

Expanded Community Advisory Panel (XCAP) Meeting

Agenda Item #3a

Noise and Vibration Comparative Analysis Update

7.15.2020



Noise Report Updates

At 6/2/2020 meeting XCAP requested updates to draft noise report:

- Replace future “Electric Locomotives” with new EMU units.
- Reassess Passenger Train Speeds in accordance with Caltrain projected speed profiles.
- Increase daily total and peak hour train events to 114 trains/day, and 16 trains/peak hour (per Caltrain Electrification Study).
- Consider use of 6-foot parapet noise barriers on Closure and Underpass alternatives.
- Provide table showing relative noise reduction for each alternative.
- Revise or remove combined summary table.

Replace Electric Locomotives with EMU units

The draft report assumed typical electric locomotives to replace diesel locomotives for future electrified Caltrain Service, but it was determined that Caltrain have selected new Electric Multiple Unit (EMU) trains rather than Electric Locomotives for future service.



Replace Electric Locomotives with EMU units

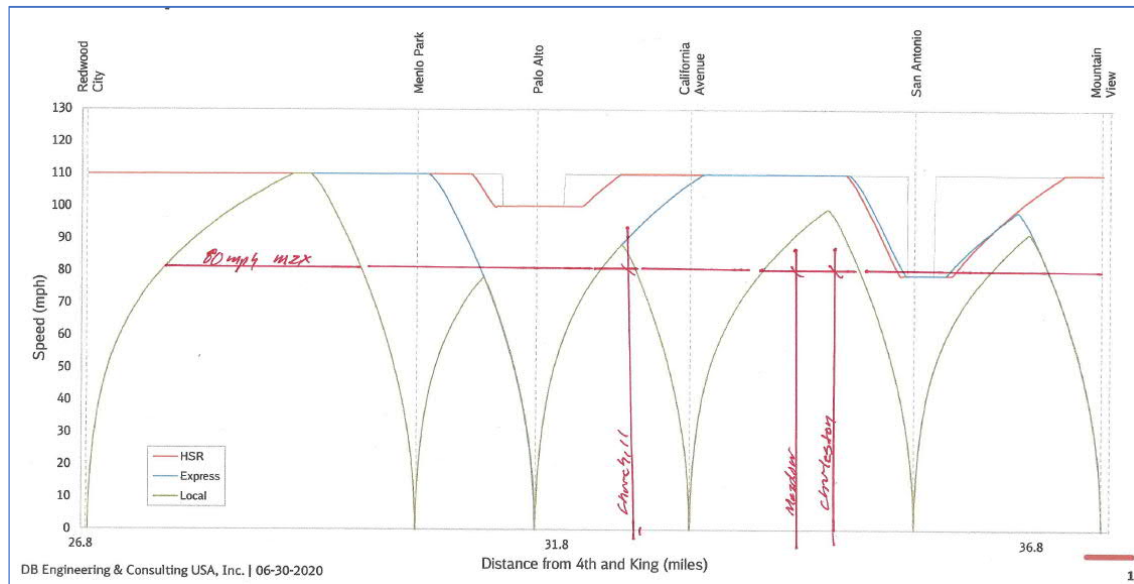
Acoustical data for the new EMU units was not available from either the manufacturer or Caltrain. Rather, reference acoustic parameters for similar EMUs were taken from the Caltrain 2014 Electrification Study (2014) and predicted results compared to Caltrain Specification for maximum allowable noise level for new units:

EMU Vs. Electrical Acoustical Parameters			
Train type	SEL-propulsion	SEL-cars	Speed Coefficient.
Diesel Locomotive	92	82	-10
Electric Locomotive	90	82	10
EMU	77.5	82	0

Caltrain Specification EMU (dBA, Leq at 25 feet)		
Speed	Allowed	Predicted
Up to 50 mph	81	78.7
Up to 80 mph	87	82.4

Increase Train Speeds

Based upon Caltrain-provided future speed profiles, speeds for future EMU trains near existing grade-crossings was determined to be at or near the 80 mph limit, so this speed was used for future passenger rail operations for all predictions (freight speeds remain at 50 mph).

