Chapter 5
Alternatives

5.1 Introduction

CEQA requires that an EIR describe a range of reasonable alternatives to the project or to the location of the project that could feasibly avoid or lessen any significant environmental impacts while substantially attaining the basic objectives of the project. An EIR should also evaluate the comparative merits of the alternatives. This chapter analyzes the impacts of several alternatives in comparison with the potential environmental impacts associated with the Proposed Project, describes potential alternatives to the Proposed Project that were considered, and identifies alternatives that were eliminated from further consideration and reasons for dismissal.

Key provisions of the State CEQA Guidelines (Section 15126.6) pertaining to the alternatives analysis are summarized below.

- The discussion of alternatives will focus on alternatives to the project or its location that are capable of avoiding or substantially lessening any significant effects of the project, even if those alternatives would impede to some degree the attainment of the project objectives or be more costly.
- The no project alternative will be evaluated along with its impacts. The no project analysis will discuss the existing conditions at the time the notice of preparation was published as well as what would be reasonably expected to occur in the foreseeable future if the project were not approved based on current plans and consistent with available infrastructure and community services.
- The range of alternatives required in an EIR is governed by a "rule of reason"; therefore, the EIR must evaluate only those alternatives necessary to permit a reasoned choice. Alternatives will be limited to those that would avoid or substantially lessen any of the significant effects of the project.
- An EIR need not consider an alternative with effects that cannot be reasonably ascertained, when implementation is remote and speculative, and if its selection would not achieve the basic project objectives.
- The range of feasible alternatives is selected and discussed in a manner to foster meaningful public participation and informed decision making. Among the factors that may be taken into account when addressing the feasibility of alternatives, as described in State CEQA Section 15126.6(f)(1), are environmental impacts, site suitability, economic viability, social and political acceptability, technological capacity, availability of infrastructure, general plan consistency, regulatory limitations, jurisdictional boundaries, and whether the proponent could reasonably acquire, control, or otherwise have access to the alternative site.

5.2 Alternatives Considered for Further Analysis

As discussed below in Section 5.4, *Alternative Screening Process*, the JPB considered a wide range of alternatives suggested during the scoping process and then conducted a three-part screening evaluation to select the alternatives to be analyzed in this EIR. Alternatives determined to be infeasible, to not avoid or substantially reduce one or more significant impacts of the Proposed

Project, or to not meet all or most of the project's purpose and need were dismissed from further analysis. An additional alternative, the Tier 4 Diesel Locomotive Alternative was added for the Final EIR per comments on the DEIR.

Based on the screening process results, this EIR analyzes five ~~four~~ alternatives.

- No Project Alternative.
- Diesel Multiple Unit (DMU) Alternative.
- Dual-Mode Multiple Unit (MU) Alternative.
- Electrification with OCS Installation by Factory Train Alternative.
- Tier 4 Diesel Locomotive (T4DL) Alternative.

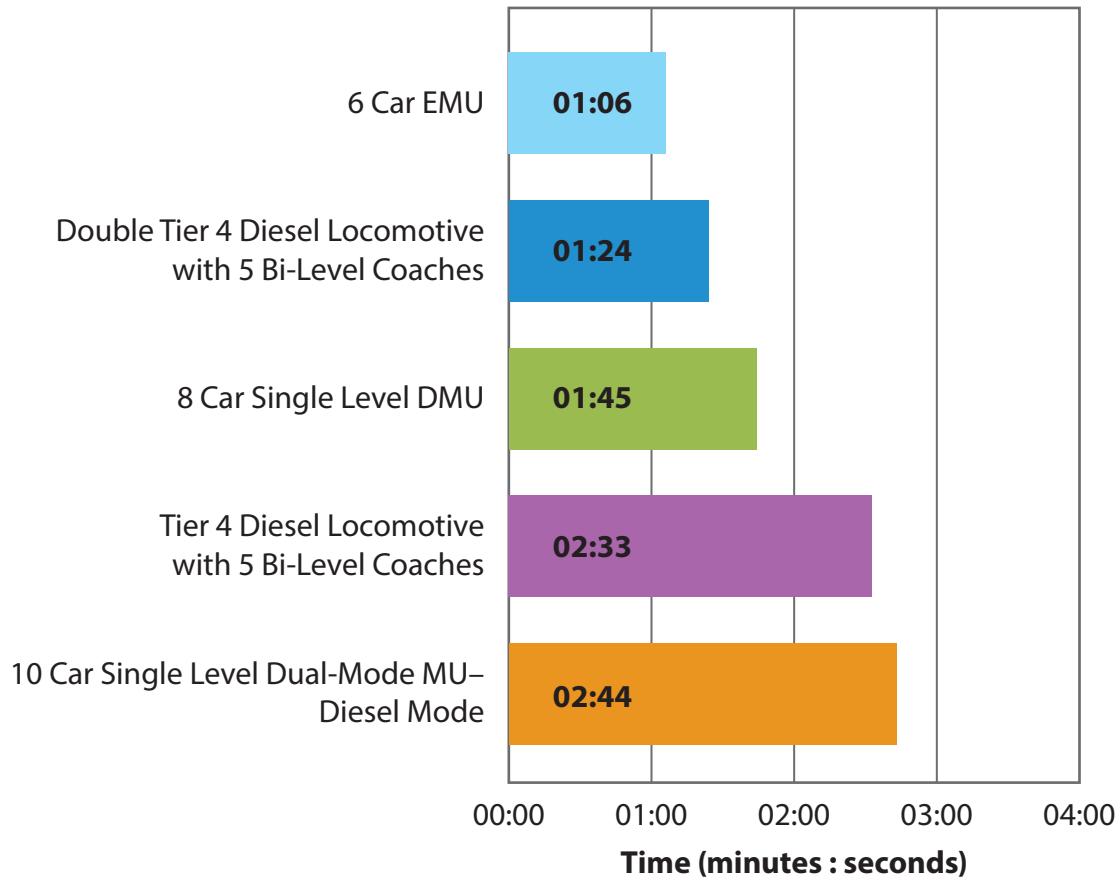
The Caltrain corridor includes many closely spaced stations. As a result, a key driver of train service is the ability to accelerate and decelerate quickly. Trains that can accelerate and decelerate quickly can be used to service more station stops, thus increasing ridership without compromising overall travel time. Because differences in ridership will result in differences in impacts on regional traffic, air quality and greenhouse gas emissions in this analysis, the comparative initial acceleration rates of the different alternatives and the Proposed Project are presented in Table 5-1.

Table 5-1. Estimated Initial Acceleration Rates of Different Alternatives and the Proposed Project

Operator	Diesel Locomotives (No Project)	Dual-Mode Multiple Units	Diesel Multiple Units	Tier 4 Diesel Locomotive (T4DL)	Electric Multiple Units (Proposed Project)
Initial Acceleration Rate (mph/sec)	0.5 (Existing) 1.1 (New)	~~1.1 (Diesel)~~ ~~1.5 (Electric)~~ 1.7 (both modes)	~~1.4~~ 1.8	1.1 (Single) 2.1 (Double)	2.1
Sources	Mass. EOT 2008 (Table 3.1) LTK 2014 (LTK-T4)	~~Railway Gazette 2007~~ Agility 2009	~~EOT 2008 (Table 3.1)~~ Stadler 2009	LTK 2014 (LTK-T4)	LTK 2012

Initial acceleration is not the only story. As a train continues to accelerate, the acceleration over the course of time begins to vary more widely between the EMU and the DMU, Dual-Mode MUs (in diesel mode) and single-diesel locomotives. A DMU or Dual-Mode MU (in diesel mode) acceleration rate will decrease over time, while an EMU will maintain a much more stable acceleration over time. Thus, the time it takes an EMU to reach maximum operating speed is much shorter when compared to a DMU or Dual-Mode MU (in diesel mode), even if their initial acceleration rates are comparable. For a single new Tier 4 diesel locomotives, the same would be true, but for train consists with two new Tier 4 diesel locomotives, then the acceleration could roughly match the EMUs. Figure 5-1 shows the comparative acceleration times to 79 mph of the different alternatives.

The Proposed Project EMUs have a nominal deceleration rate of 2.0 mphps. In general, any multiple unit train (EMU, DMU, or dual-mode MU) can achieve a deceleration rate in the range of the Proposed Project EMUs. This deceleration rate is possible due to the larger quantity of traction motors distributed throughout the train, and thus a higher contribution from dynamic braking is possible. In contrast, locomotives only have traction motors on the locomotive, and so dynamic braking contributes less to the overall brake rate. Therefore, deceleration rate is not necessarily a deciding factor between EMUs, DMUs, and dual-mode MUs. However, multiple unit trains have somewhat of an advantage over locomotive-hauled equipment (the No Project scenario and the T4DL Alternative) in terms of deceleration rate. The new T4DLs being manufactured by Siemens have a reported maximum braking rate of 1.8 mphps (Siemens 2013). This is the braking rate of the



Source: LTK 2014.

Graphics ... 00606.12 (11-20-2014)

Note: This is a new figure prepared for the Final EIR

Figure 5-1
Simulated Acceleration Times to 79 mph by Alternative
Peninsula Corridor Electrification Project

locomotive on its own and does not take into account the deceleration rate with full passenger coaches. It is also important to note that the type of braking equipment used in addition to dynamic braking (such as tread brakes, disc brakes, or track brakes) can affect the brake rate substantially on any of these vehicle types. Thus, the 2.0 mphps nominal brake rate used for EMUs is a reference point only, and could be affected by a number of different design factors.

Ridership modelling was complete for the No Project Alternative as well as the Proposed Project. No ridership modelling was done for the other alternatives. Qualitatively, the other alternatives will likely have lower ridership due to inferior performance compared to the Proposed Project. In order to provide a conservative analysis, it was assumed that the non-electrification alternatives would have the same ridership in 2020 as the Proposed Project. For 2040, The DMU, T4DL-SH and T4DL-DH alternatives would all assumed to have lower ridership as these alternatives cannot reach TTC. The Dual-Mode MU Alternative could reach TTC and thus, as a conservative assumption, it was assumed that this alternative would have the same ridership as the Proposed Project in 2040.

Table 5-2. Comparison of Ridership Estimates/Assumptions by Alternative

	No Project	Dual-Mode MU	DMU	T4DL (SH/DH)[1]	Proposed Project
2020 Modelled[2]	57,400	---	---	---	69,900
2020 Assumptions[3]	---	69,900	69,900	69,900	---
2040 Modelled[2]	83,900	---	---	---	111,100
2040 Assumptions[3]	---	111,100	105,700 – 111,100	105,700 to 111,100	---

Notes:

[1] SH = single-head = single locomotive; DH = double-head

[2] No Project and Project ridership based on ridership modelling using VTA regional model.

[3] Ridership adjusted for performance for inability to reach TTC (DMU Alternative and T4DL for 2040). Ridership scenario assuming same ridership as PCEP also included for all action alternatives. See Appendix K for specific assumptions.

The amount of rolling stock was also estimated for each alternative as shown in Table 5-3.

Table 5-3. Comparison of Assumed Rolling Stock by Alternative

	No Project[1]	Dual-Mode MUs[3]	DMUs[3]	T4DL (SH to DH) [1, 4]	Proposed Project[2]
2020 - new	16 T4DLs 73 coaches	160 Dual-Mode MUs	120 DMUs	18 (SH) to 35 (DH) T4DLs 88 coaches	96 EMUs
2020 - existing	3 F40s (1998), 6 MP36s (2003), 45 existing coaches [Same for all scenarios]				
Full Replacement	25 T4DLs 118 coaches	240 Dual-Mode MUs 6 T4DLs 31 coaches	180 DMUs 6 T4DLs 31 coaches	27 (SH) to 44 (DH) T4DLs 146 coaches	138 to 150 EMUs 6 T4DLs 31 coaches

Notes:

[1] No Project and T4 DL Alternative new locomotives estimated by LTK (2014).

[2] Project fleet estimated by Caltrain.

[3] Dual-Mode MUs and DMUs estimated by ICF based on passenger seat ratios compared to EMUs.

[4] Coaches for T4DL Alternative estimated by ICF by scaling trains/day (114 vs. 92 with No Project).

See Appendix K for assumptions for the sensitivity analysis for other alternatives.

Capital cost estimates were only prepared for the No Project and the Proposed Project. Fuel costs were estimated for all alternatives. Qualitative descriptions of other costs are noted for the action alternatives for the sake of comparison as shown in Table 5-4.

Table 5-4. 2020 Costs by Alternative ($million)

	No Project	Dual-Mode Multiple Units	Diesel Multiple Units	Tier 4 Diesel Locomotive (SH/DH)	Proposed Project
Rolling Stock	$318	Similar to Proposed Project	Similar to Proposed Project	Similar to Proposed Project	$524 to 576
Infrastructure	None	Cost of Extended Platforms	Costs of Extended Platforms	None	$950 to $958
Total Capital	***$318***	***N/A***	***N/A***	***N/A***	***$1,474 to 1,531***
Fuel Costs	$ 26	$ 32	$ 32	$ 31/$43	$ 13

Notes:

[1] The DTX would have overhead electric wires used by the Dual-Mode MUs and the EMUs, but their costs are included in DTX costs, not the PCEP.

Sources: See Appendix K.

5.2.1 The No Project Alternative

Section 15126.6 (e) of the State CEQA Guidelines requires the analysis of a No Project Alternative. The No Project analysis must discuss the existing condition as well as what would reasonably be expected to occur in the foreseeable future if the project were not approved. Section 15126.6(e)(3)(B) of the State CEQA Guidelines states the following.

> If the project is…a development project on an identifiable property, the "no project" alternative is the circumstance under which the project does not proceed. Here the discussion would compare the environmental effects of the property remaining in its existing state against environmental effects that would occur if the project were approved. If disapproval of the project under consideration would result in predictable actions by others, such as the proposal of some other project, this "no project" consequence should be discussed. In certain instances, the "no project" alternative means "no build," wherein the existing environmental setting is maintained. However, where failure to proceed with the project will not result in preservation of existing environmental conditions, the analysis should identify the practical result of the project's non-approval and not create and analyze a set of artificial assumptions that would be required to preserve the existing physical environment.

The No Project Alternative is neither required nor expected to meet the project's purpose and need or avoid or reduce any of the significant impacts associated with the project.

The No Project Alternative would include no electrification of the Caltrain ROW between San Jose and San Francisco, no purchase of electric multiple units (EMUs), and no increase in train service. The current train service is assumed to continue unchanged to 2020 and 2040. This service consists of five trains per peak hour, 92 trains per day, through use of diesel engine–hauled locomotive trains.

Because Caltrain's existing fleet is aging, the No Project Alternative would include replacement of roughly 75 percent of its existing rolling stock with 16 new T4DLs and 73 new passenger coaches. For this analysis, the new T4DLs were assumed to have the same characteristics as the T4DLs under construction by Siemens for Caltrans which would be 4200 horsepower diesels capable of acceleration up to 1.1 mphps and top speed of 125 mph (Siemens 2013). These diesel locomotives would be more powerful than Caltrain's current diesels which have lower acceleration, lower top speeds, and range from 3,200 to 3,600 horsepower. The remaining rolling stock of 9 diesel locomotives and 45 passenger coaches would continue to be used until they reached the end of their service life. In the long run, the No Project Alternative fleet would include 25 Tier 4 diesel locomotives and 118 passenger coaches. The length of trains would be the same as today, meaning a

single diesel locomotive would be hauling 5 passenger coaches with a nominal seating capacity of 620 seats.

While this alternative would not increase train service, ridership would still increase, similar to how ridership has been increasing in recent years, meaning that trains would have a higher occupancy average in the future. Under this alternative, like the Proposed Project, other Caltrain improvements (such as the Communications Based Overlay Signal System Positive Train Control [CBOSS PTC] project, other station improvements, and the South Terminal Project) described in Section 4.1.3.1, *Rail Projects Planned within the Caltrain Corridor*, would go forward, but Caltrain service itself would not increase.

Table 5-5 ~~5-2~~ shows the estimated daily boardings for Caltrain and other Peninsula transit systems with the Proposed Project and the No Project Alternative for 2020 and 2040.

Table 5-5 ~~5-2~~. Estimated Daily Ridership, Proposed Project and No Project Alternative

Operator	2013 Observed	2020 No Project	2020 Project	2040 No Project	2040 Project (& DTX/TTC)
Caltrain	47,100	57,400	69,900	83,900	111,100
BART	366,600	459,500	459,100	678,900	676,900
SamTrans Bus (Local and BRT)	39,800	73,400	75,800	103,200	100,000
VTA Light Rail	34,600	70,600	70,700	129,300	129,900
VTA Bus (Local and BRT)	103,100	165,600	167,100	246,100	247,100
MUNI Metro	173,500	203,800	205,200	252,200	250,100
MUNI Bus	531,700	592,600	595,500	736,600	740,200
Shuttles (Caltrain + Private)	NA	12,200	16,600	20,700	27,000
Total	**1,297,700**	**1,683,400**	**1,718,700**	**2,311,600**	**2,332,600**

Source: Appendix I, Ridership Technical Memorandum

As shown, Caltrain ridership is expected to increase with or without the Proposed Project, but would increase by approximately 22 percent with the Proposed Project compared with the No Project Alternative in 2020 and by approximately 32 percent by 2040 (including the Downtown Rail Extension [DTX] and San Francisco Transbay Transit Center [TTC]. As described in Chapter 4, the ridership analysis for 2040 included an assumed two trains to TTC; with more trains to TTC station ridership at TTC will increase and system ridership may increase overall.

Construction

Under the No Project Alternative, Caltrain would continue to operate between San Francisco and San Jose under the existing conditions. No new construction activities would occur under this alternative. As discussed, other Caltrain projects, such as CBOSS PTC, are presumed to be constructed, but this is the same assumption for the Proposed Project. Thus, for the sake of comparison to the Proposed Project, it is assumed there would be no construction-related impacts associated with the No Project Alternative.

Operation

Aesthetics

Under this alternative, there would be no permanent change to the visual character, views, nighttime lighting, and daytime glare. This alternative would not involve the installation of an Overhead Contact System (OCS) or additional removal of vegetation. Current maintenance trimming of vegetation would continue as at present, but the maintained area would not change (with the Proposed Project the maintained area would expand outward as necessary for the OCS electrical safety zone [ESZ]). Therefore, the No Project Alternative would have no impact on aesthetics, and its impacts would be less than the Proposed Project.

Air Quality

Under this alternative, ~~the same level of~~ criteria pollutants and Toxic Air Contaminants (TACs) would continue to be emitted from the operation of diesel locomotives as at present but the emissions would be lower than existing conditions since the new T4DLs would comply with the far more stringent USEPA T4 emission requirements.

As shown in Table 5-6 ~~5-3~~ below the No Project Alternative would substantially result in greater daily emissions of reactive organic gases (ROG), nitrogen oxides (NO_X), carbon monoxide (CO), and particulate matter less than 10 micrometers in size (PM10) than the Proposed Project due to the effect of cleaner EMUs and due to a lower ridership (and thus higher vehicle-related emissions) than the Proposed Project. These differences in emissions between No Project and Proposed Project conditions in 2020 of the respective criteria pollutants all exceed Bay Area Air Quality Management District (BAAQMD) daily thresholds with the exception of PM2.5 in which the difference is just under the threshold.

Table 5-6 ~~5-3~~. Estimated Operational Emissions by Alternative (pounds per day)

Condition	ROG	NO_X	CO	PM10	PM2.5
Existing (2013)					
Caltrain Diesel Consumption	251	5,973	637	159	154
Caltrain Electricity Consumption	0	6	5	0	0
Total Caltrain System Emissions[a]	**251**	**5,979**	**642**	**159**	**155**
No Project (2020)					
Caltrain Diesel Consumption	45	1,043	731	23	23
Caltrain Electricity Consumption	0	4	4	0	0
Total Caltrain System Emissions[a]	**46**	**1,048**	**735**	**24**	**23**
DMU Alternative (2020)					
Caltrain Diesel Consumption	65	1,496	1,141	32	31
Caltrain Electricity Consumption	0	4	4	0	0
Total Caltrain System Emissions[a]	65	1,501	1,144	33	32
Change in VMT emissions[b]	*-159*	*-330*	*-1,296*	*-181*	*-53*
Total Emissions	**-94**	**1,171**	**-152**	**-148**	**-21**
T4DL-SH Alternative (2020)					
Caltrain Diesel Consumption	56	1,287	873	29	28
Caltrain Electricity Consumption	0	6	5	0	0
Total Caltrain System Emissions[a]	56	1,292	878	29	29
Change in VMT emissions[b]	*-159*	*-330*	*-1,296*	*-181*	*-53*

Condition	ROG	NO_X	CO	PM10	PM2.5
Total Emissions	**-103**	**961**	**-419**	**-151**	**-24**
T4DL-DH Alternative (2020)					
Caltrain Diesel Consumption	66	1,526	1,179	33	32
Caltrain Electricity Consumption	0	6	5	0	0
Total Caltrain System Emissions[a]	66	1,532	1,184	33	32
Change in VMT emissions[b]	*-159*	*-330*	*-1,296*	*-181*	*-53*
Total Emissions	**-93**	**1,201**	**-112**	**-148**	**-20**
Proposed Project (2020)					
Caltrain Diesel Consumption	32	707	131	21	20
Caltrain Electricity Consumption	5	105	86	5	5
Total Caltrain System Emissions[a]	37	812	218	26	25
Change in VMT emissions[b]	*-159*	*-330*	*-1,296*	*-181*	*-53*
Total Emissions	**-122**	**482**	**-1,078**	**-155**	**-27**
No Project (2040)					
Caltrain Diesel Consumption	23	539	689	8	8
Caltrain Electricity Consumption	0	4	4	0	0
Total Caltrain System Emissions[a]	**23**	**543**	**693**	**8**	**8**
DMU Alternative (2040)					
Caltrain Diesel Consumption	43	1,025	1,312	15	15
Caltrain Electricity Consumption	0	6	5	0	0
Total Caltrain System Emissions[a]	43	1,031	1,316	16	15
Change in VMT emissions[b]	*-390*	*-807*	*-3,093*	*-387*	*-116*
Total Emissions	**-346**	**224**	**-1,776**	**-371**	**-101**
Total Emissions (same ridership as PCEP)[c]	*-444*	*22*	*-2,550*	*-468*	*-129*
T4DL-SH Alternative (2040)					
Caltrain Diesel Consumption	30	707	905	11	10
Caltrain Electricity Consumption	0	6	5	0	0
Total Caltrain System Emissions[a]	30	713	910	11	11
Change in VMT emissions[b]	*-390*	*-807*	*-3,093*	*-387*	*-116*
Total Emissions	**-360**	**-96**	**-2,184**	**-376**	**-105**
Total Emissions (same ridership as PCEP)[c]	*-457*	*-298*	*-2,958*	*-473*	*-134*
T4DL-DH Alternative (2040)					
Caltrain Diesel Consumption	40	946	1,211	14	14
Caltrain Electricity Consumption	0	6	5	0	0
Total Caltrain System Emissions[a]	*40*	*952*	*1,216*	*14*	*14*
Change in VMT emissions[b]	*-390*	*-807*	*-3,093*	*-387*	*-116*
Total Proposed Project Emissions	**-350**	**145**	**-1,877**	**-372**	**-102**
Total Emissions (same ridership as PCEP)[c]	*-447*	*-57*	*-2,650*	*-469*	*-131*
Full Electrification (2040)					
Caltrain Diesel Consumption	1	26	33	0.4	0.4
Caltrain Electricity Consumption	6	133	109	6	6
Total Caltrain System Emissions[a]	*7*	*159*	*142*	*7*	*7*
Change in VMT emissions[b]	*-487*	*-1,009*	*-3,866*	*-483*	*-145*

Condition	ROG	NO_X	CO	PM10	PM2.5
Total Full Electrification Emissions	**-480**	**-850**	**-3,724**	**-477**	**-138**
Comparisons					
2020 Project vs. 2020 No Project	-168	-566	-1,813	-179	-50
2020 DMU vs. 2020 No Project	-139	**123**	-885	-172	-44
2020 T4DL-SH vs. 2020 No Project	-148	-86	-1,153	-175	-47
2020 T4DL-DH vs. 2020 No Project	-138	**153**	-847	-171	-43
2040 Full Elec. vs. 2040 No Project	-503	-1,393	-4,417	-485	-146
2040 DMU vs. 2040 No Project	-369	-319	-2,469	-379	-109
2040 DMU vs. 2040 No Project (same ridership as PCEP scenario)	*-467*	*-521*	*-3,242*	*-476*	*-137*
2040 T4DL-SH vs. 2040 No Project	-383	-639	-2,877	-384	-113
2040 T4DL-SH vs. 2040 No Project (same ridership as PCEP scenario)	*-480*	*-840*	*-3,650*	*-481*	*-142*
2040 T4DL-DH vs. 2040 No Project	-372	-398	-2,570	-381	-110
2040 T4DL-DH vs. 2040 No Project (same ridership as PCEP scenario)	*-470*	*-600*	*-3,343*	*-477*	*-139*
BAAQMD Thresholds	**54**	**54**	**N/A**	**82**	**54**

[a] Includes diesel and electricity emissions but not VMT-related reductions due to increased ridership.

[b] Change in VMT emissions relative to No Project conditions. For 2020, DMU, T4DL-SH, and T4DL-DH alternatives all assumed to have same ridership as PCEP, even though these alternatives would have lesser performance than Proposed Project. For 2040, DMU, T4DL-SH, and T4DL-DH assumed to have 80% of increase in ridership as PCEP over No Project conditions (due to not reaching TTC), but assumption does not take into account lesser performance.

[c] Sensitivity analysis uses assumption that alternative would have same ridership and same VMT reductions as Proposed Project.

[d] All impacts are less than significant except 2020 DMU and T4DL-DH NOx increases over No Project conditions.

~~As discussed in Section 3.2, *Air Quality*, the Proposed Project would reduce diesel particulate matter (DPM) emissions by approximately 80 percent compared with current conditions. Another way of looking at this issue is that the No Project Alternative would result in 80 percent higher health risks associated with DPM to residents along the Caltrain ROW.~~

The No Project Alternative would reduce diesel particulate matter (DPM) emissions by 85 percent compared to existing conditions. An example was provided in Section 3.2, *Air Quality*, of an area in Menlo Park proposed for mixed use where the current diesel locomotives would result in an indoor risk of cancer from DPM emissions of 39 ~~24~~ in a million, but the Proposed Project would reduce that level to 5.0 ~~7~~ in a million in 2020. The No Project Alternative would have similar effects of reducing the risks along the right of way due to DPM emissions to 5.7 in a million in 2020.

As discussed below for the DMU Alternative and in Section 3.2, the effect of tree removal avoidance compared to the Proposed Project on particulate emissions and health risks and other emissions (such as pantograph wear emissions) is likely minimal and would not change the conclusions noted above.

Therefore, due to the substantially higher criteria pollutant emissions, the No Project Alternative would have substantially higher impacts on air quality than would the Proposed Project but the No Project Alternative would represent a substantial improvement over existing conditions.

Biological Resources

This alternative would avoid new impacts on biological resources. Existing tree trimming to maintain physical clearance zones for trains would continue but would not be expanded as in the Proposed Project.

This alternative would have continued diesel emissions along the Caltrain ROW, which would result in continued deposition of diesel contaminants into adjacent upland and aquatic areas. In addition, diesel emissions also result in nitrogen deposition adjacent to the Caltrain ROW and in areas a number of miles from the Caltrain ROW. As discussed in Section 3.3, *Biological Resources*, deposition of nitrogen from vehicle emissions and other emission sources has resulted in a "fertilization effect" in natural areas that has favored non-native species over some native species, in particular affecting habitat for host plants for certain rare butterfly species.

Cultural Resources

Operation of the No Project Alternative would not impact cultural resources. Therefore, for operations under this alternative, the impact on cultural resources would be similar to the Proposed Project (which would affect cultural resources during construction but not during operations).

Electromagnetic Fields/Electromagnetic Interference

Operation of the No Project Alternative would not involve an OCS or a similar system with the change in electromagnetic fields (EMF) levels or the potential for electromagnetic interference (EMI). Therefore, impacts associated with EMF/EMI would be less than the Proposed Project.

Geology, Soils and Seismicity

Operation of this alternative would not result in any new exposure of structures and people to seismic, soil, or geologic hazards or result in any impacts on paleontological resources Therefore, impacts associated with geologic, soil, or seismic hazards would be less than the Proposed Project.

Greenhouse Gas Emissions and Climate Change

Under this alternative, the continued use of diesel fuel would emit greenhouse gas (GHG) emissions that contribute to the effects of climate change. While the USEPA Tier 4 emissions requirements for new diesel locomotives would result in much lower criteria pollutant emissions compared to existing conditions, the Tier 4 requirements do not include any requirement for reduction of GHG emissions. Because the new T4DLs are more powerful than the existing diesel locomotives, they would consume more fuel than the existing diesels they are replacing and thus GHG emissions would increase compared to existing conditions.

