrogen buses.

As noted previously, the following additional items need to be considered upon reviewing the program funding assessment provided in both Table 21 and Table 22:

- The current program total is based on planning-level cost estimates for known future efforts of the program. This includes estimates for the environmental, design, construction and system engineering phases of current Innovate 680 projects.
- The current program total does not include any costs for the O&M phase of any future project-level efforts, such as the O&M phase of the current AT Project effort to deploy CARM on I-680.
- The current program total is not inclusive of future phases of projects that are outlined in the program operational concept, such as the future buildout of the MOD and ADS projects beyond their current pilot/demonstration stages.
- The current program total does not include the estimated costs for designing, implementing, operating or maintaining the Advanced Technologies System that will support and manage O&M at the program-level.

The items listed above point to several funding challenges and constraints that will require significant consideration in the future. This points to a significant funding need for the program, which may be filled by pursuing new regional and/or local sales tax measures, or through other federal grants that have yet to be identified. While this Program ConOps does not identify these future costs and potential fund sources, it is recommended that the next phase of the program evaluate these needs. Program schedule/priority would change depending on funding availability. For example, should funding for SMH or Express Buses become available first, the priority of those projects would increase in comparison with other projects in the program that may be lacking funding to advance.

8.3 Program Schedule Overview

The current Program schedule is shown in Figure 48. The overall Program schedule provides a breakdown of individual projects/efforts with schedule details classified into high-level stages. Those steps in blue and/or green are planning-level efforts, those in yellow are generally design, and those in orange are either construction or operation depending on the type of project/effort. Due to the high-level detail of the Program schedule, the schedule is updated on a quarterly cycle based on input from the project teams. Of note are the number of projects/efforts, including Part Time Transit Lane and Shared Mobility Hubs, that have been put on hold due to funding impacts relative to COVID-19 and impacts due to on-going policy and legislative efforts. These projects will be restarted as funding and other requirements are met.

As noted in the prior section, several projects require additional funding beyond their current phase. Furthermore, several projects require additional scoping to support the planning, design and implementation of system components that are outlined in the Proposed Concept. Collectively, these issues point to a need for the Program to further evaluate existing, planned, and future projects relative to funding availability. This evaluation is recommended to be part of a future Program Implementation Plan. It is recommended that the Program Implementation Plan consider:

- Prioritizing projects that deliver key capabilities of the operational concept;

- The sequencing of projects to ensure key system interdependencies are evaluated and identified;
- Opportunities to deliver projects in the near term that can demonstrate immediate benefits to corridor travelers; and
- Funding obligations that will require specific projects to be delivered in a specified time frame.

In order to support the development of the Program Implementation Plan in the future, two Innovate 680 project-level efforts are recommended to be prioritized for earliest implementation by the Program as they support two foundational elements of the operational concept, 1) the development of a managed freeways system, and 2) development of the mobility as a service platform.

The development of a Managed Freeways system that can support a future CARM deployment on I-680, as part of the AT Project. It is anticipated that CCTA and Caltrans will enter into an integrated team agreement to support the integration of CARM into the existing Caltrans TOS/Fiber/Ramp Metering SHOPP Project. This agreement is likely to designate CCTA as the lead agency for systems engineering, design, and implementation. Through this work, CCTA will have the opportunity to deploy an initial, advanced traffic management system (the Managed Freeways system) that aims to provide centralized control of ramp metering on the I-680 corridor. This system can be utilized as an opportunity to pilot delegated operational control and maintenance of existing highway system elements owned and operated by Caltrans. To do this, CCTA and Caltrans will be required to develop an agreement to memorialize a change in the existing roles and responsibilities for operations and maintenance on the I-680 corridor. This agreement can then be utilized as a baseline for establishing future agreements that seek to change roles and responsibilities on the I-680 corridor, including those with other program stakeholders. If successful, this effort can be utilized as a proof of concept for a future DSS and eventually be expanded to encapsulate the full vision of delegated control that is envisioned for the program. For these reasons, the development of CARM and the Managed Freeways system should be prioritized as a critical need for the program. Stakeholders should ensure that the development and implementation of this system is properly funded in both the short term and long term.

