Prepared for
CPB HEB Joint Venture
ABN: N/A

Post-construction Noise Model Validation

Transmission Gully

02-May-2023
Transmission Gully

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Client: CPB HEB Joint Venture

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Prepared by

AECOM New Zealand Limited
8 Mahuhu Crescent, Tāmaki Makaurau|Auckland 1010, PO Box 4241, Tāmaki Makaurau|Auckland 1140, New Zealand
T +64 9 967 9200 F +64 9 967 9201 www.aecom.com

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Table of Contents

1.0 Introduction

The Transmission Gully (TG) motorway was officially opened on the 30th of March 2022. Designation condition NZTA.81A requires that post-construction validation of the noise assessment is undertaken, and condition NZTA.81B requires that a report detailing the results and any corrective actions arising from the post-construction validation is submitted to the Council within ten months of the road opening for areas where low-noise road surfaces were not implemented.

The relevant conditions are re-produced in Table 1:

Table 1 Conditions regarding the post-construction noise model validation

Reference	Conditions – NZ Transport Agency Confirmed Notices of Requirement
NZTA.81A	A Noise Mitigation Plan shall be prepared by a suitably qualified acoustics specialist prior to commencement of construction including details of: a) Detailed Mitigation Options b) Qualifying Buildings c) Methods for post-construction validation of the noise assessment. This shall include: i. Prior to opening: confirmation of the location of the as-built alignment in the noise model, visual inspection from the far-side carriageway of the relationship of PPFs to earthworks and noise barriers, verification of as-built noise barrier dimensions, and confirmation of as-built road surfaces, ii. 3 to 9 months after opening and checking the actual traffic volumes, and iii. Noise monitoring to validate the noise model to be undertaken within 6 months of the design road surfaces being laid.
NZTA.81B	A report detailing the results and any corrective actions arising from the post construction validation of the noise assessment shall be provided to the Council within nineteen months of opening of the road in areas with low-noise road surfaces, and within ten months of opening the road in all other areas.

A separate memo has previously been prepared by AECOM detailing the results of the portion of the post-construction noise model validation requirements covered by NZTA.81A.c).i (except for the confirmation of the as-built alignment in the noise model). This memo and its relevant attachments have been included in Appendix A.

The memo was prepared following the Covid-19 lockdowns that were in place in New Zealand from August to December 2021, during which time an AECOM Acoustics specialist was not available to undertake the noise wall inspections in-person. Therefore, AECOM personnel under remote supervision of the AECOM Acoustics specialist undertook the in-person inspections of the noise barriers, including visual inspection from the far-side carriageway and verification of the as-built noise barrier dimensions.

1.1 Board of Inquiry findings

The Transmission Gully Board of Inquiry (BOI) set out their main findings on operational (road-traffic) noise in paragraphs [602] to [615] of their 2012 report[1]. The report discusses internal levels the BOI considered acceptable in terms of sleep disturbance and corresponding NZS 6806 categories relating to external noise. The BOI decision confirmed the Notices of Requirement subject to designation conditions NZTA.71 to NZTA.81B for operational noise. These are prescriptive conditions in which the BOI set clear and unambiguous performance standards for operational noise. The BOI conditions are amended from those originally put forward by Waka Kotahi, to address specific issues identified by the BOI.

The BOI conditions are consistent with the discussion in the BOI report in that condition NZTA.72 controls NZS 6806 categories for external noise, which acts as an indirect control on internal noise. For

[1] https://www.epa.govt.nz/assets/FileAPI/proposal/NSP000008/Boards-decision/bb53e16652/Transmission-Gully-Final-decision-volume-1-Report-and-decision.pdf

new roads, condition NZTA.76 requires buildings in Categories B and C to be investigated for treatment, rather than just Category C buildings as required under NZS 6806. When any building is investigated for treatment, condition NZTA.78 requires action for all levels above 40 dB LAeq(24h), rather than 45 dB LAeq(24h) under NZS 6806.

