



Boral Cement

Chloride Bypass Plant
Operational Noise Verification Report
December 2023

Addendum to Report of Assessment
May 2024

For

Berrima Cement Plant

31 May, 2024

Boral Cement Berrima

Chloride Bypass Plant

Operational Noise Verification Report

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Addendum to Report of assessment

May 2024

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Executive Summary

The Berrima Cement works of Boral Cement completed construction and commissioning of a Chloride Bypass Plant (CBP) attached to the No.6 Kiln in November 2023. Approval was granted for this in May 2021 and commissioning was completed on 30 November 2023. The approval conditions included requirements to prepare a Noise Verification Report prior to construction and also within three-months of commencement of operations. The Operational Noise Verification Report was provided on 31 January 2024.

This document provides an Addendum to the initial Operational Verification report. This Addendum deals with condition 3.6B(b), which required the following:

(b) a detailed analysis of annoying noise characteristics in accordance with Fact Sheet C of the Noise Policy for Industry (EPA, 2017) to confirm the plant and equipment associated with the chloride bypass system does not exhibit annoying noise characteristics

The information for this assessment was included in the initial Operational Verification report and a separate report of the Annual Environmental Noise Assessment of the Boral Cement - Berrima Cement Works 2023; however the Operational Verification Report did not specifically address the analysis of potentially annoying noise characteristics of the Chloride Bypass Plant. This Addendum report provides that specific analysis, with reference to tonality and low-frequency sound. The CBP is not a source of impulsive or intermittent noise, which are the other aspects of potentially annoying noise in Fact Sheet C.

With reference to the condition of approval for the plant to be compliant with the requirements of Fact Sheet C of the NPfI regarding potentially annoying noise characteristics, this Addendum Report to the ONVR has provided data from the AENAR 2023 to show that this condition is complied with.

Measured sound levels at receiver locations were assessed and found to be non-tonal. The plant is not a source of impulsive or intermittent noise emissions, being relatively continuous in operation and sound source operation.

Since the measured sound low-frequency levels from the CBP in operation are unable to be measured within the background and ambient of current environmental noise, the Policy allows the use of predicted sound levels for such analysis. These predictions, which used two different and accepted methods of calculation, indicate that the CBP contribution sound levels in the low-frequency range are well below the criteria of the Policy and therefore considered to be in compliance with the condition.

Based on these results, it is the assessment of this Addendum Report and the original ONVR report that the noise emissions from the operational CBP are in compliance with the recommended objectives of the Pre-construction Verification Report.

1 Introduction

The Operational Noise Verification Report for the Chloride Bypass Plant (CBP) at the Boral Cement Limited New Berrima cement works was provided in January 2024. Approval for the CBP was received in May 2021 and commissioning completed in November 2023. The approval conditions for the CBP Operational Noise Verification Report (ONVR) include in condition 3.6B(b) for an assessment of potentially annoying noise characteristics discussed in the Noise Policy for Industry Fact Sheet C. This is noted below:

3.6B The Noise Verification Reports required by condition 3.6A must be prepared by a suitably qualified and experienced acoustic consultant and include:

(b) a detailed analysis of annoying noise characteristics in accordance with Fact Sheet C of the Noise Policy for Industry (EPA, 2017) to confirm the plant and equipment associated with the chloride bypass system does not exhibit annoying noise characteristics.

Potentially annoying noise characteristics are described in the Introduction of Fact Sheet C of the *Noise Policy for Industry* (NPfI) as follows:

Where a noise source contains certain characteristics, such as tonality, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. On the other hand, some sources may cause less annoyance where only a single event occurs for a limited duration.

While the information required to assess tonality and low-frequency content was provided in the ONVR and the Annual Environmental Noise Assessment Report for the Boral Cement Berrima Cement Works 2023 (AENAR2023), it was not specifically discussed or described in the ONVR because the predicted receiver contribution sound levels from the CBP were more than 10 dB below the contribution objectives, which are in turn typically 10 dB below rating background sound levels and are therefore not expected to be audible nor potentially annoying. The analysis of the attended monitoring done for the AENAR 2023 had also not been completed.

This document is an Addendum to the ONVR to provide analysis and discussion of tonal noise and low frequency noise received at residential receiver locations from the CBP.

The CBP is considered to not exhibit impulsive or intermittent noise emission characteristics. This is because the sources it contains are fans, air and dust collection movement systems which continue relatively non-stop at relatively stable levels or operation. Thereby they do not operate intermittently, for short-term periods, nor include impulsive sound levels which could be audible at the residential receiver locations.

2 Assessment of Tonality

The AENAR 2023 provided results of attended sound level monitoring which included the operational testing of the CBP on 1 and 14 December 2023. Measurement results of attended monitoring were provided at residential receiver and site boundary receiver locations as follows:

- 4 Melbourne St
- Adelaide St near Taylor Avenue
- 12 Brisbane St.
- North Fence
- Location 20

As well as the specific attended results noted above, one-third octave band spectra and tonality from listening attended monitoring at 4 Melbourne St. was also provided in Tables 4.9 and 4.10 of the AENAR 2023. Graphs of these spectra were provided in Appendix A Figures A1 to A18. This data is reproduced in Tables A1 and A2 and graphed in Figures A1 to A17 of this report.

In the tonality results, only one receiver location had measurement results which exceeded the tonality objectives, and this was 4 Melbourne St. on three occasions. The first was for an $L_{Aeq,15-min}$ measurement at 4 Melbourne St on 2 December from 23:30 to 23:45 and the exceedance was in the 8 kHz and 12.5 kHz bands. The exceedance did not occur in the $L_{A90,15-min}$ spectrum, which indicates the source is most likely to be an insect close to the microphone. The second occasion was in the period from 8:30pm to 8:45pm on 4 December with an exceedance in the 4 kHz band. Again, this exceedance did not occur in the $L_{A90,15-min}$ spectrum. The third occasion was on 14 December in the period from 9:16am to 9:31am, with the exceedance marginal in the 10kHz band of the $L_{A90,15-min}$ spectrum; this is not likely to be related to cement plant noise emissions.

The findings of the AENAR over many years have been that the receiver sound level spectra are not tonal and this was again confirmed in the 2023 assessment. It is considered that the noise emissions of the CBP are also non-tonal when measured at residential receiver locations.

Attended Monitoring Spectra during CBP Operation on 1 and 14 December 2023

Table A2: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report

Time	Location	Measure Date Time	File No.	Type
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Note: For all 4 Melbourne St logger periods, All plant was operating except for 5/12 Night, when All plant on except CBP & CM6, wind Northerly reducing to calm

Boral Cement Berrima - CBP Verification Assessment December 2023: 4 Melbourne St 1 December 2023
9:16am File 2538 One Third Octave Band Spectra and Tonality

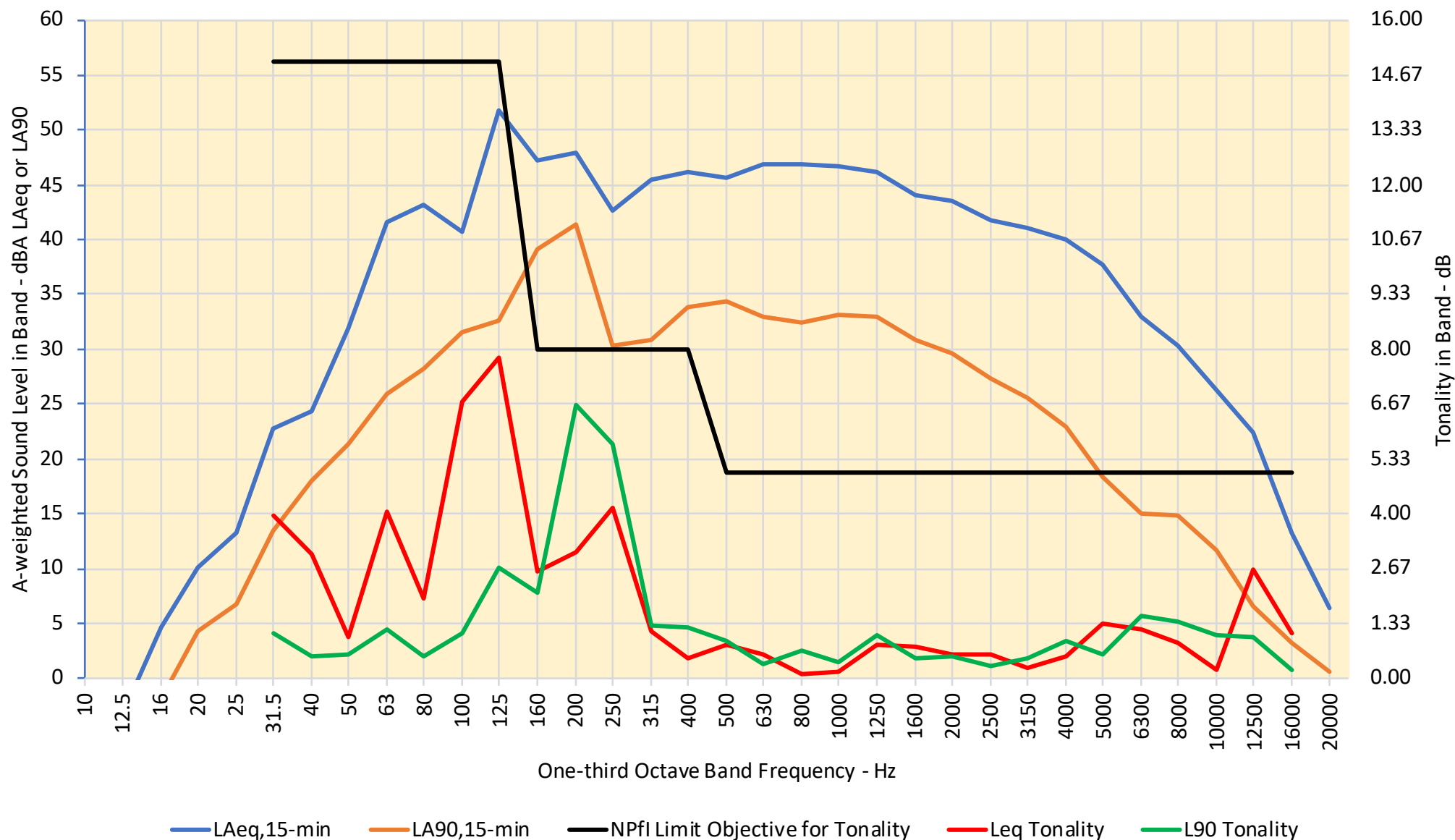


Figure A1: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Attended Monitoring One-third Octave Band Spectra and Tonality during CBP Operation on 1 & 14 December 2023: 4 Melbourne St 9:16am 1 December 2023

Boral Cement Berrima - CBP Verification Assessment December 2023: Adelaide St 1 December 2023
9:36am File 2539 One Third Octave Band Spectra and Tonality

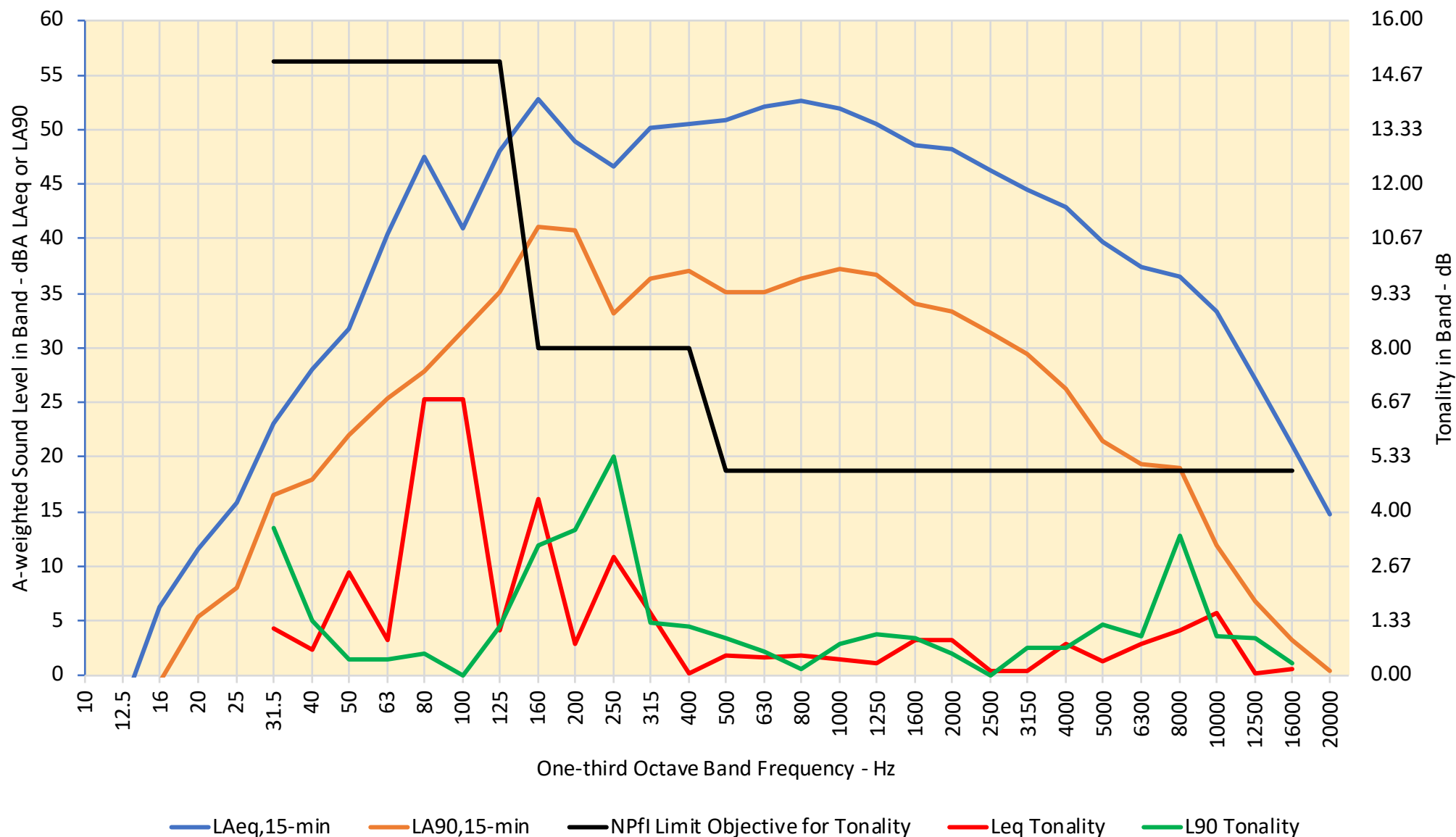


Figure A2: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Attended Monitoring One-third Octave Band Spectra and Tonality during CBP Operation on 1 and 14 December 2023: Adelaide St 9:36am 1 December 2023

Boral Cement Berrima - CBP Verification Assessment December 2023: 12 Brisbane St 1 December 2023
10:30am File 2542 One Third Octave Band Spectra and Tonality

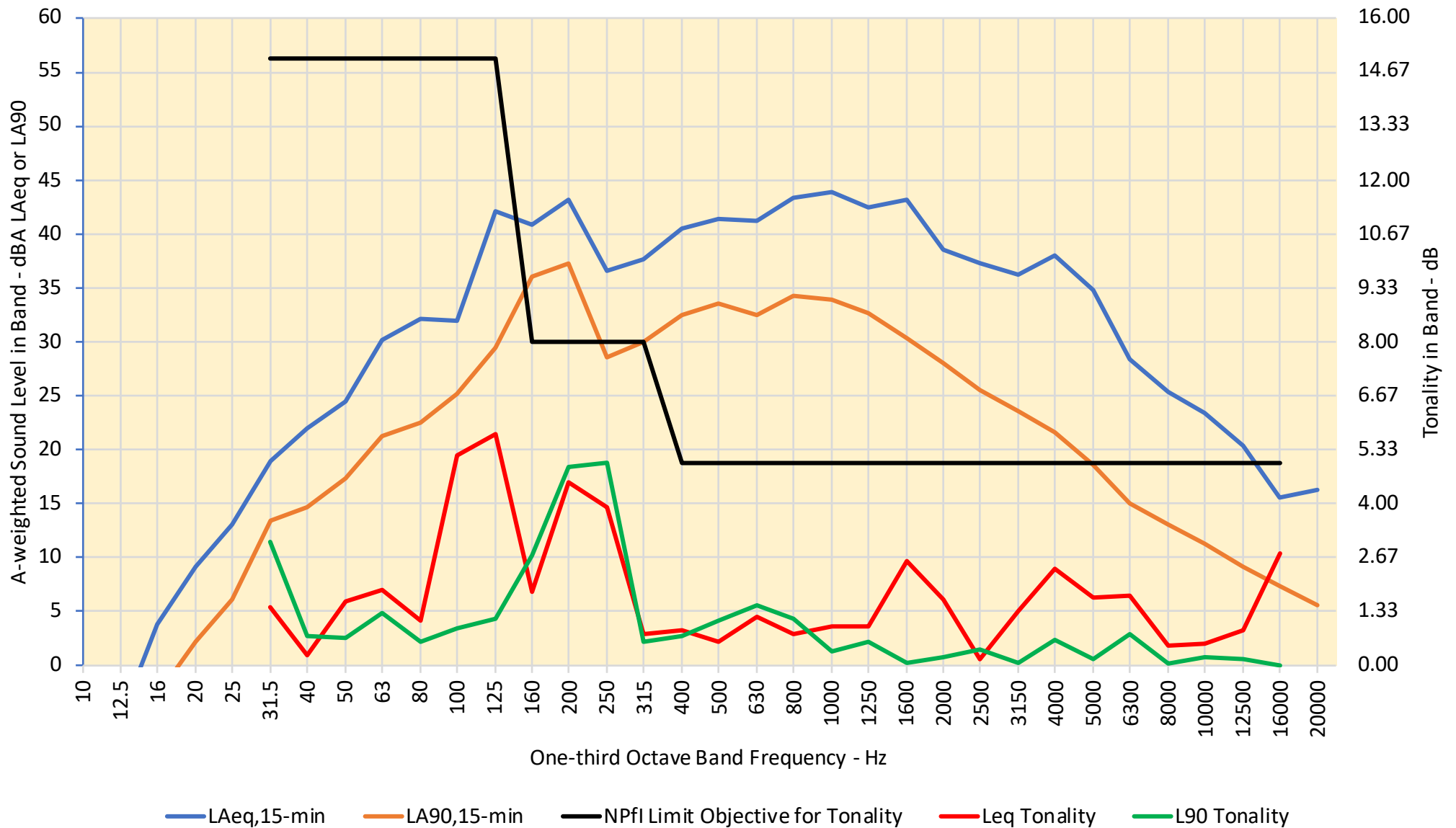


Figure A3: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Attended Monitoring One-third Octave Band Spectra and Tonality during CBP Operation on 1 & 14 December 2023:12 Brisbane St 10:30am 1 December 2023