The development of the mobility as a service platform that is being piloted for the MOD Project. As evidenced by its inclusion in almost every operational scenario, this platform is a key element of the program, enabling I-680 travelers' access to real-time traveler information and connectivity to multi-modal transportation services offered in the program area. In order to support this feature, the MOD system will require connectivity to several regional transportation agencies, transit providers, mobility providers and data providers. As it is currently envisioned, the system will develop a cloud-based data management solution that will serve the real-time data needs of the MOD system. This connectivity is likely to require agreements with both public and private entities to establish continuous data sharing among partners of the program. As such, this data sharing and data management solution can serve as a proof of concept for the future CCD envisioned for the program. For these reasons, the development of the MOD system should be prioritized as a critical need for the program. Stakeholders should ensure that the development and implementation of this system is properly funded in both the short-term and long-term.

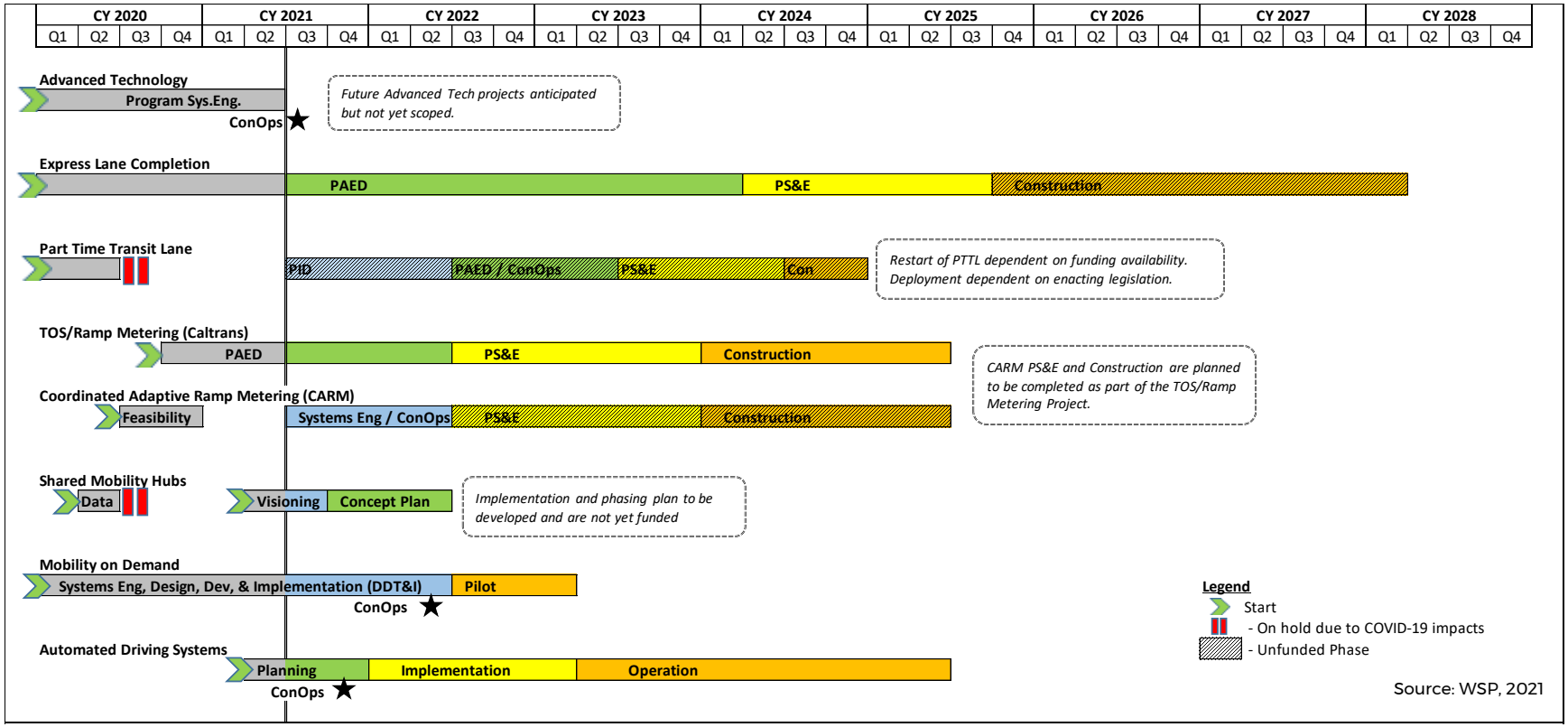


Figure 48 – Current Program Schedule

Appendices

The following appendices provide further information and references for this document:

