Styles Group
Acoustics & Vibration Consultants

ASSESSMENT OF NOISE EFFECTS

STAGE 1 AND 2
DRURY CENTRE PRECINCT

PREPARED FOR

Kiwi Property No.2 Limited

DATE

27 February 2025

Acoustic assessment prepared by Styles Group for Kiwi Property No.2 Limited.

REVISION HISTORY

Rev:	Date:	Comment:	Version:	Prepared by:	Reviewed by:
1	16/01/25		Draft	Jon Styles, MASNZ Director and Principal Styles Group	Gemma Sands Consultant Styles Group
2	17/02/25		Final Draft		
3	27/02/25		Final		

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Statement of Experience – Jon Styles

I am and have been the Director and Principal of Styles Group Acoustics and Vibration Consultants for 20 years. I am a Council Member of the Acoustical Society of New Zealand (ASNZ) and I am on the Board of Directors of the Australasian Association of Acoustical Consultants (AAAC).

I have over 24 years' experience in advising on the management of noise and vibration effects, including the construction, maintenance and operational noise effects of major and strategic transport infrastructure (including port, road, air and rail) and the development of provisions to improve the compatibility of residential development around such infrastructure.

I have undertaken a significant number of acoustic assessments across New Zealand for projects subject to acoustic treatment controls to manage noise generated from business activities and transport infrastructure. I am regularly engaged by Councils across New Zealand to review resource consents and Notices of Requirement subject to noise and vibration standards.

I am a regular and experienced expert witness for Council, Environment Court, District Court and High Court and Board of Inquiry hearings. I confirm that, in my capacity as author of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Executive summary

Styles Group has assessed the operational noise and construction noise and vibration effects associated with the subdivision and development of land for Stage 1 and 2 of the Drury Metropolitan Centre (the Project). The Project comprises a range of commercial, retail, accommodation and community buildings and activities. This report focusses on noise and vibration effects from Stage 2 only.

Summary of construction noise and vibration effects

This report assesses compliance with the relevant construction noise and vibration standards contained in Chapter E25 *Noise and Vibration.* This report specifically addresses the construction noise and vibration effects of the works required to construct the Project, including bulk earthworks, civil works such as road construction, building platform construction, installation or services and construction of the buildings and other features.

The key findings of this report in relation to construction noise and vibration effects are:

- Construction noise and vibration can be managed to comply with the noise permitted noise and vibration limits prescribed by the Auckland Unitary Plan (AUP) for long term construction projects for the vast majority of the works at occupied buildings that are more than 50m from the closest high- noise generating construction work.
- The construction noise and vibration limits apply at any building that is occupied during construction work. Our assessment finds that the receiving environment is dynamic, and several adjacent sites are subject to Designations for large-scale infrastructure that is planned or under construction (Drury Central Interchange and SH1- Takanini to Drury). This means that some receivers to the north and west of the Site are unlikely to exist at the time construction on this Project commences. There is also potential for new development to establish on the adjacent BMUZ land in proximity to the northern and eastern Site boundaries.
- The proposal is to prepare and implement a Construction Noise and Vibration Management Plan (CNVMP) that will identify the receivers that physically exist at the time construction work on this Project commences. The CNVMP will specify the measures to ensure that construction noise and vibration levels do not exceed the limits specified below.

Resource consent is sought for:

- An exceedance of the permitted construction noise limits of E25.6.27 by up to 10dB (80dB L_{Aeq} and 95dB L_{AFmax}) when the permitted noise standards of 70dB L_{Aeq} and 85dB L_{AFmax} would otherwise apply (during the daytime Monday to Saturday); and

- To exceed the permitted vibration amenity limits of E25.6.30 (b) of 2mm/s PPV but comply with the vibration limits to avoid building damage at all times (no greater than 5mm/s PPV) and only at the same times that the exceedance of the construction noise limit applies.

We expect that any exceedances of the permitted standards will be confined to areas of the adjacent BMUZ and BMCZ land to the north and east of the Site when high noise or vibration generating construction work is within 50m of any occupied building. The sites that may receive construction noise and vibration (amenity) levels that are higher than the permitted standards include 54 Flanagan Road, 117,121 and 131 Fitzgerald Road and the closest potential future development within Stage 1 of the Drury Centre. Exceedances will only occur at proximate development that physically exists and is occupied when construction work is underway.

The proposal is to manage construction noise and vibration through a detailed CNVMP. The CNVMP will include a specific section on the management of effects for works that cannot practicably comply with the permitted standards for construction noise and vibration at the receivers that are occupied when construction works is underway.

The exceedances are predicted to be temporary and intermittent. The construction noise and vibration levels at the nearest receivers will be significantly lower than the permitted standards for the vast majority of the Project. All receivers separated from the closest areas of construction work by distances greater than 50m are predicted to receive construction noise and vibration levels that comply with the permitted standards.

Our assessment finds that construction noise and vibration effects will be reasonable.

Summary of compliance with operational noise standards

This report assesses compliance with the relevant noise standards contained in Chapter E25 *Noise and Vibration* and Chapter I450 *Drury Centre Precinct.* These standards are designed to ensure that:

- Activities Sensitive to Noise (ASN) within the Drury Centre Precinct are located and designed to achieve compatibility with the noise levels generated from the rail network and business activities
- Land use activities are designed, located and managed to achieve compliance with the maximum permitted noise levels that apply at all adjacent sites.

The key findings of this report are:

- The masterplan has been designed to ensure that buildings containing ASN are more than 60m from the rail corridor and well separated from the state highway corridor. This avoids the need to acoustically treat ASN within 60m of these noise sources.
- All buildings containing ASN will be acoustically treated to comply with the façade design and mechanical ventilation and cooling requirements specified by Standard

E25.6.10. The AUP requires this for all ASN in the Business zones. The extent of acoustic treatment will be straightforward and will be specified in the detailed design phase when the appropriate level of construction detail is available.

- Noise generating activities within the site can be designed and operated to achieve compliance with the maximum permitted noise levels that apply at all adjacent sites.
- The proposal is to comply with all operational noise standards that control noise levels generated and received between sites
- We recommend that an Acoustic Design Report (**ADR**) is prepared to demonstrate that the Major Retail Development on Lot C and buildings containing ASN have been designed and constructed to comply with the relevant standards in Chapter E25. The ADR should be submitted to the Council before the commencement or occupation of the relevant activity(s). All other land use activities are expected to achieve straightforward compliance with the relevant standards in Chapter E25 without any specific acoustic design input.

We have prepared a brief set of outcomes for conditions of consent to deliver. We have worked with the Project team to draft the final set of conditions.

1.0 Introduction

Kiwi Property No.2 Limited has engaged Styles Group to assess the operational and construction noise effects associated with the subdivision and development of land for Stage 1 and 2 of the Drury Metropolitan Centre at 64, 68, 108, 120 and 132 Flanagan Road, 139, 133, 155, 173, 189 Fitzgerald Road and 61 Brookfield Road, Drury (the **Site**).

This acoustic assessment evaluates the proposal against the relevant noise standards contained in Chapter E25 *Noise and Vibration* and Chapter I450 *Drury Centre Precinct* of the Auckland Unitary Plan Operative in Part (**AUP**). This report includes:

- An assessment against the relevant construction noise and vibration standards for permitted activities
- An assessment of compliance with the relevant noise standards that are designed to ensure Activities Sensitive to Noise (**ASN**)[1] are compatible with noise generated from rail and Business Zone activities
- An assessment of compliance with the relevant noise standards that are designed to control operational noise levels generated and received between sites.

We have prepared a set of outcomes for conditions of consent to deliver.

Our assessment is based on our understanding of the proposal following ongoing discussions with the project team and review of the proposed masterplan. This report should be read in conjunction with the application site plans and the Assessment of Environmental Effects. A glossary of acoustical terms used within this document is attached as Appendix A.

2.0 The Proposal

Stage 2 of the Drury Centre comprises a range of commercial, retail, accommodation and community buildings and activities (the **Project**). These activities compliment the development and activities approved in Stage 1.

The proposed accommodation activities include hotels, apartments and residential dwellings. These activities are defined as ASN by the AUP.

The Project also includes the creation of open spaces, bulk earthworks, installation of infrastructure and roading network.

[1] Chapter J1 of the AUP defines ASN as:
"Any dwelling, visitor accommodation, boarding house, marae, papakāinga, integrated residential development, retirement village, supported residential care, care centres, lecture theatres in tertiary education facilities, classrooms in education facilities and healthcare facilities with an overnight stay facility"

Stage 2 follows the resource consent granted for the subdivision and development of Stage 1 of the Drury Centre, directly to the south of the Site. The proposal includes a fee simple subdivision of Stage 1 superlots, comprising the creation of 292 residential lots and 13 JOALs.

This report focusses on noise and vibration effects from Stage 2 only. No noise and vibration effects are expected to arise from the subdivision of the Stage 1 superlots. The Stage 1 land subject to the proposed subdivision is already subject to an approved land use consent for enabling earthworks.