As above, condition NZTA.72 requires the NZS 6806 Category at each PPF to be maintained as the Category considered in 2012 by the BOI, subject to matters set out in other conditions. The design and construction of Transmission Gully has proceeded on the basis that categories will be maintained (or improved) at all PPFs, such that potential exceptions under condition NZTA.74 have not been invoked. The BOI specifically added a requirement in conditions NZTA.81A and NZTA.81B for post-construction validation, including noise monitoring. This post-construction validation confirms that NZS 6806 categories have been achieved as required under NZTA.72, hence controlling noise effects as determined by the BOI.

1.2 Personnel

This report has been prepared by Shivam Jakhu, a Senior Acoustics Engineer at AECOM. He has a degree in Mechatronics Engineering and is a member of the Acoustical Society of New Zealand. Shivam has six years' experience as an acoustics consultant. This report was reviewed by Claire Drewery, who is a member of the Institute of Acoustics (UK) and has an IOA PG Diploma in Acoustics and Noise Control. She has over 21 years' experience as an acoustics consultant and has been the acoustics lead on a number of major New Zealand infrastructure projects.

1.3 Porirua Link Roads

Post-construction noise model validation for the Porirua Link Roads is not required under the designation conditions listed in Table 1, or in the Principal's Requirements for the Porirua Link Roads; as described in the Noise Mitigation Plan prepared for Porirua Link Roads, noise modelling was not undertaken as part of the detailed design phase, therefore it was not deemed necessary to include this in the post-construction review.

A post-construction inspection of the noise barrier adjacent to 216-220 Warspite Avenue was undertaken on Thursday 18th November 2021 by AECOM personnel under remote supervision of the AECOM Acoustics specialist. The results from the inspection were summarised in an email issued to Juliet Spagnolo on the 30th of November 2021 and is included for information in Appendix B. No corrective actions were required following the inspection.

1.4 Post-construction validation

A meeting was held on the 21st of July 2022 between representatives from AECOM, CPB/HEB JV, Waka Kotahi, Porirua City Council and Wellington City Council to agree on the approach to be taken for the post-construction noise model validation.

During this meeting, it was agreed that:

1. Confirmation of the as-built alignment would be undertaken in accordance with NZTA P40 "Specification for Noise Mitigation"[2], however at the request of Waka Kotahi's noise specialist (Stephen Chiles), the noise model would be updated with more information than strictly required under P40 or condition NZTA.81A.c).i. The additional information was requested in order to maximise the accuracy of the 2031 noise predictions as far as practicable. The updated noise model would also include:
    - The latest as-built road, terrain and noise barrier data.
    - Updated forecasts of 2031 traffic flows along TG, based on the latest information available for traffic modelling including recent traffic counts, updated results from Wellington regional strategic transport models and other data relevant to traffic forecasting.

[2] https://www.nzta.govt.nz/assets/resources/noise-mitigation/docs/nzta-p40-noise-mitigation-specification.pdf

The predicted noise levels based on the updated noise model would be compared against the results of the detailed design noise model prepared in 2015 for the Noise Mitigation Plan.

2. Noise monitoring would be undertaken at the locations agreed in advance or similar locations (as set out in Section 3.1) and the noise measurements would be corrected for the 2031 design year in accordance with “NZTA Noise Monitoring Requirements” (the Noise Monitoring Requirements – a copy of this document is included in Appendix H). The results of this exercise would be compared to the results of the noise modelling exercise detailed above.

For clarity, the noise model from bullet point 1 above is referred to from here as the “Post-Construction model”. The noise predictions corrected for 2031 from the measurements undertaken are referred to as the “2031 corrected noise levels”. The noise model prepared in 2015 for the Detailed Design phase is referred to as the “Detailed Design noise model”.

The following sections detail each of the tasks undertaken and results found.

2.0 Noise Modelling of As-Built Design

2.1 Inputs

2.1.1 Unchanged parameters

The noise model was prepared in general accordance with the requirements of New Zealand Standard NZS 6806:2010, including the requirements set out in Section 5.3.2 of that Standard.

