

Noise and Vibration Sub-Plan

Cross River Rail – Rail, Integration and Systems Alliance

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Document Approval

Rev	Date	Prepared By	Reviewed By	Approved By	Remarks
A	28/06/19	UNITY – Environment Manager	UNITY – Delivery Manager		IFR
B	08/09/19	UNITY – Environment Manager	UNITY – Delivery Manager		IFR
C	15/09/19	UNITY – Environment Manager	UNITY – Delivery Manager		IFR
00	19/09/19	UNITY – Environment Manager	UNITY – Delivery Manager	UNITY – Environment Manager	IFU
01	20/07/20	UNITY – Senior Environmental Advisor	UNITY – Environment Manager		IFR
02	07/09/20			UNITY – Environment Manager	IFU
03	26/08/21	UNITY – Senior Environmental Advisor	UNITY – Environment Manager		IFR
04	11/10/21			UNITY – Environment	IFU
Signature:					

Plan Control

This Noise and Vibration Sub-Plan (the plan) has been developed for the Cross River Rail – Rail, Integration and Systems Project.

Approvals, Revisions and Amendments

Plan approval is in accordance with Section 4.1.2 of the Construction Environmental Management Plan (C-EMP).

Plan reviews and updates is in accordance with Section 7 and Section 8.1 of the C-EMP.

Revision Details

Revision	Remarks
A	Final C-EMP for Review and endorsement by the Environmental Monitor
B	Updated Plan to incorporate the IEM's comments from 19 August 2019
C	Updated Plan to incorporate clarification received on 12 September 2019 on the interpretation of condition 11.c
00	Updated Plan to incorporate the IEM's comments from 18 September 2019. Plan endorsed by IEM on 20 September 20
01	6 monthly review and updated to incorporate changes linked to RfPC-7 and Updated O-EMP The update does not include new or additional Relevant Project Works
02	Issued for Use
03	Issued for review to the IEM 6 monthly review and update to incorporate <ul style="list-style-type: none"> changes linked to RfPC-11 addition of the Southern Area Scope of Works (Dutton Park and Buranda)
04	Issued for Use

1 Purpose of this Plan

This sub-plan has been prepared to comply with:

- Coordinator-General's Condition of Approval:
 - Condition 10 (d) and 10(e)
 - Condition 11 (all excluding Cosmetic Damage Vibration goals contained in Table 3)
 - Condition 12(a)
 - Recommendation 8 – Noise and Vibration – the proponent should consult with relevant advisory agencies in the development of mitigation measures for predicted and monitored noise and vibration impacts above the goals for the C-EMP
- Final Outline – Environment Management Plan (O-EMP) – Outline Noise and Vibration Management Plan
- Vibration Monitoring Limits – Clem7.

Note that Unity currently does not intend to undertake any blasting as part of the works. In the event that blasting is required this plan must be reviewed, updated as required and endorsed by the Independent Environmental Monitor in accordance with Condition 4(g) or Condition 4(h) of the Coordinator General Change Report.

Component	Details
Environmental Outcome(s)	<ul style="list-style-type: none"> • Project works must aim to achieve the project noise goals for human health and wellbeing in Table 2 below • Project works must aim to achieve the construction vibration goals in Table 3 below • The management measures are adaptive to the Sensitive Places impacted by construction noise and vibration • During construction, monitor and report on noise and vibration • Construction activities are designed, planned and implemented to maintain human health and wellbeing, to the extent reasonable and practical • Construction activities generally are designed, planned and implemented to maintain daily patterns of activity, and to minimise sleep disturbance at night • Construction activities are managed to avoid vibration-related structural damage on all properties, including listed heritage places, to minimise other vibration-related impacts on properties and any vibration-sensitive plant and equipment (e.g. transmission electron microscopes) • For works and activities (including demolition) that are carried out in the close vicinity of the Clem7 tunnel structure and have an impact on it, Transurban requires tunnel vibration monitoring to be undertaken with consideration of trigger levels as per DTMR's Design Criteria for Bridges and Other Structures February (s7.5.3.(f) of Annexure C).
Relevant Area	<p>Site wide Key areas:</p> <ul style="list-style-type: none"> • RNA and Old Museum – impact to heritage structures in particular the John McDonald Stand • O'Connell Terrace – vibration impact to Clem7 • Northern Corridor – Impacts to Energex substation and BGS / BGGS • F2S – impact to Queensland Rail heritage structures and residents • Southern Area – Princess Alexandra Hospital, impact to Queensland Rail heritage structures and residents • Clapham Yard – impact to residents.