2.1 The Project Masterplan

The Project Masterplan is reproduced below. We have marked it up to show the critical aspects for construction and operational noise effects that are discussed in further detail throughout this report.

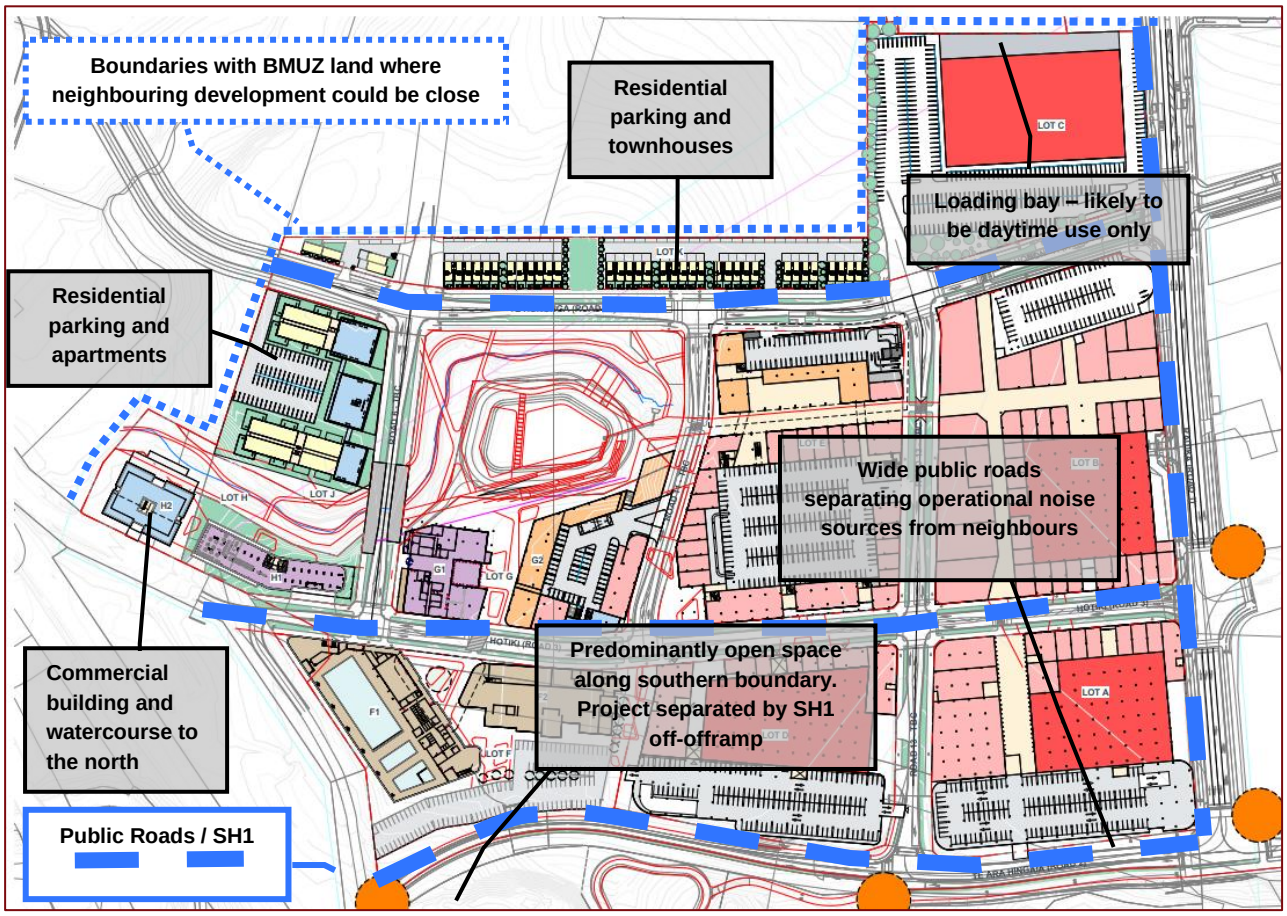

Figure 1 Masterplan- key aspects for noise

Our markup of the Masterplan shows that much of the development will be separated from the physically existing and future / legal receiving environment by wide public roads or open space. The land adjacent to the northern and north-eastern boundaries may be occupied with future development built reasonably close to the Site. That potential future development is all in the

BMUZ where ASN must be acoustically treated, and where the noise standards for permitted activities are reasonably high. The receiving environment is described in the following section.

3.0 The Site and receivers

The majority of the Site is in the Business Metropolitan Centre Zone (**BMCZ**) and sub-precinct A of the Drury Centre Precinct. The eastern-most part of the Site is in the Business Mixed Use Zone (**BMUZ**) and sub-precinct C of the Drury Centre Precinct.

The land surrounding the Site has a dynamic and varied zoning pattern, containing a range of land use activities. Figure 1Figure 2 displays the zoning arrangement surrounding the Site. The zones and established land use activities include:

i. **To the west of the Site**: The residential dwellings on Flanagan Road in the Future Urban Zone (**FUZ**).

ii. **To the north of the Site**: The residential dwellings on Flanagan and Waihoehoe Roads, in the Drury Centre Precinct and Business Mixed Use Zone (**BMUZ**).

iii. **To the east of the Site:** The residential dwellings accessed from Fitzgerald Road, in the BMUZ and Drury Centre Precinct.

iv. **To the south of the Site:** The land in the Business Metropolitan Centre Zone and Drury Centre Precinct that is currently being developed for Stage 1 of the Drury Centre Precinct.

The North Island Main Trunk rail line (**NIMT**) runs along the northern side of Flanagan Road and State Highway 1 (**SH1**) is located to the west of the Site.

We have assessed the potential noise effects on the **physically existing receiving environment** and the **future / legal receiving environment**. We have assessed the effects on the future / legal receiving environment on the basis that the BMUZ and BMCZ zoning of the adjacent land provides for intensification. Large-scale infrastructure projects have also been confirmed on the adjacent land.

3.1 Physically existing receiving environment

The nearest physically existing receivers and the separation distances to the nearest works are presented in Figure 2 and set out in Table 1. Distances have been measured using the Auckland Council Geomaps GIS viewer.

3.2 Future / legal receiving environment

The dynamic nature of the receiving environment means that several existing receivers may not exist at the time construction on this Project commences.

Our assessment of the future / legal receiving environment is based on the possibility that development could be completed and occupied on neighbouring BMUZ and BMCZ sites before or during construction of the Project. Our assessment assumes that such development could potentially be established within 5m of the Site boundaries that interface with other BMUZ and BMCZ sites. We have assumed that the nature of any future development is consistent with the underlying zone and precinct provisions.

3.2.1 Land subject to Designations for infrastructure

We also understand that several of the adjacent dwellings may not exist or may not be occupied at the time construction on this Project commences as they have been designated for major transport infrastructure projects.

KiwiRail's Designation 6309 for the Drury Central Interchange affects several adjacent properties to the north of the Site. The sites subject to the designation include 8, 16, 20, 22, 24, 28, 32, 36, 44 and 54 Flanagan Road and 28, 31, 35, 39, 41, 44, 45, and 67 Waihoehoe Road. Figure 2 displays the designation footprint and the concept plan for the transport interchange. The concept plan shows that several of the adjacent sites that are currently occupied by residential dwellings and buildings will be removed to facilitate the construction of the project. KiwiRail's website states that construction is expected to be completed from late 2025.

Waka Kotahi's Designation 6706 for SH1 Takanini to Drury affects several of the adjacent FUZ sites on Flanagan Road. We understand that several of the adjacent dwellings will be removed to facilitate the construction of the project. The designation footprint is also displayed in Figure 2.

3.3 Overall approach to managing noise and vibration effects on future receivers

This assessment sets out how construction noise and vibration and operational noise will be managed at all existing and potential future receivers.

The proposal is to manage construction noise and vibration effects at the receivers that physically exist at the time of construction through a Construction Noise and Vibration Management Plan (CNVMP). The CNVMP will be prepared prior to commencement of construction work and updated as required throughout the Project. The CNVMP will identify the receivers that physically exist when construction on the Project commences and prescribe the measures to manage effects on those receivers.

Operational noise levels will be managed by complying with the relevant permitted noise standards for noise generated and received between sites according to the underlying zoning and relevant AUP standards.