In order to construct the Post-Construction noise model, the Detailed Design noise model was updated to include the latest information. That noise model was constructed in the noise modelling software Cadna/A 4.4, implementing the CRTN algorithm. Other model parameters included:

- Order of reflections: 1
- Ground absorption: 1
- Receiver height: 1.5m (4.5m for upper floors) at the most exposed façade
- Free-field receiver positions

The CRTN algorithm gives results in terms of the $L_{A10(18h)}$ noise metric. To convert this to the $L_{Aeq(24h)}$ noise metric, a -3 dB adjustment was made. In addition, a -2 dB adjustment was made for a reference asphaltic concrete road surface compared to CRTN, in accordance with Transit Research Report 28[3]. The adjustments were implemented in the software in conjunction with the road surface adjustment.

These model parameters were kept unchanged from the last iteration of the noise model. Locations of Protected Premises and Facilities (PPFs) and other buildings also remained unchanged in the noise model.

Although it was initially agreed to include an update to the road alignment, the Waka Kotahi noise specialist advised it appropriate to adopt the Detailed Design road alignment in the Post-Construction noise model. This is because the as-built road only deviated from the design by up to 3cm in few locations, which would have no impact on noise predictions at receivers in the vicinity of the deviations.

2.1.2 Noise barriers

Post-construction inspection of the as-built noise barriers and earth bunds was carried out in September and November 2021, as summarised in Appendix A. The noise barrier dimensions were edited in the Post-Construction noise model to match the dimensions that were physically measured on site. Edits to the noise barriers included lowering the heights the walls in the noise model where the recorded heights were lower than the design heights. The gap left for the culvert under the noise wall at Flightys was also included in the noise model, in order to account for any noise leakage under the wall.

Noise Wall N1A was replaced by a bund at Flightys as confirmed by CPB/HEB JV, and as inspected on site in November 2021. The as-built geometry of the bund was included in the Post-Construction noise model.

2.1.3 Traffic flows

At the request of the Waka Kotahi noise specialist, additional traffic modelling was undertaken to capture the latest available information.

The traffic modelling was undertaken by AECOM, and a report detailing the results of the modelling was prepared and is included in Appendix D.

The traffic modelling took into account the latest available information including:

- Traffic survey information (as set out in Section 3.2).

[3] Research Report 28. Traffic noise from uninterrupted traffic flows, Transit, 1994.
https://www.nzta.govt.nz/assets/resources/research/reports/028/028-Traffic-noise-from-uninterrupted-traffic-flows.pdf

- Population growth data.
- Vehicle Kilometres Travelled (VKT) data.
- Rail patronage data.
- Traffic volume data from the Wellington Transport Strategy Model and North of Wellington Saturn Model.

Multiple scenarios were modelled, including lower-growth and higher-growth scenarios. For the purposes of the noise modelling, an arithmetic average of the predicted traffic volumes between these scenarios was used. This approach was checked and approved by the traffic modeller prior to calculation of the noise model.

The results from the traffic modelling entered in the noise model are summarised in Table 2. The traffic flows used in the Post-Construction model were found to be generally higher than those used in the Detailed Design model.

Table 2 2031 forecasted traffic data

Site Reference	Location	Total Flow	Total HGV	HGV Percentage
11031	Mackays Crossing - SB	15930	1410	9%
21031	Mackays Crossing - NB	13320	1405	11%
21038	Horokiri Ki Raro - NB	11440	1405	12%
11038	Horokiri Ki Raro - SB	12645	960	8%
21048	Waitangirua - NB	12085	1335	11%
11048	Waitangirua - SB	12980	1795	14%
21053	South of Waio Hata - NB	10860	770	7%
11053	South of Waio Hata - SB	12005	690	6%
22053	SH1-Linden - NB	33025	2175	7%
12053	SH1-Linden - SB	33950	1800	5%

Refer to Appendix D for further details on how the traffic flows in Table 2 were calculated.

2.1.4 Terrain

Updated terrain information was provided by CBP/HEB JV. This terrain data was based on the most recent aerial survey information following completion of construction. This terrain dataset was applied within the project designation boundary; beyond this, terrain data from the Detailed Design noise model was re-used.