- Appendix A – Program Goals & Metrics Development
- Appendix B – Data Sources for Existing Conditions Evaluation
- Appendix C – Equity Overlay Maps

Appendix A – Program Goals & Metrics Development

The Program goals were developed through a collaborative stakeholder engagement process initiated by CCTA in early 2020. First, an initial set of program goals were created and shared with the Innovate 680 CMT and SDT, focusing on the need to distill the existing Innovate 680 Strategies and Projects to a set of goals that:

- represent the key objectives of existing program efforts,
- provide guidance for developing and implementing future program efforts; and
- outline concrete, measurable goals for future performance monitoring of the program.

To guide the development of the program goals, the consultant team developed a matrix of initial Innovate 680 projects and proposed goals to illustrate the inter-relationship between program goals, projects, potential performance metrics, and possible data sources for future consideration. Throughout its development, the consultant team continued to share iterations of the program goals with the CMT and SDT, while also beginning to share and facilitate comments from the PLT, TAC and PAC, with an eye towards ensuring the goals were representative of a shared understanding of where the program should align its future efforts.

Additionally, the team began outlining ways in which each of the proposed program goals could be measured and evaluated in the future. This information was shared with the various stakeholder committees to ensure a common understanding of how the program would seek to evaluate its effectiveness in achieving any of the stated goals. As shown in the table below, each of the proposed program goals were matched with a listing of potential performance metrics that could be utilized to measure the success of future program efforts. Ultimately, this information was used to guide the development of the Program performance metrics, described further below.

It should be noted that the development of the program goals is an ongoing process – the Program goals are intended to provide guidance for the strategic direction of the program and will likely require review and/or amendments in the future as the landscape of potential transportation technologies, funding, regional mandates and needs evolve. The current goals outlined in this document are intended to provide a foundation for the program to develop an initial system concept and implementation plan, recognizing the need to revisit the goals in the future if necessary. If such action is required, it is recommended to reconvene the appropriate stakeholder committees to review, evaluate, and communicate changes to the program goals, while also updating this document to reflect the rationale and corresponding changes.

Initial Mapping of Goals to Projects

Innovate Goals	Innovate Projects						
	Express Lane Completion	Part-time Transit Lane	Shared Mobility Hubs	Advanced Technology	Mobility as a Service	Automated Driving Systems	Ramp Metering (Caltrans)
Improve Safety, Efficiency, and Reliability	✓	✓	✓	✓	✓	✓	✓
Prepare for Future and Maximize Productivity of Infrastructure	✓			✓		✓	✓
Shift Travel Modes	✓	✓	✓	✓	✓	✓	
Improve Connectivity and Services		✓	✓		✓	✓	
Provide Mobility Options		✓	✓		✓	✓	
Improve Air Quality	✓	✓	✓	✓	✓	✓	✓
Promote Equity and Provide Access to Transportation Services	✓	✓	✓	✓	✓	✓	✓