Operation of the diesel locomotive engines emits more GHG emissions than electric engines in the Proposed Project EMUs, taking into account both direct engine GHG emissions as well as indirect GHG emissions from electricity generation. In addition, the No Project Alternative would result in less increased Caltrain ridership than the Proposed Project, meaning greater passenger vehicle GHG emissions as well. As shown in Table 5-8 ~~5-4~~ below, the Proposed Project would result in 79,000 ~~68,000~~ metric tons (MT) of carbon dioxide equivalent (CO_2e) less than the No Project Alternative in 2020. Therefore, this alternative would have a greater impact associated with GHG emissions.

Regarding the effects of climate change, the potential future impacts of sea level rise on the Caltrain ROW would be similar to the Proposed Project in terms of the track and station vulnerability, but the No Project Alternative would not have any new OCS or traction power facilities (TPFs) potentially subject to flooding, so its vulnerability would be slightly less than the Proposed Project.

Hazards and Hazardous Material

Under this alternative, there would be an ongoing potential for the release of and exposure to diesel fuel and other hazardous materials during maintenance activities. Operation of this alternative would also generate hazardous waste material from the use of lubricants and solvents. These impacts would not represent an increase over existing conditions. However, compared with the Proposed Project, the No Project Alternative would require much more handling and transfer of diesel fuel, which increases the potential for release of diesel. Therefore, this alternative would have greater impacts associated with the release of and exposure to hazardous materials than the Proposed Project would have.

Hydrology and Water Quality

Under this alternative, the impervious area in the project area and drainage would remain the same as at present. This alternative would not require the construction of TPFs or the OCS. Therefore, operation of this alternative would not increase stormwater runoff that could degrade water quality. Although this alternative would avoid any new facilities or impervious area, the No Project Alternative would require much more handling and transfer of diesel fuel, which would increase the potential for release of diesel that may affect water quality. Because the Proposed Project's operational impact on water quality is readily addressed through application of existing regulations and because the Proposed Project would require far less handling of diesel fuel, the No Project Alternative is considered to have a higher risk of spills and water quality effects than the Proposed Project.

The areas of the Caltrain ROW and associated facilities potentially subject to flooding would remain the same. The Proposed Project would place some new facilities into the 100-year floodplain that would be subject to flooding effects, but mitigation is available to reduce effects to a less-than-significant level. Both the No Project Alternative and the Proposed Project would have similar vulnerabilities to future flooding associated with sea level rise, but the Proposed Project would place slightly more facilities at risk than the No Project Alternative. Thus, the No Project Alternative would have less impact related to flooding than the Proposed Project.

Land Use and Recreation

Under this alternative, operation would not require installation of the OCS, removal of trees, acquisition of land adjacent to the Caltrain ROW and operation of traction power substations in the City of South San Francisco and the City of San Jose. Operation of this alternative would not physically divide an existing community, would create no new conflicts with land use policies or plans (or tree ordinances), or increase the demand for recreational facilities. Therefore, this alternative would have less impact on land use and recreation than the Proposed Project.

However, as noted above, the Proposed Project would have substantially lower health risk effects due to diesel emissions than the No Project Alternative, which would mean areas next to the Caltrain ROW would be more suitable for residential and mixed use with the Proposed Project.

Noise and Vibration

Under this alternative, noise and vibration levels would not change relative to train operations. Operation of locomotive-hauled diesel engine vehicles would generate a higher level of noise than the Proposed Project's EMUs would generate. Based on Table 3.11-15, in Section 3.11, *Noise and Vibration*, and presuming that the No Project Alternative would have noise levels similar to existing levels, the following conclusions can be made for the 49 study locations.

- Noise levels higher with the No Project Alternative: 41~~33~~ study locations.

- No change between No Project Alternative and Proposed Project: ~~8~~No locations.
- Noise levels lower with the No Project Alternative: 8 locations.

Therefore, this alternative would have a greater impact on sensitive receptors from noise than the Proposed Project, although impacts will be worse at 8 locations with the Proposed Project.

As discussed in Section 3.11, *Noise and Vibration*, vibration levels are not substantially different for diesel locomotives and EMUs, so the No Project Alternative would be similar to the Proposed Project for vibration.

Population and Housing

This alternative would not directly or indirectly induce population growth in the project area through new employment or new housing units, or displace existing businesses or housing units. Therefore, this alternative would have a similar impact on population and housing as the Proposed Project.

Public Services and Utilities

Operation of the existing Caltrain service would not increase the demand for public services or disrupt utilities. Under this alternative, the impact on public services and utilities would be the similar to the Proposed Project for operations.

Transportation/Traffic

Regional Traffic

Caltrain ridership would be lower with the No Project Alternative and thus regional traffic conditions would be worse than with the Proposed Project as the No Project Alternative would result in approximately 235,000 more vehicle miles per day than the Proposed Project in 2020 (with greater differences in 2040).

Localized Traffic

Under this alternative, the gate-down time would be reduced at some at-grade crossings due to the installation of CBOSS PTC and would not be increased due to increased service. Compared with the Proposed Project, gate-down times would be shorter during peak hours at 16 out of the 29 at-grade crossings with gates in the project area, longer at six crossings, and longer during one peak period but shorter during the other peak period at the remaining seven crossings.

As described above, ridership will increase with or without the Proposed Project (due to general growth on the San Francisco Peninsula) but would increase substantially more with the Proposed Project. In addition, background growth will continue to result in worsened localized traffic levels.

Taking these factors into account, the traffic analysis shows that the No Project Alternative would have less impact on localized traffic delays at the at-grade crossings and near Caltrain stations. As discussed in Section 3.14, *Transportation and Traffic,* compared with No Project conditions, the Proposed Project would have significantly worse traffic impacts at 21 study locations (out of 82 study locations) under project 2020 conditions. As discussed in Section 4.1, *Cumulative Impacts,* compared with 2040 No Project conditions, there would be significant cumulative traffic impacts at 39 study locations (out of 82 study locations). Thus, the No Project Alternative would result in less localized traffic impacts around Caltrain stations and at certain at-grade crossings.

Transit Systems

As discussed in Section 3.14, *Transportation and Traffic,* the Proposed Project would not substantially change the ridership of other transit systems compared with No Project conditions; thus, the alternatives are similar for impacts on transit systems. The No Project Alternative would avoid any potential OCS-related conflict with other transit projects (such as the 22-Fillmore Project or DTX). However, the No Project Alternative would be in conflict with the DTX and TTC projects because it would only provide for continued diesel train operations as opposed to the electrified operations anticipated by DTX and TTC.

Pedestrian/Bike Facilities

As discussed in Section 3.14, *Transportation and Traffic,* the Proposed Project would have a less than significant impact on pedestrian facilities with mitigation. Since ridership would increase with the No Project Alternative, but less than with the Proposed Project, the No Project Alternative would have a smaller less than significant impact on pedestrian facilities, although mitigation may still be needed at the San Francisco 4th and King Station to accommodate pedestrian traffic.

As discussed in Section 3.14, *Transportation and Traffic* and Section 4.1, *Cumulative Impacts*, the Proposed Project would result in an increased demand for bike facilities, but mitigation measures identified in these sections would address this increased demand. There would also be an increase in demand for bike facilities with the increased ridership expected with the No Project Alternative; however Caltrain could address this demand by similar means. Because the No Project alternative would result in a lower demand for bicycle facilities, it would have a lesser impact than the Proposed Project relative to bicycle facilities.

Station Parking and Access

As discussed in Section 3.14, *Transportation and Traffic* and Section 4.1, *Cumulative Impacts*, the Proposed Project would result in an increased demand for parking, but this increase demand is not expected to result in significant secondary impacts on the environment related to air quality, noise, traffic or due to the construction of parking facilities. The No Project Alternative would result in a lower increase in parking demand thus alternative would have less impact than the Proposed Project relative to parking demand.

Emergency Vehicle Access

Because the No Project Alternative would result in more regional vehicle miles traveled, on a regional basis it would have greater impacts on emergency response times than the Proposed Project would have.

Freight Service Impact

The No Project Alternative would avoid any impacts on freight service in the direct or cumulative context, which~~, presuming the Federal Railroad Administration (FRA) waiver requirements for temporal separation remain in force,~~ would mean this alternative would have less impact on freight service than the Proposed Project would have because it would avoid any impacts related to constraining future freight due to OCS clearance heights. ~~If the FRA waiver requirement for temporal separation is revised in current FRA rule-making to eliminate or reduce the time needed for temporal separation, then the Proposed Project may not require a change in freight operational hours.~~

5.2.2 Diesel Multiple Unit (DMU) Alternative

As explained in Section 5.4, *Alternative Screening Process* below, the DMU Alternative is considered feasible, would avoid or substantially reduce one or more significant impacts of the Proposed Project and would meet some, but not all of the project's purpose and need.

The DMU Alternative would not meet the project's purpose to provide electrical infrastructure compatible with high-speed rail. ~~This purpose is fundamental to the project, especially given that the primary source of funding for the project's construction would be Proposition 1A high-speed rail bond funds. Because this alternative fails to meet this fundamental purpose, the JPB could decide not to analyze it in this EIR.~~

In addition, while the increase train service under this alternative would increase revenue, this alternative would also increase diesel fuel consumption compared with existing conditions[1] which would increase operating fuel costs. ~~and~~ This alternative would likely have lower ridership than the Proposed Project due to a slower acceleration profile. Therefore, this alternative would only partially meet the project's objectives ~~purpose and need~~ to increase operating revenue and would not meet the objective to reduce operating fuel costs. ~~However, there has been community interest, expressed most recently in scoping comments, in the analysis of a DMU Alternative and, thus, the JPB decided to provide this alternative analysis for informational purposes.~~

DMUs are self-propelled diesel-mechanical vehicles with engines located below the passenger compartment. DMUs include single- and bi-level versions that are available either as individual units or married pairs.[2] The married pairs are typically powered by two diesel engines with maintenance requirements similar to bus engines. As indicated in Table 5-1, DMUs have initial acceleration rates of approximately 1.8 ~~1.4~~ mph per second (Stadler 2009 ~~EOT 2008~~) and operate at maximum speeds of 65 to 100 mph (Mass. EOT 2008). DMUs can also act as "locomotives" and either push or pull trailer cars. However, the addition of trailer cars reduces acceleration performance.

All DMUs derive their power from a diesel engine which then transmits motive power to the wheels either mechanically via gearbox, through a hydraulic torque converter, or to an electrical generator which then drives electric traction motors which drives the wheels. ~~DMUs are powered by diesel engines, which drive an axle through a hydraulic torque converter, and some DMUs utilize direct mechanical or electrical transmissions~~. DMUs are configured to use diesel engines to generate electricity, which powers the electric propulsion motor. The diesel engines can burn low sulfur diesel fuel and would meet state and federal air quality standards (BART 2008).

The key DMU characteristics related to desired service improvements is the reduction of running times due to faster acceleration than traditional push-pull service. DMUs require less time to accelerate up to full speed from stations stops and slow areas, reducing overall travel times, particularly on a corridor featuring frequent stops. New DMUs could also be configured with up to three sets of automatic doors, reducing the time trains spend stopped in stations. A DMU with three

[1] 2020 No Project diesel consumption is estimated as ~~4.5~~ 5.6 million gallons/year compared with 2020 DMU Alternative diesel consumption of 6.9 ~~7.1~~ million gallons/year. With the eight-car DMU consist assumed for this analysis, diesel fuel consumption would be approximately 3.9 gallons/revenue mile (including non-revenue service and idling) compared with today's diesel locomotive five-car consists which consume approximately 3.1 gallons/revenue mile (including non-revenue service and idling). In general, DMUs are more fuel efficient than diesel locomotives for consists of five cars or fewer but less fuel efficient for consists longer than five cars. The Proposed Project includes six-car consists to accommodate approximately 600 passenger seats per train to meet ridership demands. Thus, an eight-car DMU was assumed to accommodate a similar level of passengers. Train length and fuel efficiency are two reasons that a DMU option is not as favorable for the Caltrain service as EMUs, among many other considerations.

[2] Married pairs are two single cars that are permanently connected and operate in pairs or multiples of pairs.

sets of doors would therefore speed the boarding process during these periods (Mass. EOT 2008).

For the purposes of this alternative analysis, the following assumptions were made.

- An eight-car single-level DMU train, with a capacity of 78 passengers per car (624 passengers per train) was analyzed in order to analyze an alternative that would roughly match the capacity ~~ridership~~[3] per train ~~capacity~~ of the Proposed Project (Caltrain 2011).
- Only a single-level is being evaluated because a double-deck would not fit in the Caltrain system tunnels and because there is no existing market for double-deck DMUs.
    - There is no established current domestic or international double deck or bi-level DMU market in which proven platforms are readily available for sale by multiple suppliers. A search of the websites of major DMU manufacturers (like Siemens, Nippon Sharyo/Sumitomo and Bombardier) could not locate any details on new bi-level DMUs in production. The Caltrain 2011 technology assessment (Caltrain 2011) examined double-deck DMUs and identified a nominal vertical height of 19' 8" which would not fit in any of the SF tunnels. This is the basis of the conclusion in the EIR that the double-deck DMUs could not fit in the San Francisco Tunnels. U.S. Railcar (formerly Colorado Railcar) has manufactured double-deck DMUs with a height of 19'10" in the past, several of which are in operation in the U.S. (US Railcar, no date), but no reference to new double-deck DMUs are in production or on order by US Railcar.
    - While it is possible that a DMU could be developed to fit within the Caltrain clearance envelope, maximizing passenger capacity within the constraints of existing platform lengths (basically a six-car train), such a train would not typically have the horsepower-to-weight ratio and adhesion to match the EMU acceleration rate and deliver the proposed service model. To provide 500 to 600 passenger capacity, the train would have to be bi-level or double deck, similar to Caltrain's existing coach fleet. To meet the desired acceleration rate, every vehicle would have to be fitted with diesel propulsion packages, which take up valuable passenger space and add weight, reducing the overall benefit that the DMU concept provides, which is a scalable train. Traditionally, analyses performed for the Colorado Railcar prototype double deck DMU indicated that locomotive hauled trains were more economical than DMUs once the train length reached approximately six cars. Furthermore, that prototype vehicle was 19 feet tall, roughly 4 feet taller than the existing gallery and bi-level cars. A DMU of this height would not fit through the Caltrain tunnels. This extra height was required to allow two full levels of seating, with the engines being installed beneath the main floor.
    - In concept, a 16-foot double deck DMU would give up most of the lower seating level to propulsion equipment. Alternate concepts have been proposed by US Railcar (the owner of the Colorado Railcar prototype design) in which single level DMUs pull bi-level coaches. This concept was proven at SFRTA in Miami by Colorado Railcar prior to construction of the double deck DMU prototypes. This provides a train that will meet the Caltrain clearance requirement, but does not meet the EMU acceleration performance . Given these factors, Caltrain would be better off retaining their existing locomotive-hauled trains, as neither the DMU nor DMU-Hauled coach concept would be able to practically deliver the proposed service model. Caltrain service would soon reach maximum capacity, and commuters would be required to look elsewhere for a means of transportation on the peninsula. If Caltrain commissioned the design and construction of a diesel trainset that met all of the requirements for the proposed service model (which the current selection of off-the-shelf double deck EMUs meet), a considerable schedule and budget risk would be imposed. It is very likely that there would be a single proposer, with limited passenger rolling stock production experience, and the design would be new, unique, and therefore unproven.

[3] The Proposed Project capacity is roughly 600 passengers per train.

- It was assumed that the Caltrain service schedule for the DMU Alternative would be the same as the Proposed Project but with lower ridership. DMUs do not accelerate ~~or decelerate~~ as fast as EMUs and, thus, either the number of station stops would likely have to be reduced to maintain the same trip time as the Proposed Project EMUs or travel times would be greater (Caltrain 2011).
- The eight-car single-level DMU train length of 680 feet would exceed the length of Caltrain platforms at most Caltrain stations and would require platform extension construction. A review of these stations indicates that the 680 feet length could be technically be achieved but there could be cross-street issues at Burlingame, San Mateo, Mountain View and Sunnyvale. There are also platform issues not related to cross-streets at some other stations.
- The DMU Alternative is assumed to terminate at the San Francisco 4th and King Station and would not proceed to the ~~Transbay Terminal Center (~~TTC~~)~~ because the ~~Downtown Extension (~~DTX~~) tunnel~~ and the TTC are designed only for electric trains. Even if ventilation were added to the DTX ~~tunnel~~, the TTC is a fully enclosed station that is not designed to handle the emissions from diesel train operations in the enclosed station. Many fully enclosed stations and tunnels, like the tunnels leading to Grand Central Station and Penn Station in New York City prohibit diesel operations due to health concerns. Other major downtown stations that allow diesel operations, such as Union Station in Chicago, face substantial controversy concerning diesel emissions in constrained spaces. Thus, due to the design of the DTX ~~tunnel~~ and the TTC and due to the health concerns about diesel emissions in enclosed spaces, this alternative does not include service to TTC.

~~No specific cost estimate was prepared for the DMU Alternative. Although this alternative would avoid the construction costs associated with the TPFs and OCS for the Proposed Project, this alternative would require construction of platform extensions. Maintenance and fuel costs over this alternative's lifetime would be similar to or higher than under the Proposed Project. Overall lifecycle costs are considered similar to the Proposed Project's costs (Caltrain 2011).~~

The assumptions above are based on FRA Alternative Compliant light-weight DMUs. ~~The FRA sets crash-worthiness standards for all passenger vehicles (including DMUs) and prohibits light-weight DMUs from operating on the same line as freight without substantial time separation (like the EMUs). The heavier rail vehicles used in traditional commuter rail operations or heavy DMUs have sufficient structural strength to operate on the same tracks as freight train traffic without temporal separation (BART 2008).~~

The base assumption for this alternatives analysis is that the DMU Alternative would use light-weight DMUs. However, where appropriate, the analysis describes what the impacts would be if FRA compliant heavy-weight DMUs were used (for example, in the air quality section ~~and the impact on freight operations~~).

Relative to ridership, the DMU alternative is assumed to result in less ridership than the Proposed Project due to the inferior acceleration~~/decelerations~~ performance compared with EMUs. While service would increase to six trains per peak hour per direction (pphpd), either the travel time will be longer or there will be fewer stations served compared with the EMUs. Both would affect ridership. While ridership was not modelled for the DMU alternative, it is presumed to be somewhat less than the Proposed Project accordingly, but substantially more than the No Project Alternative. <u>For the air quality and GHG emissions analysis in the EIR, a conservative assumption was made that the DMU Alternative would have the same ridership for 2020 as the PCEP, but would have only 80 percent of the ridership increase of the PCEP in 2040 compared to the No Project to reflect the inability to reach TTC.</u>

Construction Impacts

This alternative would involve replacing the existing Caltrain diesel locomotive-hauled vehicles with new light- or heavy-weight DMU vehicles. As discussed above, depending on the DMU trainsets selected, Caltrain platforms that are less than 680 feet in length would need to be extended.

The Proposed Project's construction at the Caltrain station is limited to OCS poles and wires. At the San Francisco tunnels, the Proposed Project would install OCS poles and wires as well as some minor notching to make room for the OCS poles and wires. The Proposed Project is consistent with the DTX ~~tunnel~~/TTC design.

The DMU Alternative would have greater construction impacts at the Caltrain stations but would require no construction at other locations. Overall, the areas of disturbance would be far less with the DMU Alternative, but the intensity of construction at the Caltrain stations for this alternative would be far higher. The following 20 stations have one or more platforms that are less than 680 feet in length: San Francisco 4th and King, 22nd Street, South San Francisco, San Bruno, Millbrae, Broadway, Burlingame, San Mateo, Hayward Park, Hillsdale, Belmont, San Carlos, Redwood City, Atherton, Menlo Park, California Avenue, San Antonio, Mountain View, Sunnyvale, and Santa Clara. Platform extension at Caltrain stations would require grading, excavation, pouring of concrete, and potential utility relocates. Because some of the stations are historic stations, care would need to be taken to avoid impacts on the historic features, similar to that required in placing the OCS facilities with the Proposed Project. There would also be temporary air emissions and noise at the construction locations. In addition, there could be temporary utility disruption if utilities are present in platform extension areas.

Overall, although the DMU Alternative would have greater impacts at Caltrain stations than the Proposed Project, given the smaller overall area of effect, this alternative would have less construction-related impacts than the Proposed Project in all subject areas with the exception of historic resources. Because this project would require platform changes at Caltrain stations, some of which are historic, the DMU Alternative could have similar or potentially higher impacts on cultural resources than the Proposed Project.

Because the DMU Alternative would include construction, but the No Project Alternative would not, the DMU Alternative would have higher construction impacts.

Operational Impacts

Operation of light- vs. heavy-weight DMUs would have similar environmental impacts with the exception of air quality, GHG emissions, <u>and</u> noise~~, and impacts on freight operations~~. The light-weight DMUs have a lighter structure and require less diesel fuel to operate. As a result, impacts associated with air quality, GHG emissions, and noise would be different for light- vs. heavy-weight DMUs. ~~For freight operations, FRA-compliant heavy-weight DMUs would not require changes in freight operational hours from the current 8 p.m. to 5 a.m. window, whereas non-compliant light-weight DMUs may require temporal separation from freight trains, and freight may be restricted to a midnight to 5 a.m. window (as would be required with the light-weight EMUs in the Proposed Project).~~

The analysis discussion for all resource areas, except where impacts differ and as noted, is applicable to light- and heavy-weight DMUs.

Aesthetics

This alternative would not involve the installation of an OCS or TPFs or additional removal of vegetation. Current maintenance trimming of vegetation would continue as at present, but the

maintained area would not change (with the Proposed Project the maintained area would expand outward as necessary for the OCS ESZ).

This alternative would require extension of a number of Caltrain station platforms, which would change the visual appearance of the affected stations with additional concrete platform areas. But with extended platforms, the change in visual appearance would likely be less than significant given it would be at-grade and can be designed to be consistent with the aesthetics of existing platforms.

Overall, the DMU Alternative would result in less permanent impacts than the Proposed Project on aesthetics along the Caltrain ROW because there would be no need for additional tree removal and an OCS, taken into consideration the changes in platform length.

Because the DMU Alternative would include visual changes at the Caltrain stations, but the No Project Alternative would not, the DMU Alternative would have higher aesthetic impacts than the No Project Alternative.

Air Quality

Emissions resulting from DMU operations were compared with EMU operations emissions under the Proposed Project. The DMUs included in this alternative are presumed to meet the USEPA Tier 4 emissions standards.

As noted above, no ridership evaluation was conducted for the DMU Alternative. As a conservative assumption, it was assumed that the DMU Alternative would result in the same increased 2020 ridership as the Proposed Project for the sake of analysis only. However, this is not likely a realistic assumption as DMU performance would be inferior to EMUs in terms of acceleration ~~and deceleration~~ and, thus, DMU travel times would be longer than EMUs for the same trip or the DMUs would not be able to stop at as many stations as the EMUs. In either case, this alternative would likely have a lower ridership than the Proposed Project and, thus, would have higher VMT-related criteria pollutant emissions than shown in Table 5-6 ~~5-3~~ below for 2020. For 2040, the DMU Alternative would not extend to TTC and, thus, would have substantially lower ridership and higher VMT-related criteria pollutant emissions than the Proposed Project. A sensitivity analysis assuming the same 2040 ridership as the Proposed Project is also provided.

As shown in Table 5-6 ~~5-3~~ below, due to higher Caltrain diesel daily consumption, the DMU Alternative would result in substantially higher daily emissions of ROG, CO, NO_X, PM10, and slightly higher emissions of particulate matter less than 2.5 micrometers in size (PM2.5) along the Caltrain ROW than the Proposed Project in both the 2020 project scenario and the 2040 fully electrified scenario. When taking into account the indirect electricity emissions and assuming the same ridership as the Proposed Project, the DMU alternative would still have substantially higher criteria pollutants in both the 2020 and 2040 scenarios. The difference~~s~~ in NO_X emissions between the DMU Alternative and the Proposed Project for 2020 are well above the BAAQMD threshold.

Because the quantitative analysis of DMUs was based on light-weight DMU vehicles, as noted above, the emissions of heavy-weight DMUs would be more than the base analysis for the eight-car single-level light-weight DMU shown in Table 5-6 ~~5-3~~. In the EIR prepared for the Sonoma-Marin Area Rail Transit (SMART) rail project (SMART 2008), it was estimated that light-weight DMUs would have approximately 20 percent lower emissions than FRA-compliant DMUs. Assuming the heavier-weight FRA compliant DMU would have 20 percent higher emissions, heavy-weight DMUs would have even more emissions than the Proposed Project along the Caltrain ROW.

The PM10 emissions shown in Table 5-6 are those associated with train diesel combustion, electricity generation, and reductions in VMT-related remissions. Using the same methodology in Section 3.2, Air Quality, additional analysis of the alternatives was conducted relative to other sources of particulates including wheel-rail contact, entrained particulates from induced wind,

pantograph wear, and the effect of tree removal. Refer to Section 3.2, Air Quality for a description of the methodology used. Table 5-7 shows the results of a conceptual analysis of particulates including all these sources.

As shown by the analysis in Table 5-7, even using highly conservative assumptions, the Proposed Project taking into account wheel-rail contact, entrained particulates, pantograph particulates, and potential effects due to tree removal would not substantially change the overall conclusions of the analysis shown in Table 5-6. The analysis in Table 5-7 is for illustrative purposes as the methods and assumptions used for the analysis of emissions other than diesel emissions, electricity generation and VMT-related emissions involves a high level of uncertainty and thus does not have a sufficient level of scientific certainty in the result. Thus, the results presented in Table 5-6 represent the best estimate of particulate emissions for the Proposed Project compared to other alternatives.

Based on the PM10 emissions shown in Table 5-6 ~~5-3~~, the DMU Alternative would also have higher DPM emissions associated with Caltrain diesel trains along the Caltrain ROW and would result in slightly higher health risks associated with DPM for residents along the Caltrain ROW compared with the Proposed Project. Using the example provided in Section 3.2, *Air Quality*, of an area in Menlo Park proposed for mixed use where the current diesel locomotives would result in an indoor risk of cancer from DPM emissions of 39 ~~24~~ in a million, and assuming that the health risks are directly proportionate to daily PM10 emissions, the cancer health risks associated with the DMU Alternative (light-weight vehicle) would be just ~~over~~ under 8 ~~11~~ in a million in 2020 at the modeled location. As noted in Section 3.2, *Air Quality*, the Proposed Project would reduce the health risk at this location to approximately 5~~7~~ in a million in 2020.

In 2020, the DMU Alternative would have lower ~~Caltrain system~~ emissions compared with the No Project Alternative for all criteria pollutants other than NOx ~~CO and overall lower emissions when taking into account VMT reductions~~. In 2040, the DMU Alternative would result in ~~higher~~ lower ~~Caltrain system~~ emissions compared with the No Project Alternative for all criteria pollutants. ~~This increase in emissions is based on the modeling assumption that diesel locomotives would be replaced over time to meet current emissions standards under the No Project Alternative, while the 2040 DMU fleet would still be dominated by the 2020 DMU purchase. However, when taking into account VMT reductions, the DMU Alternative would have less criteria pollutant emissions in the 2040 scenario.~~

In 2020, DPM health risks resulting from the DMU Alternative would be slightly more ~~less~~ than under the No Project Alternative due to slightly higher ~~lowered~~ PM emissions along the Caltrain ROW. The risks would be slightly higher in 2040 due to higher PM emissions along the Caltrain ROW.

Therefore, this alternative would have a greater impact on air quality than the Proposed Project ~~would have but a decreased impact overall~~ and would have lower impacts relative to some pollutants and higher impacts relative to some pollutants compared with the No Project Alternative.

Biological Resources

With this alternative, existing tree trimming to maintain physical clearance zones for trains would continue but would not be expanded as in the Proposed Project. Thus, this alternative would have less ongoing disruption to nesting birds and bats that might be present in trees along the Caltrain ROW.

