

Caltrain / HSR Blended Grade Crossing & Traffic APPENDIX

Appendix A

Key Study Terms

Advance Pre-emption¹ – It is the notification of an approaching train when it is forwarded to the highway traffic signal controller by the railroad equipment in advance of the activation of railroad warning devices. This is provided to improve traffic safety and circulation at the crossings. Advance pre-emption does not affect gate down time at a crossing, rather it helps to clear off vehicles across the crossing and to reduce/eliminate traffic movements allowing vehicles to proceed towards an activated grade crossing.

At-Grade Crossing – An intersection of railroad tracks, roadways, walkways or a combination of these at the same level.

Automatic territory – Track located outside of **interlockings**.

Clockface schedule – A **timetable** schedule where trains arrive at an even interval that repeats hourly.

CBOSS (Also referred to as an Advanced Signal System²) – CBOSS is an acronym that stands for Communications Based Overlay Signal Systems. Caltrain's CBOSS system is a new generation train control systems planned for Caltrain that provides for the possibility of advanced grade crossing interfaces that may benefit grade crossing down times and is intended to meet the 2008 federal mandates, called positive train control, by 2015 and also to increase system capacity to allow for future increases in ridership demand.

Control Point (CP) – A location on the Caltrain Corridor with wayside signals that can be controlled by a Train Dispatcher, allowing trains to be held at that point as required. Almost all Control Points on the Caltrain Corridor are associated with interlockings, a collection of signals and track switches where trains can be routed from track to track as needed to maintain fluid railroad operations.

EMU (Electrical Multiple Unit) – Electrified train type where all cars provide tractive effort, a force that a train's motors generate for forward movement.

Gate Down Time – It is the time from the start of gate flashers on, to the gates come down, to the time that the gates are rising and are in a mostly vertical position after the train has passed through the crossing, when pedestrian, bicycle and vehicular traffic can safely cross the railroad crossing.

Gate Down Event – A gate down event represents an incidence of gate closure at the railroad crossing, due to a train either passing a crossing or stopping at a nearby upstream station. It can also be due to simultaneous passing of two trains in opposite directions at a crossing.

Grade-Separated Crossing – A railroad crossing where roadways and railroads cross at different elevations.

¹ Definition obtained from the California Manual on Uniform Traffic Control Devices, 2012.

² Advanced signal system is a descriptor, not an official name.

Headway – Time (either scheduled or actual) between successive trains on the corridor.

Holdout rule – An operating rule on the Caltrain Corridor that requires trains to wait for other trains to pass or finish unloading passengers at stations where pedestrians must cross the track. This only applies when a train is making a station stop, otherwise two trains can travel through the station without stopping.

Inhibit Feature – The planned CBOSS feature that allows grade crossings to remain open for automobile traffic while trains are profiled to a stop at a passenger station located at the near (upstream) side of a grade crossing.

Interconnection¹ – The electrical connection between the railroad active warning system and the highway traffic signal controller assembly for the purpose of pre-emption.

Interlocking – Control point protected by signals where movable bridges, rail crossings or turnouts exist.

Level of Service (LOS) – The Federal Highway Administration (FHWA), Caltrans, City/County Association of Governments of San Mateo County and most local jurisdictions have adopted definitions of traffic service quality, which are referred to as Levels of Service. There are six categories of LOS that in alphabetical sequence describe very good traffic conditions (LOS A) to very poor traffic conditions (LOS F). Average vehicle delay is the primary indicator that is used to classify traffic conditions into the six categories.

Non-Pre-empted Intersection – An intersection that operates independent of any activated railroad grade crossing.

Pre-empted Intersection – Interconnected vehicular traffic signal controller that uses communication from the railroad grade crossing circuitry to reduce/eliminate concurrent signals from allowing vehicles to proceed to an activated grade crossing.

Pre-emption – The transfer of normal operation of roadway traffic signals to a special control mode that prioritizes railroad crossing operations and prohibits all traffic movements allowing vehicles to proceed towards an activated grade crossing. Pre-emption has no effect on the gate down times, but it has an impact on the traffic operations at the signalized intersections located in the neighborhood of an at-grade railroad crossing.

Rolling stock – Vehicle of a trainset.

Skip-stop – Scheduling technique of alternating station stops to increase average travel speeds and to reduce trip times.

Wayside signaling – Signals alongside the track that convey to the train engineer occupancy and/or routing status ahead.

Appendix B

Train Horn Sounding, Bell Ringing, and Quiet Zone Rules

This appendix provides information on train horn and quiet zones. While this topic is not the focus of this study, it was added to address questions and misunderstandings from stakeholders that surfaced through the study process.

The appendix provides the key facts associated with train horn, bell and whistle sounding rules and information about quiet zones.

Train Sounding Rules

The uses of locomotive horns at at-grade crossings for railroads in the United States are defined in the Code of Federal Regulations. Further definition is also provided in the General Code of Operating Rules (GCOR).

The train horn sounding rules state that a locomotive engineer would sound the train horn as a warning whenever necessary to ensure the safe operation of a train and safety to persons on or near the track. Specifically, the locomotive engineer must sound train horns in the following circumstances:

- When persons or livestock are on the track at other than road crossings at-grade;
- To warn railroad employees when an emergency exists;
- When approaching public at-grade crossings (the locomotive engineer is to prolong the train horn until locomotive completely occupies the crossing); and
- When approaching persons or equipment on or near the track; and
- Prior to initiating movement if the engine bell is defective.

The locomotive engineer also must sound train horns in the following circumstances, but may use other forms of communication (i.e. bell, whistle or flashing headlights) in place of a train horn:

- When air brakes are applied and pressure is equalized;
- When releasing brakes and proceeding from a stopped position;
- When acknowledging any signal not otherwise provided for (i.e. a hand held signal in a work zone?);
- When backing up from a stopped position; and
- When requesting a signal to be given or repeated if not understood.

Locomotive horn sound level requirements state that each lead locomotive shall be equipped with a horn that produces a minimum sound level of 96 dB(A) and a maximum sound level of 110 dB(A) at 100 feet forward of the locomotive in its direction of travel. The locomotive horn shall be arranged so that it can be conveniently operated from the engineer's usual position during operation of the locomotive.

The use of train bells at at-grade crossings for railroads in the United States is also defined in the GCOR. The following circumstances direct the locomotive engineer to sound the train bell:

- Before moving, except when making momentary stop and start switching movements;
- As a warning signal anytime it is necessary;
- When approaching men or equipment on or near the track; and
- Approaching public crossings at grade.

In addition to the use of horns and bells, the locomotive engineer would sound the train whistle when passing through passenger stations if the engine bell is inoperative.

Quiet Zones

Quiet zones must be a minimum of one-half mile in length and comprise one or more public at-grade crossings and may be multi-jurisdictional. A quiet zone is a location where locomotive engineers are not supposed to blow their horns except when:

- Necessary to provide warning in an emergency;
- Notified automatic warning devices are malfunctioning;
- Notified automatic warning devices are out of service;
- The quiet zone is not in effect during specified hours; (i.e. an "Intermediate Partial Quiet Zone" – where the quiet zone has specified periods of time)
- At locomotive operator's discretion to ensure safety.

In addition to the circumstances described above, in the Caltrain corridor, currently the train horn is required to activate gate arms for at-grade crossings that are adjacent to stations in order to descend the gates when the train is ready to depart the station.