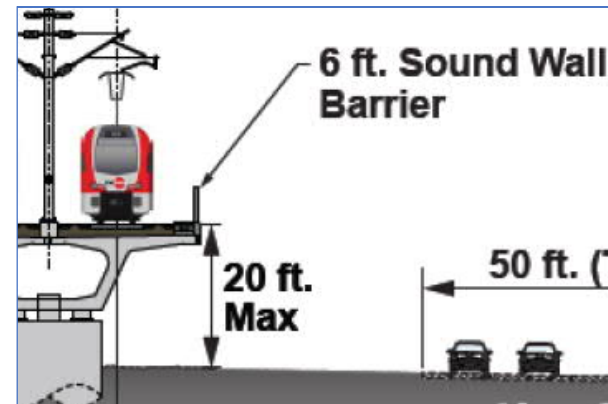


Update Train Operations

- Draft report noise predictions were based on existing Caltrain daily total of 92 trains (80/day + 12/night), and freight service of 3/night.
- Revised report assumes projected 2040 service of 114 daily total Caltrain trains (99/day + 15/night) and freight service of 3/night, as per Caltrain Electrification Study (assumes full EMU replacement).
- Future peak hour Caltrain train service was estimated to be 16/hour.
- Caltrain 2014 study also assumed up to 80 High Speed Rail (HSR) trains, but these were excluded for the current alternative analysis (in part because the addition of these addition trains would de-emphasize the relative benefits of the analyzed alternatives relative to current conditions).

Parapet Noise Barrier

- Viaduct and Hybrid Alternatives both assumed the use of 6-foot parapet noise barriers (as shown below).
- As per XCAP request, these barriers were also included as potential options for Closure and Underpass alternatives (which would provide up to an additional 12 dBA reduction for propulsion and wheel/rail noise for these alternatives).



Provide Table showing Relative Noise Reduction

XCAP requested to provide a table showing relative noise reduction for each alternative in addition to table presenting predicted noise levels.

Alternative	First Row West		Second Row West		First Row East		Second Row East		Average	
	Peak	Ldn	Peak	Ldn	Peak	Ldn	Peak	Ldn	Peak	Ldn
Existing/w Horns (EMU)	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.0
GC Closure (Diesel)	13.4	12.4	12.7	11.8	10.5	9.4	11.6	10.6	12.1	11.1
GC Closure (EMU)	14.2	12.9	13.4	12.2	10.9	9.7	12.1	10.9	12.7	11.4
GC Closure (EMU) w/barrier	18.4	16.5	16.6	15	12.3	10.9	14.1	12.7	15.4	13.8
Viaduct (Churchill)	18.4	16.5	16.6	14.1	12.3	10.9	14.1	12.2	15.4	13.4
Viaduct (Meadow/Charleston)	18.5	16.6	16.6	14.2	12.3	10.8	14.1	12.0	15.4	13.4
Hybrid	23.6	20.8	20.6	17.2	12.2	10.9	13.6	11.9	17.5	15.2
Trench	18.0	16.6	16.3	15.0	12.2	11.0	14.0	12.7	15.1	13.8
Transition (trench or tunnel)	21.1	15.6	15.5	14.1	12.6	10.4	13.3	11.9	15.6	13.0
Tunnel Pass. & Freight	18.9	17.6	16.9	15.7	12.4	11.2	14.3	13.1	15.6	14.4
Tunnel At Grade Freight	21.9	18.3	19.9	16.3	15.4	12.5	17.3	14.0	18.6	15.3
Underpass Meadow/Charleston	14.2	12.9	13.4	12.2	10.9	9.7	12.1	10.9	12.7	11.4
Underpass M/C w/barrier	18.4	16.5	16.6	14.9	12.3	10.9	14.1	12.7	15.4	13.8
Underpass Churchill	15.6	14.3	15.3	14.1	14.4	13.2	14.9	13.7	15.1	13.8
Underpass Churchill w/barrier	23.5	20.4	22.1	19.5	18.4	16.6	20	18	21.0	18.6

Revise or remove combined summary table.