Table 5-7a. Comparison of 2020 Daily PM10 Emissions using Conceptual Estimates for Other Particulate Sources (lb/day)

	Existing	2020 No Project	PCEP 2020	2020 DMU Alternative	2020 T4 Diesel Locomotive Alternative (DH)	Notes
Diesel Engine Emissions	159	23	21	32	33	From Table 3.2-7.
Wheel-Rail Particulates	NA	NA	NA	NA	NA	Negligible change from existing conditions for PCEP or alternatives per discussion above, so not meaningful for comparison.
Entrained Particulates (Conceptual Estimate)	NA	NA	NA	NA	NA	Area adjacent to ROW is graveled and contains limited soil available for resuspension.
Pantograph Particulate Emissions	0	0	0.5	0	0	
Subtotal Emissions Along ROW	*159*	*23*	*21*	*32*	*33*	
Tree Removal Benefit	NA	NA	NA	NA	NA	Speculative to estimate reductions over entire route given varying tree cover, density, and proximity to route. Tree cover is also absent in many commercial, industrial, and open areas and is low density in other areas.
Subtotal Net Emissions Along ROW	*159*	*23*	*21*	*32*	*33*	
Electricity Emissions	0	0	5	0	0	Non PCEP conditions include a small amount of emissions for idle power when plugged in at terminal.
Total Caltrain System	*159*	*24*	*26*	*33*	*33*	
Lowered VMT emissions	NA	0	-181	-181	-181	VMT reductions are relative to 2020 No Project.
TOTAL	**NA**	**24**	**-155**	**-148**	**-147**	

Table 5-7b. Comparison of Daily PM10 Caltrain Emissions using Conceptual Estimates for Other Particulate Sources (lb/day) For a Hypothetical Mile with Consistent Tree Buffer (Between San Jose and San Francisco)

	Existing	2020 No Project	PCEP 2020	2020 DMU Alternative	2020 T4 Diesel Locomotive Alternative (DH)	Notes
Diesel Engine Emissions	3.24	0.47	0.36	0.64	0.78	Only includes emissions for diesel emissions north of San Jose divided by route miles.
Wheel-Rail Particulates	NA	NA	NA	NA	NA	Negligible change from existing conditions for PCEP or alternatives per discussion above, so not meaningful for comparison.
Entrained Particulates	NA	NA	NA	NA	NA	Area adjacent to ROW is graveled and contains limited soil available for resuspension.
Pantograph Particulates	0.00	0.00	0.01	0.00	0.00	
Subtotal Emissions Along ROW	*3.24*	*0.47*	*0.37*	*0.64*	*0.78*	
Tree Removal Benefit - LOW (Conceptual Estimate)	-0.06	-0.01	0.00	-0.01	-0.02	Used lower range (2%) of Cahill estimate for 8.4 mph wind speed in laboratory study. No reduction assumed for PCEP although replanting mitigation may provide some benefit in certain locations..
Tree Removal Benefit - HIGH (Conceptual Estimate)	-0.84	-0.12	0.00	-0.17	-0.20	Used higher range (26%) of Cahill estimate for 8.4 mph wind speed in laboratory study. No reduction for PCEP. Likely substantially overstates reduction because assumes complete filtering of train diesel emissions by trees next to ROW, when train diesel emissions are emitted vertically and disperse broadly, not horizontally and given periodic openings in most tree buffer areas.
Total Net Emissions per hypothetical mile (Low tree filtration scenario)	*3.18*	*0.46*	*0.37*	*0.63*	*0.76*	*Excludes VMT reductions of PCEP and alternatives*
Total Net Emissions per hypothetical mile (High tree filtration scenario)	*2.40*	*0.35*	*0.37*	*0.47*	*0.58*	*Excludes VMT reductions of PCEP and alternatives*

Note: Even if one used the hypothetical high tree filtration scenario and multiplied by the nominal 51-mile route from San Jose to San Francisco, the difference between the PCEP and the No Project (excluding VMT reduction) would only be 1 lb/day of PM10, which would be less than significant in comparison to the BAAQMD threshold of 54 lbs/day. Multiplying by 51-miles and including VMT reduction, the PCEP would have lower PM10 emissions than existing, No Project, and Tier 4 Diesel Locomotive Alternative conditions.

This alternative would have continued diesel emissions along the Caltrain ROW (higher than the Proposed Project), which would result in continued deposition of diesel contaminants into adjacent upland and aquatic areas. In addition, diesel emissions also result in nitrogen deposition (higher than the Proposed Project) adjacent to the Caltrain ROW and in areas a number of miles from the Caltrain ROW. As discussed in Section 3.3, *Biological Resources*, deposition of nitrogen from vehicle emissions and other emission sources has resulted in a "fertilization effect" in natural areas that has favored non-native species over some native species, in particular affecting habitat for host plants for certain rare butterfly species.

With the DMU Alternative, diesel and nitrogen emissions regionally would be less than the No Project Alternative and thus this alternative would have fewer related effects on biological resources than the No Project Alternative.

Cultural Resources

Operation of this alternative would not impact archeological, cultural, or historical resources. DMUs would operate within the existing Caltrain ROW and on the existing tracks, and would not require modifications or removal of existing historical structures. Therefore, operational impacts on cultural resources would be the same as the Proposed Project and the No Project Alternative.

Electromagnetic Fields/Electromagnetic Interference

Operation of DMUs would not require an overhead OCS. Instead, the DMUs would be powered by onboard diesel engines. The operation of this alternative would not increase the level of electromagnetic fields along the Caltrain corridor and project vicinity, or increase electromagnetic interference. Therefore, the potential impacts associated with EMF and EMI would be less than the Proposed Project and the same as the No Project Alternative.

Geology, Soils and Seismicity

Under this alternative, operation of the Caltrain service would be in the same project area as the Proposed Project and would expose structures and people to the same seismic, soil, and geologic hazards as the Proposed Project. Therefore, the exposure of risks associated with seismic, soil, and geologic hazards would be the same as the Proposed Project and the No Project Alternative.

Greenhouse Gas Emissions and Climate Change

The DMU Alternative would result in greater GHG emissions overall than the Proposed Project but less overall than the No Project Alternative when taking into account all changes in emissions, including changes in VMT and associated passenger vehicle emissions.

The DMUs included in this alternative are presumed to meet the USEPA Tier 4 emissions standards, but the Tier 4 standards concern criteria pollutants, not GHG emissions.

Operation of the DMUs would emit substantially more GHG emissions than electric engines in the Proposed Project EMUs, taking into account both direct engine GHG emissions as well as indirect GHG emissions from electricity generation. While the analysis assumes that the DMU Alternative would result in the same Caltrain ridership as the Proposed Project 2020, this is unlikely to actually occur, meaning that the DMU Alternative would likely result in more passenger vehicle GHG emissions than the Proposed Project (and higher GHG emissions than shown in Table 5-8 ~~5-4~~) for 2020.

Table 5-8 ~~5-4~~. Estimated Operational GHG Emissions by Alternative (metric tons CO_2e per year)

2020 GHG Emissions	Existing	No Project	DMU	T4DL-SH	T4DL-DH	Proposed Project
Caltrain Diesel Consumption	45,899	57,720	71,267	67,502	94,673	11,067
Caltrain Electricity Consumption	*839*	*567*	*753*	*753*	*753*	*11,958*
Total Caltrain System Emissions[a]	46,738	58,287	72,020	68,255	95,426	23,025
Change in VMT[b]	*NA*	*NA*	*-44,317*	*-44,317*	*-44,317*	*-44,317*
Tree Sequestration GHG Loss[c]	NA	NA	NA	NA	NA	260
Total 2020 Emissions	46,738	58,287	27,703	23,938	51,109	-21,032
2040 GHG Emissions	**Existing**	**No Project**	**DMU**	**T4DL-SH**	**T4DL-DH**	**Proposed Project**
Caltrain Diesel Consumption	45,899	59,011	74,050	67,779	94,921	1,511
Caltrain Electricity Consumption	839	567	753	753	753	15,100
Total Caltrain System Emissions[a]	46,738	59,579	74,802	68,531	95,674	16,611
Change in VMT[b]	*NA*	*NA*	*-116,993*	*-116,993*	*-116,993*	*-146,241*
Tree Sequestration GHG Loss[c]	NA	NA	NA	NA	NA	260
Total 2040 Emissions	46,738	58,287	-42,191	-48,462	-21,319	-129,370
Total 2040 Emissions (ridership same as PCEP)[d]	*NA*	*NA*	*-71,439*	*-77,710*	*-50,568*	*NA*

[a] Includes diesel and electricity emissions but not VMT-related reductions due to increased ridership.

[b] Change in VMT emissions relative to No Project conditions. For 2020, DMU, T4DL-SH, and T4DL-DH assumed to have same ridership as PCEP, despite lesser performance. For 2040, DMU, T4DL-SH and T4DL-DH assumed to have 80% of increase in ridership as PCEP over No Project conditions.

[c] Includes annual change in carbon sequestration due to tree loss but does not include increase in carbon sequestration with tree replanting required as mitigation. Assuming a minimum 1:1 tree replacement ratio (actual ratios described in Section 3.3, Biological Resources), carbon sequestration would also increase due to replanting by 3 metric tons of CO_2 in 2020 (1 year after assumed replanting) and by 216 metric tons of CO_2 in 2040 (21 years after replanting) and thus, in time, the mitigation replanting would offset the loss in annual sequestration due to tree removal. As discussed in Section 3.7, Greenhouse Gas Emissions and Climate Change, there would also be a one-time carbon stock loss due to tree removal during construction, but these one-time emissions would be offset by the Proposed Project within approximately 3 months of operation.

[d] Sensitivity analysis uses different assumption that alternatives would have same ridership and same VMT reductions as Proposed Project.

Compared with the No Project Alternative, the DMU Alternative would have greater Caltrain system GHG emissions. The greater emissions would result from the increase in service and from the decreased fuel efficiency of longer DMU consists[4], like the eight-car consist assumed for this alternative. However, the DMU Alternative would have substantially lower emissions than the No Project Alternative overall when including lowered VMT-related emissions resulting from increased Caltrain ridership (using the assumptions noted above).

Hazards and Hazardous Material

Under this alternative, there would be an ongoing potential for the release of and exposure to diesel fuel and other hazardous materials during maintenance activities. Operation of this alternative would also generate hazardous waste material from the use of lubricants and solvents.

Compared with the No Project Alternative, this alternative would result in more Caltrain diesel fuel use due to increased train service, and because an eight-car DMU consist would be less fuel efficient than the current diesel locomotives consists. However, because the DMU Alternative would increase ridership and lower regional VMT, the decreased regional handling of gasoline would likely offset the increased Caltrain handling of diesel in terms of risk of accidents and spillage.

Compared with the Proposed Project, the DMU Alternative would require much more handling and transfer of diesel fuel, which increases the potential for release of diesel. Therefore, this alternative would have greater impacts associated with the release of and exposure to hazardous materials compared than the Proposed Project but likely similar overall impacts as the No Project Alternative.

Hydrology and Water Quality

Under this alternative, the impervious area in the project area would slightly increase with the extension of some Caltrain platforms. This alternative would not require the construction of TPFs or the OCS. With the application of regulatory requirements for addressing stormwater runoff, operation of this alternative would not significantly increase stormwater runoff that could degrade water quality. This alternative would require much more handling and transfer of diesel fuel than the Proposed Project, which would increase the potential for release of diesel that may affect water quality. Because the Proposed Project's operational impact on water quality is readily addressed through application of existing regulations, and the Proposed Project would require far less handling of diesel fuel, the DMU Alternative is considered to have a higher risk of spills and water quality effects than the Proposed Project.

The areas of the Caltrain ROW and associated facilities potentially subject to flooding would remain mostly the same, although additional platform would be needed at the platform for tracks 1 and 2 at the San Francisco 4th and King Station, which is in the 100-year floodplain. The Proposed Project would place some new facilities into the 100-year floodplain that would be subject to flooding effects, but mitigation is available to reduce effects to a less-than-significant level. Both the DMU Alternative and the Proposed Project would have similar vulnerabilities to future flooding associated with sea level rise, but the Proposed Project would place slightly more facilities at risk than the DMU Alternative. Thus, the DMU Alternative would have less impact related to flooding than the Proposed Project.

The DMU Alternative would have slightly higher impacts than the No Project Alternative because it would include additional impervious space in the form of extended Caltrain station platforms. However, the increase in runoff and the change in flooding potential would not be expected to be

[4] Generally, DMUs can be more fuel efficient than diesel locomotives for five-car consists and shorter, but are less fuel efficient for consists longer than five cars. The fuel consumption factors used for this analysis are consistent with that general understanding.

substantial. As described above, the DMU Alternative would require greater diesel duel handling by Caltrain than the No Project Alternative but less gasoline handling overall due to lowered regional VMT. These impact changes offset each other and, therefore, this alternative would have similar water quality impacts related to potential fuel spills or leakage.

Land Use and Recreation

Under this alternative, the OCS alignment and its associated vegetation clearance zone would not be required. As a result, land outside the ROW would not need to be acquired in fee or easement for OCS alignment or ESZ purposes. In addition, this alternative would not construct the traction power supply substations in the City of South San Francisco and the City of San Jose. This alternative would not increase the demand or physically impact existing recreational facilities. The additional station platform areas would be within the Caltrain ROW and thus would not displace any other land uses.

Therefore, this alternative would have less impact on land use and recreation than the Proposed Project and would have the same impacts as the No Project Alternative.

Noise and Vibration

Operation of the DMUs would generate higher levels of engine noise than the Proposed Project EMUs. The DMU Alternative would also result in increased horn noise due to increased Caltrain service, primarily in peak hours, which would be the same horn noise increase as the Proposed Project and more train horn noise than the No Project Alternative. The DMU Alternative would not generate new noise associated with the TPFs. Because the DMU engines are slightly noisier than the EMUs, while the changes in train horn noise would be the same, the DMU Alternative would have greater noise impacts than the Proposed Project along the Caltrain ROW, but less impact around the TPFs. The DMU engines are slightly quieter than diesel locomotives, but with the additional horn noise, the DMU Alternative would have slightly higher noise levels overall than the No Project Alternative.

As presented in Table 5-9 ~~5-5~~, the following conclusions can be made for the 49 study locations for the DMU Alternative relative to the No Project Alternative in 2020.

- Noise levels lower than No Project Alternative: 5 ~~nine~~ study locations
- No change between No Project Alternative and the DMU Alternative: No ~~two~~ locations
- Noise levels higher with the DMU Alternative: 44 ~~38~~ locations.

Based on Table 5-9 ~~5-5~~, the following conclusions can be made for the 49 study locations for the DMU Alternative relative to the Proposed Project in 2020.

- Noise levels lower than the Proposed Project: No study locations
- No change between DMU Alternative and the Proposed Project: ~~four~~ No study locations
- Noise levels higher with the DMU Alternative: 49 ~~45~~ locations.

Therefore, this alternative would have a greater impact on sensitive receptors from noise than the Proposed Project and the No Project Alternative. However, as shown in Table 5-9 ~~5-5~~, like the Proposed Project, the DMU Alternative would not result in any exceedances of the FTA Criteria.

Vibration impacts of the DMUs should be similar to the Proposed Project, but the FRA-compliant DMUs would likely have slightly greater vibration than the EMUs, and the non-FRA-compliant DMUs would have similar vibration characteristics as the EMUs. As discussed in Section 3.11, *Noise and Vibration*, the EMUs are not expected to have significantly different vibration characteristic than existing conditions, so the differences between alternatives for operational vibration are not substantial.

Table 5-9 ~~5-5~~. Noise Levels and Impacts from Train Operation, DMU Alternative (2020)

Receptor Site No.	City	Cross Streets	Side of Alignment	Land Use[a]	Distance to Receptor (feet)	Measurement Site ID	Existing[b]	Proposed Project	DMU Alternative	Change with DMU over Existing	FTA Impact Criteria	
							Total Ambient Noise Exposure at Receptor[c] L_{dn} (dBA)				Moderate (dBA)	Severe (dBA)
1	San Francisco	Oakdale Ave and Quint Ave	W	MFR	110	N32	69	68.8	69.1	0.1	1.1	2.9
2	San Francisco	Reddy St and Williams Ave	E	SFR	80	N33	70	69.7	70.2	0.2	1.0	2.8
3	San Francisco	Carr St and Paul Ave	E	SFR	90	N32	70	69.7	70.1	0.1	1.0	2.8
4	San Francisco	Tunnel Ave and Lathrop Ave	E	SFR	120	N31	69	68.9	69.2	0.2	1.1	2.9
5	San Bruno	Herman St and Tanforan Ave	W	SFR	110	R05	76	75.4	75.6	-0.4	0.3	2.1
6	San Bruno	Huntington Ave and San Bruno Ave	E	MFR	50	R07	77	74.6	75.0	-2.0	0.3	2.0
7	San Bruno	Montgomery Ave and Walnut St	W	SFR	120	R07	74	72.3	72.6	-1.4	0.5	2.3
8	San Bruno	1st Ave and Pine St	E	SFR	100	N53	74	71.6	71.9	-2.1	0.5	2.3
9	San Bruno	Huntington Ave and Sylvan Ave	W	SFR	150	N53	72	69.5	69.9	-2.1	0.8	2.5
10	San Bruno	San Antonio Ave and San Benito Ave	W	SFR	170	N26	67	66.8	67.1	0.1	1.2	3.2
11	Millbrae	Monterey St and Santa Paula Ave	E	MFR	160	N25	71	71.0	71.2	0.2	1.0	2.6
12	Millbrae	Hemlock Ave and Hillcrest Blvd.	W	SFR	90	R12	72	72.0	72.2	0.2	0.8	2.5
13	Burlingame	California Dr and Dufferin Ave	W	SFR	150	N50	68	67.8	68.1	0.1	1.2	3.1
14	Burlingame	California Dr and Mills Ave	W	SFR	160	R14	70	70.1	70.2	0.2	1.0	2.8
15	Burlingame	California Dr and Palm Dr	W	SFR	190	N22	70	70.0	70.1	0.1	1.0	2.8
16	Burlingame	Park Ave and Carolan Ave	E	SFR	160	N22	71	71.0	71.2	0.2	1.0	2.6
17	San Mateo	Grand Blvd and San Mateo Blvd	W	SFR	40	R18	76	76.0	76.3	0.3	0.3	2.1
18	San Mateo	Railroad Ave and Monte Diablo	E	SFR	70	R18	72	71.9	72.3	0.3	0.8	2.5
19	San Mateo	B St and 9th Ave	W	MFR	110	N47	73	73.1	73.2	0.2	0.6	2.4
20	San Mateo	South Blvd and 16th Ave	W	SFR	85	N20	67	66.5	67.3	0.3	1.2	3.2
21	San Mateo	Pacific Blvd and Otay Ave	E	SFR	100	N19	72	71.9	72.2	0.2	0.8	2.5
22	San Mateo	Country Rd and Dale View Ave	E	MFR	120	R22	70	69.7	70.2	0.2	1.0	2.8
23	Belmont	Country Rd and Marine View	E	MFR	120	N18	73	72.9	73.2	0.2	0.6	2.4
24	San Carlos	Country Rd and Springfield Ave	E	SFR	100	N17	70	70.0	70.3	0.3	1.0	2.8
25	Redwood City	D St and Stafford St	E	SFR	90	N16	73	73.1	73.3	0.3	0.6	2.4
26	Redwood City	Cedar St and Main St	E	SFR	50	N47	76	76.0	76.3	0.3	0.3	2.1

Receptor Site No.	City	Cross Streets	Side of Alignment	Land Use[a]	Distance to Receptor (feet)	Measurement Site ID	Existing[b]	Proposed Project	DMU Alternative	Change with DMU over Existing	FTA Impact Criteria	
							Total Ambient Noise Exposure at Receptor[c] L_{dn} (dBA)				Moderate (dBA)	Severe (dBA)
27	Redwood City	198 Buckingham Ave	W	MFR	110	R27	69	68.6	69.2	0.2	1.1	2.9
28	San Mateo County	Arrowhead Lane and 5th Ave	E	SFR	50	N14	72	71.6	72.2	0.2	0.8	2.5
29	Atherton	Lloyden Dr and Fair Oaks Lane	W	SFR	60	N13	70	69.7	70.4	0.4	1.0	2.8
30	Atherton	Felton Dr and Encinal Ave	E	SFR	65	N13	70	69.7	70.3	0.3	1.0	2.8
31	Menlo Park	Burgess Dr and Alma St	E	MFR	175	N45	67	66.8	67.1	0.1	1.2	3.2
32	Palo Alto	Mitchell Lane and University Ave	W	MFR	100	N44	68	67.7	68.3	0.3	1.2	3.1
33	Palo Alto	Alma St and Lincoln Ave	E	SFR	120	N42	69	68.6	69.2	0.2	1.1	2.9
34	Palo Alto	Residences near Peers Park	W	SFR	40	R34	72	71.5	72.3	0.3	0.8	2.5
35	Palo Alto	Alma St and El Dorado Ave	E	MFR	160	N10	76	75.6	75.7	-0.3	0.3	2.1
36	Palo Alto	4237 Park Blvd	W	SFR	50	R36	78	78.1	78.2	0.2	0.2	1.8
37	Mountain View	Central Exp and Thompson Ave	E	SFR	150	N9	75	74.7	74.7	-0.3	0.4	2.2
38	Mountain View	Evelyn Ave and Bryant St	W	MFR	110	N8	73	72.7	72.8	-0.2	0.6	2.4
39	Mountain View	Central Exp and Whisman Ave	E	SFR	150	N39	72	71.9	72.0	0.0	0.8	2.5
40	Mountain View	S. Bernardo Ave and Evelyn Ave	E	SFR	75	N7	68	67.4	68.3	0.3	1.2	3.1
41	Sunnyvale	Asilomar Ave and Mary Ave	E	MFR	80	N7	70	69.8	70.2	0.2	1.0	2.8
42	Sunnyvale	332 Angel Ave	E	SFR	80	N6	71	70.9	71.2	0.2	1.0	2.6
43	Sunnyvale	Fair Oaks Ave and Evelyn Ave	W	MFR	75	N6	71	70.8	71.1	0.1	1.0	2.6
44	Santa Clara	Agate St and Lawrence Exp	W	MFR	85	R44	71	71.0	71.3	0.3	1.0	2.6
45	Santa Clara	Agate Dr and Bowers Ave	W	SFR	110	N4	68	67.7	68.2	0.2	1.2	3.1
46	Santa Clara	Alvarado Dr and San Thomas Exp	W	SFR	95	N37	68	67.6	68.2	0.2	1.2	3.1
47	Santa Clara	2109 Main St	W	SFR	95	N3	68	67.6	68.2	0.2	1.2	3.1
48	San Jose	782 Auzerais Ave	W	SFR	60	R48	81	81.0	81.0	0.0	0.1	1.0
49	San Jose	456 Jerome St	E	SFR	50	R49	71	70.1	70.5	-0.5	1.0	2.6

Source: Appendix C, *Noise and Vibration Technical Report*

[a] SFR = Single-Family Residence; MFR = Multi-Family Residence

[b] Existing total noise exposure based on representative noise measurement data (see Table 3.11-6).

[c] Project/Alternative total noise exposure is the result of combining future Caltrain noise with existing non-railroad noise and freight train noise, as in Table 3.11-6.

Population and Housing

This alternative would not indirectly or directly induce population growth or the demand for new housing units in the project area. Similar to the Proposed Project, operation of this alternative would not require the displacement of existing housing units or businesses. Therefore, the impact on population and housing would be the similar to the Proposed Project and the No Project Alternative.

Public Services and Utilities

With the DMU Alternative, operations would not have appreciable changes in public services demand, similar to the Proposed Project, and no effect on utility disruption. Thus, the Proposed Project, the No Project Alternative, and the DMU Alternative would all have similar effects on public services and utilities during operations.

Transportation/Traffic

Regional Traffic

Under the DMU Alternative, there would be an increase in rail service similar to the Proposed Project and more trains than with the No Project Alternative. Regionally, the DMU Alternative would result in a lesser reduction in VMT and associated general traffic congestion compared with the Proposed Project because the DMU Alternative's inferior performance relative to the Proposed Project's EMUs would result in less Caltrain ridership. However, the DMU Alternative would be beneficial compared with the No Project Alternative.

Localized Traffic at Certain At-Grade Crossings and Caltrain Stations

In comparison with the Proposed Project, the ridership under this alternative would be somewhat less. DMUs can travel just as fast at speed as the proposed EMUs in the corridor, but cannot accelerate ~~and decelerate~~ as fast as the proposed EMUs which will mean that either less stops can be serviced or overall travel times would be less, either of which will lessen ridership.

The DMU Alternative would likely result in a similar number of gate-down events during peak hours at the at-grade crossings as the Proposed Project. At at-grade crossings that are not near stations, the gate-down time should be similar to the Proposed Project. At at-grade crossings that are near stations, the DMU Alternative would result in greater gate-down time than the Proposed Project due to the slower ~~deceleration and~~ acceleration performance of DMUs compared with EMUs. Thus, at at-grade crossing near stations, the DMU alternative would have a greater impact on localized traffic than the Proposed Project would have.

Since the DMU alternative would result in less ridership than the Proposed Project, traffic levels near Caltrain stations may be somewhat less in general. However, at certain locations (Burlingame, San Mateo, Mountain View, and Sunnyvale) there could be issues with nearby cross-streets and localized traffic circulation could be more affected with this alternative at these locations. Given these offsetting impacts, the DMU Alternative is likely to result in similar localized traffic impacts to the Proposed Project.

Relative to the No Project Alternative, the DMU Alternative would result in better regional traffic and worse localized traffic at some at-grade crossings and near Caltrain stations.

Ridership of Other Transit Systems

The DMU Alternative would result in less Caltrain ridership than the Proposed Project. Similar to the Proposed Project, this alternative would not substantially change the ridership of other transit systems compared with the No Project Alternative

Conflict with other Transit Projects

The DMU Alternative, like the No Project Alternative, would avoid any potential OCS-related conflicts with the 22-Fillmore Project or DTX. However, the DMU Alternative is incompatible with the designs for DTX and TTC and, thus, would not allow a downtown extension of Caltrain as planned, which is a major conflict given that the extension is one of the driving rationales for DTX and TTC.

The Proposed Project's impacts related to the OCS for other transit projects are either less than significant or can be managed with mitigation. The Proposed Project is consistent with DTX and TTC designs; therefore, the DMU Alternative would have more conflict with other transit projects than the Proposed Project would have.

Pedestrian/Bicycle Facilities

As discussed in Section 3.14, *Transportation and Traffic,* the Proposed Project would have a less than significant impact on pedestrian facilities with mitigation. Since ridership would increase with the DMU Alternative, but less than with the Proposed Project, the DMU Alternative would have a smaller less than significant impact (with mitigation) on pedestrian facilities.

As discussed in Section 3.14, *Transportation and Traffic* and Section 4.1, *Cumulative Impacts*, the Proposed Project would result in an increased demand for bike facilities, but proposed mitigation would address this increased demand. There would also be an increase in demand for bike facilities with the increased ridership expected with the DMU Alternative; however, Caltrain could address this demand by similar means as the proposed mitigation for the Proposed Project. Thus, the DMU Alternative would have a lesser impact than the Proposed Project relative to bicycle facilities.

Because of greater ridership, this alternative would have more impact on existing pedestrian and bicycle facilities than the No Project Alternative would have.

Station Parking and Access

As discussed in Section 3.14, *Transportation and Traffic* and Section 4.1, *Cumulative Impacts*, the Proposed Project would result in an increased demand for parking, but this would not result in significant secondary impacts on air quality, noise, or traffic or due to the construction of other parking facilities. The DMU Alternative would result in a lower increase in parking demand and, therefore, would have less impact than the Proposed Project relative to parking demand.

Because of greater Caltrain ridership, this alternative would have more impact on station parking and access than the No Project Alternative would have.

Emergency Vehicle Access

Relative to emergency vehicle access, the DMU Alternative would have a similar but smaller positive effect on reducing regional vehicle miles traveled, a similar but worse adverse effect at at-grade crossing, and similar but smaller adverse effects at intersections near stations. This alternative would have similar but fewer overall beneficial impacts on emergency response times than the Proposed Project would have.

This alternative would be beneficial relative to the No Project Alternative.

Freight Rail Operations

As discussed in Chapter 2, Caltrain now considers that temporal separation will not be required for the mixed operation of alternative compliant EMUs with freight equipment on the Caltrain Corridor because alternative compliant equipment can provide an equivalent level of safety to the Tier 1 passenger vehicle safety requirements particularly in light of the new FRA rule-making underway. Similarly, alternative compliant DMUs should also be able to share operations with freight equipment without the need for temporal separation. In fact, the Denton County Transportation Authority received authorization to operate alternative compliant DMUs on the same tracks as freight operations from the FRA without temporal separation. Thus, like the Proposed Project, the DMU Alternative would not require substantial change in the freight operational window.

~~Use of light-weight DMUs may require the same temporal separation requirements for freight as the Proposed Project's EMUs and, thus, may have the same effect on freight operations. Use of heavier FRA-compliant DMUs would allow for freight trains to operate between the current 8 p.m. and 5 a.m. period, compared with midnight to 5 a.m. under the Proposed Project (presuming the project must comply with the temporal separation requirements in the FRA waiver and the waiver requirements are not altered in the future).~~

The DMU Alternative would not require an OCS, and, thus, there would be no concerns about potential height restrictions for freight. The Proposed Project would provide adequate height clearance for existing freight service. As discussed in Section 4.1, *Cumulative Impacts*, future freight trains could be slightly constrained to the existing freight train equipment heights. But even with limited freight diversion to other modes (such as trucks), this constraint is not likely ~~expected~~ to result in significant secondary physical impacts on the environment but is disclosed as potentially resulting in localized noise or traffic impacts in the event that some diversion to freight traffic would occur due to the change in OCS heights. The DMU Alternative would avoid any such impacts because it would not restrict overhead heights along the Caltrain ROW.