Boral Cement Berrima - CBP Verification Assessment December 2023: North Fence 1 December 2023
2:15pm File 2540 One Third Octave Band Spectra and Tonality

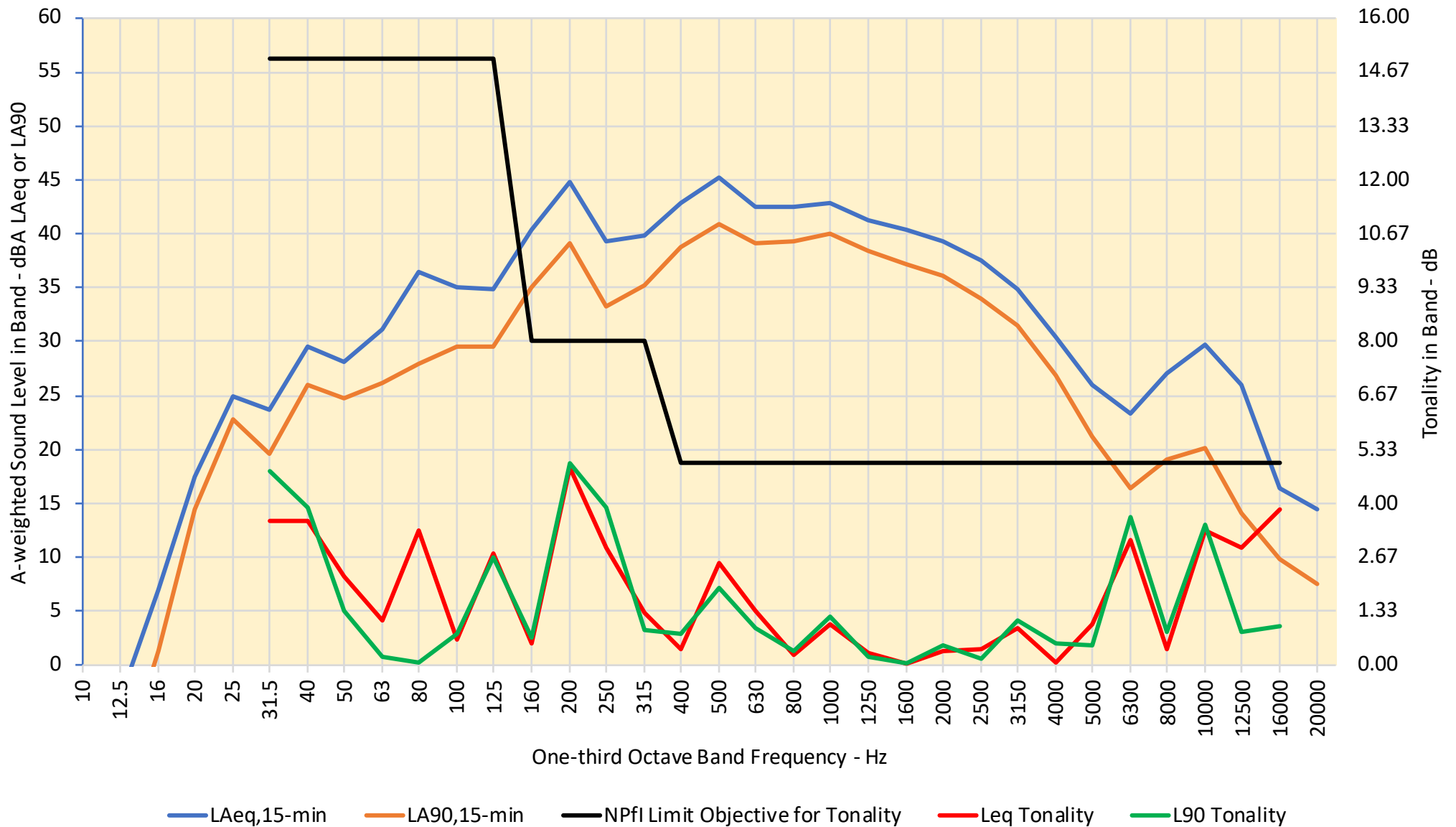


Figure A4: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Attended Monitoring One-third Octave Band Spectra and Tonality during CBP Operation on 1 and 14 December 2023: North Fence 2:15pm 1 December 2023

Boral Cement Berrima - CBP Verification Assessment December 2023: Location 20 1 December 2023
2:43pm File 2540 One Third Octave Band Spectra and Tonality

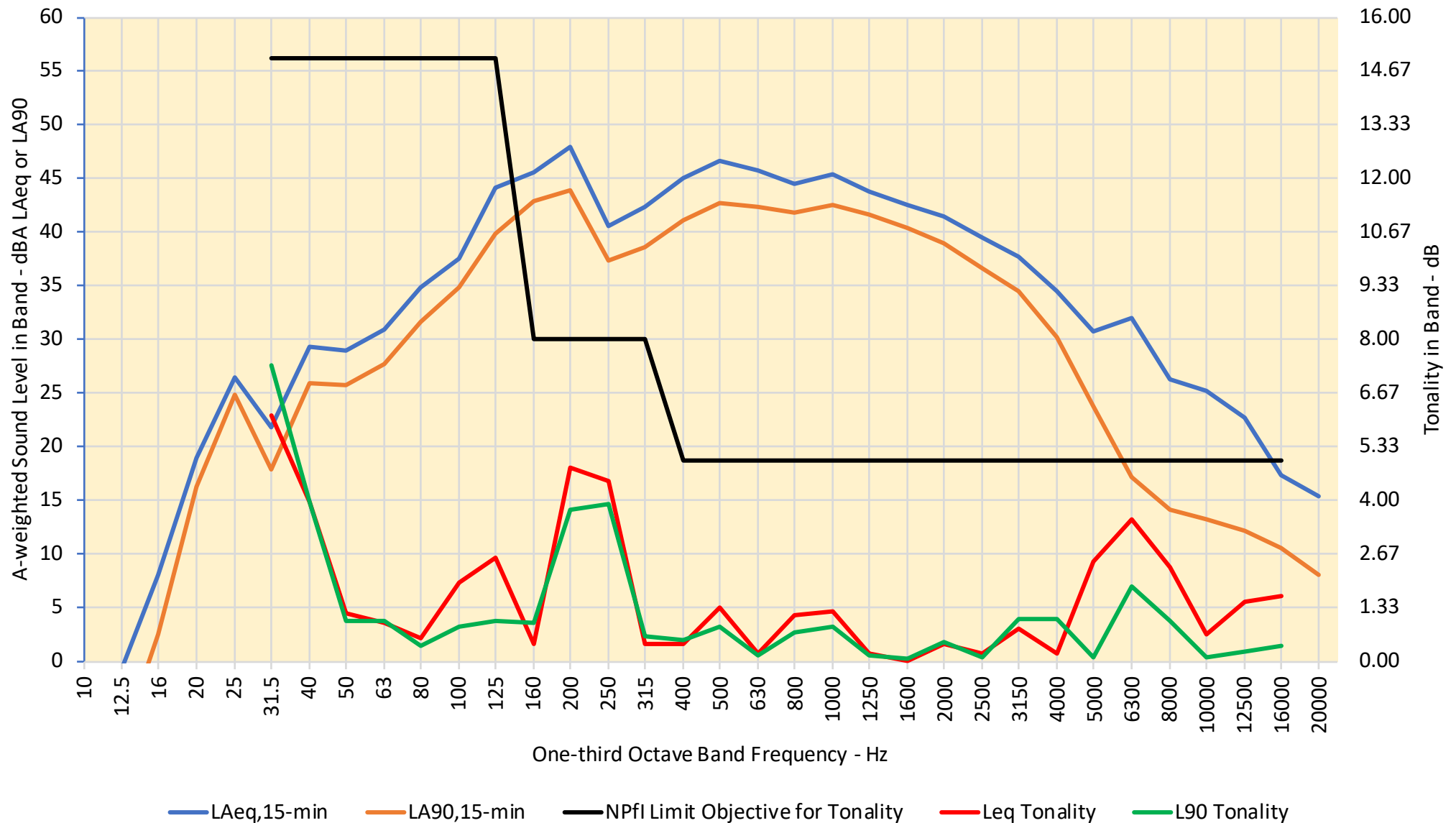


Figure A5: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Attended Monitoring One-third Octave Band Spectra and Tonality during CBP Operation on 1 and 14 December 2023: Location 20 2:43pm 1 December 2023

Boral Cement Berrima - CBP Verification Assessment December 2023: 4 Melbourne St 14 December 2023
9:16am File 2535 One Third Octave Band Spectra and Tonality

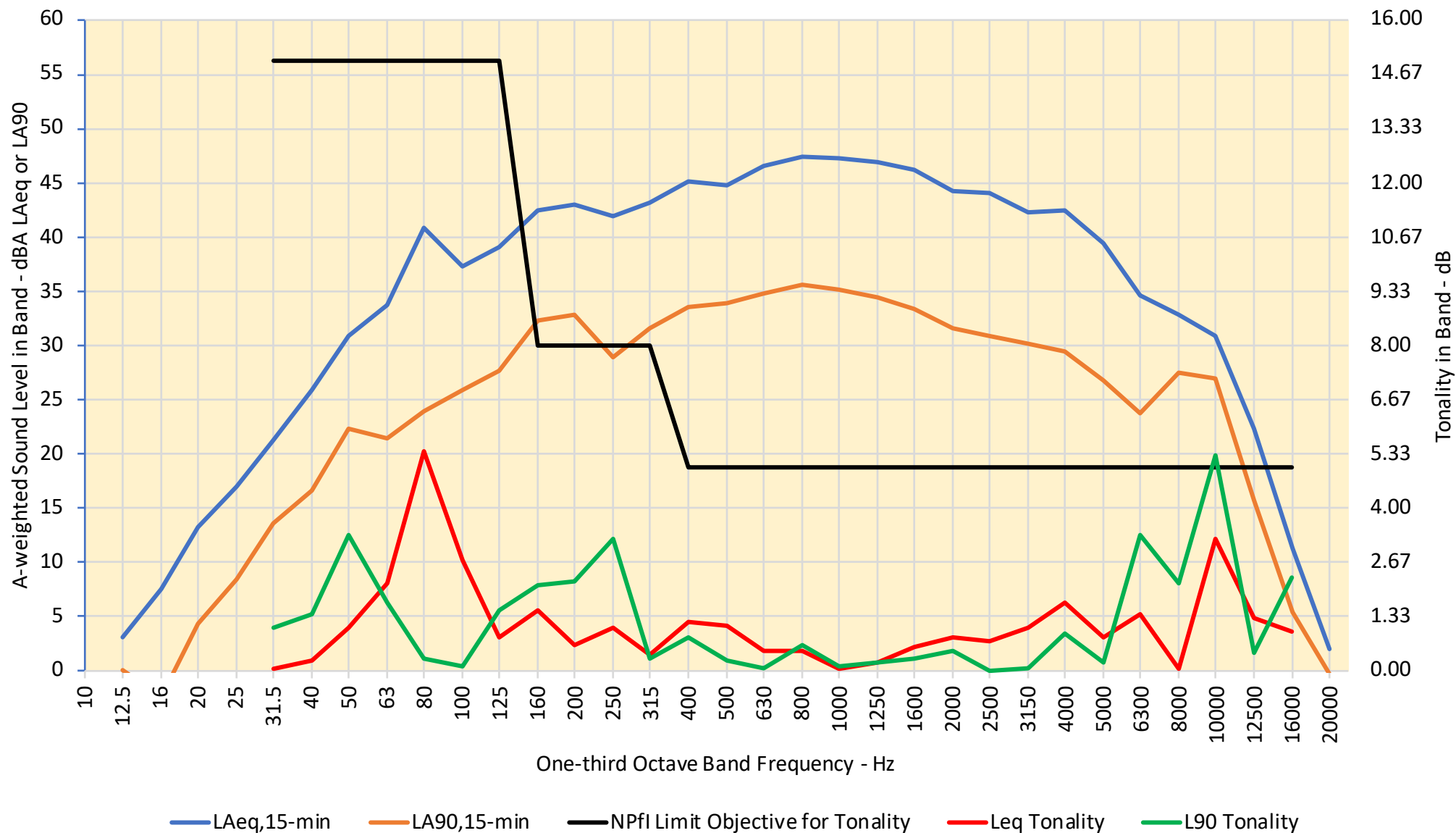


Figure A6: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Attended Monitoring One-third Octave Band Spectra and Tonality during CBP Operation on 1 & 14 December 2023:4 Melbourne St 9:16am 14 December 2023

Boral Cement Berrima - CBP Verification Assessment December 2023: Adelaide St 14 December 2023
4:47pm File 2537 One Third Octave Band Spectra and Tonality

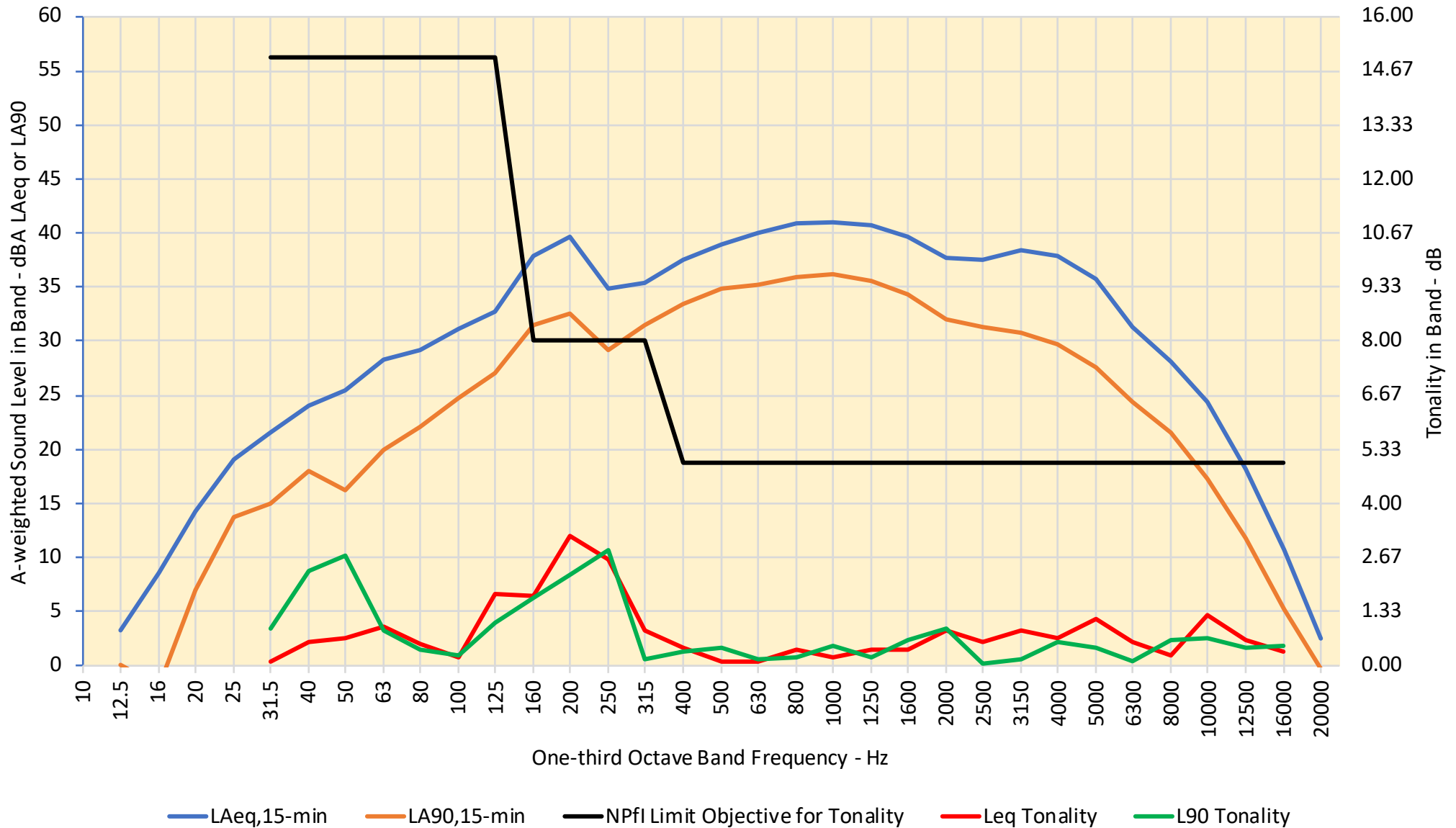


Figure A7: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Attended Monitoring One-third Octave Band Spectra and Tonality during CBP Operation on 1 and 14 December 2023: Adelaide St 4:47pm 14 December 2023

Boral Cement Berrima - CBP Verification Assessment December 2023: 12 Brisbane St 14 December 2023
5:10pm File 2536 One Third Octave Band Spectra and Tonality

