CALIFORNIA
High-Speed Rail Authority

AT-GRADE CROSSING SAFETY IN NORTHERN CALIFORNIA

Safety is a top priority for the California High-Speed Rail Authority (Authority). Portions of the high-speed rail alignment between San Francisco and Gilroy will operate at-grade, allowing for vehicle and pedestrian crossings. South of Gilroy, the dedicated alignment means there are no at-grade crossings until the train reaches the Los Angeles region.

Speeds and Safety Requirements

The current maximum speed for rail operations between San Francisco and Gilroy is 79 mph. The project improvements will increase the maximum speeds to 110 mph, which is the maximum speed allowed by the Federal Railroad Administration (FRA) for at-grade crossings.

FRA estimates that 94 percent of train-vehicle collisions can be attributed to driver behavior or poor judgment (FRA 2015). A 2012 study for the California Department of Transportation indicated a key solution to rail crossing collisions is to make it more difficult for a driver to bypass lowered gates. Median separators and long-arm or four-quadrant gates have been shown to reduce collisions by making it difficult for vehicles to bypass the gates. A four-quadrant gate system was shown to reduce the likelihood of a collision by 82 percent compared to only two-quadrant gates (Cooper and Ragland 2012).

FRA also requires states and railroads to cooperate to determine the needed warning devices, including signs, flashing lights, two-quadrant gates (close only "entering" lanes of road), long gate arms, and median barriers. FRA advocates a site-specific approach so that every crossing is evaluated individually and treated appropriately. This would include closure of two and safety improvements to 67 of the 69 existing public at-grade road crossings between San Francisco and Gilroy.

Using Technology to Improve Safety

Technological improvements play a big role in modernization by helping to monitor the rail system and make quick changes to improve safety and efficiency. The planned Automatic Train Control (ATC) system will include Positive Train Control (PTC) in compliance with FRA regulations, and Automatic Train Protection (ATP) functions of train detection, collision and overspeed prevention, broken rail detection, interlocking control, hazard detection, train separation, and work zone protection. The system will be integrated with:

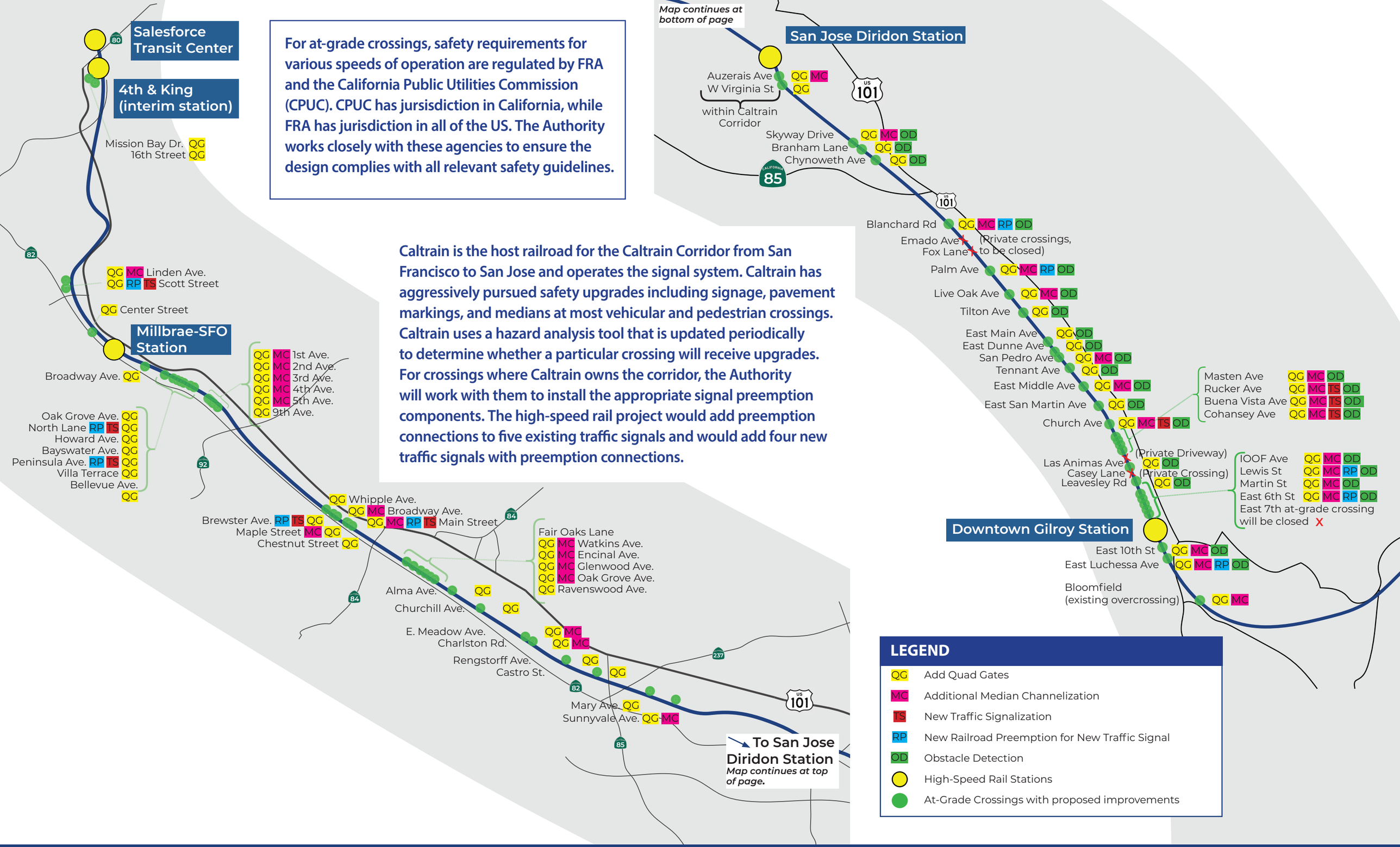
- At-grade crossing operations in the core Caltrain network North of Tamien, in addition to the crossings between Tamien and Gilroy.
- Obstacle detection on Authority-controlled portions of the right-of-way so an approaching train gets information from the ATC system about obstacles at crossings that need to be cleared before a train can proceed.
- Control of road traffic signals at at-grade crossings regulated by road traffic control systems. These systems use a one-way data exchange so that road data does not trigger lowering or raising of rail crossing barriers. The ATC grade crossing system will retain full control of the crossing gates at all times.

