

# Armadale Road to North Lake Road Bridge Project

## Construction Noise and Vibration Management Plan

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## Terms, Abbreviations and Definitions

Abbreviation	Definition
AAA	Armadale Access Alliance
Alliance	The Alliance established to deliver the Project
ARNLR	Armadale Road to North Lake Road Bride Project
CD	Collector-distributor
CIC	MRWA Customer Information Centre
CoC	City of Cockburn
COHNVMP	Consolidated Out of Hours Noise and Vibration Management Plan
CM	Construction Manager
CNVMP	Construction Noise and Vibration Management Plan
CSEM	Community and Stakeholder Engagement Manager
CSET	Community and Stakeholder Engagement Team
dB	Decibel
DWER	Department of Water and Environmental Regulation
EC	Environmental Coordinator
EPA	Environmental Protection Authority
EQSafe	Main Roads Western Australia incident reporting portal
Hz	Hertz
IMPACT	LORA incident reporting portal
LGA	Local Government Area
OLE	Overhead Line Equipment
OOH	Out-of-Hours
OOHW	Out-of-Hours Works
PDE	Project Development Envelope
PPV	Peak Particle Velocity
Project	Armadale Road to North Lake Road Bride Project, the Project
PSP	Principal Shared Path
PTA	Public Transport Authority
Main Roads	Main Roads Western Australia
MRWA	Main Roads Western Australia
RAP	Representative Assessment Period
SWTC	Scope of Works and Technical Criteria

CLAUSE NO	DESCRIPTION	IN DOC REF
Scope of Works and Technical Criteria (SWTC) Requirements		
8.1(a) Working hours	Except as required by Law the maximum working hours permitted must be between 7:00 am and 7:00 pm, Monday to Saturday, except that work outside these hours may be permitted for specific operations subject to the approval in writing of Main Roads' Representative and compliance with the noise limits of clause 9.4(j). No work will be allowed on public holidays except as permitted by Law and then only with the prior approval in writing of Main Roads' Representative.	Section 3.4.1
8.1 (b) Working hours	The Participants must obtain the approval of Main Roads' Representative of the start and finish times and working days prior to commencement of work on the Site.	Section 3.4.2
8.1 (c) Working hours	Except in the interests of traffic flow, safety or to protect life or property, work outside of the nominated and approved times cannot be executed without the express approval of Main Roads' Representative. In such cases the Participants must promptly notify Main Roads' Representative in writing of the circumstances in which the Participants requests such approval and provide evidence of LGA approval.	Section 3.4.2
9.4 (j) Construction noise	<p>(i) The Participants must comply with the Environmental Protection Act 1986 (WA) and the Environmental Protection (Noise) Regulations 1997 (WA).</p> <p>(ii) The Participants must establish, implement and maintain a Construction Noise and Vibration Management Plan to the satisfaction of the LGA.</p> <p>(iii) The Participants must:</p> <ol style="list-style-type: none"> <li>provide the Main Roads' Representative with the current Construction Noise and Vibration Management Plan which will be placed on the Main Roads' website for public information;</li> <li>minimise the effects of noise on the occupants of adjacent properties by the use of silenced plant or by operating plant as far away as practicable from those properties; and</li> <li>(C) limit working hours on those construction activities which generate significant noise.</li> </ol>	<p>Section 3.4.1.</p> <p>This Plan</p> <p>This Plan</p> <p>Section 5.2, Table 8</p> <p>Section 5.1, Table 7</p>
9.4 (k) Vibration	<p>(i) The Participants must establish, implement and maintain a Construction Noise and Vibration Management Plan.</p> <p>(ii) The Participants must limit ground vibrations in adjoining properties by ensuring that the ground particle velocities from any necessary operation of vibratory compaction or percussion equipment cause minimum nuisance and do not exceed any such limit that could result in damage to property, and at most 5 mm/s.</p> <p>(iii) The Participants must seek to minimise the effects of vibrations in adjoining properties through the use of non-vibrating or lower vibrating construction methodologies or by operating plant as far away as practicable from those properties.</p> <p>(iv) A baseline vibration measurement must be taken at two locations and at the time nominated by Main Roads' Representative. The measurements must be taken at the commencement of construction</p>	<p>This Plan</p> <p>Section 4.2, Table 6</p> <p>Section 5.2, Table 8</p> <p>Section 4.3</p>

	<p>activities involving the operation of vibratory compaction or percussion equipment.</p> <p>(v) The Participants must continuously monitor vibration levels during construction activities involving the operation of vibratory compaction or percussion equipment, with real time notification when predetermined vibration limits are exceeded, and provide a copy of the measurements to the Main Roads' Representative each month.</p> <p>(vi) If complaints of nuisance levels of vibration from residents occur, the Participants must advise Main Roads' Representative and respond to any complaint at the earliest opportunity but no later than 24 hours after the complaint is received. In addition, the Participants must take vibration measurements at the affected residence. If the vibration limits specified in clause 9.4(k) are exceeded, the Participants must modify the construction method to reduce vibration.</p>	<p>Section 4.3</p> <p>Section 6</p>
<p>10.5(c) Advance notice of disruption</p>	<p>(i) The Participants must provide three weeks prior notice to the relevant LGA and to affected residents or businesses of any significant construction activities likely to cause disruption or disturbance, including access to property, machinery noise or vibration, dust, visual pollution or potential for property damage.</p>	<p>Section 3.4.2</p>

# 1 INTRODUCTION

## 1.1 Project Overview

The Armadale to North Lake Road Bridge Project is funded by the Commonwealth and State Governments as part of a \$2.3b investment in road and rail infrastructure. Project Works will be designed and constructed under a collaborative alliance which includes Main Roads, Laing O'Rourke and BG&E and known as Armadale Access Alliance (AAA).

The Project comprises construction of a bridge over the Kwinana Freeway connecting Armadale Road to North Lake Road and construction of free-flowing traffic lanes on Armadale Road through the Solomon Road and Tapper Road intersections. Full connectivity will be retained at the intersections of Solomon Road and Tapper Road through grade separated roundabouts.



In 2016, the Armadale Road, Kwinana Freeway and Beeliar Drive interchange was ranked the fifth most congested intersection in the Perth metropolitan area, with annual congestion costs estimated at \$10+ million. Armadale Road is a strategic freight route and one of the main east-west links within Perth's metropolitan transport network. This link forms part of the route to Fremantle Port with approximately 27,000 vehicles using Armadale Road daily between Tapper and Warton Roads. This congestion is preventing the full implementation of the Cockburn Central Activity Centre Strategy and the achievement of its vision and key strategic objectives.