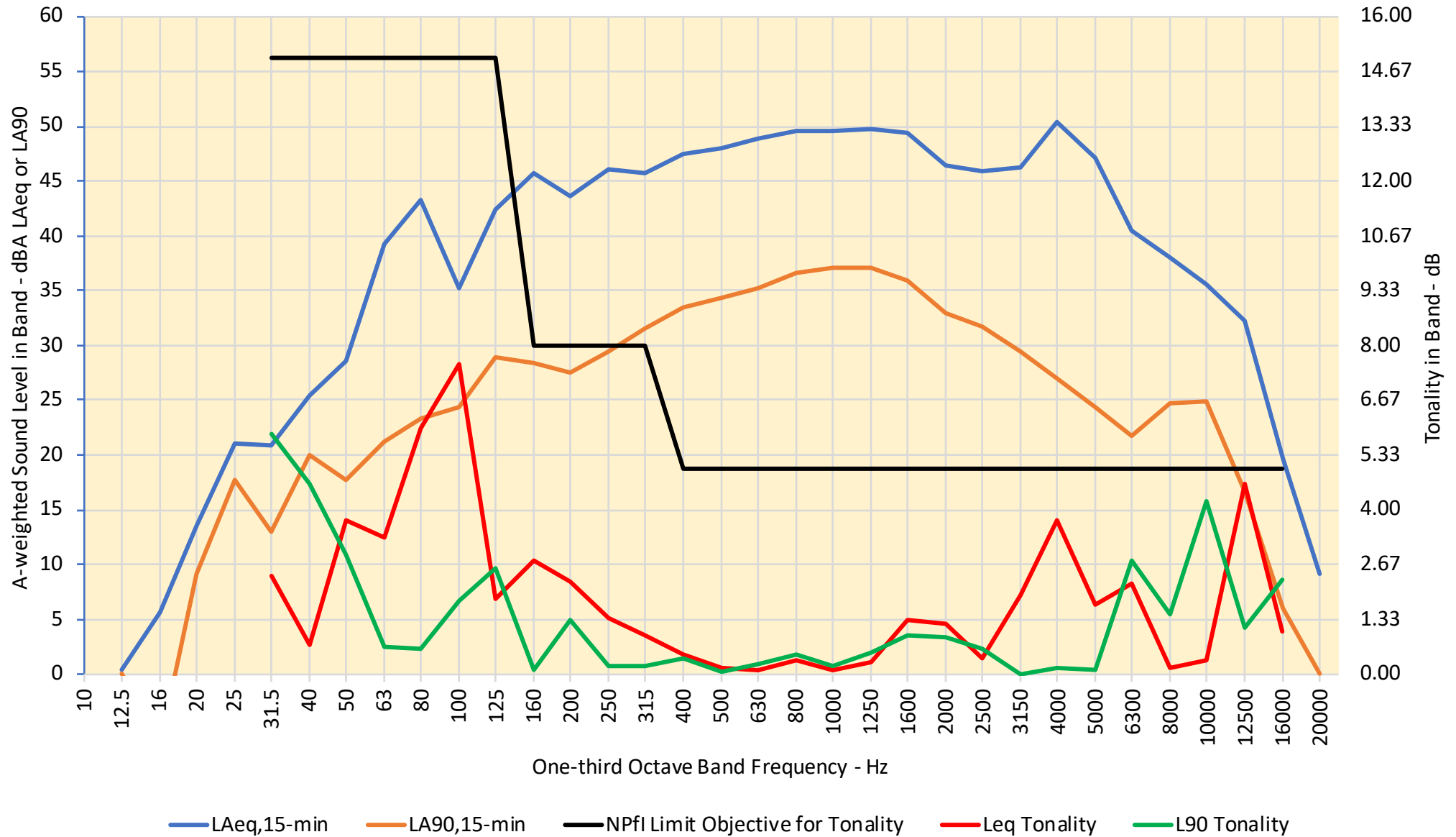


Figure A8: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Attended Monitoring One-third Octave Band Spectra and Tonality during CBP Operation on 1 & 14 December 2023:12 Brisbane St 5:10pm 14 December 2023

Boral Cement Berrima - CBP Verification Assessment December 2023: North Fence 14 December 2023
3:31pm File 2544 One Third Octave Band Spectra and Tonality

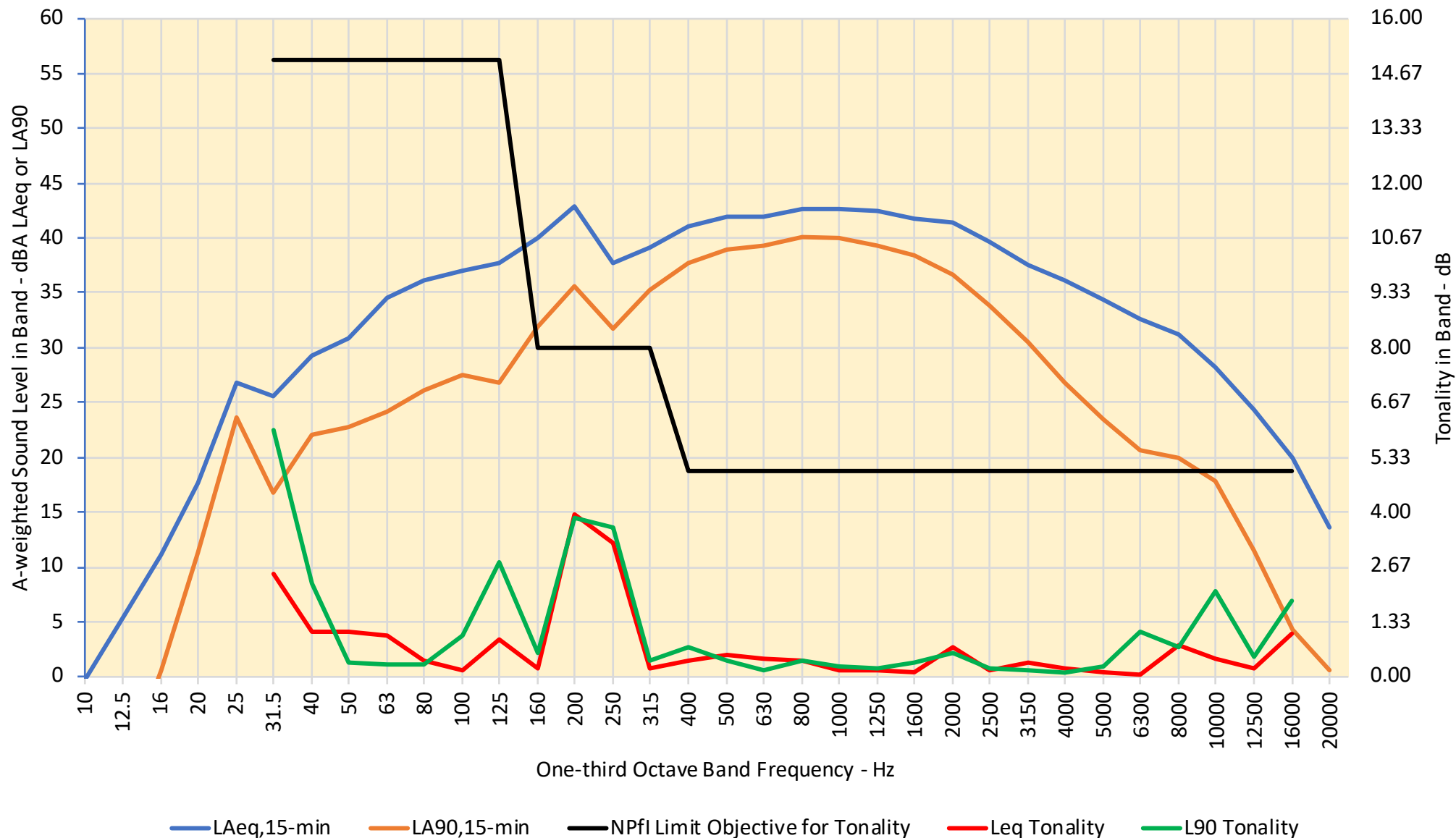


Figure A9: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Attended Monitoring One-third Octave Band Spectra and Tonality during CBP Operation on 1 and 14 December 2023: North Fence 3:31pm 14 December 2023

Boral Cement Berrima - CBP Verification Assessment December 2023: Location 20 14 December 2023
4:11pm File 2545 One Third Octave Band Spectra and Tonality

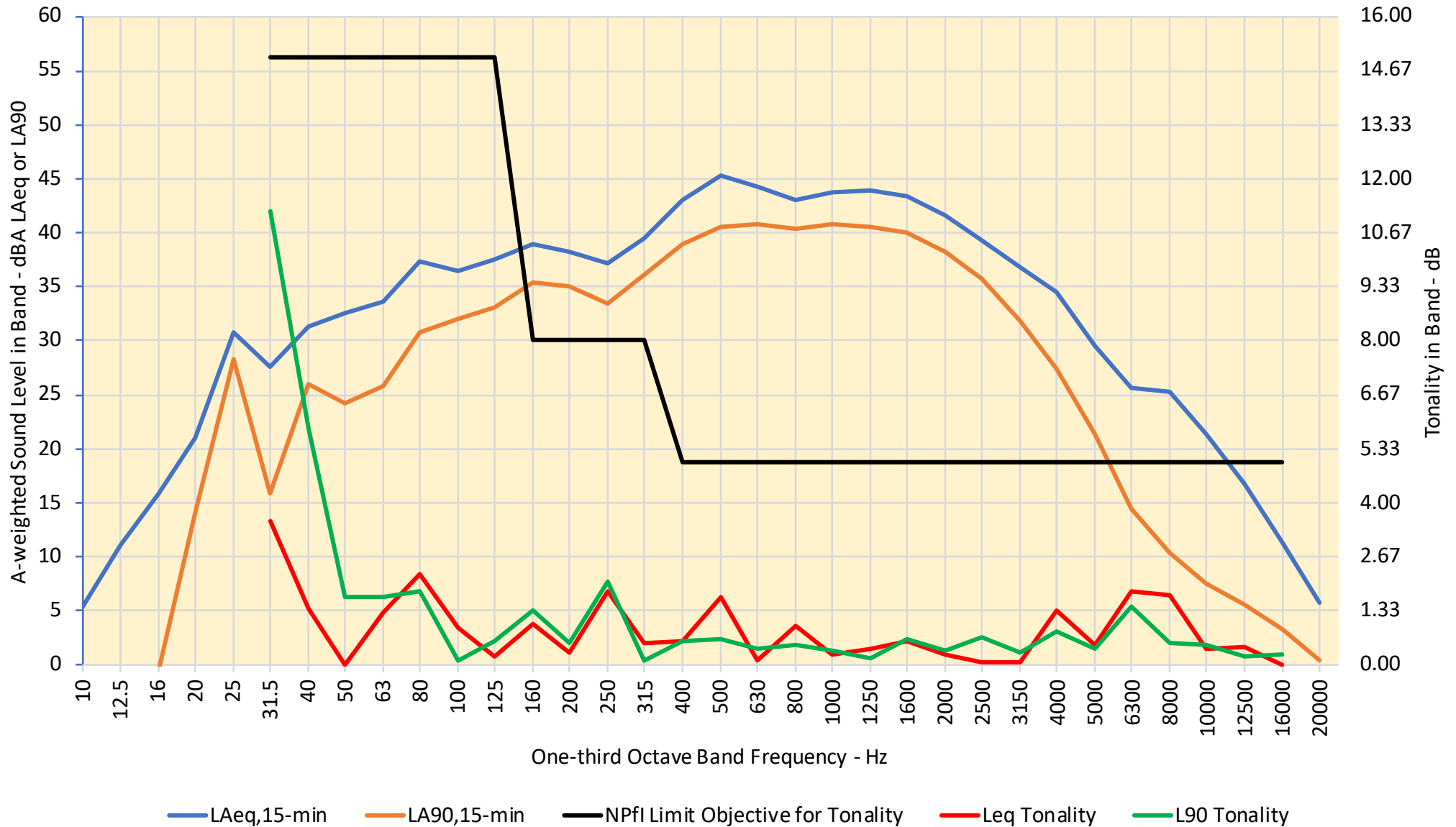


Figure A10: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Attended Monitoring One-third Octave Band Spectra and Tonality during CBP Operation on 1 and 14 December 2023: Location 20 4:11pm 14 December 2023

Boral Cement Berrima - CBP Verification Assessment December 2023: Melbourne St Logger 1 December 2023 9:00pm One Third Octave Band Spectra and Tonality

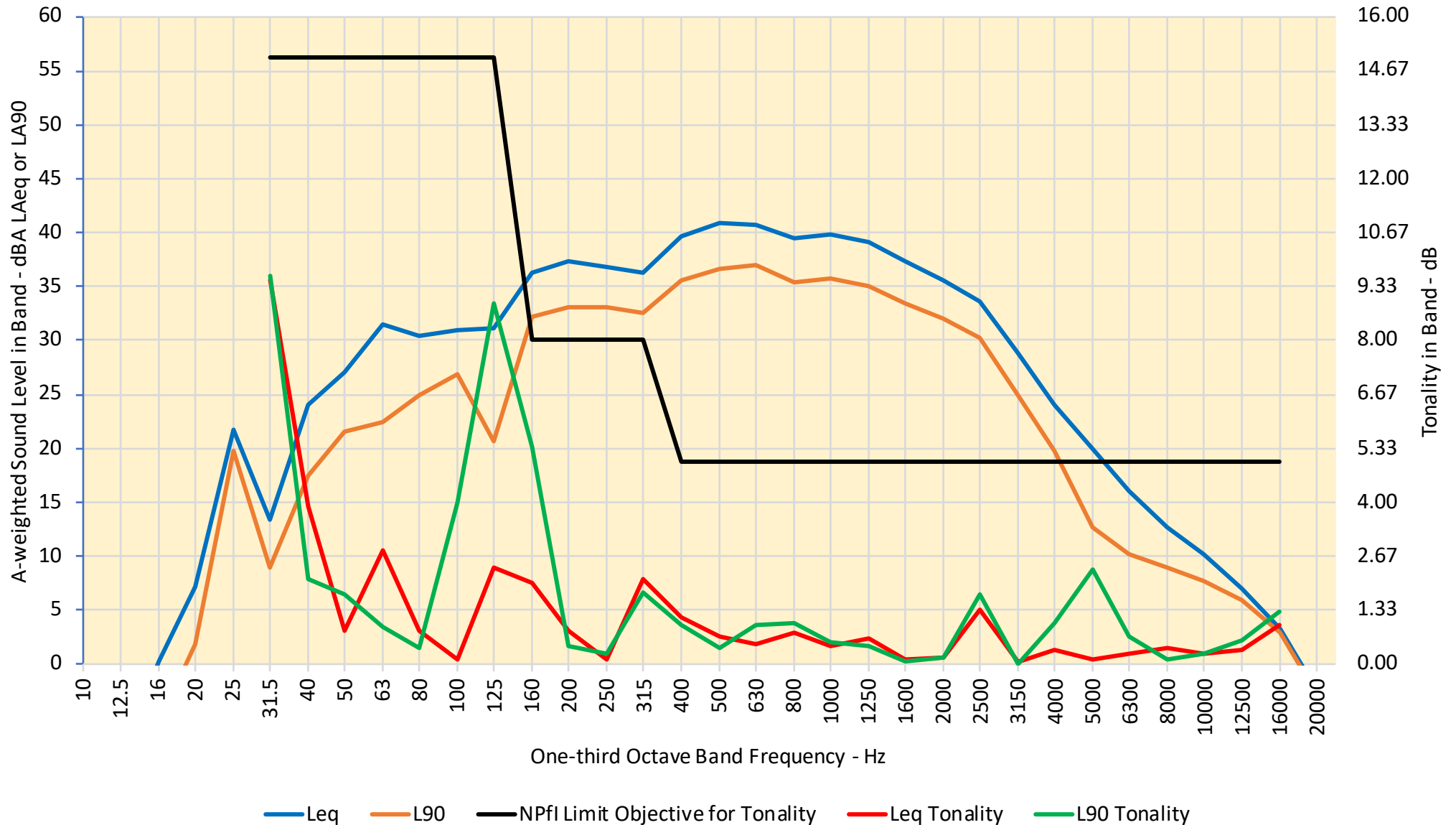


Figure A11: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Listening Monitoring One-third Octave Band Spectra and Tonality during CBP Operation 4 Melbourne St Logger: 9:00pm 1 December 2023

Boral Cement Berrima - CBP Verification Assessment December 2023: Melbourne St Logger 2 December 2023
202311:30pm One Third Octave Band Spectra and Tonality

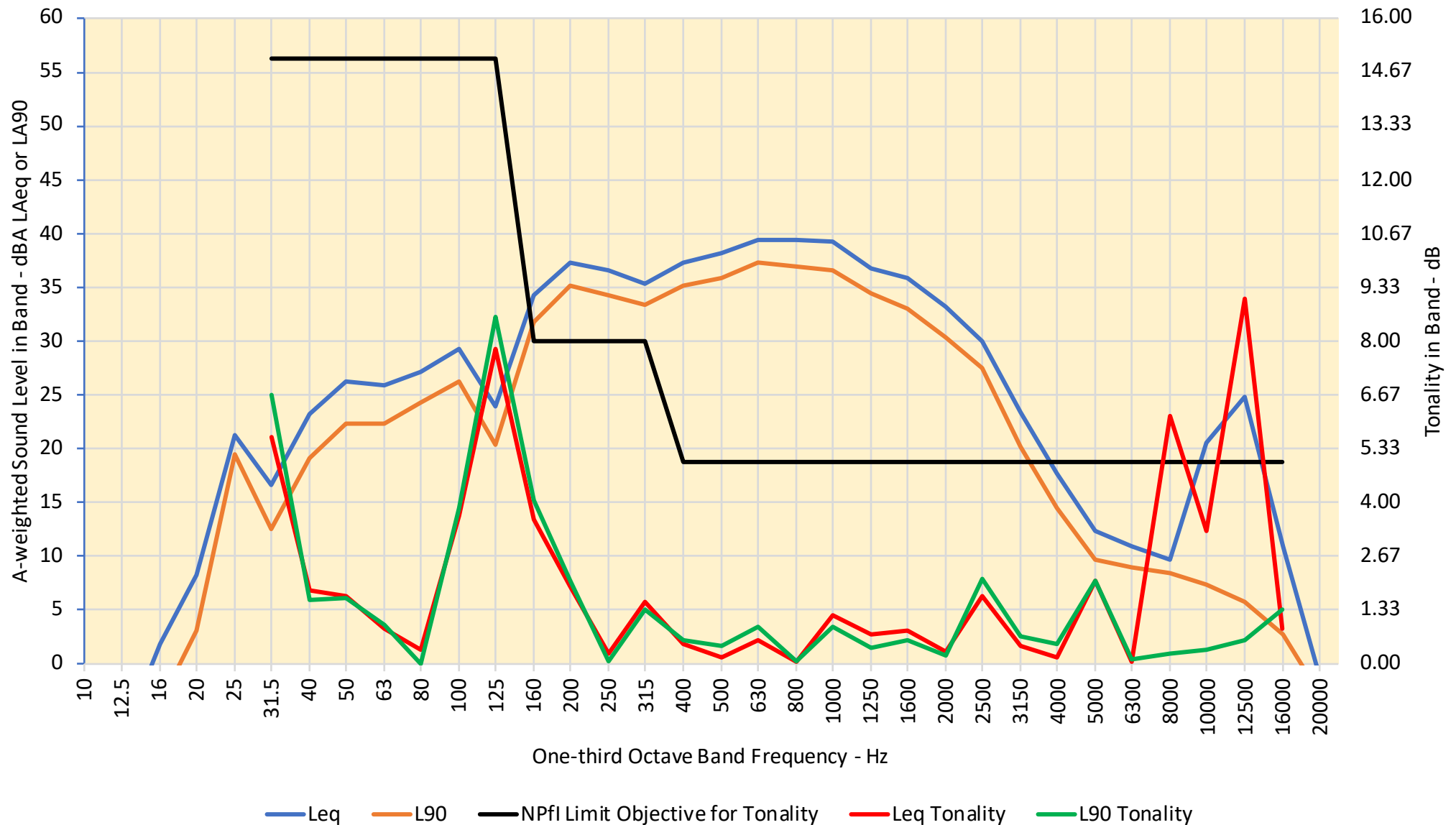


Figure A12: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Listening Monitoring One-third Octave Band Spectra and Tonality during CBP Operation 4 Melbourne St Logger: 11:30pm 2 December 2023