Component	Details
Relevant Works / Activities	<ul style="list-style-type: none"> • Night works • Possession Works in Rail or Road Corridor • Construction traffic on the local road network • High impact activities: <ul style="list-style-type: none"> – Bulk earthworks involving heavy vehicles and equipment – Piling works – particularly driven piles for noise and bored piles for vibration – Ground surface treatments using vibratory rollers – Hydraulic or jack hammering activities (rock breaking activities) – Tamping works. – Demolition Works

Component	Details
Performance Criteria	<p>Noise:</p> <ul style="list-style-type: none"> Construction works are designed, planned and implemented to achieve the noise goals as detailed in Imposed Condition 11, Table 2, where reasonable and practicable Where predictive modelling is conducted prior to commencement of works in a locality where it is indicated that the noise goals are likely to be exceeded at a Sensitive Place: <ul style="list-style-type: none"> Sensitive Places must be identified, and DAPs consulted with regarding the potential impacts and the mitigation measures proposed to address the impacts When mitigation measures are developed in consultation with DAPs on a 'case-by-case' basis prior to commencement of the works, agreed mitigation measures are included in a mitigation register maintained by the Environmental Monitor and implemented prior to undertaking construction works <p>Vibration:</p> <ul style="list-style-type: none"> Construction works designed, planned and implemented to achieve the vibration goals, as detailed in <ul style="list-style-type: none"> Imposed Condition 11, Table 3, where reasonable and practicable Imposed Condition 12 Where predictive modelling is conducted prior to commencement of works in a locality where it is indicated that the Human Comfort¹ vibration goals are likely to be exceeded: <ul style="list-style-type: none"> Sensitive Places must be identified, and DAPs consulted with regarding the potential impacts and the mitigation measures proposed to address the impacts When mitigation measures are developed in consultation with potentially affected entities on a 'case-by-case' basis prior to commencement of the works, agreed mitigation measures are included in a mitigation register maintained by the Environmental Monitor and implemented prior to undertaking construction works, or Proposed works are only allowed to occur between restricted hours as detailed in Imposed condition 11(f)(i) Where vibration goals are provided in respect of sensitive building contents, predictive modelling must consider the manufacturer's specifications for tolerance to vibration and adopt such specifications as goals for construction to avoid or minimise impacts on the normal operation of such equipment. Where predictive modelling is conducted prior to commencement of works in a locality where it is indicated that the Cosmetic Damage vibration goals² for buildings are likely to be exceeded, develop a Property Damage Sub-Plan³. <p>Clem 7 Tunnel:</p> <ul style="list-style-type: none"> Comply with the DTMR Standard <i>Design for Other Bridges and Other Structures</i> unless otherwise agreed with the Asset Owner (Brisbane City Council (BCC) and Transurban (TQ))
Sustainability	Dis-2, Dis-3, Hea-1, Sta-4.

¹ Respite periods do not apply to vibration criteria related to building or structural damage

² Continuous vibration criteria are reduced by 50% unless resonance can be demonstrated to not be occurring

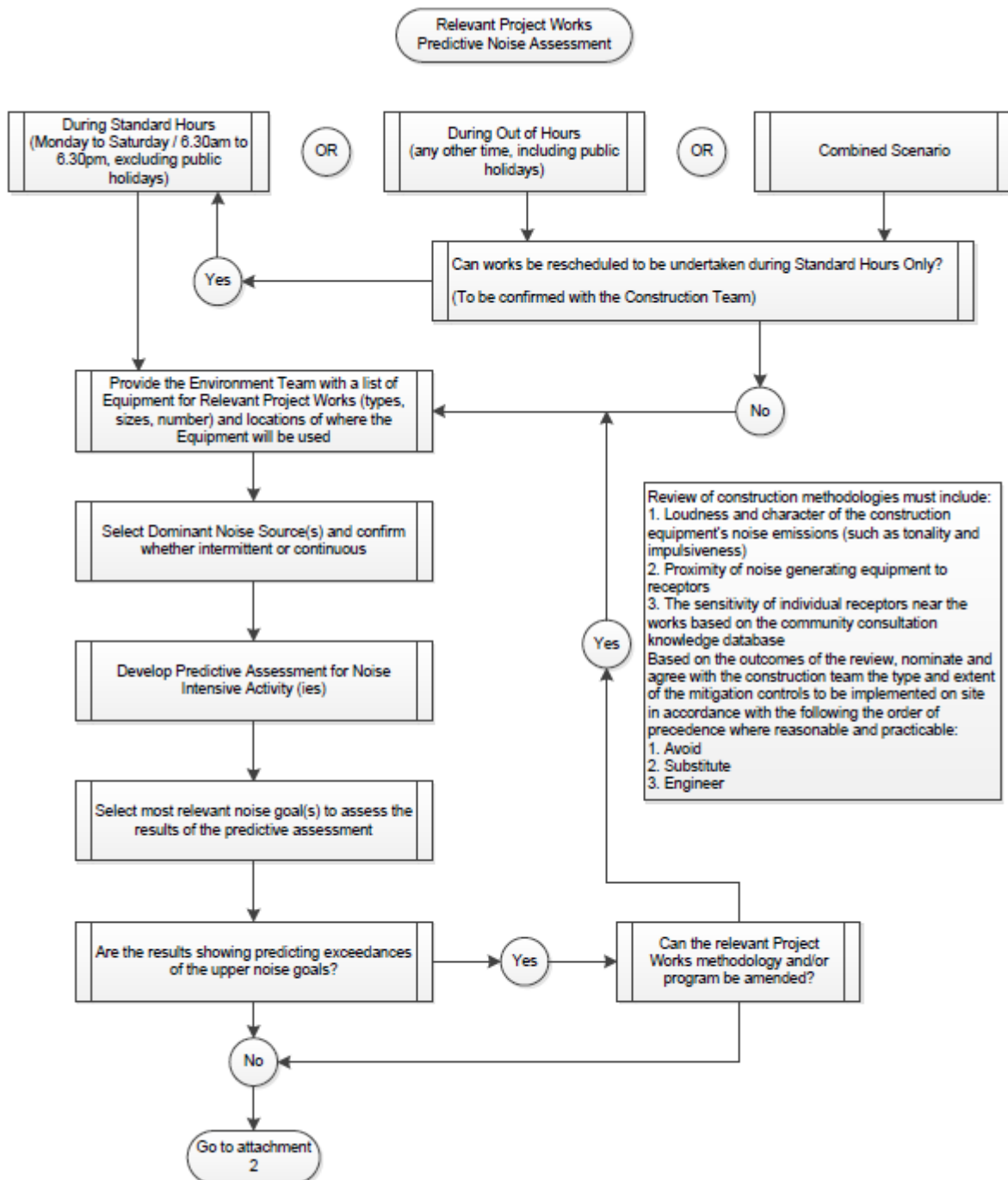
³ The criteria for Heritage Structures applies where a specific dilapidation survey has not been undertaken. Where a survey and assessment of the specific structure has been undertaken, alternative limits for the protection of the structure can be included in the Property Management Damage Sub Plan.