Overall, this alternative would have the same impacts as the No Project Alternative. ~~if FRA-compliant DMUs were used, but would have worse impacts than the No Project Alternative if light-weight DMUs were used.~~

5.2.3 Dual-Mode Multiple Unit (Dual-Mode MU) Alternative

As explained in Section 5.4, *Alternative Screening Process*, below, the Dual-Mode MU Alternative is considered feasible, would avoid or substantially reduce one or more significant impacts of the Proposed Project, and would meet some, but not all, of the project's purpose and need.

The Dual-Mode MU Alternative would not meet the project's purpose to provide electrical infrastructure compatible with high-speed rail. ~~This purpose is fundamental to the project, especially given that the primary source of funding for the project's construction would be Proposition 1A high-speed rail bond funds. Because this alternative fails to meet this fundamental purpose, the JPB could decide not to analyze it in this EIR.~~

In addition, while the increased train service under this alternative would increase revenue, this alternative would also increase diesel fuel consumption compared with existing conditions,[5] which would increase operating fuel costs. This alternative also would have lower ridership than the

[5] As explained above, the eight-car DMU Alternative would have higher fuel consumption compared with today's diesel locomotive five-car consists. Fuel consumption for a dual-mode MU has not been determined. Assuming a 10-car train and assuming dual-mode MUs would likely be heavier than corresponding DMUs due to the need for dual-mode equipment fuel consumption is likely to be more for the Dual-Mode MU Alternative than for the DMU Alternative when running in diesel mode (which would be the dominant operating mode for the Dual-Mode MU Alternative except in the DTX and TTC).

Proposed Project would have due to a slower acceleration profile. Therefore, this alternative would only partially meet the project's objective ~~purpose and need~~ to increase operating revenue and would not meet the objective to reduce operating fuel costs. ~~However, there has been community interest, expressed most recently in scoping comments, in the analysis of a Dual-Mode MU Alternative and, thus, the JPB decided to provide this alternative analysis for informational purposes.~~

A dual-mode multiple unit is a self-propelled vehicle that can operate in both a diesel mode and in an electrified mode. While there are dual-mode locomotives in operation on the East Coast, there are no known dual-mode MUs in operation in the United States at present. However, there are dual-mode MUs in operation and in construction in Europe that can operate in both a diesel mode and using an overhead 25 kVA OCS.

Dual-mode MUs have been in operation for approximately the last 10 years in Europe. ~~are a relatively recent technology and thus do not have a long track record by which to evaluate reliability and maintenance requirements.~~ Operational experience with some dual-mode locomotives ~~and trolleybuses~~ in the U.S. has shown reliability concerns. Based on 2010 data, the Long Island Railroad's (LIRR) dual-mode locomotives are the most unreliable pieces of equipment in their revenue vehicle fleet. For the same period, the LIRR single-level EMUs were the highest performers or most reliable equipment and have a Mean Distance Between Failures of about 300,000 miles versus only about 18,000 miles for the dual-mode locomotives. No data on the reliability of European Dual-Mode MUs was located. ~~A reliability concern with dual-mode transit equipment was also found in Seattle's recently retired dual-mode diesel/electric trolleybus suburban express fleet. King County Metro later removed the diesel engines and relegated these units to exclusive trolleybus use on electrified trunk routes in the city. The dual-mode buses were ultimately replaced on the suburban express bus routes by more conventional articulated hybrid buses (Tumola, Pers. Comm).~~ However, for the purposes of this analysis, Dual-Mode MUs are considered sufficiently reliable to support project purposes.

Similar to the DMU Alternative, the diesel engines in dual-mode MUs can burn low sulfur diesel fuel and would meet state and federal air quality standards. Depending on operational modes, dual-mode MUs have been reported to have 10 to 20 percent lower emissions (Alstom 2013a) and to use approximately 15 to 30 percent less energy than diesel locomotives (Alstom 2012; Railway Gazzette 2013b). Dual-Mode MUs would also meet the USEPA Tier 4 emission standards.

The key characteristics for this alternative related to desired service improvements is the reduction of running times due to faster acceleration than traditional push-pull service. Limited data on dual-mode MUs was located on acceleration rates. One source (Railway Gazzette 2007) cites initial acceleration for a Bombardier four-car, 240-foot dual-mode multiple unit with up to 220 passenger capacity as 1.1 mph per second for diesel mode and 1.5 mph per second for 25 kVA electric mode (compared with approximately 0.5 mph per second for conventional push-pull service, 1.4 mph per second for DMUs and 2.1 mph per second for EMUs). However, the specifications for the new Super Express Class 800s being developed for use in the U.K., indicate that dual-mode MU consists up to 10 vehicles can have initial acceleration rates of 1.7 mph per second (Agility 2009). The acceleration rates for the 10-car dual-mode MU presumed in this analysis (see discussion below) is unknown but for the sake of this analysis is presumed to be 1.7 mph per second which is substantially better than current diesel locomotives.[6]

[6] If this assumption is incorrect, then this alternative could still increase ridership, but the gains would be limited given the inability to add stops without slower overall travel times.

For the purposes of this alternative analysis, existing European train designs[7] were used to derive alternative assumptions:

- A 10-car single-level dual-mode MU train, consisting of two coupled five-car train sets, with a capacity of 600 passengers per train was analyzed in order to analyze an alternative that would roughly match the passengers per train capacity of the Proposed Project.
- The 10-car single-level dual-mode MU train length would be 600 feet which would ~~fit at existing Caltrain station platforms.~~ require lengthening at some of the Caltrain platforms including the platforms at 22nd Street, Broadway, California St., Sunnyvale, and Santa Clara.
- It was assumed that the Caltrain service schedule for the Dual-Mode MU Alternative would be the same as the Proposed Project but with lower ridership. Dual-mode MUs do not accelerate ~~or decelerate~~ as fast as EMUs and thus the number of station stops ~~steps~~ would likely have to be reduced to maintain the same trip time as the Proposed Project EMUs or travel times would be ~~less~~ greater.
- This alternative does not include electrification between San Jose and San Francisco. However, the DTX project has been planned assuming that the Caltrain electrification project would provide the traction power facilities to provide electrical power to the electrical train lines in the DTX ~~tunnel~~ and the TTC. Thus, this alternative would need to include traction power facilities to link the electrified lines in DTX to power from PG&E. This would involve connecting overhead or underground transmission wires from PG&E to a new traction power substation, and connecting transmission lines from the new traction power substation to the OCS for the DTX. Given the DTX and TTC location, the traction power substation would be in San Francisco, but the location is unknown. The traction power substation and transmission lines would be similar to those described for the Proposed Project.
- This Alternative is assumed to operate in a diesel mode from Tamien Station in San Jose to San Francisco and then either terminate at the San Francisco 4th and King Station or proceed in an electric mode to the TTC. In 2020, this alternative, like the Proposed Project would terminate at the 4th and King Station. In 2040, this alternative is presumed to operate with split service with four trains terminating at the 4th and King Station and two trains proceeding to TTC.

~~No specific cost estimate was prepared for this alternative.~~ This alternative would have much lower construction costs associated with the TPFs and OCS compared with the Proposed Project because this alternative would only require traction power facilities in San Francisco to connect to the DTX facilities and not the entire 51-mile corridor. ~~Maintenance and~~ Fuel costs ~~over this alternative's lifetime~~ would be ~~similar to or~~ higher than under the Proposed Project.

~~The assumptions above are based on FRA Alternative Compliant light-weight vehicles and thus the dual-mode MUs would not operate south of Tamien station and diesel locomotives would be used for service to Gilroy (as with the Proposed Project).~~

Relative to ridership, this alternative is assumed to result in less ridership than the Proposed Project due to the inferior acceleration~~/decelerations~~ performance of dual-mode MUs compared to EMUs. While service would increase to six trains pphpd, either the travel time would be longer or there

[7] This alternative is based on the Alstom Coradia Polyvalent platform, which is a dual-mode MU that is presently described as available in 3-car, 4-car and 6-car trainsets. To provide a comparable alternative to the Proposed Project, it was assumed that 5-car trainsets (300 feet, 300 passengers) would be built that would be intermediary between the 4-car trainsets (236 feet, 228 passengers) and the 6-car trainsets (360 feet, 366 passengers) (Alstom 2013a, 2013b). It is also assumed that a 5-car trainset could be coupled to provide a 10-car train (600 feet, 600 passengers) like the coupling of 3-car, 4-car, and 6-car trainsets that is feasible with current designs (Alstom 2013a and 2013b). Alstom has been building dual-mode MUs for SNCF and some entered service in 2013 with more planned. Bombardier has also been building dual-mode MUs for a number of years.

would be fewer stations served with this alternative compared with the Proposed Project. Both reduced station stops and longer travel times would affect ridership. While ridership was not modelled for this alternative, ridership is presumed to be somewhat less than under the Proposed Project but more than under the No Project Alternative due to the increased service. Nevertheless, the analysis of air quality and GHG emissions below, have assumed that the ridership would be the same as the Proposed Project, to provide a favorable comparison for the potential of this alternative.

The Dual-Mode MUs could also be used for service to Gilroy since they can be run in diesel mode. In a scenario in which Dual-Mode MUs were used in combination with full electrification (see discussion below), they could be used for one-seat transit from Gilroy to TTC. Dual-Mode MUs can also be converted to EMU only through removal of the diesel power packs during scheduled maintenance events. This alternative is also resilient through power outages as it could always operate in diesel mode. At terminals, all of the power packs onboard could be shut down and the train put on idle power from the terminal.

For this EIR, this alternative is envisioned as an alternative to avoid the Proposed Project impacts of the OCS such as aesthetics and tree removal, while still allowing service to reach TTC in the long run and thus does not include electrification between San Jose and San Francisco. However, there are other variations on this alternative in concept:

- Electrification in phases over a longer period of time if necessary to incrementally electrify instead of electrify the entire corridor at once. This is a feasible scenario in which Dual-Mode MUs could be used to provide end to end service while the corridor is electrifies over a longer period of time than proposed under the PCEP. However, at the end of the day, once the full OCS system is constructed, the impacts of this variant would have the same OCS impacts as the Proposed Project.
- Electrification of only a portion of the San Jose to San Francisco route to reduce OCS impacts: Given that the heaviest impacts of tree removals start at Atherton and head south (there would still be substantial tree removal impacts in cities like Burlingame and other north of Atherton) , one conceptual arrangement could have electrified territory from Redwood City to San Francisco (~27 miles) and non-electrified territory from Tamien to Redwood City (~24 miles). With this configuration, there would only be one changeover of power modes in the middle of the route and there could be a contiguous OCS system from Redwood City north. There would likely be a need for a full substation in Redwood City, but the rest of the configuration northward would be similar to the proposed project.
- Electrification of only a short segment near each station to provide for electrified acceleration while operating in diesel mode outside of near the stations to reduce OCS impacts:
    - To the JPB's knowledge, Dual-Mode MUs have never been used in this "start-stop" fashion anywhere in the world. Instead, Dual-Mode MUs are used to cover routes that have contiguous areas of electrified and non-electrified territory. For example, dual-mode locomotives are used to access several train stations in New York City using electrical power and then operate in diesel mode for areas outside the stations tunnels.
    - In concept, if one wanted to provide electric power for acceleration out of every station on the entire route, this could require 26 separate OCS segments on either side of each station between Tamien and SF 4th and King (not counting the Stanford station which is only used infrequently).
    - There are a number of critical issues with the design of such an alternative:
        - Length of the OCS segments is not likely to be short. Many Caltrain stations are relatively close together. From South San Francisco to Tamien, none of the stations are more than 3 miles apart and many are much closer, such as the Menlo Park and Atherton stations

which are only 1.1 miles apart. Even under electric power, trains do not reach their top speed immediately. Based on the EMU acceleration performance, it will likely take 50 to 60 seconds to reach top speed, during which time the EMU could cover perhaps 0.3 miles. In order to preserve the ability to operate service on either line (if one is out for maintenance or due to a train issue), each station would need a minimum of 0.6 miles of OCS on both tracks (perhaps 0.3 miles in each direction). Thus, between Menlo Park and Atherton, for example, the OCS associated with both stations would take up 0.6 miles between the two, leaving perhaps 0.5 miles without an OCS.

- While an electric motor can be ramped up to power nearly instantaneously, a large diesel engine cannot. Thus, in order to provide seamless power after the initial acceleration, the diesel would need to be running in a standby mode before it is called on to take the load. Further, by running both electricity and standby diesel, the efficiency is worsened. This would increase fuel consumption, air pollutant emissions and GHG emissions compared to EMU operations.
- Discontinuous OCS segments would either require substations for each short electrified segment with separate power drops from PG&E (requiring more transmission lines through adjacent communities or would require undergrounding of the live wires between the OCS segments in buried power conduit along the ROW with the current configuration of TPFs.

- For the reasons above, the "start-stop" configuration with short distances of electric mode and short distances of diesel mode would be highly inefficient and would not be cost effective as one would still need a "full" OCS if the electrified segments were distributed from San Jose to San Francisco.

While there are a myriad of permutations of this alternative, using the conceptual alternative defined above with about half of the route electrified, the partial electrification variation of the alternative would have impacts that would be somewhere in between that of the Proposed Project and the Dual-Mode Multiple Unit Alternative described in the DEIR. Compared to the Dual-Mode Multiple Unit Alternative described in this EIR, the partial electrification variant would have higher aesthetic and tree removal impacts (due to an OCS system from Redwood City to San Francisco), lower criteria pollutant and GHG emission impacts (due to more use of electricity and less of diesel), possibly higher ridership (due to better acceleration from Redwood City to San Francisco), and lower noise impacts (due to electric operations from Redwood City to San Francisco). Compared to the Proposed Project, the partial electrification alternative would have lower aesthetic and tree removal impacts (due to no OCS system from San Jose to Redwood City, higher criteria pollutant and GHG emission impacts (due to less use of electricity and more use of diesel) and higher local pollution impacts from San Jose to Redwood City (due to diesel use instead of electric power use), lower performance and ridership (due to lower acceleration in both diesel and electrical modes compared to EMUs), and higher noise impacts (due to diesel operations from Redwood City to San Francisco).

As a result, the partial electrification variant of alternative is not an independent alternative, but an intermediary alternative between the Dual-Mode Multiple Unit Alternative analyzed in this EIR and the Proposed Project, with environmental impacts at somewhat of a mid-point between the two. As such, the partial electrification variant of this alternative does not actually widen the range of alternatives in the EIR, because the reader can already see clearly the differences between the "full" Dual-Mode Multiple Unit Alternative and the Proposed Project which shows the range and types of impacts that occur when switching from diesel to electric modes. As such, the partial electrification variant of this alternative is not analyzed further below.

Construction Impacts

The Dual-Mode MU Alternative's construction impacts would be limited to new traction power facilities to connect PG&E power to the DTX OCS and extension of platforms at five stations. It is presumed that transition to the DTX ~~tunnel~~ for trains shifting from diesel mode to electrified mode to reach the 4th and Townsend Station would occur at roughly the same location as the currently planned transition to separate tracks in the current DTX design north of 16th Street.

The DMU Alternative would have greater construction impacts at five Caltrain stations but would require no construction at other locations. Overall, the areas of disturbance would be far less with the DMU Alternative, but the intensity of construction at the five Caltrain stations for this alternative would be far higher. The following 5 stations have platforms that are less than 600 feet in length: 22nd Street, Broadway, California Avenue, Sunnyvale, and Santa Clara. Platform extension at Caltrain stations would require grading, excavation, pouring of concrete, and potential utility relocates. Because some of the stations are historic stations, care would need to be taken to avoid impacts on the historic features, similar to that required in placing the OCS facilities with the Proposed Project. There would also be temporary air emissions and noise at the construction locations. In addition, there could be temporary utility disruption if utilities are present in platform extension areas.

Overall, although the Dual-Mode MU Alternative would have greater impacts at five Caltrain stations than the Proposed Project, given the smaller overall area of effect, this alternative would have less construction-related impacts than the Proposed Project in all subject areas with the exception of historic resources. Because this project would require platform changes at the historic Santa Clara station, the Dual-Mode MU Alternative could have similar or potentially higher impacts on cultural resources than the Proposed Project at the Santa Clara station.

Overall, ~~even if limited areas of additional construction were necessary to facilitate an appropriate transition area~~, construction impacts would be far less than under the Proposed Project or the DMU Alternative but would be greater than under the No Project Alternative.

Operational Impacts

When operating in diesel mode, the Dual-Mode MU Alternative would have impacts similar to those of the DMU Alternative. Thus, the analysis above for the DMU Alternative is referenced where appropriate and differences with the DMU Alternative are highlighted.

Aesthetics

This alternative would result in no changes to existing visual aesthetics, except in relation to traction power facilities and transmission lines in San Francisco, and possibly resulting from limited track work along the Caltrain ROW on the approach to the 4th and King Street Station, around 16th Street in San Francisco as well as platform extensions at five stations.

Minor track and OCS work at the transition point would not have significant impacts on existing visual aesthetics at this location under I-280 along the existing Caltrain ROW. The visual impacts of a new traction power substation and transmission lines would depend on their location, which is unknown.

This alternative would require extension of platforms at five Caltrain stations, which would change the visual appearance of the affected stations with additional concrete platform areas. But with extended platforms, the change in visual appearance would likely be less than significant given it would be at-grade and can be designed to be consistent with the aesthetics of existing platforms. The Dual-Mode MU Alternative would result in fewer permanent impacts than the Proposed Project on aesthetics along the Caltrain ROW because there would be no need for tree removal and an OCS.

This alternative would have less aesthetic impacts than the DMU Alternative as it would not require platform extension but would have aesthetic impacts greater than the No Project Alternative.

Air Quality

Emissions resulting from this alternative are presumed to be similar to the DMU Alternative for 2020 since this alternative presumes diesel operations between San Jose and San Francisco 4th and King Station. The diesel engines on the Dual-Mode MUs should have similar performance as the diesel engines on the DMUs. Given the likely train length and the somewhat heavier weight of dual-mode MUs compared to DMUs, it is ~~probably~~ possible that train-related emissions of this alternative would be higher than the DMU Alternative. For 2040, this alternative ~~may~~ will likely have lower emissions than the DMU Alternative due to the higher ridership with access to TTC and the resultant VMT-related emissions reductions.

Based on the DMU Alternative, the Dual-Mode MU Alternative would have lower emissions than the No Project Alternative in 2020 for criteria pollutants other than NOx but would likely have lower emissions compared with the No Project Alternative when taking into account VMT reductions in 2040 with the service to TTC.

Similar to the DMU Alternative, in 2020, health risks resulting from the Dual-Mode MU Alternative would be similar to, but possibly slightly higher ~~less~~ than under the No Project Alternative due to slightly higher ~~lowered~~ PM emissions along the Caltrain ROW ~~but~~ and risks may be slightly higher in 2040 depending on the No Project Alternative replacement of locomotives over time.

As discussed above for the DMU Alternative, the effect of tree removal avoidance compared to the Proposed Project on particulate emissions and health risks and other emissions (such as pantograph wear emissions) is likely minimal and would not change the conclusions noted above. Therefore, in 2020 this alternative would have a greater impact on air quality than the Proposed Project and the DMU Alternative but less impact than No Project Alternative relative to certain pollutants and more impact relative to other pollutants. In 2040, this alternative would have a greater impact on air quality than the Proposed Project, less impact than the No Project Alternative, and likely less impact than the DMU Alternative.

Biological Resources

Similar to the DMU and No Project Alternatives, this alternative would avoid the need for expanded tree removal and pruning. There would likely be limited to no biological resource impacts due to new traction power facilities and transmission lines in San Francisco.

With the Dual-Mode MU Alternative, diesel and nitrogen emissions regionally would be less than the No Project Alternative and result in fewer related effects on biological resources than the No Project Alternative. However, diesel fuel consumption would likely be higher than the DMU Alternative and would be substantially higher than the Proposed Project.

Cultural Resources

Operation of this alternative would not impact archeological, cultural, or historical resources. Dual Mode MUs would operate within the existing Caltrain ROW and on the existing tracks, and would not require modifications or removal of existing historical structures. Therefore, operational impacts on cultural resources would be the same as the Proposed Project, the DMU Alternative and the No Project Alternative.

Electromagnetic Fields/Electromagnetic Interference

Operation of this alternative would not require an overhead OCS except at the DTX ~~tunnel~~ and at TTC and new transmission lines from PG&E to the DTX. The operation of this alternative would not increase the level of electromagnetic fields along the Caltrain corridor and project vicinity, or increase electromagnetic interference in this same area. Impacts along the DTX ~~tunnel~~ and at TTC would be the same as with the Proposed Project. New transmission facilities can be designed to maintain exposure limits within health thresholds. Therefore, the potential impacts associated with EMF and EMI would be less than under the Proposed Project, but slightly greater than under the DMU Alternative and the No Project Alternative because of the Dual-Mode MU Alternative's electrified operations along the DTX ~~tunnel~~ and at TTC.

Geology, Soils and Seismicity

Under this alternative, operation of the Caltrain service would be in the same project area as the Proposed Project and would expose structures and people to the same seismic, soil, and geologic hazards as the Proposed Project. Therefore, the exposure of risks associated with seismic, soil, and geologic hazards would be the same as the Proposed Project, the DMU Alternative and the No Project Alternative.

Greenhouse Gas Emissions and Climate Change

Compared with the No Project Alternative, the Dual-Mode MU Alternative would ~~likely~~ have greater Caltrain system emissions similar to the DMU Alternative. The greater emissions would result from the increase in service and from the decreased fuel efficiency of longer MU consists. However, the Dual-Mode MU Alternative would likely have lower overall emissions than the No Project Alternative overall when including lowered VMT-related emissions resulting from increased Caltrain ridership (using the assumptions noted above).

Compared with the DMU Alternative, this alternative would likely have slightly higher GHG emissions to 2020 with the likely lower efficiency of longer and heavier dual-mode MUs. However, for 2040, this alternative is likely to have lower GHG emissions overall compared to the DMU alternative when taking into account the additional ridership likely with access to TTC.

Operation of the dual-mode MUs operating primarily in a diesel mode would produce substantially more GHG emissions than would the electric engines of the Proposed Project EMUs. This conclusion takes into account both direct engine GHG emissions and indirect GHG emissions from electricity generation, and the lower ridership likely with this alternative compared with the Proposed Project because of the alternative's relatively inferior train performance.

Hazards and Hazardous Material

Similar to the DMU Alternative, compared with the No Project Alternative, this alternative would result in more Caltrain diesel fuel use due to increased train service and due to a lower fuel efficient than the diesel locomotives. However, because the Dual-Mode MU Alternative would increase ridership, the decreased regional handling of gasoline would likely offset the increased Caltrain handling of diesel in terms of risk of accidents and spillage overall resulting in similar impacts as the No Project Alternative.

Compared with the Proposed Project, the Dual-Mode MU Alternative would require much more handling and transfer of diesel fuel, which increases the potential for release of diesel. Therefore, this alternative would have greater impacts associated with the release of and exposure to hazardous materials compared than the Proposed Project.

Because this alternative would likely be less efficient than the DMU Alternative when running in diesel mode, this alternative would likely have greater diesel consumption and handling. However in 2040, this alternative would reduce regional VMT more than the DMU Alternative and thus would have lower gasoline handling.

Hydrology and Water Quality

Under this alternative, there would be limited changes in impervious space and stormwater runoff potential due to new traction power facilities. It is assumed that new facilities would likely be out of the 100-year floodplain in San Francisco. If facilities were built in the floodplain, they could be flood-proofed similar to those of the Proposed Project. This alternative would require more handling and transfer of diesel fuel than the Proposed Project, which would increase the potential for release of diesel that may affect water quality.

The areas of the Caltrain ROW and associated facilities potentially subject to flooding would remain mostly the same, as the additional platforms at five stations would all be at stations that are not in the 100-year floodplain. for tracks 1 and 2 at the San Francisco 4th and King Station, which is in the 100-year floodplain. The Proposed Project would place some new facilities into the 100-year floodplain that would be subject to flooding effects, but mitigation is available to reduce effects to a less-than-significant level. Both the Dual-Mode MU Alternative and the Proposed Project would have similar vulnerabilities to future flooding associated with sea level rise, but the Proposed Project would place slightly more facilities at risk than the Dual-Mode MU Alternative. Thus, the Dual-Mode MU Alternative would have less impact related to flooding than the Proposed Project.

The Dual-Mode MU Alternative would have slightly higher potential for diesel spills than the No Project Alternative due to greater diesel duel handling but less gasoline handling overall due to lowered regional VMT. These impact changes offset each other and, therefore, this alternative would have similar water quality impacts to the No Project Alternative related to potential fuel spills or leakage.

Relative to the DMU Alternative, this alternative would have less impervious space and likely similar potential for fuel spills (due to more diesel use but less gasoline consumption in the long run).

Land Use and Recreation

Under this alternative, the OCS alignment and its associated vegetation clearance zone would not be required. As a result, land outside the ROW would not need to be acquired in fee or easement for OCS alignment or ESZ purposes. This alternative would require a traction power substation in San Francisco, but it is probable that this facility would be placed in commercial or industrial areas and would not result in land use incompatibilities. This alternative would not increase the demand or physically impact existing recreational facilities. The additional station platform areas would be within the Caltrain ROW and thus would not displace any other land uses.

Therefore, this alternative would have less impact on land use and recreation than the Proposed Project. This alternative would have similar impacts as the DMU Alternative and the No Project Alternative.

Noise and Vibration

Operation of the dual-mode MUs would likely have similar noise impacts as the DMU Alternative but possibly slightly greater due to heavier vehicles. Noise impacts would be greater than under the Proposed Project.

The dual-mode MUs should be quieter than today's locomotives but train horn sounding would increase with increased service and thus noise levels may be less than or similar to the No Project Alternative~~Proposed Project~~.

Population and Housing

This alternative would not indirectly or directly induce population growth or the demand for new housing units in the project area. Similar to the Proposed Project and the DMU Alternative, operation of this alternative would not require the displacement of existing housing units or businesses. Therefore, the impact on population and housing would be the similar to the Proposed Project, the DMU Alternative and the No Project Alternative.

Public Services and Utilities

With this alternative, operations would not have appreciable changes in public services demand, similar to the Proposed Project and the DMU Alternative, and no effect on utility disruption. Thus, the Proposed Project, the DMU Alternative, the No Project Alternative, and the Dual-Mode MU Alternative would all have similar effects on public services and utilities during operations.

Transportation/Traffic

Regional Traffic

Under this alternative, there would an increase in rail service similar to the Proposed Project and the DMU Alternative, but with more trains than with the No Project Alternative. Regionally, the Dual-Mode MU Alternative would result in a lesser reduction in VMT and associated general traffic congestion compared with the Proposed Project because, like the DMU Alternative, the Dual-Mode MU Alternative would result in less ridership due to inferior performance relative to the Proposed Project's EMUs. However, the Dual-Mode MU Alternative would be beneficial compared with the No Project Alternative and would reduce regional traffic more than the DMU Alternative in 2040 with access to TTC.

Localized Traffic at Certain At-Grade Crossings and Caltrain Stations

In comparison with the Proposed Project, the ridership under this alternative would be somewhat less. Dual-mode MUs cannot accelerate ~~and decelerate~~ as fast as the proposed EMUs which will mean that either less stops can be serviced or overall travel times would be less, either of which will lessen ridership.

The Dual-Mode MU Alternative would likely result in a similar number of gate-down events during peak hours at the grade crossings as the Proposed Project. At grade crossings that are not near stations, the gate-down time should be similar to the Proposed Project. At grade crossings that are near stations, the Dual-Mode MU Alternative would result in greater gate-down time than the Proposed Project due to the slower ~~deceleration and~~ acceleration performance. Thus, at grade crossings near stations, the Dual-Mode MU Alternative, like the DMU Alternative, would have a greater impact on localized traffic than the Proposed Project.

Because the Dual-Mode MU Alternative would result in less ridership than the Proposed Project, traffic impacts near Caltrain stations may be somewhat less, like the DMU Alternative. On balance localized traffic impacts are likely to be similar to the Proposed Project.

Relative to the No Project Alternative, the Dual-Mode MU Alternative would result in better regional traffic and worse localized traffic at some at-grade crossings and near Caltrain stations.

Ridership of Other Transit Systems

The Dual-Mode MU Alternative would result in less Caltrain ridership than the Proposed Project. Similar to the Proposed Project and the DMU Alternative, this alternative would not substantially change the ridership of other transit systems compared with the No Project Alternative.

Conflict with other Transit Projects

The Dual-Mode MU Alternative would be consistent with plans for DTX and TTC. Regarding the rerouting of 22-Fillmore, there may be need for crossing design to ensure the pantograph of the dual-mode MUs would not contact the direct current trolley bus overhead line, which is a similar concern to the Proposed Project, depending on the location for transition from diesel to electrified service with this alternative relative to 16th Street. If no electrification were done at 16th Street, since this alternative can run in diesel mode, there would be no conflict with the 22-Fillmore OCS.

The Proposed Project's impacts related to the OCS for other transit projects are either less than significant or can be managed with mitigation, so this difference is not considered significant.