Boral Cement Berrima - CBP Verification Assessment December 2023: Melbourne St Logger 4 December 2023 8:30pm One Third Octave Band Spectra and Tonality

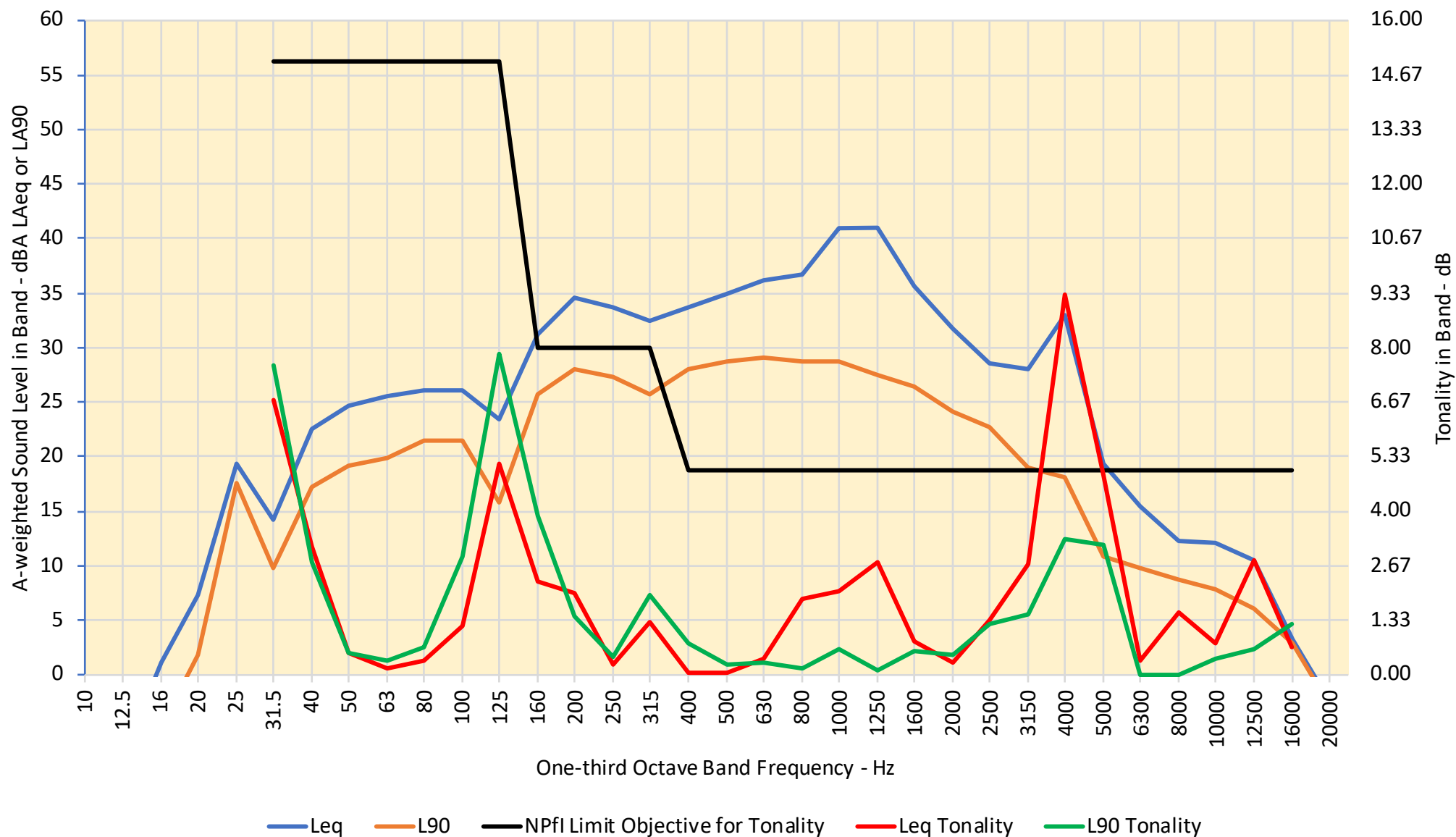


Figure A13: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Listening Monitoring One-third Octave Band Spectra and Tonality during CBP Operation 4 Melbourne St Logger: 8:30pm 4 December 2023

Boral Cement Berrima - CBP Verification Assessment December 2023: Melbourne St Logger 5 December 2023 11:00pm One Third Octave Band Spectra and Tonality - CBP and CM6 Off

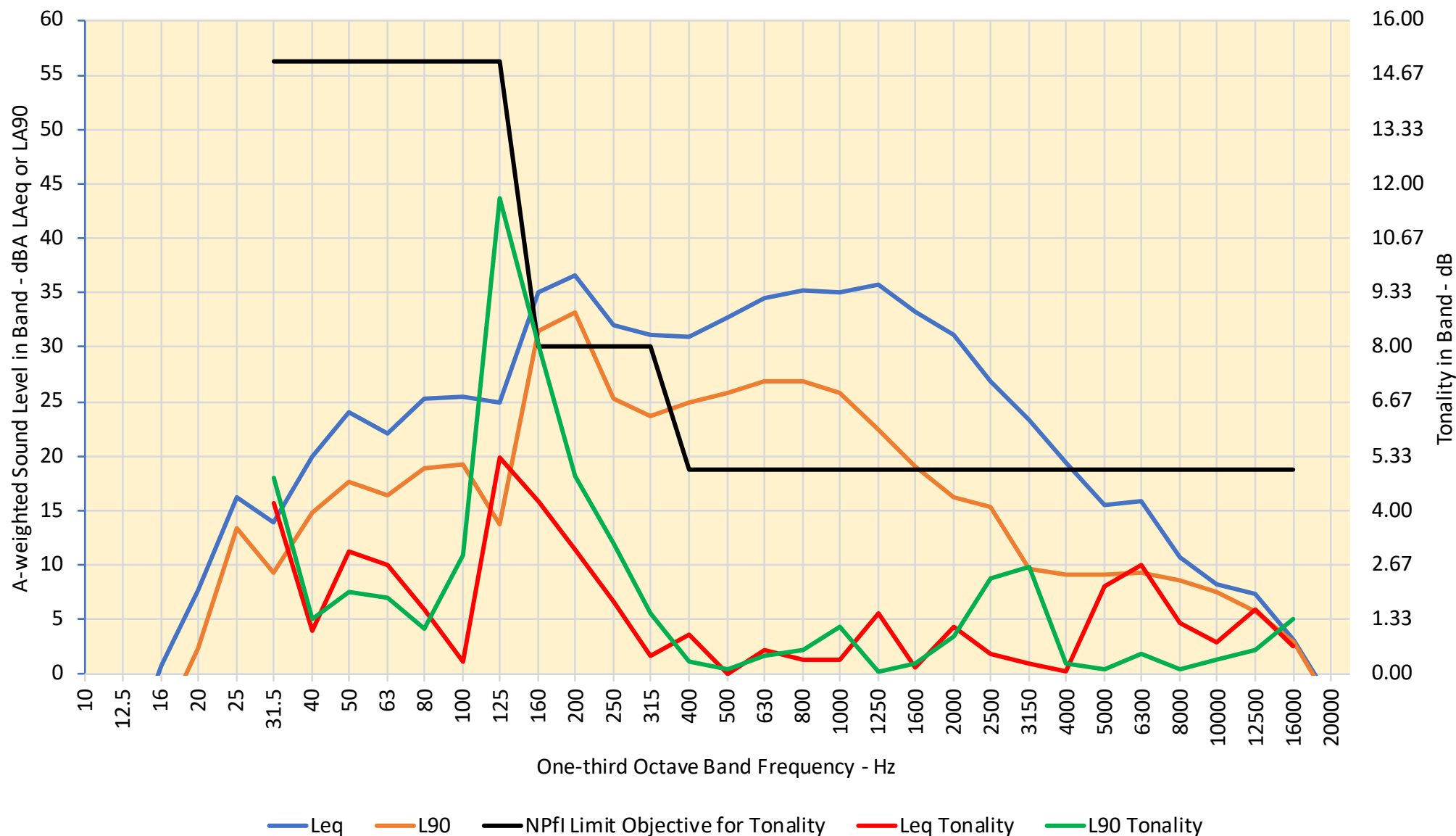


Figure A14: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Listening Monitoring One-third Octave Band Spectra and Tonality during CBP Operation 4 Melbourne St Logger: 11:00pm 5 December 2023

Boral Cement Berrima - CBP Verification Assessment December 2023: Melbourne St Logger 9 December 2023 11:30am One Third Octave Band Spectra and Tonality

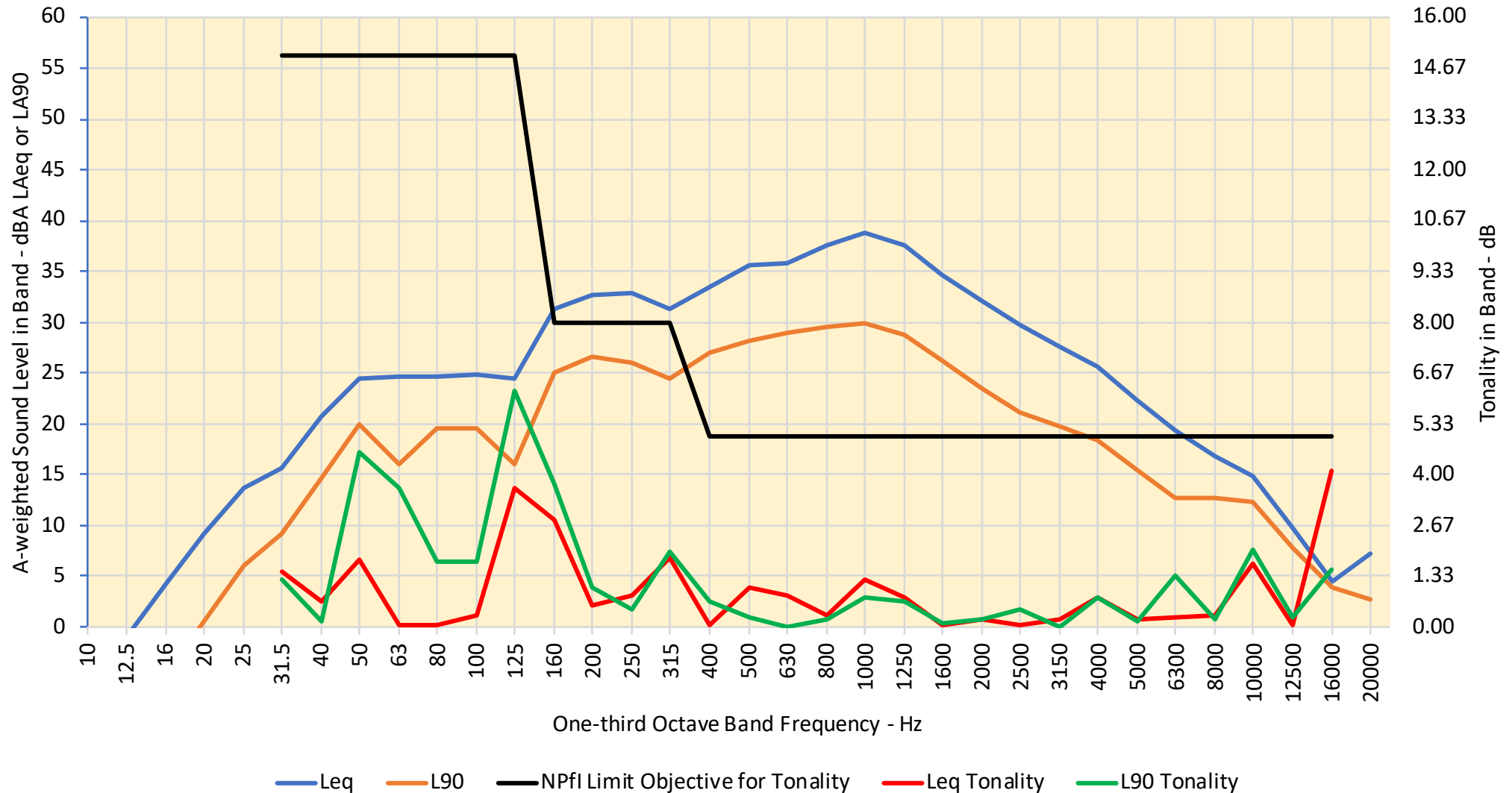


Figure A15: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Listening Monitoring One-third Octave Band Spectra and Tonality during CBP Operation 4 Melbourne St Logger: 11:30am 9 December 2023

Boral Cement Berrima - CBP Verification Assessment December 2023: Melbourne St Logger 9 December 2023 11:30pm One Third Octave Band Spectra and Tonality

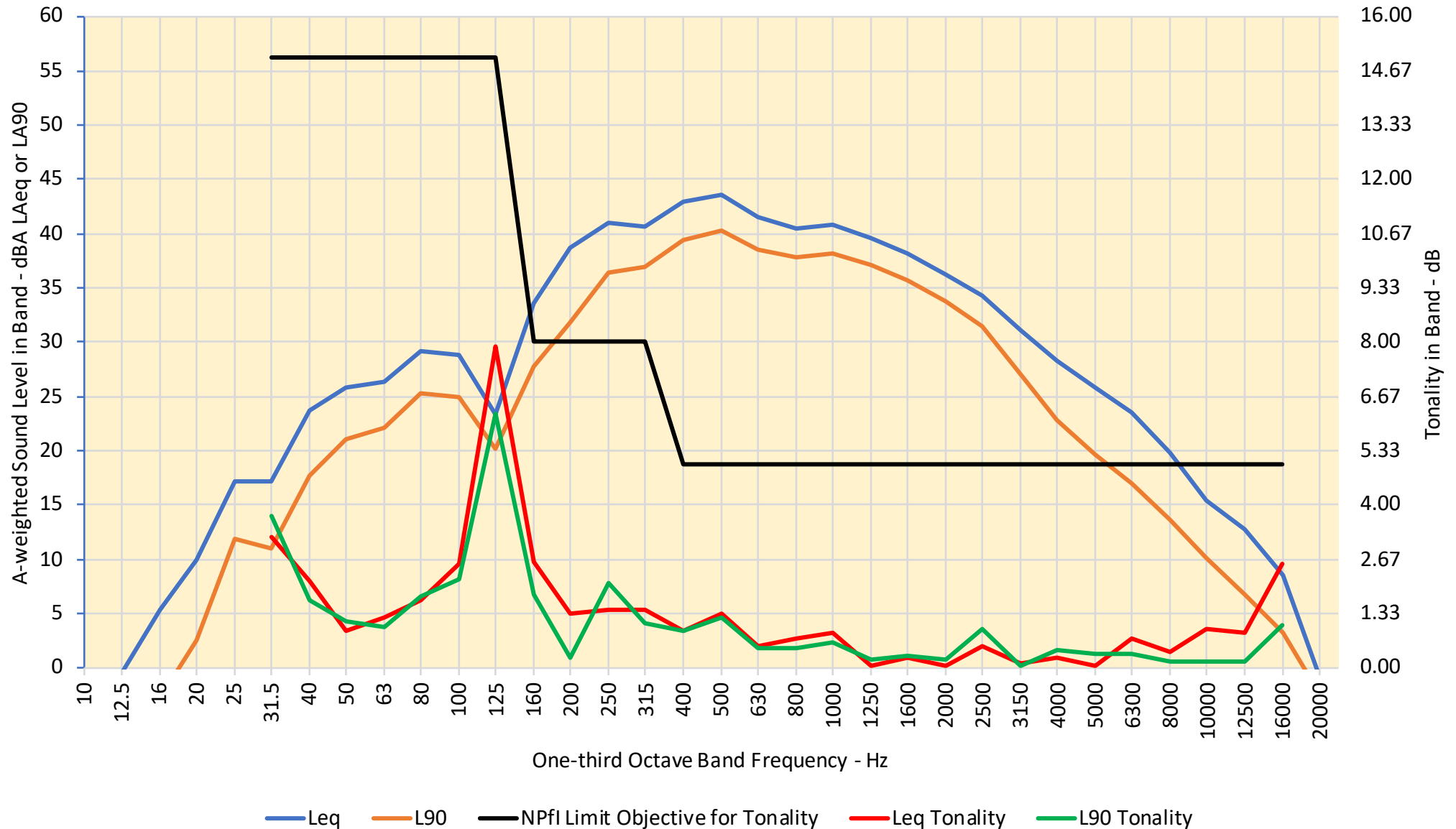


Figure A16: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Listening Monitoring One-third Octave Band Spectra and Tonality during CBP Operation 4 Melbourne St Logger: 11:30pm 9 December 2023

Boral Cement Berrima - CBP Verification Assessment December 2023: Melbourne St Logger 9 December 2023 11:45pm One Third Octave Band Spectra and Tonality