We note that the terrain model provided incorporated elevations from the natural environment (e.g. dense trees), meaning that it was a Digital Surface Model (DSM). This is opposed to a terrain model that only follows the bare earth (Digital Elevation Model or DEM). A DEM was used in the Detailed Design noise model.

A DEM would have preferably been used to model the terrain in the noise model rather than a DSM, however an up-to-date DEM was not available due to time constraints.

Use of a DSM may have resulted in additional screening in the noise model where vegetation is present, however in reality this vegetation would provide little to no noise attenuation. Because of this, the final results for this validation exercise have been taken from one of two noise model scenarios, with

the noise level reported for a given PPF being based on which terrain dataset more closely reflected the as-built terrain in reality.

The models considered were:

- Model with updated 2031 traffic flows, DSM survey data within the designation boundary and Detailed Design terrain data outside the designation boundary (1)
- Model with updated 2031 traffic flows, and Detailed Design terrain data only (2)

Visual inspections of model (1) were undertaken at PPFs where the difference between model (1) and the Detailed Design model was 3 dB or greater. Where irregularities existed in the terrain that did not reflect reality at or near these PPFs, noise levels from model (2) were adopted. These PPFs are identified in the results presented in Appendix E.

2.1.5 Road surface finishes

The road surface finishes in the Post-Construction noise model were updated in line with the following changes between the Detailed Design and as-built road surface finishes:

- Shortening of the OGPA extents at Kenepuru Link Road, with THSRA (a type of Sealed Mastic Asphalt or SMA) being used in its place.
- Change from chipseal to SMA from CH 1800 to CH 8300 (south of Mackay's Crossing)
- Change from chipseal to SMA from CH 11700 to CH 12200 (near Paekakariki Hill Road)
- Change from chipseal to SMA from CH 17200 to CH 19000 (south of SH58 interchange)

The AECOM civil design team confirmed that the road surface finishes constructed were in line with the as-built road surface finish drawings, based on their site inspections (as set out in Appendix A). In line with this, the as-built road surface finishes were updated in the Post-Construction noise model to match the as-built drawings.

2.2 Predicted noise levels

The results of the noise modelling are presented in Appendix E.

Note that the NoR design predictions are included in Appendix E for information as they were the basis for the noise criteria Categories in the designation conditions.

The results show that in most cases, the Post-Construction model noise predictions using the latest available information generally remain unchanged when compared to the Detailed Design noise model predictions. Where there are noise level changes, they are generally small, typically by only a few dB, and are likely due to the changes in traffic volumes and terrain between the two models. The difference in noise prediction results between the two models is also included as a column in Appendix E.

No noise level increases between the two models greater than 2 dB were recorded. Where noise level increases were predicted, none of the PPFs would have changed their noise criteria Category based on the noise level increase.

The one exception to this was at 85 Paremata Haywards Road, which had a predicted noise level change of 1 dB that would move its noise criteria Category from A to B between the Detailed Design and Post-Construction models. However, this PPF was already predicted to be in Category B in the NoR Design noise model. This means that its noise criteria Category now lines up again with the original Category assumed by the conditions.

Noise level differences between the two models being minor was due to there not being any significant differences between the noise models; the traffic flow differences only led to small noise level changes, and the updated terrain closely followed the original terrain used in the model.

The noise predictions indicate a move from Category B to Category A at 7 PPFs between the Detailed Design and Post-Construction noise model results. The majority of PPFs are in Category A in the Post-Construction noise model as seen in Appendix E. Where PPFs remain in Category B or C, noise mitigation has already been accounted for through the requirements of the designation conditions.

Therefore, in line with the latest noise predictions, we do not consider that additional mitigation is required at any PPFs in line with the requirements of the designation conditions following completion of the Post-Construction noise model.

