I-680 Transit Investment/Congestion Relief Options Study

Final Report

Prepared for

Contra Costa Transportation Authority

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GLOSSARY OF ACRONYMS

AGT – Automated Group Transit

ACE – Altamont Commuter Express

ACTC – Alameda County Transportation Commission

ATM – Active Traffic Management

BART – Bay Area Rapid Transit

CC – County Connection

CCTA – Contra Costa Transportation Authority

CSMP – Corridor System Management Plan

CTP – Countywide Comprehensive Transportation Plan

CV/AV – Connected Vehicle and Automated Vehicle

CSAV – Connected Shared-Use Autonomous Vehicle

DEIR – Draft Environment Impact Report

DMU – Diesel Multiple Unit

FAST – Fairfield and Suisun Transit

HOV – High Occupancy Vehicle

MTC – Metropolitan Transportation Commission

LAVTA – Livermore-Amador Valley Transit Authority

PAC – Policy Advisory Committee

PDA – Priority Development Area

RM2 – Regional Measure 2

ROW – Right of Way

RTPC – Regional Transportation Planning Committee

SFO - San Francisco International Airport

SOV – Single Occupant Vehicle

SWAT – Southwest Area Transportation Committee, the RTPC for Southwest Contra Costa County

TAC – Technical Advisory Committee

TEP – Transportation Expenditure Plan

TRANSPAC – Transportation Partnership and Cooperation, the RTPC for Central Contra Costa County

TVTC – Tri-Valley Transportation Council

EXECUTIVE SUMMARY

This document provides a recommendation for transportation investments in the I-680 corridor that facilitate the use of transit for local and regional travel and address growing traffic congestion in the corridor. The study is a continuation of planning efforts in the corridor, including the I-680 Investment Options Analysis, prepared for the Contra Costa Transportation Authority (CCTA) in 2003. In 2004, voters approved Measure J, which will provide approximately $2.7 billion (Year-of-Expenditure dollars) for countywide and local transportation projects and programs through the year 2034. Measure J provided funding for some of the improvements recommended in the 2003 study, including new auxiliary lanes, express bus service, HOV lane extensions, and direct access ramps to the I-680 High-Occupancy-Vehicle (HOV) lanes. These investments are ongoing.

In addition, MTC is currently implementing a program to convert the HOV lanes on I-680 and other freeways in the Bay Region to Express Lanes. Express Lanes are specially designated HOV lanes that continue to offer toll-free travel for carpools, vanpools, motorcycles, buses and eligible clean-air vehicles, while also allowing solo drivers the option of paying to enter the HOV lane to avoid congestion, with tolls rising and falling with congestion levels. Tolls are collected electronically via the FasTrak® system, which is managed by MTC. The Express Lane project on I-680 from Livorna Road to Alcosta is currently under construction.

Population and employment in the corridor has fluctuated with the economy. Following the "Great Recession" of 2007, employment diminished, as did traffic. Currently, with the economic recovery in full swing, traffic in the corridor has increased significantly, far surpassing pre-recession levels. While the number of jobs and residents is nearly balanced in the Tri-Valley area, almost half of residents work outside of the area, and a growing number of people are commuting into the corridor for work. BART continues to attract new riders, but the demand for parking at the stations routinely exceeds capacity, and auto access to the BART stations is difficult as congestion continues to worsen along the I-680 corridor.

In 2012, the CCTA began to update its Countywide Comprehensive Transportation Plan (CTP). A draft of the 2014 CTP was issued in August 2014. An extensive public outreach process was conducted in the fall of 2014. That effort resulted in feedback from the public indicating a strong interest in improving transit service in the I-680 corridor. In addition, the Tri-Valley, Lamorinda, and Central County Action Plans all support congestion relief and improved transit options along I-680.

To develop the recommended corridor investment, this study reviewed the current and future transportation systems, land use and travel characteristics in the corridor. Several available transportation technologies were evaluated and screened to refine the options for the corridor. The top-priority investments were further evaluated, including an assessment of costs and transportation benefits. The final result was a recommended investment package for the corridor.