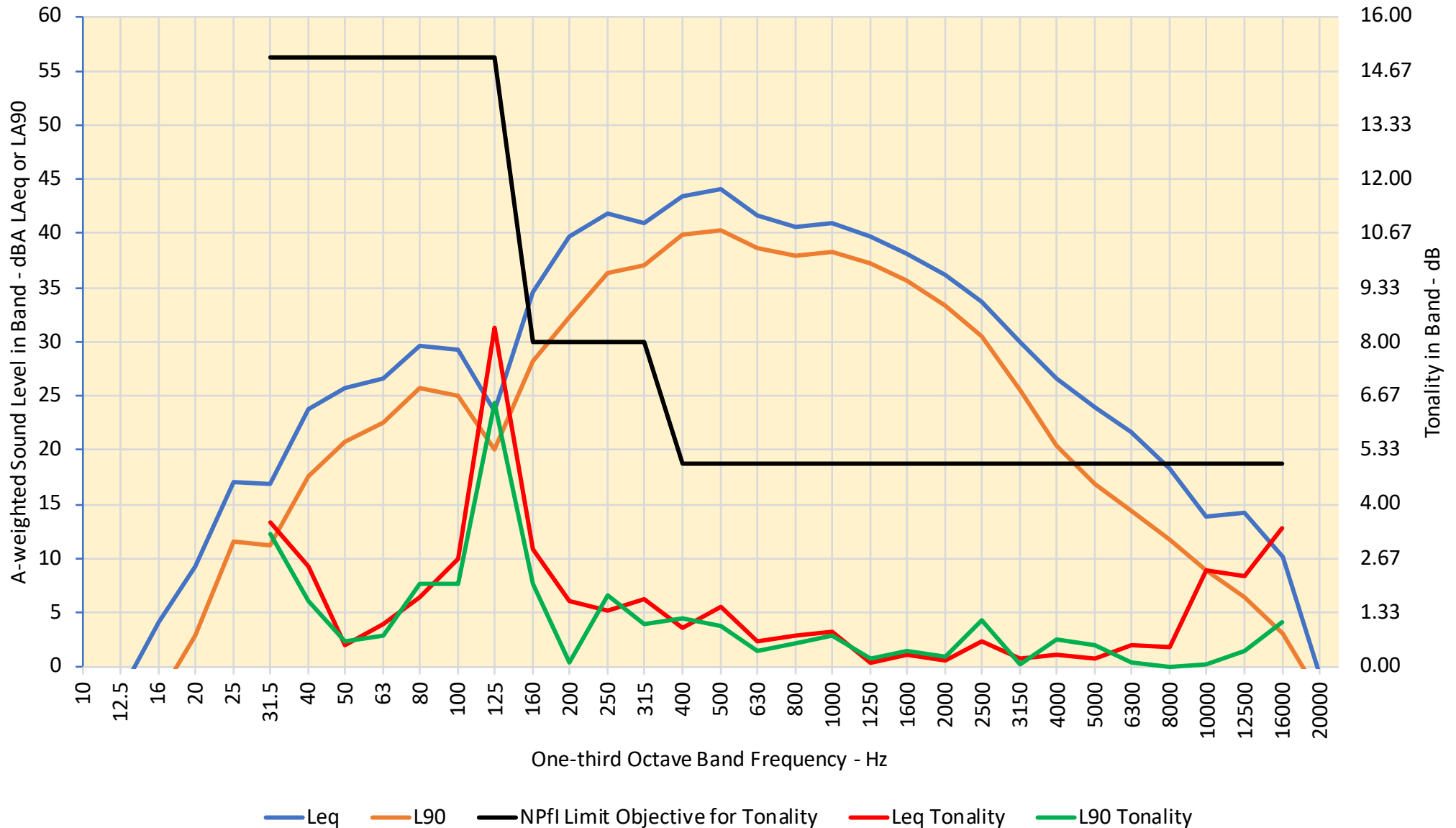


Figure A17: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Listening Monitoring One-third Octave Band Spectra and Tonality during CBP Operation 4 Melbourne St Logger: 11:45pm 9 December 2023

3 Low-frequency assessment

3.1 Measured sound levels

The AENAR 2023 provided an assessment of low-frequency noise at receiver locations. This was provided in section 4.2.3 of that report. This is reproduced in part below.

The NSW Noise Policy for Industry has a section for assessment of low frequency noise from industry as received at residential locations. This is based on an initial screening test of the C-weighted minus A-weighted $L_{eq,15-min}$ ($L_{Ceq}-L_{Aeq}$) period sound level exceeding more than 15 dB. If the screening value is exceeded a one-third octave band frequency analyses is then made of un-weighted (or Z-weighted L_z) sound levels in the low-frequency bands from 10 Hz to 160 Hz, and compared to a specific criterion or threshold value.

If the threshold levels are exceeded by up to and including 5 dB in evening or night-time, a positive adjustment of 2 dB is added to the measured sound level. If the exceedance in any band is more than 5 dB, a positive adjustment of 2 dB is added to the measured sound level for daytime and 5 dB added for evening and night-time.

The initial screening test on attended measurements indicated that exceedances were reported on seven occasions measured at 4 Melbourne Street, and one occasion for 12 Brisbane Street (from the daytime monitoring).

From the measurements in the residential receiver locations, the low frequency assessment was made on the $L_{Aeq,15-min}$ as per policy. Exceedance of the screening test were identified on six occasions out of 10 measurements for $L_{eq,15-min}$ at 4 Melbourne St, none of the two measurements from Adelaide St and one from two from 12 Brisbane St. For the North Fence location exceedance of the screening test occurred on five of the seven of the measurements analysed. The North Fence was used primarily to further the Low Frequency Noise propagation (LFN) investigation for the residential receiver locations, as discussed below.

Referring to Table 4.6 (from the AENAR 2023 shown below), six of the eight evening and night-time measurements at 4 Melbourne St. had exceedances in the 40 to 160Hz bands by 4 to 10 dB, especially in the 50 Hz band where the highest measurement had a 10 dB exceedance. This could be explained to an electrical item that was running locally. It is interesting to note that the night of 9 December 10:45pm and 11:30 pm the screening test passed at the North Fence, and the 50 Hz band for the 10:45pm measurement was higher at Melbourne St than North Fence. The North Fence data shown in Table 4.6 highlights for the same time periods, there was a higher level of low frequency content at 4 Melbourne St. than measured at North Fence by up to 4 dB for the 160Hz band case and 3 dB in the 50Hz case; consequently, it can be considered that there is potentially another local LFN source other than Berrima Cement Works present in the community which causes this effect. This is similar to the findings of the 2022 assessment. It should be noted that a new petrol station has been built on the corner of Taylor Ave and Argyle St since 2020, which is about 230m from 4 Melbourne St – this establishment may have equipment working at various times throughout the night that may explain the higher LFN observed at 4 Melbourne St than the North Fence.

12 Brisbane St location, which was measured at 4:47 pm on the 14 December, was the other residential receiver location which had an exceedance. Higher values than the criteria occurred in the 63 Hz and 80 Hz bands, which would reflect the traffic passing by; an

exceedance in the 50 Hz band indicates a potential electrical energy source. An exceedance in the 160hz band was also observed, however this value is lower than the other residential locations, indicating that road traffic was likely to be the main contributor to cause this location failing the initial screening test.

From the assessment of the 2023 AENAR survey of Low Frequency Noise, it is considered that the main source of low-frequency noise events exceeding the policy objectives for the L_{Aeq} measurements is from either the new petrol station on the corner of Taylor Ave and Argyle St, road traffic noise associated with passing trucks, either from within New Berrima or on distant roads and the freeway or a combination of both. The plant can be a source at times but this is not considered to be significant.

For this CBP Operational Verification Assessment Addendum Report, measurements of one-third octave band sound levels in the low-frequency range at receiver locations during CBP operations are provided in Table A3 and graphed in Figures A18 to A24 of this report. These indicate that for most of the attended monitoring periods presented, the low frequency sound level objectives are exceeded at frequencies above 40 Hz. As discussed above, the AENAR made the assessment that the Cement Plant was not the main source of the low frequency noise exceedances.

Table 4.6 Low Frequency Noise Analysis for Attended Monitoring : Community Locations

dB(Z)							Frequency (Hz) Criteria																Frequency (values)															
							10	13	16	20	25	32	40	50	63	80	100	125	160	10	13	16	20	25	32	40	50	63	80	100	125	160						
							92	89	86	77	69	61	54	50	50	48	48	46	44																			
							One third Octave Band Spectra																One third Octave Band Spectra Criteria values															
Description	Condition	MeasureDate	Time	L _{Aeq}	L _{ceq}	initial screening (diff >15?)	Fail screening test for LNF 1= To Proceed next stage	10 Hz	12_5 Hz	16 Hz	20 Hz	25 Hz	31_5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	10 Hz	12_5 Hz	16 Hz	20 Hz	25 Hz	31_5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz					
4 Melbourne St	Day	14/12/23	9:16 am	57	69	12.3	0	70	66	64	64	62	61	60	61	60	63	56	55	56	0	0	0	0	0	0	0	0	0	0	0	0	0					
Adelaide St 20m to Taylor level with front of house	Day	14/12/23	5:10 pm	60	71	11.2	0	70	64	62	64	66	60	60	59	66	66	54	59	59	0	0	0	0	0	0	0	0	0	0	0	0	0					
12 Brisbane St.	Day	14/12/23	4:47 pm	51	67	15.8	1	70	67	65	65	64	61	59	56	55	52	50	49	51	-22	-22	-21	-12	-5	0	5	6	5	3.7	2.3	2.9	7					
4 Melbourne St	Day	1/12/23	9:16 am	59	73	14.6	0	59	60	61	61	58	62	59	62	68	66	60	68	61	0	0	0	0	0	0	0	0	0	0	0	0	0					
Adelaide St 20m to Taylor level with front of house	Day	1/12/23	9:36 am	62	75	12.3	0	60	61	63	62	61	63	63	62	67	70	60	64	66	0	0	0	0	0	0	0	0	0	0	0	0	0					
12 Brisbane St.	Day	1/12/23	10:30 am	53	66	12.4	0	61	58	60	60	58	58	57	55	56	55	51	58	54	0	0	0	0	0	0	0	0	0	0	0	0	0					
4 Melbourne St	Evening	1/12/23	9:00 pm	50	66	16.6	1	53	55	57	58	66	53	59	57	58	53	50	47	50	-39	-34	-29	-19	-3	-8	5	7	8	5	2	1.3	6					
4 Melbourne St	Night	2/12/23	11:30 pm	48	66	17.2	1	56	56	59	59	66	56	58	57	52	50	48	40	48	-36	-33	-27	-18	-3	-5	3.9	7	2.1	1.7	0	-6	3.6					
4 Melbourne St	Evening	4/12/23	8:30 pm	48	64	16.5	1	55	56	58	58	64	54	57	55	52	49	45	40	45	-37	-33	-28	-19	-5	-7	3.2	5	1.7	0.6	-3	-6	0.7					
4 Melbourne St	Night	5/12/23	11:00 pm	45	62	16.9	1	54	55	58	58	61	53	55	54	48	48	45	41	48	-38	-34	-29	-19	-8	-8	0.6	4.2	-2	0	-4	-5	4.4					
4 Melbourne St	Day	9/12/23	11:30 am	46	62	16.0	1	63	62	61	60	58	55	55	55	51	47	44	41	45	-29	-27	-25	-17	-11	-6	1.3	5	0.8	-1	-4	-5	0.8					
4 Melbourne St	Night	9/12/23	10:45 pm	52	67	15.2	1	69	68	66	65	64	59	59	60	55	52	47	41	46	-23	-22	-20	-12	-5	-2	5	10	5	3.7	-1	-6	2.1					
4 Melbourne St	Night	9/12/23	11:30 pm	52	65	13.4	0	63	63	62	60	62	57	58	56	53	52	48	39	47	0	0	0	0	0	0	0	0	0	0	0	0	0					
4 Melbourne St	Night	9/12/23	11:45 pm	52	65	13.4	0		61	61	60	62	56	58	56	53	52	48	40	48	0	0	0	0	0	0	0	0	0	0	0	0	0					
North Fence	Evening	1/12/23	9:00 pm	54	71	17.4	1	60	59	64	67	74	60	62	57	54	52	50	44	48	-32	-30	-22	-10	5	-1	8	7	4	4	2	-2	4					
North Fence	Night	2/12/23	11:30 pm	52	70	18.3	1	61	60	64	66	72	60	64	57	52	52	49	44	47	-31	-29	-22	-11	3	-1	10	7	2	4	1	-2	3					
North Fence	Evening	4/12/23	8:30 pm	49	69	19.8	1	60	59	63	66	72	59	60	55	53	53	49	44	45	-33	-30	-23	-11	3	-2	6	5	3	5	1	-2	1					
North Fence	Night	5/12/23	11:00 pm	45	68	22.5	1	60	59	62	65	70	61	59	55	51	50	47	40	44	-32	-30	-24	-13	1	0	5	5	1	2	-2	-6	0					
North Fence	Day	9/12/23	11:30 am	48	64	16.7	1	60	60	61	62	59	59	58	56	55	52	49	47	45	-32	-30	-25	-15	-10	-2	4	6	5	4	1	1	1					
North Fence	Night	9/12/23	10:45 pm	58	72	13.9	0	66	65	67	68	72	63	60	57	55	55	53	49	57	0	0	0	0	0	0	0	0	0	0	0	0	0					
North Fence	Night	9/12/23	11:30 pm	56	71	14.4	0	65	63	66	66	72	63	62	56	53	53	52	48	53	0	0	0	0	0	0	0	0	0	0	0	0	0					

Community Locations that have Issues with Low freq Noise : +ve

Community locations which exceeds 5 dB

Melbourne St higher than North Fence NOT expected for Cement Works emissions

Table A3: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Attended Monitoring Low-frequency Spectra during CBP Operation on 1 and 14 December 2023

Detailed Monitoring Low-frequency Noise during 2023 Operations on 2 and 14 December 2023																
Receiver	Date and Time	File	Type	Z-weighted Sound Level - dBZ in One-third Octave Band Band												
One-third Octave Band Frequency - Hz				10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
	NPfl Low-frequency Limit Zwt'd			92	89	86	77	69	61	54	50	50	48	48	46	44
4 Melbourne St	1/12/23 9:16	2538	Leq	59	60	61	61	58	62	59	62	68	66	60	68	61
Adelaide St 20m t	1/12/23 9:36	2539	Leq	60	61	63	62	61	63	63	62	67	70	60	64	66
North Fence	1/12/23 14:15	2540	Leq	61	60	64	68	70	63	64	58	57	59	54	51	54
Loc 20	1/12/23 14:43	2541	Leq	64	63	65	70	71	61	64	59	57	57	57	60	59
12 Brisbane St.	1/12/23 10:30	2542	Leq	61	58	60	60	58	58	57	55	56	55	51	58	54
4 Melbourne St	14/12/23 9:16	2535	Leq	70	66	64	64	62	61	60	61	60	63	56	55	56
12 Brisbane St.	14/12/23 17:10	2536	Leq	70	64	62	64	66	60	60	59	66	66	54	59	59
Adelaide St 20m t	14/12/23 16:47	2537	Leq	70	67	65	65	64	61	59	56	55	52	50	49	51
North Fence	14/12/23 15:31	2544	Leq	70	69	68	68	72	65	64	61	61	59	56	54	54
Loc 20	14/12/23 16:11	2545	Leq	76	74	73	72	75	67	66	63	60	60	56	54	52
4 Melbourne St	1/12/23 9:16	2538	L90	51	51	55	55	52	53	53	52	52	51	51	49	53
Adelaide St 20m t	1/12/23 9:36	2539	L90	53	53	56	56	53	56	53	52	52	50	51	51	55
North Fence	1/12/23 14:15	2540	L90	54	53	58	65	67	59	61	55	52	50	49	46	48
Loc 20	1/12/23 14:43	2541	L90	56	56	59	67	70	57	60	56	54	54	54	56	56
12 Brisbane St.	1/12/23 10:30	2542	L90	52	51	54	53	51	53	49	47	47	45	44	46	49
4 Melbourne St	14/12/23 9:16	2535	L90	70	63	54	55	53	53	51	53	48	47	45	44	46
12 Brisbane St.	14/12/23 17:10	2536	L90	70	63	50	60	62	52	55	48	47	46	44	45	42
Adelaide St 20m t	14/12/23 16:47	2537	L90	70	63	55	57	59	54	53	47	46	45	44	43	45
North Fence	14/12/23 15:31	2544	L90	54	55	57	62	68	56	57	53	50	49	47	43	45
Loc 20	14/12/23 16:11	2545	L90	53	56	56	65	73	55	61	54	52	53	51	49	49
4 Melbourne St Logger Listening Monitoring 15-minute Z-weighted results																
1/12/23	9:00:00 PM		LZeq	53	55	57	58	66	53	59	57	58	53	50	47	50
			LZ90	41	49	51	52	65	48	52	52	49	48	46	37	46
2/12/23	11:30:00 PM		LZeq	56	56	59	59	66	56	58	57	52	50	48	40	48
			LZ90	45	50	53	54	64	52	54	53	49	47	45	37	45
4/12/23	8:30:00 PM		LZeq	55	56	58	58	64	54	57	55	52	49	45	40	45
			LZ90	44	49	52	52	62	49	52	49	46	44	41	32	39
5/12/23	11:00:00 PM		LZeq	54	55	58	58	61	53	55	54	48	48	45	41	48
			LZ90	43	48	52	53	58	49	49	48	43	41	38	30	45
9/12/23	11:30:00 AM		LZeq	63	62	61	60	58	55	55	55	51	47	44	41	45
			LZ90	42	51	52	51	51	49	49	50	42	42	39	32	39
9/12/23	11:30:00 PM		LZeq	64	63	62	60	62	57	58	56	53	52	48	39	47
	11:30:00 PM		LZ90	46	53	54	53	57	50	52	51	48	48	44	36	41
9/12/23	11:45:00 PM		LZeq	61	61	61	60	62	56	58	56	53	52	48	40	48
	11:45:00 PM		LZ90	46	53	54	53	56	51	52	51	49	48	44	36	42

NOTE: Red font in pink shaded cells indicate exceedance of band low-frequency limit, dependent upon frequency