It must be clearly understood that quiet zones do not eliminate horn sounding.

In addition to understanding what a quiet zone means in terms of reducing horn noise, it is just as important to understand the process of establishing a quiet zone which would be initiated by the public authority of the crossing. The public authority means the public entity responsible for traffic control or law enforcement at the public highway-rail vehicular or pedestrian crossing.

The FRA regulations for establishing a quiet zone addresses minimum requirements/eligibility, the evaluation process and crossing qualifications that must be met in order to request a quiet zone. The FRA provides a quiet zone calculator to assess the risk of eliminating the train horn at each crossing within a proposed quiet zone. This tool takes into account factors such as past traffic accidents at the

crossing, train frequency and other factors. The result of this assessment is a risk index which indicates if the quiet zone criteria have been met and if Supplemental Safety Measures (SSMs) are needed to meet the criteria.

SSMs include:

- Temporary closure of a grade crossing;
- Four-quadrant gate system;
- Two-quadrant gates with medians or channelization of specific lengths on the approaches;
- Gates blocking a one-way street; and
- Permanent closure of a grade crossing.

Other important considerations that all involved stakeholders should deliberate before requesting quiet zones include capital costs, on-going operating & maintenance costs, monitoring and reporting to the FRA, and liability responsibilities.

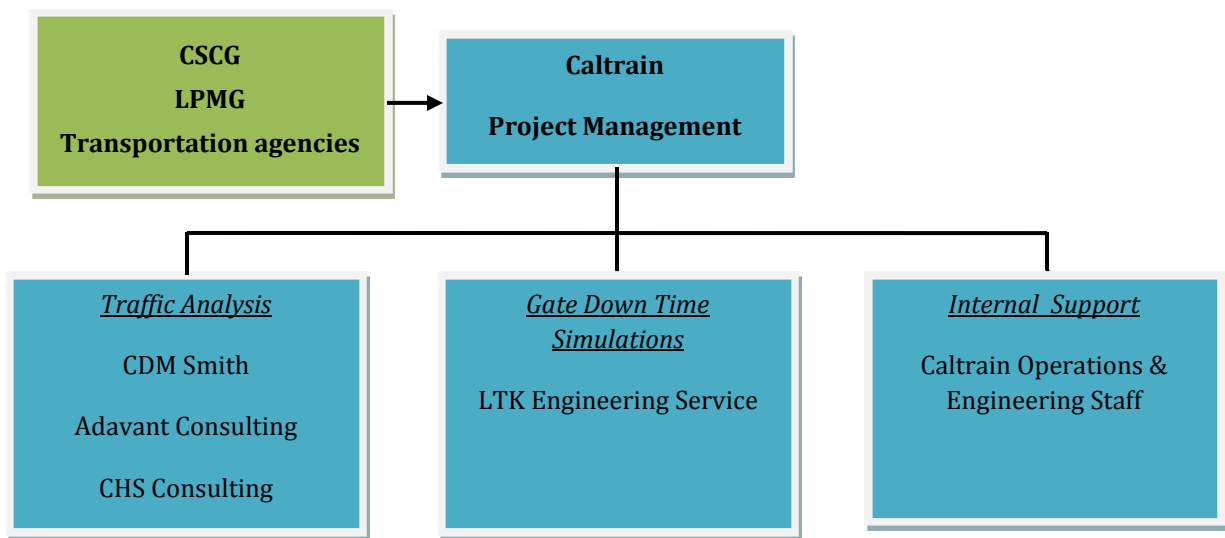
Appendix C

Stakeholder Outreach

This report was initiated in early 2012. The scope of the report was informed by stakeholders including city and county staff, elected officials, regional transportation agencies, and the California High Speed Rail Authority (CHSRA).

The project was managed by Caltrain staff with support from several consultants and in-house operations and engineering staff. The report was guided by input from the City/County Staff Coordination Group (CSCG) which is comprised of senior staff from the 17 cities and 3 counties that are directly impacted by the blended system; the Local Policy Maker Group (LPMG), which is made up of elected officials from the same 17 cities and 3 counties; and transportation agencies such as the California High-Speed Rail Authority and Santa Clara Valley Transportation Authority. **See Figure C1.**

Figure C-1: Project Organization



Preliminary findings from the analysis were shared with the CSCG and LPMG in the Fall of 2012. During January and February 2013, presentations on the preliminary findings were shared with the public, as requested and feedback on the preliminary findings presentations were incorporated into the draft report.

Caltrain staff sought another round of comments from the CSCG and transportation agencies in May and the draft report was released to the public in early June. Presentations on the draft report were given to the CSCG, LPMG, and public entities such as Friends of Caltrain.

Comments on the draft report were due June 14, 2013. All comments received and the staff responses are noted in **attached Table C1**. The comments cover a range of topics and categorized by source. Based on these comments, appropriate modifications to the draft report were made and reflected in the final report.

**TABLE 1 DRAFT Caltrain / HSR Blended Grade Crossing and Traffic Analysis
Comments and Response to Comments - June 2013**

**This table includes only those comments that are relevant to the scope of study. Other comments have been logged for future reference.
The comments included in the table have been abbreviated by staff.**

***Note: See Attachment A – Additional studies are planned as part of the Caltrain / HSR Blended System planning process.**

From	Comments	Caltrain Responses
Comments from Cities, Counties		
Atherton	Until more definitive studies are developed, it is impossible to make judgments about the preferred Blended System alternative or about the impact of the Blended System on any particular grade crossing.	Agreed. Additional studies are needed to define and analyze the blended system.*
	In the simulation examples, the restoration of service to Atherton is minimal, with only one train per hour in each direction during the peak periods. It seems appropriate to consider more weekday stops to improve the overall utility of the service.	The precise electrification schedule has not yet been determined. Prior to Caltrain schedule modifications, public discussions will take place. It should be noted though that level of ridership does influence station frequency - more riders justifies more service.
	At this point in the Blended System planning process the CEQA process should be invoked and an initial study undertaken to determine if the CEQA process should be followed.	The JPB is the lead agency in the EIR process for the Peninsula Corridor Electrification Project (PCEP). The CHSRA will be the lead agency for environmentally clearing the Blended System project.
Menlo Park	Non-preempted signals within the direct vicinity of the train tracks may experience levels of delay similar to a pre-empted intersection.	Noted.
	Additional noise and vibrations caused by increased speeds of up to 110 mph needs to be clearly stated and addressed.	Noise and vibration analysis is not in this study scope. It will be analyzed when the Blended System EIR/EIS is prepared.
	The traffic model used for this analysis (Synchro) does not provide for the inclusion of a rail system. The City requests that a SimTraffic analysis be completed.	Due to Synchro limitations, this study was re-scoped and the results were qualified to reflect model limitations. Additional traffic analysis will be prepared as part of the PCEP EIR and blended system planning process.* SimTraffic and other tools will be considered for use.
	The City has continued concerns about Caltrain and HSR sharing the tracks along the Peninsula. The City is only interested in a two-track blended system within Menlo Park, within the Caltrain right-of-way in an underground configuration.	That is JPB's understanding.