The Project will help to address significant congestion in the Cockburn Central area resulting from the growth of the Cockburn Gateway Shopping Centre, surrounding commercial, retail and residential development and traffic passing through the area to access Cockburn Central Station, Kwinana Freeway and other destinations west of Kwinana Freeway.

Once delivered, the Project will benefit the Activity Centre by providing a supporting road network that feeds traffic to 'by-pass' the heart of the Activity Centre.

### Cockburn Central Activity Centre Strategy

The Strategy confirms the vision for Cockburn Central and details objectives to support the maturity of the centre. It provides a framework to guide future growth in a logical and sustainable way and guide investment in and around the activity centre. The Strategy includes a number of key actions to manage and support the growth of the area, including important road network improvements such as the Armadale Road to North Lake Road Bridge Interchange Project.





## 1.2 Project Scope

Main Roads Project work determined a proposed scope of works for grade separating Armadale Road from local roads as outlined below.

**Table 1 - General Scope of Works for the Project**

General Scope of Works
<p>Armadale Road passing over Tapper Road and under Solomon Road</p> <p>The design combines an elevated roadway over the Armadale Road/ Tapper Road/Verde Drive roundabout, and an underpass trench structure (duck and dive) under the Armadale Road/Solomon Road roundabout. Local traffic connectivity at Solomon Road is maintained through ground level roundabouts, with through traffic lanes passing in a below ground structure. The scope of works also includes the construction and installation of a bridge across the live Kwinana Freeway and Mandurah to Perth railway line around Cockburn Station.</p>

Under the BDC, the Project general scope of works includes:

**Table 2 - Project Scope of Work**

Scope element	Scope of works
<b>Armadale Road</b>	<ul style="list-style-type: none"> <li>Four lane dual carriageway extension of North Lake Road from current termination west of the Freeway to Armadale Road east of Ghostgum Avenue</li> <li>Grade separated crossings of Kwinana Freeway, Tapper Road and Solomon Road.</li> <li>Collector-distributor (CD) roads on each side of Armadale Road to provide local access.</li> </ul>
<b>Kwinana Freeway</b>	<ul style="list-style-type: none"> <li>Southbound CD road from Berrigan Drive to Beeliar Drive.</li> <li>North-facing entry and exit ramps connecting to Armadale Road.</li> </ul>
<b>Intersections and local connections</b>	<ul style="list-style-type: none"> <li>Existing intersection modification at Midgegooroo Ave/Kentucky Court and North Lake Road.</li> <li>Signalised intersections at Freeway ramps.</li> <li>Grade separated roundabout at Solomon Road/Beeliar Drive.</li> <li>Grade separated roundabout at Tapper Road/Verde Drive.</li> <li>Additional lanes at existing intersection at Ghostgum Avenue.</li> <li>Various local connections and modifications.</li> </ul>
<b>Bridges and other structures</b>	<ul style="list-style-type: none"> <li>New Bridge No. 1733 over Kwinana Freeway.</li> <li>Two lane vehicle underpass (Bridge No. 1825) for an access road from the Public Transport Authority (PTA) carpark to the future extension of Prinsep Road.</li> <li>Grade separation of the Freeway Principal Shared Path (PSP) using an underpass (No. 9454) under the Armadale Road entry ramp.</li> <li>Retaining walls to minimise the footprint of the works.</li> <li>Gantries to accommodate guide signs and variable message signs.</li> <li><b>Trench structure enabling Armadale Road to pass underneath Solomon Road, with the Solomon Road/Beeliar Drive roundabout supported by twin bridges (No's. 1826 and 1827) over the dive structure.</b></li> <li>Elevated roadway (Bridge No. 1828) to take Armadale Road over the Tapper Road/Verde Drive roundabout.</li> </ul>
<b>Traffic signalised intersections</b>	<p>Traffic signals where North Lake Road and the new Armadale Road intersects with:</p> <ul style="list-style-type: none"> <li>Freeway entry ramp / bus station access</li> <li>Freeway exit ramps.</li> </ul> <p>Modification of existing traffic signals at:</p> <ul style="list-style-type: none"> <li>Midgegooroo Avenue/Kentucky Court</li> <li>Ghostgum Avenue.</li> </ul>

Scope element	Scope of works
<b>Shared paths, cycle paths and footpaths</b>	<ul style="list-style-type: none"> <li>• PSP on north side of Armadale Road, from the Freeway PSP to the PSP being constructed by others east of Ghostgum Avenue, with a series of at grade crossings.</li> <li>• Shared path on the south side of Armadale Road from Knock Place to Tapper Road.</li> <li>• Realignment of the Kwinana Freeway PSP where affected by the Project.</li> <li>• Connecting shared paths, cycle paths and road crossings at various locations to ensure all pedestrian and cyclist lines are accommodated.</li> <li>• Replacement or realignment of affected existing paths and temporary paths.</li> </ul>
<b>Noise and screen walls</b>	<ul style="list-style-type: none"> <li>• Traffic noise mitigation measures adjacent to noise sensitive developments where the predicted traffic will increase traffic noise levels above the noise level objectives.</li> <li>• Provision of screen walls where privacy of residents and the quality of views from adjacent properties may otherwise be reduced.</li> </ul>
<b>Resurfacing</b>	<ul style="list-style-type: none"> <li>• Resurfacing of existing roads where lane markings change, either for permanent works or resulting from temporary markings.</li> <li>• Resurfacing a section of the Freeway northbound carriageway.</li> </ul>
<b>Fencing</b>	<ul style="list-style-type: none"> <li>• Provision of boundary fencing and pedestrian and cyclist safety fencing.</li> </ul>
<b>Accommodation works</b>	<ul style="list-style-type: none"> <li>• Accommodation works within properties affected by the Project and accesses to properties.</li> </ul>
<b>Safety barriers</b>	<ul style="list-style-type: none"> <li>• Roadside and median safety barriers where required to meet safe system requirements.</li> <li>• Replacement of a section of wire rope barrier in the Freeway median with a concrete barrier.</li> </ul>
<b>Drainage</b>	<ul style="list-style-type: none"> <li>• Drainage including underground drainage, swales, basins, subsoil drainage and culverts</li> <li>• <b>Proposed pump station at the base of the dive structure to drain the low point at Solomon Road.</b></li> </ul>
<b>Lighting</b>	<ul style="list-style-type: none"> <li>• Installation of street lighting to all roads.</li> <li>• Installation of lighting to shared paths and cycle paths.</li> </ul>
<b>Signing and pavement marking</b>	<ul style="list-style-type: none"> <li>• Removal of signing and pavement markings no longer required, provision of new signing, gantries and pavement markings and modifications to existing signing and pavement markings within and outside the Site which are required as a consequence of the Project.</li> </ul>
<b>Intelligent Transport Systems (ITS)</b>	<p>Installation of Intelligent Transport Systems along the route and on key connecting roads for:</p> <ul style="list-style-type: none"> <li>• Traveller and user information.</li> <li>• Road use information.</li> <li>• Information for traffic control and incident management.</li> </ul> <p>This must include such infrastructure as:</p> <ul style="list-style-type: none"> <li>• Fibre optic cabling.</li> <li>• Specialised ITS infrastructure at high risk locations.</li> <li>• Variable message signs.</li> <li>• Vehicle detection loops.</li> <li>• Traffic monitoring cameras (CCTV).</li> <li>• Linkage of all ITS infrastructure back to Main Roads' Traffic Control Centre.</li> <li>• Integration of all ITS to Main Roads' traffic management control system (STREAMS).</li> <li>• Testing, acceptance, commissioning and handover of all ITS.</li> </ul>
<b>Urban design and public art</b>	<ul style="list-style-type: none"> <li>• Production and integration of urban design elements, incorporating public art works, within the Project.</li> </ul>
<b>Services</b>	<ul style="list-style-type: none"> <li>• Relocation or modification of all services which are affected by the Project or the construction of the Project.</li> <li>• Allowance for new and future services.</li> <li>• Incorporation of enhancements funded by others.</li> </ul>