Throughout the process, the consulting team worked closely with CCTA staff, and a Policy Advisory Committee (PAC) and Technical Advisory Committee (TAC) were established for the

project. The Consulting team consisted of DKS Associates, Parsons Corporation and Circlepoint. The PAC included elected officials from:

- CCTA
- Contra Costa County Board of Supervisors
- County Connection
- BART
- TRANSPAC, TVTC, and SWAT (representatives from the Town of Danville, and the Cities of Walnut Creek, Lafayette, Pleasant Hill, San Ramon, and Dublin)

The TAC included representatives from:

- CCTA
- Alameda County Transportation Commission (ACTC)
- BART
- Bishop Ranch
- Caltrans
- County Connection
- TRANSPAC, TVTC, and SWAT (representatives from the Town of Danville, and the Cities of Walnut Creek, Lafayette, Martinez, Orinda, Pleasant Hill, Pleasanton, San Ramon, Walnut Creek, and Dublin)
- Contra Costa County Department of Conservation and Development
- Bike East Bay
- Livermore Amador Valley Transit Authority (LAVTA – Wheels)

Initial Options Considered and Screening

The study identified five modal groups for analysis:

- Connected Vehicles/Automated Vehicles (CV/AV) and Related Infrastructure (2 variations)
- Bus Transit (3 variations)
- Light Rail (4 variations)
- Ultra-Light Rail (2 variations)
- Heavy Rail (5 variations)

Within each of the categories, various alignments and propulsion methods were assessed for a total of 16 preliminary options. These were scored and compared using the following criteria:

- Increase Person Throughput
- Attractiveness to New Users
- Enhance Connectivity
- Minimize Impact to Traffic Operations
- Minimize Right-of-way Requirements

- Community Acceptance
- Policy Consistency
- Minimize Construction Impacts
- Minimize Environmental Impacts
- Cost
- Markets

In addition, a rough cost estimate was developed for each option.

Evaluation of the Top Priority Options

After the initial screening and consultation with the PAC and TAC, the top priority options were identified as:

- Connected Vehicles/Automated Vehicles (CV/AV) and Related Infrastructure
- Enhanced Bus
- Ultra-Light Rail
- Heavy Rail

At this level of analysis, the Light Rail mode was eliminated as an option and the other modes were refined. The potential communication equipment and related infrastructure needed for the CV/AV option was identified. For the enhanced bus option, potential locations for park-and-ride lots were identified and a service plan was developed to estimate the number of additional buses required. The alignments of the rail options were defined to allow for a more detailed cost estimate and to ensure that the routes were feasible.

The following evaluation criteria were used to compare the relative strengths and weaknesses of each option:

- Capital and Operating Costs
- Travel Time Impacts
- Potential Mode Shift
- Markets Served
- Connectivity
- Construction Impacts
- Potential Environmental Impacts
- Conflicts with Other Traffic
- Constructability Issues

All rail options were found to have capital and operating costs that would be infeasible to fund under a one-half cent extension of Measure J, although they would provide higher capacity and generally lower in-vehicle travel times than the enhanced bus option alone. The Enhanced Bus and CV/AV options had complementary strengths in reducing travel times while improving transit capacity in the corridor. These options were combined and expanded upon for the final evaluation.

Recommended Investment Package

After careful consideration of a broad range of investment options for the I-680 corridor and with considerable input from the PAC and TAC, the DKS Team developed a recommendation for investment for the corridor that would: A) improve transit service, by extending service hours, expanding areas served, offer new services, and increasing operational capacity along the corridor; and B) improve freeway operations and reduce congestion on I-680. The recommended investment strategy would build on the progress made with previous investments in transit services in the corridor. It would also take advantage of the significant advancements in communications, vehicle automation and transportation system management that are changing how people will travel and interact with each other in the future.

A) **Improve Transit Service**: The recommended strategy for the I-680 corridor would improve transit service and capacity by providing additional local and express bus service, new park-and-ride facilities with shuttle service to BART, and provide operational benefits for buses by reconstructing segments of the I-680 shoulder and extending auxiliary lanes between ramps to allow buses to use these lanes to bypass traffic congestion in the general purpose lanes. Shared-use mobility elements would be incorporated into the transit-enhancement elements of the strategy. Existing and proposed park-and-ride facilities would serve as Smart Mobility Hubs with passenger information and amenities, secure bike parking, and access to bike sharing, car sharing, dynamic ridesharing, and demand-responsive transit services.

B) **Improve Freeway Operations:** The recommended investment strategy would implement a suite of advanced technologies and techniques known as Innovative Transportation Systems Management. This package includes support for connected and automated vehicles on I-680 using new communication technologies and high-visibility pavement markings. Active Traffic Management would be used to monitor traffic conditions, provide information to drivers and to connected vehicles, and improve efficiency through techniques such as adaptive ramp metering and dynamic lane use. Connected Shared Autonomous Vehicles would provide demand-responsive transportation between transit hubs, residences, and businesses using driverless electric vehicles operating on local streets.