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Comments from Cities, Counties		
Mountain View	The assumed efficiencies of the advanced signal system in addition to the schedule coordination to facilitate trains passing in opposite directions at the crossing to reduce gate down times may be overly optimistic and time savings in the study may be exaggerated.	It is unclear if the results of the study are overly optimistic. The model inputs reflect performance attributes of the advanced signal system design. And the prototypical schedule was developed to provide a range of station service levels linked to station ridership. No schedule modifications were made to orchestrate trains crossing at the same time at a crossing to reduce the gate down time.
	The study uses a traffic modeling software, Synchro, which does not have the ability to model signal preemption. The City suggests using other software systems such as VISSIM that have the ability to model signal preemption.	Additional traffic analysis will be prepared as part of the PCEP EIR and blended system planning process.* VISSIM and other tools will be considered to conduct additional studies.
	The study should analyze the change in gate down time associated with the efficiencies of advanced signal system, with no increase in Caltrain service.	The suggested scenario was not included in the study because the purpose of the study was to understand how increased service would impact gate downtime.
	Include a better explanation of how the draft Study can be used to help define the blended service schedule, grade crossing improvements and local traffic circulation strategies.	Explanation is reflected in the final report.
	The study assumes the long-middle four-track passing track option for the gate down time simulation. The use of this option for the simulation appears to indicate that the south four-track passing track option is not a viable option.	There are five passing track options. The south four-track passing track option is one of the five options. The model shows all are viable but they do have differing operational performance.
	The study downplays the major issues of safety surrounding the City's two at-grade crossings, Castro Street and Rengstorff Avenue, including pedestrian and bicycle circulation.	The purpose of the study is to assess operational performance of the railroad. Safety issues is important but not the topic for this analysis.
	The study does not analyze grade separating Castro Street.	The purpose of the study is to assess operational performance at the existing at-grade crossings and inform future discussions about grade separations. The purpose of the study was not assessing grade separations.
Palo Alto	Comments made in the City of Palo Alto Caltrain Electrification Notice of Preparation (NOP) letter should also apply to this report.	The NOP comments related to the PCEP EIR will be addressed through the environmental process currently underway.
	The "base" draft traffic study used in this analysis utilizes ABAG 2035 growth projections. Those predictions, however, predict significant growth that may not be representative of actual population conditions in 2035. Include two alternative scenarios: (1) utilizing the Department of Finance population projections, and (2) a no growth in population scenario.	We understand that the ABAG 2035 projections are in many cases higher than local growth projections. However, ABAG projections are the best available regional-scale long-term estimates of future population, housing, and employment growth for the region and used by transportation providers for long-term planning.

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Comments from Cities, Counties		
San Francisco	Will there be an "Existing Conditions + Caltrain Modernization" scenario presented?	No additional analysis will be conducted as part of this study. However, the suggested scenario will be analyzed as part of the PCEP EIR .
	Include the volume to capacity (V/C) ratio for the traffic analysis results in the report.	V/C ratio data will not be included in the report but can be made available to the city if requested. Because the traffic analysis results have limited application, adding additional detailed results may increase the level of speculation regarding application of study results and misunderstandings.
	For the 16th Street crossing, why did the average gate down time per event in the AM peak increase? Wouldn't the gate time per event be improved due to faster acceleration / deceleration and CBOSS?	It is true that the electric vehicles can accelerate and decelerate faster than today's diesel trains. However, for this location, the tested prototypical schedule has more of a significant influence on the gate down time. This is because of the speed restrictions coming in and out of the terminal. In terms of the tested schedule, these results are showing that the trains are crossing the 16th Street crossing more efficiently today than under the tested prototypical schedules.
	Why did the level of service in the PM improve, considering it is degraded in the AM?	All of the results are highly contingent on the tested schedule. As is true today, the AM peak schedule is not the same as in the PM peak. Under the tested prototypical schedule, the average gate down time in all of the future blended system PM peak scenarios is more than 10 seconds less than the average gate down time today. The LOS is reflective of the decreased average gate down time per event.
	Tables 3-1 through 3-6 report increased total gate time across all scenarios, which seem to contradict these findings of improvements in PM LOS.	No. Tables 3-1 through 3-6 show today's gate down time, the future change and the total gate down time for each crossing under the "6/0", "6/2" and "6/4" blended system scenarios. These tables show both increases and decreases in total gate down time which varies by scenario and by location.
San Mateo	The information in the report could be distracting from key findings, including, the future conditions LOS study results not matching local estimates. However, the web page information and Chapter 5 does a great job of focusing attention on the key findings.	Thank you.
Sunnyvale	As you move forward with defining parameters and policy that will govern the scope of the grade crossing improvement program, consider the degree of impact on crossings from blended system operations. Remedying some locations to minimize or alleviate impact may have more environmental benefit than attempting to improve locations that are functionally built out.	Noted. This consideration will be factored in the Blended System planning efforts to come.*

TABLE 1 DRAFT Caltrain / HSR Blended Grade Crossing and Traffic Analysis
Comments and Response to Comments - June 2013

