

# California Transportation: Current Practices, Challenges & Opportunities

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Transportation Research Board  
Future Interstate Study Committee

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*The National Academies of*  
**SCIENCES • ENGINEERING • MEDICINE**

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Caltrans, District 4 – Traffic Operations  
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## 1. Background

## 2. Current Practices

- Transportation Management System
- Incident & Emergency Management
- Freeway Operations
- Commercial Vehicles Operations
- Pedestrians & Bicycles
- Transit & Rail
- California Connected Vehicle Test Bed

## 3. Challenges

- Population, Housing, Jobs, and Transportation
- Climate Change
- Funding

## 4. Opportunities

- California Senate Bill 1 (2017)
- Asset Management
- California Connected Corridors
- Express Lanes Network
- Connected/Autonomous Vehicles
- Next Steps
- Predictions, Anyone?

## 5. Questions

- Appendix

## Demographics (2017)

- **Population: 39.5 million people (>12% of the US total!)**
- **Four of the Top 10 Most Populated Regions in US**  
Los Angeles/Long Beach (#1); San Francisco/Oakland (#3);  
Riverside/San Bernardino (#13); San Diego (#17)
- **170,000 miles of roadways**
- **Licensed Drivers: ± 26 million**
- **Registered Light Vehicles: ± 25 million**
- **Registered Trucks/Delivery Vehicles: ± 6 million**



## Safety (all roads)

- **Number of Injury Crashes (2014): ± 166,000 (rising)**
- **Number of Deaths (2015): ± 3,200 (also rising)**

## Highway Traffic Congestion

- **Annual Highway VMT: ± 330 billion, growing at >2% per year**
- **Three of the US Top 20 Most Congested Urban Regions** Los Angeles; San Francisco; and San Diego
- **Average Daily Vehicle Hours of Delay: BIG!**

### Caltrans: Owner and Operator of the State Highway System



- Responsible for > 50 K lane-miles of highways
  - Planning
  - Design
  - Construction
  - Operation
  - Maintenance
- Operates Inter-city rail services
- Permits > 400 public and special use airports and heliports
- Partners with regional and local agencies
  - 19 MPO's
  - 58 Counties
  - > 500 Incorporated Cities
- 12 Districts

# Caltrans - District 4 San Francisco Bay Area



- District 4 encompasses nine San Francisco Bay Area counties of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Solano, Sonoma, and Santa Clara
- About 2,900 positions with an annual operating budget of over \$460 million
- Manages about 6,500 lane miles on over 770 centerline miles of conventional highways and 690 centerline miles of freeways, including 494 miles of managed lanes (HOV and Express Lanes)
- Owns/Operates seven toll bridges: Antioch, Benicia-Martinez, Carquinez, Richmond-San Rafael, San Mateo-Hayward, San Francisco-Oakland and Dumbarton
- 156 projects in construction for \$1.56 B
- FY 16/17 Contract for Delivery: 48 projects for \$349 M



# California State Highway System

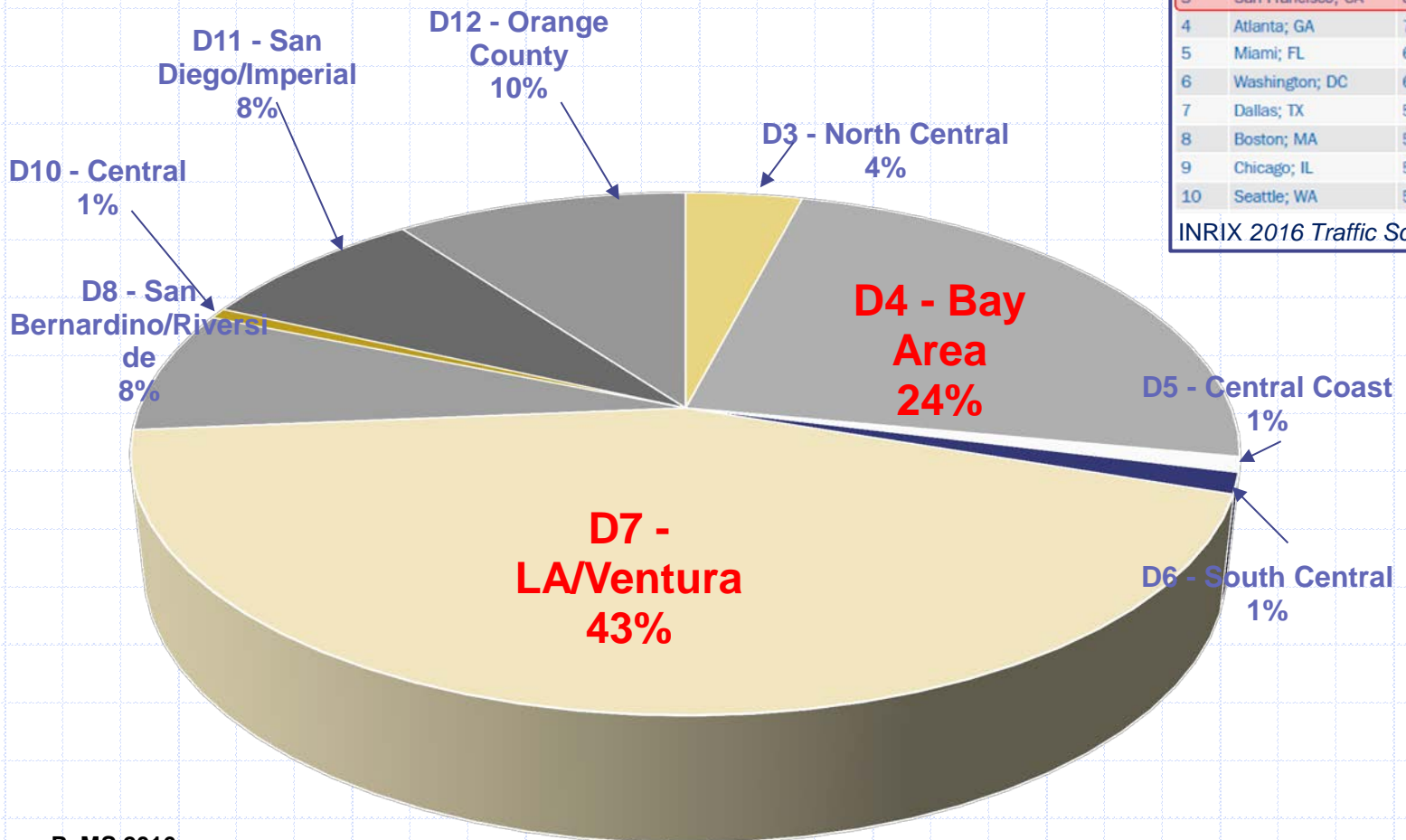
Inventory	Statewide	District 4
Lane Miles	50,000	6,468
Bridges	12,559	2,500
Acres of Landscape	29,000	4,600
Culverts	205,000	43,059
Roadside Rest Area	87	3
Park & Ride Lots	325	46
Vista Points	146	20
Traffic Signals	6,263	1,441
Vehicle Miles of Travel, Billion Miles	148	31
2014 Collisions* Total (Fatal + Injury)	94,539(49,884)	28,110 (9,583)
2016 Congestion Delay*, Million Vehicle Hours	305	73

\* TASAS and PeMS Preliminary Data, State Highways only

# California 2016 Congestion by Caltrans Districts (Delay at 60 MPH)

RANK	CITY	PEAK HOURS SPENT IN CONGESTION
1	Los Angeles; CA	104
2	New York; NY	89
3	San Francisco; CA	83
4	Atlanta; GA	71
5	Miami; FL	65
6	Washington; DC	61
7	Dallas; TX	59
8	Boston; MA	58
9	Chicago; IL	57
10	Seattle; WA	55

INRIX 2016 Traffic Scorecard





# San Francisco Bay Area Freeway Congestion Costs, 2016

San Francisco Bay Area County	Period	Vehicle Hours of Delay (VHD)	Lost Time, \$ (VHD x 15.7/hr)	Wasted Fuel, \$ (VHD x 1.719 x 2.727)	Total Cost, \$
Alameda	Annual	24,983,000	392,233,000	117,113,000	509,346,000
	Daily	68,000	1,075,000	321,000	1,395,000
Santa Clara	Annual	16,843,000	264,435,000	78,955,000	343,390,000
	Daily	46,000	724,000	216,000	941,000
Contra Costa	Annual	10,229,000	160,595,000	47,951,000	208,546,000
	Daily	28,000	440,000	131,000	571,000
San Mateo	Annual	7,490,000	117,593,000	35,111,000	152,704,000
	Daily	21,000	322,000	96,000	418,000
San Francisco	Annual	4,820,000	75,674,000	22,595,000	98,269,000
	Daily	13,000	207,000	62,000	269,000
Solano	Annual	3,719,000	58,388,000	17,434,000	75,822,000
	Daily	10,000	160,000	48,000	208,000
Marin	Annual	2,178,000	34,195,000	10,210,000	44,405,000
	Daily	6,000	94,000	28,000	122,000
Sonoma	Annual	2,636,000	41,385,000	12,357,000	53,742,000
	Daily	7,000	113,000	34,000	147,000
Napa	Annual	93,000	1,460,000	436,000	1,896,000
	Daily	250	4,000	1,000	5,000
All	Annual	72,991,000	1,145,959,000	342,161,000	\$ 1,488,120,000
	Daily	200,000	3,140,000	937,000	\$ 4,077,000

**\$1.5 B  
Annual  
\$4 M  
Daily**

Notes:

- Cost of lost time assumes: total delay x \$15.70 per hour; average vehicle occupancy of 1.15; nine percent truck volume; and 4% real discount rate.
- Cost of wasted fuel = wasted fuel (gallons) x \$2.727 a gallon.
- Wasted fuel (gallons) = total delay in VHD x 1.719 for each vehicle hour of delay.
- Figures may not add up exactly due to rounding.