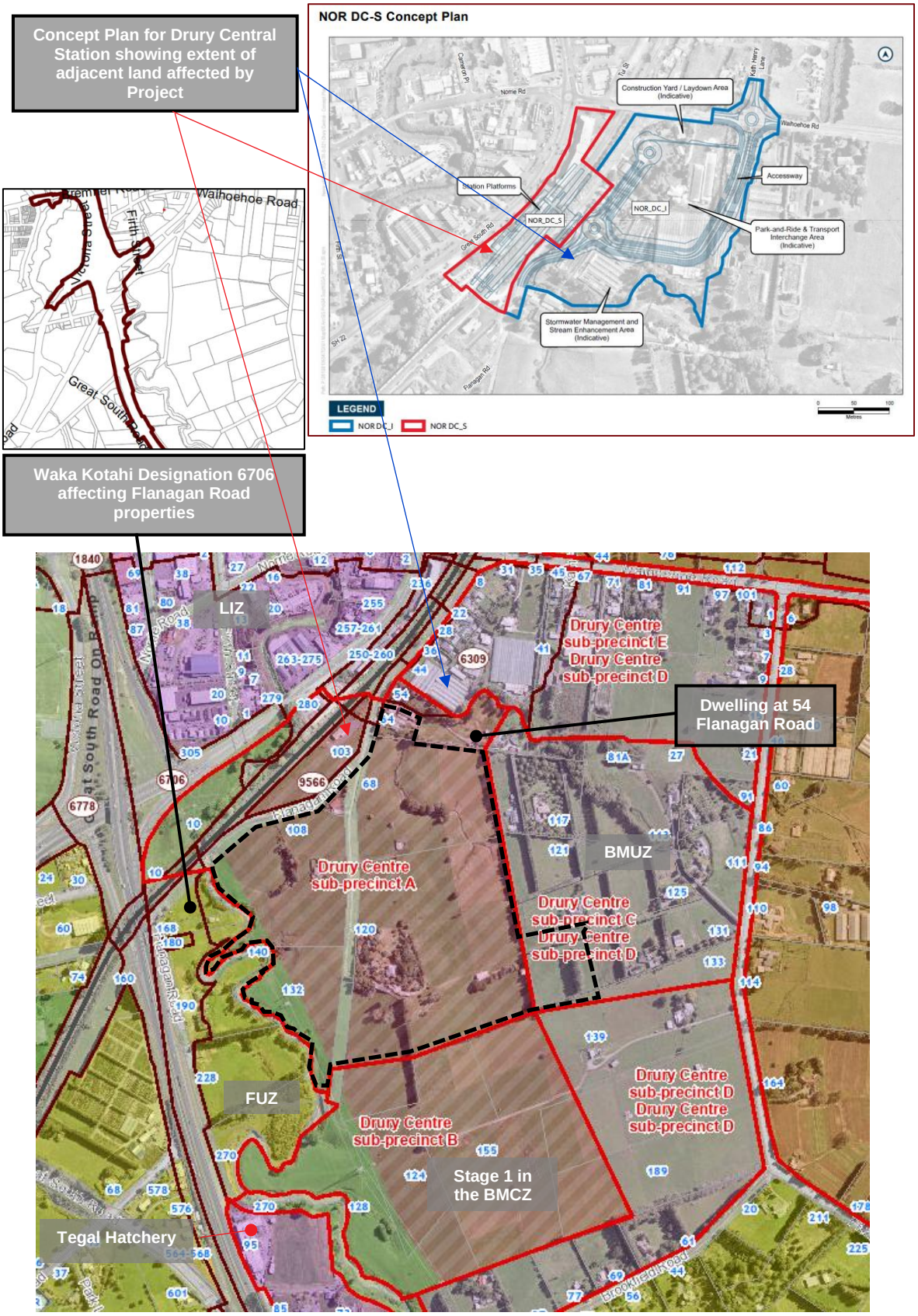

Figure 2 Zones, precincts and extent of Designations 6309 and 6706. Stage 2 site boundaries shown as black-dash

Table 1: Nearest receivers to Stage 2

Address	Zone	Building type	Separation distance from building façade to nearest potential construction works
168 Flanagan Road *Dwelling inside Designation 6706*	Future Urban Zone	Single level dwelling	150 m
180 Flanagan Road *Dwelling inside Designation 6706*	Future Urban Zone	Single level dwelling	150 m
190 Flanagan Road *Dwelling inside Designation 6706*	Future Urban Zone	Single level dwelling	150 m
95 Tegal Road	Light Industry Zone	Chicken hatchery and worker accommodation	>250m
280 Great South Road	Business Mixed Use Zone	Contractors yard	100m
250 Great South Road	Business Mixed Use Zone	Drury Railway Station	50m
44 Flanagan Road* *Designation 6309. See 3.4*	Business Mixed Use Zone (Drury Centre)	Glasshouses	33m
54 Flanagan Road* *Part of site inside Designation 6309 See 3.5*	Business Mixed Use Zone (Drury Centre)	Single level dwelling/ Bed and Breakfast	2.5m from boundary of sub-precinct A Approximately 20m from nearest building
117 Fitzgerald Road	Business Mixed Use Zone (Drury Centre)	Single level shed containing accommodation facilities Two story dwelling	12m from eastern boundary of sub-precinct A 63m from eastern boundary of sub-precinct A
121 Fitzgerald Road	Business Mixed Use Zone (Drury Centre)	Single level dwelling	87m from eastern boundary of sub-precinct A

Address	Zone	Building type	Separation distance from building façade to nearest potential construction works
131 Fitzgerald Road	Business Mixed Use Zone (Drury Centre)	Single level dwelling	74m from eastern site boundary
139 Fitzgerald Road	Business Mixed Use Zone (Drury Centre)	Single level dwelling	135m from eastern site boundary
Brookfield Road dwellings	Business Mixed Use Zone (Drury Centre	Single level dwellings	>350m

3.4 44 Flanagan Road

The glasshouses at 44 Flanagan Road are close to the northern boundary of the Site.

We understand that the buildings on 44 Flanagan Road will be removed to facilitate the construction of the Drury Central Interchange. We understand that the development of the Drury Central Interchange is likely to precede development on the Site. Our assessment assumes that the buildings on 44 Flanagan Road will be removed by the time construction work for this project may commence and that there will be no other future buildings containing ASN on this site based on the concept plans for the Interchange.

3.5 54 Flanagan Road

Designation 6309 affects the western part of 54 Flanagan Road; however the existing dwelling is outside the designation footprint.

Our assessment assumes that the dwelling on 54 Flanagan Road may still exist at the time that construction works on this project commence. The construction noise levels could be higher than the permitted standards if the dwelling is occupied when construction works in proximity to the dwelling are taking place.

We also consider it reasonable to assume that this site may be intensified in the future in accordance with its BMUZ Zoning and that new buildings containing ASN may be occupied before or during construction of this Project.

3.6 Tegel Hatchery

The nearest part of the Tegel chicken hatchery site at 95 Tegal Road[2] is located approximately 250m south of Stage 2. This is a significant separation distance from the Project. Construction noise and vibration and operational noise generated from the Site will readily comply with the permitted noise standards that apply at the Tegal hatchery without the need for any specific mitigation.

4.0 Assessment of construction noise levels

4.1 AUP permitted construction noise standards

The Site is in the BMCZ and BMUZ. The permitted limits for construction noise are set out in Standard E25.6.27 (for works undertaken in the BMUZ) and Standard E25.6.28 (for works undertaken in the BMCZ):

> **E25.6.27. Construction noise levels in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone**
>
> 1) Noise from construction activities in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone must not exceed the levels in Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone when measured 1m from the façade of any building that contains an activity sensitive to noise that is occupied during the works.

Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone

Time of week	Time Period	Maximum noise level (dBA)	
		L_{eq}	L_{max}
Weekdays	6:30am – 7:30am	60	75
	7:30am – 6:00pm	75	90
	6:00pm - 8:00pm	70	85
	8:00pm - 6:30am	45	75
Saturdays	6:30am – 7:30am	45	75
	7:30am – 6:00pm	75	90
	6:00pm - 8:00pm	45	75
	8:00pm - 6:30am	45	75
	6:30am – 7:30am	45	75

[2] We understand the Tegel land includes 95 and 115 Tegal Road and 250, 260 and 270 Flanagan Road.

Time of week	Time Period	Maximum noise level (dBA)	
		L_{eq}	L_{max}
Sundays and public holidays	7:30am – 6:00pm	55	85
	6:00pm - 8:00pm	45	75
	8:00pm - 6:30am	45	75

2) Noise from construction activities in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone must not exceed the levels in Table E25.6.27.2 Construction noise levels for noise affecting any other activity when measured 1m from the façade of any other building that is occupied during the works.

Table E25.6.27.2 Construction noise levels for noise affecting any other activity

Time Period	Maximum noise levels L_{eq} (dBA)
7:30am – 6:00pm	75
6:00pm – 7:30am	80

3) For a project involving a total duration of construction work that is less than 15 calendar days, the noise levels in Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone and Table E25.6.27.2 Construction noise levels for noise affecting any other activity above may be increased by 5dB in all cases.

4) For a project involving a total duration of construction work that is more than 20 weeks the noise limits in Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone and Table E25.6.27.2 Construction noise levels for noise affecting any other activity above may be decreased by 5dB in all cases.