This alternative would be consistent with the plans for DTX and TTC which would be a lower impact than either the DMU Alternative or the No Project Alternative both of which would be in conflict.

Pedestrian/Bicycle Facilities

As discussed in Section 3.14, *Transportation and Traffic,* the Proposed Project would have a less than significant impact on pedestrian facilities with mitigation. Since ridership would increase with the Dual-Mode MU Alternative, but less than with the Proposed Project, this alternative would have a smaller less than significant impact (with mitigation) on pedestrian facilities. It would have a similar impact as the DMU Alternative.

As discussed in Section 3.14, *Transportation and Traffic* and Section 4.1, *Cumulative Impacts*, the Proposed Project would result in an increased demand for bike facilities, but proposed mitigation would address this increased demand. There would also be an increase in demand for bike facilities with the increased ridership expected with this alternative; however, Caltrain could address this demand by similar means as the proposed mitigation for the Proposed Project. Thus, the Dual-Mode MU Alternative would have a lesser impact than the Proposed Project relative to bicycle facilities.

Station Parking and Access

As discussed in Section 3.14, *Transportation and Traffic* and Section 4.1, *Cumulative Impacts*, the Proposed Project would result in an increased demand for parking, but this would not result in significant secondary impacts on air quality, noise, or traffic or due to the construction of other parking facilities. The Dual-Mode MU Alternative would result in a lower increase in parking demand and, therefore, would have less impact than the Proposed Project relative to parking demand.

Emergency Vehicle Access

Relative to emergency vehicle access, the Dual-Mode MU Alternative would have a similar but smaller positive effect on reducing higher regional vehicle miles traveled, a similar but worse adverse effect at at-grade crossing, and similar but smaller adverse effects at intersections near stations. This alternative would have similar but less overall beneficial impacts on emergency response times as the Proposed Project. This alternative would be beneficial relative to the No Project Alternative.

Freight Rail Operations

This alternative ~~would require the same temporal separation requirements for freight as the Proposed Project's EMUs and, thus,~~ would have the same effect on freight operations as the Proposed Project because it is presumed that alternative compliant dual-mode MUs could operate in a shared environment with freight trains, like the Proposed Project's EMUs.

This alternative would not require an OCS (outside of DTX/TTC); consequently, there would be no concerns about potential height restrictions for freight. Overall this alternative would have the same impacts as the DMU Alternative ~~(presuming light-weight DMUs),~~ less impacts than the Proposed Project (due to lack of OCS), and ~~more~~ similar impacts to ~~than~~ the No Project Alternative.

5.2.4 Tier 4 Diesel Locomotive Alternative (T4DL)

A Tier 4 Diesel Locomotive (T4DL) Alternative is feasible as new diesel locomotives are under construction in the U.S. that can meet the USEPA's Tier 4 emissions standards.

The T4DL Alternative would not meet the project's purpose to provide electrical infrastructure compatible with high-speed rail. In addition, while the increase train service under this alternative would increase revenue, this alternative would also increase diesel fuel consumption compared with existing conditions[8] which would increase operating fuel costs. Therefore, this alternative would only partially meet the project's objective to increase operating revenue and would not meet the objective to reduce operating fuel costs. In addition, as discussed below, this alternative would not lower engine noise compared to the No Project Alternative.

Although this alternative does not meet three of the project objectives, it was analyzed to respond to public interest. It should be noted that this alternative is actually an extension of the No Project Alternative. The No Project Alternative also uses Tier 4 Diesel Locomotives; the differences are that the Tier 4 Diesel Locomotive Alternative includes an increase to 114 trains per day and 6 trains per peak hour per direction, a change from the existing schedule to the Proposed Project schedule, and he T4DL-DH variant of this alternative would include two locomotives per consist. If this alternative were advanced, it would require no CEQA analysis, because CEQA exempts increases of passenger service on existing rail lines if it involves no new construction of new rail lines. As such, this alternative does not actually meaningfully expand the range of alternatives considered in the DEIR and it is not mandatory to analyze this alternative further. However, as noted above, due to public interest, this alternative is analyzed to respond to comments on the DEIR.

As indicated in Table 5-1, a new Tier 4 single diesel locomotive hauling passenger coaches would have initial acceleration rates of approximately 1.1 mphps and a train consist with two diesel locomotives would have an initial acceleration rate of approximately 2.1 mphps. The new Tier 4 diesel locomotives under construction by Siemens can reach up to 125 mph top speed and have a maximum deceleration of approximately 1.8 mphps (Siemens 2013) but the deceleration profile would be somewhat less than that of the EMUs as the passenger coaches would not have independent braking like the EMUs.

[8] 2020 No Project diesel consumption is estimated as 5.6 million gallons/year compared with 2020 T4DL Alternative diesel consumption of 6.5 to 9.2 million gallons/year (Single-head vs. double-head scenario). Nominal fuel consumption for a single T4 diesel locomotive is 3.6 gallons/mile (including non-revenue) compared to 3.1 gallons/mile (including non-revenue) for today's diesels, which are less powerful. Double-head scenario would have higher fuel consumption due to use of two locomotives per consist. As discussed in text, 2020 scenarios for the T4DL Alternative assume continued use of 1998 and 2003 remnant diesel locomotives until they reach the end of their service life to match the project's use of remnant diesel locomotives as well.

This alternative includes two variants: 1) a single-head (SH) scenario which includes operation of train consists with only one locomotive; and 2) a double-head (DH) scenario in which trains are operated with two locomotives.

Newer diesel locomotives would reduce running times due to faster acceleration than current Caltrain diesel equipment.

For the purposes of this alternative analysis in order to make "apples to apples" comparisons to the Proposed Project to contrast the consequences of using a different train technology, the following assumptions were made.

- Train consists would be the same as today with a single or double locomotive hauling 5 bi-level passenger coaches with a nominal capacity of 600 passenger seats per train order to analyze an alternative that would roughly match the ridership[9] per train capacity of the Proposed Project.
- It was assumed that the Caltrain service levels (6 trains per peak hour, 114 trains/weekday) would be the same as the Proposed Project.
- For 2020, the single-head scenario would likely not result in the same amount of ridership given the differences in both acceleration and deceleration as the proposed project and thus the number of stops during peak hours would have to be less than the Proposed Project and/or end to end trip times would be longer. For the sake of EIR analysis only, it was assumed that this scenario would have the same ridership as the PCEP, even though it would have inferior performance compared to the PCEP.
- For 2020, the double-head scenario would accelerate almost as fast as EMUs, Even though its deceleration profiles would be less than the EMUs, for the sake of the environmental analysis only, ridership is assumed to be the same as the PCEP.
- For 2020, both scenarios assume continued use of the remaining Caltrain diesel locomotives that are less than 30 years old including the three 1998 F40s and the six 2003 MP36s. this is the same assumption as for the PCEP, which will operate a mixed fleet in 2020.
- For 2040, both scenarios would presume 100 percent use of Tier 4 diesel locomotives.
- For 2040, the T4DL Alternative is assumed to terminate at the San Francisco 4th and King Station and would not proceed to the TTC because the DTX and the TTC are designed only for electric trains. Even if ventilation were added to the DTX tunnel, the TTC is a fully enclosed station that is not designed to handle the emissions from diesel train operations in the enclosed station. Many fully enclosed stations and tunnels, like the tunnels leading to Grand Central Station and Penn Station in New York City prohibit diesel operations due to health concerns. Other major downtown stations that allow diesel operations, such as Union Station in Chicago, face substantial controversy concerning diesel emissions in constrained spaces. Thus, due to the design of the DTX and the TTC and due to the health concerns about diesel emissions in enclosed spaces, this alternative does not include service to TTC.
- For 2040, two sub-scenarios were evaluated for ridership: one assuming 20% less ridership increase over the No Project ridership compared to the PCEP and one assuming the same ridership as the PCEP. This is to account for the potential differences due to not serving TTC compared to the PCEP.

Construction Impacts

This alternative would involve replacing the existing Caltrain diesel locomotive-hauled vehicles with new T4DL vehicles but would involve no new construction.

[9] The Proposed Project capacity is roughly 600 passenger seats per train.

Operational Impacts

Aesthetics

This alternative would not involve the installation of an OCS or TPFs or additional removal of vegetation. Current maintenance trimming of vegetation would continue as at present, but the maintained area would not change (with the Proposed Project the maintained area would expand outward as necessary for the OCS ESZ).

Overall, the T4DL Alternative would have substantially less aesthetic impact than the Proposed Project and the same impacts as the No Project alternative.

Air Quality

Emissions resulting from T4DL operations were compared with EMU operations emissions under the Proposed Project.

As noted above, no ridership evaluation was conducted for the T4DL Alternative. The single-head and double-head scenario were both assumed to have the same ridership as the PCEP in 2020. For 2040, two scenarios were studied: 1) assuming 80 percent of the ridership increase of the PCEP above the No Project conditions (due to not reaching TTC) and 2) assuming the same ridership as the PCEP.

As shown in Table 5-6 above, due to higher Caltrain diesel daily consumption, the T4DL Alternative would result in substantially higher daily emissions of ROG, CO, and NO_X and slightly higher emissions of PM10 and PM2.5 along the Caltrain ROW than the Proposed Project in both the 2020 project scenario and the 2040 fully electrified scenario. When taking into account the indirect electricity emissions and assuming the same ridership as the Proposed Project, the T4DL Alternative would still have substantially higher criteria pollutants in both the 2020 and 2040 scenarios. In 2020, the differences in NO_x emissions between the T4DL Alternative and the Proposed Project are well above the BAAQMD threshold. For 2040, assuming different ridership, the differences between The T4DL Alternative and the Proposed Project for ROG, NOx and PM10 would be above the BAAQMD threshold. For 2040, assuming the same ridership, the differences between the T4DL Alternative and the Proposed Project for NOx would be above the BAAQMD threshold.

Based on the PM10 emissions shown in Table 5-6, the T4DL Alternative would also have slightly higher DPM emissions associated with Caltrain diesel trains along the Caltrain ROW and would result in higher health risks associated with DPM for residents along the Caltrain ROW compared with the Proposed Project. Using the example provided in Section 3.2, *Air Quality*, of an area in Menlo Park proposed for mixed use where the current diesel locomotives would result in an indoor risk of cancer from DPM emissions of 39 in a million, and assuming that the health risks are directly proportionate to daily PM10 emissions, the cancer health risks associated with the T4DL Alternative would be 7 to 8 in a million in 2020 at the modeled location. As noted in Section 3.2, *Air Quality*, the Proposed Project would reduce the health risk at this location to approximately 5 in a million in 2020.

In 2020, the T4DL-DH Alternative would have lower Caltrain system emissions compared with the No Project Alternative for all criteria pollutants when taking into account VMT reductions. The T4DL-DH Alternative would have lower criteria pollutant emissions overall, except for NO_X emissions which would be higher than the No Project Alternative by more than the BAAQMD threshold. In 2040, the T4DL-DH Alternative would result in lower emissions compared with the No Project Alternative for all criteria pollutants.

In 2020, health risks resulting from the T4DL Alternative would be slightly higher than under the No Project Alternative due to slightly higher DPM emissions along the Caltrain ROW. The risks also

would be slightly higher in 2040 due to higher DPM emissions along the Caltrain ROW. But the differences are not significant and this alternative, like all of the alternatives would result in substantial reductions in DPM emissions compared to existing conditions.

As discussed above for the DMU Alternative, the effect of tree removal avoidance compared to the Proposed Project on particulate emissions and health risks and other emissions (such as pantograph wear emissions) is likely minimal and would not change the conclusions noted above.

Therefore, this alternative would have a greater impact on air quality than the Proposed Project but would have but a decreased impact overall compared with the No Project Alternative in the long run (e.g., with full replacement).

Biological Resources

With this alternative, existing tree trimming to maintain physical clearance zones for trains would continue but would not be expanded as in the Proposed Project. Thus, this alternative would have less ongoing disruption to nesting birds and bats that might be present in trees along the Caltrain ROW.

This alternative would have continued diesel emissions along the Caltrain ROW (higher than the Proposed Project), which would result in continued deposition of diesel contaminants into adjacent upland and aquatic areas. In addition, diesel emissions also result in nitrogen deposition (higher than the Proposed Project) adjacent to the Caltrain ROW and in areas a number of miles from the Caltrain ROW. As discussed in Section 3.3, *Biological Resources*, deposition of nitrogen from vehicle emissions and other emission sources has resulted in a "fertilization effect" in natural areas that has favored non-native species over some native species, in particular affecting habitat for host plants for certain rare butterfly species.

With the T4DL Alternative, diesel and nitrogen emissions regionally would be less than the No Project Alternative and thus this alternative would have fewer related effects on biological resources than the No Project Alternative.

Cultural Resources

Operation of this alternative would not impact archeological, cultural, or historical resources. T4DLs would operate within the existing Caltrain ROW and on the existing tracks, and would not require modifications or removal of existing historical structures. Therefore, operational impacts on cultural resources would be the same as the Proposed Project and the No Project Alternative.

Electromagnetic Fields/Electromagnetic Interference

Operation of T4DLs would not require an overhead OCS. Instead, the T4DLs would be powered by onboard diesel engines. The operation of this alternative would not increase the level of electromagnetic fields along the Caltrain corridor and project vicinity, or increase electromagnetic interference. Therefore, the potential impacts associated with EMF and EMI would be less than the Proposed Project and the same as the No Project Alternative.

Geology, Soils and Seismicity

Under this alternative, operation of the Caltrain service would be in the same project area as the Proposed Project and would expose structures and people to the same seismic, soil, and geologic hazards as the Proposed Project. Therefore, the exposure of risks associated with seismic, soil, and geologic hazards would be the same as the Proposed Project and the No Project Alternative.

Greenhouse Gas Emissions and Climate Change

Compared to existing conditions, the T4DL-SH Alternative in 2020 would result in lower GHG emissions but the T4DL-DH Alternative would result in a slight increase in GHG emissions. Boh variants of the T4DL Alternative would result in substantially lower GHG emissions in 2040 than under existing conditions.

The T4DL Alternative would result in greater GHG emissions overall than the Proposed Project but less overall than the No Project Alternative when taking into account all changes in emissions, including changes in VMT and associated passenger vehicle emissions.

Operation of the T4DLs would emit more GHG emissions than electric engines in the Proposed Project EMUs, taking into account both direct engine GHG emissions as well as indirect GHG emissions from electricity generation. The analysis used the same sensitivity approach to ridership as described above for the air quality analysis.

Compared with the No Project Alternative, the T4DL Alternative would have greater Caltrain system emissions. The greater emissions would result from the increase in service. However, the T4DL Alternative would have lower emissions than the No Project Alternative overall when including lowered VMT-related emissions resulting from increased Caltrain ridership (using the assumptions noted above).

Hazards and Hazardous Material

Under this alternative, there would be an ongoing potential for the release of and exposure to diesel fuel and other hazardous materials during maintenance activities. Operation of this alternative would also generate hazardous waste material from the use of lubricants and solvents.

Compared with the No Project Alternative, this alternative would result in more Caltrain diesel fuel use due to increased train service. However, because the T4DL Alternative would increase ridership and lower regional VMT, the decreased regional handling of gasoline would likely offset the increased Caltrain handling of diesel in terms of risk of accidents and spillage.

Compared with the Proposed Project, the T4DL Alternative would require much more handling and transfer of diesel fuel, which increases the potential for release of diesel. Therefore, this alternative would have greater impacts associated with the release of and exposure to hazardous materials compared than the Proposed Project but likely similar overall impacts as the No Project Alternative.

Hydrology and Water Quality

Under this alternative, there would be no change in impervious area in the project area. This alternative would not require the construction of TPFs or the OCS. This alternative would require much more handling and transfer of diesel fuel than the Proposed Project, which would increase the potential for release of diesel that may affect water quality. Because the Proposed Project's operational impact on water quality is readily addressed through application of existing regulations, and the Proposed Project would require far less handling of diesel fuel, the T4DL Alternative is considered to have a higher risk of spills and water quality effects than the Proposed Project.

The areas of the Caltrain ROW and associated facilities potentially subject to flooding would remain the same. The Proposed Project would place some new facilities into the 100-year floodplain that would be subject to flooding effects, but mitigation is available to reduce effects to a less-than-significant level. Both the T4DL Alternative and the Proposed Project would have similar vulnerabilities to future flooding associated with sea level rise, but the Proposed Project would place slightly more facilities at risk than the T4DL Alternative. Thus, the T4DL Alternative would have less impact related to flooding than the Proposed Project.

The T4DL Alternative would have the same impacts than the No Project Alternative relative to stormwater runoff and flooding. As described above, the T4DL Alternative would require greater diesel duel handling by Caltrain than the No Project Alternative but less gasoline handling overall due to lowered regional VMT. These impact changes offset each other and, therefore, this alternative would have similar water quality impacts related to potential fuel spills or leakage.

Land Use and Recreation

Under this alternative, the OCS alignment and its associated vegetation clearance zone would not be required. As a result, land outside the ROW would not need to be acquired in fee or easement for OCS alignment or ESZ purposes. In addition, this alternative would not construct the traction power supply substations in the City of South San Francisco and the City of San Jose. This alternative would not increase the demand or physically impact existing recreational facilities.

Therefore, this alternative would have less impact on land use and recreation than the Proposed Project and would have the same impacts as the No Project Alternative.

Noise and Vibration

Operation of the T4DLs would generate higher levels of engine noise than the Proposed Project EMUs. The T4DL Alternative would also result in increased horn noise due to increased Caltrain service, primarily in peak hours, which would be the same horn noise increase as the Proposed Project and more train horn noise than the No Project Alternative. The T4DL Alternative would not generate new noise associated with the TPFs. Because the T4DL engines are noisier than the EMUs, while the changes in train horn noise would be the same, the T4DL Alternative would have greater noise impacts than the Proposed Project along the Caltrain ROW, but less impact around the TPFs. The T4DL engines are slightly quieter than existing diesel locomotives, but with the additional horn noise, the T4DL-DH Alternative would have higher noise levels overall than the No Project Alternative.

As presented in Table 5-10, the following conclusions can be made for the 49 study locations for the T4DL-DH Alternative relative to No Project conditions.

- Noise levels lower than No Project Alternative: Four locations
- No change between No Project Alternative and the T4DL-DH Alternative: No locations
- Noise levels higher with the T4DL Alternative: 45 locations.

Based on Table 5-10, the following conclusions can be made for the 49 study locations for the T4DL-DH Alternative relative to the Proposed Project.

- Noise levels lower than the Proposed Project: No study locations
- No change between T4DL Alternative and the Proposed Project: No study locations
- Noise levels higher with the T4DL Alternative: 49 locations.

Therefore, this alternative would have a greater impact on sensitive receptors from noise than the Proposed Project and the No Project Alternative. As shown in Table 5-10, unlike the Proposed Project, the T4DL-DH Alternative would result in exceedances of the FTA Criteria at four locations and thus would result in a significant project-level noise impact whereas the Proposed Project would not.

Table 5-10. Noise Levels and Impacts from Train Operations, Tier 4 Diesel Locomotive Alternative – Double-Head Scenario (2020)

Receptor Site No.	City	Cross Streets	Side of Alignment	Land Use[a]	Distance to Receptor (feet)	Measurement Site ID	Existing[b]	Proposed Project	T4DL-DH Alternative	Change with T4DL over Existing	FTA Impact Criteria	
							Total Ambient Noise Exposure at Receptorc L_{dn} (dBA)				Moderate (dBA)	Severe (dBA)
1	San Francisco	Oakdale Ave and Quint Ave	W	MFR	110	N32	69	68.8	69.5	0.5	1.1	2.9
2	San Francisco	Reddy St and Williams Ave	E	SFR	80	N33	70	69.7	70.6	0.6	1.0	2.8
3	San Francisco	Carr St and Paul Ave	E	SFR	90	N32	70	69.7	70.5	0.5	1.0	2.8
4	San Francisco	Tunnel Ave and Lathrop Ave	E	SFR	120	N31	69	68.9	69.6	0.6	1.1	2.9
5	San Bruno	Herman St and Tanforan Ave	W	SFR	110	R05	76	75.4	75.7	-0.3	0.3	2.1
6	San Bruno	Huntington Ave and San Bruno Ave	E	MFR	50	R07	77	74.6	75.4	-1.6	0.3	2.0
7	San Bruno	Montgomery Ave and Walnut St	W	SFR	120	R07	74	72.3	72.9	-1.1	0.5	2.3
8	San Bruno	1st Ave and Pine St	E	SFR	100	N53	74	71.6	72.4	-1.6	0.5	2.3
9	San Bruno	Huntington Ave and Sylvan Ave	W	SFR	150	N53	72	69.5	70.4	-1.6	0.8	2.5
10	San Bruno	San Antonio Ave and San Benito Ave	W	SFR	170	N26	67	66.8	67.4	0.4	1.2	3.2
11	Millbrae	Monterey St and Santa Paula Ave	E	MFR	160	N25	71	71.0	71.3	0.3	1.0	2.6
12	Millbrae	Hemlock Ave and Hillcrest Blvd.	W	SFR	90	R12	72	72.0	72.4	0.4	0.8	2.5
13	Burlingame	California Dr and Dufferin Ave	W	SFR	150	N50	68	67.8	68.4	0.4	1.2	3.1
14	Burlingame	California Dr and Mills Ave	W	SFR	160	R14	70	70.1	70.4	0.4	1.0	2.8
15	Burlingame	California Dr and Palm Dr	W	SFR	190	N22	70	70.0	70.3	0.3	1.0	2.8
16	Burlingame	Park Ave and Carolan Ave	E	SFR	160	N22	71	71.0	71.3	0.3	1.0	2.6
17	San Mateo	Grand Blvd and San Mateo Blvd	W	SFR	40	R18	76	76.0	76.6	0.6	0.3	2.1
18	San Mateo	Railroad Ave and Monte Diablo	E	SFR	70	R18	72	71.9	72.6	0.6	0.8	2.5
19	San Mateo	B St and 9th Ave	W	MFR	110	N47	73	73.1	73.3	0.3	0.6	2.4
20	San Mateo	South Blvd and 16th Ave	W	SFR	85	N20	67	66.5	67.9	0.9	1.2	3.2
21	San Mateo	Pacific Blvd and Otay Ave	E	SFR	100	N19	72	71.9	72.5	0.5	0.8	2.5
22	San Mateo	Country Rd and Dale View Ave	E	MFR	120	R22	70	69.7	70.6	0.6	1.0	2.8

Receptor Site No.	City	Cross Streets	Side of Alignment	Land Use[a]	Distance to Receptor (feet)	Measurement Site ID	Existing[b]	Proposed Project	T4DL-DH Alternative	Change with T4DL over Existing	FTA Impact Criteria	
							Total Ambient Noise Exposure at Receptorc L_{dn} (dBA)				Moderate (dBA)	Severe (dBA)
23	Belmont	Country Rd and Marine View	E	MFR	120	N18	73	72.9	73.4	0.4	0.6	2.4
24	San Carlos	Country Rd and Springfield Ave	E	SFR	100	N17	70	70.0	70.6	0.6	1.0	2.8
25	Redwood City	D St and Stafford St	E	SFR	90	N16	73	73.1	73.4	0.4	0.6	2.4
26	Redwood City	Cedar St and Main St	E	SFR	50	N47	76	76.0	76.5	0.5	0.3	2.1
27	Redwood City	198 Buckingham Ave	W	MFR	110	R27	69	68.6	69.8	0.8	1.1	2.9
28	San Mateo County	Arrowhead Lane and 5th Ave	E	SFR	50	N14	72	71.6	72.7	0.7	0.8	2.5
29	Atherton	Lloyden Dr and Fair Oaks Lane	W	SFR	60	N13	70	69.7	70.9	0.9	1.0	2.8
30	Atherton	Felton Dr and Encinal Ave	E	SFR	65	N13	70	69.7	70.8	0.8	1.0	2.8
31	Menlo Park	Burgess Dr and Alma St	E	MFR	175	N45	67	66.8	67.4	0.4	1.2	3.2
32	Palo Alto	Mitchell Lane and University Ave	W	MFR	100	N44	68	67.7	68.7	0.7	1.2	3.1
33	Palo Alto	Alma St and Lincoln Ave	E	SFR	120	N42	69	68.6	69.7	0.7	1.1	2.9
34	Palo Alto	Residences near Peers Park	W	SFR	40	R34	72	71.5	73.0	1.0	0.8	2.5
35	Palo Alto	Alma St and El Dorado Ave	E	MFR	160	N10	76	75.6	75.7	-0.3	0.3	2.1
36	Palo Alto	4237 Park Blvd	W	SFR	50	R36	78	78.1	78.4	0.4	0.2	1.8
37	Mountain View	Central Exp and Thompson Ave	E	SFR	150	N9	75	74.7	74.8	-0.2	0.4	2.2
38	Mountain View	Evelyn Ave and Bryant St	W	MFR	110	N8	73	72.7	73.0	0.0	0.6	2.4
39	Mountain View	Central Exp and Whisman Ave	E	SFR	150	N39	72	71.9	72.1	0.1	0.8	2.5
40	Mountain View	S. Bernardo Ave and Evelyn Ave	E	SFR	75	N7	68	67.4	69.0	1.0	1.2	3.1
41	Sunnyvale	Asilomar Ave and Mary Ave	E	MFR	80	N7	70	69.8	70.6	0.6	1.0	2.8
42	Sunnyvale	332 Angel Ave	E	SFR	80	N6	71	70.9	71.6	0.6	1.0	2.6

Receptor Site No.	City	Cross Streets	Side of Alignment	Land Use[a]	Distance to Receptor (feet)	Measurement Site ID	Existing[b]	Proposed Project	T4DL-DH Alternative	Change with T4DL over Existing	FTA Impact Criteria	
							Total Ambient Noise Exposure at Receptorc L_{dn} (dBA)				Moderate (dBA)	Severe (dBA)
43	Sunnyvale	Fair Oaks Ave and Evelyn Ave	W	MFR	75	N6	71	70.8	71.5	0.5	1.0	2.6
44	Santa Clara	Agate St and Lawrence Exp	W	MFR	85	R44	71	71.0	71.6	0.6	1.0	2.6
45	Santa Clara	Agate Dr and Bowers Ave	W	SFR	110	N4	68	67.7	68.5	0.5	1.2	3.1
46	Santa Clara	Alvarado Dr and San Thomas Exp	W	SFR	95	N37	68	67.6	68.7	0.7	1.2	3.1
47	Santa Clara	2109 Main St	W	SFR	95	N3	68	67.6	68.7	0.7	1.2	3.1
48	San Jose	782 Auzerais Ave	W	SFR	60	R48	81	81.0	81.1	0.1	0.1	1.0
49	San Jose	456 Jerome St	E	SFR	50	R49	71	70.1	71.6	0.6	1.0	2.6

Source: Appendix C, Noise and Vibration Technical Report

[a] SFR = Single-Family Residence; MFR = Multi-Family Residence

[b] Existing total noise exposure based on representative noise measurement data (see Table 3.11-6).

[c] Project/Alternative total noise exposure is the result of combining future Caltrain noise with existing non-railroad noise and freight train noise, as in Table 3.11-6.

Results in bold exceed the FTA impact criteria.

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The T4DL-SH Alternative would have similar but lesser noise effects than the T4DL-DH Alternative and greater noise levels at all 49 locations compared to the Proposed Project. However, the T4DL-SH Alternative would not result in any exceedances of the FTA noise criteria and thus, like the Proposed Project would not result in a significant project-level noise impact. Results for noise evaluation of both the T4DL-SH and T4DL-DH Alternative are found in Appendix C.

Vibration impacts of the T4DL Alternative should be similar to the Proposed Project, but the T4DLs would likely have greater vibration than the EMUs. As discussed in Section 3.11, *Noise and Vibration*, the EMUs are not expected to have significantly different vibration characteristic than existing conditions, so the differences between alternatives for operational vibration are not substantial.

Population and Housing

This alternative would not indirectly or directly induce population growth or the demand for new housing units in the project area. Similar to the Proposed Project, operation of this alternative would not require the displacement of existing housing units or businesses. Therefore, the impact on population and housing would be the similar to the Proposed Project and the No Project Alternative.

Public Services and Utilities

With the T4DL Alternative, operations would not have appreciable changes in public services demand, similar to the Proposed Project, and no effect on utility disruption. Thus, the Proposed Project, the No Project Alternative, and the T4DL Alternative would all have similar effects on public services and utilities during operations.

Transportation/Traffic

Regional Traffic

Under the T4DL Alternative, there would be an increase in rail service similar to the Proposed Project and more trains than with the No Project Alternative. Regionally, the T4DL-SH Alternative, would result in a lesser reduction in VMT and associated general traffic congestion compared with the Proposed Project because the T4DL-SH Alternative would have inferior performance relative to the Proposed Project's EMUs and thus would result in less Caltrain ridership. The T4DL-DH Alternative would have the same ridership in 2020, but likely lower ridership in 2040, due to not being able to reach TTC.

The T4DL Alternative would be beneficial compared with the No Project Alternative due to the increased service and reduction of VMT.