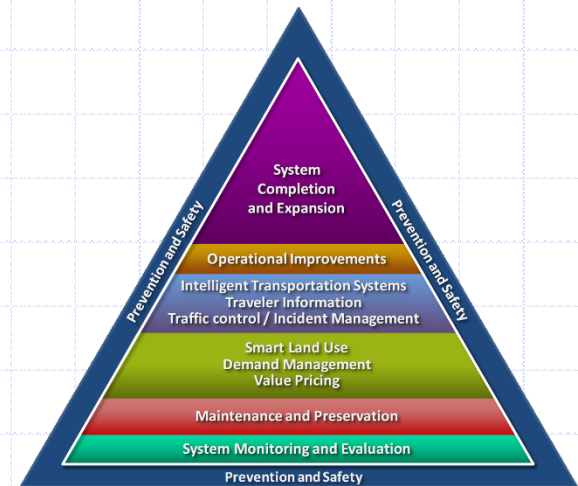




# Transportation Management System

# California Department of Transportation Embracing Transportation System Management & Operations (TSMO)

- Mobility Pyramid established in early 2000's with foundation on maintenance & system management
- Performance as the basis for investment decisions
- Updated Mission, Vision & Goals and Strategic Management Plan
- “Fix it First” (TSMO) Philosophy



 **Caltrans®**

## Mission

Provide a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability

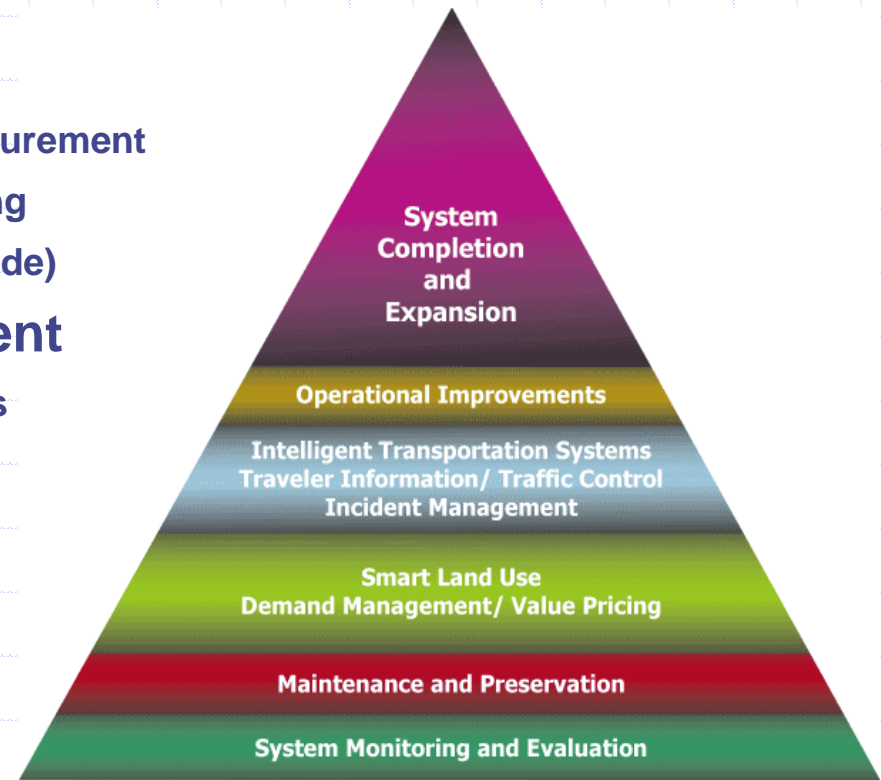
## Vision

A performance-driven, transparent and accountable organization that values its people, resources and partners, and meets new challenges through leadership, innovation and teamwork

# California Focus Areas

## Transportation System Management & Operations (TSMO)

- **Transportation Management System**
  - Build-out (TMS)
  - Adaptive Ramp Metering
- **Emergency Management**
  - System Monitoring & Performance Measurement
  - Incident Management & Disaster Planning
  - Traveler Information (Regional & Statewide)
- **Integrated Corridor Management**
  - Integrated Freeway & Arterial Operations
  - Transit/Rail, Pedestrians, & Bicyclists
- **Operational Improvements & System Completion**
  - Express or High Occupancy/Toll Lanes
  - Strategic Improvements
- **Embrace New Technology**
  - Connected/Automated Vehicles & Infrastructure



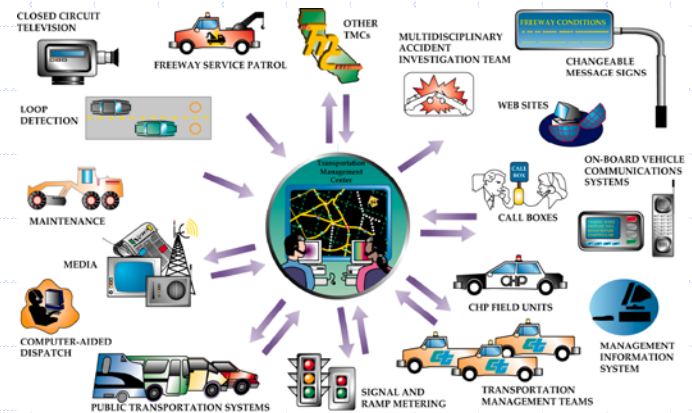
# Traffic Management Systems (TMS) for Improved Mobility



511 Traveler Information (Regional)



Caltrans Quickmap (Statewide)



Coordinated Emergency Response



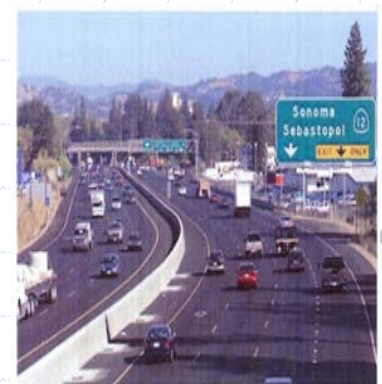
Changeable Message Signs



Highway Advisory Radios

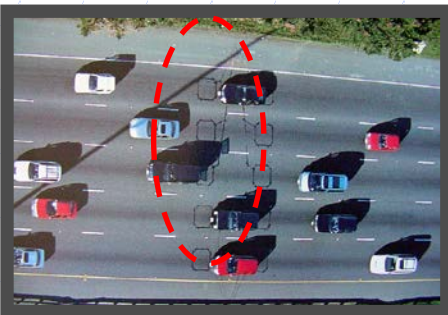


CCTV Cameras



A U.S. Highway 101 project widened the route from four to six lanes, extended the carpool lane for two and a half miles and upgraded interchange in Santa Rosa — six months ahead of schedule.

Planned Highway Work



Detection Stations



Ramp Meters



# California Transportation Management System (TMS)

Inventory	Statewide
Traffic Signals	6,263
Closed Circuit TV Cameras (CCTV)	2,821
Changeable Message Signs (CMS)	897
Highway Advisory Radio (HAR)	188
Extinguishable Message Sign (EMS)	585
Vehicle Detection Stations (VDS)	17,723



## Notes:

- CCTVs includes freeway and arterial signal cameras.
- CMSs include larger informational display boards & smaller variable message signs.
- EMSs include informational message signs and curve warning signs.
- VDSs include freeway mainline, connectors, & on- & off-ramps.

# San Francisco Bay Area Ramp Metering

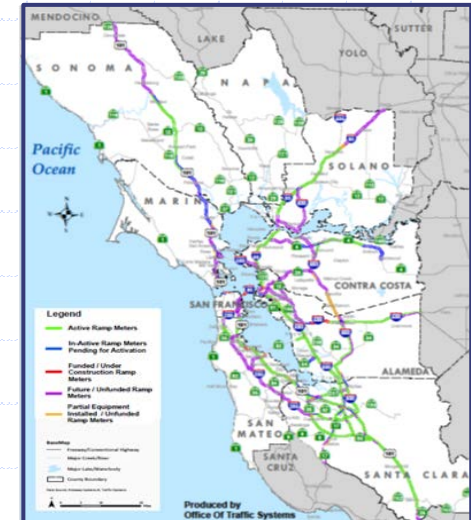
(Various Stages of Development)

County	Total Existing as of 2016	Planned Activation in 2017	Planned Activation in 2018	Planned Activation in 2019	Total By 2019	Total Funded & Installed In-Active	Total Unfunded	Total Existing & Planned
ALA	156	0	0	38	194	7	105	306
CC	57	0	23	0	80	4	122	206
MRN	0	0	10	0	10	6	48	64
NAP	0	0	0	0	0	0	16	16
SCL	248	8	9	0	265	12	76	353
SF	0	0	0	0	0	5	35	40
SM	72	0	0	0	72	2	81	155
SOL	42	0	0	0	42	1	83	126
SON	43	0	0	0	43	11	25	79
Total	618	8	42	38	706	48	591	1345

Note:

The estimated cost to complete the system is ±\$1.1B.

- Ramp Metering is a key element of the TMS, and continues to grow.



- As an Example, in the next two years, the existing 618 active ramp meters in the Bay Area are expected to grow by 14% to 706, and then more than double in the future as funding becomes available.



# San Francisco Bay Area TMS Performance & Health

TMS Element	August 2012		April 2017	
	Inventory	Performance	Inventory	Performance
Changeable Message Sign	128	69%	172	92%
Closed Circuit TV Camera	353	43%	591	84%
Ramp Meter	347	97%	618	94%
Vehicle Detection Station	2,334	47%	3,676	74%
Vehicle Sensors (Lane)	7,533	48%	10,777	71%

## Notes:

- Performance Target: 80% or better (90% or better by 2020)
- Additional State SHOPP funds invested \$19M (2013 – 2016)
- System Degradation is currently at less than 4% of inventory per month.
- Continued Investment:
  - 2014 SHOPP, 3 Service Contracts(\$18M, 2016-2018) – Started Sept 2016.
  - MTC I-880 Performance-based TOS Device Maintenance Contracts (\$12M, 2016-21)
  - \$65.7 M SHOPP funds programmed for TMS Health (2018-25)
    - 2016 SHOPP TOS Service Contract (\$16M, 2017-2019)
    - 2016 SHOPP Detection Repair (\$30M, 2018 or later)
    - 2018 SHOPP Asset Management Pilot ATMS Upgrade Project (\$3.7M, 2020-25)
    - 2016 SHOPP Detection Life Cycle Replacement (\$16M, 2022)

# Incident & Emergency Management



## Caltrans/CHP Goal:

Clear major highway incidents within 90 minutes or less  
(achieved for 75% of incidents in FY 2015/16).