3.0 Noise Monitoring

3.1 Methodology

Noise monitoring to validate the Post-Construction noise modelling was undertaken in accordance with the Noise Monitoring Requirements set out in Appendix H. The procedure set out in that document was followed for this monitoring, namely:

- The measurement locations were agreed in advance with Waka Kotahi, Wellington City Council and Porirua City Council. The measurement locations are shown on a map in Appendix F. Appendix G contains summary sheets for each location, including photographs showing each measurement location from at least two angles. The measurement locations agreed upon were:
    - 10 South Street (changed from 18 South Street as access to this PPF could not be arranged)
    - 75A Paremata Haywards Road
    - 247C Flightys Road
    - 366 State Highway 1
    - 500 Takapu Road
    - 504A Paekakariki Hills Road
    - 111A Bradey Road
- The measurements were conducted in general accordance with NZS 6801:2008.
- Noise logging took place over a 12-day period.
- Noise loggers recorded the $L_{Aeq(15min)}$ in each 15-minute period during the logging.
- Microphones were place 1m from the façade and 1.5m above the ground at all monitoring locations.
- The measurements were undertaken from Friday 9th September to Tuesday 20th September 2022; the noise measurements were not undertaken during school or public holidays.

We note that 111A Bradey Road was agreed upon as a noise monitoring location and a noise logger was deployed there during the monitoring period, however due to a fault with the device that was unknown at the time, the logger did not record any data over the monitoring period. Despite this, sufficient noise logging data was captured by the other six loggers in order for the model validation exercise to be considered sufficient to meet the requirements of Condition NZTA.81.A.

3.1.1 Meteorological conditions

Meteorological data was taken from the closest representative permanent monitoring station for each measurement location. These were:

- Paraparaumu Ews (Agent number 12442)
- Porirua, Elsdon Park Aws (Agent number 41559)

3.2 Traffic count data

Traffic count data was collected at five locations along the alignment as detailed in Appendix D. These are shown in Figure 1.