Source: WSP, 2021

Initial Mapping of Goals to Potential Performance Metrics

	Innovate Projects						
Innovate Goals	Express Lane Completion	Part-time Transit Lane	Shared Mobility Hubs	Advanced Technology	Mobility as a Service	Automated Driving Systems	Ramp Metering (Caltrans)
Improve Safety, Efficiency, and Reliability	• EL Travel Time • VHT, VHD, VMT • PHT, PHD, PMT • Buffer time index • Transit Travel Time Reliability • No. of incidents • Crash risk – speed diff.	• Transit schedule adherence • Transit travel times • Transit travel time reliability by route • Transit ridership by route • PMT, PHT, PHD • Crash risk – speed diff.	• Localize safety (design)	• GPL Travel Time • Buffer time index • Incident clearance time • VHT, VHD, VMT • PHT, PHD, PMT • No. of incidents • Crash frequency • Crash severity • Economic Benefit	• TBD	• TBD	• GPL Travel Time • Buffer time index • VHT, VHD, VMT • PHT, PHD, PMT • No. of incidents
Prepare for Future and Maximize Productivity of Infrastructure	• VHT, VHD, VMT • PHT, PHD, PMT			• VHT, VHD, VMT • PHT, PHD, PMT • Incident clearance time • Economic Benefit		• TBD	• GPL Travel Time • Buffer time index • VHT, VHD, VMT • PHT, PHD, PMT • No. of incidents
Shift Travel Modes	• Avg. vehicle occupancy • No of SOVs vs. No. of HOVs	• Transit ridership by route • Mode share	• Transit ridership by route • No. of people using shared mobility options	• Travel Time Index?	• Number of trips matched • AVO in corridor	• Ridership on demo ADS projects	
Improve Connectivity and Services		• Transit ridership by route	• No. of shared mobility options • No. of people using shared mobility options		• Number of trips matched	• Ridership on demo ADS projects	
Provide Mobility Options		• Transit ridership by route • Mode share	• Bike/pedestrian accessibility • No. of shared mobility options • No. of people using shared mobility options		• Number of trips matched	• Ridership on demo ADS projects	
Improve Air Quality	• VMT Reductions • GHG Reductions	• VMT Reductions • GHG Reductions	• VMT Reductions • GHG Reductions	• VMT Reductions • GHG Reductions	• VMT Reductions • GHG Reductions	• VMT Reductions • GHG Reductions	• VMT Reductions • GHG Reductions
Promote Equity and Provide Access to Transportation Services	• Transit ridership • No. of people using express lane by group (disabled, elderly, low-income, minority, etc.)	• Disabled and elderly transit and paratransit ridership	• No. of people using shared mobility options by group (disabled, elderly, low-income, minority, etc.) • No. of paratransit options	• No. of people traveling the corridor (disabled, elderly, low-income, minority, etc.)	• No. of people using MaaS options by group (disabled, elderly, low-income, minority, etc.)	• Ridership on demo ADS projects	• TBD

Source: WSP, 2021

In conjunction with the program goals, the program performance metrics were developed through a collaborative stakeholder engagement process initiated by CCTA. As described in the previous section, an initial set of possible performance metrics were shared with the stakeholder committees, allowing for the agencies to review, comment, and provide feedback. From here, the consultant team aimed to:

- Develop a "short list" of performance metrics;
- Determine the appropriate data sets for evaluating each metric, and
- Develop an existing conditions baseline for future program performance monitoring.

As shown in the figure below, the listing of possible performance metrics was consolidated to a "short list" of recommended metrics, capturing key, measurable data that was the most representative and accessible for monitoring progress on the Program goals. This listing of performance metrics aimed to see beyond the data available for individual projects, seeking to consider the range of possible metrics that could more holistically track progress across the program, irrespective of impacts by individual projects.

Additionally, the consultant team evaluated the range of possible data sources that could support the evaluation of performance metrics and performance monitoring into the future. Shown in table below are the initial data sources that were identified and coupled with the recommended performance metrics shown above. Both the recommended performance metrics and data sources were shared with the program stakeholder committees to ensure a shared understanding of the ways in which the program intended to track progress towards achieving the stated program goals.

It should be noted that, similar to the program goals, performance monitoring is an ongoing process. The current performance metrics are intended to provide a baseline for an initial evaluation of corridor performance, and will likely require review and/or amendments in the future as the landscape of available data sources, proposed system elements, and updated program goals require changes to the approach to performance monitoring for the program.

Initial Proposed Performance Metrics

Innovate Goals	Innovate Projects						
	Express Lane Completion	Part-time Transit Lane	Shared Mobility Hubs	Advanced Technology	Mobility as a Service	Automated Driving Systems	Ramp Metering (Caltrans)
Improve Safety, Efficiency, and Reliability		• VHT, VHD, VMT • PHT, PHD, PMT	• Travel Time (EL, SOV, transit) • Travel Time Reliability (EL, SOV, transit)		• No. of incidents • Collision rate • Crash severity		
Prepare for Future and Maximize Productivity of Infrastructure							
Shift Travel Modes		• Avg. vehicle occupancy • Transit ridership by route			• Mode share • No. of people using shared mobility options		
Improve Connectivity and Services							
Provide Mobility Options							
Improve Air Quality		• VMT Reductions			• GHG Reductions		
Promote Equity and Provide Access to Transportation Services		• Transit and paratransit ridership • No. of people using shared mobility options			• No. of people being served in Communities of Concern		