Scope element	Scope of works
<b>Rehabilitation and landscaping</b>	<p>Rehabilitation, landscaping and revegetation over the entire Site, including hard landscaping. The landscaping must be consistent with the Urban Design elements and must:</p> <ul style="list-style-type: none"> <li>• Maximise retention of existing vegetation.</li> <li>• Use native plants and exotic (deciduous trees) to maximise shade and shelter for pedestrians.</li> <li>• Provide a higher quality planting treatment adjacent to the shared path on the south side of the Road and in the roundabouts.</li> <li>• Screen out undesirable visual elements.</li> </ul>
<b>Modifications to existing infrastructure</b>	<ul style="list-style-type: none"> <li>• Provision of all connections, modifications and improvements necessary to roads and properties affected by the Project, including removal of redundant road infrastructure, modifications to drainage, traffic signals and islands and new lane markings as necessary.</li> <li>• Modifications to PTA overhead line equipment (OLE) and other affected PTA assets necessary to accommodate the construction of Bridge No. 1733.</li> </ul>
<b>PTA carpark</b>	<ul style="list-style-type: none"> <li>• Construction of PTA carpark bays to replace those impacted by the Project works and a short section of PTA carpark access road under Bridge No. 1825</li> <li>• Modification of associated infrastructure including drainage, lighting and cameras.</li> </ul>

### 1.3 Project Noise and Vibration Objectives

The AAA noise and vibration objectives for the project are:

- Minimise potential noise and vibration impacts on the community and any other stakeholders;
- Avoid structural damage to buildings and other structures;
- Ensure appropriate noise and vibration controls are implemented during construction; and
- Undertake active community consultation and maintain positive working relationships.

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## 2 PURPOSE AND SCOPE OF THIS PLAN

This Construction Noise and Vibration Management Plan (CNVMP) has been produced to supplement the Armadale Access Alliance (AAA) Environmental Management Plan (EMP) for implementation by the Alliance throughout the Armadale Road to North Lake Road Bridge (ARNLR) Project.

The CNVMP outlines AAA's approach to the management of nuisance noise and vibration created from the Project. The implementation of this Plan will allow for effective management of potential noise and vibration impacts associated with the construction phase of the Project. This CNVMP has been developed with reference to the documentation outlined in Section 2.2 below.

This CNVMP applies to the entire project alignment during construction. Management measures detailed in this CNVMP are in alignment with the relevant guidelines and shall be adopted for the duration of the project by AAA.

### 2.1 Interactions with other management plans and procedures

This CNVMP forms part of an integrated set of project specific environmental management sub plans and procedures linked to the AAA Construction Management Plan to be managed by the AAA Environmental Coordinator.

This CNVMP must also be read in conjunction with the overall environmental and construction management strategies and approaches as outlined in the following AAA plans:

- Stakeholder and Community Engagement Management Plan (ARNLR-AAA-MPL-0000-CS-0001)
- Interface Management Plan (ARNLR-AAA-MPL-0000-PM-0002)
- Safety and Health Management Plan (ARNLR-AAA-MPL-0000-HS-0001)
- Construction Management Plan (ARNLR-AAA-MPL-0000-CN-0001)
- Traffic Management Plan (ARNLR-AAA-MPL-0000-TR-0001)

### 2.2 Information Resources

Information in this CNVMP has been based upon a review and where applicable referencing and inclusion of the following:

- Western Australia Environmental Protection Act 1986;
- Western Australia Environmental Protection (Noise) Regulations 1997;
- Western Australia EPA Guidance No 8 Guidance for the Assessment of Environmental Factors;
- Australian Standard AS2107:2000 Acoustics – Recommended design sound levels and reverberation times for building interiors;
- Australian Standard AS2436-2010 Guide to Noise and Vibration Control on Construction, Demolition and Maintenance sites;
- Australian Standard AS2670.2-1990 Evaluation of Human Exposure to whole body vibration Part 2 Continuous and shock induced vibrations in buildings (1 Hz to 80 Hz);
- Australian Standard AS1055 -1997 Description and measurement environmental noise;
- British Standard BS 5228:2009: Code of practice for noise and vibration control on construction and open sites;

- British Standard BS 7385: Part 2-1993 Evaluation and measurement for vibration buildings Part 2;
- British Standard 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings - Vibration sources other than blasting;
- German Standard DIN 4150 Structural vibration - Human exposure to vibration in building Part 2;
- German Standard DIN 45669:1995 1 - Mechanical vibration and shock Part 1 Measuring equipment;
- MRIA | Armadale Road to North Lake Road - Noise Assessment Report, 2018;
- AAA Scope of Works and Technical Criteria 2019 (SWTC), Contract Number 237/16;
- Western Australia Occupational Health and Safety Regulations 1996; and
- UK Control of Vibration at Work Regulations 2005.

## 3 NOISE

The potential impacts of noise on any particular location can vary greatly depending on factors such as the relative proximity of sensitive receptors to the source of the noise, the overall duration of works undertaken, and the character of the noise generated by the works. Activities associated with construction works have the potential to increase localised noise, impacting on the community and public adjacent to the project area.