Traffic Signals and Signal Preemption

Connecting signal preemption to traffic signals near crossings helps clear vehicle queues away from tracks prior to a train passing through. Along the alignment, several crossings already have traffic signals with signal preemption connected. Caltrain has contracted with Wabtec Corporation to implement the Interoperable Electronic Train Management System (I-ETMS) Positive Train Control system. The system prevents trains from traveling onto tracks without permission, speed limit violations, unauthorized entry into work zones, and unsafe train movement in the event of human error, all of which reduce the potential for train accidents. It also monitors and ensures the train's crew complies with all operating instructions and calculates warning and braking curves as the train moves down the tracks.

For at-grade crossings, safety requirements for various speeds of operation are regulated by FRA and the California Public Utilities Commission (CPUC). CPUC has jurisdiction in California, while FRA has jurisdiction in all of the US. The Authority works closely with these agencies to ensure the design complies with all relevant safety guidelines.

Caltrain is the host railroad for the Caltrain Corridor from San Francisco to San Jose and operates the signal system. Caltrain has aggressively pursued safety upgrades including signage, pavement markings, and medians at most vehicular and pedestrian crossings. Caltrain uses a hazard analysis tool that is updated periodically to determine whether a particular crossing will receive upgrades. For crossings where Caltrain owns the corridor, the Authority will work with them to install the appropriate signal preemption components. The high-speed rail project would add preemption connections to five existing traffic signals and would add four new traffic signals with preemption connections.



LEGEND

QG	Add Quad Gates
MC	Additional Median Channelization
TS	New Traffic Signalization
RP	New Railroad Preemption for New Traffic Signal
OD	Obstacle Detection
●	High-Speed Rail Stations
●	At-Grade Crossings with proposed improvements

HOW DO THESE SAFETY IMPROVEMENTS WORK?

Glossary of Terms

Four-quadrant gates have arm mechanisms on both sides of the tracks for each vehicle travel lane. The exit gates blocking the lane leading away from the tracks are equipped with a delay, to avoid trapping vehicles on the tracks.

A median is a safety feature that helps prevent drivers from going around lowered gates in the opposing travel lane by creating a physical barrier between travel lanes.

Automatic Train Protection (ATP) functions include train detection, collision and overspeed prevention, broken rail detection, interlocking control, hazard detection, train separation, and work zone protection.

Positive Train Control (PTC) provides a proactive train control system to prevent train collision and derailments due to overspeeding, and protection of work zones. These features protect against overspeed derailments and would include containment systems designed to contain a derailed train upright within the trackway in the event of a derailment.

Electronic Train Management System (I-ETMS) includes the following features:

- New technology is integrated with existing train control and operating systems to enhance train operation and safety.
- The I-ETMS prevents track authority violations (trains occupying tracks without permission), speed limit violations, unauthorized entry into work zones, and unsafe train movement in the event of human error, all of which reduce the potential for train accidents.
- With I-ETMS, the train crew remains in control of the train. The system monitors and ensures the train crew's compliance with all operating instructions, while the I-ETMS display screen provides the train crew operating information.
- As the train moves down the track, the I-ETMS on-board computer, with the aid of an on-board geographic database and global positioning system, calculates warning and braking curves based on relevant train and track information, including speed, location, movement authority, speed restrictions, work zones, and the length of the train.
    - I-ETMS also communicates with wayside devices, checking for broken rails, proper switch alignment, and signal aspects.
    - All information is combined and analyzed in real time to provide a "safety net" for improved train operation.