Component	Details
Mitigation Measures – Noise - Human Comfort	<ul style="list-style-type: none"> • Adopt the principles of the 'Transport Noise Management Code of Practice: Volume 2 - Construction Noise and Vibration' to inform planning, consultation and construction activities • Undertake predictive modelling to ascertain extent of potential impact to human receivers prior to works commencing. Refer to Attachment 1 and Attachment 2. • The mitigation measures agreed with the construction team because of the modelling outputs are to be documented in the workpacks and the SEPs and communicated to the CSE Team to support their notification and consultation process. • The mitigation measures developed on a case by case basis with DAPs are to be included in the mitigation register maintained by the Environmental Monitor • Project Notifications will be provided in the areas regardless of whether residents or business are predicted to be affected with sufficient information to enable them to understand the likely nature, extent and duration of noise and vibration impacts during various construction activities. • The community will be kept informed of the project schedule and potential impacts, particularly in regard to unavoidable weekend and night works, in accordance with the timeframes nominated in the CEP. <ul style="list-style-type: none"> – Complaints will be managed in accordance with the procedure described in the CEP and Attachment 5 • Standard Mitigation Measures for Noise Management <ul style="list-style-type: none"> – Swearing or unnecessary shouting or loud stereos/radios on site should not be tolerated. – Vehicle radios and engines should be turned off wherever possible. – Appropriately sized equipment should be selected for the task, such as vibratory compactors and rock excavation equipment. – Avoid the use of horns within the construction area, except in the case of emergency – Set site entry and egress points as far from sensitive receptors as practically possible – Utilise main roads for site vehicle access, wherever possible – Avoid using plant and equipment simultaneously adjacent to sensitive receptors where reasonably practical. The combined noise/vibration levels could be significantly less when sources operate separately – Use mufflers and engine cover/screens, where reasonable and practicable – Restrict the number of nights per week that works are undertaken, or schedule in respite measures, unless it can be adequately demonstrated that the sequencing of works to a shorter timeframe will result in reduced exposure duration to high noise levels. – Where possible, the duration of simultaneous operation of noise or vibration-intensive plant should be minimised. Plant and equipment used intermittently or no longer in use should be throttled or shut down. – Where feasible, the location for site access points and roads, gathering points, shift changes, parking, etc will be sited away from sensitive receptors. – Construction plant, vehicles, equipment and machinery should be maintained and operated in accordance with manufacturer's instructions to minimise noise and vibration emissions. – Non-tonal reversing beepers (or an equivalent mechanism) should be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work. Without compromising site safety, unnecessary reversing should be avoided and turning circles used instead. – The drop height of materials will be minimised, for example, while loading and unloading vehicles or in storage areas. – The speed of construction traffic should be minimised near noise sensitive receptors, including acceleration. • For any works to be undertaken outside Standard Hours an Out of Work Hours permit is to be approved by the Environment Manager, CSE Manager and Project Manager (or delegate) prior to works commencing.