A Transportation Noise Monitoring assessment was undertaken by Lloyd George Acoustics (April 2017) for Main Roads WA (MRWA) at 8 locations along Armadale Road between 14<sup>th</sup> of March and 23<sup>rd</sup> of November 2017. The Lloyd George report provides baseline data of existing traffic noise levels along the Armadale Road section of the alignment. More recently, Lloyd George completed an Acoustic Impact and Design Report (July 2019) which included further site measurements, as well as modelling of noise levels and predicted impacts of the Project's operation phase. Although this report does not target construction noise criteria and its predicted impacts, it concludes that compliance with operational phase noise criteria (with controls such as noise walls in place) can be achieved.

### 3.1 Existing environment

The ARNLR Project is in close proximity to major roads, a variety of planning zones, and standalone sensitive receptors. Noise sensitive receptors include existing residences and public buildings such as medical centres, schools, places of worship and libraries. A number of noise sensitive receptors located in the vicinity of the Project site are identified in Table 3.

It is also noted that a large number of residential properties immediately back onto the Project Development Envelope (PDE) boundary. Attachment A identifies properties within 100m of the ARNLR Project Construction Footprint.

### 3.2 Construction activities

A variety of plant will be used during the construction phase of the Project, including excavators, graders, loaders, vibratory rollers, tipper trucks, compactors, lifting and access equipment, drilling machinery, and rattle guns. Noise and vibration generated through the use of these items will consist of steady production as well as some impulsive components.

Stationary plant such as generators and compressors will also be required, with noise from these items being mainly steady in nature. Deliveries will be completed during standard construction working hours unless they are completed in accordance with the ARNLR Consolidated Out of Hours Noise and Vibration Management Plan (COHNVMP).

It is expected that some project activities will be required to be undertaken outside of the approved construction hours to ensure worker and traffic safety. Should Out of Hours Works be required, AAA will work in accordance with the COHNVMP and gain the necessary approvals from MRWA and City of Cockburn. If the tasks to be completed out of hours differ to those included in the COHNVMP, a separate Out of Hours Noise and Vibration Management Plan (OOHNVMP) specific to the task will be developed. This OOHNVMP will include modelling of noise and/or vibration dissipation distances, identification of sensitive receivers and notification ranges, and relevant mitigation measures.

**Table 3 – Nearby potential noise sensitive receptors**

Receptor(s)	Description	Identified as a Noise Sensitive Premise
Operating Railway Station / Bus Terminal	Existing transport infrastructure (Cockburn Central Station)	No
Office / Industrial Premises	Commercial premises	No

Receptor(s)	Description	Identified as a Noise Sensitive Premise
Residential properties between Kwinana Freeway and Tapper Road to the south of Armadale Road as well as those to the east and west of Kwinana Freeway between Armadale Road and Berrigan Drive	Premises occupies solely for the purpose of residential accommodation	Yes
Schools / Child Care	Atwell Primary School located to the south of the alignment Early Start Childcare Centre, 12 Solomon Road	Yes
Hospitals / Medical Centres	Fiona Stanley Hospital and a number of medical centres located to the North and East of the alignment	Yes
Library	Success Library located to the East of the alignment	Yes

### 3.3 Noise Targets

Noise levels will be monitored with the aim to understand noise generated as a result of ARNLR construction activities. Intervention and Action targets are presented in Table 4. AAA will use a combination of quantitative and qualitative data to assess noise generation from construction works. This includes monitoring data collected from noise monitoring stations situated in the vicinity of sensitive receptors along the Project alignment, together with public complaints arising from construction noise. All works shall comply with occupational health and safety guidelines and be conducted in accordance with State Planning Policy 5.4 (WAPC, 2009), the Environmental Protection Noise Regulations 1997, Section 4.5 of AS 2436 – 2010 Guide to Noise Control on Construction, Maintenance and Demolition Sites and Section 3.4 of this plan.

**Table 4 – Intervention and Action target levels**

Noise Criteria	Intervention target (investigate source and implement mitigation)	Action target (stop works and investigate source)
Qualitative	Up to 2 complaints within 24 hours from a stakeholder, local community member of business.	Multiple (>2) complaints within 24 hours from a stakeholder, local community member or business.
Quantitative	N/A	LAeq, 8 hours of 85dB(A)*

\*As identified within Occupational Safety and Health Regulations, this value reflects the exposure standard for noise exceedance – 85dB over an eight-hour period (during construction hours)

### 3.4 Noise Controls

#### 3.4.1 Working hours

Audible and vibratory construction activities shall be restricted to occur between 0700 hours and 1900 hours Monday to Saturday. All works during normal operation hours will be undertaken in accordance with Regulation 13 of the Environmental Protection (Noise) Regulations 1997. These Regulations state that assigned levels do not apply to construction work undertaken within normal operation hours (i.e. between 0700 and 1900 hours Monday to Saturday) under the following conditions:

- Construction work must be carried out in accordance with environmental noise practices set out in Section 4 of AS 2436-2010 Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites;
- The equipment used for construction must be the quietest reasonably available; and
- If the contractor is required to submit a noise management plan that it is prepared and given in accordance with the requirement, approved by the relevant Chief Executive Officer (CEO) and the work is carried out in accordance with the plan.

The AAA Community and Stakeholder Engagement Team will issue a three-week advance notice to MRWA, City of Cockburn and affected residents and/or businesses of significant construction works during normal operation hours that may cause disruptions or disturbances.

### 3.4.2 Out-of-hours works

In order to meet the required project programme, it is expected that construction works will need to be completed outside of normal construction hours. These works include areas with traffic constraints or in proximity to high trafficked areas which, if undertaken between 0700 hours and 1900 hours, would pose risk to worker and/or traffic safety. Other activities may include bulk deliveries or installation (e.g. T-Roff Beams for bridge construction). Should out-of-hours works be required, and the noise generated is expected to exceed the assigned levels at sensitive receivers, AAA will ensure the following:

- Construction work must be carried out in accordance with environmental noise practices set out in Section 4 of AS 2436-2010 Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites;
- The equipment for construction must be the quietest reasonably available;
- Advise all nearby sensitive receptors likely to receive noise levels which fail to comply with the assigned levels under regulation 8 of the works to be done at least 24 hours before it commences;
- Show that it was reasonably necessary for the work to be done out of hours; and
- Submit to the relevant CEO a noise management plan at least seven days prior to the commencement of work and the plan must be approved by the CEO. The plan must include details of:
  - Reasons for the construction works needing to be completed out of hours;
  - Details of the durations of activities which are likely to result in high noise emissions;
  - Predictions of the noise emissions from the site;
  - Details of measures used to control noise (including vibration) emissions;
  - Procedures to be adopted for monitoring noise (including vibration) emissions; and
  - Complaint response procedures to be adopted.