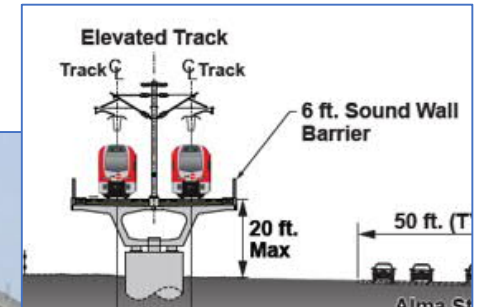
- XCAP requested to revise the summary table to either provide more technical justification for the methodology used in combining results for operational noise, operational vibration, and construction noise and vibration assessments, or remove table entirely.
- After some reconsideration, it was determined by the report's author that any attempt to combine the various assessments was ultimately a subjective decision based upon the author's opinion of which of these various assessments was more or less important, and that different opinions on relative importance could influence the results.
- Therefore, it was decided to remove this attempt to consolidate the assessment results and leave the exercise to XCAP.

Addition Explanation of Structure Radiated Noise

- One XCAP member had presented some questions regarding whether structure-radiated noise for viaduct, and perhaps overpass alternatives might have been under predicted.
- In response, the author recognizes that on some older style (metal) rail bridge and viaduct structures produce significant additional noise due to structure-radiated noise. However, our analysis assumed that modern, reinforced concrete viaduct and bridge structures would be incorporated into any future design.
- These modern structure designs (including greater mass and internal damping characteristics than older style structures), would reduce any structure-radiated noise to a less than significant level relative to other rail and non-rail noise sources.

Addition Explanation of Structure Radiated Noise

Comparison of older and newer style rail bridge and viaduct structures



Predicted Operational Noise – Revised Assumptions

Parameter	Modeling Assumption (changes from draft report in red)
Trains speeds	All passenger trains speeds 80 mph, all freight 50 mph
Train consists	Passenger: 6 car EMU, 3 powered. Freight: 2 locomotives + 50 cars
Daily trains ¹	Passenger trains: 99/day + 15/night, Freight: 0/day + 3/night
Peak hour trains ¹	16 Passenger trains/hour, no freight trains
Daily roads	Alma: 4 lanes, 36,000 daily total, 4% trucks/buses, 85% day/15% night, all 35 mph
Peak hour roads	Alma Street: 900 vehicles/lane/hour, 4% trucks/buses, all 35 mph
Building Row Attenuation ²	First Row building row (<35% gap) provide 5 dB Noise reduction for second row homes, except for Hybrid and Viaduct Alts for engine noise
Parapet Barrier Attenuation ²	Assumed acoustically absorptive on train facing side, 12 dBA reduction for propulsion and wheel/rail noise for EMU, 12 dBA for wheel/rail noise only freight
Trench Attenuation ²	Full depth trench 5 dBA for engine noise, 10 dBA for wheel/rail noise For transition/partial depth, 0 dBA for engine, 5 dBA for wheel/rail Assume trench walls lined for acoustical absorption
Tunnel Attenuation	Assume 40 dBA reduction, any ventilation designed to limit exterior noise
Ground type	Hard ground, no additional acoustical absorption
Backyard fences	No additional noise reduction.
1) Passenger train operations from Caltrain Electrification Study 2014 2) FTA 2018, Tables 4-28, 4-29	

Predicted Operational Noise (Previous)