Component	Details
Mitigation Measures – Vibration - Human Comfort	<ul style="list-style-type: none"> • Adopt the principles of the 'Transport Noise Management Code of Practice: Volume 2 - Construction Noise and Vibration' to inform planning, consultation and construction activities • Undertake predictive modelling to ascertain extent of potential impact to human receivers prior to works commencing. Refer to Attachment 3 and Attachment 4. • Where residual exceedances of the vibration goals are predicted, liaise with the Community & Stakeholders Engagement Team to confirm whether DAPs may be sensitive to sleep disturbance • The mitigation measures agreed with the construction team because of the modelling outputs are to be documented in the workpacks and the SEPs and communicated to the Community and Stakeholder Engagement Team to support their notification and consultation process. • The mitigation measures developed on a case by case basis and agreed with DAPs are to be included in the mitigation register maintained by the Environmental Monitor • Standard Mitigation Measures for Vibration Management <ul style="list-style-type: none"> – Materials should not be dropped from height; metal items should not be thrown – Appropriately sized equipment should be selected for the task, such as vibratory compactors and rock excavation equipment. – Avoid using plant and equipment simultaneously adjacent to sensitive receptors where reasonably practical. The combined vibration levels could be significantly less when sources operate separately – Restrict the number of nights per week that works are undertaken, or schedule in respite measures, unless it can be adequately demonstrated that the sequencing of works to a shorter timeframe will result in reduced exposure duration to high vibration levels. – Where possible, the duration of simultaneous operation of vibration-intensive plant should be minimised. Plant and equipment used intermittently or no longer in use should be throttled or shut down. – Equipment should be operated in the correct manner and correctly maintained – Construction plant, vehicles and machinery should be maintained and operated in accordance with manufacturer's instructions to minimise noise and vibration emissions. – The drop height of materials will be minimised, for example, while loading and unloading vehicles or in storage areas. • For any works to be undertaken outside Standard Hours an Out of Work Hours permit is to be approved by the Environment Manager, and CSE Manager and Project Manager (or delegate) prior to works commencing
Mitigation Measures – Vibration - Buildings	<ul style="list-style-type: none"> • Undertake predictive modelling to ascertain extent of potential impact to structures (in particular heritage structures) prior to works commencing. • Where residual exceedances of the vibration goals are predicted to affect Local, QR or State Heritage Structures that will not be demolished as part of the construction works <ul style="list-style-type: none"> – Obtain the relevant Approvals from the Queensland Heritage Council and Department of Environment Science Heritage Unit for works near Structures listed on the Queensland Heritage Register (QHR) and abide by the Approvals / Permit Conditions for State Heritage Places – Ensure that upon completion of the predictive modelling at RNA Showgrounds consultation with RNA and O'Connell Residents and businesses is undertaken prior to works commencing, inclusive of demolition works. – Provide notification to Queensland Rail Heritage Council and BCC Heritage Unit prior to the works commencing • Implement the Non-Indigenous Cultural Heritage Management Plan for heritage structures when the predicted exceedances may present a risk to the structure • Undertake the necessary building condition surveys prior to works commencing where predictive modelling indicates potential for cosmetic damage • Comply with the Property Damage Sub-Plan

Component	Details
Mitigation Measures – Clem 7	<ul style="list-style-type: none"> Minimise where possible, the use of machinery that may create high levels of Vibration (e.g. substitute plant) Consult with BCC (Asset Owner) about any conditions that apply to construction adjacent to CLEM 7 and comply with these conditions Undertake monitoring and compare against the agreed trigger levels if different to performance criteria set in the DTMR <i>Standard Design for Other Bridges and Other Structures</i>
Mitigation Measures – Sensitive Contents	<ul style="list-style-type: none"> Predictive vibration modelling and sensitive building contents <ul style="list-style-type: none"> Where residual exceedances of the vibration goals are predicted, liaise with the Community & Stakeholders Engagement Team to confirm whether DAPs have sensitive building contents (e.g sensitive laboratory equipment) Where sensitive building contents exist, to the extent that is reasonable and practicable review the predicted exceedances against the manufacturer's specifications for tolerance to vibration. Where predictive modelling indicates the specified criteria would not be achieved by the Project Works, such works may proceed only in accordance with specific mitigation measures agreed with the potentially Directly Affected Persons. Undertake Vibration Monitoring as recommended by the Alliance Acoustic Specialist or upon receipt of a complaint or following dialog with operators of sensitive equipment
Monitoring	<ul style="list-style-type: none"> Monitoring will be generally undertaken in accordance with Attachment 2, Attachment 4 and Attachment 5 of this Sub-Plan. Monitoring is undertaken at a suitable frequency to inform future predictive assessments and to confirm the mitigation measures are suitable to manage nuisance to occupied Sensitive Places as detailed in Attachment 4 of the C-EMP The monitoring locations are informed based on the outcomes of the predictive assessment and will be detailed in the relevant SEP Monitoring will be undertaken by trained and competent persons with records retained to demonstrate competencies.
Reporting	Reporting will be undertaken in accordance with Section 8.2 of the C-EMP. Reporting protocols and responsibilities of exceedances with DTMR vibration limits for Clem7 are yet to be agreed.
Corrective Action	Management of corrective actions will be undertaken as per Section 6 of the C-EMP.
Auditing	As per Section 7 of the C-EMP.

Attachment 1 Predicted Noise Goals Modelling – Criteria selection



Attachment 2 Predicted and Actual Noise Exceedances Management

Condition 11.a and Condition 11.c must be read in conjunction with Condition 10 (Approved Hours of Work) and Condition 9.c (consultation with DAPs).