At least three weeks' notice will be given to MRWA and City of Cockburn to obtain the necessary approvals to conduct work out-of-hours. For tasks included within the COHNVMP, three weeks' notice will be given for initial approval of the plan. Following approval of the consolidated Plan, 10 days' notice will be given to both MRWA and City of Cockburn to obtain approval to undertake OOHW. Residents and affected businesses will also be notified in accordance with the AAA Community and Stakeholder Engagement Management Plan (ARNLR-AAA-MPL-0000-CS-0001). When issuing notifications, special consideration will be given to those residents which may fall outside of the setback area but reside in high rise apartment complexes due to the differences in noise attenuation which are likely to be experienced.

No OOHW are to be conducted without prior approval from the AAA Project leader, Project Environmental Coordinator, MRWA and City of Cockburn (as applicable) through a submitted and approved Out of Hours Construction Noise and Vibration Management Plan (or Notification Form if task is included in the COHNVMP).

Emergency construction works or activities required to ensure/maintain the safe use of public roads, no loss of life, no damage to property and no environmental harm may be undertaken outside of approved working



hours without prior approval from MRWA. Emergency OOHW must be notified to MRWA as soon as practicable, with evidence of LGA approval.

### **3.5 Noise Monitoring**

Monitoring will be undertaken to assess the noise generated by AAA construction activities and will be carried out in accordance to the Environmental Protection (Noise) Regulations 1997. A number of monitoring stations will be established along the alignment in proximity to sensitive receptors. The AAA Team proposes to maintain up to seven (7) Casella C633C noise monitors. The locations of these monitors will likely be influenced by the location of works, and will be tracked within an environmental monitoring register.

The Casella is a reliable mobile noise monitoring system which has a number of features and telemetry capabilities including an e-mail and SMS alert system that instantaneously distributes real time data. The data collected by these monitoring units will be assessed either weekly or daily, depending on the sensitivity of the surrounding environment. All data will be reviewed by a suitably qualified person to ensure the Project is meeting the adopted noise criteria. All data recorded will be maintained within a register and provided to MRWA on a monthly basis. Data will also be made available to City of Cockburn upon request.

AAA shall conduct monitoring of sound levels during construction activities as close to the nearest identified receiver as possible. Monitors shall be positioned on the boundary of works, situated between the area of activity and the closest sensitive receiver. Where specific monitoring is required, equipment shall be positioned in locations adjacent to an identified sensitive receptor. Where there are multiple worksites, monitors shall be utilised per work front which have the potential to impact sensitive receptors.

Weekly environmental inspections will also be conducted which will incorporate noise management. Inspections will assess on-site environmental conditions including the implementation of noise management controls and mitigation measures.

## 4 VIBRATION

Vehicle and machinery operation, particularly large plant and tracked equipment (e.g. excavators, vibratory rollers, large compactors), used during construction activities may cause an increase in localised vibration of neighbouring properties, surrounding buildings (residential, commercial and recreational), heritage buildings or sites and public utilities / infrastructure.

These types of construction vibration can lead to:

- Cosmetic and structural building damage; and / or
- Loss of amenity due to perceptible vibration, termed human comfort.

### 4.1 Existing Environment

The project is situated in close proximity to a number of sensitive receivers, residential premises and heritage areas. Human perception of vibration and impact on amenity can occur at significantly lower levels than that which may cause actual cosmetic or structural damage. It is expected that residential areas will be most aware of increases in vibration emitted during works.

Table 5 provides a review of the potential sensitive receptors within 100m of the Project footprint.

**Table 5 – Nearby vibration sensitive receptors**

Vibration sensitive receptor(s)	Within 100m of PDE boundary	Description
Operating Railway	Yes	Existing transport infrastructure (Cockburn Central Station)
Hospitals	No	Fiona Stanley Hospital located approximately 4.5km north of the Project area
Residential development with and without pools	Yes	Residential properties between Kwinana Freeway and Tapper Road to the south of Armadale Road as well as those to the east and west of Kwinana Freeway between Armadale Road and Berrigan Drive
Universities	No	Murdoch University located approximately 4.5km north east of the Project area
Commercial printer	No	Office Works Jandakot
Schools / Child care	No	Atwell Primary School located to the south of the alignment Early Start Childcare Centre, 12 Solomon Road
Heritage listed buildings / other places	No	Aboriginal heritage sites: 18752, 3423, 3428, 3429, 3301, 3447, 21811, 3446. Old Jandakot School, Banjup Memorial Park, Dutch Windmill

Receptors existing within 100m of the PDE boundary have been identified as potential receivers of vibration. Residential properties dominate the volume of expected receptors and are distributed closer than other receptors. Commercial businesses operate to the north of Armadale Road, although those that are vibration sensitive fall outside of the 100m buffer zone. Residential and commercial properties along the road corridor

where works are to take place may be impacted by vibration intensive activities, although this would be predominately relevant to premises within 50m (dependent on works) of the PDE.

A number of Aboriginal (largely artefact scatter and mythological sites) and European heritage sites have been identified in the vicinity of the Project area. However, none of these occur within 100m of the PDE boundary and are unlikely to be impacted by vibration generating construction activities.

Existing infrastructure within and adjacent to the corridor may also be subject to vibration impacts; these items include the gas and Water Corporation pipelines (Asbestos and Cement and Mild Steel Concrete Lined). Avoidance of impact to underground services will be managed through construction processes such as permits. These permits will identify control measures including restrictions on machinery types and exclusion zones.

## 4.2 Vibration Targets

AAA shall aim to complete all construction works which require vibration intensive activities within 100m of sensitive receivers during specific (less sensitive) times of the day in attempt to limit the impact on human comfort. Should vibration intensive works be conducted within 100m of sensitive receptors, AAA shall notify the affected receivers and monitor vibration levels against the target levels in Table 6.

## 4.3 Buildings and Underground Services

As there is currently no guidance in Australia specifically addressing cosmetic damage to buildings or damage to underground services from vibration, international standards have been considered when determining Project vibration criteria. Two international standards are typically used for the assessment of cosmetic damage in buildings; British Standard BS 7385-2: 1993 *Evaluation and measurement for vibration in buildings* and German Standard DIN 4150-3: 1999 *Structural Vibration – Part 3: Effects of vibration on structure*. German Standard DIN 4150-3 1999 *Structural Vibration – Part 3: Effects of Vibration on structures* has been referenced to provide safe vibration levels for buried utilities.