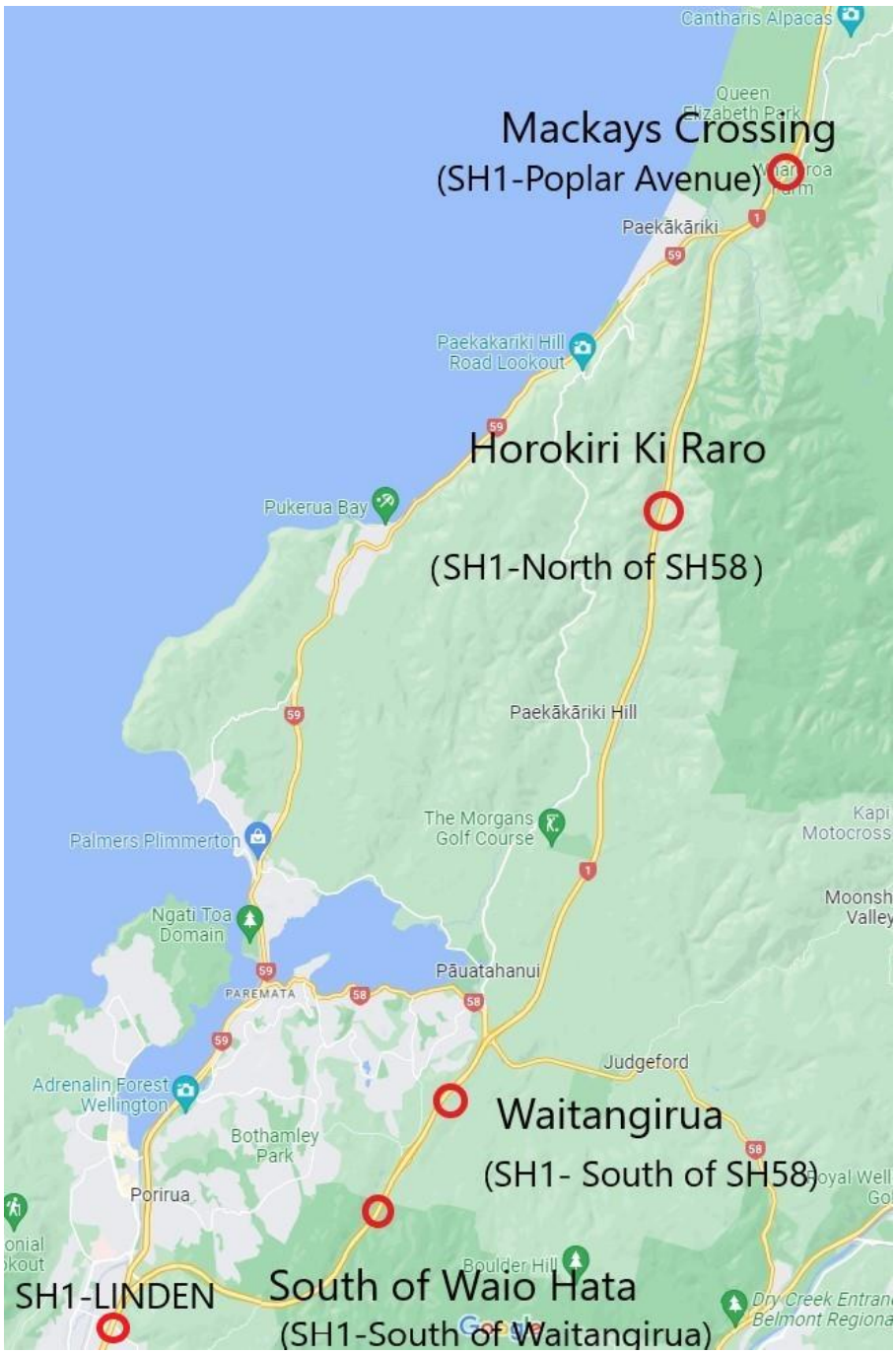

Figure 1 Traffic monitoring locations

Due to technical constraints, the tonnage of the vehicles could not be collected. Therefore, tonnage of vehicles was assumed by vehicle length, where:

- Private Class 1 passenger vehicles were assumed to be a length of 0-6m.
- For the purposes of the noise modelling exercise, Heavy Commercial vehicles were assumed to be greater than 6m.

The traffic count locations are summarised in Table 3. We note that while traffic data was provided for Mackays Crossing Mainline and Waitangirua, traffic data from these locations was not required for the 2031 noise level corrections; for Mackays Crossing, the data from the Horokiri Ki Raro location was more representative of traffic flows producing noise received at 366 State Highway 1, and the

monitoring location at Waitangirua would have been suitable for data processing at 111A Bradey Road, however the logger deployed at that location did not record noise data due to a logger fault that was unknown at the time.

Table 3 Traffic count locations data

Name	ID	Section	Chainage	lat	lon
SBD - Mackays Crossing Mainline	11031	13	1300	-40.980086	174.975084
NBD - Mackays Crossing Mainline	21031	14	1400	-40.980537	174.973989
SBD - Horokiri ki Raro Mainline	11038	86	8550	-41.041336	174.953299
NBD - Horokiri ki Raro Mainline	21038	87	8650	-41.042131	174.953114
SBD - Waitangirua Mainline	11048	181	18050	-41.118359	174.913666
NBD - Waitangirua Mainline	21048	182	18150	-41.118885	174.912784
SBD - South of Wai o Hata mainline	11053	238	23750	-41.155742	174.870937
NBD - South of Wai o Hata mainline	21053	239	23850	-41.155542	174.86975
NBD - SH1-Linden (Tawa College)	22053	-	-	-41.159720	174.836530
SBD - SH1-Linden (Tawa College)	12053	-	-	-41.159720	174.836530

Summaries of the traffic data recorded at each of Horokiri ki Raro, South of Waio Hata and Linden are provided in Table 4, Table 5 and Table 6 respectively.