E25.6.28. Construction noise levels in the Business – City Centre Zone and the Business – Metropolitan Centre Zone

(1) Construction activities in the Business – City Centre Zone and the Business – Metropolitan Centre Zone must comply with Standard E25.6.27(1) above for any receiver not in a Business – City Centre Zone or a Business – Metropolitan Centre Zone and must not exceed the levels in Table E25.6.28.1 Construction noise levels for construction less than 15 consecutive calendar days duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone and Table E25.6.28.2 Construction noise levels for construction of 15 consecutive calendar days or more duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone when measured for any 30 minute period 1m from the façade of any building in the Business – City Centre Zone or the Business – Metropolitan Centre Zone that is occupied during the work.

…..

Table E25.6.28.2 Construction noise levels for construction of 15 consecutive calendar days or more duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone

Time	$L_{Aeq(30min)}$	L_{AFmax}
Monday to Friday 6.30am-10.30pm	75 dB	90 dB
Saturday 7am- 11pm	80 dB	90 dB
Sunday 9am- 7pm	65 dB	85 dB
All other times (night time)	60 dB	75 dB

Where external measurement of construction noise is impractical or inappropriate, the upper limits for the noise measured inside the building will be 20dB less than the relevant levels in Table E25.6.28.1 Construction noise levels for construction less than 15 consecutive calendar days duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone and Table E25.6.28.2 Construction noise levels for construction of 15 consecutive calendar days or more duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone above.

Standard E25.6.1(3) of the AUP states that noise from any construction work activity must be measured and assessed in accordance with the requirements of New Zealand Standard NZS 6803: 1999 *Acoustics – Construction Noise*.

This means the assessment position for all construction noise is 1m from the most exposed façade of any occupied building.

4.2 Summary of construction noise limits

All noisy construction works will be undertaken between 07:30 and 18:00, Monday to Saturday. The work will take more than 20 weeks to complete. The relevant permitted construction noise limits are therefore 5 dB lower than those stated in Tables E25.6.27.1 and E25.6.27.2 of the AUP.

The permitted construction noise limits for the proposed works on the Site are summarised as follows:

Receivers in the BMCZ

- 75 dB L_{Aeq} and 90 dB L_{Amax} at 1 m from the most exposed façade of any building in the BMCZ (for works undertaken between Monday to Friday 6.30am-10.30pm).
- 80 dB L_{Aeq} and 90 dB L_{Amax} at 1 m from the most exposed façade of any building in the BMCZ (for works undertaken between the hours of 7am- and 11pm on Saturday)

Receivers in all zones <u>except</u> the BMCZ

- 70 dB L_{Aeq} and 85 dB L_{Amax} at 1 m from the most exposed façade of any occupied dwelling or other building containing an ASN (that is not in the BMCZ)
- 70 dB L_{Aeq} at 1 m from the most exposed façade of any other occupied building (that is not in the BMCZ).

4.3 Reasons for consent- construction noise

Appendix B includes construction noise level predictions based on the nature of construction work that we expect to be undertaken.

Our assessment finds that noise levels from civil works could intermittently reach levels as high as 80dB L_{Aeq} when measured and assessed at any building on the adjacent BMUZ and BMCZ, where any building is occupied and within 50m of the closest area of high-noise generating construction work on the Site.

Resource consent is sought as a restricted discretionary activity to authorise an exceedance of the permitted construction noise limits, including:

a) Construction noise received in the BMUZ - Standard E25.6.27 by up to 10dB when the permitted 70dB L_{Aeq} limit normally applies[3]; and

b) Construction noise received in the BMCZ - Standard E25.6.28 by up to 5dB when the permitted 75dB L_{Aeq} limit normally applies[4]

The exceedance is only likely to occur for short periods when construction works are undertaken within 10-20m of the receiving building. Example situations might include several hours over a day or a few days when a bulldozer and/or large compactor might be required for earthworks near to the boundary, boring pile holes within 30-40m of a receiver or concrete pours required near to the boundary.

Figure 3 displays the adjacent sites (shaded orange) where the predicted exceedance may occur, when high noise generating construction activity is undertaken near to the Site boundary (area shaded blue). The effects areas presented in Figure 3 are approximate. The proposal is to submit a CNVMP prior to construction based on the specific equipment and durations of work phases for the Project. The CNVMP will confirm the distances in which noise (and vibration) generating activities may require mitigation or management.

The adjacent sites that may receive construction noise levels higher than the permitted standards include:

i. The existing dwelling on 54 Flanagan Road if it is occupied during construction

ii. Any future occupied buildings(s) on 54 Flanagan Road that are established near to the boundary of the Site.

[3] Construction work undertaken between 07:30 and 18:00, Monday to Saturday

[4] Construction work undertaken between 6.30am and 10.30pm, Monday to Friday

iii. The existing barn building containing accommodation on 117 Fitzgerald Road.

iv. Any future occupied buildings(s) on 117 Fitzgerald Road that are established near to the boundary of the Site.

v. Any future occupied buildings(s) on 121 Fitzgerald Road that are established near to the boundary of the Site.

vi. Any future occupied buildings(s) on 131 Fitzgerald Road that are established near to the boundary of the Site.

vii. Any future occupied buildings(s) on the Stage 1 land in the BMCZ to the South.

These sites are shaded orange in Figure 3.

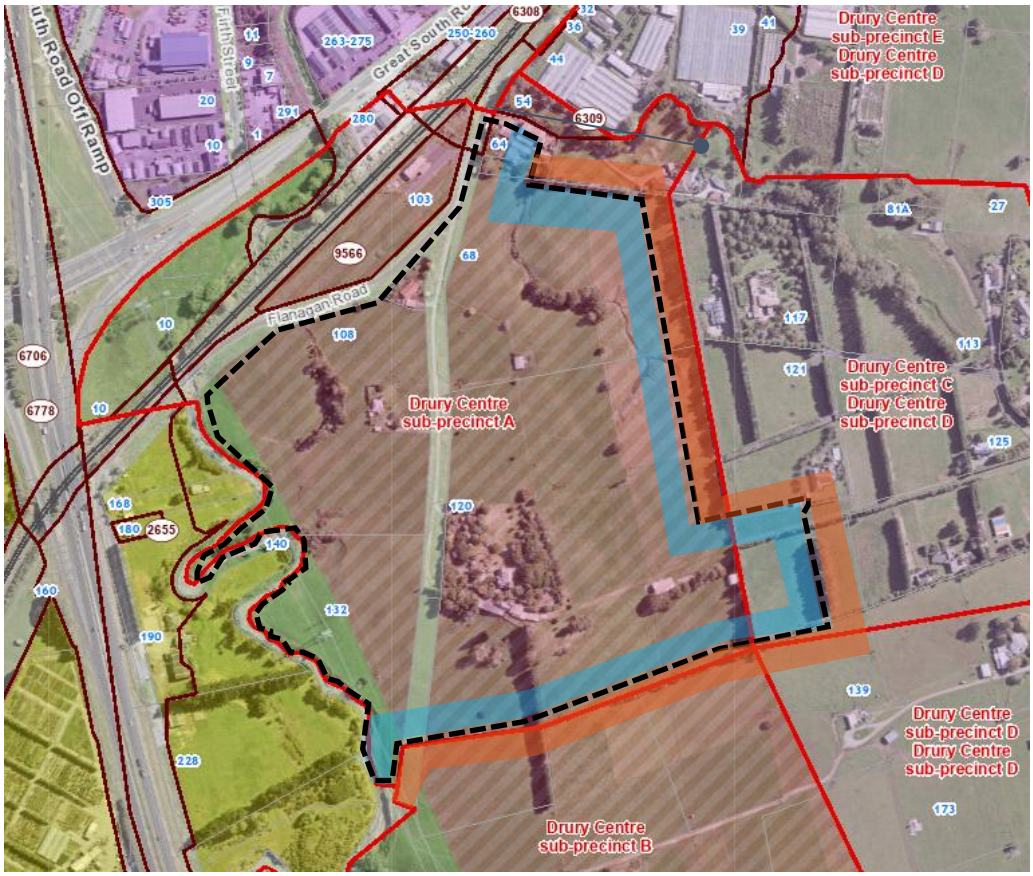

Figure 3 Areas of adjacent sites (shaded orange) that may receive construction noise and vibration (amenity) levels higher than the permitted standards if high noise /vibration generating construction work is undertaken within 50m* of any occupied building

Distances are approximate only and will be confirmed in the CNVMP.

The proposal is to manage construction noise (and vibration) effects at the receiver that physically exist and are occupied at the time of construction through the CNVMP. The CNVMP will set out the specific measures to control construction noise levels to be no greater than 80dB L_{Aeq} and 95dB L_{AFmax} at any occupied building on an adjacent site.

We expect that it would be typical for the infringements of the permitted noise standards to be exceeded for a cumulative total of up to 15-20 working days across the Project. The infringements will be intermittent and generally short term (even over a day) as works progress across the Site and the different phases of work near to the receivers occurs.