Localized Traffic at Certain At-Grade Crossings and Caltrain Stations

In comparison with the Proposed Project, the ridership under this alternative under the single head scenario would be somewhat less.

The T4DL Alternative would result in the same number of gate-down events during peak hours at the at-grade crossings as the Proposed Project. At at-grade crossings that are not near stations, the gate-down time should be similar to the Proposed Project. At at-grade crossings that are near stations, the T4DL Alternative single-head variant would result in greater gate-down time than the Proposed Project due to the slower deceleration and acceleration performance but the double-head trains would have similar performance and thus similar gate-down time. Thus, at at-grade crossing

near stations, the T4DL alternative would have a greater impact on localized traffic than the Proposed Project would have under the single-head scenario but similar impacts under the double-head scenario.

Since the T4DL alternative would result in less ridership than the Proposed Project in the single-head scenario, traffic levels near Caltrain stations may be somewhat less in general. In the double-head scenario, traffic levels near Caltrain stations would be the same in 2020, but somewhat lower in 2040 due to lower ridership due to not reaching TTC.

Relative to the No Project Alternative, the T4DL Alternative would result in better regional traffic and worse localized traffic at some at-grade crossings and near Caltrain stations.

Ridership of Other Transit Systems

The T4DL Alternative, single-head variant would result in less Caltrain ridership than the Proposed Project and similar 2020 ridership with the double-head variant. Similar to the Proposed Project, this alternative would not substantially change the ridership of other transit systems compared with the No Project Alternative

Conflict with other Transit Projects

The T4DL Alternative, like the No Project Alternative, would avoid any potential OCS-related conflicts with the 22-Fillmore Project or DTX. However, the T4DL Alternative is incompatible with the designs for DTX and TTC and, thus, would not allow a downtown extension of Caltrain as planned, which is a major conflict given that the extension is one of the driving rationales for DTX and TTC.

The Proposed Project's impacts related to the OCS for other transit projects are either less than significant or can be managed with mitigation. The Proposed Project is consistent with DTX and TTC designs; therefore, the T4DL Alternative would have more conflict with other transit projects than the Proposed Project would have.

Pedestrian/Bicycle Facilities

As discussed in Section 3.14, *Transportation and Traffic,* the Proposed Project would have a less than significant impact on pedestrian facilities with mitigation. Since ridership would increase with the T4DL Alternative, but less than with the Proposed Project, the T4DL Alternative would have a smaller less than significant impact (with mitigation) on pedestrian facilities.

As discussed in Section 3.14, *Transportation and Traffic* and Section 4.1, *Cumulative Impacts*, the Proposed Project would result in an increased demand for bike facilities, but proposed mitigation would address this increased demand. There would also be an increase in demand for bike facilities with the increased ridership expected with the T4DL Alternative; however, Caltrain could address this demand by similar means as the proposed mitigation for the Proposed Project. Thus, the T4DL Alternative would have a lesser impact than the Proposed Project relative to bicycle facilities.

Because of greater ridership, this alternative would have more impact on existing pedestrian and bicycle facilities than the No Project Alternative would have.

Station Parking and Access

As discussed in Section 3.14, *Transportation and Traffic* and Section 4.1, *Cumulative Impacts*, the Proposed Project would result in an increased demand for parking, but this would not result in

significant secondary impacts on air quality, noise, or traffic or due to the construction of other parking facilities. The T4DL Alternative would result in a lower increase in parking demand in the long run and, therefore, would have less impact than the Proposed Project relative to parking demand.

Because of greater Caltrain ridership, this alternative would have more impact on station parking and access than the No Project Alternative would have.

Emergency Vehicle Access

Relative to emergency vehicle access, the T4DL Alternative would have a similar but smaller positive effect on reducing regional vehicle miles traveled in the long run, a similar but smaller adverse effect at at-grade crossings and at intersections near stations. This alternative would have similar but fewer overall beneficial impacts on emergency response times than the Proposed Project would have.

This alternative would be beneficial relative to the No Project Alternative.

Freight Rail Operations

The T4DL Alternative could share tracks with freight and thus would have no effect on freight operational windows.

The T4DL Alternative would not require an OCS, and, thus, there would be no concerns about potential height restrictions for freight. The Proposed Project would provide adequate height clearance for existing freight service. As discussed in Section 4.1, *Cumulative Impacts*, future freight trains could be slightly constrained to the existing freight train equipment heights. But even with limited freight diversion to other modes (such as trucks), this constraint is not likely to result in significant secondary physical impacts on the environment but is disclosed conservatively to potentially have localized noise or traffic impacts if diversion to trucks does occur. The T4DL Alternative would avoid any such impacts because it would not restrict overhead heights along the Caltrain ROW.

Overall, this alternative would have the same impacts as the No Project Alternative.

5.2.5 Electrification with OCS Installation by "Factory Train"

This alternative consists of the same operational elements as the Proposed Project (electrified service with EMUs) but with a different method for construction of the OCS.

An alternative method of installing the OCS could be through the use of a so-called "Factory Train" (also called an "Electrification Train" and a "High Output Plant System" or the HOPS train), which is a moveable assembly line system, mounted on rails. One of the prime advantages of a Factory Train is the rate of progress in OCS installation. Rates of progress up to 1 mile/night have been reported, and the system can reportedly be used while allowing for adjacent rail lines to be used by existing trains (European Railway Review 2011) although there may be speed restrictions for the use of adjacent lines (Railway Gazette 2013a).

This is a new technology developed by a German company, Windhoff Bahn- und Anlagentechnik GmbH. The first reported use of this system will be on the Great Western Main Line Electrification Project for Network Rail in the United Kingdom (UK), starting in early 2014 The system that has been assembled for the UK project cost £40 million (about $67 million as of early January 2014) and

consists of 23 vehicles with a combined length of 500 meters (about 1,640 feet) (Railway Gazette 2013a). The different elements to the HOPS train to be used for the UK project are as follows (Network Rail UK 2013).

- A piling rig (with two multi-purpose vehicles with Movax vibro piling heads, to vibrate the steel piles into the soil, two pile carrying wagons, and a Fambo hydraulic percussion hammer multi-purpose vehicle for tougher ground)[10].
- An excavation and concrete batching unit with an Hitachi excavator plus a Kniele concrete unit to mix concrete from onboard aggregate, cement, and water tanks.
- A structures unit that erects the masts, portal booms, and twin track cantilevers.
- An ancillary conductor to install the earthing wires, return wires, and small parts such as registration arms and other equipment.
- The contact and catenary unit to string up the remaining wires under tension. Another unit installs other things such as wires under low bridges, and records information such as height and stagger.

Each of the above elements includes two multi-purpose vehicles with full driving cabs, powered by MTU power packs, which can be driven at 60 mph offsite. Onsite driving cabs mean the train can be driven very slowly when installing contact wire.

The HOPS being used for the project in the UK is based at a purpose-built depot and then split up, to head to different parts of the line at its 60 mph top speed. It carries enough supplies and equipment to avoid the need to bring anything to the trackside on trucks. Staff can be picked up at stations en-route (Network Rail 2013). Construction is planned to be six nights per week (Network Rail 2013).

Given that the manufacturer is a German company and no other manufacturers have such a system at present, use of this method would require transporting such a system via ship to the United States and then transporting it to the Caltrain ROW via rail.

No feasibility or cost analysis has been completed ~~for the Proposed Project using~~ for this construction method. A Factory Train built in Germany and used in the UK may be not be feasible here because of the potentially lengthy FRA certification process. An additional concern would be the 0.31 mile train length, which would block some at-grade crossings when in operation.

As a rough comparison of costs, Network Rail in the U.K. is electrifying 2,000 track miles, including the Great Western Line using a factory train approach for approximately $3.3 billion ($2014), which corresponds to a cost of $1.6 million per track mile. As described in Chapter 2, the cost estimate for electrifying the Caltrain Corridor is $950 million to $958 million, which corresponds to approximately $7 million per track mile. The U.K. electrification program noted above, while including some urban areas, also includes extensive rural areas where costs will be lower due to ease of construction in contrast to the Caltrain Corridor which is entirely within the an urban context, which makes for more difficult construction. There are also substantial differences between California and the United Kingdom in terms of labor markets, cost of living, costs of materials, as well as experience construction electrification projects. However, despite the substantial contextual differences between the U.K. electrification programme and the PCEP, a factory train still has the potential to reduce construction costs substantially due to the rate of progress and efficiency of construction.

[10] At present, the ~~35%~~ preliminary design for the Proposed Project does not include any piles.

For the purpose of this analysis, a Factory Train is considered feasible.

The following assumptions are made only for the purposes of the alternative analysis.

- The Factory Train can be manufactured (even if in Europe) and transported to the Caltrain ROW via ship and rail.
- Construction using this method would be comparable in cost or less costly than conventional construction.
- The Factory Train would be used to install approximately 80 percent of the OCS installation, and conventional construction would be used in areas of complexity or construction, including stations, tunnels, complex junctions, and sidings.
- Construction is assumed to be at night[11] with allowed use of adjacent tracks by passenger and freight rail, though possibly with speed restrictions.
- Because this is a new system that has not yet completed its first project, a 50 percent contingency is used to derive an estimated average rate of progress of 0.5 mile/night, and construction is assumed to be 5 nights/week. Assuming that 80 percent of the 130 to 140 miles of OCS system would be installed by a Factory Train, this portion of the OCS system could be completed in approximately 10 to 11 months. The remaining 20 percent of the OCS system is assumed to be constructed using conventional methods and would take approximately 6 to 7 months for a total of 16 to 18 months (compared with the Proposed Project's schedule for overall OCS installation of 33 months).[12] If the conventional work is done in parallel to the use of the Factory Train, this could cut an additional 6 to 7 months from the construction schedule.
- One operational base would be needed for the system. The location of this base is unknown, but possible locations could include the former railyard in Brisbane south of the Caltrain Bayshore Station,[13] CEMOF, the South San Francisco yard, or other locations not yet identified. The base could be located off the Caltrain ROW at a suitable yard with sufficient size and rail access, provided it is sufficiently close to the Caltrain ROW to allow for rapid deployment each night. The operational base would require several buildings, vehicle access, lighting, potential reconfiguration of track access, parking and receiving space for deliveries, and storage areas for construction materials and fuels.

This alternative is only a construction methodology alternative to conventional construction of the OCS. Thus, analysis is limited to differences between the Proposed Project and this alternative relative to OCS construction. As noted above, about 80 percent of the OCS is presumed to be installed using a Factory Train with the remaining 20 percent assumed to be installed using conventional construction. Thus, the discussion below is only relevant to the 80 percent installed by a Factory Train with this alternative; impacts on the other 20 percent would be the same as for the Proposed Project.

[11] There is nothing to prevent use of the Factory Train during the day, but this would substantially disrupt passenger rail service to shut down one line and thus it was assumed that construction would be at night. The Proposed Project assumes that a substantial amount of work would likely also need to be at night to avoid disruption of passenger rail service.

[12] By way of comparison, the Great Western Main Line project plans to install approximately 16,000 OCS poles over 4 years, which works out to an average of a 330 poles/month.

[13] Presuming this site is available during construction. As described in Chapter 4, *Other CEQA-Required Analysis*, this site is proposed for mixed use development by the Brisbane Baylands project.

This alternative would have greater construction impacts than the No Project Alternative (which does not include construction) and the Dual-Mode MU Alternative and the DMU Alternative (which have less construction).

Aesthetics

This alternative would have the same construction impacts due to tree removal/trimming as the Proposed Project. The temporary construction aesthetic impacts could be more or less than the Proposed Project depending on individual perceptions regarding the tradeoff of duration reduction with a likely increase in the intensity of nighttime construction. However, construction staging may be more consolidated with this alternative, which could reduce temporary impacts on any staging areas with adjacent sensitive receptors that are avoided. OCS construction aesthetic disruption would be shorter overall and likely shorter at individual locations, but the activity would always be at night and would be more intense with the Factory Train. However, use of the Factory Train would reduce impacts associated with material and personnel trucks because they can both be brought to each construction site by the Factory Train itself (there would still be some local vehicle access for support activities). For those people perceiving that a greater level of nighttime intensity would outweigh the benefits of a shorter construction duration, this alternative would have greater impacts. For people perceiving that the benefits of a shorter construction duration would outweigh a greater level of nighttime construction intensity, this alternative would result in less impact than the Proposed Project.

Air Quality

The only prior environmental statement for use of a Factory Train (for the Great Western Main Line Electrification Project; Atkins 2012) did not provide any quantification of construction criteria pollutant emissions. Because of the lack of data, a quantitative comparison of this alternative's construction emissions with the Proposed Project's emissions was not completed; however, a qualitative assessment was completed.

The Factory Train would result in construction criteria pollutant emissions for both the onboard equipment as well as the train's diesel engine itself. The emissions for the various construction activities themselves (installing foundations, erecting poles, stringing wire) are likely similar to the emissions for conventional construction. The *Great Western Main Line Environmental Statement* (Atkins 2012) noted that at any one receptor, the duration of impact would be between a few hours and one night as the OCS is installed within proximity of any one receptor, and asserted that emissions from the Factory Train were unlikely or had a low potential to be significant in relation to annual or hourly air quality ambient concentrations.

Overall, lacking a strict quantitative basis by which to compare this alternative to the Proposed Project, it is considered unlikely that overall construction criteria pollutant emissions would be substantially greater with this alternative or would cause any exceedance of hourly or annual air quality ambient standards. Given that the Factory Train would install the OCS faster than conventional construction, it is possible that daily emissions might be higher due to the greater intensity of activity, but that has to be balanced with the offsetting greater efficiency of this method, which should result in less emissions. The consolidation of transportation of equipment, materials, and crews made possible with a Factory Train compared with the separate transport of all three with conventional construction means there could be a possible overall net reduction in construction emissions measured over the entire construction duration.

Concerning TAC emissions, the Factory Train would also have DPM emissions from construction equipment on the train and the train's diesel engines. Health risks from DPM emissions are concerned with the overall mass of emissions in all of construction, which are considered to be no greater than and possibly lower with the Factory Train than the Proposed Project given the greater efficiency of this construction method.

Biological Resources

This alternative would result in the same tree removal and trimming and similar activity along the Caltrain ROW as the Proposed Project. However, construction staging may be more consolidated with this alternative, which could reduce temporary impacts on any staging areas that contain biological resources (most staging areas for the Proposed Project would be in locations with no or limited biological resources).

Cultural Resources

This alternative would have similar overall impacts as the Proposed Project relative to cultural resources because the amount of excavation and alteration to structures would be the same. Construction at historic stations and tunnels would not be different with this alternative, particularly since construction at some stations and all tunnels would likely be with conventional construction. However, construction staging may be more consolidated with this alternative, which could reduce temporary potential for disturbance of cultural resources at staging areas (if and where present).

Geology, Soils, and Seismicity

This alternative would have similar impacts as the Proposed Project relative to geology, soils, and paleontological resources because the amount of excavation would be the same. However, construction staging may be more consolidated with this alternative, which could reduce temporary erosion impacts at staging areas.

Greenhouse Gas Emissions and Climate Change

The only prior environmental statement for use of a Factory Train (for the Great Western Main Line Electrification Project; Atkins 2012) did not provide any quantification of construction GHG emissions. Because of the lack of data, a quantitative comparison of this alternative's construction emissions with the Proposed Project's emissions was not completed; however, a qualitative assessment was completed.

As discussed above in the *Air Quality* section, a Factory Train would be more efficient overall than conventional construction by consolidating staging and the transportation of equipment, materials, and personnel to and from the construction site. Therefore, it is doubtful that GHG emissions for this alternative would be greater than for the Proposed Project, and GHG emissions would possibly be lower.

Hazards and Hazardous Material

This alternative would have similar impacts as the Proposed Project relative to excavation of potentially contaminated areas. However, construction staging may be more consolidated with this alternative, which may reduce the potential for accidental release of petroleum or hazardous materials.

Hydrology and Water Quality

This alternative would have similar impacts as the Proposed Project. However, construction staging may be more consolidated with this alternative, which may reduce the potential for erosion/sedimentation as well as accidental release of petroleum or hazardous materials.

Land Use and Recreation

Similar to the discussion of aesthetics above, the temporary construction and temporary disruption of land use could be more or less than the Proposed Project depending on individual perceptions regarding the tradeoff of duration reduction vs. an increase in nighttime construction intensity. However, construction staging may be more consolidated with this alternative, which could reduce temporary land use impacts at staging areas overall. OCS construction land use disruption would be shorter overall and likely shorter at individual locations, but the activity would always be at night and would be more intense for sensitive land uses (i.e., residential) with the Factory Train. For those people perceiving that a greater level of nighttime intensity would outweigh the benefits of a shorter construction duration, this alternative would have greater temporary land use disruption impacts. For people perceiving that the benefits of a shorter construction duration outweigh a greater level of nighttime construction intensity, this alternative would result in less temporary land use disruption than the Proposed Project.

Because recreational use occurs during daytime (for the most part), this alternative would result in less construction disruption than the Proposed Project because it would limit OCS installation to nighttime. Removal of trees and trimming would need to occur during the day (prior to arrival of the Factory Train), and thus recreational disruption due to tree removal/trimming would be the same as for the Proposed Project.

Noise and Vibration

The temporary construction noise impacts could be more or less than the Proposed Project depending on individual perceptions regarding the tradeoff of noise impact duration reduction vs. increased nighttime noise impacts. OCS construction noise disruption would be shorter overall and likely shorter at individual locations, but the activity would always be at night and may be more intense with the Factory Train. Review of the Environmental Impact Statement prepared for the first use of a Factory Train (Atkins 2012) indicated that, in general, the noise of the individual pieces of equipment on the Factory Train would be similar to the noise levels estimated in Section 3.11, *Noise and Vibration*, for conventional construction of the OCS. However, with the Factory Train, the diesel engine on the train itself is likely to be in continuous operation and is one of the noisier elements associated with OCS installation next to the hydraulic hammer rig (Atkins 2012).

Use of the Factory Train would reduce noise impacts associated with material and personnel trucks because they can both be brought to each construction site by the Factory Train itself (there would still be some local vehicle access for support activities). For those people perceiving that a greater level of nighttime noise would outweigh the benefits of a shorter construction duration, this alternative would have greater impacts. For people perceiving that the benefits of a shorter construction duration would outweigh a greater level of nighttime noise, this alternative would result in less impact than the Proposed Project.

Population and Housing

This alternative would have a similar, less-than-significant temporary impact as the Proposed Project, although impacts might be a little less due to a shorter duration of construction.

Public Services and Utilities

This alternative would have the same impact as the Proposed Project relative to utility disruption because utilities would have to be relocated and excavation would have to occur in the same manner as the Proposed Project. This alternative would have a similar, less-than-significant temporary impact on public services as the Proposed Project, although impacts might be a little less due to a shorter duration of construction.

Transportation/Traffic

This alternative would have similar but possibly greater temporary traffic impacts overall during construction. There would be a shorter duration of construction, consolidation of staging areas, and delivery of materials and crew using the Factory Train itself, which would help to reduce construction traffic overall.

The Factory Train would result in more nighttime traffic delays at the at-grade crossings. The Factory Train can be quite lengthy, and, thus, during transit along the Caltrain ROW would result in more lengthy gate-down times at at-grade crossings than the Caltrain passenger trains. Also, the Factory Train could block at-grade crossings during OCS installation near at-grade crossings. Because construction would be at night outside of peak hours, the increased traffic delays would be adverse, but less than significant. The Factory Train is often broken up into its element parts when working on the OCS installation itself, and thus temporary closure of at-grade crossings can be managed to limit the time to when the different elements of the Factory Train need to work at the at-grade crossing itself.

Given that this alternative is presumed to be constructed at night outside of peak hours, this alternative is considered likely to result in fewer temporary traffic impacts than the Proposed Project relative to OCS installation. Because the project's effects on traffic would be less, it would also have less impact on emergency vehicle response time

5.3 Environmentally Superior Alternative

The State CEQA Guidelines require that an environmentally superior alternative be identified. The environmentally superior alternative is the alternative that would avoid or substantially lessen, to the greatest extent, the environmental impacts associated with the project while feasibly obtaining most of the major project objectives. If the alternative with the least environmental impact is determined to be the No Project Alternative, the EIR must also identify an environmentally superior alternative among the other alternatives.

The identification of the environmentally superior alternative results from a comparison of the impacts associated with each alternative to the Proposed Project, as shown in Table 5-11 ~~5-6~~. As shown in that table, there are distinct differences between the construction impacts and operational impacts of the alternatives.

For construction, the No Project Alternative and the Tier 4 Diesel Locomotive Alternative would both be the environmentally superior alternative because ~~it~~ neither would have ~~no electrification infrastructure (OCS or TPF)~~ construction. ~~Excluding the No Project Alternative,~~ The Dual-Mode MU Alternative ~~would be the environmentally superior construction alternative because it~~ would result in a lower level of construction than the DMU Alternative, the Proposed Project and the Electrification with OCS Installation by Factory Train Alternative. Given what is known about the Factory Train construction at this time,[14] it is considered environmentally superior to the Proposed Project for construction.

For operations, the No Project Alternative would be environmentally inferior to the DMU Alternative, the Dual-Mode MU Alternative, the Tier 4 Diesel Locomotive Alternative and the Proposed Project because it would result in substantially lower ridership and, thus, higher criteria pollutant and GHG emissions, ~~higher noise levels at a majority of locations~~, and worse regional traffic conditions. However, the No Project Alternative would have lower noise levels than the DMU Alternative, the Dual-Mode MU Alternative and the Tier 4 Diesel Locomotive Alternative. The Dual-Mode MU Alternative would have higher 2020 operational impacts than the DMU Alternative for 2020 (due to a heavier train set and likely more fuel consumption), but due to likely higher ridership in the long run with DTX/TTC, the Dual Mode MU Alternative is likely to result in long-term better air quality, lower GHG emissions and better regional traffic conditions than the DMU Alternative and the Tier 4 Diesel Locomotive Alternative. Thus, for operations, of the alternatives to the Proposed Project, the Dual-Mode MU Alternative would be the environmentally superior alternative.

However, compared with the Proposed Project, the non-electrification alternatives ~~Dual-Mode MU Alternative and the DMU Alternative~~ would result in higher criteria pollutant and GHG emissions, higher noise levels, and likely worse regional traffic in the long run, but would avoid the long-term impacts of the OCS infrastructure and tree removal.[15] The tradeoff between aesthetics impacts versus air quality, GHG emissions, noise, and traffic impacts is not easily evaluated given the dissimilar nature of these different impacts. Nevertheless, one way to evaluate these impacts is to identify the people affected by these different impacts.

- Aesthetics: As described in Section 3.1, *Aesthetics*, the permanent effects of the OCS infrastructure and tree removal would primarily affect the visual character of the area immediately around the Caltrain ROW instead of significantly affecting scenic vistas. Thus, the sensitive receptors of this impact are the residents of adjacent homes, users of adjacent parks, and the less-sensitive workers at adjacent businesses (industrial and roadway receptors are not considered sensitive to aesthetics). Consequently, where residential areas and parks are located adjacent to the Caltrain ROW, the immediately adjacent users would be significantly less affected relative to aesthetics by the non-electrification alternatives ~~Dual-Mode MU Alternative and the DMU Alternative~~ compared to the Proposed Project.

[14] As noted above, this is a new technology, and the first OCS installation using it starts in early 2014, so there is no in-practice data by which to judge the impacts of that project, only the one single Environmental Statement completed for the Great Western Main Line Electrification Project. Despite that project lacking certain data, such as quantification of construction air quality or GHG emissions, the evidence in the Environmental Statement appears to support a conclusion that taking into account all construction subjects, a Factory Train alternative would be environmentally superior.

[15] As described in Section 3.3, *Biological Resources*, the Proposed Project's biological impacts relative to tree removal can be mitigated to less-than-significant levels, but as noted in Section 3.1, *Aesthetics*, the visual aesthetic impacts of tree removal may not always be mitigable to a less-than-significant level; thus, the comparison herein focuses on the visual aesthetic impacts of tree removal.

Table 5-11 ~~5-6~~. Comparison of Project Alternatives with the Proposed Project

Environmental Topic Area	Level of Proposed Project Impact	No Project Alternative (Relative to the Proposed Project)	DMU Alternative (Relative to the Proposed Project and No Project Alternative)	Dual-Mode Multiple Unit Alternative (Relative to the Proposed Project , DMU Alternative and the No Project Alternative)	Tier 4 Diesel Locomotive Alternative (DH Variant) (Relative to the Proposed Project and other operational alternatives)	Electrification with OCS Installation by Factory Train Alternative (Relative to Proposed Project, OCS construction only)
Aesthetics	Construction: Less than significant with mitigation	No impact (less)	Less than Proposed Project Greater than No Project	Less than Proposed Project and DMU Greater than No Project	Less than Proposed Project, DMU and Dual-Mode MU Alternative Same as No Project	Greater or less than Proposed Project depending on perception of tradeoff of shorter duration for higher intensity
	Operations: **Significant and unavoidable (tree removal)** Less than significant with mitigation (all other impacts)	No impact (less)	Less than Proposed Project (overall but visual changes at Caltrain stations greater than Proposed Project) Greater than No Project	Less than Proposed Project and DMU Greater than No Project	Less than Proposed Project, DMU and Dual-Mode MU Alternative Same as No Project	Same as Proposed Project
Air Quality	Construction: Less than significant with mitigation	No impact (less)	Less than Proposed Project Greater than No Project	Less than Proposed Project and DMU Greater than No Project	Less than Proposed Project, DMU and Dual-Mode MU Alternative Same as No Project	Not likely to be greater and possibly less than Proposed Project overall due to increased efficiency.
	Operations: Beneficial (criteria pollutants and toxic air contaminants)	No impact (greater)	Greater than Proposed Project Less than No Project	Greater than Proposed Project Greater than DMU for 2020 but less for 2040 Less than No Project	Greater than Proposed Project, DMU, and Dual-Mode MU Alternative Less than No Project	Same as Proposed Project
Biological Resources	Construction: Less than significant with mitigation	No impact (less)	Less than Proposed Project Greater than No Project	Less than Proposed Project and DMU Greater than No Project	Less than Proposed Project, DMU and Dual-Mode MU Alternative Same as No Project	Similar to Proposed Project (possibly less due to more central staging)
	Operations: Beneficial due to reduction of diesel and nitrogen emissions	Not beneficial	Less Beneficial than Proposed Project More Beneficial than No Project	Less Beneficial than Proposed Project and DMU for 2020 but more beneficial for 2040 More Beneficial than No Project	Less Beneficial than Proposed Project, DMU and Dual-Mode MU Alternative More Beneficial than No Project	Same as Proposed Project
Cultural Resources	Construction: Less than significant with mitigation	No impact (less)	Less than Proposed Project except at historic Caltrain stations More than No Project	Less than Proposed Project and DMU Greater than No Project	Less than Proposed Project, DMU and Dual-Mode MU Alternative Same as No Project	Similar to Proposed Project (possibly less due to more central staging)
	Operations: No impact	No impact (same)	No Impact (same as Proposed Project and No Project)	No Impact (same as all others)	No Impact (same as Proposed Project, other alts. and No Project)	Same as Proposed Project
EMF/EMI	Operation Only: Less than significant (EMF) Less than significant with mitigation (EMI)	No impact (less)	No Impact (less than Proposed Project; same as No Project)	Less impact than Proposed Project Greater impact than DMU and No Project	No Impact (less than Proposed Project; same as No Project and other alts.)	Same as Proposed Project
Geology and Soils	Construction: Less than significant with mitigation	No impact (less)	Greater than Proposed Project (due to more excavation) Greater than No Project	Less than Proposed Project and DMU Greater than No Project	Less than Proposed Project, DMU and Dual-Mode MU Alternative Same as No Project	Similar to Proposed Project (possibly less due to more central staging)
	Operations: No impact	No impact (less)	No Impact (same as Proposed Project and No Project)	No Impact (same as others)	No Impact (same as Proposed Project, other alts. and No Project)	Same as Proposed Project
Greenhouse Gas Emissions and Climate Change	Construction/Operations: Beneficial (GHG emissions)	Not beneficial	Less beneficial than Proposed Project More beneficial than No Project	Less beneficial than Proposed Project Less beneficial than DMU for 2020 but more for 2040 More beneficial than No Project	Less beneficial than Proposed Project, DMU and Dual-Mode MU Alternative More beneficial than No Project	For construction: Not likely to be greater and possibly less than Proposed Project overall due to increased efficiency. For operation: Same as Proposed Project.
	Less than significant (climate change effects other than sea level rise)	Similar	Similar to other alternatives	Similar to other alternatives	Similar to other alternatives	Same as Proposed Project