Boral Cement Berrima - CBP Verification Assessment December 2023: Low-frequency One Third Octave Band Spectra and Limit 4 Melbourne St 1 and 14 December 2023

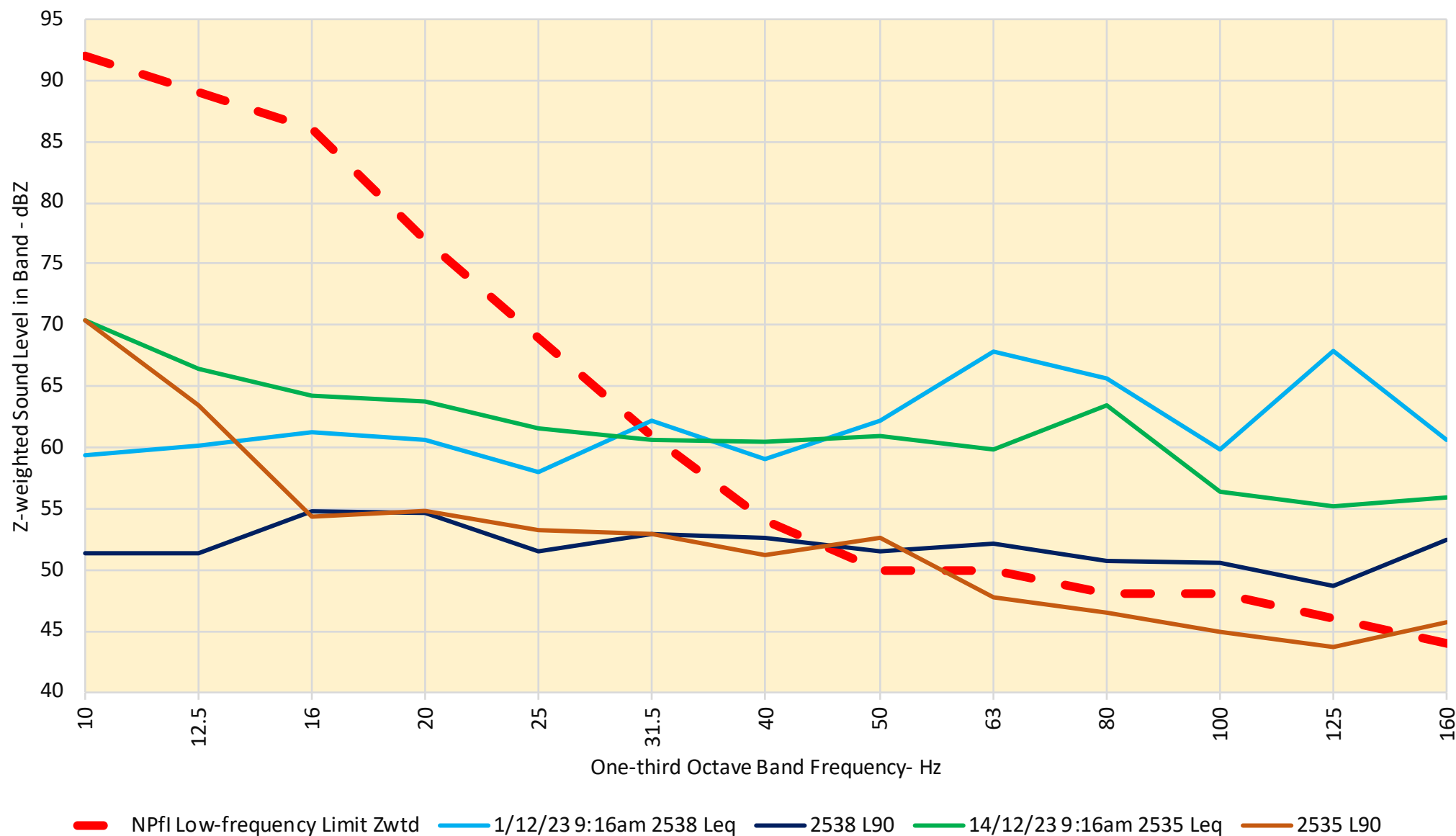


Figure A18: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Attended Monitoring One-third Octave Band Low-frequency Spectra during CBP Operation on 1 and 14 December 2023: 4 Melbourne St

Boral Cement Berrima - CBP Verification Assessment December 2023: Low-frequency One Third Octave
Band Spectra and Limit Adelaide St 1 and 14 December 2023

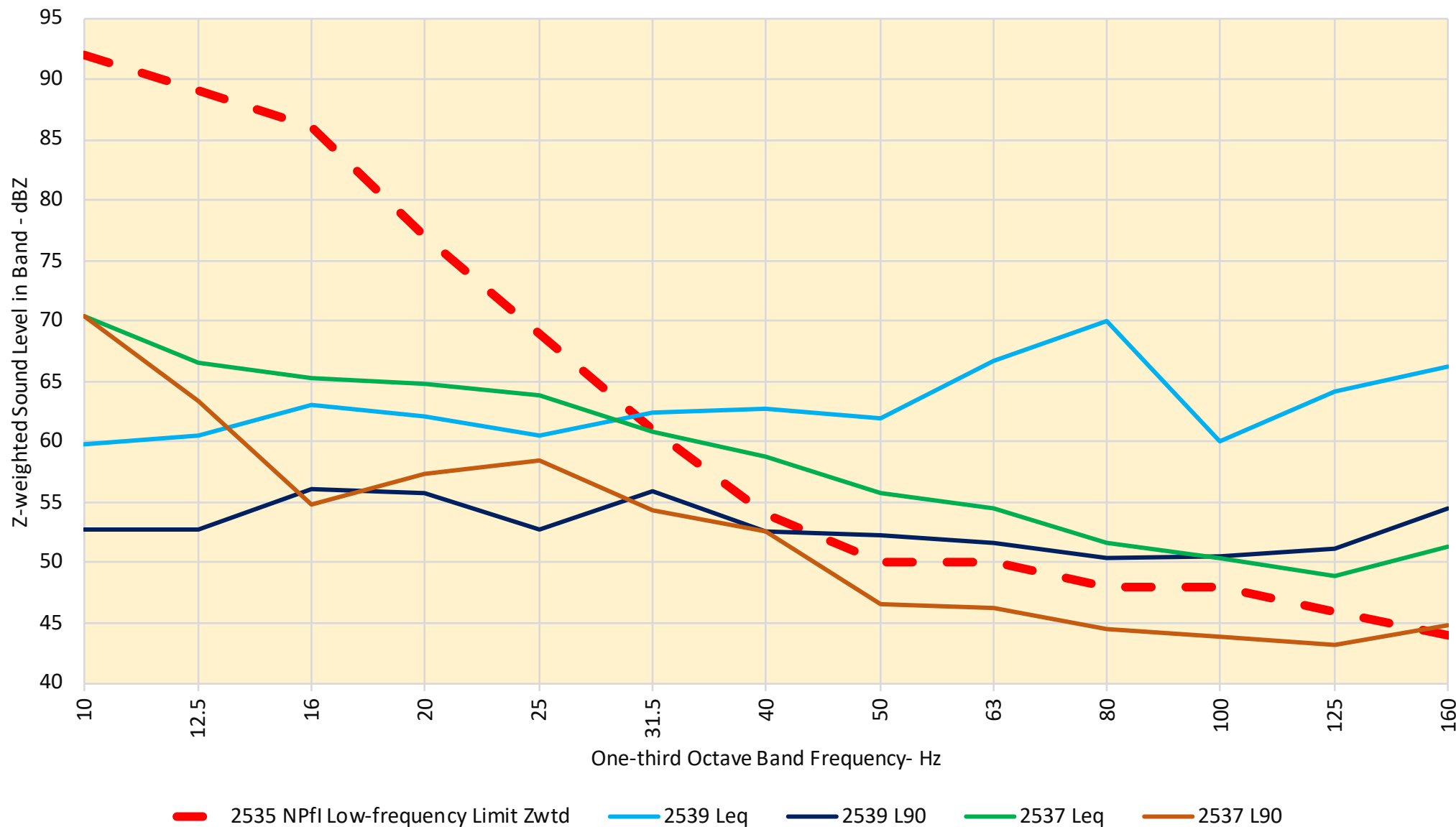


Figure A19: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Attended Monitoring One-third Octave Band Low-frequency Spectra during CBP Operation on 1 and 14 December 2023: Adelaide St

Boral Cement Berrima - CBP Verification Assessment December 2023: Low-frequency One Third Octave
Band Spectra and Limit 12 Brisbane St 1 and 14 December 2023

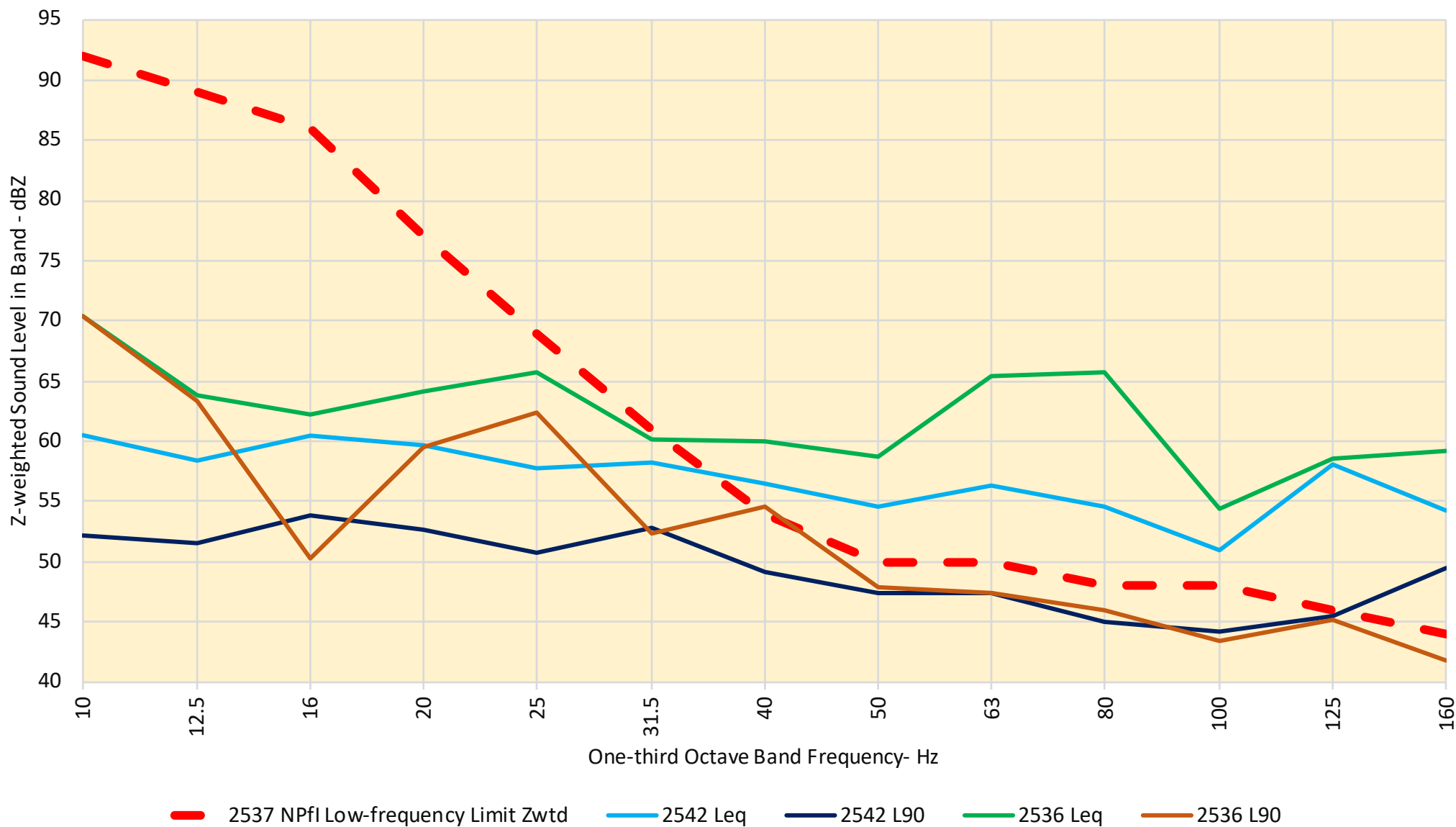


Figure A20: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Attended Monitoring One-third Octave Band Low-frequency Spectra during CBP Operation on 1 and 14 December 2023: 12 Brisbane St

Boral Cement Berrima - CBP Verification Assessment December 2023: Low-frequency One Third Octave
Band Spectra and Limit North Fence 1 and 14 December 2023

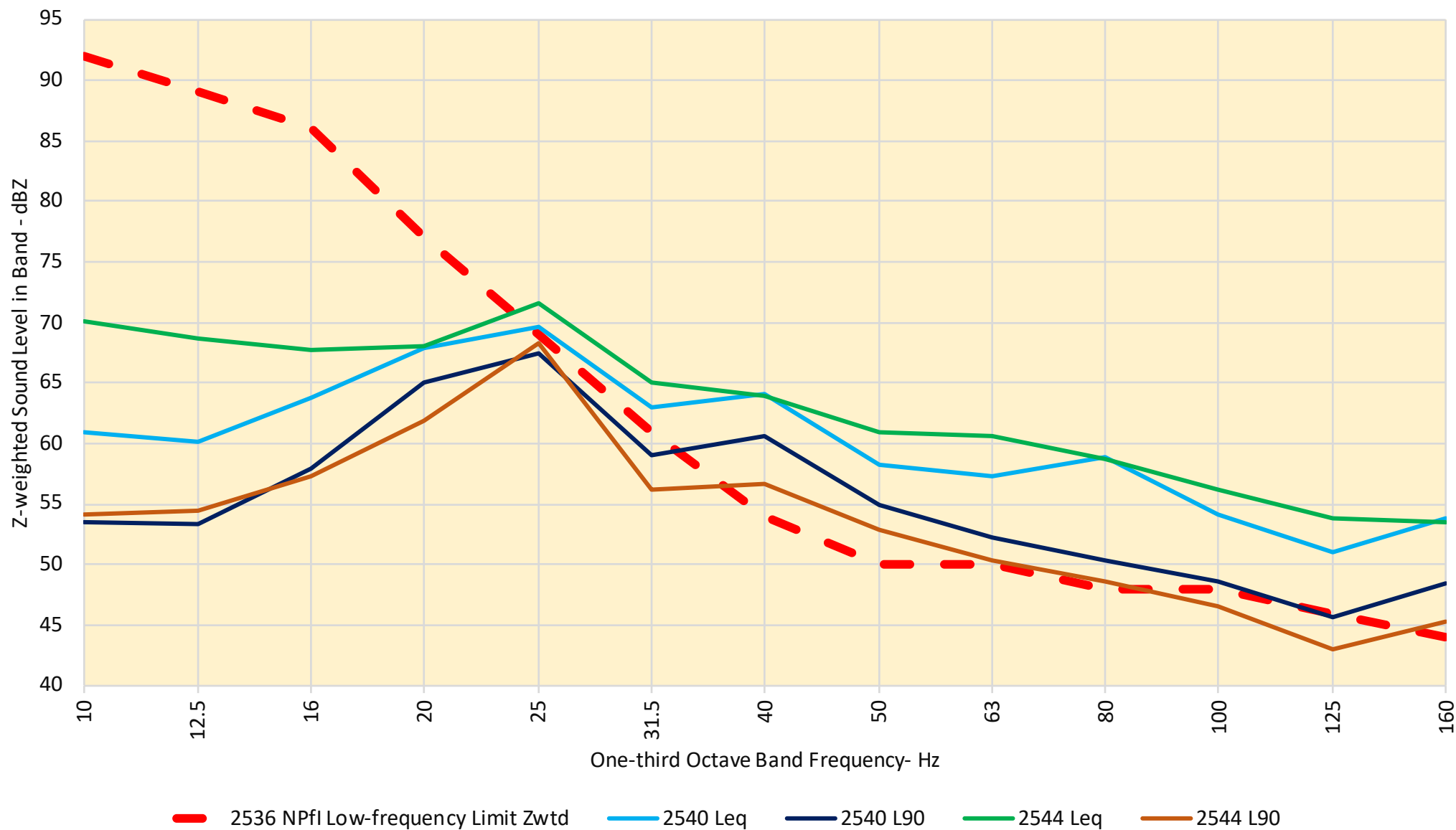


Figure A21: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Attended Monitoring One-third Octave Band Low-frequency Spectra during CBP Operation on 1 and 14 December 2023: North Fence

Boral Cement Berrima - CBP Verification Assessment December 2023: Low-frequency One Third Octave
Band Spectra and Limit Location 20 1 and 14 December 2023