### CHP CAD: INCIDENTS REPORTED PER DAY

total "incidents" reported	4000
traffic hazard reports	165
accident reports	140
reports reviewed by Caltrans	300
reports involving Caltrans field activities	270
reports requiring action by TMC	69

### 24/7 TMC



- Caltrans Communications Center and Traffic Operators
- California Highway Patrol
- MTC-511 Travel Information



# Caltrans TMCs & Emergency Operations Centers



**Cal EMA**  
CALIFORNIA EMERGENCY  
MANAGEMENT AGENCY



**Caltrans**



California  
Highway  
Patrol



Metropolitan  
Transportation  
Commission



WETA



United  
States  
Coast  
Guard

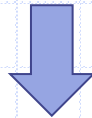
- Emergency Operations through pre-planning & coordination among multiple agencies with defined roles & responsibilities.
- Caltrans Inter-regional, Regional, and Satellite TMCs.
- Caltrans Emergency Operations Centers (EOCs) are activated as a separate unit in response to incidents regionally impacting transportation mobility.



# Freeway Operations

# Caltrans Freeway Operations

- Many congested urban corridors
  - commute/recreational/freight traffic
  - Significant incident patterns
  - Ridesharing & Transit Integration
- Widening no longer always viable.
- Must use technology to make existing transportation system more efficient.



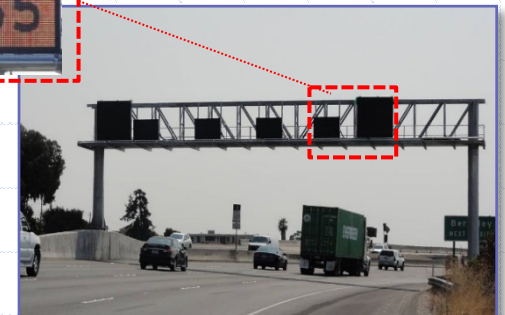
- **Integrated Corridor Management (ICM)**
  - I-80 Smart Corridor (Alameda/Contra Costa Co.)
  - US 101 Smart Corridor (San Mateo County)
  - Interstate 880 ICM (Alameda County)
  - Interstate 680 Forward (Contra Costa County)
  - Interstate 210 ICM Pilot (Los Angeles County)



# San Francisco Bay Area: Integrated Corridor Management I-80 Smart Corridor

## Active Traffic Management Toolbox:

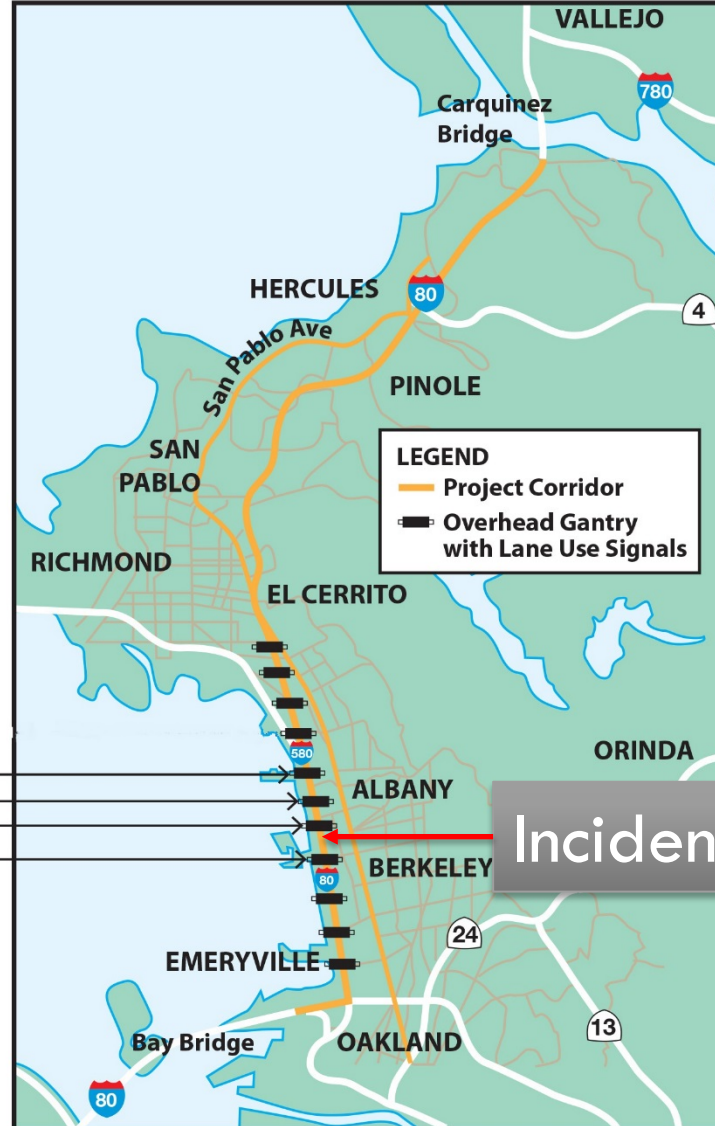
- **20-Mile Freeway segment, fully outfitted with ITS elements:**
  - Vehicle Detection Stations
  - Closed Circuit TV Cameras
  - Electronic Changeable Message Signs
  - Variable Advisory Speed Signs
  - Information Display Board
  - Adaptive Ramp Meters (5 a.m.- 8 p.m., including weekends)
  - Highway Advisory Radios
  
- **Arterial Elements**
  - Interconnected Signal Systems
  - CCTVs at Traffic Signals
  - Transit Signal Priority
  - System Detectors
  - “Trailblazer” Signs
  
- **Results, promising!**
  - Official After-study expected in Fall 2017



# San Francisco Bay Area: Integrated Corridor Management I-80 Smart Corridor

Freeway: Electronic signs on overhead gantries turn ON upstream of an incident, and immediately past.

Open  
Blocked Merge  
Open



8/25/16 to 4/1/17  
 Activations: 155  
 WB I-80: 107  
 EB I-80: 46  
 Typ. Duration: 30'

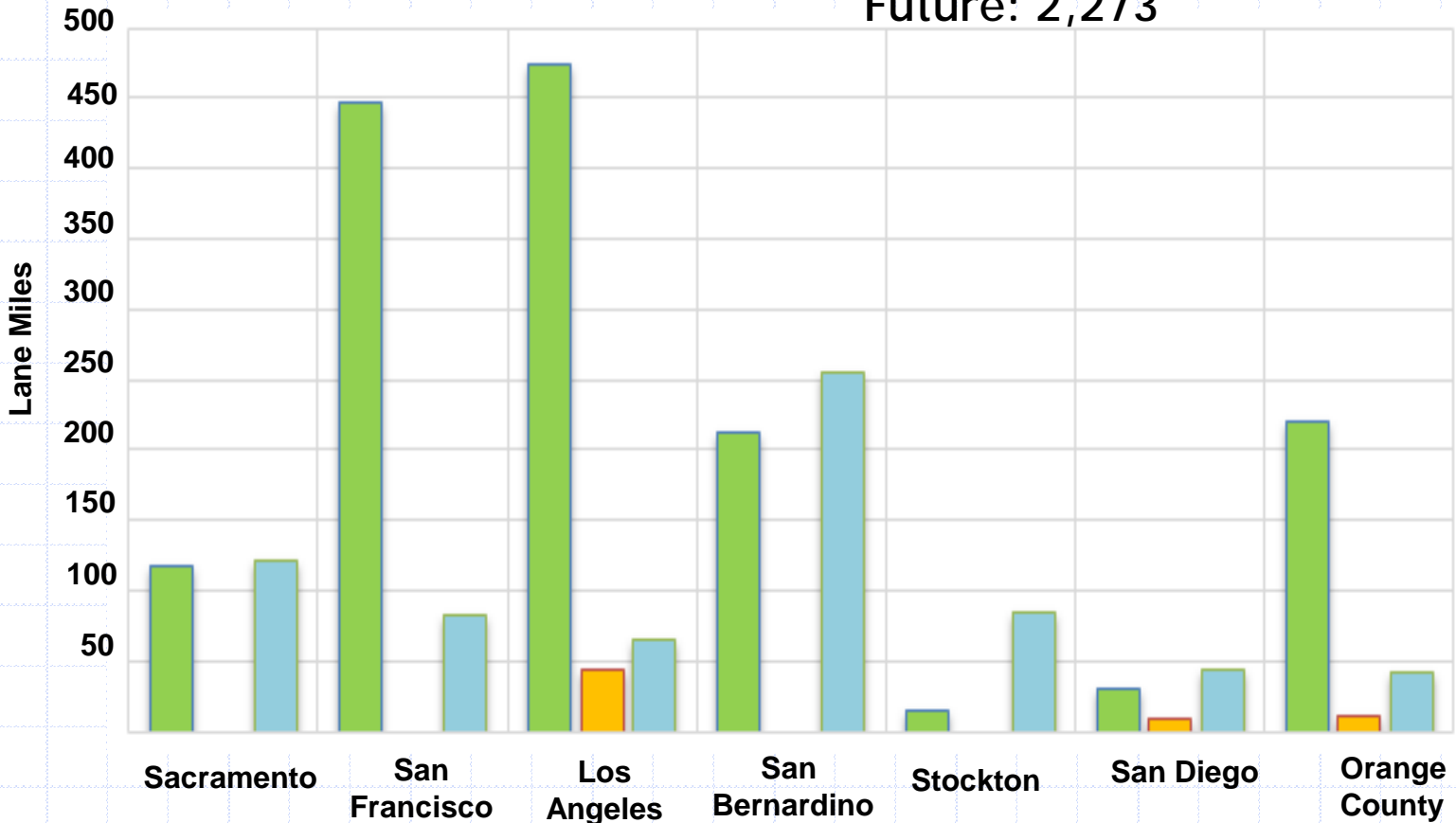
Arterial: Trailblazer Signs turn ON and signal "flush plan" implemented along main arterial to guide traffic back to freeway