We expect that construction works further inside the Site boundaries will be compliant with the relevant permitted construction noise standards for the remainder of the construction phase.

4.4 AUP permitted construction vibration standards

Standard E25.6.30 *Vibration* of the AUP includes limits to manage the potential effects of vibration generated by construction and demolition activities.

Standard E25.6.30 is reproduced below:

E25.6.30. Vibration

1) Construction and demolition activities must be controlled to ensure any resulting vibration does not exceed:

   a. the limits set out in German Industrial Standard DIN 4150-3 (1999): Structural vibration – Part 3 Effects of vibration on structures when measured in accordance with that Standard on any structure not on the same site; and

   b. the limits in Table E25.6.30.1 Vibration limits in buildings in any axis when measured in the corner of the floor of the storey of interest for multi-storey buildings, or within 500mm of ground level at the foundation of a single storey building.

Table E25.6.30.1 Vibration limits in buildings

Receiver	Period	Peak Particle Velocity Limit (mm/s)
Occupied activity sensitive to noise	Night time 10pm to 7am	0.3 mm/s
	Daytime 7am to 10pm	2 mm/s
Other occupied buildings	At all times	2 mm/s

Works generating vibration for three days or less between the hours of 7am to 6pm may exceed the limits in Table E25.6.30.1 Vibration limits in buildings above, but must comply with a limit of 5mm/s peak particle velocity in any axis when measured in the corner of the floor of the storey of interest for multi-storey buildings, or within 500mm of ground level at the foundation of a single storey building, where:

   i. all occupied buildings within 50m of the extent of the works generating vibration are advised in writing no less than three days prior to the vibration-generating works commencing; and

ii. the written advice must include details of the location of the works, the duration of the works, a phone number for complaints and the name of the site manager

4.5 Predicted construction vibration and reasons for consent

4.5.1 Building damage limits

The DIN[5] limits in Standard E25.6.30(1)(a) are designed to ensure that construction vibration avoids damage to buildings. The proposal is predicted to comply with the vibration limits in Standard E25.6.30(1)(a) for avoiding building damage at all times. Our assessment finds that vibration generated by construction work on the Site will comply with the limits for avoiding building damage without requiring any specific mitigation. This is due to the nature of construction work near to the boundary and the distance between any vibration-generating activities on Site and the nearest existing and potential future buildings.

4.5.2 Amenity limits

The PPV limits in Table E25.6.30(1)(b) are designed to manage the potential effects of vibration on the amenity of building occupants. Compliance with the AUP permitted construction vibration amenity limit (2 mm/s PPV) set out in E25.6.30(1)(b) will depend on several factors, including:

- Whether or not vibratory compaction works are required at the site boundary
- The subsoil conditions
- The response of the receiving building
- Whether or not the receiving buildings are occupied during the works.

Appendix C presents typical vibration levels for the relevant construction activities. Our assessment finds that the permitted vibration amenity limit of 2 mm/s PPV may be exceeded if:

- Vibratory compaction is undertaken within approximately 20-30m of any neighbouring occupied building
- Other heavy tracked plant is used within 10-20m of any neighbouring occupied building.

Resource consent is sought to authorise temporary and intermittent exceedances of the vibration amenity limits in E25.6.30(1)(b) at the sites identified in Section 4.3 and Figure 3.

These distances are approximate as the plant and equipment has not been specified at this early stage. The proposal is to prepare and implement a CNVMP to manage vibration levels to no greater than 5 mm/s PPV at any adjacent building that is occupied during the works. The

[5] *German Industrial Standard DIN 4150-3 (1999): Structural vibration – Part 3 Effects of vibration on structures*

CNVMP will set out more accurate distances and mitigation measures when the actual plant and work methodologies are known.

The proposal is predicted to comply with the vibration amenity limits at all other receivers.

5.0 Construction noise and vibration management plan

In our experience, a CNVMP is an important tool for the successful management of noise and vibration effects on receivers in proximity to large scale construction works. In this case, it will be designed to mitigate the effects of the potential minor infringements of the construction noise and vibration amenity limits at the receivers that physically exist at the time construction works on this Project commence

We recommend that a CNVMP is prepared for the project with reference to Annex E of the construction noise Standard NZS 6803:1999. This should be submitted to the satisfaction of Auckland Council before any works start on site.

The overall aim of the project with respect to construction noise and vibration is to ensure that the Best Practicable Option is adopted so the effects are minimised to the greatest extent practicable.

The following mitigation measures will be adopted where practicable to reduce noise and vibration emissions from the Site so the noise levels are reasonable for the surrounding receivers.

i. All occupied receivers within 50 m of the Site boundary will be advised in writing about the works. The advice will inform the receivers that construction noise will be experienced during the works and vibration may be perceptible at times during the day when works are near to the site boundary. The advice will also include:

- The hours of works on site
- The expected (and approximate) duration of the earthworks and vibratory compaction
- A contact name and telephone number for any complaints, questions or concerns, or to discuss any sensitive times for noise or vibration.

ii. The CNVMP must specify the minimum unmitigated separation distances where additional mitigation must be employed to manage or minimise construction noise and vibration effects. The predictions in Table 2 (Appendix B) and Table 3 (Appendix C) of this report shall be updated based on the specific plant, equipment and proposed construction methodology.

iii. The noise and vibration effects will be mitigated by restricting all noisy works to only take place between 07:00 and 18:00, Monday to Saturday. There will be no noisy works (that may exceed the permitted standards) at night or on Sundays or public holidays.

iv. The Best Practicable Option must be investigated and adopted for works that exceed the noise or vibration standards for permitted activities. This may include using smaller machinery to complete the work, using an alternative method, (such as more passes with a static roller instead of a vibratory compactor) or temporary acoustic screening. The process for this must be set out in the CNVMP.

v. All mitigation measures required to ensure that construction noise levels do not exceed 80dB L_{Aeq} and 95dB L_{AFmax} and vibration levels do not 5mm/s PPV at any occupied building that is occupied during works.

The CNVMP will set out how these matters will be addressed, as well as general details such as (without limitation):

- The construction noise and vibration limits for the project
- Limitations on working hours for specific activities and work areas
- Specifications and requirements for acoustically effective barriers
- Minimum separation distances for compliance with the noise and vibration limits in the consent conditions
- Procedures for response to neighbour's concerns and dealing with any complaints
- Procedures for any noise and vibration monitoring during the works
- Details of any further noise and vibration mitigation measures available
- Details for advising the occupiers of the neighbouring buildings of the works, including when the highest noise levels and perceptible vibration can be expected
- Details for ensuring that contractors and operators on site are aware of the requirement to minimise noise and vibration effects on the neighbouring sites.

6.0 Assessment of construction noise and vibration effects

We have reviewed the potential construction noise and vibration effects arising from proposed civil and general construction works associated with the Project, including preparation of building platforms, future road construction, and trenching for drainage and utilities and construction of buildings.

We understand that the proposed construction works will not include any rock breaking or blasting due to the nature of the ground conditions.

Resource consent is sought for:

1) An exceedance of the permitted construction noise limits of E25.6.27 (for receivers in the BMUZ) by up to 10dB (80dB L_{Aeq} and 95dB L_{AFmax}) when the permitted noise standards of 70dB L_{Aeq} and 85dB L_{AFmax} would otherwise apply;

2) An exceedance of the permitted construction noise limits of E25.6.28 (for receivers in the BMCZ) by up to 5dB (80dB L_{Aeq} and 95dB L_{AFmax}) when the permitted noise standard of 75dB L_{Aeq} would otherwise apply; and

3) To exceed the permitted vibration amenity limits of 2mm/s PPV in E25.6.30 (b) but to comply with the vibration limits to avoid building damage at all times (5mm/s PPV) and only when the infringements of the permitted construction noise standards is authorised.

6.1 Assessment of construction noise effects

The proposed works will comply with the permitted construction noise limits at most receivers for the vast majority of the construction phase. There may be some intermittent and short-term infringements of these limits when works are very close to occupied buildings in the physically existing and future / legal receiving environment. Example situations might include several hours over a day or a few days when a bulldozer and/or large compactor might be required for earthworks near to the boundary, boring pile holes within 30-40m of a receiver or concrete pours required near to the boundary. Noise mitigation measures will be employed to ensure that the infringements will not exceed 80dB L_{Aeq} during normal work hours.

The adjacent sites where the predicted exceedances may occur when high noise generating construction activity is undertaken near to the Site boundary are displayed in Figure 3. This includes Stage 1 land that is owned by the applicant.

We expect that it will be likely for the infringements of the permitted noise and vibration standards to be exceeded at any one receiver for a cumulative total of up to 15-20 working days across the Project. The infringements will be intermittent and generally short term (even over a day) as works progress across the Site and the different phases of work near to the receivers occurs. As set out above, we expect that the maximum noise level can be controlled to be no greater than 80dB L_{Aeq} at any occupied building.