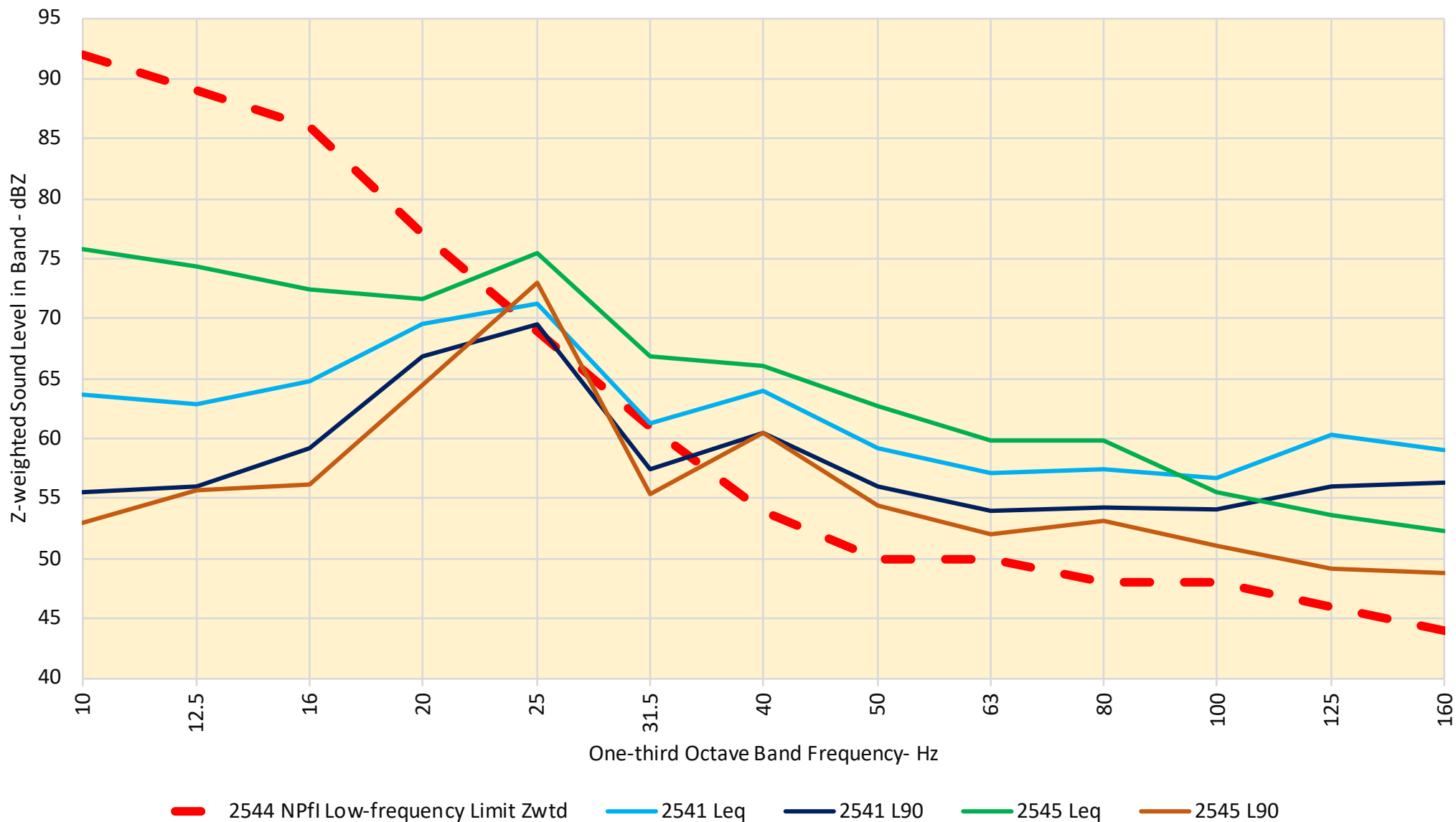


Figure A22: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Attended Monitoring One-third Octave Band Low-frequency Spectra during CBP Operation on 1 and 14 December 2023: Location 20

Boral Cement Berrima - CBP Verification Assessment December 2023: Low-frequency One Third Octave Band Spectra and Limit 4 Melbourne St 1 to 9 December 2023 Listening Measurements Leq,15-min results

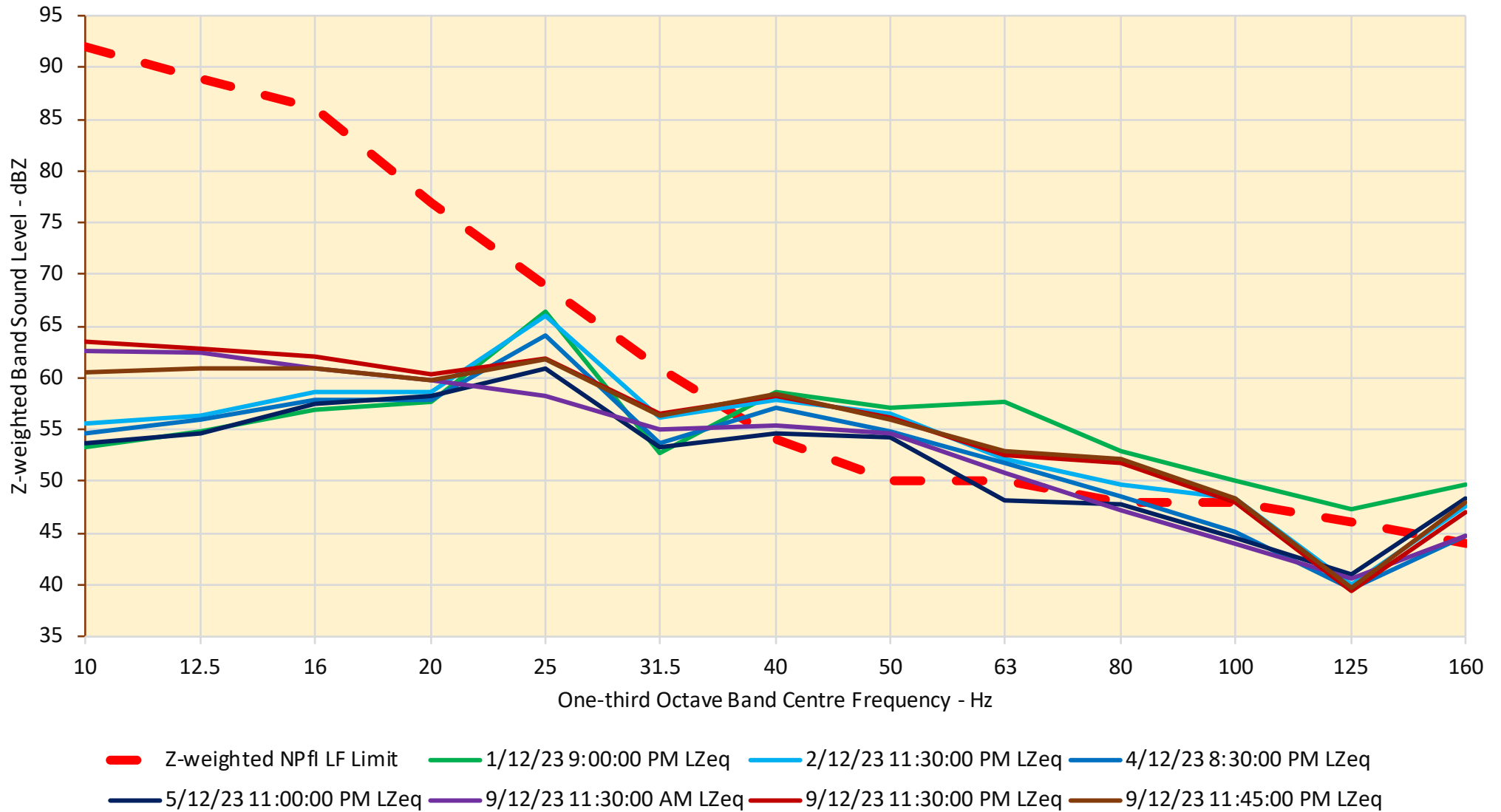


Figure A23: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Listening Attended Monitoring One-third Octave Band Low-frequency Spectra during CBP Operation 1 to 9 December 2023: 4 Melbourne St LZeq,15-min

Boral Cement Berrima - CBP Verification Assessment December 2023: Low-frequency One Third Octave Band Spectra and Limit 4 Melbourne St 1 to 9 December 2023 Listening Measurements L90,15-min results

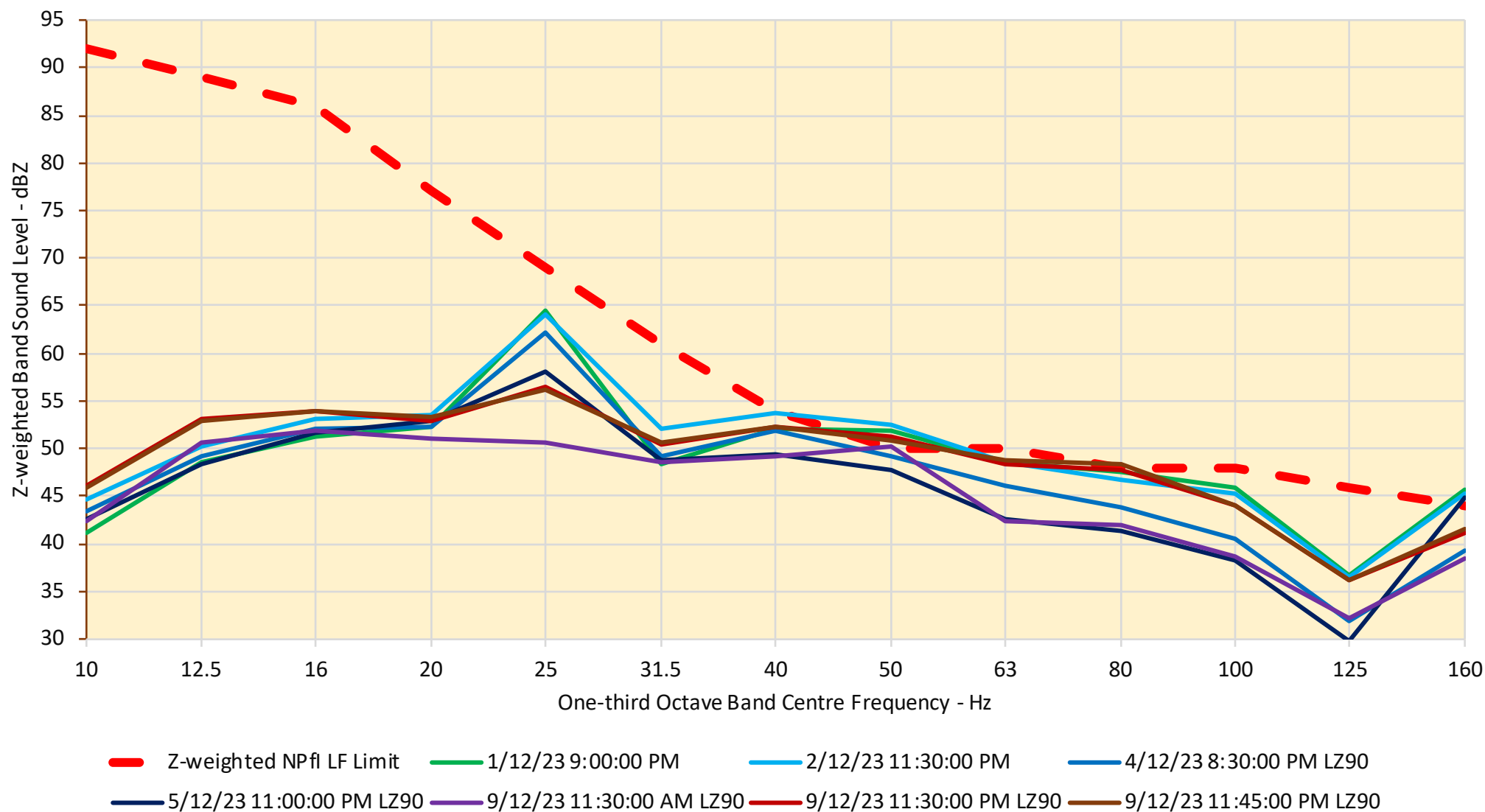


Figure A24: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
Listening Attended Monitoring One-third Octave Band Low-frequency Spectra during CBP Operation 1 to 9 December 2023: 4 Melbourne St LZ90,15-min

3.2 Predicted CBP Contribution Sound levels in the low frequency range

The ONVR included predictions of sound levels expected in receiver locations from measured noise sources at the CBP. This was done by two different methods. The first reported in the ONVR, used the computer noise model **Predictor** V2023.01 with source sound power levels obtained with an ISO-9614-2 sound intensity measurement system. This sound intensity measurement system is only able to measure source sound levels from 50 Hz to 6,300 Hz. Category D and Category F meteorological conditions were calculated for the receiver locations.

The second method used was with the computer noise model **ENM** and sound power levels determined from sound pressure level measurements from 12.5Hz to 20 kHz, although the model only calculates from 25 Hz to 20 kHz. Predictions were made for calm-neutral conditions, and Category F conditions (wind speed 2m/s and atmospheric lapse rate +3°C/100m).

Table A4 shows the predicted Z-weighted sound levels in the low-frequency range for different receiver locations using the **ENM** model with the worst-case conditions of Category F conditions. Figure A25 shows graphs of these results compared to the Low Frequency criteria.

Table A5 shows the predicted Z-weighted sound levels in the low-frequency range for different receiver locations using the **Predictor** model with the Category D and Category F meteorological conditions. Figures A26 and A27 shows graphs of these results compared to the Low Frequency criteria of the Policy.

These tables and figures show that the predicted sound levels from the CBP in the Low Frequency range are well below the Policy criteria, in most cases at least 10 dB below the criteria in each frequency band, for both the **Predictor** and **ENM** model calculations.

On the basis of these prediction calculations, it is considered that the noise emissions from the CBP do not cause low frequency sound at residential receiver locations to exceed the criteria of the NPfl Fact Sheet C.

Table A4: Boral Cement Berrima - CBP Verification Assessment December 2023:
ENM Predicted Worst case Low-frequency One Third Octave Band Spectra and NPfI LF Limit for Predicted sound levels at Residential Receiver Locations and Location 20, for Wind speed 2m/s with Lapse Rate +3 and comparison to Predictor

Receiver Location	ENM Run	ENM Predicted Z-weighted Sound Level in One-third Octave Band - dBZ									Total A dBA	
Band Frequency - Hz		25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	ENM	Predictor
NPfI	LF Limit values	69	61	54	50	50	48	48	46	44		
4 Melbourne St	Original	35	27	26	26	26	28	27	22	23	35	24
	Adjusted 2	34	35	32	37	35	33	30	20	23	30	
Adelaide St	Original	36	28	28	28	28	29	29	25	23	36	24
12 Brisbane St	Original	35	27	27	26	26	27	27	22	20	34	25
Location 20	Original	42	33	33	33	34	34	33	31	30	41	30
	Adjusted 1	42	34	34	34	34	34	32	31	30	41	
North Fence	Not run in ENM											28

Boral Cement Berrima - CBP Verification Assessment December 2023: ENM Predicted Worst case Low-frequency One Third Octave Band Spectra and Limit for Reidental Receiver Locations and Location 20

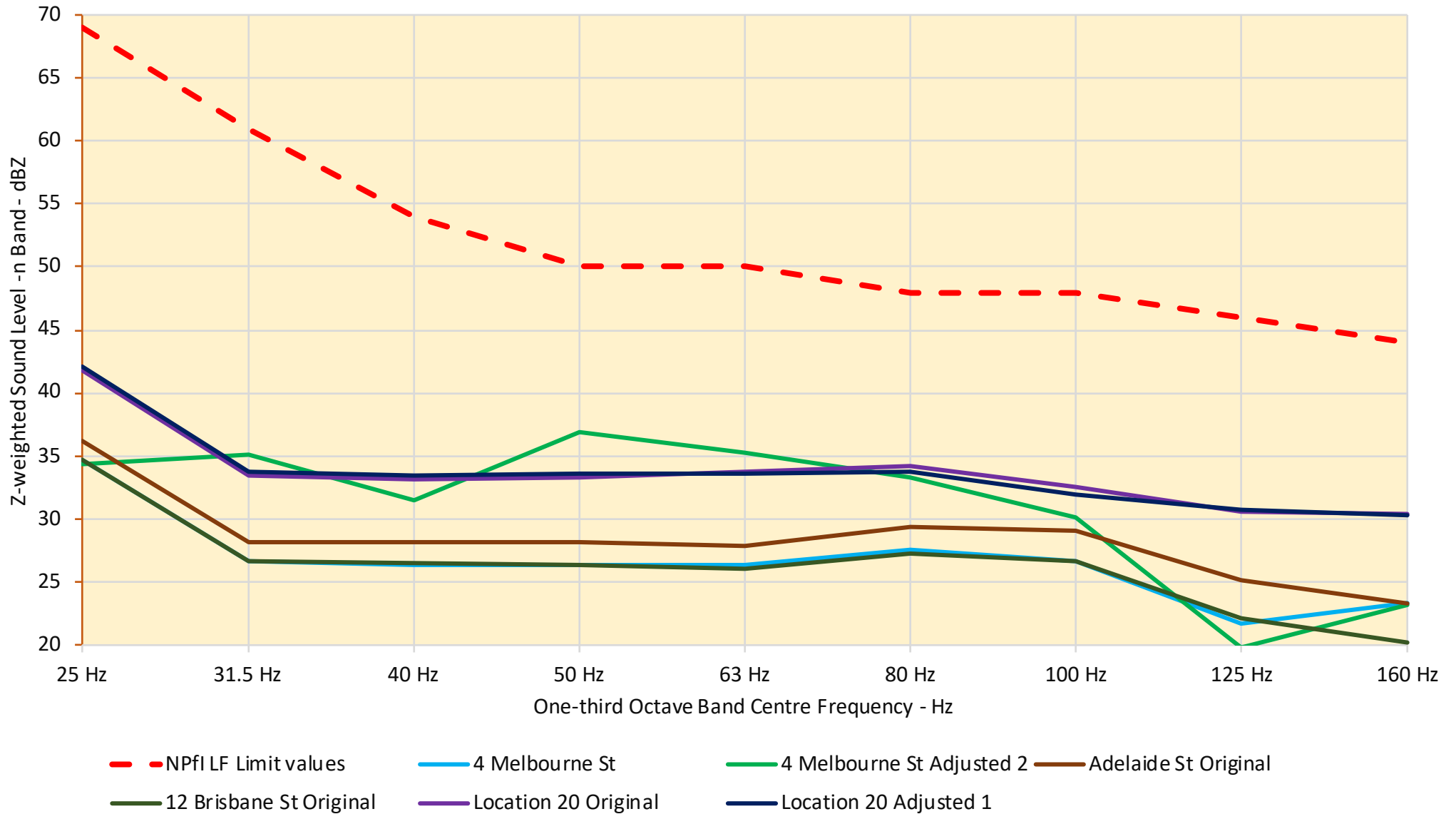


Figure A25: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
ENM Predicted One-third Octave Band Low-frequency Spectra at receiver locations for CBP Operation worst case wind speed 2m/s, Lapse Rate +30c/100m

Boral Cement Berrima - CBP Verification Assessment December 2023: Predicted Low-frequency One Third Octave Band Spectra and Limit for Receiver Locations for Cat D meteorological conditions using iNoise Predictor