# California High Occupancy Vehicle (HOV) Lanes

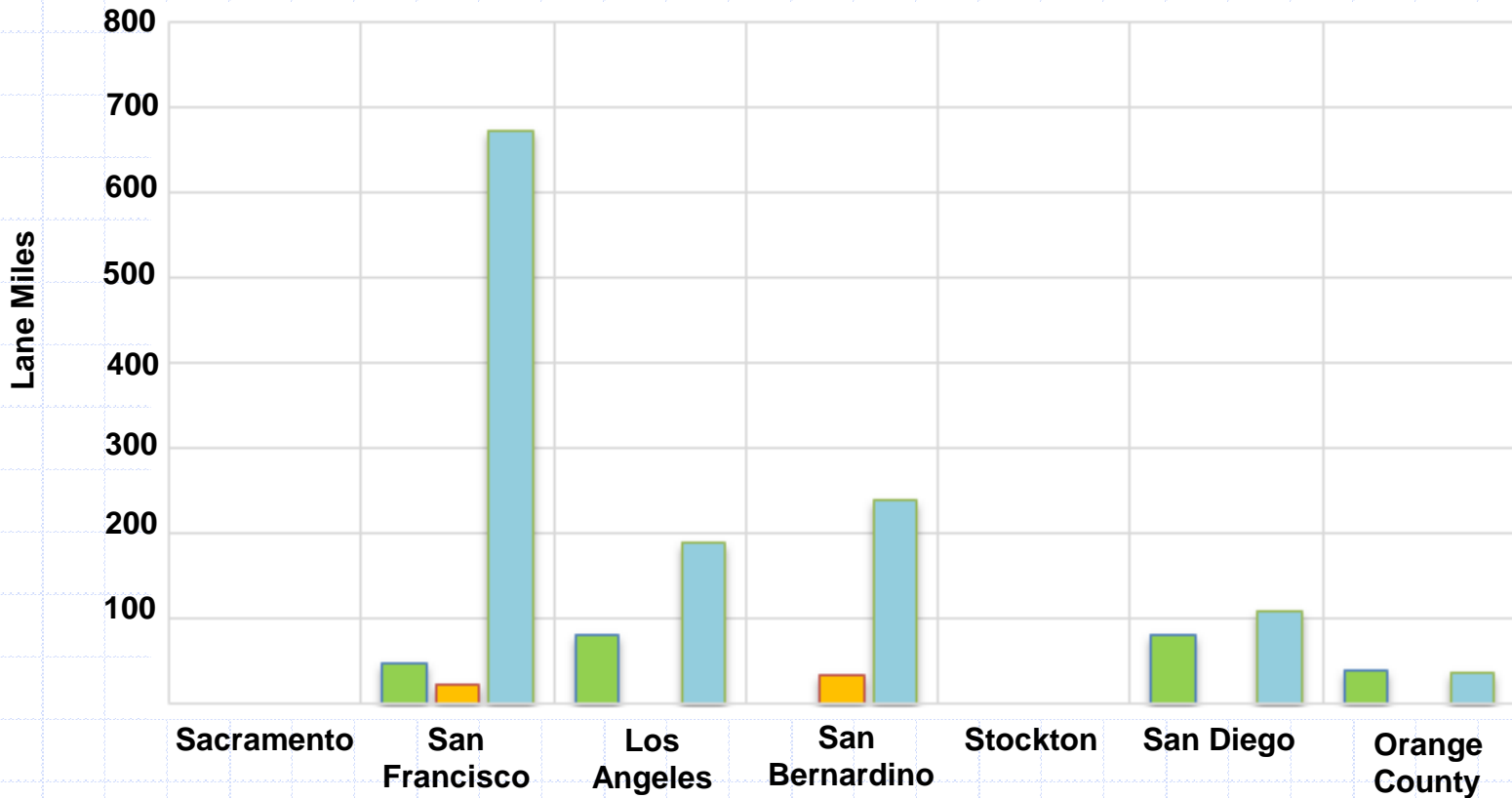
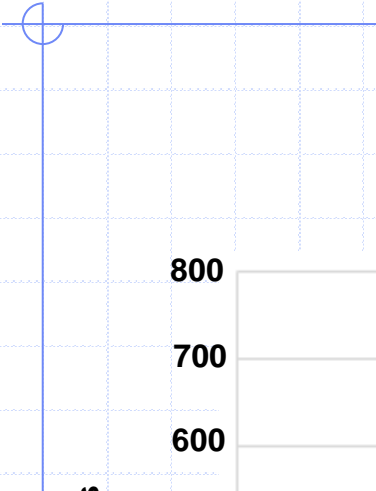
Existing: 1,515 Miles  
Under Construction: 63 Miles  
Proposed/Programmed: 695 Miles  
Future: 2,273





# California Express (or HOV/Toll) Lanes

- Existing: 250 Miles
- Under Construction: 58 Miles
- Proposed/Programmed: 1,250 Miles
- Future: 1,558 Miles





# Caltrans

## Rural Freeway Operations

- Freeway Operations in rural areas are more focused on safety and responding to changing conditions, such as:
  - Weather (snow; chain controls)
  - Wildfires
  - Mud or Rock Slides
  - Floods
  - Major crashes, particularly involving trucks
- Providing accurate timely, and reliable traveler information is the primary objective, in addition to efficient response to incidents.



# Commercial Vehicles Operations

# Truck Routes in California

**Caltrans works** with the trucking industry, California Legislature, California Highway Patrol (CHP), and the US Department of Transportation to provide a safe & efficient environment for commercial vehicle operations on California roadways.

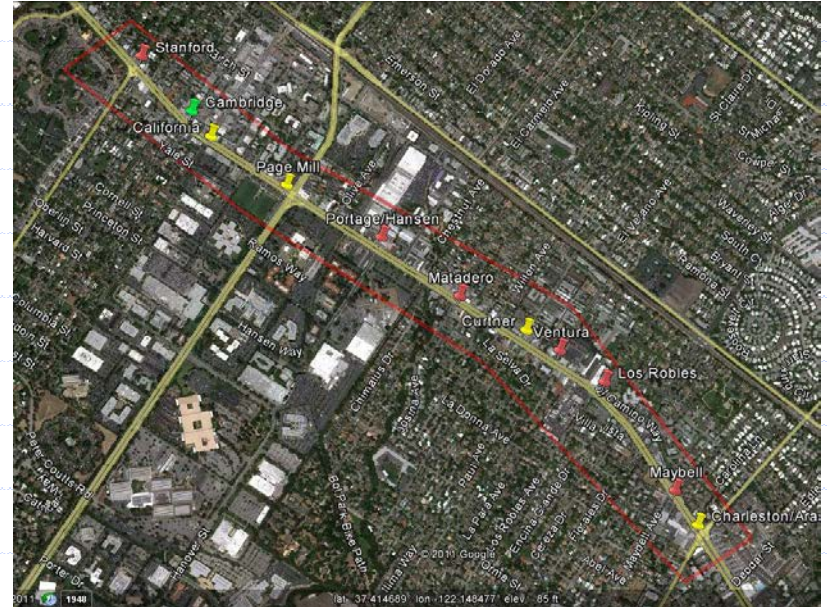


- **Truck routes are reviewed and selected** based on truck volumes, absence of alternate routes, length of detour, and time savings.
- **127 Commercial Vehicle Enforcement Facilities (CVEF)** at major ports of entry and rural routes with high truck traffic for inspection of safety systems, size/weight compliance, and driver vehicle credentials.
- **137 Weigh-in-Motion (WIM) sites** with sensors embedded in the roadway to capture and record axle weights and gross vehicle weights as vehicles drive over them at a reduced or normal traffic speed. Truck axle weight data are collected for reporting, structure analysis, freight traffic modeling, highway performance monitoring, and immediate enforcement by the CHP.
- **Pre-Pass** uses WIM data for electronic screening & clearance system for qualifying motor carriers that meet compliance criteria, allowing trucks to bypass the adjacent CVEF.
- **Bridges & overpasses** along routes are being considered for strengthening or replacement based on structure age, substandard weight rating, and vertical clearance.

# California Connected Vehicles Test Bed

# San Francisco Bay Area California Connected Vehicle Test-bed

- In 2005, Caltrans and MTC created the first locally funded CV Test Bed on State Route 82 (El Camino Real), in Palo Alto.
- Today, the following 11 intersections along a 2-mile long segment are equipped with DSRC radios broadcasting SPAT and MAP messages: Stanford; Cambridge; California; Page Mill; Portage/Hansen; Matadero; Curtner; Ventura; Los Robles; Maybell; Charleston



## Pedestrians/Bicycles

**Pedestrians and bicyclists need to be able to safely use and cross highways and freeway interchanges.**

- **Various related guides:**
  - Main Street, California Guide
  - Complete Streets Policy
  - Endorsement of the National Association of City Transportation Officials “Urban Design Guide”, and “Urban Bikeway Design Guide”
  - Active Transportation Program
  - “Yes We Can” Brochure for bicycle and pedestrian accommodating designs that can be used on California Highway System
  - Statewide Bicycle and Pedestrian plan, Under development; District 4 Bike Plan to include list of prioritized projects underway
- **Caltrans Changing Culture from “design standards” to “flexible or practical design”.**





# Transit & Rail



# San Francisco Bay Area Transit & Rail

- **29 Transit Agencies, including:**
  - Bay Area Rapid Transit (BART)
  - Caltrain
  - San Mateo County Transit District (SAMTRANS)
  - Alameda Contra Costa County Transit (ACTransit)
  - Santa Clara Valley Transportation Authority (VTA)
  - San Francisco Municipal Transportation Agency (MUNI)
  - Golden Gate Bridge Highway & Transportation District
  - West Contra Costa County Transit (WESTCAT)
- **Two Bus Rapid Transit projects underway**
  - San Francisco, Van Ness Avenue (U.S. 101/SR1), 3 mile
  - International BI/E. 14<sup>th</sup> Avenue (SR185), 9.5 mile
- **Sonoma – Marin Area Rail Transit** (nearly completed)
- **Caltrain Electrification & BART Extension**
- **Tech Firm Shuttles/Bus Services** (Google, Genentech, etc.)
- **Mobility Companies** (Uber, Lyft, & other)



**There is an increasing interest to consider freeway part-time lanes and bus-on-shoulder operations.**

# Challenges

# San Francisco Bay Area Population, Housing, Jobs, & Transportation

- Plan Bay Area 2040, a blueprint for regional growth and transportation investment to be adopted in July 2017.
- Where will the region plan for the 820,000 new households?
- Where will the region plan for the 1.3 million new jobs?
- How will the limited available Transportation funds be invested?

Plan  
Bay Area  
2040

2.6 million  
households  
rise to  
3.4 million

3.4 million  
Jobs rise to  
4.7 million

# San Francisco Plan Bay Area 2040 Funding Distribution in Year-Of-Expenditure

- Transportation investments that preserve the existing infrastructure & support economic development, and resiliency.