Condition 11a and condition 11c provide for Lower Noise Limits and Upper Noise Limits to inform

- Level of consultation required with DAPs prior to works commencing
- Work restrictions that may be imposed on the construction activities unless the Relevant Project works Comply with Imposed Condition 10(d)

Where Lower Noise Limits are predicted to be exceeded, consultation with Directly Affected persons must occur. The most suitable method of consultation will be selected by the Community and Stakeholder Engagement Manager or their team following a review of the predicted exceedances. Consultation may range from periodic Generic Notifications to more Specific Notifications such as emails, phone calls and doorknocking to particular areas.

The below tables summarise the Lower (LL) and Upper (UL) Noise Goals based on Noise Types for Standard Work Hours and Out of Hours Work.

Standard Work Hours are defined as follows:

- Monday to Saturday – 6.30am to 6.30pm
- Excludes Public Holidays

Out of Hours are defined as follows

- Monday to Saturday – 6.30pm to 6.30am
- Sundays
- Public Holidays

Consistent with Imposed Condition 10(d), the following works, when predicted or monitored to exceed the Upper Noise Goals may be undertaken Out of Hours or during Standard Work Hours without Respite Periods subject to compliance with this plan, the processes detailed in Table 1 and Table 2 and the overarching C-EMP for approved rail possessions:

- Transport, assembly or decommissioning of oversized plant, equipment, components or structures
- Delivery of “in time” materials such as concrete, hazardous materials, large components and machinery
- Continuous construction support, such as continuous concrete pours, pie-jacking or other forms of ground support necessary to avoid a failure or construction incident
- Spoil haulage and materials / equipment delivery

Consistent with Imposed Condition 10(e), Project Works that are not an Approved Rail Possession or part of an Approved Rail Possession, inclusive of associated spoil haulage and materials / equipment delivery, when predicted or monitored to exceed the Upper Noise Goals, may be undertaken Out of Hours or during Standard Work Hours without Respite Periods subject to compliance with this plan, the processes detailed in Table 2, the overarching C-EMP and written confirmation from the Department of Transport and Main Roads (DTMR).

Table 1: Standard Work Hours – Monday to Saturday 6.30am to 6.30pm (excluding Public Holidays)

Noise Type	Noise Levels (indoors / outdoors ⁴)	Noise <LL Management	LL < Noise <UL Management	Noise >UL Management
Continuous	<ul style="list-style-type: none"> LL: up to⁵ 55dBA indoors (est. 65 dBA outdoors) UL: up to 75dBA (est. 85 dBA outdoors) 	Prior to Construction <ul style="list-style-type: none"> Works are deemed Managed Works and therefore can be undertaken 24 hours, 7 days a week Generic Notifications to be issued along the Corridor a minimum of 1 week before the works commence. Whilst consultation is not required – this is good practice 	Prior to Construction <ul style="list-style-type: none"> Consultation with DAP via means of Generic Notifications a minimum of 2 weeks before the works commence For DAPs the most likely to be affected specific notifications may be sent Implement generic Noise mitigation measures Review construction methodologies (see below for more details) to confirm whether additional noise mitigation measures can be implemented 	Respite periods may apply if the upper limit is predicted to be exceeded unless authorised as per imposed condition 10(d) or 10(e) Prior to Construction <ul style="list-style-type: none"> Review construction methodologies to confirm whether additional measures can be implemented to reduce predicted Noise to below the UL Develop mitigation measures on a 'case by case' basis in consultation with Directly Affected Persons Implement relevant case by case mitigation measures Ensure the mitigation measures developed with the DAP are communicated to the IEM and the CRM and included in the mitigation register maintained by the IEM
Intermittent	<ul style="list-style-type: none"> LL: up to 65dBA (est. 75 dBA outdoors) UL: up to 85dBA (est. 95dBA outdoors) 	During Construction <ul style="list-style-type: none"> Implement generic Noise mitigation measures detailed in this subplan Undertake spot check monitoring to confirm works are still Managed Works as nominated in the SEP Enact Complaints Response Protocol if triggered⁶ 	During Construction <ul style="list-style-type: none"> Undertake attended noise monitoring (outdoors) at the commencement of the noise intensive Activity(ies)⁷ to validate the model where predicted noise levels are within 10dBA of the UL. Enact Complaints Response Protocol if triggered⁸ Stop work if the actual noise >UL and re-assess construction methodologies 	During Construction <ul style="list-style-type: none"> Undertake attended noise monitoring (outdoors) to validate the model⁹ at the commencement of the Activity(ies), and Implement relevant case by case mitigation measures, and Enact Complaints Response Protocol if triggered, and, Keep the DAPs informed of the construction progress OR <ul style="list-style-type: none"> Only work during the hours 7.00am to 6.00pm Monday to Friday, with a respite period between 12.00noon and 2.00pm each day

⁴ This is based on a conservative façade reduction of 10 dBA for a typical Queenslander with single glazed windows shut. Review of the buildings' settings (e.g. masonry buildings, double glazed windows) will inform whether further façade noise reductions can be applied

⁵ The actual limit is dependent on the type of occupancy of the buildings as per AS2107 and will vary along the project area. Unity's Acoustic Specialist will advise which are the most suitable AS2017 design sound levels to be used as part of the predictive modelling

⁶ If Monitoring is required it will be outdoors and attended

⁷ Need for ongoing monitoring requirements will be determined based on the outcomes of the monitoring results