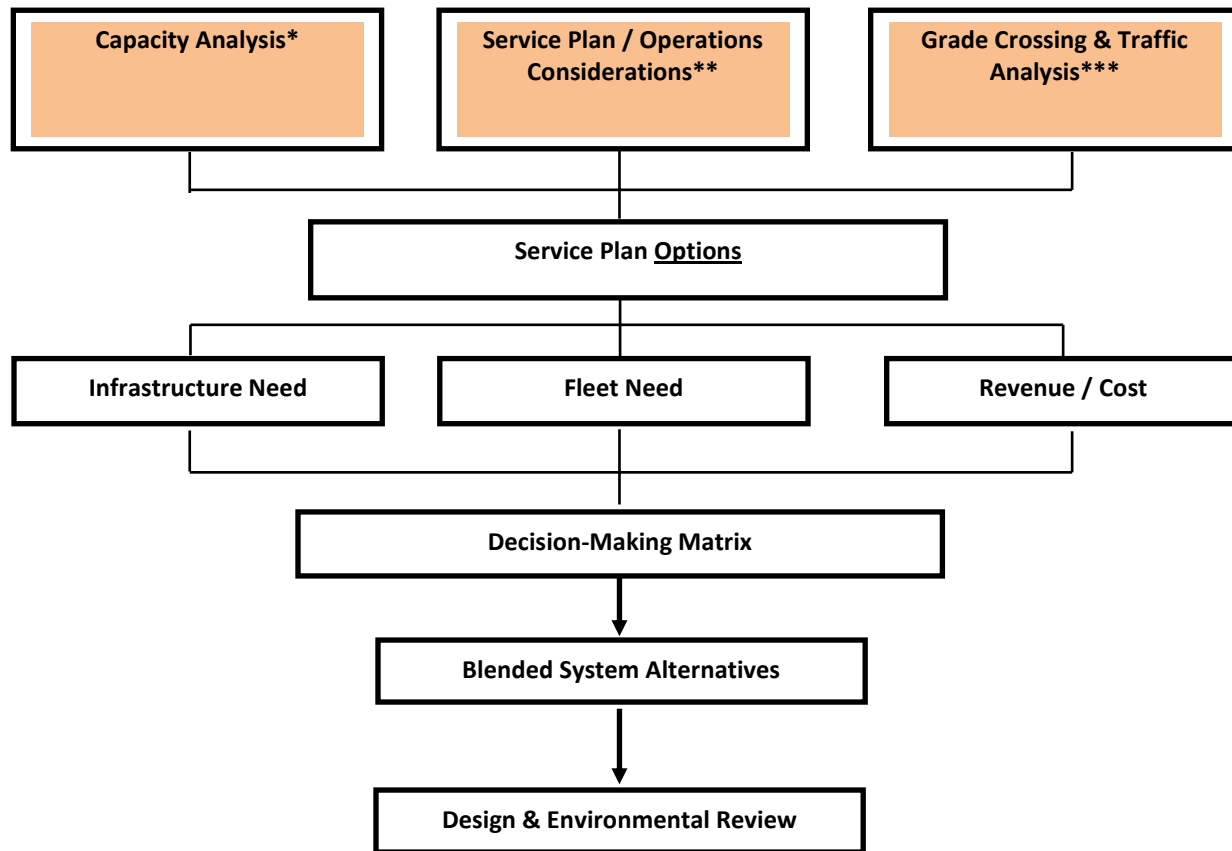
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From	Comments	Caltrain Responses
Comments from Cities, Counties		
Santa Clara County	The study should be re-scoped for Central Expressway / Rengstorff Avenue and Central Expressway / Castro Street to understand level of sensitivity between future gate down times and local traffic level of service.	No further traffic analysis is being contemplated as part of this study. However, additional traffic analysis will be prepared for the PCEP EIR.
	Recommend an increase in advance preemption time at both Central Expressway / Rengstorff Avenue and Central Expressway / Castro Street per LA DOT calculations.	
	Include safety improvements, not limited to a right turn lane for eastbound traffic on Central Expressway / Rengstorff Avenue. Traffic queuing from the train gates creates a safety hazard.	Additional traffic analysis will be prepared as part of the PCEP EIR and blended system planning process.* Other model tools will be considered for use.
	Reconsider the usefulness of evaluating preempted traffic signals with Synchro.	
	Remove "double gate action" at Central Expressway / Castro Street, due to train stopping at a station nearby with improved detection technology already in use at other locations.	The elimination of the "double gate action" is planned to occur with the implementation of the new advanced signal system, anticipated to be installed by 2015.
	Grade separations at Central Expressway / Rengstorff Avenue and Central Expressway / Castro Street are recommended to improve safety and operational benefits for residents / commuters.	Noted.
Comments form Advocacy Groups		
Friends of Caltrain	A critical timeframe will be 2019 when Caltrain will be electrified. The long-term ABAG 2035 forecasts show dramatic increases in vehicle trips, regardless of any changes to train service. This seems incompatible with longer term trends in VMT and the region's legal requirement for VMT reduction under SB375.	We understand that the ABAG 2035 projections are in many cases significantly higher than projected local growth projections. However, ABAG projections are the best available regional-scale long-term estimates of future population, housing, and employment growth and used by regional transportation providers for long-term planning. No additional analysis will be conducted as part of this study. However, additional analysis will be prepared as part of the PCEP EIR and the Blended System planning process.*
Comments from Individuals		
Stephen Rosenblum	The sole transit benefit of this system is proposed to be an increase in the number of day and evening rush hour Caltrain's from 5 to 6 per hour. There will be no improvement in the San Francisco to San Jose travel time.	It's too early to say. The prototypical schedules do not reflect decreases in SF to SJ travel times. But there are on-going discussions about if the planned efficiencies in the system should be applied to increasing station stops and/or reducing travel times. Decisions on this topic has not yet been made.
	The analysis centered on changes in gate down time at the crossings. It appeared that any performance improvement was mainly due to CBOSS and train electrification had little to do with it.	The key drivers to improved gate down time are the advanced signal system and multiple trains crossing at the same at-grade crossing.
	The critical point is whether the system chooses to use its funds to allow building grade separations.	There is no funding for grade separations in the \$1.5B early investment program. However, through other efforts, Caltrain is continuing to work with local communities on grade separation projects.

Attachment A: Caltrain / HSR Blended system Planning Process

The following is a visual depiction of the proposed planning process for conceptually defining the blended system.



The process is focused on:

1. Gathering technical information and education about priority operational issues
2. Using technical information to inform development of the blended service options
3. Identifying tradeoffs for each option related to infrastructure / fleet needs and revenue/cost assumptions
4. Developing a decision-making matrix and facilitating policy discussions
5. Selecting project alternatives for environmental evaluation

In 2012, Caltrain conducted the **Caltrain/ California HSR Blended Operations Analysis***, which showed that a blended system is operationally viable in the peninsula corridor. Following, in 2013, Caltrain prepared two studies called the **Caltrain / HSR Blended Service Plan/ Operations Considerations Analysis **** and the **Caltrain / HSR Blended Grade Crossing and Traffic Analysis *****. All three studies address step #1 in the process described above.

Tasks associated with the remaining boxes are to be conducted. Timing is to be developed allowing for prioritization of the peninsula corridor electrification program delivery and consistency with the CHSRA business plan.

Appendix D

Highway Capacity Manual 2000 Methodology

Intersection LOS Definitions

Table D-1: Level of Service Criteria and Definitions for Signalized Intersections

Level of Service	Stopped Delay (seconds/vehicle)	Typical Traffic Condition
A	≤ 10.0	Very Low Delays: Progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all.
B	> 10.0 and ≤ 20.0	Minimal Delays: Generally good progression, short cycle lengths, or both. More vehicles stop than with LOS A, causing higher levels of average delay. Drivers begin to feel restricted.
C	> 20.0 and ≤ 35.0	Acceptable Delays: Fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear, though many still pass through the intersection without stopping. Most drivers feel somewhat restricted.
D	> 35.0 and ≤ 55.0	Tolerable Delays: The influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high v/c ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable. Queues may develop but dissipate rapidly, without excessive delays.
E	> 55.0 and ≤ 80.0	Significant Delays: Considered by many agencies to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent occurrences. Vehicles may wait through several signal cycles and long queues of vehicles form upstream.
F	> 80.0	Excessive Delays: Considered to be unacceptable to most drivers. Often occurs with oversaturation, that is, when arrival flow rates exceed the capacity of the intersection. Poor progression and long cycle lengths may also be major contributing causes to such delay levels. Queues may block upstream intersections.

Source: Highway Capacity Manual 2000, Transportation Research Board

Table D-2: Level of Service Criteria and Definitions for Two-Way Stop-Controlled Intersections

Level of Service	Average Total Delay (seconds/vehicle)	Typical Traffic Condition
A	≤ 10	Little or no delay
B	> 10 and ≤ 15	Short traffic delays
C	> 15 and ≤ 25	Average traffic delays
D	> 25 and ≤ 35	Long traffic delays
E	> 35 and ≤ 50	Very long traffic delays
F	> 50	*

Source: Highway Capacity Manual 2000, Transportation Research Board

Note: *Level of Service F exists when there are insufficient gaps of suitable size to allow a side street demand to cross safely through a major street traffic stream. This level of service is generally evident from extremely long total delays experienced by side street traffic and by queuing on the minor approaches.

Table D-3: Level of Service Criteria for All-Way Stop-Controlled Intersections

Level of Service	Average Total Delay (seconds/vehicle)
A	≤ 10
B	> 10 and ≤ 15
C	> 15 and ≤ 25
D	> 25 and ≤ 35
E	> 35 and ≤ 50
F	> 50

Source: Highway Capacity Manual 2000, Transportation Research Board

Appendix E-1

Simulated Traffic Methodology

1. Terminology

- An event represents an incidence of gate closure at the railroad crossing. It can be due to one or more trains traveling across the railroad crossing at the same time.