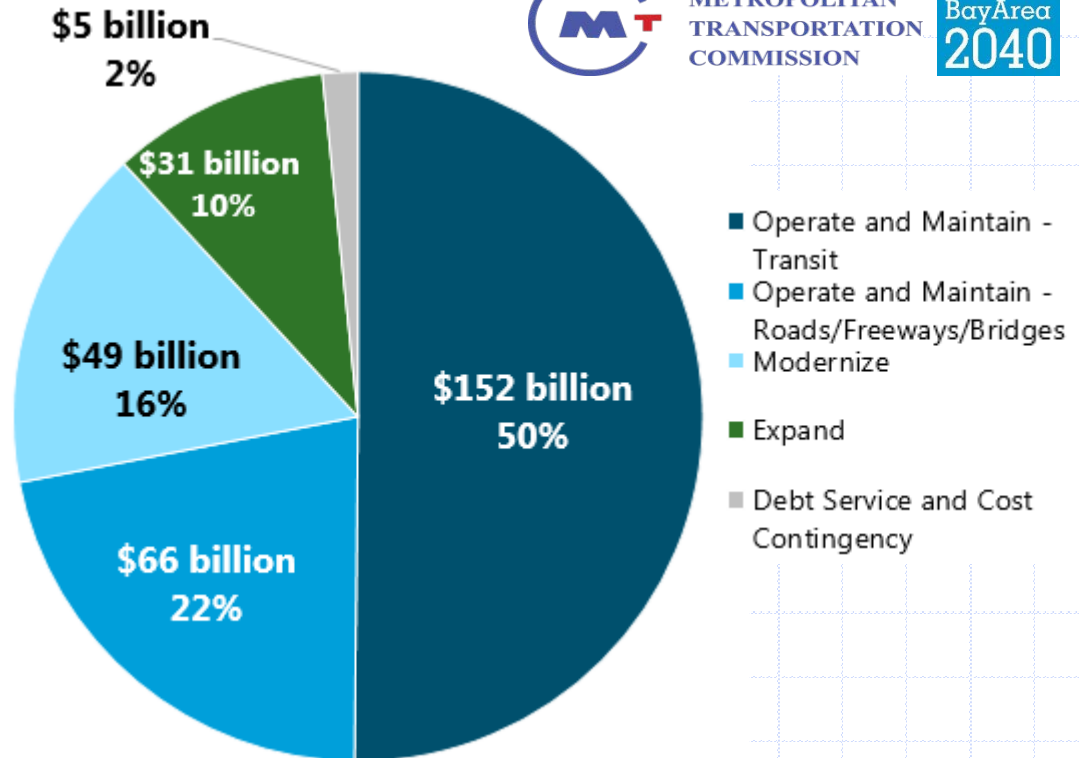


METROPOLITAN  
TRANSPORTATION  
COMMISSION

Plan  
BayArea  
2040

**90%**  
Operate, Maintain,  
and Modernize

**10%**  
Expand Existing  
System



Total = \$303 Billion

- **Emphasis on sustainability & resilience**

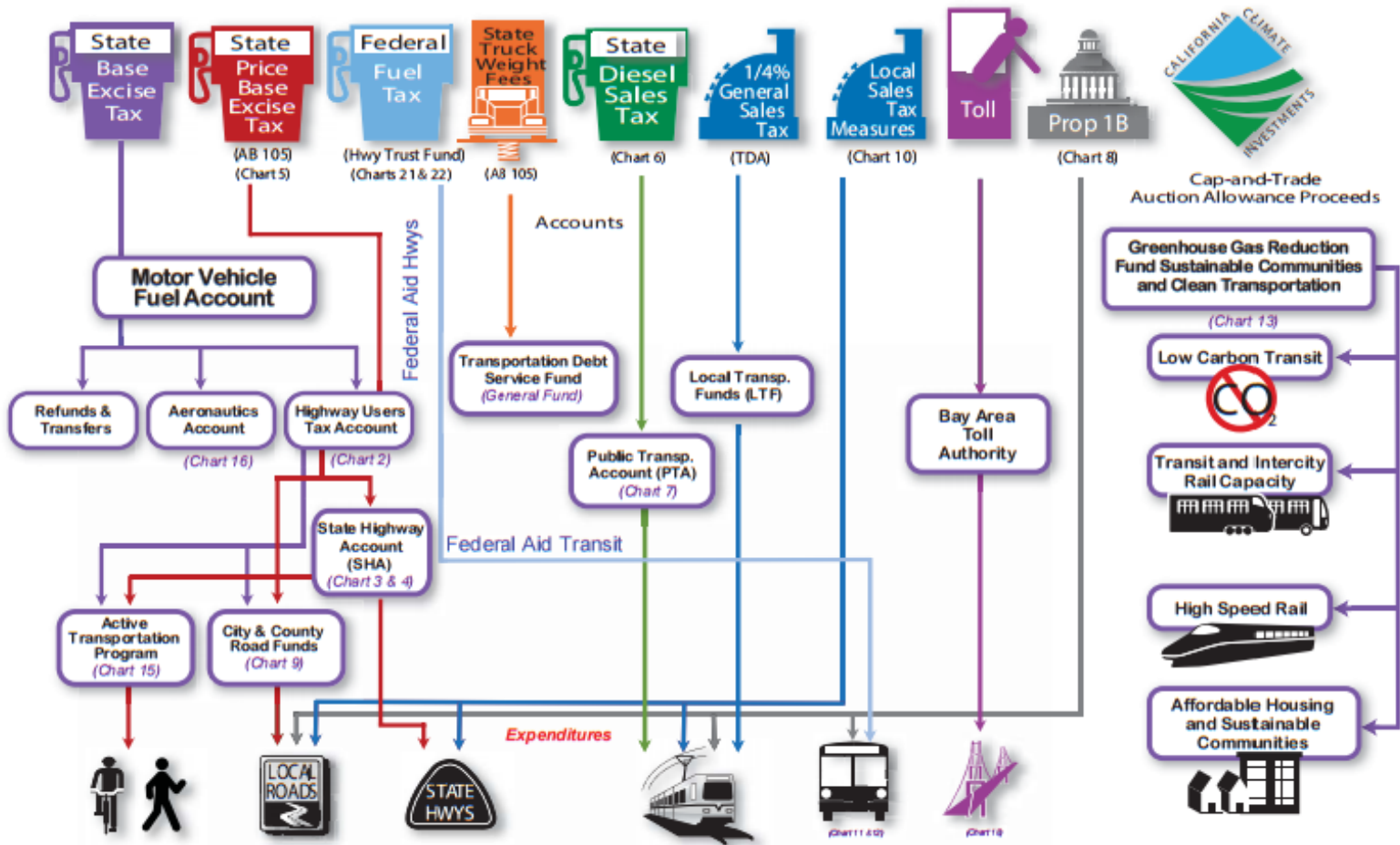
- **Collaborative Efforts**

- *2011, Adapting to Rising Tides: Transportation Vulnerability and Risk Assessment Pilot Project (Caltrans, MTC, & BCDC)*
- *2014, Climate Change and Extreme Weather Adaptation Options for Transportation Assets in the Bay Area (Caltrans, MTC, BCDC, BART)*
- *2016, State Route 37 Integrated Traffic, Infrastructure and Sea Level Rise Analysis (UC Davis)*
- *A Resilient Transportation System for Safe and Sustainable Communities (Caltrans, BART, MTC, BCDC)*
- *Underway: Caltrans District 4 Climate Change Vulnerability Assessment (Caltrans HQ Climate Change Branch)*



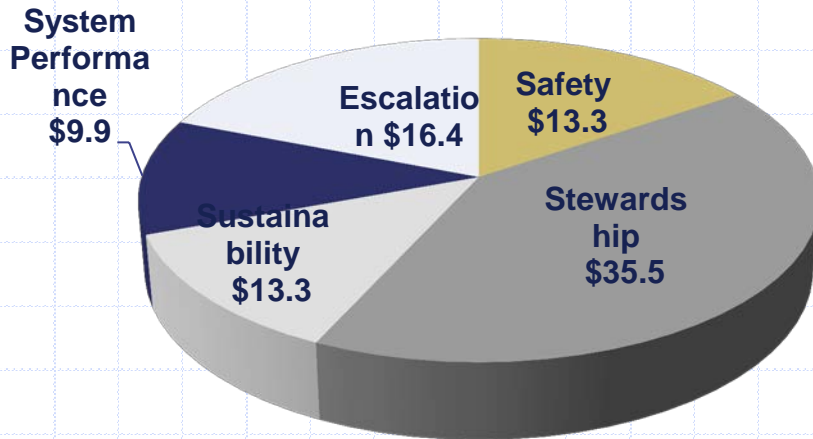
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## A Simplified Overview of California Transportation Funding

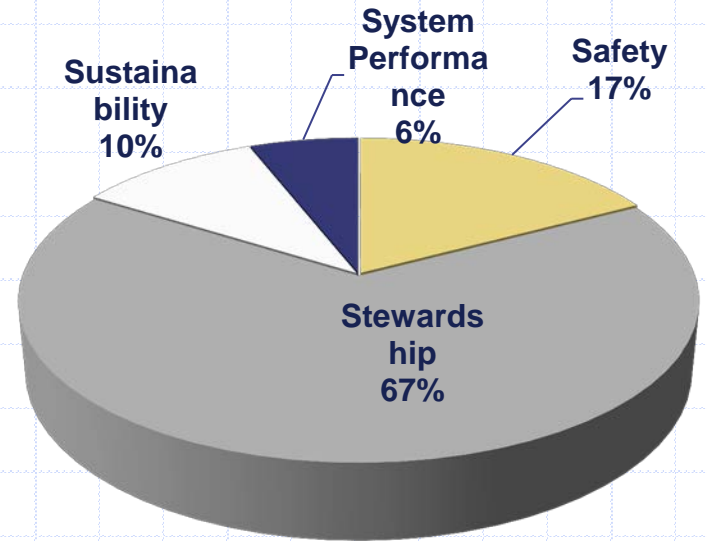


## 2016 State Highway Operation & Protection Plan (SHOPP)

Needs Assessment - \$86.5 B



Investment Plan - \$26.6 B



**Fix it First.**

# Opportunities





# California Department of Transportation Funding

- **SB 1- Road Repair and Accountability Act of 2017 provides significant additional funds in the form of tax and fee increases.**
  - \$7.3 B by increasing diesel excise tax 20 cents;
  - \$3.5 B by increasing diesel sales tax to 5.75%;
  - \$24.4 B by increasing gasoline excise tax 12 cents;
  - \$16.3 B by an annual transportation improvement fee based on a vehicle's value;
  - \$200 M from an annual \$100 Zero Emission Vehicle fee (commencing in 2020);
  - \$706 M in General Fund loan repayments;
  - **TOTAL: \$52.406 Billion**
    - \$25.9 Billion for State Highway System and Other Infrastructure.
    - \$26.6 Billion for Local Streets and Roads
  - Amounts identified are over 10 year figures but the Tax/fee increases are permanent.