⁸ If Monitoring is required it will be outdoors and attended

⁹ Need for ongoing monitoring requirements will be determined based on the outcomes of the monitoring results

Table 2: Out of Hours Works

Noise Type	Noise Levels (indoors / outdoors ¹⁰)	Noise <LL Management	LL < Noise <UL Management	Noise >UL Management
Continuous	<ul style="list-style-type: none"> LL: 35 dBA indoors (est. 45 dBA outdoors) UL: 55 dBA (est. 65 dBA outdoors) 	Prior to Construction <ul style="list-style-type: none"> Works are deemed Managed Works and therefore can be undertaken 24 hours, 7 days a week Generic Notifications to be issued along the Corridor a minimum of 1 week before the works commence Implement generic Noise mitigation measures Raise an OOH Work Permit prior to works commencing 	Prior to Construction <ul style="list-style-type: none"> Consultation with DAP via means of Generic Notifications a minimum of 2 weeks before the works commence For DAPs the most likely to be affected specific notifications may be sent Implement generic Noise mitigation measures Review construction methodologies (see below for more details) to confirm whether additional noise mitigation measures can be implemented Raise an OOH Work Permit prior to works commencing 	<p>Out of hours works cannot occur if the upper limit is predicted to be exceeded unless authorised as per Imposed Condition 10(d) and Condition 10(e)</p> <p><i>If the works are authorised under Imposed Condition 10(d)</i></p> <p>Prior to Construction</p> <ul style="list-style-type: none"> Review construction methodologies to confirm whether additional measures can be implemented to reduce predicted Noise to below the UL Develop mitigation measures on a 'case by case' basis in consultation with Directly Affected Persons Implement relevant case by case mitigation measures Ensure the mitigation measures developed with the DAP are communicated to the IEM and the CRM and included in the mitigation register maintained by the IEM Raise an OOH Work Permit prior to works commencing For Project Works that are not part of an Approved Rail Possession and must be undertaken after 10pm Monday to Friday or Out of Hours, obtain written confirmation from DTMR
Intermittent	<ul style="list-style-type: none"> LL: 42 dBA (est. 52 dBA outdoors) UL: 62 dBA (est. 72 dBA outdoors) 	During Construction <ul style="list-style-type: none"> Undertake spot check monitoring to confirm works are still Managed Works as nominated in the SEP and / or the OOH permit Enact Complaints Response Protocol if triggered¹¹ Comply with the approved OOH Work permit 	During Construction <ul style="list-style-type: none"> Undertake attended noise monitoring (outdoors) at the commencement of the noise intensive Activity(ies)¹² to validate the model where predicted noise levels are within 10dBA of the UL. Enact Complaints Response Protocol if triggered¹³ Stop work if the actual noise >UL and re-assess construction methodologies Comply with the approved OOH Work permit 	<p>During Construction</p> <ul style="list-style-type: none"> Undertake attended noise monitoring (outdoors) to validate the model¹⁴ at the commencement of the Activity(ies), and Implement relevant case by case mitigation measures Enact Complaints Response Protocol (Attachment 5) if triggered, Keep the DAPs informed of the construction progress Comply with the approved OOH Work permit

¹⁰ This is based on a conservative façade reduction of 10 dBA for a typical Queenslander with single glazed windows shut. Review of the buildings' settings (e.g. masonry buildings, double glazed windows) will inform whether further façade noise reductions can be applied. Table 2 of the CG Conditions requires that intermittent construction noise be assessed using the LA10 descriptor. The large majority of noise emission from UNITY construction activities will be classified as intermittent. The LAeq parameter is a more appropriate descriptor for determining the impacts of intermittent construction noise. For the purpose of checking compliance against the CG Conditions either the LA10 or LAeq descriptor will be used, whichever is more appropriate.