Initial Proposed Data Sources

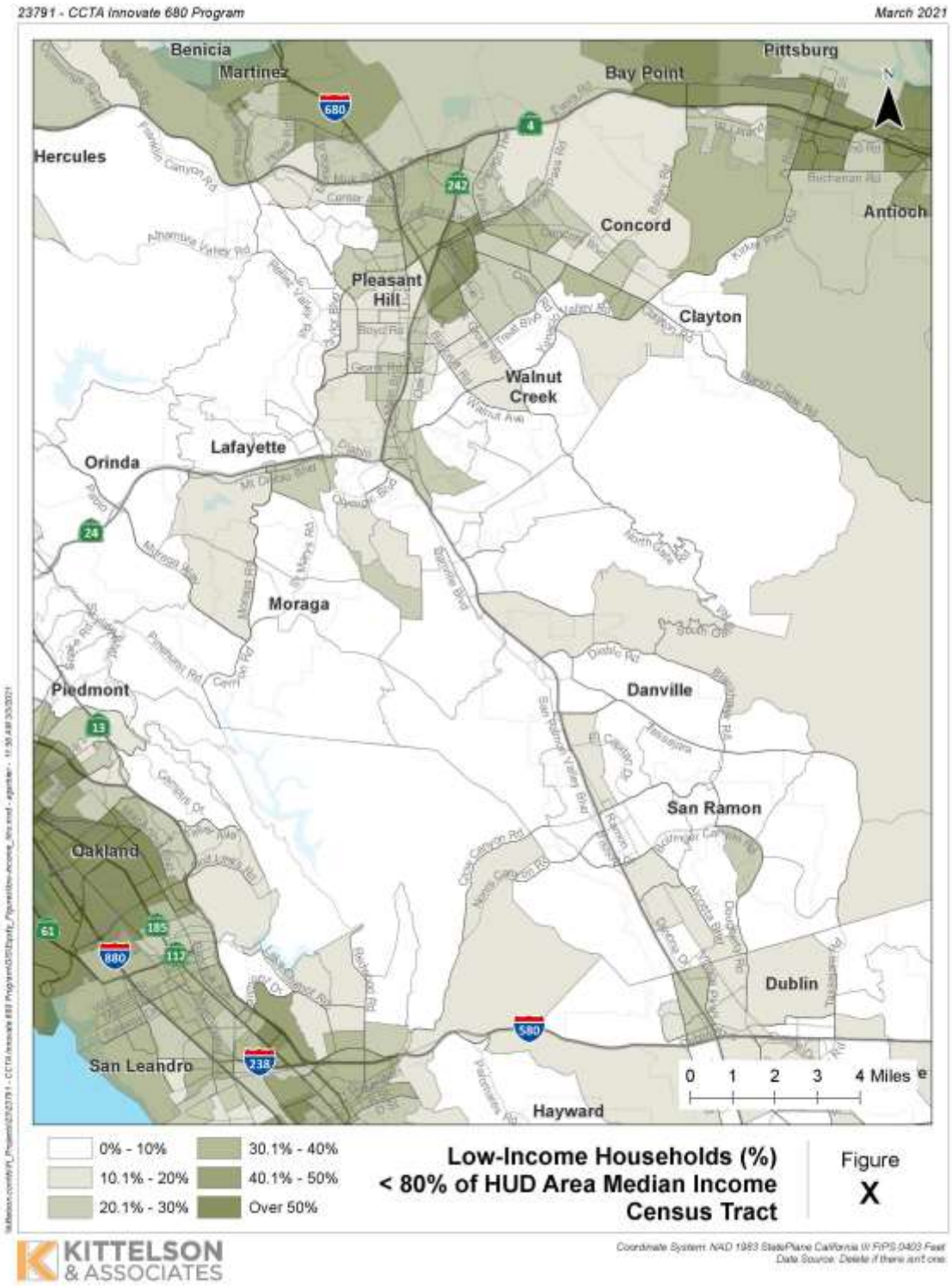
Metric	Source
VHT, VHD, VMT	PeMS, Streetlight, CCTA travel demand model, field collection
PHT, PHD, PMT	CCTA travel demand model
Travel Time (autos)	PeMS, Inrix, field collection
Travel Time (transit)	County Connection, BART, LAVTA, Moovit
Travel Time Reliability (autos)	PeMS, Inrix (autos)
Travel Time Reliability (transit)	County Connection, BART, LAVTA, Moovit (transit)
No. of incidents	TASAS, SWITRS, TIMS, FARS
Collision rate	TASAS, SWITRS
Crash severity	TASAS, SWITRS, FARS
Average vehicle occupancy	CCTA travel demand model, ABAG, manual field occupancy and classification counts
Mode share	CCTA travel demand model, manual counts