Source: California Governor's Office

- **California Road User Charge Pilot**

# San Francisco Bay Area Express Lanes Network



METROPOLITAN  
TRANSPORTATION  
COMMISSION

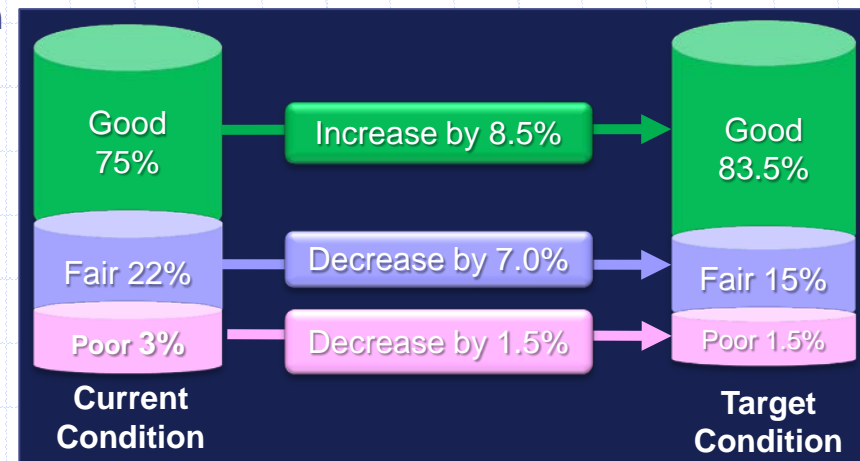
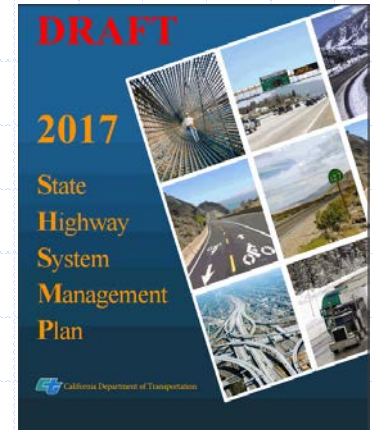
## Working with MTC and local partners to expand and convert HOV lanes into an Express Lanes Network

- Optimizes use of the existing system.
- Improved mobility for all, utilizing available unused capacity in HOV Lanes.
- Dynamic pricing controls demand & preserves ridesharing incentives.
- Added Choice & Reliability.
- Enhanced Environment.
- New funding source to close gaps in network, to provide additional time savings and incentives for transit & carpools.

Existing, 45 Miles  
By 2020, 150 "  
By 2030, 200 "  
Beyond, 150 "



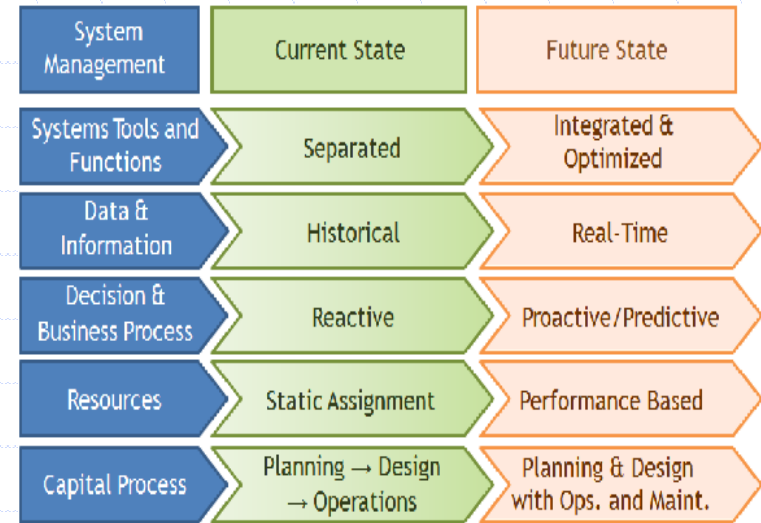
- **2017 State Highway System Management Plan**
  - Integrates 10 Year SHOPP & five-Year Maintenance Plans.
  - Aligns objectives with Caltrans Strategic Plan
  - Transparency
- **Implements Performance Management (of physical assets)**
  - Use individual objective management systems
  - Use deterioration rates, service life estimates, & expert judgement
  - Establish condition targets & determine condition gaps
  - Determine unconstrained need & develop a constrained investment plan
  - Distribute funding for objectives based on a statewide performance target (not \$'s) in proportion to each objective performance gap for each district
  - If a District has achieved the statewide goal, their target will be zero.
  - Balance work across all objectives
  - Fiscal targets are set for a 5 year period and included in 10 Year SHOPP



# California Connected Corridors Program

- **Caltrans intends to utilize Capability Maturity Model as a tool to support ICM:**

- Regional Operations Workshops to evaluate capabilities by corridor for integrated management
- Move from separate ad-hoc processes towards mature, cross functional, integrated and optimized operations.



- **Focus to be on transportation corridors with maximum peak travel time delay.**
- **Caltrans Strategic Management Plan commits to ICM implementation:**
  - By 2018, five corridors (SR-57, I-80, SR-91, I-110, 210)
  - BY 2020, three corridors (SR-57, I-80, I-210)

# Next Steps: CVO Issues, Challenges, & Recommendations

- **Congestion and delays:**

Congestion in the urban areas is also a challenge for commercial vehicles which need to be considered as part of mobility improvements, integrated & connected corridors, express lanes, traveler information.

- **Hours of service:** Fatigue is a big issue facing drivers and a major cause of crashes; recommend stricter enforcement on the hours of operations.



- **Parking shortage:** Parking shortages at rest areas and near the origin/destination is an issue; recommend building more truck-friendly parking facilities.

- **Safety Awareness/Education:** Drivers still need to be made aware of the operational limitations of commercial vehicles traveling on the highway. Crashes involving commercial vehicles tend to be more severe and result in greater loss of life than those involving only passenger cars.

## Next Step: Connected Vehicles

- **Connected Vehicles use vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication technology to provide information, alerts, and if necessary, warnings to drivers that enable them to travel safely and more efficiently.**
- **On freeways, end-of-queue warnings using V2V can address 50% of the crashes.**
- **V2I can alert drivers to slow or stopped traffic just ahead of them.**



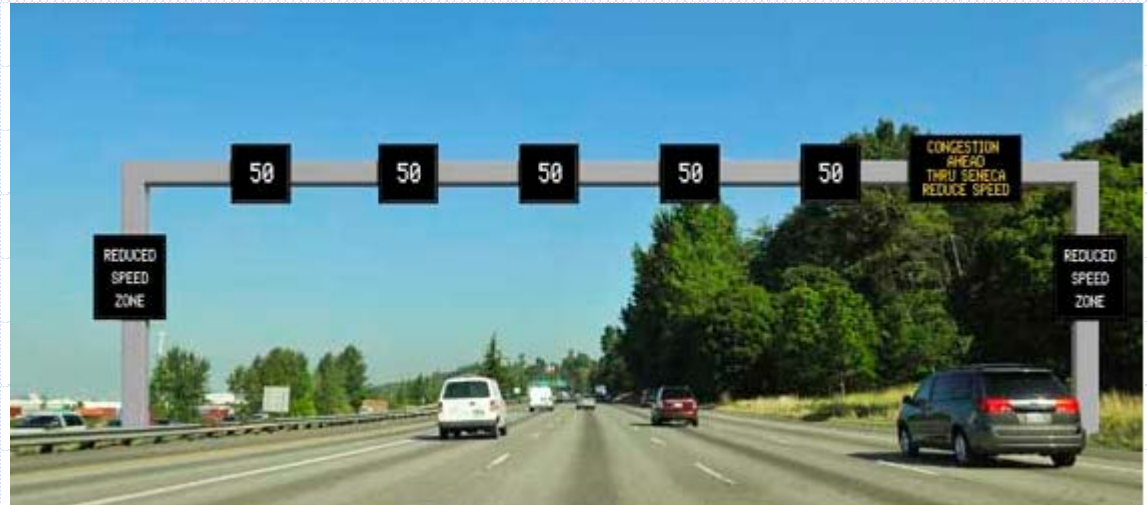
# Next Steps: Automated Vehicles

- Machines perform the same functions that are currently performed by human drivers.
- Intuitively, machines should not ever be distracted or inattentive, so they should be safer.
- Improvements to signing and striping on freeways will help machine vision systems.
- While not full vehicle automation, truck platooning, using cooperative adaptive cruise control technology, is gaining momentum.