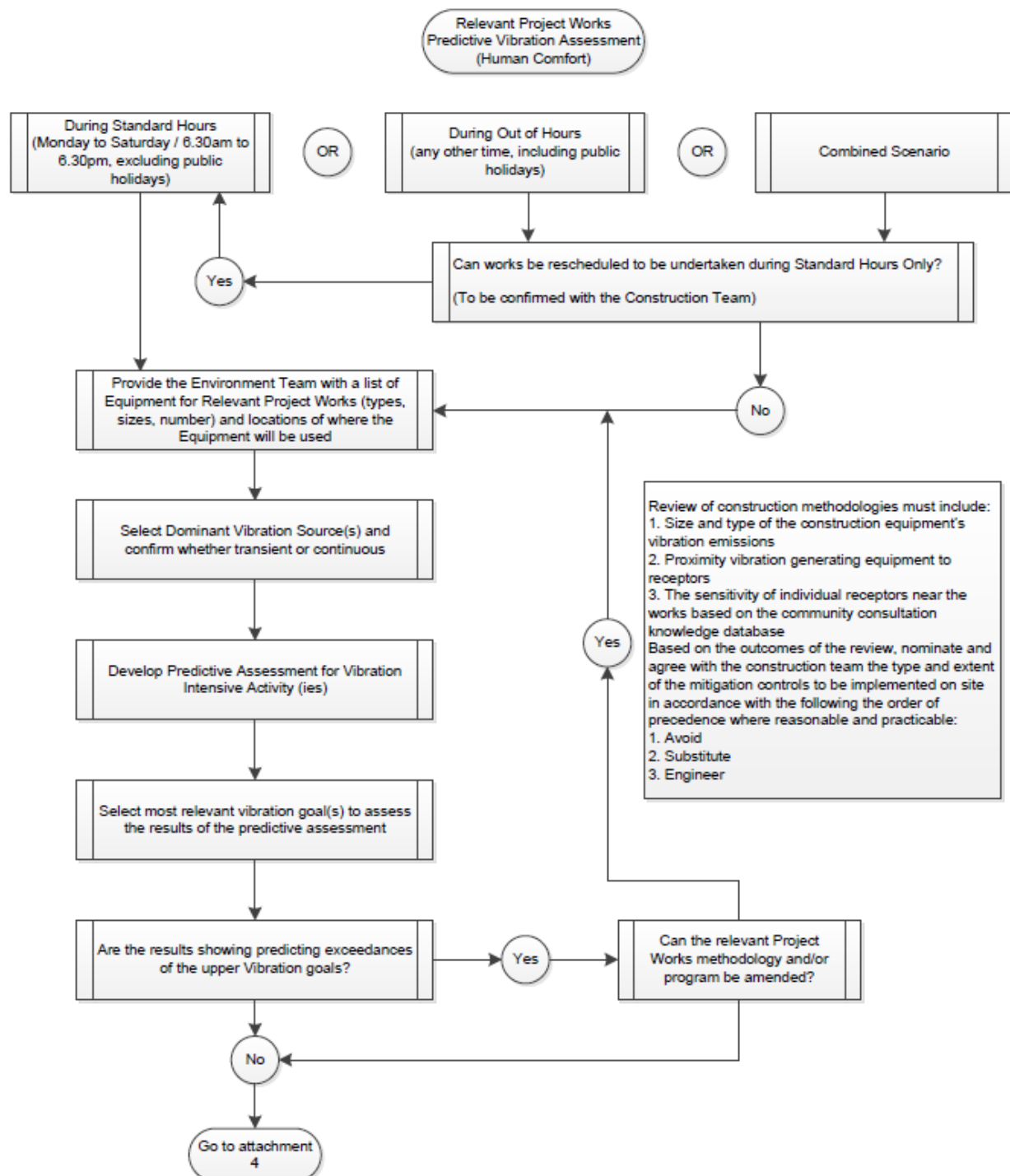
¹¹ If Monitoring is required it will be outdoors and attended

¹² Need for ongoing monitoring requirements will be determined based on the outcomes of the monitoring results

¹³ If Monitoring is required it will be outdoors and attended

¹⁴ Need for ongoing monitoring requirements will be determined based on the outcomes of the monitoring results

Attachment 3 Predicted Vibration Goals Modelling – Human Comfort - Criteria selection



Attachment 4 Predicted and Actual Vibration Exceedances Management - Human Comfort

Condition 11.d and Condition 11.f must be read in conjunction with Condition 10 (Approved Hours of Work) and Condition 9.c (consultation with DAPs).

Condition 11d and condition 11f provide for Lower Vibration Limits and Upper Vibration Limits to inform

- Level of consultation required with DAPs prior to works commencing
- Work restrictions that may be imposed on the construction activities hours of operation unless mitigation measures are developed in consultation with and agreed by DAPs

Where Lower Vibration Limits are predicted to be exceeded, consultation with Directly Affected persons must occur. The most suitable method of consultation will be selected by the Community and Stakeholder Engagement Manager or their team following a review of the predicted exceedances. Consultation may range from periodic Generic Notifications to more Specific Notifications such as emails, phone calls and doorknocking to particular areas.

The below table summarises the Lower (LL) and Upper (UL) Vibration Limits based on Occupancy Types for Standard Work Hours and Out of Hours Work.

Standard Work Hours are defined as follows:

- Monday to Saturday – 6.30am to 6.30pm
- Excludes Public Holidays

Out of Hours are defined as follows

- Monday to Saturday – 6.30pm to 6.30am
- Sundays
- Public Holidays

The management of vibration insofar as it relates to Cosmetic Damage is detailed under a separate cover in the Property Damage Mitigation Sub-Plan (RIS-UNA-ENV-MPL-00284).