The following fact sheets summarize the key features of the recommended strategy, which are grouped into four categories:

1. Enhanced Bus Service
2. Connected and Automated Vehicle Support on I-680
3. Active Traffic Management
4. Demand-Responsive Transit Service (using Connected Shared Autonomous Vehicles on local streets)

Implementation of the strategy would allow integration of transportation infrastructure, management, technologies, policies and operational efficiency and foster collaboration among agencies and across jurisdictions in the I-680 corridor.

1. Enhanced Bus Service (Walnut Creek to Dublin)

General Description	This package of improvements would provide additional transit service in the corridor. This would include construction of new park-and-ride facilities with shuttle service to BART; addition of express, local and school buses services; and the addition of auxiliary lanes and reconstruction of shoulder lanes on I-680 (as needed) to allow buses to operate in the auxiliary lanes and shoulders to bypass congestion in the general purpose lanes. Buses could operate in the Express Lanes as well.
Key Elements	**Additional Park-and-Ride Lots with Smart Mobility Hubs** – Four new park-and-ride facilities would be constructed near I-680 between Walnut Creek and San Ramon. The facilities would accommodate a total of 1,100+ parking spaces, provide passenger amenities, and potentially incorporate car sharing, bike sharing, demand-responsive services and employer-based transportation. **New Shuttle Service and Enhanced Local and Express Bus Service** – Six shuttle routes would provide direct service between park-and-ride lots and BART stations (2 from existing and 4 from new facilities). Current express and local service would be increased during the off-peak periods. **Bus On Shoulder Operation (I-580 to SR-24)** – Shuttle and express buses would operate on I-680 in existing or expanded auxiliary lanes and in shoulder lanes to bypass traffic congestion in the general purpose lanes. Longer-haul buses could use the Express Lanes. Operating buses in the shoulder lanes would require a change in California Vehicle Code and a change in Caltrans policies. **Increased School Bus Service** – The existing TRAFFIX Program supported by Measure J would be expanded and/or supplemented. TRAFFIX is a traffic congestion relief program operated jointly by the Town of Danville, City of San Ramon, Contra Costa County, and the San Ramon Valley Unified School District. **Additional Transit Vehicles** – New vehicles would include buses needed for shuttle service, buses for expanded local and express service and school buses.

2. Connected and Automated Vehicle Support (Benicia Bridge to SR-84)

General Description	This package of improvements would facilitate Limited Self-Driving Automation (known as Level 3 automation), where the driver cedes full control of all safety-critical functions to the vehicle in almost all circumstances while on the freeway. Enhanced pavement markings and maintenance would provide improved visual guidance and reduced interference for automated driving functions. Transit vehicles, automobiles and their drivers would receive information about upcoming road and traffic conditions, via two-way vehicle-to-infrastructure communications along the corridor, with the goal of preventing incidents. The roadside equipment and connected vehicles would also provide information for managing the freeway.
Key Elements	**Vehicle-to-Infrastructure Communication** – Advanced radios and processors along the roadway would have capabilities to send and receive data to and from vehicles. This could include information on upcoming traffic conditions and lane closures. **Fiber Optic Communication** – Devices along the roadway would be connected through a network and transmit data to a central location. **High Visibility Pavement Markings –** Vehicles with automation capabilities use pavement markings for guidance and enhanced markings would improve accuracy. **Increased Roadway Maintenance –** Maintaining excellent road conditions and removing debris would reduce interference for automated vehicles and transit vehicles using shoulder lanes. **Transit Vehicle Assist and Automation** – Adding automated driving functions to transit vehicles would potentially reduce the width required for buses operating on the shoulder lanes.