Environmental Topic Area	Level of Proposed Project Impact	No Project Alternative (Relative to the Proposed Project)	DMU Alternative (Relative to the Proposed Project and No Project Alternative)	Dual-Mode Multiple Unit Alternative (Relative to the Proposed Project , DMU Alternative and the No Project Alternative)	Tier 4 Diesel Locomotive Alternative (DH Variant) (Relative to the Proposed Project and other operational alternatives)	Electrification with OCS Installation by Factory Train Alternative (Relative to Proposed Project, OCS construction only)
Hazards and Hazardous Materials	Construction: Less than significant with mitigation	No impact (less)	Less than Proposed Project Similar to No Project	Less than Proposed Project and DMU Greater than No Project	Less than Proposed Project, DMU and Dual-Mode MU Alternative Same as No Project	Similar to Proposed Project (possibly less due to shorter duration)
	Operations: Less than significant with mitigation	No impact (greater)	Greater than Proposed Project Similar to No Project	Greater than Proposed Project Greater than DMU for 2020 but less for 2040 Similar to No Project	Greater than Proposed Project, DMU, and Dual-Mode Alternative, and No Project (due to more diesel use)	Same as Proposed Project
Hydrology and Water Quality	Construction: Less than significant with mitigation	No impact (less)	Less than Proposed Project Greater than No Project	Less than Proposed Project and DMU Greater than No Project	Less than Proposed Project, DMU and Dual-Mode MU Alternative Same as No Project	Similar to Proposed Project (possibly less due to more central staging)
	Operations: Less than significant with mitigation	No impact (greater: water quality; less: flooding)	Greater than Proposed Project and No Project (water quality and possibly flooding)	Less than Proposed Project for flooding but greater for water quality (due to more diesel use) Similar to DMU Alternative and No Project (water quality and possibly flooding)	Greater than Proposed Project, No Project, DMU and dual-Mode Alternative (water quality due to diesel use)	Same as Proposed Project
	Flooding relative to sea level rise (potentially significant and unavoidable)	Similar	Similar to other alternatives	Similar to other alternatives	Similar to other alternatives	Same as Proposed Project
Land Use and Recreation	Construction: Less than significant with mitigation	No impact (less)	Less than Proposed Project Same as No Project	Less than Proposed Project Same as DMU Alternative and No Project	Less than Proposed Project, DMU and Dual-Mode MU Alternative Same as No Project	Tradeoff of shorter duration for higher intensity
	Operations: Less than significant with mitigation	No Impact (less)	No impact (Less than Proposed Project; Same as No Project)	No impact (Less than Proposed Project; Same as DMU Alternative and No Project)	No impact (Less than Proposed Project and other alternatives) Same as No Project	Same as Proposed Project
Noise and Vibration	**Construction: Significant and unavoidable with mitigation**	No impact (less)	Less than Proposed Project (overall, but higher intensity at Caltrain stations) Greater than No Project	Less than Proposed Project and DMU Greater than No Project	Less than Proposed Project, DMU and Dual-Mode MU Alternative Same as No Project	Greater or less than Proposed Project depending on perception of tradeoff of shorter duration for potential higher nighttime intensity.
	Operational noise: • Beneficial at many study locations (33) • No change at some locations (8) • Less than significant at some locations (8) Operational vibration: Less than significant	No impact (greater)	Similar to but slightly greater than Proposed Project (DMUs noisier than EMUs) Greater than No Project Alternative overall (DMUs quieter than diesel locomotives but more train noise due to service increase)	Greater than Proposed Project (Dual-Mode MUs noisier than EMUs) Similar to but possibly slightly greater than DMU Similar to No Project Alternative overall (Dual-Mode MUs quieter than diesel locomotives but more train noise due to service increase; traction power facility noise can be mitigated as under Proposed Project)	Greater than Proposed Project, No Project, DMU, and Dual-Mode Alternative (more diesel locomotives are louder than other technologies and louder than less number of trains with No Project)	Same as Proposed Project
Population and Housing	Less than significant	No impact (same)	Same as Proposed Project Greater than No Project	Same as Proposed Project and DMU Greater than No Project	Same as Proposed Project, DMU and Dual-Mode MU Greater than No Project	Same as Proposed Project
Public Services and Utilities	Construction: Less than significant with mitigation	No impact (less)	Less than the Proposed Project Greater than No Project	Less than the Proposed Project and DMU Greater than No Project	Less than Proposed Project, DMU and Dual-Mode MU Alternative Same as No Project	Same as Proposed Project
	Operations: Less than significant	No impact (same)	Same as Proposed Project Greater than No Project	Same as Proposed Project and DMU Greater than No Project	Same as Proposed Project, DMU, and Dual-Mode MU Alternative Greater than No Project	Same as Proposed Project

Environmental Topic Area	Level of Proposed Project Impact	No Project Alternative (Relative to the Proposed Project)	DMU Alternative (Relative to the Proposed Project and No Project Alternative)	Dual-Mode Multiple Unit Alternative (Relative to the Proposed Project , DMU Alternative and the No Project Alternative)	Tier 4 Diesel Locomotive Alternative (DH Variant) (Relative to the Proposed Project and other operational alternatives)	Electrification with OCS Installation by Factory Train Alternative (Relative to Proposed Project, OCS construction only)
Transportation and Traffic	Construction: Less than significant with mitigation	No impact (less)	Less than Proposed Project Greater than No Project	Less than Proposed Project and DMU Greater than No Project	Less than Proposed Project, DMU and Dual-Mode MU Alternative Same as No Project	Tradeoffs of less traffic due to shorter duration, consolidated staging areas and delivery of materials and crew by train with increased nighttime delays at the at-grade crossings. Given construction would be outside of peak hours, overall traffic impacts likely less than Proposed Project.
	Regional traffic and congestion: Beneficial	No impact (greater)	Less beneficial than Proposed Project More beneficial than No Project	Less beneficial than Proposed Project Less beneficial than DMU for 2020 but more beneficial for 2040. More beneficial than No Project	As beneficial as Proposed Project in 2020, but less beneficial in 2040 (no TTC). Similar to DMU and Dual Mode MU in 2020. Similar to DMU in 2040. Less beneficial than Dual Mode MU in 2040 More beneficial than No Project	Similar to Proposed Project (but night-time traffic effects higher during OCS installation, offset by shorter duration).
	Localized traffic: Nine intersections, significant and unavoidable with mitigation	No Impact (less)	Similar to Proposed Project Greater than No Project	Similar to Proposed Project and DMU Greater than No Project	Same as Proposed Project in 2020, but less adverse in 2040. Similar to DMU and Dual Mode MU in 2020. Similar to DMU in 2040. Less adverse than Dual Mode MU in 2040 Greater than No Project	Same as Proposed Project
	Transit: Less than significant	Greater impact due to conflict with plans for DTX and TTC	Greater than Proposed Project due to conflict with DTX/TTC Same as No Project	Less than Proposed Project Less than DMU and No Project	Greater than Proposed Project and Dual-Mode MU due to conflict with DTX/TTC Same as No Project and DMU.	Same as Proposed Project
	Bike: Less than significant with mitigation Pedestrian: Less than significant with mitigation at one location	No impact (less)	Less than Proposed Project Greater than No Project	Less than Proposed Project Less than DMU Greater than No Project	Same as Proposed Project in 2020, but less in 2040. Similar to DMU and Dual Mode MU in 2020. Similar to DMU in 2040. Less than Dual Mode MU in 2040 Greater than No Project	Same as Proposed Project
	Station parking and access: Less than significant	No impact (less)	Similar but less than Proposed Project Greater than No Project	Station Parking and Access Similar but less than Proposed Project Similar to DMU Greater than No Project	Same as Proposed Project in 2020, but less in 2040. Similar to DMU and Dual Mode MU in 2020. Similar to DMU in 2040. Less than Dual Mode MU in 2040 Greater than No Project	Same as Proposed Project
	Emergency vehicle access: Less than significant	Greater regional impact due to higher regional VMT	Similar but less than Proposed Project Less than No Project	Similar to Proposed Project and DMU Less than No Project	Same as Proposed Project in 2020, but greater in 2040. Similar to DMU and Dual Mode MU in 2020. Similar to DMU in 2040. Greater than Dual Mode MU in 2040 Less than No Project	Same as Proposed Project
	Freight rail operations: Less than significant Cumulative rail vertical clearance: Potentially significant	No impact (less)	Less than Proposed Project (due to lack of OCS) Same as No Project ~~for FRA-compliant DMUs but greater if non-FRA-compliant DMUs)~~	Less than Proposed Project (due to no OCS except north of area used by freight) Same as DMU and No Project ~~Greater than No Project (due to temporal separation)~~	Less than Proposed Project (due to no OCS) Same as DMU, Dual-Mode MU and No Project	Same as Proposed Project

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- Air Quality: As described in Section 3.2, *Air Quality*, the permanent effects of emissions have two different sets of receptors. Criteria pollutant emissions affect the ambient air quality of the San Francisco Bay Area Basin, which includes the millions of people who reside in the Bay Area. These people would be more affected by the non-electrification alternatives ~~Dual-Mode MU Alternative and the DMU Alternative~~ than by the Proposed Project. TAC emissions affect people in the immediate vicinity of the Caltrain ROW; these are the same people affected by aesthetic impacts of the Proposed Project as described above, and they would be more affected by the non-electrification alternatives ~~Dual-Mode Alternative and the DMU Alternative~~ than by the Proposed Project.
- GHG Emissions: As described in Section 3.7, *Greenhouse Gas Emissions and Climate Change*, GHG emissions contribute to cumulative GHG emissions that affect the global climate, which can result in long-term effects on the Bay Area, California, and the planet as a whole. The non-electrification alternatives ~~Dual-Mode Alternative and the DMU Alternative~~ would have a greater effect on GHG emissions and associated climate change than the Proposed Project.
- Noise: As described in Section 3.11, *Noise and Vibration,* the sensitive receptors of this impact are primarily the residents of adjacent homes, users of adjacent parks, and the less-sensitive workers at adjacent businesses (industrial and roadway receptors are not considered sensitive to noise impacts) along the ROW, in addition to the hotel receptors near one of the traction power substation locations (TPS1, Option 3). These receptors would be more affected by the non-electrification alternatives ~~Dual-Mode Alternative and the DMU Alternative~~ than by the Proposed Project.
- Regional Traffic: As described above, in the long run, the non-electrification alternatives ~~Dual-Mode Alternative and the DMU Alternative~~ would result in somewhat lower ridership than the Proposed Project resulting in higher regional traffic, which would be experienced by drivers on San Francisco peninsula roadways.
- Localized Traffic: As described above, in the long run, the non-electrification alternatives ~~Dual-Mode Alternative and the DMU Alternative~~ would result in somewhat lower ridership than the Proposed Project resulting in somewhat lower localized traffic impacts around Caltrain stations, but these alternatives would result in similar, if not worse traffic near at-grade crossings and thus this not a key differentiator between the alternatives.

The following summarizes the key differentiators between the non-electrification alternatives ~~Dual-Mode Alternative, the DMU Alternative~~ and the Proposed Project.

- Residents, park users, and other sensitive receptors along the Caltrain ROW would have less aesthetic impacts, slightly higher TAC emission health risks, and higher noise impacts with the non-electrification alternatives ~~Dual-Mode Alternative and the DMU Alternative~~.
- Bay Area residents would be more affected relative to air quality and regional traffic by the non-electrification alternatives ~~Dual-Mode Alternative and the DMU Alternative~~ than by the Proposed Project.
- Contributions to GHG emissions, which cumulatively affect the entire planet, would be higher with the non-electrification alternatives ~~Dual-Mode Alternative and the DMU Alternative~~ than with the Proposed Project

While respecting the negative aesthetic impacts that would be experienced by individual receptors, on balance, the Proposed Project is considered environmentally superior to the non-electrification alternatives ~~Dual-Mode Alternative and the DMU Alternative~~ for operations because the air quality,

TAC emission, GHG emissions, noise levels, and regional traffic all affect the physical health or safety of receptors along the Caltrain ROW, in the San Francisco Bay Area, and on the planet as a whole. Comparison of different impact subjects requires one to make value judgments; on balance, the JPB places a greater value on overall public health and safety in making this judgment.

When considering construction and operations together, a similar reasoning is applied. Given the long-term benefits to public health and safety and the temporary nature of construction, the Proposed Project is considered environmentally superior to the No Project Alternative, the Dual-Mode Alternative and the DMU Alternative and the Tier 4 Diesel Locomotive Alternative. Inclusion of the Factory Train Alternative as part of the Proposed Project would be environmentally superior to the Proposed Project only using conventional OCS construction methods. Excluding the Factory Train Alternative, which is only a partial alternative, the Dual-Mode MU Alternative would be the environmentally superior alternative among the full alternatives because it would result in better long-term benefits to public health and safety by having lower criteria pollutant emissions, lower GHG emissions, and lower regional traffic than the DMU Alternative and the No Project Alternative.

5.4 Alternatives Screening Process

The JPB conducted a comprehensive alternative identification and screening process to identify which alternatives to analyze in this EIR. During the scoping process, the JPB solicited input from the public, agencies, and stakeholders about potential alternatives for consideration. The JPB also reviewed the impacts of the Proposed Project and identified several additional potential alternatives for consideration as well. One additional alternative was added in response to comment on the Draft EIR. All of the identified alternatives (52 ~~51~~ in total other than the No Project Alternative) were then further evaluated using a three-level screening analysis described below.

5.4.1 Alternatives Considered

As noted above, alternatives were identified by input from the public, agencies, and stakeholders during scoping, and were also developed by the JPB. The Scoping Summary is provided in Appendix A of this Draft EIR. The following alternatives were identified and classified into several categories, as described below.

5.4.1.1 No Project Alternative

CEQA requires analysis of a No Project Alternative.

5.4.1.2 Technology Alternatives

Technology alternatives considered included the following.

- Use of electric locomotives instead of EMUs.
- Diesel multiple units (DMUs).
- Dual-mode multiple units (Dual-Mode MUs) or locomotives: These trains can operate in both diesel and electric modes. Two variants to this alternative were considered:
  (1) Light-weight alternative compliant Dual-Mode MUs operating in diesel mode from San Jose to San Francisco and electric mode in the DTX ~~tunnel~~ to TTC.

(2) Heavy-weight FRA-compliant dual-mode locomotives operating in diesel mode from Gilroy to San Jose and electrified mode from San Jose to San Francisco.

- Caltrain third-rail alternative.
- Extension of BART from Millbrae to Santa Clara using the Caltrain ROW.
- 100 percent electrified service between San Francisco and San Jose by 2020 ~~2019~~.
- Use of Tier 4 Diesel Locomotives instead of EMUs

5.4.1.3 Electrified Train Design Alternatives

Train design alternatives considered included the following.

- 125 mph trains.
- Single-level trains with less than 30-second dwell times.
- Wifi service on trains.
- Trains with less than 60-second coupling and decoupling (to allow for splitting of trains).

5.4.1.4 Alignment Alternatives

Several alignment alternatives to the Caltrain ROW were considered, as described below.

Horizontal Alignment Alternatives

One horizontal alignment alternative was mentioned in scoping.

- San Francisco Alternative Alignment, which includes undergrounding from around 22nd street to 3rd street and King under Mission Bay (approximately 1.3 miles), a new underground station at 3rd and King, and a new alignment to TTC other than proposed in the DTX.

Vertical Alignment Alternatives

The following vertical alignment alternatives were considered.

- San Francisco Undergrounding (from 22nd, Mariposa, or 16th northward to 4th and King, including new underground station at 4th and King and new offsite storage yard).
- Buried trench (buried the entire way or part of the way).
- Fully grade-separated.
- Elevated alignment in Menlo Park from San Francisquito Creek past Encinal.

Electrification Location Alternatives

Four electrification location alternatives were considered.

- Electric service only in San Francisco (no diesel operations north of Bayshore).
- No electrification of maintenance facilities.

- Electrification of a minimum number of Centralized Equipment Maintenance and Operations Facility (CEMOF) tracks. Use Tracks Nos. 7 and 8 for electrified traffic (instead of MT-2/MT-3) while taking diesel around MT-2/MT-03 loop.
- Electrification of a minimum number of San Jose Diridon Station platforms.

5.4.1.5 Electrified Service Alternatives

Five electrified train service alternatives were considered.

- Five trains pphpd with six-car train consists.
- Five trains pphpd with eight-car train consists.
- EIght trains pphpd with six-car train consists.
- 26 trains/day between San Jose and Gilroy.
- Gilroy/Blossom Hill turnaround instead of at Tamien Station. Alternative was suggested to avoid congestion due to ACE, Capitol Corridor, other use of siding south of Tamien.

5.4.1.6 Platform Alternatives

The platform alternatives considered included the following.

- Level boarding.
- Common platform heights (Caltrain/HST).

5.4.1.7 Traction Power System Alternatives (other than OCS)

Alternatives related to the traction power system considered included the following.

- Size power to 50% more than need only.
- Alternative paralleling station location in Burlingame north of proposed location.

5.4.1.8 Freight Operations Alternatives

Alternatives related to freight operations considered included the following.

- 23-foot overhead clearance everywhere.
- Maintain existing overhead clearances everywhere.
- Retain existing 8 p.m. to 5 a.m. freight operational window.

5.4.1.9 Overhead Contact System Alternatives

Alternatives related to the OCS considered included the following.

- Center poles along the entire ROW.
- No headspans for any area where speeds in the future might go above 80 mph.
- No square poles.
- Multi-face poles in public areas.

- Reduced diameter and increased thickness poles.
- Wire-tensioning weights housed inside larger diameter poles.
- Feed and return wire underground or on track side of poles.

5.4.1.10 Other Operational Alternatives (assuming Electrification)

Other operational alternatives considered, all assuming electrification, included the following.

- Underground all other utilities as part of the Proposed Project.
- Avoid all ROW takes.
- Install solar panels in the Caltrain ROW.
- Install a bike trail along the Dumbarton ROW bike to Facebook.
- Install pedestrian/bike tunnels for connectivity.
- Install pedestrian/bike trail along rail corridor.
- Update entire corridor with "Quiet Zone" improvements such as quad gates, intrusion and impenetrable barriers at at-grade crossings.
- Allow no further retracking until certified for 125 mph speeds.
- Include Dumbarton Rail Project in the Proposed Project (including holding track up to Fair Oaks Lane or beyond)

5.4.1.11 Construction Alternatives

Construction-related alternatives considered included the following.

- Construction of shoofly tracks.
- Multi-track closures.
- Electrification with OCS Installation by Factory Train.
- No night work.

5.4.2 Screening Process

Alternatives were evaluated as to whether they are feasible, whether they would avoid or substantially lower one or more significant impact of the Proposed Project, and whether they would meet most of the project's purpose and need. If an alternative did not pass a tier, then it was not evaluated for the subsequent tiers.

5.4.2.1 Feasibility Screening (Tier 1)

The first tier of screening involved examining whether potential alternatives are feasible. Only feasible alternatives passed this screening. Feasibility was examined from several different aspects, including the following.

- Technically Feasible—Can the alternative be built using current construction techniques as proposed and operated?

- Logistically Feasible—Can the alternative be implemented taking into account legal, social, or regulatory constraints?
- Financially Feasible—Can the alternative be implemented within the financial capability of the Sponsor?

The results of the Tier 1 screening are presented in Table 5-12 ~~5-7~~ at the end of this chapter.

5.4.2.2 Environmental Impact Screening (Tier 2)

Only those alternatives considered feasible or potentially feasible (per Tier 1) were then examined to see whether they would avoid or substantially reduce one or more significant impacts of the Proposed Project.

An alternative analysis needs to focus on the potential significant impacts of the Proposed Project over existing conditions that may be avoided or substantially reduced with the implementation of a feasible alternative that meets the Proposed Project's basic purposes. Table 5-11 ~~5-6~~ above lists the significant impacts of the Proposed Project identified in Chapter 3, *Settings, Impacts, and Mitigation Measures,* and Chapter 4, *Other CEQA-Required Analysis*. Alternatives need not reduce all impacts of the Proposed Project. Alternatives that would avoid or substantially reduce one or more of the significant impacts were considered to pass this level of screening. The significant impacts of the Proposed Project that were the focus of the environmental screening were as follows.

- Construction (all resource areas)
  - Construction disruption (air quality, cultural resources, noise, traffic, and other subject areas).
- Operations
  - Aesthetics
    - Aesthetic impacts due to overhead contact system (OCS) appearance or tree removal.
  - Noise
    - Change in noise levels along the Caltrain right-of-way (ROW).
  - Traffic
    - Increased roadway traffic delays at at-grade crossings or near Caltrain stations.

The results of the Tier 2 screening are presented in Table 5-13 ~~5-8~~ at the end of this chapter.

5.4.2.3 Purpose and Need Screening (Tier 3)

Only those alternatives determined to be feasible (or potentially feasible) and that would avoid or substantially lower one or more significant impacts of the Proposed Project were evaluated in Tier 3.

The final tier of screening involved evaluating whether potential alternatives met the Proposed Project's Purpose and Need, which is described in detail in Chapter 1*, Introduction*. CEQA does not require alternatives to be analyzed if they do not meet most of a project's basic objectives; for the purpose of this Draft EIR, the basic objectives are considered to be the primary purposes identified in Chapter 1, *Introduction*. If an alternative met most, if not all, of the purposes, it was considered to pass Level 1 screening.

The primary objectives ~~purposes~~ of the Proposed Project, as described in Chapter 1, *Introduction,* are as follows.

- Improve train performance, increase ridership, and increase service.
- Increase revenue and reduce fuel cost.
- Reduce environmental impact by reducing noise emanating from trains.
- Reduce environmental impact by improving regional air quality and reducing greenhouse gas emissions.
- Provide electrical infrastructure compatible with high-speed rail.

The results of the Tier 3 screening are presented in Table 5-14 ~~5-9~~ at the end of this chapter.

5.4.3 Alternatives Screening Results and Conclusions

The overall results of the screening evaluation of the 52~~51~~ alternatives (other than the No Project Alternative) are summarized in Table 5-15 ~~5-10~~ at the end of this chapter and below:

- Tier 1 (Feasibility)—Half (27 ~~25~~) of the alternatives are considered feasible; three alternatives are of questionable feasibility; the remainder (22 ~~23~~) of the alternatives are not considered feasible.
- Tier 2 (Environmental Impact)—Of the 30 ~~28~~ feasible or potentially feasible alternatives, only 13 ~~12~~ would avoid or substantially reduce one or more significant impacts of the Proposed Project.
- Tier 3 (Purpose and Need)—Of the 13 ~~12~~ feasible or potentially feasible alternatives that would reduce significant impacts, eight of them would meet the project's purpose and need, ~~two~~three would ~~not~~ only meet some of the project's purpose and need ~~but were carried forward due to public~~ interest, and two would not meet project's purpose and need and were not carried forward.
- After eliminating the 41 alternatives that failed either the Tier 1, Tier 2, or Tier 3 screening (other than the No Project Alternative), 11 ~~10~~ potential alternatives remained (other than the No Project Alternative).
- Of these 11 ~~10~~ alternatives, seven of them are analyzed as part of the project as follows.
  - The following alternative is included as a construction method in this Draft EIR.
    - Multi-track closures.
  - The following are included as options in Mitigation Measure AES-2b:
    - No square poles.
    - Multi-face poles in public areas.
    - Reduced diameter and increased thickness poles.
    - House wire-tensioning eights inside larger diameter poles (if feasible).
    - Feed and return wire ~~underground or~~ on track side of poles (if feasible).
  - The following alternative is included as consideration for Mitigation Measure NOI-CUMUL-1 for addressing cumulative noise impacts.

- Update entire corridor with "quiet zone" improvements.

- This Draft EIR analyzes the <u>four</u> ~~three~~ remaining alternative in this chapter along with the No Project Alternative:
  - DMU Alternative.
  - Dual-Mode MU alternative.
  - <u>Tier 4 Diesel Locomotive Alternative.</u>
  - Electrification with OCS installation by Factory Train.

Table 5-12 ~~5-7~~. Alternatives Screening, Tier 1 (Feasibility)

No.	Name	Technically Feasible?	Logistically Feasible?	Financially Feasible?	Otherwise Feasible?	PASS?	Notes
NP	No Project Alternative	Yes	Yes	Yes	Yes	**Yes**	
Project	Proposed Project	Yes	Yes	Yes	Yes	**Yes**	
Technology Alternatives							
T1	Electric Locomotives	Yes	Yes	Yes	Yes	**Yes**	
T2	Diesel Multiple Units	Yes	Yes	Yes	Yes	**Yes**	Feasible to operate from Gilroy to San Francisco 4th and King Station but not feasible for service to TTC, which is not designed for diesel trains. Would require platform extensions at most Caltrain stations.
T3	Dual-Mode Multiple Units (or Locomotives)	Yes	Yes	Yes	Yes	**Yes**	
T4	Caltrain Third-Rail Alternative	Yes	Unk	No	Yes	No	See description below for BART, which is a third-rail system. A third-rail system would have to be grade separated the entire way including substantial ROW and station modifications between SF and Santa Clara (BART connection). Using the costs below for a BART extension, a 51.4-mile third-rail system from SF to Tamien could cost $8 billion to $9 billion.
T5	Extend BART from Millbrae to Santa Clara	Yes	Yes	No	Unk	No	Insufficient funding: BART extensions can cost hundreds of millions per mile. The Warm Springs Extension was 5.4 miles at cost of $890 million (http://www.bart.gov/about/projects/wsx/index.aspx). The San Francisco International Airport (SFO) Extension was 8.7 miles at a cost of $1.5 billion. Using these costs, a Millbrae (MP 13.6) to Santa Clara (MP 44.9) extension (30.7 miles, due to 0.6-mile offset) could cost $5.1 to $5.3 billion.
T6	100% Electrified Service by 2020 ~~2019~~	Yes	Yes	No	Yes	No	The estimated cost of rolling stock for the Proposed Project is $524 to 576 ~~$440~~ million, which will provide 75% electrified service from SF to Tamien. ~~Using these~~ costs Including the costs for additional rolling stock, electrifying 100% of the service could cost $786 to 860~~$590~~ million, or an additional $262 to 287 million ~~$150~~ million, which has not been secured by Caltrain.

No.	Name	Technically Feasible?	Logistically Feasible?	Financially Feasible?	Otherwise Feasible?	PASS?	Notes
T7	Tier 4 Diesel Locomotive Alternative	Yes	Yes	Yes	Yes	**Yes**	
Electrified Train Design Alternatives							
TD1	125 mph Trains	Yes	Yes	Yes	Yes	**Yes**	
TD2	Single-Level with < 30-Second Dwell Times	Yes	No	Yes	Yes	No	Would have inadequate seats to meet projected demand.
TD3	Wifi	Yes	Yes	Yes	Yes	**Yes**	
TD4	< 60-Second Coupling/ Decoupling	Yes	Yes	Yes	Yes	**Yes**	
Horizontal Alignment Alternatives							
HA1	San Francisco Alternative Alignment (to 3rd Street/King)	Yes	No	No	Yes	No	No specific feasibility study has been done of this alignment, but given the lack of existing ROW and existing development, the additional construction of the new alignment would require substantial construction works, including extensive underground tunneling as well as new underground stations at 3rd Street. By way of comparison, the original design for high-speed rail (HSR) approaching SF which included extensive undergrounding from around 23rd Street to the 4th and King Station (distance of 1.3 miles) at a cost for an underground option of $348 million, which does not include costs of a new station. The alternative is inconsistent with adopted DTX/TTC plans and thus logistically considered infeasible due to the substantial delay to DTX completion to redesign an entirely new approach.
Vertical Alignment Alternatives							
VA1	San Francisco Undergrounding	Yes	Unk	No	Yes	No	No specific feasibility study has been done of underground for Caltrain. The original design for HSR approaching SF (see Supplemental AA, 2010) included extensive undergrounding from around 23rd street to the 4th and King Station (distance of 1.3 miles) at a cost for an underground option of $348 million, excluding ROW acquisition costs as needed. The Proposed Project would not require any undergrounding.

No.	Name	Technically Feasible?	Logistically Feasible?	Financially Feasible?	Otherwise Feasible?	PASS?	Notes
VA2	Buried Trench	Yes	Yes	No	Yes	No	No specific feasibility study has been done of a buried trench alternative for Caltrain. The original design for HSR on the Peninsula included a two-track buried trench option (see Supplemental AA, 2010). The costs for an open trench option in Palo Alto from the California High-Speed Rail Authority (CHSRA) *Supplemental AA Report* (2010) were estimated as $513 million for 2.7 miles ($190 million/mile). Using this average per mile amount, the gross cost for a buried trench for the entire 51.4 miles would be $9.8 billion. Even if only half the route were put in a buried trench (in the most sensitive areas for example), the cost for the buried trench sections could still be $4.9 billion in addition to the cost of electrification for the other at-grade half (of $393 million), for a total of $5.3 billion.
VA3	Fully Grade Separated	Yes	Yes	No	Yes	No	There are an estimated 45 at-grade crossings on the route (42 after the San Bruno Grade Separation project). Grade separation costs are highly site-specific and thus can vary dramatically. No feasibility study has been done of every at-grade crossing. However, using the San Bruno grade separation costs ($147 million for three at-grade crossings for an average of $49 million each), if all 42 remaining at-grade crossing were grade separated, the additional cost could be $2 billion, which would more than double the project cost.
VA4	Elevated Alignment in Menlo Park	Yes	Yes	No	No	No	A specific feasibility study has not been conducted of this alternative. However, using the Preliminary AA costs for the high-speed rail elevated section for a 1.7 mile segment in Atherton/Menlo Park, which was estimated to cost $166 million for a 2-track option ($178 million for a four-track option), cost per mile is $98 to $105 million. Menlo Park section of ROW is approximately 1.6 miles, and thus cost would be about $156 to $168 million.