Table 3: Vibration Goals Exceedances Management – Human Comfort

Vibration Type	Vibration levels (mm/s PPV) ¹⁵	Vibration <LL - Management	LL < Vibration <UL - Management	Vibration >UL - Management
Continuous	<ul style="list-style-type: none"> LL: up to¹⁶ 2 mm/s UL: 2 mm/s 	Prior to Construction <ul style="list-style-type: none"> Works are deemed Managed Works and therefore can be undertaken 24 hours, 7 days a week 	Prior to Construction <ul style="list-style-type: none"> Consultation with DAP via means of Generic Notifications a minimum of 2 weeks before the works commence For DAPs the most likely to be affected specific notifications may be sent to confirm Review construction methodologies (see below for more details) to confirm whether additional noise mitigation measures can be implemented For OOH works - Raise an OOH Work Permit prior to works commencing 	<p>Night works cannot occur if the upper limit is predicted to be exceeded unless agreement has been received from the DAP</p> Prior to Construction <ul style="list-style-type: none"> Review construction methodologies to confirm whether additional measures can be implemented to reduce predicted Noise to below the UL advance notification and consultation his undertaken with Directly Affected Persons or potentially Directly Affected Persons about the predicted impacts and the approach to mitigation of such impacts develop <u>and agree</u> mitigation measures on a 'case by case' basis in consultation with Directly Affected Persons Implement relevant case by case mitigation measures prior to works starting Ensure the mitigation measures developed <u>and agreed</u> with the DAP are communicated to the IEM and the CRM and included in the mitigation register maintained by the IEM For OOH works - Raise an OOH Work Permit prior to works commencing
Transient	<ul style="list-style-type: none"> LL: up to 2 mm/s UL: 10 mm/s 	<ul style="list-style-type: none"> Generic Notifications to be issued along the Corridor a minimum of 1 week before the works commence. Whilst consultation is not required – this is good practice For OOH works - Raise an OOH Work Permit prior to works commencing During Construction <ul style="list-style-type: none"> Undertake spot check monitoring to confirm works are still Managed Works as nominated in the SEP and / or the OOH permit Enact Complaints Response Protocol if triggered For OOH works – Comply with the approved OOH Work permit 	During Construction <ul style="list-style-type: none"> Undertake vibration monitoring (outdoors) at the commencement of the vibration intensive Activity(ies)¹⁷ to validate the model where predicted levels are > 5mm/s or within 1 mm/s of the UL, whichever is the highest. Enact Complaints Response Protocol if triggered Stop work if the actual vibration >UL and re-assess construction methodologies For OOH works – Comply with the approved OOH Work permit 	During Construction <ul style="list-style-type: none"> Undertake vibration monitoring (outdoors) to validate the model¹⁸ at the commencement of the Activity(ies), Enact Complaints Response Protocol if triggered Keep the DAPs informed of the construction progress For OOH works – Comply with the approved OOH Work permit <p>OR</p> <ul style="list-style-type: none"> Only work during the hours 7:00am to 6:00pm Monday to Friday, with a respite period between 12:00noon and 2:00pm each day when mitigations measures have not been developed in consultation with and agreed by DAP¹⁹

¹⁵ Vibration goals for Human Comfort in Table 3, are based on Peak Particle Velocity (PPV) but refer to AS2670 as an undated reference. AS 2670.2-1990 *Australian Standard Evaluation of Human Exposure to whole-body vibration Part 2: Continuous and shock-induced vibration in buildings (1 to 80Hz)* does not provide human comfort vibration goals in PPV, but rather base curves (spectra) representing “magnitudes of approximately equal human response with respect to human annoyance and/or complaints about interference with activities” for acceleration and velocity. The use of a vibration velocity based metric (PPV) for human comfort is considered an appropriate method of addressing the requirements of Table 3 of the CG Conditions, where PPV criteria are referenced back to the guidance provided in AS2670.2 1990, as required by the CG Conditions.

¹⁶ The actual limit is dependent on the type of occupancy of the buildings and will vary along the project area. Unity's Acoustic Specialist will determine which are the most suitable vibration levels to be used as part of the predictive modelling. Typically for Day Time operations, a lower limit of 0.57 mm/s is used for occupants of Residential, including Healthcare, Places of Worship, Education Places and a lower limit of 2mm/s is used for occupants of Offices, and Commercial Places, including light and medium industrial during day time. Typically for Night Time operations, a lower limit of 0.5 mm/s is used for occupants of Residential, including Healthcare, Places of Worship, Education Places, whilst no lower limit is assigned for Offices, and Commercial Places, including light and medium industrial as they are assumed unoccupied

¹⁷ Need for ongoing monitoring requirements will be determined based on the outcomes of the monitoring results

¹⁸ Need for ongoing monitoring requirements will be determined based on the outcomes of the monitoring results

Attachment 5 Noise Complaints Management – Out of Hours Works

It is understood that whilst indoor noise measurements are intrusive, and the Queensland Ombudsman findings as part of the investigation into Airport Link ²⁰

validated the use of proven façade reduction as part of predictive assessment and model validation measurements. Should the DAP specifically request attended indoors monitoring this may still be provided in key circumstances.

As such the below additional mitigation measure is required with regards to the implementation of attended indoors monitoring.

The RIS Scope of Works should consider offering attended indoors noise monitoring in the event of an out of hours noise complaint that cannot be resolved at the time of the complaint to the satisfaction of the complainant unless there are safety concerns associated with attended monitoring including but not limited to COVID-19.

The below decision flowchart steps out the key measures to be implemented in the event of an out of hours noise complaint.

²⁰ https://www.ombudsman.qld.gov.au/ArticleDocuments/218/Airport_Link_Ombudsman_Statement.pdf.aspx, pages 208-210, Section 9.8.6