Alternative	First Row West		Second Row West		First Row East		Second Row East	
	Leq _{Peak}	Ldn	Leq _{Peak}	Ldn	Leq _{Peak}	Ldn	Leq _{Peak}	Ldn
Existing/w Horns (Diesel)	85.5	84.1	73.5	73.3	80.8	80.6	72.7	72.5
Existing/w Horns (Electric)	83.4	83.2	73.5	73.3	80.7	80.6	72.7	72.5
Churchill								
GC Closure (Electric)	69.4	70.3	60.6	61.3	71.1	71.3	61.6	62.0
Viaduct	68.4	68.7	61.5	61.9	70.7	70.8	62.2	62.5
Underpass	67.1	68.6	57.6	59.0	66.5	67.4	57.6	58.8
Meadow/Charleston								
Viaduct	68.0	68.2	61.3	61.7	70.8	70.9	62.4	62.7
Hybrid	64.4	65.3	58.8	59.6	70.7	70.8	62.2	62.5
Trench	67.4	67.5	59.1	59.2	70.5	70.4	60.7	60.7
Tunnel Pass. & Freight	66.6	66.5	58.6	58.5	70.3	70.2	60.4	60.3
Tunnel At-Grade Freight	63.6	65.8	55.6	57.9	67.3	68.9	57.4	59.4
Underpass	69.4	70.3	60.6	61.3	71.1	71.3	61.6	62.0

Predicted Operational Noise (Updated)

Alternative	1 st Row West		2 nd Row West		1 st Row East		2 nd Row East		Average	
	Peak	Ldn	Peak	Ldn	Peak	Ldn	Peak	Ldn	Peak	Ldn
Existing/w Horns (Diesel)	85.5	84.1	75.5	74.2	82.7	81.4	74.7	73.4	79.6	78.3
Existing/w Horns (EMU)	85.5	84.1	75.5	74.2	82.7	81.4	74.6	73.5	79.6	78.3
Churchill										
GC Closure	71.3	71.2	62.1	62.0	71.8	71.7	62.6	62.5	67.0	66.9
GC Closure w/barrier	67.1	67.6	58.9	59.2	70.4	70.5	60.6	60.7	64.3	64.5
Viaduct w/barriers	67.1	67.6	58.9	60.1	70.4	70.5	60.6	61.2	64.3	64.9
Underpass	69.9	69.8	60.2	60.1	68.3	68.2	59.8	59.7	64.6	64.5
Underpass w/barrier	62.0	63.7	53.4	54.7	64.3	64.8	54.7	55.4	58.6	59.7
Meadow/Charleston										
Viaduct	67.0	67.5	58.9	60.0	70.4	70.6	60.6	61.4	64.2	64.9
Hybrid	61.9	63.3	54.9	57.0	70.5	70.5	61.1	61.5	62.1	63.1
Trench	67.5	67.5	59.2	59.2	70.5	70.4	60.7	60.7	64.5	64.5
Tunnel Pass. & Freight	66.6	66.5	58.6	58.5	70.3	70.2	60.4	60.3	64.0	63.9
Tunnel, at Grade Freight	63.6	65.8	55.6	57.9	67.3	68.9	57.4	59.4	61.0	63.0
Underpass	71.3	71.2	62.1	62.0	71.8	71.7	62.6	62.5	67.0	66.9
Underpass w/barrier	67.1	67.6	58.9	59.3	70.4	70.5	60.6	60.7	64.3	64.5

Conclusions

XCAP requested updates to draft noise report:

- Several updates in assumptions based on XCAP comments (future train types, daily events, speeds, alternatives)
- Updated tables with new predicted noise levels, but similar results.
- No changes to qualitative assessment on operation vibration and construction noise and vibration.
- Removed combined summary table, that assessment better left to XCAP together with other considerations.

A green-tinted photograph of a railway track. In the foreground, a crossing sign is visible on the left side. The tracks lead towards a crossing in the distance. The text "Thank you" is centered in white over the image.

Thank you