3. Active Traffic Management (Benicia Bridge to SR-84)

General Description	This package of improvements would provide technology to collect data and communicate with drivers to maximize the efficiency of the roadway. These technologies would initially use a combination of roadside digital signs and in-vehicle messages, but eventually would fully transition to in-vehicle communication technologies as more vehicles are equipped. Adaptive ramp metering would be used to control the flow of vehicles entering I-680. Implementation of these technologies would involve a cooperative, multi-jurisdictional planning process throughout the corridor.
Key Elements	**Vehicle Detection and Surveillance** – A combination of sensors and cameras along the roadway would monitor vehicle speeds and provide real-time information on traffic flow and incidents to the traffic management center. **Driver Information System** – Drivers would receive information on advisory speeds, notices on traffic conditions, queue warnings, lane closures and construction activities. **Dynamic Lane Use Management** – Lane usage would be managed based on traffic data and inputs from the traffic management center. Drivers would be informed of lane closures in advance to allow lane changes and avoid rear-end collisions. For example, during construction or an incident, lane usage could be dynamically adjusted to maximize flow around the affected area. **Adaptive Ramp Metering** – Traffic signals on ramps would dynamically control the rate vehicles enter the freeway based on real-time traffic conditions and historic data. The system could be integrated with adjacent arterial traffic signal operations to optimize the flow of the freeway while preventing backups to the adjoining roadways. Authorized transit, emergency and police vehicles would be able to receive an earlier green light or bypass ramp meters, in some cases. **Integrated Information Management System** – A network of computer systems would process data from the roadway (and from connected vehicles) and allow management of the ramp meters and driver information systems. Roadside cameras would provide visual information to traffic management staff. Data from the management system could be shared with emergency/incident response teams.

4. Demand-Responsive Transit Service (Connected Shared Autonomous Vehicles)

General Description	Connected Shared Autonomous Vehicles (CSAVs) are self-driving (Level 4) electric vehicles designed to travel on local roadways at speeds less than 25 miles per hour. In the I-680 corridor, the vehicles would provide demand-responsive service between park-and-ride locations, residences and employers. The service would be requested using a computer, smart phone, or at consoles placed at park-and-ride mobility hub locations.
Key Elements	**CSAV Fleet and Operational Environment** – The electric shuttles would have a capacity of 12 passengers (6 seating and 6 standing) and would operate at speeds up to 25 mile per hour. The vehicles would be capable of operating on various local streets and in commercial areas. **CSAV Hub/Docking Station** – The vehicles would drop off and pick up passengers at park-and-ride locations along the corridor. These areas would also serve as locations for battery charging and light maintenance/cleaning. Consoles would be placed at the hubs to enable people to request vehicles without using a smart phone. **Sensor and Communications** – The vehicles would be capable of sensing their environment and navigating without human control. This would be accomplished through multiple sensors and communication technologies to ensure safe and accurate navigation. **Advanced Control Systems** –Advanced control systems would interpret sensory information to identify appropriate navigation paths, as well as obstacles and relevant signage and prioritize safety. **Innovative Business Models** – The technology and services offered by the vehicles would have the potential to create new business models for demand-driven transit with a mixture of fixed-route transit service for communities along the I-680 corridor and private-sector services such as Uber or Lyft.

Expected Cost and Effectiveness of the Investment Package

The estimated cost for the recommended investment option is between $215 and $230 million in capital construction and vehicle costs for the entire corridor. The annual operating and maintenance cost is estimated at $22.4 - $24.7 million. Roughly 85% of the capital costs would be in Contra Costa County but almost 95% of the operating costs.

As a result of the additional transit service, expected safety improvements from Connected and Automated Vehicles, better freeway management from the Active Traffic Management systems, travel time reductions are expected for single-occupant vehicles, vehicles using the HOV express lanes, and transit users. Depending on the trip length on I-680, the time savings vary from 5 to 7 minutes for single-occupant vehicles, 3 to 5 minutes for vehicles using the HOV express lanes and 12 to 18 minutes for transit users. The majority of the transit time savings were due to reduced wait and transfer times due to more frequent service.

Ridership for the proposed bus shuttles between the park-and-ride lots and BART was expected to be largely a function of the number of available parking spaces. It was estimated that 1,143 parking spaces would be provided at the park-and-ride lots to serve the traditional commute from within the corridor to outside the corridor. In addition, a number of riders would access transit through demand-responsive transit services, walking, biking and auto drop-off. Finally, reverse commenters would be able to access the corridor via transit. In total, the estimated transit ridership was approximately 2,300 to 2,800 daily boardings.

Next Steps

Several steps remain before the recommended investment can be implemented. Funding must be secured, potentially as a part of an expenditure plan for a sales tax increase to supplement Measure J. The individual components will require further planning and design, including identification of specific locations for park-and-ride lots. In addition, many of the components will depend on integration of various systems and policies, further development of technology, and new regulations for their use.