2. Methodology

1. Railway tracks are represented in a Synchro model as a two-way roadway with one lane in each direction, a railroad crossing as an intersection controlled by a traffic signal, and trains as large trucks traveling along the two-way roadway as shown in **Figure 1**.

Figure 1: Field Conditions vs. Synchro Model



Field Conditions

Synchro Model Representation

2. The traffic signal at a railroad crossing is coded to operate in conjunction with the traffic signal at the neighboring pre-empted intersection, i.e., both these traffic signals are coded to operate as a single traffic controller. In the example shown in Figure 1, the traffic signal at the railroad crossing (Signal 1) and the traffic signal at the neighboring pre-empted intersection (Signal 2) are coded to operate as a single traffic controller. This function would enable coordinated traffic movement at the neighboring pre-empted intersection with the arrival and departure of trains.

Traffic signal at a railroad crossing is coded to operate independently in the absence of a neighboring pre-empted intersection.

3. To code an operational railroad crossing in Synchro, two inputs are required – the number of events and the duration of an event. Both these inputs are obtained by post-processing the crossing data provided by LTK as follows:
 - a. A peak hour is identified for each peak period of traffic analysis (AM peak period from 7 to 9 AM and PM peak period from 4 to 6 PM). Peak hour

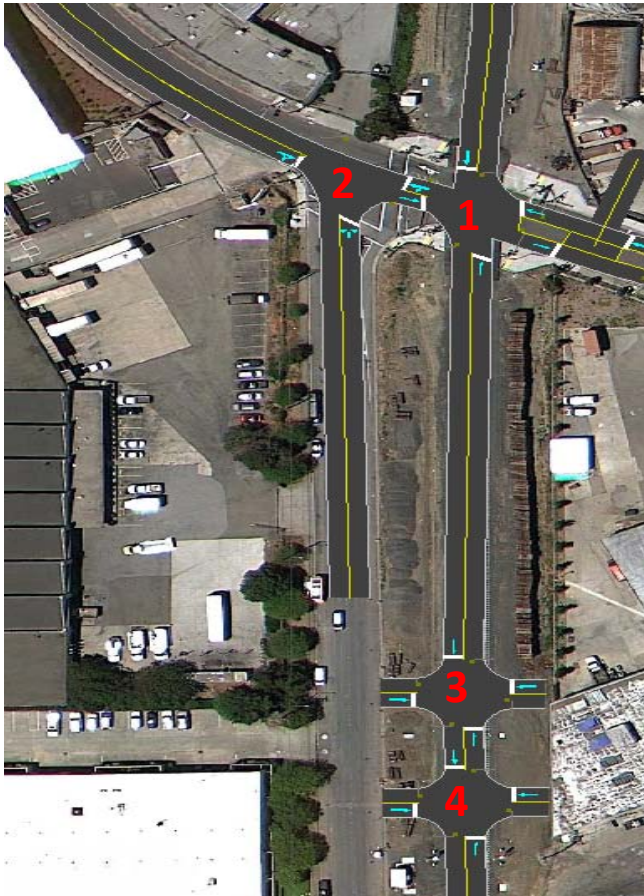
represents the hour within the peak period that has the highest cumulative gate downtime. In the example shown in **Figure 2**, the peak hour would be from 8 to 9 AM, since it has the highest cumulative gate downtime (429 seconds). The peak hour is identified for each crossing and peak period separately. The number of events and average gate downtime corresponding to the identified peak hour are used as Synchro inputs. In the following example, the railroad crossing gate closes nine times in an hour for about 48 seconds each time.

Figure 2: Example for Post-Processing of Crossing Data

AM Peak Period			Gates Downtime (s)	
From	To	Event Count	Cumulative	Average
7:00:00 AM	8:00:00 AM	10	388	38.8
7:15:00 AM	8:15:00 AM	10	393	39.3
7:30:00 AM	8:30:00 AM	9	398	44.2
7:45:00 AM	8:45:00 AM	8	386	48.3
8:00:00 AM	9:00:00 AM	9	429	47.7

- At crossings where advance pre-emption is provided, another dummy signalized intersection is created on the railway tracks upstream of the railroad crossing as shown in **Figure 3**.

Figure 3: Advance Pre-emption Representation in Synchro Model



In the example shown in Figure 3, Signal 3 was coded such that when a train starts leaving this signal, the advance pre-emption is activated. The regular pre-emption will be activated when the train starts leaving Signal 1. The advance and regular preemptions will be activated only when a train arrives at Signals 3 and 1. In all other scenarios, Signal 2 would operate normally.

5. To ensure that the number of events and gate downtimes identified from the crossing data are represented properly in the Synchro model, the following additional coding was performed:
 - a. All trains are coded to travel in one direction. This will avoid two events occurring at the same time in the Synchro model due to two trains crossing the gate, one in either direction at the same time.
 - b. Another dummy signalized intersection (Signal 4) is created on the railway tracks just upstream of Signal 3. This intersection and its traffic signal are designed in such a way that only one vehicle at a time reaches Signal 3 and in turn Signal 1. Since the number of events can be controlled in Synchro, but not the schedule of events, there may be situations when two or more vehicles travel together along the railway track, which would reduce the number of events occurring in the Synchro model. The device discussed above would avoid those situations.
6. As mentioned in Step 5, the schedule of events cannot be controlled in a Synchro model; vehicles are generated randomly. This is because microsimulation tools utilize algorithms that consider and reflect the interaction of individual vehicles throughout the given roadway network. Microsimulation tools assign probabilities to many of the decisions drivers make on a sub-second level (for example; whether or not to make a lane change) for the purpose of better reflecting the randomness inherent in the field. Random numbers are generated within the microsimulation tool to account for the fact that drivers do not always make the same decisions under the same conditions. As a result, a fixed set of assumptions and known conditions could generate different output results in separate runs.

To account for this, multiple runs using the same assumptions and conditions are performed. Single runs that are not representative of the random nature of these tools will reduce the credibility of the analysis and reduce the acceptance of the results. Therefore, for this project five different runs will be performed for each Synchro model and an average of the five runs will be used to obtain queuing lengths.

Appendix E-2

Model Validation Results

A summary of existing peak hour traffic operations for all of the at-grade crossing intersections are provided in **Table E-2.1**.