# Next Steps: Active Traffic Management

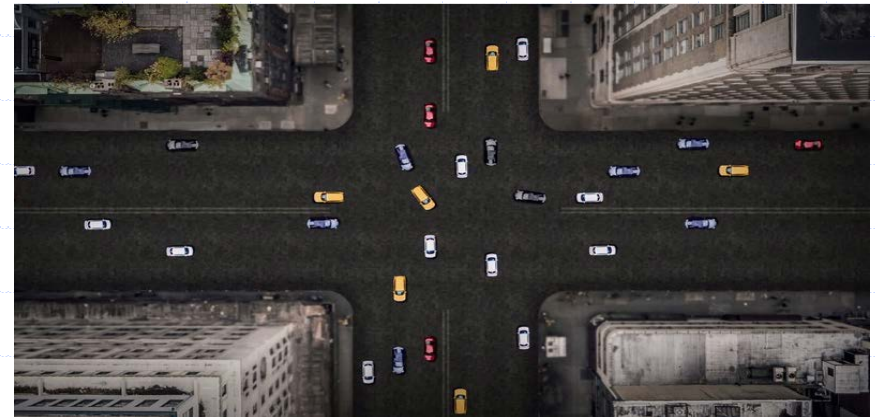
- **Supplementing ICM, Active Traffic Management includes Coordinated Ramp Metering (CRM) and Variable Speed Limits (VSL).**



- **After analyzing the corridor's traffic patterns using simulation and modeling tools, optimal plans are determined for CRM and VSL that squeeze more efficiency out of the existing freeway.**
- **Using V2I, vehicle speeds can be controlled to delay or even eliminate the onset of stop-and-go driving.**



- **By 2020**, 50% of mobility as a service rides will be via autonomous vehicles.
- **By 2025**, No one will own a car; we'll be able to ride Hyperloop; there will be 88 Smart Cities worldwide.
- **By 2029**, 146 million vehicles in the US will have connected vehicle technology.
- **By 2040**, you can travel by Hypersonic Jet.
- **By 2045**, There will be buildings 18-24 miles high; flying cars will exist in the near future. Connected/Autonomous vehicles will eliminate the need for roadway sensors, all roadway signage, traffic signals, etc.

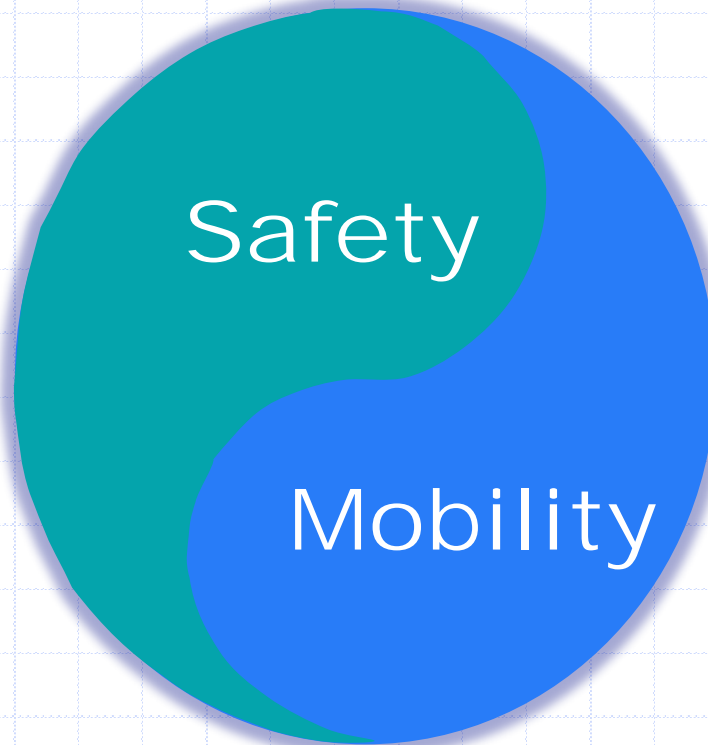


## San Francisco Bay Area Possible Transportation Network Improvements

- (A) Second BART Tube
- (B) High Speed Rail / Standard Rail Tube
- (C) Southern Vehicular Crossing
- (D) 101 Corridor
- (E) Ferries to the South Bay
- (F) Dumbarton / ACE / Menlo Park - San Jose Corridor
- (G) BART to San Jose and Airport
- (H) High Speed Rail to Sacramento
- (I) Highway 37 Corridor



# Questions?



# San Francisco Bay Area Innovative Pedestrian & Bicycle Facilities

**Bicycle-Pedestrian Bridge,  
Across Interstate 80/580, Berkeley, CA  
Completed: 2002**



**Bay Bridge Bicycle-Pedestrian Path,  
Across Interstate 80, Oakland, CA  
Completed: 2013/16**



**Richmond-San Rafael Bridge Bike Path  
with Moveable barrier on shoulder  
Estimated Completion: Spring 2018**



**Old Redwood Highway at U.S. 101**  
**Raised crosswalk & bike lane at ramp**  
**Status: Completed 2014**



**Alpine Road bike lanes**  
**across I-280 ramp crossings**  
**Status: Completed in 2013**



**San Pablo Avenue (SR 123)**  
**Two-way raised cycle track**  
**Status: In Construction**

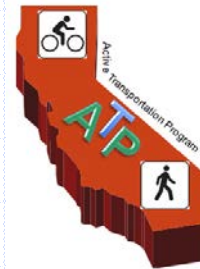


## Sloat Boulevard (State Route 35), San Francisco:

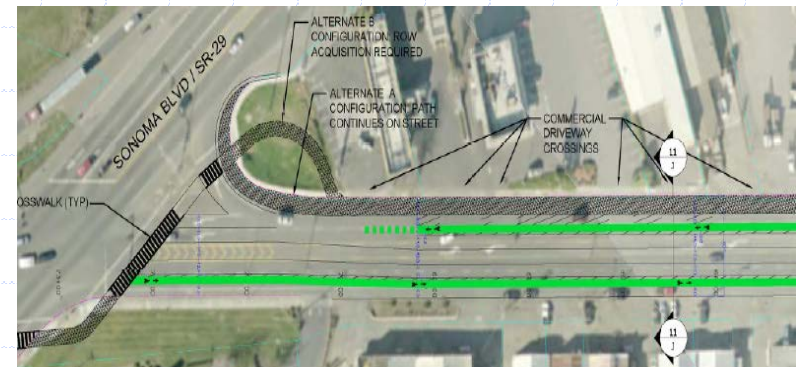
- “Road Diet” from six to four lanes
  - New Bicycle lanes with buffer
  - Speed & Crash Reduction



- **Active Transportation Program (ATP) 2017- Cycle 3**
  - **District 4 (Statewide ATP): \$31.76 M (of \$131.76 M)**
  - **MTC (Regional ATP): \$22.171 M**
  
- **New Senate Bill 1 Provisions:**
  - **\$100 million/year for ATP**



*Oakland - Fruitvale Alive Gap Closure*



*Vallejo - Bay Trail/Vine Trail Gap Closure*

# San Francisco Bay Area: Integrated Corridor Management

## San Mateo US 101 Smart Corridor

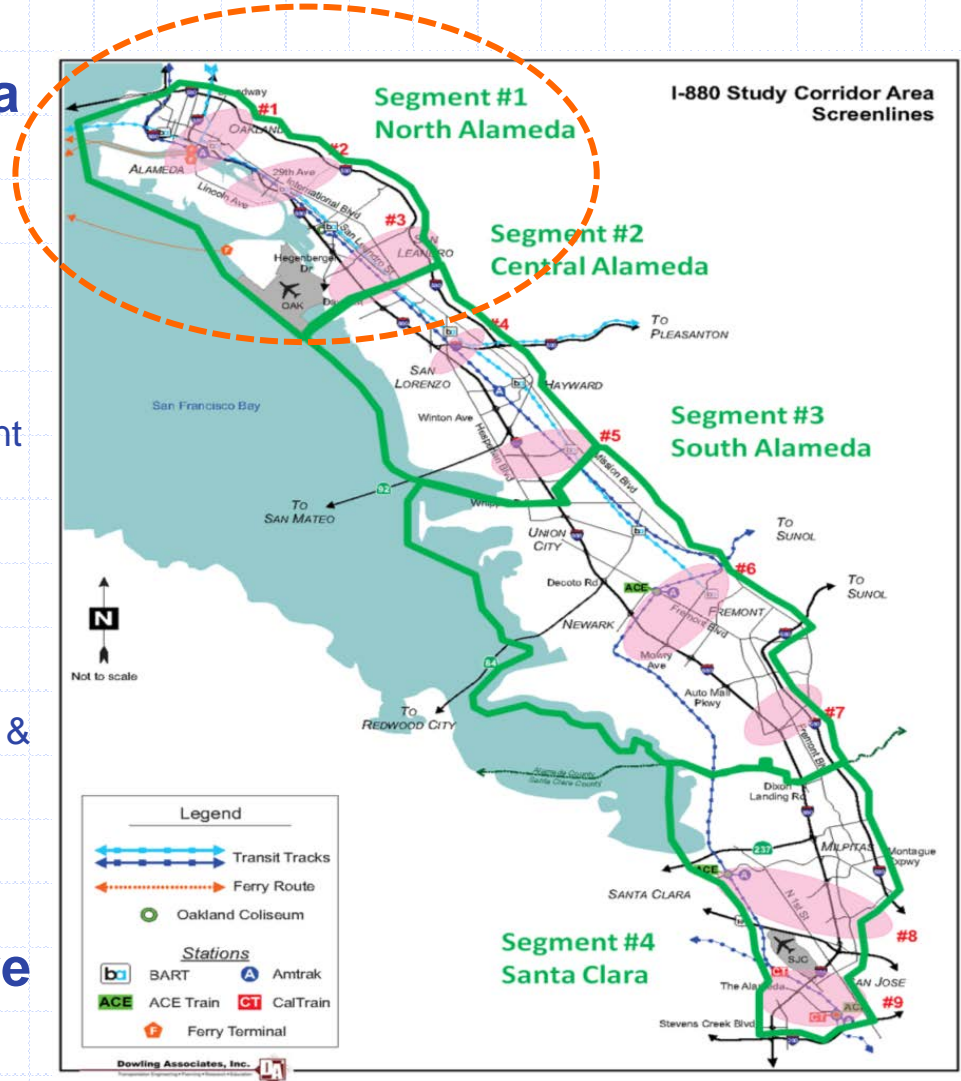


- \$ 35.3 M project for Enhanced Congestion Monitoring & Management
- 20-mile freeway stretch through 10 cities in San Mateo County
- New & upgraded field elements and communication
- State & local TMCs + remote operations
- “Smart Corridor Routes”: Local arterials & State Routes 82, 84, 109, 114



# San Francisco Bay Area: Integrated Corridor Management Interstate 880 Smart Corridor

- 32 mile corridor in Alameda & Santa Clara Counties, including nine cities
- Segment 1 focuses on arterial improvements for incident management.
  - Improved Arterial Incident Management
  - ITS components: trailblazer signs, CCTV, detection stations, signal coordination, and communications improvements
  - Parallel State Arterials: SR 61 (Davis Street & Doolittle Drive), SR 77 (42nd Avenue), SR 112 (Davis Street), & SR185 (International Blvd).
  - Project Cost: \$14M
  - Completion: 2019
- Future Segments 2 and 3 are In Alameda County and Segment 4 would extend to Santa Clara County.