Metric	Source
Transit ridership by route	County Connection, BART, LAVTA, Moovit
Transit and paratransit ridership	County Connection (LINK), 511 Contra Costa
No. of people using shared mobility options	County Connection (LINK), manual counts
VMT Reductions	Traffic analysis, microsimulation
GHG Reductions	Model
No. of people being served in Communities of Concern	Model

Appendix B – Data Sources for Existing Conditions Evaluation

Program Performance Metric	Data Source
Vehicle Travel Time	• Highways: Caltrans PeMS • Arterials: INRIX
Travel Time Reliability	• Highways: Caltrans PeMS • Arterials: INRIX
Transit Travel Time	• County Connection APC Data
Vehicle Hours Traveled (VHT)	• Highways: Caltrans PeMS • Arterial Volumes: StreetLight • Arterial Travel-Times: INRIX
Vehicle Hours of Delay (VHD)	• Highways: Caltrans PeMS • Arterial Volumes: StreetLight • Arterial Travel-Times: INRIX
Vehicle Miles Traveled (VMT)	• Highways: Caltrans PeMS • Arterials: StreetLight
Number of Incidents	• CA Highway Patrol
Crash Rate	• TIMS, SWITRS
Crash Severity	• TIMS, SWITRS
Average Vehicle Occupancy	• Manual Surveys
Transit Ridership by Route	• County Connection APC Data • Tri-Delta APC Data • BART Ridership Reports
Number of People Using Shared Mobility Options	• County Connection Collected Data • Shared Mobility Providers
Bus Service Headways	• County Connection APC Data
Parking Supply/Utilizations at BART Stations	• BART Observations
Go San Ramon (Uber/Lyft Subsidy) Utilization	• County Connection Collected Data
Note: PeMS, INRIX and StreetLight data were obtained for calendar year 2019. Annual average performance metrics were quantified using only midweek (Tuesday, Wednesday, Thursday) data.	