Table E-2.1 Existing Conditions (LOS and Delay Value)

City	#	Intersection	Traffic Control	Average Delay (sec per vehicle) / LOS	
				AM Peak	PM Peak
San Francisco	1	Mission Bay Drive/7 th Street	Signal	13.3 / B	15.7 / B
	2	Mission Bay Drive/Berry Street	Signal	-	-
	3	16th Street/7 th Street/Mississippi Street	Signal	42.1 / D	35.2 / D
	4	16th Street/Owens Street	Signal	12.8 / B	20.1 / C
South San Francisco	5	Linden Avenue/Herman Street/Dollar Avenue	Signal	15.3 / B	20.7 / C
	6	Linden Avenue/San Mateo Avenue	Signal	12.6 / B	14.6 / B
San Bruno	7	Scott Street/Herman Street ¹	3WSC	11.9 (NB) / B	9.1 (NB) / A
	8	Scott Street/Montgomery Avenue	2WSC	10.6 (NB) / B	11.4 (NB) / B
Millbrae	9	Center Street/El Camino Real	Signal	11.4 / B	10.7 / B
	10	Center Street/Monterey Street	3WSC	7.7 (NB) / A	7.7 (NB) / A
Burlingame	11	Broadway/California Drive	Signal	>80 / F	>80 / F
	12	Broadway Avenue/Carolan Avenue	Signal	43.7 / D	54.3 / D
	13	Oak Grove Avenue/California Drive	Signal	36.9 / D	40.4 / D
	14	Oak Grove Avenue/Carolan Avenue ¹	3WSC	>50 (WB) / F	>50 (WB) / F
	15	North Lane/California Drive	1WSC	27.1 (WB) / D	26.3 (WB) / D
	16	North Lane/Carolan Avenue	2WSC	20.4 (NB) / C	13.8 (NB) / B
	17	Howard Avenue/California Drive	Signal	12.9 / B	17.5 / B
	18	Howard Avenue/East Lane	1WSC	10.9 (SB) / B	11.4 (SB) / B
	19	Bayswater Avenue/California Drive	Signal	9.9 / A	9.7 / A
	20	Bayswater Avenue/Anita Road	2WSC	11.0 (NB) / B	10.6 (NB) / B
	21	Peninsula Avenue/California Dr./San Mateo Dr.	Signal	15.6 / B	16.5 / B
San Mateo	22	Peninsula Avenue/Arundel Rd/Woodside Way	2WSC	33.0 (SB) / D	34.7 (NB) / D
	23	Villa Terrace/San Mateo Drive	2WSC	27.1 (WB) / D	28.0 (WB) / D
	24	Villa Terrace/Woodside Way	2WSC	9.8 (NB) / A	9.2 (NB) / A
	25	Bellevue Avenue/San Mateo Drive	AWSC	22.6 (SB) / C	16.9 (NB) / C
	26	Bellevue Avenue/Claremont Street	AWSC	9.2 (WB) / A	7.9 (EB) / A
	27	1 st Avenue/B Street	Signal	7.3 / A	8.4 / A
	28	1 st Avenue/Delaware Street	Signal	3.6 / A	6.6 / A
	29	2 nd Avenue/B Street	Signal	8.3 / A	9.9 / A
	30	2 nd Avenue/Delaware Street	Signal	9.8 / A	18.8 / B
	31	3 rd Avenue/B Street	Signal	13.1 / B	14.5 / B
	32	3 rd Avenue/Claremont Street	Signal	6.2 / A	7.5 / A
	33	4 th Avenue/B Street	Signal	12.8 / B	14.5 / B
	34	4 th Avenue/Claremont Street	Signal	8.3 / A	9.3 / A
	35	5 th Avenue/B Street	Signal	10.5 / B	11.4 / B
	36	5 th Avenue/Delaware Street	Signal	12.4 / B	11.1 / B
	37	9 th Avenue/B Street	Signal	8.1 / A	8.1 / A
	38	9 th Avenue/Delaware Street	Signal	11.8 / B	12.8 / B

City	#	Intersection	Traffic Control	Average Delay (sec per vehicle) / LOS	
				AM Peak	PM Peak
San Mateo	39	25 th Avenue/El Camino Real	Signal	18.8 / B	23.3 / C
	40	25 th Avenue/Delaware Street	Signal	10.2 / B	10.3 / B
Redwood City	41	Whipple Avenue/El Camino Real	Signal	47.6 / D	61.0 / E
	42	Whipple Avenue/Arguello Street	Signal	18.3 / B	23.8 / C
	43	Brewster Avenue/El Camino Real	Signal	28.2 / C	21.5 / C
	44	Brewster Avenue/Arguello Street	Signal	28.9 / C	35.4 / D
	45	Broadway/El Camino Real	Signal	22.8 / C	26.1 / C
	46	Broadway/Arguello Street/Marshall Street	Signal	16.1 / B	21.9 / C
	47	Maple Street/El Camino Real	Signal	6.1 / A	10.7 / B
	48	Maple Street/Main Street	2WSC	10.6 (NB) / B	13.8 (SB) / B
	49	Main Street/Beech Street	2WSC	11.2 (EB) / B	16.2 (WB) / C
	50	Main Street/Middlefield Road	Signal	25.4 / C	36.0 / D
	51	Chestnut Street/Main Street	Signal	12.3 / B	10.6 / B
	52	Chestnut Street/Middlefield Road	Signal	11.6 / B	14.0 / B
Atherton	53	Fair Oaks Lane/El Camino Real	Signal	54.8 / D	34.8 / C
	54	Fair Oaks Lane/Middlefield Road	2WSC	>50 (WB) / F	>50 (EB) / F
	55	Watkins Avenue/El Camino Real	1WSC	>50 (WB) / F	>50 (WB) / F
	56	Watkins Avenue/Middlefield Road	1WSC	>50 (EB) / F	>50 (EB) / F
Menlo Park	57	Encinal Avenue/El Camino Real	Signal	26.1 / C	17.7 / B
	58	Encinal Avenue/Middlefield Road	Signal	22.7 / C	13.1 / B
	59	Glenwood Avenue/El Camino Real	Signal	37.8 / D	35.7 / D
	60	Glenwood Avenue/Middlefield Road ¹	2WSC	>50 (EB) / F	43.6 / E
	61	Oak Grove Avenue/El Camino Real	Signal	48.7 / D	44.5 / D
	62	Oak Grove Avenue/Laurel Street	Signal	13.4 / B	8.9 / A
	63	Ravenswood Avenue/El Camino Real	Signal	67.5 / E	72.8 / E
	64	Ravenswood Avenue/Laurel Street	Signal	22.6 / C	14.3 / B
Palo Alto	65	Alma Street/El Camino Real	Signal	20.0 / C	27.8 / C
	66	Alma Street/Palo Alto Avenue	1WSC	15.6 (WB) / C	19.9 (WB) / C
	67	Churchill Avenue/El Camino Real	Signal	17.9 / B	17.7 / B
	68	Churchill Avenue/Alma Street	Signal	49.9 / D	71.1 / E
	69	Meadow Drive/Park Boulevard	2WSC	13.4 (NB) / B	12.1 (NB) / B
	70	Meadow Drive/Alma Street	Signal	60.0 / E	47.4 / D
	71	Charleston Road/Wilkie Way	Signal	5.3 / A	4.3 / A
	72	Charleston Road/Alma Street	Signal	>80 / F	>80 / F
Mountain View	73	Rengstorff Avenue/California Street	Signal	27.5 / C	30.5 / C
	74	Rengstorff Avenue/Central Expressway	Signal	60.9 / E	73.0 / E
	75	Castro Street/Villa Street	Signal	13.5 / B	17.4 / B
	76	Castro Street/Central Expressway	Signal	44.1 / D	55.4 / E
Sunnyvale	77	Mary Avenue/Evelyn Avenue	Signal	37.3 / D	35.8 / D
	78	Mary Avenue/California Avenue	Signal	16.2 / B	10.4 / B
	79	Sunnyvale Avenue/Evelyn Avenue	Signal	21.2 / C	25.7 / C
	80	Sunnyvale Avenue/Hendy Avenue	Signal	11.7 / B	21.8 / C

Notes:

¹ Due to limitations of HCM 2000 Methodology at unsignalized intersections, delay/LOS values were reported using SimTraffic results at this location.