# San Francisco Bay Area: Integrated Corridor Management State Route 4 Smart Corridor



- Approximately 30 miles from I-80 to SR-160 through seven cities
- In Early planning stage
- 18 month schedule: Prepare Concept of Operations & High Level System Requirements for:
  - Corridor Ramp Metering
  - Incident Management
  - Travel Demand Management

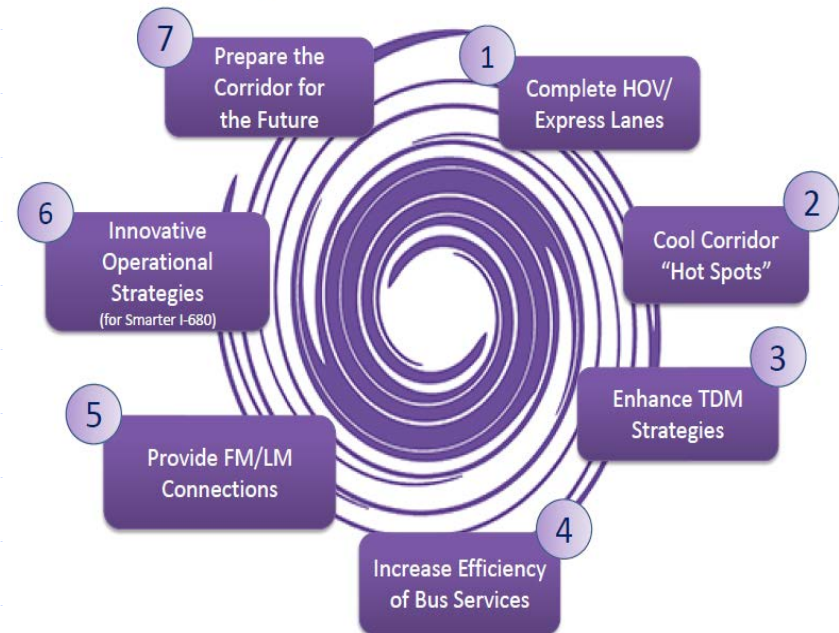
# San Francisco Bay Area: Integrated Corridor Management Interstate 680 Smart Corridor

## Contra Costa County I-680 Forward

- 25 mile Corridor, from Benicia-Martinez Bridge to Alameda County Line
- Corridor Ramp Metering
- Incident Management
- Bus on Shoulder Use
- First Mile/Last Mile, including Autonomous/Connected Vehicles,
- Travel Demand Management



## Moving I-680 Forward 7 Strategies



# California Integrated Corridor Management Interstate 210 ICM Pilot

- 11.5-mile corridor, between SR-134 in Pasadena to I-605 in Duarte, including:
  - Fragmented Arterial signal systems & modal operations
  - Advanced Ramp metering Operations, light-rail, and several transit operators
  - A multitude of express commuter transit and distributed parking facilities
  - Excellent freeway detection and communication system
- Project features:
  - Improved real-time system monitoring capabilities
  - Improved incident response coordination
  - Improved traffic and demand management applications
  - Optimized corridor operations in real-time
- Completion Date:
  - Freeway ITS Improvements: March 2018
  - Arterial improvements & Decision Support System (DSS) : 2018
- Cost: \$ 26.4 M



# San Francisco Bay Area Van Ness Avenue (US 101) BRT

- San Francisco's first BRT
- 3-mile corridor
- Converts one of three existing lanes in each direction to a dedicated bus lane
- Showcases Caltrans' *Main Streets* and *Complete Streets* policies
- Other features:
  - Replaces MUNI's Overhead Contact System;
  - Upgrades of Traffic signal system and street lighting;
  - Replacement of Water, Sewer and Auxiliary Water Supply System
- Completion date: March 2020
- Project Cost: ±\$273 M



# San Francisco Bay Area East Bay Bus Rapid Transit

- **9.5-mile alignment on International Boulevard/E. 14<sup>th</sup> Street (SR 185), from Uptown Oakland to San Leandro BART Transit Center**
- **A combination of 80% dedicated bus-only & mixed-flow lanes**
- **Includes 34 stations (46 total platforms at 21 median, 12 curbside & 1 southern terminal)**
- **27 hybrid-electric buses (low-emission, 60-foot articulated)**
- **Pedestrian scale lighting & visibility**
- **New traffic & pedestrian signals with transit priority**
- **Best ADA Practices & level boarding**
- **Bike Racks at platforms and inside the bus**
- **Same fare as local service (with 7 to 8 minute headways for increased frequency and reliability)**
- **Revenue Service Date: Anticipated 2018**



# San Francisco Bay Area Sonoma-Marin Area Rail Transit (SMART)



- SMART is a voter-approved passenger rail and bicycle-pedestrian pathway
- 70-mile corridor from Larkspur to Cloverdale
  - Phase 1: 43-mile route from San Rafael to Santa Rosa, including 10 stations, and 2 planned future stations
  - Phase 2: Remainder, including five planned stations
- Train service between Sonoma County Airport and San Rafael is scheduled to begin in late Spring 2017
- First rail agency to use Positive Train Control technology, enhancing safety & service reliability along the corridor
- Made in the USA: Trains, Rails, Ties, & Ballast produced domestically
- SMART contracts have put >\$24M into the local economy

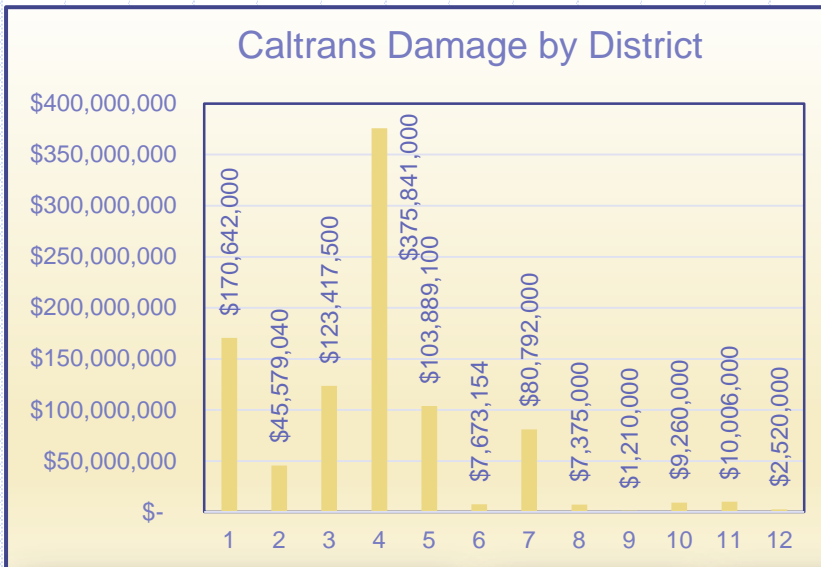




# San Francisco Bay Area Planned Express Lanes Projects

	<u>Begin Construction</u>	<u>Expected Opening</u>
Alameda/Santa Clara I-680 (Southbound)	2008	Opened 9/20/2010
Santa Clara 880/237 (Connectors)	2011	Opened 3/20/2012
Eastbound Alameda I-580	2014	Opened 2/19/2016
Westbound Alameda I-580	2014	Opened 2/20/2016
Contra Costa 680	2015	2017 ← <b>Next</b>
Santa Clara State Route 237	2017	2018
Alameda I-880	2017	2019
Alameda I-680 (Northbound)	2017	2019
Alameda 84 & 92	2017	2020
Solano I-80	2018	2021
Alameda I-80	TBD	TBD
Santa Clara State Route 85	TBD	TBD

- Recent 2017 storms: 21 Bay Area vulnerable locations



County	Repair Costs	Number of Incidents
Alameda	\$ 37,425,000	37
Contra Costa	\$ 8,805,000	7
Marin	\$ 104,071,000	58
Napa	\$ 20,240,000	61
Santa Clara	\$ 79,125,000	85
San Francisco	\$ 675,000	19
San Mateo	\$ 68,045,000	61
Solano	\$ 17,480,000	35
Sonoma	\$ 39,975,000	102
<b>Total</b>	<b>\$375,841,000</b>	<b>465</b>





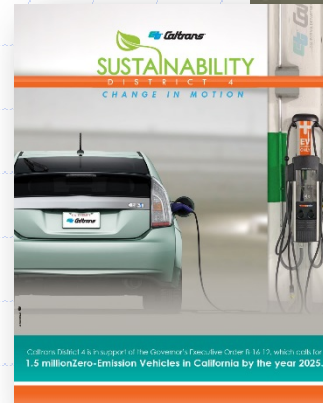
- **Caltrans Green Fleet & Green Building Measures**
- **ZEV 30-30: Charging Stations at 30 locations in 30 months (Park & Ride Lots, and Maintenance Stations)**
- **Water Savings: Smart controllers for landscaping irrigation & Recycled Water**
- **Recycled construction materials (asphalt and concrete)**
- **LEED Gold Certified, SFOBB Maintenance Complex**
- **Implosion project at SFOBB**
  - (Construction Manager General Contractor hired micro-blasting sub minimized water pollutant and reduced Carbon footprint.)



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Caltrans District 4 is a supporter of the Governor's Executive Order E-16-10, which calls for 1.5 million Zero-Emission Vehicles in California by the year 2025.



# California High Speed Rail

- Over the next 30/40 years, California will add the current population of New York state to its current 38 million residents.
- First high speed rail (HSR) system in the nation, California HSR will connect mega-regions, contribute to economic development & a cleaner environment, create jobs and preserve agricultural and protected lands.
- By 2029, the system will run from San Francisco to the Los Angeles basin in under three hours at speeds over 200 MPH.
- HSR will eventually extend to Sacramento and San Diego, totaling 800 miles with up to 24 stations.
- **ENVIRONMENTAL/QUALITY OF LIFE BENEFITS**
  - Tree planting and other programs will result in about 520,000 tons of GHG reductions.
  - In first year of operation HSR will take the equivalent of 31,000 passenger vehicles off road.
  - Caltrain electrification program will reduce an estimated 68 thousand tons of CO<sup>2</sup> a year starting in 2019.