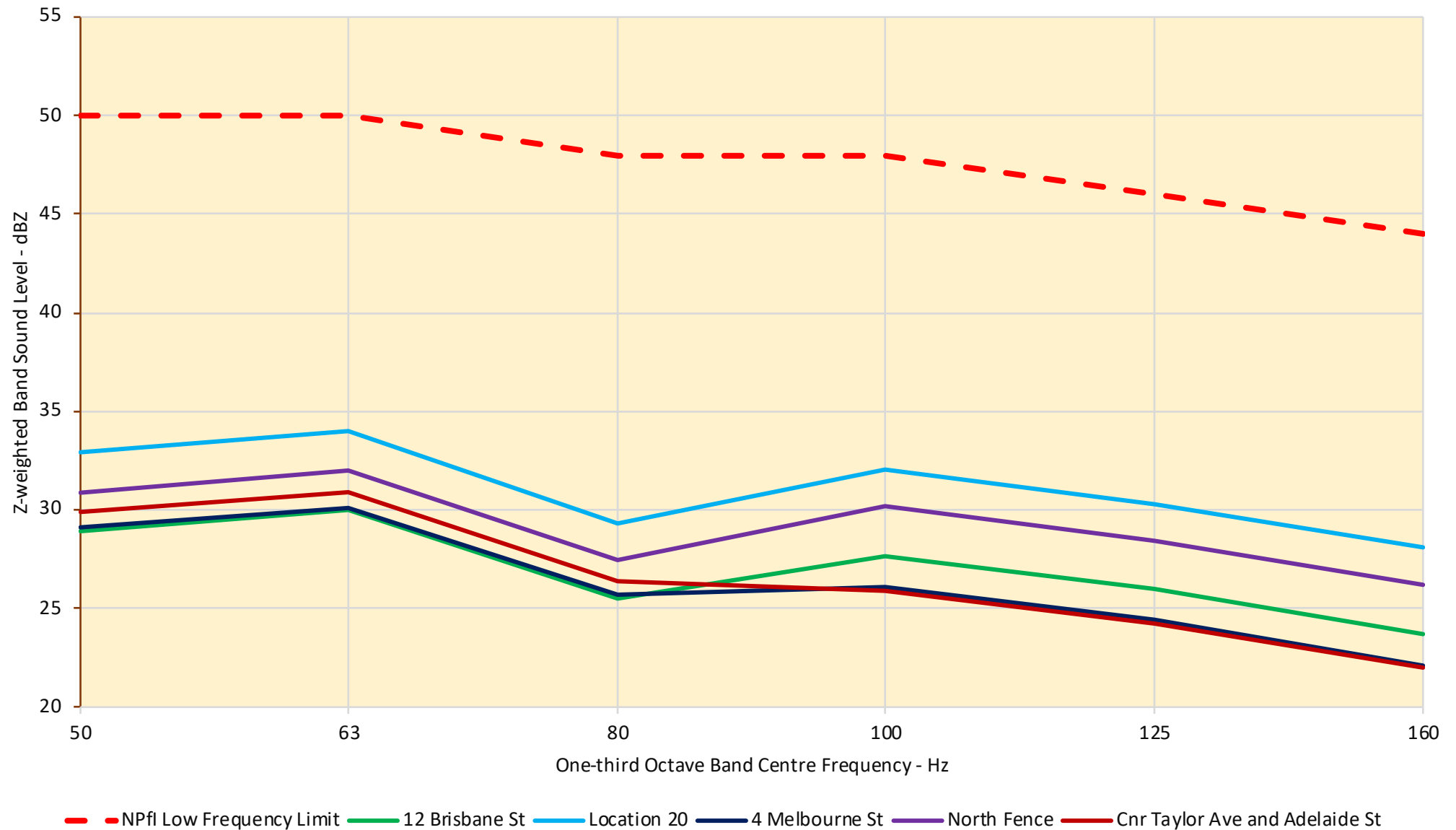


Figure A26: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
iNoise Predictor Predicted One-third Octave Band Low-frequency Spectra at receiver locations for CBP Operation Cat D conditions 0.5m/s

Boral Cement Berrima - CBP Verification Assessment December 2023: Predicted Low-frequency One Third Octave Band Spectra and Limit for Receiver Locations for Cat F meteorological conditions using iNoise Predictor

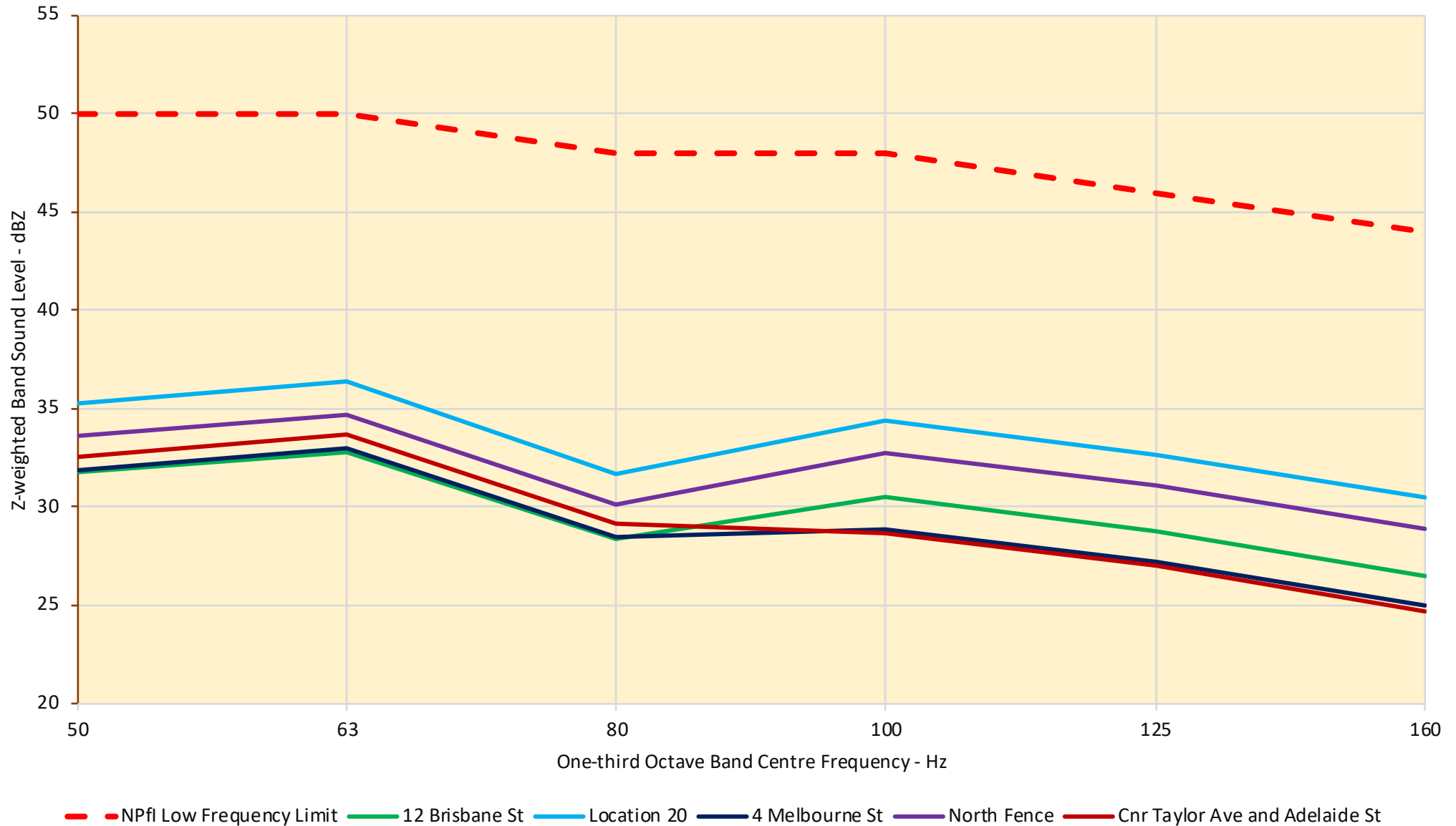


Figure A27: Boral Cement Berrima - Chloride Bypass Plant - Verification Assessment December 2023: Addendum Report
iNoise Predictor Predicted One-third Octave Band Low-frequency Spectra at receiver locations for CBP Operation Cat F conditions 2m/s

4 Summary and Conclusions

The Operational Noise Verification report of the Chloride Bypass Plant at Berrima Cement provided measured sound levels in normal operations with the **On** and in the **Off** condition. Sound levels around the CBP were found to be affected significantly by emissions from the other parts of the cement plant. This is to be expected because the noise specification sound levels for the new CBP were intended to be relatively low. Sound levels measured at many locations around the CBP were not significantly different (i.e. within 3 dB of each other) for the **On** and **Off** cases. In some locations, the **Off** condition sound level was higher, probably due to minor changes in process conditions in the rest of the Cement plant at the time. For this reason, sound levels measured at residential receiver locations and Location 20 did not change for the two CBP operational conditions and it was not discernible.

With reference to the condition of approval for the plant to be compliant with the requirements of Fact Sheet C of the NPfI regarding potentially annoying noise characteristics, this Addendum Report to the ONVR has provided data from the AENAR 2023 to show that this condition is complied with.

Measured sound levels at receiver locations were assessed and found to be non-tonal. The plant is not a source of impulsive or intermittent noise emissions, being relatively continuous in operation and sound source operation. Further to this, an assessment of tonality for sound levels measured at 4 Melbourne St during periods when the major sources at the Cement Plant were not operating is shown in Table A6. This indicates results similar to periods when the plant is fully operating, that no significant tonality occurs. When the limits are exceeded it is typically in higher frequencies, caused by insects or birds or other environmental sources.

Since the measured sound low-frequency levels from the CBP in operation are unable to be measured within the background and ambient of current environmental noise, the Policy allows the use of predicted sound levels for such analysis. These predictions, which used two different and accepted methods of calculation, indicate that the CBP contribution sound levels in the low-frequency range are well below the criteria of the Policy and therefore considered to be in compliance with the condition. Further to this, Table A7 shows a low-frequency assessment for sound levels measured at 4 Melbourne St during periods when the major sources at the Cement Plant were not operating. This shows similar results to those in Table A3 when the plant was operating, that the low-frequency criteria are exceeded and bands above 40 Hz. This supports the contention in this report and the AENAR that the plant is not a significant source of low frequency sound.

Based on these results, it is the assessment of this Addendum Report and the original ONVR report that the noise emissions from the operational CBP are in compliance with the recommended objectives of the Pre-construction Verification Report.

Table A6: Boral Cement Berrima - Addendum Report on Operational Verification Assessment for CBP December
2023 Assessment of Tonality of Sound in Periods with no major plant operational, measured at 4 Melbourne St

Date	Time	LAEq tonality	Tonality - dB in One-third Octave Band Centre Frequency - Hz																											
LAEq	Frequency Band		31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	12500	16000
NPfl Tonality limit			15	15	15	15	15	15	15	8	8	8	8	8	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
4/12/23	8:30		1	2	3	1	10	6	2	3	1	1	1	1	0	1	0	1	0	0	0	1	0	1	0	1	0	0	1	0
	8:45		0	1	2	1	4	2	2	2	1	2	1	1	0	0	0	1	1	0	0	0	1	3	1	0	1	1	0	1
7/12/23	16:30-17:45																													
	16:30		3	2	8	5	5	1	4	3	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	4
	16:45		2	1	1	1	6	4	3	2	2	0	1	1	0	0	0	0	1	0	0	0	0	1	1	0	1	2	1	4
	17:00		2	1	2	1	2	1	2	1	2	0	1	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	4
	17:15		3	0	2	3	5	1	5	2	3	0	1	0	0	0	0	1	1	0	0	0	0	1	0	0	0	1	1	3
	17:30		1	0	0	1	4	3	1	0	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	3
8/12/23	6:00 to 10:30																													
	6:15		0	1	0	0	2	0	0	0	2	3	2	0	0	0	0	0	1	1	5	10	0	6	4	4	2	4	2	3
	6:30		2	1	1	1	1	2	1	2	1	2	2	0	1	1	0	1	1	0	0	1	0	3	0	0	1	1	3	1
	6:45		0	2	0	0	3	1	1	0	1	2	1	2	0	0	1	1	0	0	1	0	3	6	3	5	5	2	1	0
	7:00		1	1	1	3	2	3	2	2	0	2	1	1	0	1	0	0	1	1	0	1	1	1	1	1	1	0	1	0
	7:15		1	2	3	4	3	2	0	1	1	2	1	1	0	0	1	0	1	0	1	2	3	1	2	1	1	1	0	0
	7:30		1	1	1	1	2	0	1	0	1	2	1	1	0	1	0	0	0	1	1	5	1	5	2	4	4	0	0	0
	7:45		1	1	0	2	0	0	1	1	2	3	1	1	0	0	0	1	0	0	1	1	2	3	1	2	2	2	2	1
	8:00		1	0	2	0	0	1	1	1	2	3	1	1	0	1	0	1	1	1	0	1	2	4	1	2	1	0	1	0
	8:15		3	0	3	3	6	2	2	2	2	3	1	1	0	1	0	1	0	1	1	1	1	5	1	3	4	0	1	0
	8:30		1	2	2	3	2	1	0	1	1	3	1	1	0	0	0	1	1	1	0	3	0	5	1	3	4	1	0	1
	8:45		2	1	1	2	0	1	1	3	3	2	1	1	0	0	0	1	1	0	0	1	4	8	0	3	3	0	2	1
	9:00		2	2	2	5	2	1	0	1	0	3	1	1	0	0	0	0	1	1	2	6	2	2	0	0	2	1	0	0
	9:15		0	2	1	0	0	0	0	1	0	2	1	1	0	0	0	1	1	0	0	0	0	1	2	1	1	1	1	0
	9:30		1	0	0	4	2	3	2	1	1	2	1	0	0	0	0	1	1	0	0	0	3	5	1	1	2	1	2	1
	9:45		1	2	0	0	1	0	1	1	0	2	1	0	0	1	0	1	1	0	0	0	1	0	0	0	0	2	1	0
	10:00		1	2	1	3	0	1	3	2	1	3	1	1	0	1	0	1	0	1	0	5	4	0	3	4	2	4	1	1
	10:15		2	2	0	2	5	1	2	3	3	2	1	1	0	0	1	0	0	0	0	1	1	1	0	0	1	1	1	0
8/12/23	15:30 to 16:15																													
	15:30		0	1	1	1	0	0	1	1	1	3	2	0	0	0	0	0	2	1	0	0	1	1	0	0	0	2	1	2
	15:45		1	1	1	1	1	2	3	0	1	2	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	2	0	1
	16:00		1	1	1	1	2	0	1	1	1	3	1	1	0	0	0	1	1	0	0	1	2	6	2	1	4	1	1	1
		LA90 tonality																												
4/12/23	8:30		31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	12500	16000
4/12/23	8:30		1	4	1	1	0	1	3	3	2	3	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2
	8:45		0	3	0	1	0	1	3	2	1	3	1	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	2
7/12/23	16:30-17:45																													
	16:30		4	1	3	1	0	3	7	4	2	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	1	0
	16:45		3	0	1	0	0	2	7	4	3	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0
	17:00		4	1	3	1	0	3	7	3	3	1	1	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
	17:15		4	1	4	2	0	3	7	4	4	2	1	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	1
	17:30		3	1	4	1	0	3	7	4	4	2	1	0	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	1
8/12/23	6:00 to 10:30																													
	6:15		2	2	2	1	2	0	3	3	1	0	1	1	1	1	1	0	1	0	0	0	0	1	0	1	0	0	0	2
	6:30		1	3	0	1	2	0	4	3	1	0	1	0	1	0	1	1	0	0	0	0	0	1	0	1	1	0	0	2
	6:45		1	1	3	2	1	0	3	3	1	0	1	1	1	0	2	0	0	0	0	0	1	0	0	2	2	1	1	2
	7:00		1	1	4	2	2	1	2	2	1	1	0</																	

Table A7: Boral Cement Berrima - Addendum Report on Operational Verification Assessment for CBP December 2023 Assessment of Low-frequency Sound in Periods with no major plant operational, measured at 4 Melbourne St

Date	Time	Z-weighted Sound Level - dBZ in One-third Octave Band Centre Frequency - Hz												
		10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
NPfI Low Frequency Limit		92	89	86	77	69	61	54	50	50	48	48	46	44
4/12/23	8:30	55	56	59	59	59	58	61	59	63	69	56	54	57
	8:45	54	55	56	57	59	59	61	61	58	59	52	49	50
7/12/23	16:30-17:45	only CM7 on												
	16:30	65	63	64	62	64	60	62	68	59	62	55	50	53
	16:45	59	58	60	59	62	58	59	61	62	63	52	48	52
	17:00	66	65	65	63	65	61	61	62	61	59	54	50	51
	17:15	63	62	63	62	65	59	61	62	58	62	54	49	53
	17:30	65	64	64	63	66	63	63	64	65	65	57	55	55
8/12/23	6:00 to 10:30													
	6:15	54	65	59	59	62	63	64	62	62	62	58	55	52
	6:30	53	54	54	56	57	56	59	59	58	56	54	50	48
	6:45	52	62	58	57	60	61	63	62	60	60	54	51	49
	7:00	59	57	58	59	58	56	58	59	62	61	54	54	50
	7:15	52	60	56	56	57	57	59	59	65	64	57	54	51
	7:30	54	63	58	58	61	60	61	60	60	59	55	51	50
	7:45	54	61	58	57	62	60	61	61	61	58	55	52	49
	8:00	53	57	57	58	60	58	60	60	59	57	54	50	49
	8:15	54	56	57	56	58	54	56	58	54	58	51	48	49
	8:30	55	59	55	55	59	58	61	59	62	60	55	52	48
	8:45	57	55	56	56	55	54	57	59	59	56	54	50	47
	9:00	49	51	53	55	55	53	55	55	58	51	48	46	45
	9:15	51	61	57	58	59	61	63	62	59	57	54	51	48
	9:30	52	58	57	57	59	58	59	60	62	57	56	51	49
	9:45	52	62	58	57	62	61	63	62	61	59	56	52	50
	10:00	53	55	58	57	59	58	60	58	60	57	53	53	48
	10:15	58	59	61	61	60	59	62	61	60	63	55	50	51
8/12/23	15:30 to 16:15													
	15:30	53	55	56	54	58	58	60	60	58	54	51	49	48
	15:45	53	54	56	59	60	59	59	59	57	57	55	49	49
	16:00	53	55	55	56	58	57	60	60	60	58	53	49	48

NOTE: Pink shaded and red lettered cells exceeded criteria

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