Works undertaken close to neighbouring receivers and that might exceed the permitted standards may affect concentration and telephone conversations indoors. Occupants may not want to spend any length of time outside when noisy works occur near to the site boundary. Such effects from construction noise are typical and are anticipated and provided for by Chapter E25 of the AUP.

All “future receivers” established after the date that the current BMUZ and BMCZ zonings were confirmed are required to be acoustically treated in accordance with Chapter E25. This acoustic treatment will provide significant mitigation from construction noise.

Works further inside the boundary of the Site will be compliant with the noise standards for permitted activities for much or all of the remainder of the construction phase.

The proposal is to implement a CNVMP that will ensure the timing, duration and level of construction noise will be reasonable for the receivers that may exist at the time of construction.

6.2 Assessment of construction vibration effects on amenity

The permitted vibration amenity limit of 2 mm/s may be temporarily exceeded when vibratory compaction works are undertaken within approximately 20-30m of any neighbouring occupied building, or other heavy tracked plant is operated within 10-20m of any neighbouring occupied building.

The vibration limits may be exceeded if the BMUZ land to the north and northwest is developed and occupied very close to the Site boundary prior to such works commencing. Construction vibration between 2 mm/s and 5 mm/s will be clearly felt within buildings. This is typically tolerated providing that it occurs intermittently, during the day, and where there is effective prior engagement.

Potential effects on building damage from vibration are assessed under the AUP in accordance with the German Standard DIN 4150–3:1999 *Structural vibration, Part 3: Effects of vibration on structures*. The guideline values recommended by this standard to avoid cosmetic damage occurring in dwellings from short-term vibration at dominant frequencies of 15 Hz to 40 Hz are 6.25 mm/s to 12.5 mm/s PPV (measured at the foundations of the structure). Vibration from the proposed activity will be significantly lower than these guideline values.

Any perceptible vibration would be for short periods when heavy plant is operated at the Site boundary. Cosmetic damage to buildings from construction vibration, such as cracked plaster or enlargement of existing cracks, will not occur based on the guidance of DIN 4150–3:1999.

We consider that construction vibration effects can be effectively managed through the following measures:

- The implementation of a CNVMP which will set out the measures by which vibration (and noise) emissions will be minimised as far as practicable or are otherwise compliant at all times
- Restricting vibration generating works, such as vibratory compaction, near to dwellings to daytime hours only
- Providing written advice to all receivers within 50m of the site boundary that construction vibration may be perceptible at times during the day when works are near to the site boundary. This will form part of the advice provided about the project in accordance with the CNVMP.

The vibration levels will comply with the permitted construction vibration amenity limits at receivers that are separated from high vibration generating construction work by distances exceeding 50m. The effects from the compliant vibration levels will range from not noticeable to noticeable but are unlikely to unreasonably disrupt residential or normal business activities.

6.3 Summary of construction noise and vibration effects

The construction noise and vibration amenity effects will only be relevant when (or if) the closest buildings are occupied when construction work on this Project commences.

There will be no adverse noise or vibration effects if the higher noise and vibration works can be scheduled to occur at times when the closest receivers are not occupied or are not otherwise sensitive. This approach may require careful planning, however such methods have been successfully used to completely avoid adverse construction effects on other projects. The extent to which it is practicable (or necessary) in this case will not be known until closer to the beginning of works and after engagement with the neighbours that are occupied when construction is underway. The CNVMP sets out the requirements to ensure that this engagement occurs.

It is our opinion that the noise and vibration from the works will not exceed a reasonable level in terms of section 16 of the Act. This includes the following considerations:

- The ability of the works to comply with the permitted construction noise and vibration limits at most receivers for the vast majority of the construction phase
- The ability of the works to comply with the permitted construction vibration limits to avoid building damage at all times
- The limited exposure times and duration of the noise and vibration exceeding the noise and vibration standards for permitted activities that will be experienced at the potentially affected sites
- The management of construction noise and vibration through a CNVMP
- Consistency with the AUP objectives and policies for construction noise and vibration set out in E25.2 and E25.3.

7.0 Assessment of operational noise effects

7.1 Noise received **within** the Site

The proposal is to develop the Site for a range of commercial, community and high-density residential activities. We understand that the nature of the development is consistent with the permitted land use activities anticipated in the BMCZ and BMUZ by the AUP.

The AUP anticipates and provides for ASN as permitted activities within the BMCZ and BMUZ of the Drury Centre Precinct. The AUP relies on the acoustic treatment requirements in Chapter E25 to achieve land use compatibility between noise generating activities and ASN in business zones. Chapter E25 also includes maximum permitted noise levels to control the level of noise that can be generated and received between sites.

The proposal is to ensure that all buildings containing ASN are located, designed and constructed to achieve compliance with the relevant standards contained in Chapters E25 and I450 *Drury Centre Precinct.*

The Project is at a relatively early design stage and there is little or no detail on many of the important noise-related aspects required to build a computer noise model or to predict noise levels with any reasonable degree of certainty. Such detail includes:

1) Traffic flows through car parking areas and private roads
2) The layout and operational nature and hours of operation of any hospitality in the Precinct, including the capacity and nature of use of any outdoor areas
3) The detailed design and frequency / nature of use of loading docks near to Site boundaries
4) The layout and operational nature and hours of operation of any other noise-generating activities in the Precinct, such as gyms, events / conference venues and function centres or recreational areas.

Accordingly, we have reviewed the Masterplan to determine if there are any obvious challenges in terms of designing, location and operating land use activities to achieve compliance with the relevant standards.

We address compliance with each standard below.

7.1.1 Standard E25.6.8- Noise levels in the BMCZ

Standard E25.6.8 requires that the noise (rating) level and maximum noise level arising from any activity in the BMCZ or BMUZ must not exceed the levels in Table E25.6.8.1, when measured or assessed as the incident level on the façade of any other building on any other site in the BMCZ or BMUZ:

Table E25.6.8.1 Noise levels in the Business – Metropolitan Centre Zone and Business Mixed Use Zone

Time	Business Metropolitan Centre Zone	Business -Mixed Use Zone
7am – 11pm	65 dB L_{Aeq}	65 dB L_{Aeq}
11pm and 7am	60 dB L_{Aeq} 65 dB at 63Hz LA_{eq} 60 dB at 125Hz LA_{eq} 75 dB L_{AFmax}	55 dB L_{Aeq} 65 dB at 63Hz LA_{eq} 60 dB at 125Hz LA_{eq} 75 dB L_{AFmax}

(2) The 63Hz and 125Hz octave band limits do not apply to fixed mechanical plant.

The proposal is for all land use activities to be located, designed and managed to comply with the maximum permitted noise levels that apply to each zone in Standard E25.6.8.

Standard E25.6.22 requires that where noise is generated by any activity in one zone (i.e. the BMCZ) is received by any activity on a site in a different zone (the BMUZ), the activity generating the noise must comply with the noise limits and standards of the zone at the receiving site. This means that activities in the BMUZ must comply with the noise limits that apply in the BMCZ and vice versa.

Our review of the Masterplan and proposed buildings and activities is that there should be no challenge to meet the noise standards for permitted activities.

7.1.2 Standard E25.6.10 – Noise sensitive spaces in the BMCZ

All buildings containing ASN (i.e. the apartments, hotel and residential development) are in the BMCZ.

Standard E25.6.10 requires that all noise sensitive spaces[6] in the BMCZ must be designed and constructed to achieve the following internal noise levels:

Unit affected	Time	Noise level
Bedrooms and sleeping areas	Between 11pm and 7am	35dB L_{Aeq} 45 dB at 63Hz L_{eq} and 40 dB at 125Hz L_{eq}
Other noise sensitive spaces	At all other times	40 dB L_{Aeq}

[6] Any indoor space within an activity sensitive to noise excluding any bathroom, water closet, laundry, pantry, walk in wardrobe, corridor, hallway, lobby, stairwell, clothes drying area, kitchens not part of a dwelling, garage or other space of a specialised nature occupied neither frequently nor for extended periods

E25.6.10(2) also requires that noise sensitive spaces are provided with mechanical ventilation and cooling. The requirements of clause G4 of the New Zealand Building Code must also be met. These requirements ensure an adequate cooling and sufficient fresh air to flush contaminants and moisture. Jointly, these requirements are designed to ensure that occupants of noise sensitive spaces can close external windows and doors to reduce external noise levels and remain adequately ventilated and thermally comfortable.

The proposal is to ensure that all buildings containing ASN (the dwellings, hotel and apartments) are designed, constructed and maintained to achieve compliance with the façade treatment and mechanical ventilation and cooling requirements in E25.6.10. The building facades will need to achieve a maximum outside to inside noise reduction of 25 dB to achieve the internal design noise level of 35dB inside bedrooms and sleeping areas. This level of noise reduction will be straightforward to achieve.