1WSC – One-way stop-control, 2WSC – Two-way stop-control, 3WSC – Three-way stop-control, AWSC – All-way stop-control

NB – Northbound, SB – Southbound, EB – Eastbound, WB – Westbound

For unsignalized intersections, delay and LOS are reported for the worst operating movement, annotated in parentheses ().

To validate the model simulation of existing conditions, the LOS and delay values reported in Table E-2.1 were compared to those provided by the cities, wherever available. The LOS and delay values provided by the cities were obtained from recently completed transportation studies and environmental impact reports. Of the 80 study intersections, city-provided data was available for 25 intersections.

In general, the LOS and delay values presented in this report were similar to those provided by the cities. There were differences in the AM or PM delay values by 20 percent or more at five intersections:

- Whipple Avenue/El Camino Real
- Broadway/Arguello Street/Marshall Street
- Churchill Avenue/Alma Street
- Meadow Drive/Alma Street
- Charleston Road/Alma Street

Possible reasons for the discrepancy range from differences in traffic volumes to differences in analysis tools.

Appendix E-3

HCM Results

Intersection Operations - 2035 Conditions

City	#	Intersection	Traffic Control	Existing				2035 No Build				2035 6/0				2035 6/2				2035 6/4			
				AM Delay	LOS	PM Delay	LOS	AM Delay	LOS	PM Delay	LOS	AM Delay	LOS	PM Delay	LOS	AM Delay	LOS	PM Delay	LOS	AM Delay	LOS	PM Delay	LOS
San Francisco ¹	3	16th Street/7th Street/Mississippi Street	Signal	41.7	D	35.2	D	224.4	F	283.6	F	227.1	F	256.4	F	231.3	F	238.0	F	231.3	F	240.9	F
San Mateo	39	25th Avenue/El Camino Real	Signal	18.8	B	23.3	C	171.1	F	74.7	E	171.1	F	74.7	E	171.1	F	74.7	E	171.1	F	74.7	E
	40	25th Avenue/Delaware Street	Signal	10.2	B	10.3	B	12.4	B	13.1	B	12.5	B	15.0	B	13.1	B	15.6	B	13.1	B	15.6	B
Redwood City ²	45	Broadway/El Camino Real	Signal	22.8	C	26.1	C	47.9	D	61.5	E	47.9	D	61.5	E	47.9	D	61.5	E	47.9	D	61.5	E
Palo Alto	68	Churchill Avenue/Alma Street	Signal	49.9	D	71.1	E	103.2	F	132.5	F	107.4	F	132.5	F	108.6	F	134.1	F	117.0	F	138.6	F

Notes:

Synchro (HCM) outputs represent static results, which do not consider the effect of neighboring traffic operations on the operations of the study intersection.

Bold represents LOS E or LOS F.

1. 2035 No Build values are higher than those obtained from the UCSF Facility Office Building Traffic Analysis (LOS D during the PM peak hour), since the UCSF analysis was performed using TRAFFIX analysis tool and did not consider the effect of the railroad crossing on the intersection operations.
2. 2035 No Build values are higher than those obtained from the Redwood City Downtown Precise Plan EIR (LOS C during both the AM and PM peak hours), since the cumulative year for both the studies are different. Also, the Downtown analysis was performed using TRAFFIX analysis tool.

Intersection Operations - 2035 Conditions (Grade-Separated Rail Crossings)

City	#	Intersection	Traffic Control	Existing				2035 No Build (At-Grade Crossing)				2035 Build (Grade-Separated Crossing)			
				AM Delay	AM LOS	PM Delay	PM LOS	AM Delay	AM LOS	PM Delay	PM LOS	AM Delay	AM LOS	PM Delay	PM LOS
San Mateo	39	25th Avenue/El Camino Real	Signal	18.8	B	23.3	C	171.1	F	74.7	E	171.1	F	74.7	E
	40	25th Avenue/Delaware Street	Signal	10.2	B	10.3	B	12.4	B	13.1	B	7.3	A	8.1	A
Redwood City	45	Broadway/El Camino Real	Signal	22.8	C	26.1	C	47.9	D	61.5	E	46.5	D	61.4	E

Notes:

Synchro (HCM) outputs represent static results, which do not consider the effect of neighboring traffic operations on the operations of the study intersection.

Bold represents LOS E or LOS F.

Appendix F

Gate Down Time Sensitivity

Detailed review of the gate down time simulation results for the simulated operating plans revealed insights into the factors that contribute to increases and decreases in gate down time at individual crossings. One of the more sensitive factors is the train schedule.

To analyze the level of gate down time sensitivity to a particular schedule, an alternative schedule was tested for the “6/0” scenario. The baseline “6/0” scenario schedule is a “skip stop” zone express trains per peak hour per direction. The alternative plan utilized a Baby Bullet type operation, with 2 “super express” trains per hour per direction and 4 “skip stop” trains per hour. While the overall train volume was the same, the number of trains stopping at some individual stations on the Caltrain Corridor differed between the two operating plans.

Tables F-1 and F-2 show a sample hour of the the northbound AM Caltrain schedules simulated for the sensitivity test. Table F-1 shows the baseline “6/0” scenario and Table F-2 shows the alternative (Baby Bullet) plan.

Comparing the simulated gate down times of the two prototypical future Caltrain operating plans, the total duration of gate down time within the Caltrain corridor during the morning peak hour was similar (6 hours and 18 minutes for the baseline versus 6 hours and 24 minutes for the alternative schedule).

This system wide gate down time difference of six minutes reflects a difference of about 2%. However, individual crossing gate down times showed more significant variability between the two operating plans. For example, the 16th Street crossing in San Francisco dropped by one minute from approximately 14.5 minutes under the baseline to 13.5 minutes under the alternative schedule, a decrease of 13 percent. At the Churchill Avenue crossing in Palo Alto, there was an increase of 13 percent under the alternative compared to the baseline schedule.

Tables F-3 and F-4 show a comparison between the baseline and alternative schedule gate down times for the morning and evening peak hours.

Table F-1 Northbound Caltrain 6/0 Baseline Plan (AM Peak Hour)

Station	Train Number					
	416	418	420	422	424	426
Tamien Station		7:02a			7:32a	
San Jose Diridon Station	7:00a	7:10a	7:20a	7:30a	7:40a	7:50a
College Park Station ¹						
Santa Clara Station	7:05a			7:35a		
Lawrence Station		7:18a			7:48a	
Sunnyvale Station	7:11a	7:21a	7:30a	7:41a	7:51a	8:00a
Mountain View Station	7:16a	7:26a	7:35a	7:46a	7:56a	8:05a
San Antonio Station			7:38a			8:08a
California Ave. Station	7:21a			7:51a		
Palo Alto Station	7:25a	7:34a	7:44a	7:55a	8:04a	8:14a
Menlo Park Station		7:36a	7:46a		8:06a	8:16a
Atherton Station	7:28a					
Redwood City Station	7:32a	7:43a	7:51a	8:01a	8:13a	8:21a
San Carlos Station			7:54a			8:24a
Belmont Station		7:47a			8:17a	
Hillsdale Station	7:39a	7:50a	7:58a	8:08a	8:20a	8:28a
Hayward Park Station			8:00a			
San Mateo Station	7:42a	7:53a		8:11a	8:23a	
Burlingame Station		7:56a			8:26a	
Broadway Station				8:15a		
Millbrae Station	7:50a	8:01a	8:08a	8:19a	8:31a	8:37a
San Bruno Station			8:12a			8:41a
South SF Station	7:57a			8:26a		
Bayshore Station						8:45a
22nd Street Station			8:19a			
4th & King Station	8:04a	8:14a	8:23a	8:33a	8:44a	8:52a