Table 4 Horo ki Raro Mainline traffic count data

Date	Southbound_11038		Nortbound_21038		Percentage of heavy vehicles (%)	Total
	Light	Heavy	Light	Heavy		
7/09/2022	13405	615	13069	1326	7%	28415
8/09/2022	13369	573	13154	1210	6%	28306
9/09/2022	13893	546	14507	1240	6%	30186
10/09/2022	12826	191	13034	584	3%	26635
11/09/2022	13831	186	11820	369	2%	26206
12/09/2022	12578	506	11456	1043	6%	25583
13/09/2022	13051	599	12397	1229	7%	27276
14/09/2022	13579	545	12912	1183	6%	28219
15/09/2022	11788	470	11145	1119	7%	24522
16/09/2022	11779	468	12057	1032	6%	25336
17/09/2022	11412	170	11165	543	3%	23290
18/09/2022	11983	181	9510	381	3%	22055
19/09/2022	10435	420	9234	853	6%	20942
20/09/2022	10439	447	9507	1070	7%	21463

Table 5 South of Waio Hata traffic count data

Date	Southbound_11053		Nortbound_21053		Percentage of heavy vehicles (%)	Total
	Light	Heavy	Light	Heavy		
7/09/2022	12867	1059	12495	1230	8%	27651
8/09/2022	12782	940	12523	1208	8%	27453
9/09/2022	13055	891	13596	839	6%	28381
10/09/2022	11024	360	10039	291	3%	21714
11/09/2022	11373	266	9708	675	4%	22022
12/09/2022	12107	883	11151	1128	8%	25269
13/09/2022	12738	973	12101	1103	8%	26915
14/09/2022	12985	822	12087	1159	7%	27053
15/09/2022	12036	885	11435	1084	8%	25440
16/09/2022	12174	606	12826	777	5%	26383
17/09/2022	10832	375	9962	316	3%	21485
18/09/2022	10674	329	8702	592	5%	20297
19/09/2022	11109	799	10042	1007	8%	22957
20/09/2022	11968	939	10977	1096	8%	24980

Table 6 Linden traffic count data

Date	Both directions		p measurement date (%)	Total
	Light	Heavy		
9/09/2022	25368	1748	6%	27116
10/09/2022	22338	870	4%	23208
11/09/2022	20005	732	4%	20737
12/09/2022	38594	2542	6%	41136
13/09/2022	48611	3771	7%	52382
14/09/2022	24662	1820	7%	26482
15/09/2022	25142	1864	7%	27006
16/09/2022	25447	1718	6%	27165
17/09/2022	22847	980	4%	23827
18/09/2022	20931	736	3%	21667
19/09/2022	38516	2680	7%	41196

3.3 Processing of data

The monitoring data was processed in accordance with the Noise Monitoring Requirements set out in Appendix H, i.e.:

- Data points during rain or average wind speeds greater than 5m/s were excluded
- Data points during upwind conditions (3-5 m/s) were excluded.

- Abnormally high data points were excluded.
- Excluded data points were replaced by a linear interpolation of noise levels between the data points surrounding the excluded data.
- If more than 5 hours of data during the day or 3 hours of data at night was excluded, then the day's measurement was discarded.
- The noise levels measured were converted to free-field levels by including a -2.5 dB façade correction.
- Values for the $L_{Aeq(24h)}$ were corrected to the AADT for the 2031 design year and were calculated for each day, with the final values for each location based on the energetical average of all valid days.
- The corrections for the 2031 design year were calculated as follows:
    - $L_{Aeq(24h,\ 2031)} = L_{Aeq(24h,\ measured)}$ + Correction (1) + Correction (2)
    - Correction (1) = 10 * log ($Q_{nominated\ year\ AADT}$ / $Q_{measurement}$ date)
    - Correction (2) = 10 * log ((1 + 5 * $p_{nominated\ year\ AADT}$ / V) / (1 + 5 * $p_{measurement\ date}$ / V))
    - Q – total traffic volume over 24 hour period
    - V – mean traffic speed (km/h)
    - p – percentage of heavy vehicles

3.4 Results

The results of the noise monitoring, including the correcting of noise levels to 2031 conditions in line with the Noise Monitoring Requirements, is presented in Table 7. More details for each site are included in Appendix G.

We note that the noise level prediction for 247C Flightys Road in Table 7 does not match the levels presented in Appendix E. This is because the point along the façade of this building that the noise logger was deployed at was chosen to be away from potential sources of extraneous noise, i.e. an outdoor lounge area. Therefore, the noise level for this location provided in Table 7 was taken directly from the models at the point along the façade where the logger was deployed.