The proposal is to design and construct all buildings containing ASN so that compliance with Standard E25.6.10 is achieved. The specific acoustic treatment requirements for each building will be specified as part of the design phase when the appropriate level of construction detail is available.

7.1.3 Standard I450.6.9 – ASN within 60m of the rail corridor

Drury Centre Precinct Standard I450.6.9 requires that any building containing ASN within 60m of the rail corridor are designed with acoustic attenuation measures to protect people's health and residential amenity while they are indoors.

The Masterplan has been designed so that all buildings containing ASN are setback further than 60m from the railway corridor.

Standard I450.6.9 is not triggered by the proposal.

7.1.4 Road-traffic noise effects on ASN

There are no standards in the Drury Centre Precinct Chapter or Chapter E25 that require buildings containing ASN inside the Precinct to be protected from road-traffic noise. We understand that the Plan Change process deliberated the need for controls, however it was determined that compliance with E25.6.10 would provide adequate protection from business noise, as well as road-traffic noise.

We have reviewed the existing and proposed roading networks to identify the corridors likely to generate high levels of road-traffic noise effects on future ASN within the Site, and to confirm that compliance with E25.6.10 will be sufficient to mitigate noise from business activities as well as road-traffic noise.

The highest levels of road-traffic noise will be generated from Great South Road, State Highway 1 and Road 2. We understand that Road 2 will form a future direct connection from State Highway 1 via a single slip lane from the SH1 interchange.

We consider that the large separation distances between the areas of proposed residential development and Great South Road, State Highway 1 and Road 2, combined with the significant acoustic treatment requirements in E25.6.10 will ensure that buildings containing ASN are adequately protected from road-traffic noise without any additional or specific treatment.

7.2 Assessment of operational noise effects generated **from** the Site

The proposal is to ensure that all activities within the Site are located, designed and operated to achieve compliance with the relevant noise standards that apply at all adjacent sites.

The surrounding land is subject to a varied zoning pattern. The relevant noise limits are determined by the zoning of the receiving site. We address compliance with each of the relevant noise standards below.

7.2.1 Noise generated from activities within the Site and received in the FUZ

Standard E25.6.19 controls the maximum permitted noise levels generated from the BMCZ or BMUZ when measured and assessed at any notional boundary of a dwelling in the Future Urban Zone:

Table E25.6.19.1 Noise levels at the business zone interface

Time	Noise level
Monday to Saturday 7am-10pm	55dB L_{Aeq}
Sunday 9am-6pm	
All other times	45 dB L_{Aeq} 60 dB L_{eq} at 63Hz 55 dB L_{eq} at 125Hz 75 dB L_{AFmax}

These noise limits are designed to provide a reasonable level of amenity for non-acoustically treated residential dwellings that are near to the business zone interface.

The proposal is to design and operate all activities so that compliance with the permitted noise levels in Standard E25.6.19 is achieved at all notional boundaries in the FUZ. We understand that many of the closest dwellings in the FUZ may not exist in the future due to the works required for Designation 7606 (SH1- Takanini to Drury).

We have not identified any constraints in terms of achieving compliance with the noise limits in Standard E25.6.19 due to the ample separation distances involved to all existing FUZ dwellings, and the relatively low levels of noise that will be generated by activities near to the FUZ interface.

7.2.2 Noise generated from the Site and received in the BMUZ

The land to the north and east of the Site is zoned BMUZ. Standard E25.6.22 requires that where noise is generated by any activity in one zone (i.e. the BMCZ) is received by any activity on a site in a different zone (the BMUZ), the activity generating the noise must comply with the noise limits and standards of the zone at the receiving site.

Standard E25.6.8 and Table E25.6.8.1 prescribes the following maximum permitted noise levels for the BMCZ and BMUZ:

Table E25.6.8.1 Noise levels in the Business – Metropolitan Centre Zone and Business Mixed Use Zone

Time	Business Metropolitan Centre Zone	Business -Mixed Use Zone
7am – 11pm	65 dB L_{Aeq}	65 dB L_{Aeq}
11pm and 7am	60 dB L_{Aeq} 65 dB at 63Hz L_{eq} 60 dB at 125Hz L_{eq} 75 dB L_{AFmax}	55 dB L_{Aeq} 65 dB at 63Hz L_{eq} 60 dB at 125Hz L_{eq} 75 dB L_{AFmax}

The proposal is to comply with the maximum permitted noise levels in Standard E25.6.8 at all other sites in the BMUZ.

The BMUZ and BMCZ both permit the same noise level of 65 dB L_{Aeq} during the daytime period, however the permitted nighttime noise level in the BMUZ is 5 dB lower than in the BMCZ. All noise limits apply when measured or assessed at the façade of any building on another site in the BMUZ. These noise limits are quite high and are designed to allow business activities to operate with low attention to noise generation and to allow a vibrant and active environment. All ASN in the BMUZ and BMCZ must be acoustically treated and mechanically cooled and ventilated.

Our assessment finds that the maximum permitted noise levels will be sufficiently enabling for the noise generating activities located on the northern and eastern perimeters of the Site. We have not identified any challenges in terms of designing and operating all activities so that compliance with the permitted noise standards is achieved on an ongoing basis.

The only activity that may require attention to design and management is the rear loading dock for a major retail development on Lot C in the north-east of the Site. Possible constraints may include limiting the use of the dock to daytime only (when the higher noise limits apply) and / or acoustic fencing or partial enclosure. The final design measures can be confirmed in the Acoustic Design Report recommended in Section 7.3 of this report.

7.2.3 Noise generated from the Site and received in the BMCZ

The land to the south of the Site is also zoned BMCZ and is currently being developed for Stage 1 of the Drury Centre. The two sub-precincts and stages of development will be separated by Road 1.

The proposal is predicted to comply with the maximum permitted noise levels in Standard E25.6.8 (set out above) at all other sites in the BMCZ.

We have not identified any challenges in terms of designing and operating the activities so that compliance with the permitted noise standards is achieved on an ongoing basis.

7.2.4 Noise generated from the Site and received in the LIZ

Land to the north and south-west of the Site is zoned LIZ. The Tegal Hatchery to the south-west of the Site is over 200m from the Site.

Standard E25.6.22 requires that where noise generated by any activity on a site in one zone is received by any activity on a site in a different zone, the activity generating the noise must comply with the noise limits and standards of the zone at the receiving site. Noise levels generated from the Site must therefore comply with the permitted noise standards for the LIZ in E25.6.5. Table E25.6.5.1 permits noise levels of 65 dB L_{Aeq} in the LIZ at any time.

Noise levels generated from the Site and received at a site in the LIZ (including the Tegal Hatchery) will comply with the permitted noise standards by a significant margin due to the large separation distance.

7.3 Acoustic Design Report

Our preliminary assessment of the Masterplan and experience with similar projects is that there should be no or minimal challenge for the proposed activities to achieve compliance with the relevant operational noise standards. Our assessment finds that the only activities that are likely to require acoustic design input are buildings containing ASN and the Major Retail development on Lot C.

At this early stage of the design phase, there is insufficient detail to demonstrate that these activities comply with the relevant permitted noise standards. We consider that compliance would be best demonstrated by including a condition to the consent that requires an Acoustic Design Report (**ADR**) to be submitted to the Council

The ADR would require compliance to be demonstrated for noise generated by the Major Retail Tenancy on Lot C, and to demonstrate compliance with the relevant acoustic treatment requirements for all ASN. The ADR would be prepared and submitted prior to the relevant land use activity it covers being commenced or occupied (buildings containing ASN). The condition of consent would require the ADR to demonstrate what, (if any) physical or management measures are required to ensure that the noise standards for permitted activities are complied with.

8.0 Recommended outcomes for conditions of consent

We recommend that conditions are included in the consent to deliver the following outcomes:

1) Requiring compliance with the construction noise standards for permitted activities at all times, except to allow for noise levels up to 80dB L_{Aeq} and 95dB L_{AFmax} at receivers in the BMUZ and only at times when the 70dB L_{Aeq} and 85dB L_{AFmax} noise limits in E25.6.27 normally apply.

2) Requiring compliance with the construction noise standards for permitted activities at all times, except to allow for noise levels up to 80dB L_{Aeq} and 95dB L_{AFmax} at receivers in the BMCZ and only at times when the 75dB L_{Aeq} noise limit in E25.6.28 normally applies.

3) Allowing construction vibration levels to exceed the 2mm/s PPV vibration amenity limit in E25.6.30.1.b while implementing a CNVMP to ensure vibration does not exceed 5 mm/s PPV at any adjacent building that is occupied during the works (and only when the infringements of the permitted construction noise standards are authorised).

4) Requiring construction vibration levels to comply with the limits to avoid building damage in E25.6.30.1.a at all times.

5) Requiring a CNVMP to be prepared prior to construction work commencing. The CNVMP should be prepared to address the requirements set out in this report and should be considered a 'live' document that should be updated as required throughout the construction of the Project. The CNVMP must contain a specific section for managing the effects on the buildings at 54 Flanagan Road, 117 and 121 Fitzgerald Road if they are occupied during construction, and for any other occupied building within 50m of construction works on the Site.