Appendix C – Equity Overlay Maps




2379f - CCTA Innovate 680 Program
March 2021
Benicia
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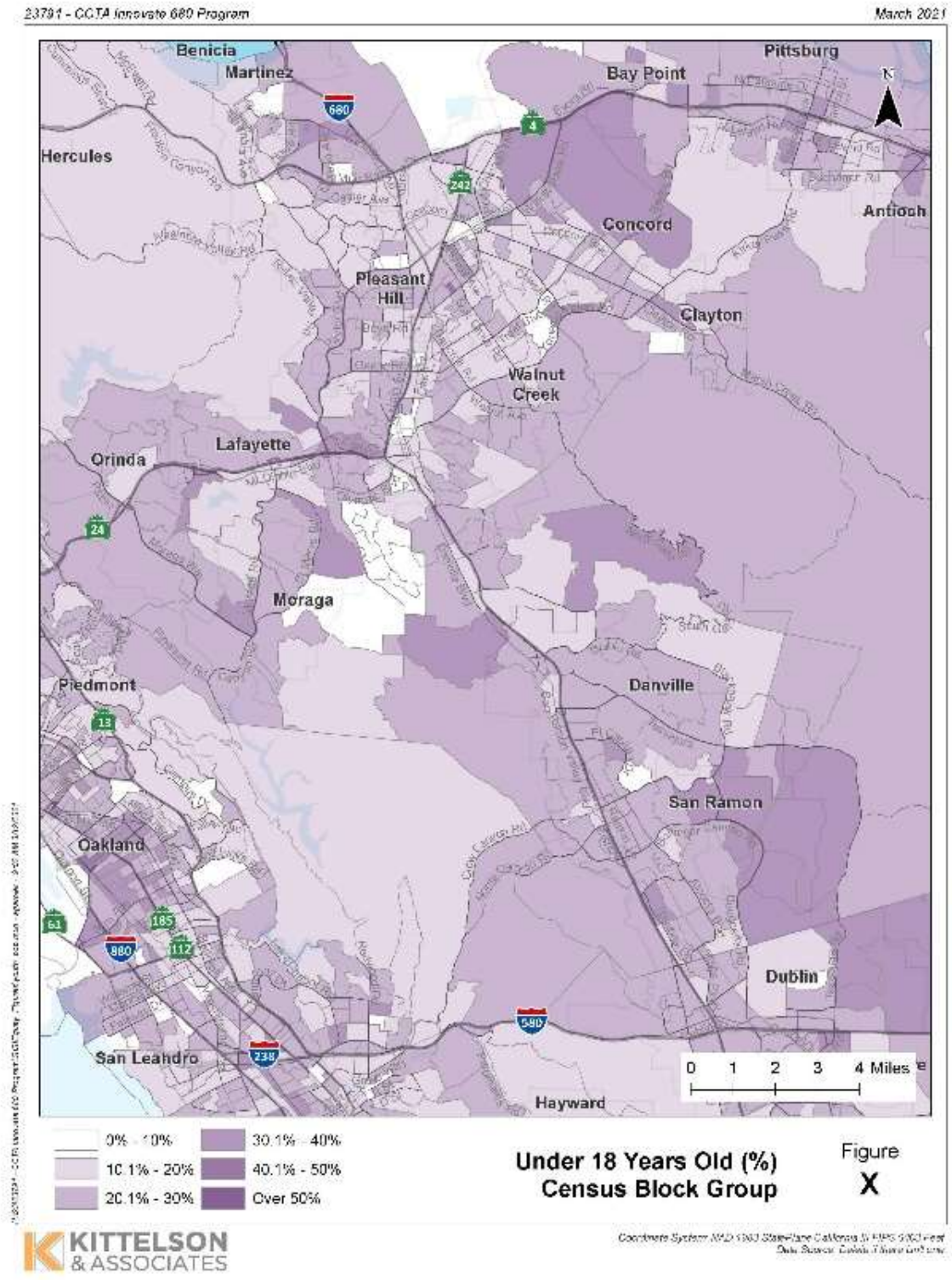
Bay Point
Pittsburg
Hercules
Concord
Antioch
Pleasant Hill
Clayton
Walnut Creek
Lafayette
Orinda
Moraga
Piedmont
Danville
San Ramon
Oakland
Dublin
San Leandro
Hayward
0 1 2 3 4 Miles
Less than 20%
20.1% - 40%
40.1% - 60%
60.1% - 80%
80.1% - 100%
Person of Color (%)
Non-White and/or Hispanic
Block Group
Figure
X
KITTELSON & ASSOCIATES