No.	Name	Technically Feasible?	Logistically Feasible?	Financially Feasible?	Otherwise Feasible?	PASS?	Notes
Electrification Location Alternatives							
E1	Electric Only in SF	Yes	Yes	Yes	Yes	**Yes**	
E2	Do Not Electrify Maintenance Facilities	Yes	No	Yes	Yes	No	Need electrified maintenance facilities to maintain trains.
E3	Electrify Minimum Number of CEMOF Tracks	Yes	No	Yes	Yes	No	Limits operational flexibility.
E4	Electrify Minimum Number of Diridon Platforms	Yes	No	Yes	Yes	No	Limits operational flexibility.
Electrified Service Alternatives							
S1	5 Trains pphpd with 6-Car Consists	Yes	Yes	Yes	Yes	**Yes**	
S2	5 Trains pphpd with 8-Car Consists	Yes	Yes	Yes	Yes	**Yes**	
S3	8 Trains pphpd with 6-Car Consists	Yes	Yes	Yes	Yes	**Yes**	
S4	26 Trains/Day between San Jose and Gilroy	Yes	~~Yes~~ No	No	Yes	No	Insufficient demand to justify expense. Electrification Infrastructure Costs from San Jose to San Francisco (51.4 miles) is $950 to $958 ~~$785~~ million. Based on this, the cost to electrify the additional 26 miles of dual track ~~from San Francisco~~ from south of Tamien to Gilroy (52 track ~~77~~ miles not counting any yard or siding track) would be approx. additional $353 to $356 million bringing total infrastructure costs to $1.3 ~~$1.175~~ billion, not including cost of additional rolling stock to replace diesel trains servicing Gilroy and expand service from six trains per day at present. Costs may be lower through use of a factory train. Regardless of cost, Union Pacific is on record as being opposed to electrifying any tracks that it owns making this alternative infeasible

No.	Name	Technically Feasible?	Logistically Feasible?	Financially Feasible?	Otherwise Feasible?	PASS?	Notes
S5	Gilroy/Blossom Hill Turnaround instead of Tamien	Yes	~~Yes~~ No	No	Yes	No	Would require electrification of tracks within UPRR south of Tamien, which could introduce additional potential conflicts with freight and would require UPRR permission. Costs to electrify to Gilroy noted above. Costs to electrify from Tamien to Blossom Hill (approximately 3.5 miles of dual track for 7 track miles) using project average cost per track mile would be approximately $27 ~~$53.5~~ million in additional cost. Costs may be lower through use of a factory train. Regardless of cost, Union Pacific is on record as being opposed to electrifying any tracks that it owns making this alternative infeasible
Platform Alternatives							
P1	Level Boarding	Yes	Yes	Yes	Yes	**Yes**	
P2	Common Platform Heights (Caltrain/HST)	Yes	Yes	Yes	Yes	**Yes**	Common platform heights would only be needed at shared stations if both Caltrain and HSR used the same platform. At present, HSR would have dedicated platforms at TTC, Millbrae, and Diridon (and possibly at Redwood City if selected as a HSR station). Common platform heights would require common decisions on vehicle designs between Caltrain and HSR. Because there is no proposal to share platforms at present and no platform improvements in the Proposed Project, this is not an alternative to the Proposed Project.
Traction Power System Alternatives (other than OCS)							
TPS1	Size Power to 50% More than Need Only	Yes	Yes	Yes	Yes	**Yes**	
TPS2	Alternative TPS Location (Burlingame)	Yes	Yes	Yes	Yes	**Yes**	

No.	Name	Technically Feasible?	Logistically Feasible?	Financially Feasible?	Otherwise Feasible?	PASS?	Notes
Freight Operations Alternatives							
F1	23-Foot Overhead Clearance Everywhere	Yes	Yes	No	Yes	No	Would require reconstruction of all four SF tunnels as well as either lowering tracks or raising bridges at other locations to provide for additional clearance. Tunnels would all need additional clearance. Full replacement of all four tunnels (2.3 miles), using CHSRA estimates for 2-track new tunnel cost of $278 million/mile could cost $650 million additional. Costs to lower tracks to expand existing tunnels not estimated. Costs of lowering tracks or raising bridges at other locations not estimated.
F2	Maintain Existing Overhead Clearances Everywhere	Yes	Yes	~~Unk~~ No	Yes	~~**TBD**~~ No	Would require lowering tracks, or notching or reconstructing tunnels beyond that proposed in the Project to provide additional clearance to compensate for the effect of OCS on overhead clearance. Would require rebuild or replacement of San Francisquito Bridge.
F3	8 p.m. to 5 a.m. Freight Operations	Yes	Yes ~~No~~	Yes	Yes ~~No~~	**Yes** ~~No~~	While not currently allowed by Federal Railroad Administration (FRA) waiver, Caltrain is now of the opinion that alternative compliant EMUs and freight equipment can operate on the corridor without temporal separation because EMUs can provide equivalent safety to Tier 1 passenger safety requirements and due to the forthcoming FRA rule-making. Thus, the project now assumed no substantial change in freight operational windows. As such this is now an assumption of the EIR and not an alternative.
OCS Alternatives							
OCS1	100% Center Pole	Yes	No	Yes	Yes	No	Insufficient track separation in many areas. Center poles are one option being considered as mitigation where feasible.
OCS2	No Headspans for > 80 mph	Yes	Yes	Yes	Yes	**Yes**	
OCS3	No Square Poles	Yes	Yes	Yes	Yes	**Yes**	
OCS4	Multi-Face Poles in Public Areas	Yes	Yes	Yes	Yes	**Yes**	

No.	Name	Technically Feasible?	Logistically Feasible?	Financially Feasible?	Otherwise Feasible?	PASS?	Notes
OCS5	Reduced Diameter and Increased Thickness	Yes	Yes	Yes	Yes	**Yes**	
OCS6	House Wire-Tensioning Weights inside Larger Diameter Poles	Unk	Yes	Yes	Yes	**TBD**	Engineering checking feasibility as part of aesthetic mitigation
OCS7	Run Feed and Return Wire Underground or on Track Side of Poles	Unk	Yes	Yes	Yes	**TBD**	Engineering checking feasibility as part of aesthetic mitigation
Other Alternatives (all assume electrification)							
O1	Underground all Other Utilities	Yes	Yes	Yes	Yes	**Yes**	
O2	Avoid all ROW Takes	No	Yes	Yes	Yes	No	Impossible to avoid ROW takes for traction power substations and electrical clearance where ROW is too narrow.
O3	Solar in the Caltrain ROW	Yes	No	Unk	Yes	No	Incompatible with rail operational safety.
O4	Dumbarton ROW Bike Trail to Facebook	Yes	No	Yes	Yes	No	Incompatible with rail operational safety.
O5	Pedestrian/Bike Tunnels for Connectivity	Yes	Yes	Unk	Yes	**Yes**	
O6	Bike/Pedestrian Trail along Rail Corridor	Yes	No	Unk	Yes	No	Incompatible with rail operational safety.

No.	Name	Technically Feasible?	Logistically Feasible?	Financially Feasible?	Otherwise Feasible?	PASS?	Notes
O7	Update Entire Corridor with "Quiet Zone" Improvements	Yes	Yes	Unk	Yes	**Yes**	As described in Section 3.11, *Noise and Vibration*, a quiet zone can only be proposed to the FRA by a local jurisdiction (not by ~~a~~ train operators). 42 at-grade crossings will remain after San Bruno grade separation project completed. Costs per crossing can range up to $1 million to $2 million for 4-quadrant gates. If all 42 at-grade crossings got quad gates at the high end of cost range, total cost could be up to $42 to $84 million. This is not financially feasible as part of the Proposed Project, but may be fundable in the long-run through local, state, and federal funds.
O8	No Further Retracking until Certified for 125 mph	Yes	Yes	Yes	Yes	**Yes**	
O9	Include Dumbarton Rail Project in the Proposed Project	Yes	No	No	Yes	No	Proposed Project funding does not include DRC; DRC is a separate project that is not fully funded at present.
Construction Alternatives							
C1	Construction Shoofly Tracks	Yes	Yes	No	Yes	No	Caltrain analyzed and found to be prohibitively expensive for this project (and highly disruptive to build).
C2	Multi-Track Closures	Yes	Yes	Yes	Yes	**Yes**	
C3	Electrification with OCS Installation by Factory Train	Yes	Yes	Unk	Yes	**Yes**	
C4	No Night Work	Yes	Yes	Yes	Yes	**Yes**	

Table 5-13 ~~5-8~~. Alternatives Screening, Tier 2 (Environmental Impact)

No.	Name	Increased Horn Noise?	Roadway Traffic Delays at At-Grade Crossings?	Roadway Traffic Delays Near Stations?	Aesthetic Impacts due to OCS Appearance?	Tree Removal?	Construction Disruption?	Other Impact (see notes)?	Avoids or Substantially Reduced One or More Project Impacts?	Notes
NP	No Project Alternative	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**Yes**	Other impacts avoided/reduced: no new impervious surfaces, but the Proposed Project's impact due to impervious surface would be less than significant.
Project	Proposed Project	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No	
Technology Alternatives										
T1	Electric Locomotives	No	No	No	No	No	No	No	No	Would not avoid any project-level impacts over baseline.
T2	Diesel Multiple Units	No	No	No	Yes	Yes	Yes	Yes	**Yes**	Also avoids impacts associated with TPS noise.
T3	Dual-Mode Multiple Units with no Electrification from San Jose to San Francisco	No	No	No	Yes	Yes	Yes	Yes	**Yes**	Presuming diesel operations from San Jose to San Francisco 4th and King Station and electrified operations from 4th and King Station to TTC. Also avoids impacts associated with TPS noise.
	Dual-Mode Locomotives with Electrification from San Jose to San Francisco	No	No	No	No	No	No	No	No	Would not avoid any project-level impacts over baseline.
T7	Tier 4 Diesel Locomotive Alternative	No	No	No	Yes	Yes	Yes	Yes	**Yes**	Also avoids impacts associated with TPS noise
Electrified Train Design Alternatives										
TD1	125 mph Trains	No	No	No	No	No	No	No	No	Would not avoid any project-level impacts over baseline.
TD3	Wifi	No	No	No	No	No	No	No	No	Would not avoid any project-level impacts over baseline.

No.	Name	Increased Horn Noise?	Roadway Traffic Delays at At-Grade Crossings?	Roadway Traffic Delays Near Stations?	Aesthetic Impacts due to OCS Appearance?	Tree Removal?	Construction Disruption?	Other Impact (see notes)?	Avoids or Substantially Reduced One or More Project Impacts?	Notes
TD4	< 60-Second Coupling/Decoupling	No	No	No	No	No	No	No	No	Project does not propose split service, so would not lower any project-level impacts over baseline.
Electrification Location Alternatives										
E1	Electric Only in SF	No	No	No	No	No	No	No	No	Would lower air quality impacts of continuing diesel service from Gilroy to SF, but this is an existing condition, not a project condition.
Electrified Service Alternatives										
S1	5 Trains pphpd with 6-Car Consists	Yes	Yes	Yes	No	No	No	No	**Yes**	
S2	5 Trains pphpd with 8-Car Consists	Yes	Yes	No	No	No	No	No	**Yes**	
S3	8 Trains pphpd with 6-Car Consists	No	No	No	No	No	No	No	No	Would not avoid any project-level impacts over baseline.
Platform Alternatives										
P1	Level Boarding	No	No	No	No	No	No	No	No	Would not avoid any project-level impacts over baseline.
P2	Common Platform Heights (Caltrain/HST)	No	No	No	No	No	No	No	No	Would not avoid any project-level impacts over baseline.
Traction Power System Alternatives (other than OCS)										
TPS1	Size Power to 50% More than Need Only	No	No	No	No	No	No	No	No	Would only affect capacity/footprint at traction power substations in industrial/ commercial areas, not sensitive areas.
TPS2	Alternative TPS Location (Burlingame)	No	No	No	No	No	No	No	No	Relocation north would not reduce aesthetic impact.

No.	Name	Increased Horn Noise?	Roadway Traffic Delays at At-Grade Crossings?	Roadway Traffic Delays Near Stations?	Aesthetic Impacts due to OCS Appearance?	Tree Removal?	Construction Disruption?	Other Impact (see notes)?	Avoids or Substantially Reduced One or More Project Impacts?	Notes
Freight Operations Alternatives										
F2	Maintain Existing Overhead Clearances Everywhere	No	No	No	No	No	No	Yes	**Yes**	Would reduce potential diversion of existing rail to truck however the Proposed Project would accommodate existing freight and cumulative effects on freight are considered to have less than significant environmental impact .
F3	8 p.m. to 5 a.m. Freight Operations	No	No	No	No	No	No	No	**No**	Since this is now part of the Proposed Project, it would not avoid any impacts of the Proposed Project.
OCS Alternatives										
OCS2	No Headspans for > 80 mph	No	No	No	No	No	No	No	No	Would not avoid any project-level impacts over baseline (project < 79 mph).
OCS3	No Square Poles	No	No	No	Yes	No	No	No	**Yes**	
OCS4	Multi-Face Poles in Public Areas	No	No	No	Yes	No	No	No	**Yes**	
OCS5	Reduced Diameter and Increased Thickness	No	No	No	Yes	No	No	No	**Yes**	
OCS6	House Wire-Tensioning Weights inside Larger Diameter Poles	No	No	No	Yes	No	No	No	**Yes**	
OCS7	Run Feed and Return Wire Underground or on Track Side of Poles	No	No	No	Yes	Yes	Yes	No	**Yes**	
Other Alternatives (all assume electrification)										
O1	Underground All other Utilities	No	No	No	No	No	No	No	No	Would lower aesthetic impact of existing utilities, but that is a baseline impact not a project impact.

No.	Name	Increased Horn Noise?	Roadway Traffic Delays at At-Grade Crossings?	Roadway Traffic Delays Near Stations?	Aesthetic Impacts due to OCS Appearance?	Tree Removal?	Construction Disruption?	Other Impact (see notes)?	Avoids or Substantially Reduced One or More Project Impacts?	Notes
O5	Pedestrian/Bike Tunnels for Connectivity	No	No	No	No	No	No	No	No	Proposed Project maintains existing pedestrian–bike connectivity.
O7	Update Entire Corridor with "Quiet Zone" Improvements	Yes	No	No	No	No	No	No	**Yes**	
O8	No Further Retracking until Certified for 125 mph	No	No	No	No	No	No	No	No	Would not avoid any project-level impacts over baseline.
Construction Alternatives										
C2	Multi-Track Closures	No	No	No	No	No	Yes	No	**Yes**	Would reduce construction duration.
C3	Electrification with OCS Installation by Factory Train	No	No	No	No	No	Yes	No	**Yes**	Would reduce construction disruption.
C4	No Night Work	No	No	No	No	No	No	No	No	Would reduce construction disruption at night, but lengthen construction duration overall.

Table 5-14 ~~5-9~~. Alternatives Screening, Tier 3 (Purpose and Need)

No.	Name	Improve Train Performance, ridership and service	Increase operating revenue and reduce operating fuel costs	Reduce engine noise from trains compared with existing diesel trains	Improve air quality	Reduce Greenhouse Gas Emissions	Electrification infrastructure Compatible with High-Speed Rail	PASS?	Notes
NP	No Project Alternative	No	No	No	No	No	No	**Yes**	CEQA requires analysis of No Project Alternative
Project	Proposed Project	Yes	Yes	Yes	Yes	Yes	Yes	**Yes**	
Technology Alternatives									
T2	Diesel Multiple Units	Yes	Yes (fare revenue) No (fuel costs)	Yes	Yes	Yes	No	**Partially ~~No~~**	Would not meet project's purpose to provide electrification compatible with HSR and would not reduce operating fuel costs. Meets some of Purpose and Need. Carried forward ~~due to Public interest~~
T3	Dual-Mode Multiple Units (with no electrification from San Jose to San Francisco)	Yes	Yes (fare revenue) No (fuel costs)	Yes	Yes	Yes	No	**Partially ~~No~~**	Would not meet project's purpose to provide electrification compatible with HSR and would not reduce operating fuel costs. Meets some of Purpose and Need. Carried forward ~~due to Public interest~~
T7	Tier 4 Diesel Locomotive Alternative	Yes	Yes (fare revenue) No (fuel costs)	No	Yes	Yes	No	**Partially**	Would not meet project's purpose to provide electrification compatible with HSR, would not reduce operating fuel costs and would not lower engine noise. Meets some of Purpose and Need. Carried forward.

No.	Name	Improve Train Performance, ridership and service	Increase operating revenue and reduce operating fuel costs	Reduce engine noise from trains compared with existing diesel trains	Improve air quality	Reduce Greenhouse Gas Emissions	Electrification infrastructure Compatible with High-Speed Rail	PASS?	Notes
Electrified Service Alternatives									
S1	5 Trains pphpd with 6-Car Consists	No	No	Yes	Yes	Yes	Yes	No	
S2	5 Trains pphpd with 8-Car Consists	No	No	Yes	Yes	Yes	Yes	No	Would not increase service and thus may not increase ridership.
OCS Alternatives									
OCS3	No Square Poles	Yes	Yes	Yes	Yes	Yes	Yes	**Yes**	
OCS4	Multi-Face Poles in Public Areas	Yes	Yes	Yes	Yes	Yes	Yes	**Yes**	
OCS5	Reduced Diameter and Increased Thickness	Yes	Yes	Yes	Yes	Yes	Yes	**Yes**	
OCS6	House Wire-Tensioning Weights inside Larger Diameter Poles	Yes	Yes	Yes	Yes	Yes	Yes	**Yes**	
OCS7	Run Feed and Return Wire Underground or on Track Side of Poles	Yes	Yes	Yes	Yes	Yes	Yes	**Yes**	
Other Alternatives (all assume electrification)									
O7	Update Entire Corridor with "Quiet Zone" Improvements	Yes	Yes	Yes	Yes	Yes	Yes	**Yes**	
Construction Alternatives									
C2	Multi-Track Closures	Yes	Yes	Yes	Yes	Yes	Yes	**Yes**	
C3	Electrification with OCS Installation by Factory Train	Yes	Yes	Yes	Yes	Yes	Yes	**Yes**	

Table 5-15 ~~5-10~~. Alternatives Screening, Results

No.	Name	Feasible?	Avoids or substantially Reduces one or More Impacts of the Project	Meets Purpose and Need?	*Potentially Analyzed in the EIR?*	Expands Range of Alternatives	Recommended for Analysis in the EIR	Notes
NP	No Project Alternative	Yes	Yes	No	*Yes*	Yes	**Yes**	Required by CEQA.
Project	Proposed Project	Yes	No	Yes	*Yes*	Yes	**Yes**	Proposed Project.
Technology Alternatives								
T1	Electric Locomotives	Yes	No	N/A	*No*	N/A	No	Would not avoid or substantially lower significant impacts of the project.
T2	Diesel Multiple Units	Yes	Yes	No	*Yes*	Yes	**Yes**	Although does not meet project purpose and need to lower operating fuel costs and to provide electrical infrastructure compatible with high-speed train (HST), alternative is analyzed in EIR ~~due to public interest~~.
T3	Dual Mode Multiple Units (with no electrification from San Jose to San Francisco)	Yes	Yes	No	*Yes*	Yes	**Yes**	Although does not meet project purpose and need to lower operating fuel costs and to provide electrical infrastructure compatible with high-speed train (HST), alternative is analyzed in EIR ~~due to public interest~~.
	Dual Mode Locomotives (with electrification from San Jose to San Francisco)	Yes	No	N/A	*No*	N/A	No	Would not avoid or substantially lower significant impacts of the project.
T4	Caltrain Third-Rail Alternative	No	N/A	N/A	*No*	N/A	No	Not considered feasible
T5	Extend BART from Millbrae to Santa Clara	No	N/A	N/A	*No*	N/A	No	Not considered feasible
T6	100% Electrified Service by 2020 ~~2019~~	No	N/A	N/A	*No*	N/A	No	Not considered feasible

No.	Name	Feasible?	Avoids or substantially Reduces one or More Impacts of the Project	Meets Purpose and Need?	*Potentially Analyzed in the EIR?*	Expands Range of Alternatives	Recommended for Analysis in the EIR	Notes
T7	Tier 4 Diesel Locomotive Alternative	Yes	Yes	Some	*Yes*	No	**Yes**	Although does not meet project purpose and need to lower operating fuel costs, to lower engine noise, and to provide electrical infrastructure compatible with high-speed train (HST), alternative is analyzed in EIR. It should be noted that with two diesel-based DMU Alternative and Dual-Mode Alternatives, which meet more of the project objectives, and a No Project Alternative that continues use of diesel locomotives, this alternative doesn't meaningfully expand the range of alternatives.
Electrified Train Design Alternatives								
TD1	125 mph Trains	Yes	No	N/A	*No*	N/A	No	Trains can do 125 mph but this would not lower any impacts of the project.
TD2	Single-Level with < 30-Second Dwell Times	No	N/A	N/A	*No*	N/A	No	Not considered feasible
TD3	Wifi	Yes	No	N/A	*No*	N/A	No	Would not avoid or substantially lower significant impacts of the project.
TD4	< 60-Second Coupling/Decoupling	Yes	No	N/A	*No*	N/A	No	Would not avoid or substantially lower significant impacts of the project.
Horizontal Alignment Alternatives								
HA1	San Francisco Alternative Alignment (to 3rd Street/King)	No	N/A	N/A	*No*	N/A	No	Not considered feasible
Vertical Alignment Alternatives								
VA1	San Francisco Undergrounding	No	N/A	N/A	*No*	N/A	No	Not considered feasible
VA2	Buried Trench	No	N/A	N/A	*No*	N/A	No	Not considered feasible
VA3	Fully Grade-Separated	No	N/A	N/A	*No*	N/A	No	Not considered feasible

No.	Name	Feasible?	Avoids or substantially Reduces one or More Impacts of the Project	Meets Purpose and Need?	*Potentially Analyzed in the EIR?*	Expands Range of Alternatives	Recommended for Analysis in the EIR	Notes
VA4	Elevated Alignment in Menlo Park	No	N/A	N/A	*No*	N/A	No	Not considered feasible
Electrification Location Alternatives								
E1	Electric Only in SF	Yes	No	N/A	*No*	N/A	No	Would not avoid or substantially lower significant impacts of the project.
E2	Do Not Electrify Maintenance Facilities	No	N/A	N/A	*No*	N/A	No	Not considered feasible
E3	Electrify Minimum Number of CEMOF Tracks	No	N/A	N/A	*No*	N/A	No	Not considered feasible
E4	Electrify Minimum Number of Diridon Platforms	No	N/A	N/A	*No*	N/A	No	Not considered feasible
Electrified Service Alternatives								
S1	5 Trains pphpd with 6-Car Consists	Yes	Yes	No	*No*	N/A	No	Would not meet project's purpose and need.
S2	5 Trains pphpd with 8-Car Consists	Yes	Yes	No	*No*	N/A	No	Would not meet project's purpose and need.
S3	8 Trains pphpd with 6-Car Consists	Yes	No	N/A	*No*	N/A	No	Would not avoid or substantially lower significant impacts of the project.
S4	26 Trains/Day between San Jose and Gilroy	No	N/A	N/A	*No*	N/A	No	Not considered feasible
S5	Gilroy/Blossom Hill Turnaround Instead of Tamien	No	N/A	N/A	*No*	N/A	No	Not considered feasible
Platform Alternatives								
P1	Level Boarding	Yes	No	N/A	*No*	N/A	No	Would not avoid or substantially lower significant impacts of the project. Future level boarding not precluded by Proposed project.
P2	Common Platform Heights (Caltrain/HST)	Yes	No	N/A	*No*	N/A	No	

No.	Name	Feasible?	Avoids or substantially Reduces one or More Impacts of the Project	Meets Purpose and Need?	*Potentially Analyzed in the EIR?*	Expands Range of Alternatives	Recommended for Analysis in the EIR	Notes
Traction Power System Alternatives (other than OCS)								
TPS1	Size Power To 50% More Than Need Only	Yes	No	N/A	*No*	N/A	No	Would not avoid or substantially lower significant impacts of the project
TPS2	Alternative TPS Location (Burlingame)	Yes	No	N/A	*No*	N/A	No	Would not avoid or substantially lower significant impacts of the project
Freight Operations Alternatives								
F1	23-Foot Overhead Clearance Everywhere	No	N/A	N/A	*No*	N/A	No	Not considered feasible
F2	Maintain Existing Overhead Clearances Everywhere	TBD	Yes	Yes	*Yes*	Yes	**Project**	Potentially feasible, but would result in substantial impact, especially to historic tunnels. Would not lower impacts of the Proposed Project over baseline. Analyzed as part of cumulative mitigation for potential future impacts on freight service.
F3	8 p.m. to 5 a.m. Freight Operations	Yes ~~No~~	No ~~N/A~~	N/A	*No*	N/A	No	~~Not considered feasible.~~ Proposed Project now presumes no need for temporal separation so this alternative would not avoid any impacts of the Proposed Project.
OCS Alternatives								
OCS1	100% Center Pole	No	N/A	N/A	*No*	N/A	No	Not considered feasible
OCS2	No Headspans for > 80 mph	Yes	No	N/A	*No*	N/A	No	Would not avoid or substantially lower significant impacts of the project
OCS3	No Square Poles	Yes	Yes	Yes	*Yes*	No	**Project**	Considered for Aesthetic mitigation.
OCS4	Multi-Face Poles in Public Areas	Yes	Yes	Yes	*Yes*	No	**Project**	Considered for Aesthetic mitigation.
OCS5	Reduced Diameter and Increased Thickness	Yes	Yes	Yes	*Yes*	No	**Project**	Considered for Aesthetic mitigation.

No.	Name	Feasible?	Avoids or substantially Reduces one or More Impacts of the Project	Meets Purpose and Need?	*Potentially Analyzed in the EIR?*	Expands Range of Alternatives	Recommended for Analysis in the EIR	Notes
OCS6	House Wire-Tensioning Weights inside Larger Diameter Poles	TBD	Yes	Yes	*Yes*	No	**TBD**	Considered for Aesthetic mitigation if feasible
OCS7	Run Feed And Return Wire Underground or on Track Side of Poles	TBD	Yes	Yes	*Yes*	No	**TBD**	Considered for Aesthetic mitigation if feasible.
Other Alternatives (all assume electrification)								
O1	Underground all Other Utilities	Yes	No	N/A	*No*	N/A	No	Would not avoid or substantially lower significant impacts of the project
O2	Avoid all ROW Takes	No	N/A	N/A	*No*	N/A	No	Not considered feasible
O3	Solar in the Caltrain ROW	No	N/A	N/A	*No*	N/A	No	Not considered feasible
O4	Dumbarton ROW Bike Trail to Facebook	No	N/A	N/A	*No*	N/A	No	Not considered feasible
O5	Pedestrian/Bike Tunnels for Connectivity	Yes	No	N/A	*No*	N/A	No	Would not avoid or substantially lower significant impacts of the project
O6	Bike/Pedestrian Trail along Rail Corridor	No	N/A	N/A	*No*	N/A	No	Not considered feasible
O7	Update Entire Corridor with "Quiet Zone" Improvements	Unk	Yes	Yes	*Yes*	Yes	**Project/ Cumulative**	Consider quiet zone improvements as potential mitigation where noise effects are identified as significant. Not considered feasible for all at-grade crossings in corridor as part of the Proposed Project but may be fundable in the long-term through the combination of local, state and federal funds and funding participation of other rail operators and local municipalities.
O8	No Further Retracking until Certified for 125 mph	Yes	No	N/A	*No*	N/A	No	Would not avoid or substantially lower significant impacts of the project

No.	Name	Feasible?	Avoids or substantially Reduces one or More Impacts of the Project	Meets Purpose and Need?	*Potentially Analyzed in the EIR?*	Expands Range of Alternatives	Recommended for Analysis in the EIR	Notes
O9	Include Dumbarton Rail Project in the Proposed Project	No	N/A	N/A	*No*	N/A	No	Not considered feasible
Construction Alternatives								
C1	Construction Shoofly Tracks	No	N/A	N/A	*No*	N/A	No	Not considered feasible
C2	Multi-Track Closures	Yes	Yes	Yes	*Yes*	Yes	**Project**	Analyzed as part of the Proposed Project.
C3	Electrification with OCS Installation by Factory Train	Yes	Yes	Yes	*Yes*	Yes	**Yes**	Analyzed as alternative in this chapter
C4	No Night Work	Yes	No	N/A	*No*	N/A	No	Would not avoid or substantially lower significant impacts of the project