For all measurement locations, the measured noise level and corrected 2031 noise level was less than the noise predictions from both the Detailed Design noise model and Post-Construction noise model. This is likely due to localised screening at measurement locations that may not have been included in the noise models, as well as normal uncertainty inherent to the noise prediction calculations.

The noise monitoring is considered to have validated the Post-Construction noise model based on comparison of the measured and predicted noise levels.

Table 7 Results from noise model validation exercise

Location	Number of valid days[#]	Prediction for 2031 from Detailed Design model	Prediction for 2031 from Post-construction model	Measured noise level 2022 (Traffic noise only)[^]	Corrected noise level for 2031	Discussion
10 South Street	7	64	63	57	61	Noise level consistent with Post-Construction noise model prediction (within +/- 2 dB).

Location	Number of valid days[#]	Prediction for 2031 from Detailed Design model	Prediction for 2031 from Post-construction model	Measured noise level 2022 (Traffic noise only)[^]	Corrected noise level for 2031	Discussion
75A Paremata Haywards Road	3	64	62	60	60	Noise level consistent with Post-Construction noise model prediction (within +/- 2 dB).
247C Flightys Road	5	56	56	55	55	Noise level consistent with Post-Construction noise model prediction (within +/- 2 dB).
366 State Highway 1*	3	52	50	44	45	Noise level 5 dB below prediction from Post-Construction model. This is likely due to additional screening from dense vegetation and the deck between the road and receiver position that was not reflected in the noise model. This can be seen in the photos in Appendix G.
500 Takapu Road	3	47	47	46	47	Noise level consistent with Post-Construction noise model prediction (within +/- 2 dB). Note that there was a building left in the Detailed Design noise model that provided additional screening to this PPF that did not reflect reality; this was removed in the Post-Construction model.

Location	Number of valid days[#]	Prediction for 2031 from Detailed Design model	Prediction for 2031 from Post-construction model	Measured noise level 2022 (Traffic noise only)[^]	Corrected noise level for 2031	Discussion
504A Paekakariki Hills Road	6	54	55	52	52	Noise level 3 dB below prediction from Post-Construction model. This is likely due to additional screening from dense vegetation between the road and receiver position that was not reflected in the noise model. This can be seen in the photos in Appendix G.

*Note that noise prediction results for 366 State Highway 1 were not originally included in the Detailed Design results, however the noise levels at this PPF were calculated in both the Detailed Design model and Post-Construction model for this exercise.
[#]Valid as per the definition set out in section 3.3.
[^]Adjusted data as per section 3.3.

4.0 Conclusion

A Post-Construction noise model was prepared in order to reflect the as-built alignment for TG. Noise levels from this model were calculated and compared to the Detailed Design phase noise model. Noise levels were generally consistent between the two models, and any noise level changes between the two models were likely due to differences in the terrain and traffic information entered between the two models.

Noise monitoring was undertaken in accordance with the Noise Monitoring Requirements (Appendix H) in order to validate the Post-Construction noise model. At four of the six locations monitored, the 2031 projected noise level was within 2 dB of the Post-Construction noise model. Noise levels measured at 504A Paekakariki Hills Road and 366 State Highway 1 were lower than the predictions in the Post-Construction noise model by 3 dB and 5 dB respectively; the noise level differences are likely due to additional screening from dense vegetation that was not captured in the noise models, along with additional screening from the deck at 366 State Highway 1 where the noise logger was deployed.

The noise monitoring is considered to have validated the Post-Construction noise model based on comparison of the measured and predicted noise levels.

The checks required by condition NZTA.81A have all been carried out and have been documented in this report as required by condition NZTA.81B. No corrective actions are required as a result of the validation of the Post-Construction model.

Appendix A - Linden and Flightys Noise Wall Inspections

Appendix B – Porirua Link Roads Noise Wall Inspection

Appendix C – Noise Wall Heights at Linden

Appendix D – Traffic Forecasting Report

Appendix E – Predicted Noise Levels

Appendix F – Noise Monitoring Locations

Appendix G – Monitoring Summary Sheets

Appendix H – Noise Monitoring Requirements