6) Requiring compliance with AUP standards E25.6.8, E25.6.10, E25.6.19 and E25.6.22 (this may be left to the AUP without a specific condition); and

7) Requiring an ADR to be prepared to demonstrate to the Council that the Stage 2 land use activities will be designed and managed to comply with:

    i. Standard E25.6.8 relating to noise generated on Lot C and received in the neighbouring BMUZ land; and

    ii. Standard E25.6.10 relating to acoustic treatment of all ASN on the Site.

    The ADR process should be flexible enough to allow one ADR to address all activities or individually as the lots are developed. The ADR process should only apply to the initial development of the Project and not to potential future redevelopment or change of land use.

Appendix A Glossary of terms

Noise	A sound which serves little or no purpose for the exposed persons and is commonly described as 'unwanted sound'. The definition of noise includes vibration under the Resource Management Act.
Best practicable option	Defined in section 2 of the Resource Management Act as: in relation to a discharge of a contaminant or an emission of noise, means the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to— a. the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and b. the financial implications, and the effects on the environment, of that option when compared with other options; and c. the current state of technical knowledge and the likelihood that the option can be successfully applied.
dB (decibel)	The basic measurement unit of sound. The logarithmic unit used to describe the ratio between the measured sound pressure level and a reference level of 20 micropascals (0 dB).
A-weighting	A frequency filter applied to the full audio range (20 Hz to 20 kHz) to approximate the response of the human ear at lower sound pressure levels.
$L_{Aeq(t)}$ (dB)	The A-weighted equivalent sound pressure level with the same energy content as the measured varying acoustic signal over a sample period (t). The preferred metric for sound levels that vary over time because it takes into account the total sound energy over the time period of interest.
L_{AFmax} (dB)	The maximum A-weighted sound pressure level recorded during the measurement period using a fast time-weighting response.
Noise rating level	A derived noise level used for comparison with a noise limit.
Notional boundary	A line 20 metres from any side of a residential unit or other building used for a noise sensitive activity, or the legal boundary where this is closer to such a building.
NZS 6801:2008	N.Z. Standard NZS 6801:2008 Acoustics – Measurement of environmental sound.
NZS 6802:2008	N.Z. Standard NZS 6802:2008 Acoustics – Environmental noise.
NZS 6803:1999	N.Z. Standard NZS 6803:1999 Acoustics – Construction noise.
s16	Section 16 of the Act states that "every occupier of land (including any premises and any coastal marine area), and every person carrying out an activity in, on, or under a water body or the coastal marine area, shall adopt the best practicable option to ensure that the emission of noise from that land or water does not exceed a reasonable level".

DIN 4150–3:1999	German Standard DIN 4150-3:1999 Structural Vibration – Part 3: Effects of vibration on structures. Typically adopted for the assessment of structure borne vibration in New Zealand.
PPV	Peak particle velocity, measured in mm/s. The standard metric for the measurement of ground borne vibration in New Zealand. The instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position.
CNVMP	Construction noise and vibration management plan. A document to help the contractor manage noise and vibration emissions during construction works.

Appendix B Predicted construction noise levels

A contractor has not yet been appointed which means that there is little or no detail on the type of equipment and durations of work phases for the Project. However, we have worked on a significant number of projects of a similar nature and scale which allows us to reliably estimate the type of activities, durations and likely noise levels at neighbouring properties.

We have calculated construction noise levels at the neighbouring sites based on reasonable worst-case scenarios and the references displayed in Appendix B. Our references are based on measurement data. They are generally consistent with the data provided in NZS 6803:1999 Appendix C *Guide to Sound Level Data on Site Equipment and Site Activities* (but more relevant to modern construction equipment than the Standard).

The Masterplan indicates that the majority of the works close to the Site boundaries will comprise bulk earthworks at the beginning, followed by levelling, filling (particularly beneath future roads and car parks), compaction, paving and installation of services. This will require very typical plant and machinery such as bulldozers, compactors, excavators, paving machines, concrete pours and trucks.

The vertical construction of the proposed buildings is generally at least 10m inside the Site boundaries and will generally be quieter than the civil works. We expect that craneage will be positioned further into the Site to maximise efficiency and reach.

Other works such as installation of street furniture, planting and landscaping will be much quieter such that compliance with the relevant construction noise standards are predicted to be achieved for these phases of construction

Our assessment is based primarily on the earthworks and civil works as these will be the noisiest works and will be conducted closest to the boundaries of the Site. In our experience, construction of the buildings themselves is generally quieter than the civil works and will generally be further away from receivers, especially where they are separated from boundaries by roads or open spaces.

Table 2 displays the minimum separation distances for each activity to comply with the relevant AUP permitted noise limit based on the following assumptions:

- The minimum distance stated is from the noise generating plant to the assessment position at 1 m from the most exposed façade of the building (e.g., from the excavator to 1 m from the building façade)
- The plant is being used continuously at the reference distance over a 30-minute sample period (i.e., 100% on-time) unless otherwise stated
- The distances include a +3 dB adjustment to the noise levels for reflections from the façade of the receiving building (as required by NZS 6803:1999)
- Acoustically reflective ground is assumed between the noise source and the receiver

- The mitigated compliance distances are based on construction noise barriers effectively screening the ground level of the building from the noise generating activity and reducing the noise levels by 10dB. A noise barrier may not be practicable in some cases due to the size of the Site, height of neighbouring buildings (particularly in the future / legal receiving environment) and the height of the main noise source of the plant itself.

Table 2: Reference noise levels and compliance distances

Construction activity	Unmitigated $L_{Aeq(15\ min)}$ noise level at 10 m	Unmitigated compliance distance	Mitigated compliance distance (with noise barrier)
Bored piling with a 20-t excavator	79 dB	38 m	12 m
Chainsaw works to remove trees (33% on-time)	77 dB	30 m	10 m
D6, D7, or D8 bulldozer working in small area	76 dB*	27 m	9 m
Padfoot vibratory compaction roller 15t – 20-t	76 dB*	27 m	9 m
Cut and fill, clearing, and loading trucks with a 40-t – 50-t excavator	72 dB	17 m	6 m
Cat 825 static compactor 30-t	72 dB*	17 m	6 m
Cut and fill, clearing, and loading trucks with a 20-t excavator	69 dB	12 m	4 m
Cat 815 static compactor 18-t	69 dB*	12 m	4 m
Concrete pump and truck discharging	69 dB	12 m	4 m
Cut and fill, clearing, and loading trucks with a 12-t excavator	67 dB	10 m	3 m
Large generator	66 dB	9 m	3 m
Terrex TS14 30-t motor scraper	65 dB*	8 m	3 m
7,000 L watercart	65 dB	8 m	3 m
Grader	62 dB*	6 m	2 m

Construction activity	Unmitigated $L_{Aeq(15\ min)}$ noise level at 10 m	Unmitigated compliance distance	Mitigated compliance distance (with noise barrier)
Idling delivery truck, dump truck, moxy, tractor	62 dB	6 m	2 m
Paving works (with all ancillary equipment operating)	75 dB	25 m	8 m

* Reference noise level is for a moving noise source.

Appendix C Predicted vibration levels

The operation of heavy plant near the boundary of the Site will generate vibration that may be perceptible within the nearest neighbouring buildings. Typically, vibration levels as low as 0.3 mm/s are perceptible within buildings and levels of 1 mm/s during the daytime can cause complaints if the vibration is unexpected or the source is unknown to the receiver.

Construction vibration levels are largely dependent on the equipment used, the skill of the operator, the subsoil conditions and the response of the receiving structure. Accurate predictions are not always possible without site, receiver and plant specific data.

The highest construction vibration levels will be generated during excavation, compaction, and heavy vehicle movements when they are operating close to the boundaries of the Site. The vibration from works further within the Site (>30-50m) will generally go unnoticed at neighbouring sites.

The vibration levels in nearby buildings will depend on the separation distance, the size of the plant and how it is used, the ground conditions, and the response of the building itself.

Table 3 presents typical vibration levels for the relevant construction activities. These are derived from previous measurements using a geophone buried in the ground. Measuring these activities from a building will likely provide lower results due to the loss of energy when the vibration transfers from the ground into the foundations and structure.

Table 3 Typical construction vibration levels

Construction activity	Distance	Typical vibration level (PPV)
Vibratory compaction with a 15-t – 20-t roller	10 m	3-4 mm/s
Vibratory compaction with a 5-t – 7-t roller	10 m	2-3 mm/s
Compaction with a large static roller	10 m	1 mm/s
Cut and fill works, loading trucks, and tracking slowly with a 20-t excavator	10 m	1-2 mm/s
Heavy vehicle or tractor pass-by on even ground	10 m	<1 mm/s

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