### 4.3.1 PTA Infrastructure

Vibration limits also apply to PTA infrastructure and are outlined within PTA Procedure - *Working in and Around the PTA Rail Reserve*. It is noted in Appendix 3 of the PTA Procedure that prolonged vibrations such as demolition, driving or withdrawing of piles, vibratory compaction or any similar operation shall not exceed 15 mm/s.

### 4.3.2 Human Comfort (amenity)

Guidance in relation to assessing potential disturbance from ground-borne vibration is set out in Australian Standard AS 2670.2-1990 *Evaluation of Human Exposure to whole body vibration Part 2 Continuous and shock induced vibrations in buildings AS2670:1997*. AS2670 provides a recommended objective vibration level of 0.2 mm/s (Lv 106 dB ref 1x10<sup>-6</sup> mm/s) for residential premises during the daytime. These criteria will be utilised to assess human disturbance within residential buildings to vibration for the project. The criteria as per AS 2670 will be 0.4 mm/s (Lv 112 dB) for offices and 0.8 mm/s (Lv 118 dB) for industrial premises.

Project specific targets have been established according to the above mentioned standards and procedures to prevent construction works from causing damage to buildings, heritage sites, PTA infrastructure, and underground utilities. The Project vibration targets are detailed below in Table 6.

**Table 6 – Project vibration criteria**

Vibration Sensitive Receptor	SITE CONTROL CRITERIA (PPV IN ANY ORTHOGONAL DIRECTION) MM/S	
	Intervention target (investigate source and implement mitigation)	Action target (stop works and investigate source)
Residential and occupiable buildings	3	5

	SITE CONTROL CRITERIA (PPV IN ANY ORTHOGONAL DIRECTION) MM/S	
Vibration Sensitive Receptor	Intervention target (investigate source and implement mitigation)	Action target (stop works and investigate source)
PTA Infrastructure	12	15
Buried pipes (not gas)	20	25
Electrical and Communication Cables	40	50
Gas pipelines*	4	5
Residential (Human Comfort)	N/A	0.2
Commercial (Human Comfort)	N/A	0.4
Industrial (Human Comfort)	N/A	0.8

\*The most stringent ATCO criteria has been chosen for gas pipelines

#### 4.4 Vibration Monitoring

Vibration monitoring using InstanTel's MicroMate shall be conducted continually during construction activities. These monitors will be used to measure AAA vibration in mm/s PPV generated by works and emitted to nearby structures/buildings and infrastructure. Up to seven (7) sensors will be deployed along the Project alignment. At the commencement of construction activities, AAA will measure baseline vibration at two locations.

Vibration trials may also be conducted prior to vibration-intensive activities that may have significant impact on receptors to gauge potential setback distances or start-up locations. Vibration monitoring will likely occur alongside noise monitoring. The location of these monitoring stations will be dependent upon the location of works and corresponding sensitive receivers.

The data collected by these monitoring units will be assessed either weekly or daily, depending on the sensitivity of the surrounding environment. All data will be reviewed by a suitably qualified person to ensure the Project is meeting the adopted vibration criteria. All data recorded will be maintained within a register and available to MRWA and City of Cockburn upon request.

AAA shall conduct monitoring during construction activities as close to the nearest identified receiver as possible. Monitors shall be positioned on the boundary of works, situated between the area of activity and the closest sensitive receiver. Where there are multiple worksites, monitors shall be utilised per work front which have the potential to impact sensitive receptors. If specific monitoring is required (e.g. in the case of a complaint), the landowner's permission will be obtained and monitoring equipment positioned on or in the property of interest adjacent to construction works. All monitoring equipment shall be installed as per the manufacturers specifications.

Weekly environmental inspections will also be conducted which will incorporate vibration management. Inspections will assess on-site environmental conditions including the implementation of vibration management controls and mitigation measures.

## 5 MITIGATION MEASURES

### 5.1 General

The noise mitigation management measures outlined in Table 7 will be implemented in order to reduce disturbance to nearby receivers during the project.

**Table 7 - Management Controls**

Action Required	Applies	Details
Working hours	Noise Vibration	Construction activities are to be only undertaken between 7.00 am and 7.00 pm Monday to Saturday unless otherwise approved. Information regarding working hours is to be included in Project Induction, Pre Start Briefings, Toolbox Talks etc.
Out of hours works	Noise Vibration	All requests for Out of Hours Works are to be assessed by the Environmental Coordinator using processes outlined in the CNVMP and COHNVMP.
Respite periods	Noise Vibration	Restricting time when noisy and vibration intensive works are carried out. Works will be scheduled in order to reduce the impact of noise and vibration on sensitive receivers where practicable.
Implement community consultation measures	Noise Vibration	<ul style="list-style-type: none"> <li>• Periodic letterbox notifications</li> <li>• Project website</li> <li>• Main Roads Customer Information Centre</li> <li>• Email distribution list</li> <li>• Informal community- based forums</li> </ul>
Site inductions	Noise Vibration	<p>All AAA employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include:</p> <ul style="list-style-type: none"> <li>• All relevant Project-specific and standard noise and vibration mitigation measures</li> <li>• Relevant licence and approval conditions</li> <li>• Permissible hours of work</li> <li>• Any limitations on high noise generating activities</li> <li>• Location of nearest sensitive receivers</li> <li>• Construction employee parking areas</li> <li>• Designated loading/unloading areas and processes</li> <li>• Site opening/closing times (including deliveries)</li> <li>• Environmental incident response processes</li> </ul>
Behavioural practices	Noise	<p>No swearing or unnecessary shouting or loud stereos/radios on site.</p> <p>No dropping of materials from height, throwing of metals items and slamming of doors.</p>

Action Required	Applies	Details
Monitoring	Noise Vibration	A monitoring program as specified in Sections 3.5 and 4.4 is to be carried out for the duration of the works
Cease work	Noise Vibration	In the event of an exceedance of the specified action target levels (refer to Tables 4 and 6), impacts can be controlled by ceasing the activity until received noise/vibration levels can be reduced to within acceptable levels.

## 5.2 Source Controls

The source noise mitigation measures outlined in Table 8 will be implemented in order to reduce the disturbance to nearby receivers during the project.