23791 - CCTA Innovate 680 Program
March 2021
Benicia
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Bay Point
Pittsburg
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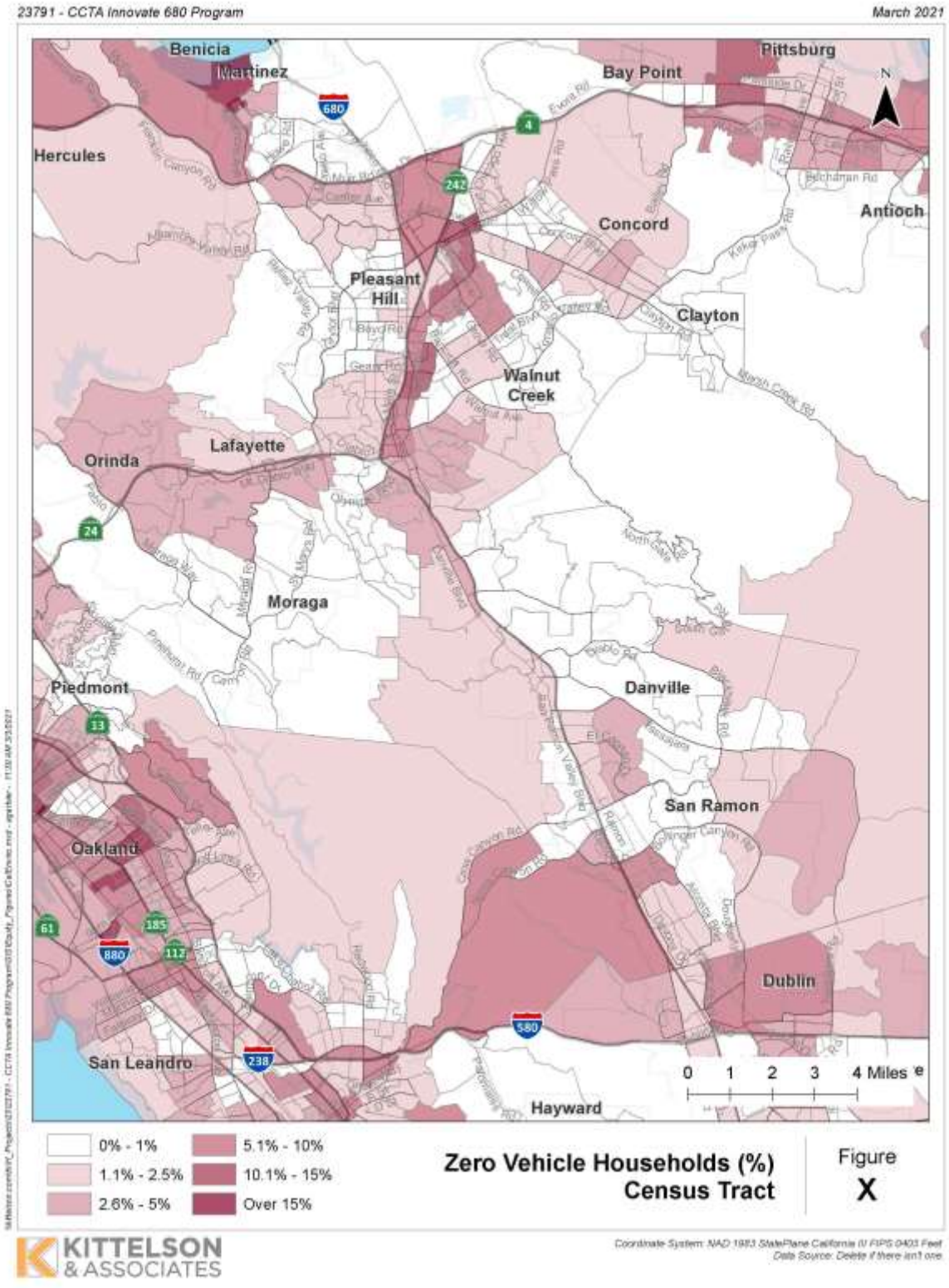
Concord
Antioch
Pleasant Hill
Clayton
Walnut Creek
Lafayette
Orinda
Moraga
Piedmont
Danville
San Ramon
Oakland
Dublin
San Leandro
Hayward
0 1 2 3 4 Miles
0% - 10%
10.1% - 20%
20.1% - 30%
30.1% - 40%
40.1% - 50%
Over 50%
Under 18 Years Old (%)
Census Block Group
Figure
X
KITTELSON & ASSOCIATES


23791 - CCTA Innovate 680 Program
March 2021
Benicia
Martinez
Bay Point
Pittsburg
N
Hercules
Antioch
Concord
Pleasant Hill
Clayton
Walnut Creek
Lafayette
Orinda
Moraga
Piedmont
Danville
San Ramon
Oakland
Dublin
San Leandro
Hayward
0 1 2 3 4 Miles
0% - 10%
10.1% - 20%
20.1% - 30%
30.1% - 40%
40.1% - 50%
Over 50%
65 Years and Older
Census Block Group
Figure
X
KITTELSON & ASSOCIATES
Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet
Data Source: Delete if there isn't one


23791 - CCTA Innovate 680 Program
March 2021
Benicia
Martinez
Bay Point
Pittsburg
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Hercules
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Antioch
Pleasant Hill
Clayton
Walnut Creek
Lafayette
Orinda
Moraga
Piedmont
Danville
San Ramon
Oakland
Dublin
San Leandro
Hayward
680
4
242
24
13
61
185
880
112
580
238
0 1 2 3 4 Miles
0% - 1%
1.1% - 2.5%
2.6% - 5%
5.1% - 10%
10.1% - 15%
Over 15%
Zero Vehicle Households (%)
Census Tract
Figure
X
KITTELSON & ASSOCIATES
Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet
Data Source: Delete if there isn't one