Notes:¹Schedule to be determined

Table F-2 Northbound Caltrain 6/0 Alternative (Baby Bullet) Plan (AM Peak Hour)

Station	Train Number					
	416	418	420	Baby Bullet	424	Baby Bullet
Tamien Station		7:03 AM		7:24 AM	7:32 AM	
San Jose Diridon Station	7:00 AM	7:11 AM	7:18 AM	7:32 AM	7:40 AM	7:55 AM
College Park Station ¹						
Santa Clara Station	7:04 AM					
Lawrence Station		7:11 AM			7:40 AM	
Sunnyvale Station	7:09 AM	7:15 AM	7:27 AM	7:41 AM	7:44 AM	8:04 AM
Mountain View Station	7:12 AM	7:18 AM	7:30 AM		7:47 AM	
San Antonio Station			7:33 AM			
California Ave. Station	7:19 AM					
Palo Alto Station	7:20 AM	7:28 AM	7:38 AM	7:50 AM	7:57 AM	8:13 AM
Menlo Park Station		7:30 AM	7:41 AM		7:59 AM	
Atherton Station	7:25 AM					
Redwood City Station	7:27 AM	7:36 AM	7:46 AM	7:56 AM	8:05 AM	
San Carlos Station			7:49 AM			
Belmont Station		7:41 AM			8:10 AM	
Hillsdale Station	7:33 AM	7:44 AM	7:52 AM		8:13 AM	8:23 AM
Hayward Park Station			7:55 AM			
San Mateo Station	7:37 AM	7:49 AM		8:04 AM	8:18 AM	
Burlingame Station		7:51 AM			8:20 AM	
Broadway Station						
Millbrae Station	7:42 AM	7:55 AM	8:00 AM	8:09 AM	8:24 AM	8:30 AM
San Bruno Station			8:04 AM			
South SF Station	7:47 AM					
Bayshore Station						
22nd Street Station			8:13 AM			
4th & King Station	8:02 AM	8:12 AM	8:20 AM	8:26 AM	8:41 AM	8:47 AM

Notes:¹Schedule to be determined

Table F-3 Gate Down Time Summary of Changes – 6/0 Prototypical Plan versus 6/0 Sensitivity Test Plan (AM Peak Hour)

City	6/0	Sensitivity Test Plan	Model Results Approximate Minutes/Peak AM Hour	
			Decrease	Increase
San Francisco	14.5	-1.0	Mission Bay Boulevard	
	12.5	-1.0	16 th Street	
South San Francisco	10.0	-0.5	Linden Avenue	
San Bruno	9.0	-1.0	Scott Street	
Millbrae	8.5	1.0		Center Street
Burlingame	9.0	-0.5	Broadway	
	10.0	0.5		Oak Grove Avenue
	9.5	0.0	North Lane	
	10.5	0.0	Howard Avenue	
	10.0	0.0	Bayswater Avenue	
Burlingame, San Mateo	10.0	0.0	Peninsula Avenue	
San Mateo	8.5	0.5		Villa Terrace
	9.5	0.5		Bellevue Avenue
	9.0	1.0		First Avenue
	9.5	-0.5	Second Avenue	
	8.5	0.0	Third Avenue	
	8.5	0.0	Fourth Avenue	
	8.5	0.5		Fifth Avenue
	8.0	1.0		Ninth Avenue
	9.0	-1.0	25 th Avenue	
Redwood City	9.0	1.0		Whipple Avenue
	8.5	0.0	Brewster Avenue	
	11.0	0.5		Broadway
	10.0	0.5		Maple Street
	10.5	0.0	Main Street	
	9.0	0.0	Chestnut Street	
Atherton	9.0	1.0		Fair Oaks Lane (restored)
	8.5	1.0		Watkins Avenue
Menlo Park	8.5	1.0		Encinal Avenue
	9.5	0.5		Glenwood Avenue
	9.5	1.0		Oak Grove Avenue
	11.0	-1.0	Ravenswood Avenue	
Palo Alto	10.0	0.5		Alma Street
	8.0	1.0		Churchill Avenue
	8.5	-0.5	East Meadow Drive	
	9.0	-0.5	Charleston Avenue	
Mountain View	8.5	0.5		Rengstorff Avenue
	10.0	0.0	Castro Street	
Sunnyvale	8.5	0.5		Mary Avenue
	9.0	0.5		Sunnyvale Avenue

Notes:

- Represents decrease in gate down times compared to 6/0 Prototypical Plan
- Represents increase in gate down times compared to 6/0 Prototypical Plan

Table F-4 Gate Down Time Summary of Changes – 6/0 Prototypical Plan versus 6/0 Sensitivity Test Plan (PM Peak Hour)

City	6/0	Sensitivity Test Plan	Model Results Approximate Minutes/Peak PM Hour	
			Decrease	Increase
San Francisco	14.5	1.0	Mission Bay Boulevard	
	13.0	1.5	16 th Street	
South San Francisco	9.5	1.0	Linden Avenue	
San Bruno	8.5	0.5	Scott Street	
Millbrae	8.0	0.0	Center Street	
Burlingame	8.0	-1.0		Broadway
	9.5	-0.5		Oak Grove Avenue
	9.0	0.0	North Lane	
	10.0	0.5	Howard Avenue	
	9.5	0.0	Bayswater Avenue	
Burlingame, San Mateo	9.5	0.0	Peninsula Avenue	
San Mateo	8.5	-0.5		Villa Terrace
	9.5	0.0	Bellevue Avenue	
	9.0	-1.5		First Avenue
	9.5	0.0	Second Avenue	
	8.5	-0.5		Third Avenue
	8.5	-0.5		Fourth Avenue
	9.0	-0.5		Fifth Avenue
	8.5	0.0	Ninth Avenue	
	8.0	-0.5		25 th Avenue
Redwood City	9.5	-0.5		Whipple Avenue
	8.0	0.0	Brewster Avenue	
	10.5	0.0	Broadway	
	10.5	1.0	Maple Street	
	10.5	0.5	Main Street	
	8.0	-1.0		Chestnut Street
Atherton	9.0	0.5	Fair Oaks Lane	
	8.0	-0.5		Watkins Avenue
Menlo Park	8.5	-0.5		Encinal Avenue
	9.5	0.5	Glenwood Avenue	
	10.0	0.0	Oak Grove Avenue	
	11.0	0.0	Ravenswood Avenue	
	10.0	-0.5	Alma Street	
Palo Alto	6.5	-2.0	Churchill Avenue	
	8.5	-0.5	East Meadow Drive	
	8.5	-0.5	Charleston Avenue	
Mountain View	8.0	-0.5	Rengstorff Avenue	
	9.5	0.0		Castro Street
Sunnyvale	8.5	0.5		Mary Avenue
	8.5	-0.5	Sunnyvale Avenue	

Notes:

- Represents decrease in gate down times compared to 6/0 Prototypical Plan
- Represents increase in gate down times compared to 6/0 Prototypical Plan