**Table 8 - Source controls**

Action Required	Applies	Details
Equipment selection	Noise	All fixed plant at the work sites are to be selected to be as quiet as practicable and where required, fitted with silencers, acoustical enclosures and other noise attenuation measures.
Equipment selection	Vibration	Quieter and less vibration emitting construction methods will be used where feasible and reasonable.
Rental plant and equipment	Noise	The noise levels of plant and equipment items are to be considered in rental decisions.
Maintenance of plant	Noise Vibration	Vehicle, plant and equipment maintenance schedules and lubrication will be maintained as per manufacturers' specifications.  Regular checks are to be undertaken to ensure all equipment and vehicles are in good working order and are operated correctly.
Use and siting of plant	Noise	Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be avoided.  The offset distance between noisy plant and adjacent sensitive receivers is to be maximised.  Plant used intermittently to be throttled down or shut down when not in use.  Noise-emitting plant to be directed away from sensitive receivers.
Plan worksites and activities to minimise noise and vibration	Noise Vibration	Plan traffic flow, parking and loading / unloading areas to minimise reversing movements within the site.  Prevent vehicles and plant queuing to access site.
Non-tonal reversing alarms	Noise	Non-tonal reversing alarms (or an equivalent mechanism) will be fitted and used on all construction vehicles and mobile plant used on site.

Action Required	Applies	Details
Minimise disturbance arising from delivery of goods to construction sites	Noise	<p>Loading and unloading of materials / deliveries is to occur as far as possible from sensitive receivers.</p> <p>Site access points and roads as far as possible away from sensitive receivers will be used.</p> <p>Dedicated loading / unloading areas to be shielded if close to sensitive receivers.</p> <p>Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.</p>
Hand tools	Noise	<p>As much as practical the use of hand tools such as grinders, impact wrenches, hammers etc. will be used in specifically designated areas as far as possible from sensitive receivers and preferably separated by a barrier. Metal on metal contact will be avoided where possible.</p>

### 5.3 Path Controls

The noise mitigation path control outlined in Table 9 will be implemented in order to reduce the disturbance to the nearby receivers during the project.

**Table 9 - Source controls**

Action Required	Applies	Details
Shield stationary noise sources such as pumps, compressors, fans etc.	Noise	<p>Stationary noise sources will be enclosed or shielded where possible whilst ensuring that the occupational health and safety of workers is maintained.</p>
Shield sensitive receivers from noisy activities	Noise	<p>Use structures to shield residential receivers from noise such as site shed placement; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when siting plant.</p> <p>Should a permanent acoustic barrier for operational noise control be erected consideration will be given to building it prior to the rest of the construction works (i.e. noise walls).</p>
Acoustic barriers	Noise	<p>Erecting barriers on site at source where practical will be considered to reduce the impact of noise at receivers. AS2436 identifies the options for barriers to reduce noise emissions from construction sites.</p>

### 5.4 Dilapidation Surveys

All property owners within a 100m buffer of the PDE will be provided with the opportunity to have a dilapidation survey conducted at their property, both pre and post construction. These surveys will be carried out by an independent, qualified assessor agreed to by Main Roads' Representative.

Each dilapidation survey report will include:

- A visual inspection of all building and structures (more specifically internal and external walls, ground level floors and pavements, any exposed foundations, connections to other structures above ground level and their connection at ground level);
- Photographs of all cracks and defects observed; and,
- A record of the location of all cracks and defects observed, and measurements of the crack width or defect size.

A copy of the reports will be provided to properties owners and signed off as a correct record. Property dilapidation reports shall be held by AAA for comparison following the second survey upon completion of the Project. All reports will also be provided to Main Roads' Representative.



## 6 COMPLAINTS

All complaints shall be handled in accordance with the AAA Community and Stakeholder Engagement Management Plan. Where a noise or vibration complaint is received, AAA shall respond to the complaint and notify MRWA within 24 hours of receipt of complaint. The complaint will also be recorded in the MRWA customer relationship management database, *Connect*.

Stakeholders can contact the MRWA Customer Information Centre (CIC) on 138 138 with complaints. The CIC operates 24 hours a day. All complaints will be entered into *Connect* and be responded to by the AAA Community and Stakeholder Engagement Team (CSET) within 24 hours.

For complex or intrusive works, the contact phone number of the rostered site supervisor will be provided to the CIC if urgent information is required. All other enquiries and complaints will be handled via the process outlined above. Enquiries and complaints may also be received via the [enquiries@mainroads.wa.gov.au](mailto:enquiries@mainroads.wa.gov.au) email address and directed to the AAA CSET via *Connect*.

Where a complaint is identified as being a direct result of a non-conformance or incident, the procedure outlined in Section 7 of this Plan will be followed to allow AAA to identify and amend existing procedures and implement appropriate actions.

Potential contingencies include but are not limited to the actions outlined in Table 10. Where the contingency actions do not resolve the issue, MRWA are to be notified as per section 7.

**Table 10 – Noise and vibration complaint contingency actions**

Complaint Type	Contingency Actions
Noise complaint is received	<ul style="list-style-type: none"><li>• Complaint received by CIC and recorded in <i>Connect</i></li><li>• AAA to investigate the source of the noise levels</li><li>• Assess the location of monitoring equipment and the need for additional monitoring near origin of complaint</li><li>• Respond to complaint and report to MRWA within 24 hours (and to CoC if 2 or more complaints are received)</li><li>• Modify the methodology, employ controls i.e. screens, substitute the source of the noise, or stage the works at less disruptive hours of work</li></ul>
Vibration complaint is received	<ul style="list-style-type: none"><li>• Complaint received by CIC and recorded in <i>Connect</i></li><li>• AAA to investigate the source of the vibration levels</li><li>• Assess the location of monitoring equipment</li><li>• Respond to complaint and report to MRWA within 24 hours (and to CoC if 2 or more complaints are received)</li><li>• Request vibration monitoring with the landowner at complaint origin</li><li>• Modify the methodology, employ controls i.e. dampeners/buffers, substitute the source of the vibration i.e. higher hertz or smaller machinery, or stage the works at less disruptive hours of work</li></ul>

## 7 NON-COMFORMANCE, INCIDENT AND CORRECTIVE ACTION

Where monitoring confirms noise or vibration action criteria (as defined in Tables 5 and 7) have been met, AAA shall investigate the cause of the exceedance. Where vibration limits are reached, AAA will complete a record of an incident on IMPACT, Laing O'Rourke's Online Incident Investigation and Reporting Tool. The incident shall also be reported through MRWA electronic reporting system, EQSafe. If noise levels are exceeded at a monitoring location, this will be recorded as a non-conformance. Where confirmation is possible using additional monitoring as per Table 10 above or reasonably extrapolated to within a residential dwelling or business premise, the exceedance will be recorded as an incident.

All contingency actions taken will be recorded in IMPACT (incidents) and the corrective action register (non-conformances).

Incidents/complaints involving noise and vibration typically involve a complaint from the community, notification by a regulatory authority or non-compliance with an approval or licence condition. These and other typical noise and vibration incidents and appropriate responses are detailed in Table 11 below.

**Table 11 – Incident planning and response**

Situation	Response	Responsibility
Works occurring outside standard work hours without approval or appropriate notification to community/authorities	Immediately cease work where safe to do so. Notify authorities required under licence/approval condition.  Undertake investigation of incident to determine corrective/preventative actions.  Apply for approval if works still required.	AAA Construction Manager (CM), Environmental Coordinator (EC), Community and Stakeholder Engagement Manager (CSEM)
Malfunction of equipment used for tasks causing excessive noise / vibration emissions	Cease activities under direction of the EC and / or CM.  Notify relevant staff, and organise use of appropriate equipment to complete task.	CM CSEM
Noise or vibration causing community complaint and/or action level exceedance	Investigate, identify and review the source of the noise and/or vibration levels.  Respond to the complaint within 24 hours of receipt.  Record the complaint / incident in IMPACT and EQSafe.  Assess the location of monitoring equipment and potential for additional or specific monitoring requirements  Modify the methodology, employ controls, or stage the works at less disruptive hours of work	CSEM CM EC
Vibration causing structural damage	In the case where monitoring shows excessive vibration levels, cease activities causing vibration under direction of the CM. If appropriate, evacuate any occupants of buildings with due consideration to safety, and secure the area to prevent unauthorised access.	CM CSEM

Situation	Response	Responsibility
	Undertake a structural assessment and compare results with any previous condition survey. If any damage is associated with construction, implement rectification works or agree compensation.	
Noise causing disturbance for site workers	Cease activities causing disturbance under direction of the CM. Conduct assessment of noise exposure in accordance with worksite Health and Safety Regulations. Implement buffer zones for hearing protection where necessary.	CM WHS Manager

In addition to the Project induction, issues with noise and vibration compliance will be included in daily pre-starts and environmental Toolboxes to raise awareness and educate the Project team.

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## 8 REPORTING REQUIREMENTS

Results from noise and vibration monitoring will be reviewed by AAA for compliance and, if required, analysed by a suitably qualified specialist. The results will be recorded and provided to MRWA (monthly) and City of Cockburn (upon request).

The AAA Environmental Coordinator will conduct daily observations of noise and vibration monitoring and complete weekly environmental inspections on Project work areas to assess environmental site conditions, ensuring environmental controls are implemented and legislative requirements are adhered to.

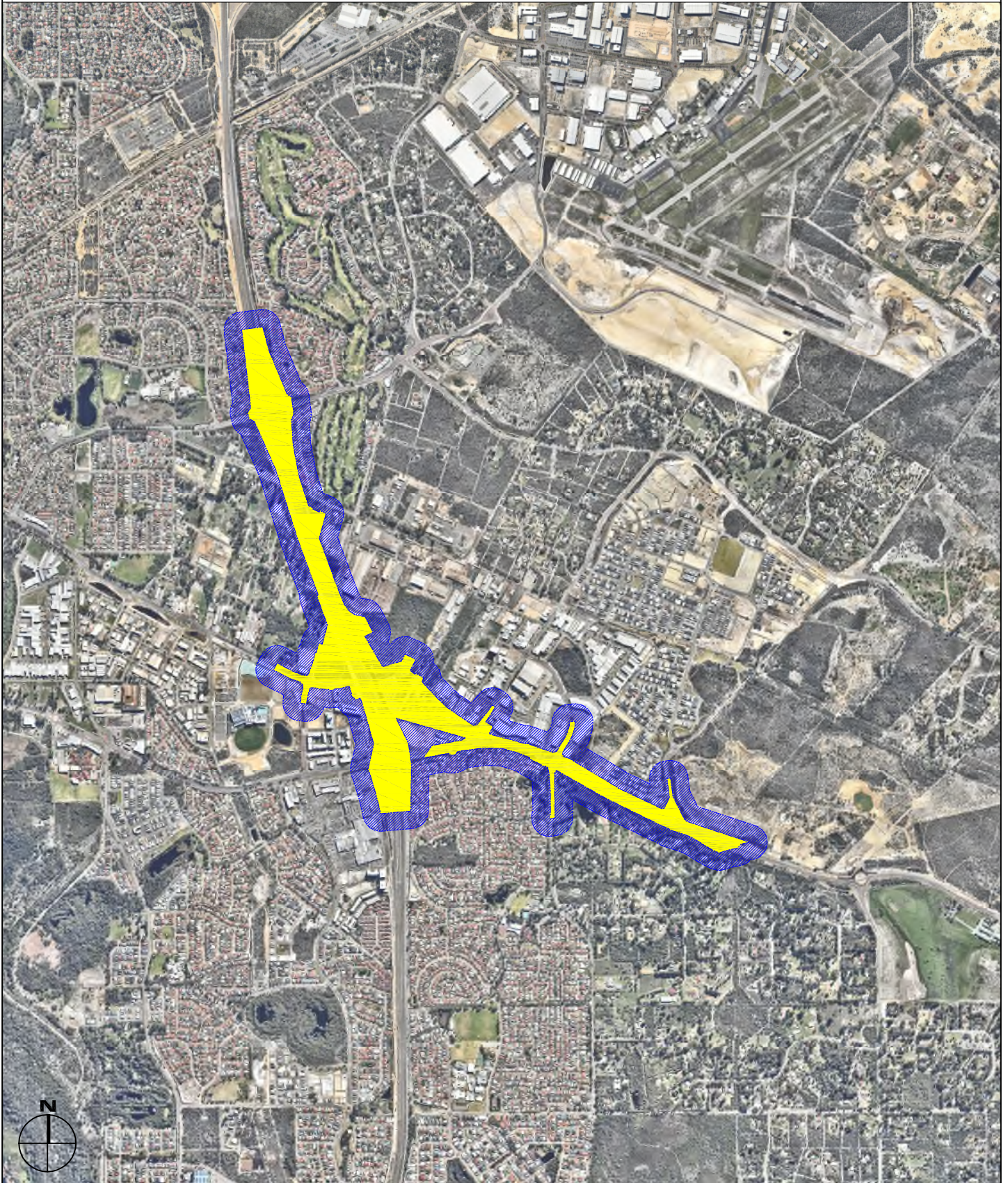
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APPENDIX A



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# Project Construction Footprint with 100m Buffer

# Project Construction Footprint showing 100m Buffer Zone



## Legend

-  Project Footprint
-  100m Buffer

Armada Road to North  
Lake Road Bridge Project



**Armadale  
Access  
Alliance**



SCALE: 1:30,000

Contract No. 237/16

Date: 28/10/19

Revision: A

Drawn By: RW