APA Sturt Plateau Pipeline – Environmental Approvals

Construction Noise and Vibration Assessment

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Making Sustainability Happen

Revision Record

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2.0	14 October 2024	Glyn Cowie	Steve Henry/Mark Caslin	Glyn Cowie
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Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with APA SPP Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

Executive Summary

SLR Consulting Australia Pty Ltd (SLR) has been engaged by APA SPP Pty Ltd (APA) to conduct noise and vibration assessment associated with the construction phase of the proposed Sturt Plateau Pipeline Project (the Project). This desktop noise modelling and vibration calculation assessment has been undertaken to:

- Predict noise levels from the anticipated noise intensive pipeline construction stages to determine offset noise buffer distances to achieve the applicable noise limits.
- Calculate vibration levels from horizontal boring under the Stuart Highway onto the Stuart Highway.

Operational noise from the pipeline is expected to be very limited and associated with infrequent safety and maintenance activities for the pipeline (ie pigging would be undertaken periodically to assess the integrity of the transmission pipeline, with minor amounts of venting to occur to facilitate this activity). Accordingly, operational noise has been omitted from this study.

This noise and vibration assessment has considered the following receptors and structures:

- Noise:
  - Residential receptor – Hayfield Homestead, located 2.7 km north of the proposed Project Area
  - Residential and commercial receptor – Dunmarra Roadhouse, located 2.7 km north of the proposed Project Area
  - Workers Camp – Tamboran B2 Pty Ltd's (Tamboran) Camp, located 2.85 km south of the proposed Project Area.
- Vibration:
  - Structure – Stuart Highway – pipeline horizontal boring works under the Stuart Highway, with a pipeline depth of cover anticipated be a minimum of 2.2 m to the top of the pipe.

It is noted that a temporary construction camp will be required to support the Project construction workers during the duration of the construction program. However, this temporary construction camp has not been included as an assessable receptor of the basis of the following:

- The camp will be under the control of the Project construction contractor
- During periods where Project construction works are occurring, the camp will be largely unoccupied.

A total of four (4) pipeline construction scenarios have been assessed, being:

- Scenario 1: Stage 1 Survey and Stage 3 Clear and Grade
- Scenario 2: Stage 6 Pipe Stringing
- Scenario 3: Stage 13 Ditch, Padding and Bedding
- Scenario 4: Horizontal boring under the Stuart Highway.

The noise model was utilised to predict construction noise off-set buffers to achieve the applicable noise limits onto assessed receptors applicable for the proposed 6:00 am to 6:00 pm construction hours, for different weather conditions as summarised below:

- Scenario 1: Stage 1 Survey and Stage 3 Clear and Grade:

- Night-time (6:00 am to 7:00 am) 35 dBA L_{Aeq} noise limit – 900 m for neutral weather, 1,600 m for adverse weather.
- Day-time (7:00 am to 6:00 pm) 45 dBA LAeq noise limit – 425 m for neutral weather, 675 m for adverse weather.

- Scenario 2: Stage 6 Pipe Stringing:
  - Night-time (6:00 am to 7:00 am) 35 dBA L_{Aeq} noise limit – 675 m for neutral weather, 1,100 m for adverse weather.
  - Day-time (7:00 am to 6:00 pm) 45 dBA LAeq noise limit – 325 m for neutral weather, 500 m for adverse weather.
- Scenario 3: Stage 13 Ditch, Padding and Bedding:
  - Night-time (6:00 am to 7:00 am) 35 dBA L_{Aeq} noise limit – 1,000 m for neutral weather, 1,600 m for adverse weather.
  - Day-time (7:00 am to 6:00 pm) 45 dBA LAeq noise limit – 500 m for neutral weather, 675 m for adverse weather.
- Scenario 4: Horizontal boring under the Stuart Highway:
  - Night-time (6:00 am to 7:00 am) 35 dBA L_{Aeq} noise limit – 675 m for neutral weather, 1,050 m for adverse weather.
  - Day-time (7:00 am to 6:00 pm) 45 dBA LAeq noise limit – 325 m for neutral weather, 500 m for adverse weather.

The 70 dBA L_{Aeq} construction noise level limits applicable to Category Two commercial receptors requires an offset distance of less than 100 m to achieve this limit for all predicted pipeline construction scenarios.

As no exceedances of the most stringent night-time noise level limit of 35 dBA $L_{Aeq,15min}$ have been predicted regardless of whether pipeline construction commence at KP 0 or KP 37 and accounting for the wider 500 m overall Project Area, specific noise mitigation measures, such as equipment noise attenuation or silencers, are not warranted. However, it is good practice to be aware of some general measures that can be adopted to limit noise emitted from the pipeline construction works. The Noise Management Guideline sets out numerous practical recommendations to assist in mitigating construction noise emissions, which have been reproduced in this report.

Potential cumulative noise impacts were investigated with consideration to the noise emission associated with the adjoining Tamboran proposed Sturt Plateau Compression Facility (SPCF) located on Shenandoah Station. The nearest non-project receptor (Hayfield Homestead) is located 17 km northwest from the proposed SPCF. With reference to the highest predicted pipeline construction noise at Hayfield Homestead, cumulative noise impact (above the most stringent 35 dBA L_{Aeq} night time noise limit) is not predicted when the noise emission from the proposed compression facility (or associated construction work) is at or below 34 dBA L_{Aeq} at this receptor. A noise level of 34 dBA L_{Aeq} from the construction, or operations of compressor facility located 17 km away is extremely unlikely. Therefore cumulative noise impacts from these two (2) projects is not expected.

A high-level fauna noise assessment has been included in this report. The findings from the associated literature review indicate that fauna (including domesticated mammals) exposed to less than 65 dBA L_{Aeq} are unlikely to experience adverse impacts. The corresponding offset noise buffer distance from pipeline construction works to achieve this target is 100 m applicable to all predicted pipeline construction scenarios.

A vibration assessment has been completed for proposed horizontal boring under the Stuart Highway. A vibration criterion for the Stuart Highway has been derived with reference to AS 2187-2:2006 Table J4.5(B) Line 2. This Standard recommends a peak particle velocity (PPV) of 100 mm/s for unoccupied structures.

Based on the minimum working distances nominated in this assessment, the following key points are provided with regard to construction generated vibration onto the Stuart Highway:

- A minimum working distance of 1.6 m is required for the nominated JT60 Horizontal Directional Drill (or similar rated boring rig) to achieve the derived 100 mm/s vibration criterion.

Utilising information supplied by APA, it has been identified that the Stuart Highway is to be a nominal 2.2 m from the drilling path throughout the operation (ie 2.2 m nominated pipeline depth of cover to the top of the pipe). As this distance is greater than the aforementioned minimum working distance of 1.6 m, vibration intensive works associated with horizontal boring under the Stuart Highway are expected to be compliant.

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Acronyms and Abbreviations

ACARP	Australian Coal Industry Research Program
AGP	Amadeus Gas Pipeline
APA	APA SPP Pty Ltd
AS	Australian Standard
CROW	Construction right of way
dBA	Decibels, A-weighted
Daytime	The time period of 7:00am to 7:00pm Monday to Saturday or 9:00am to 6:00pm on Sundays and public holidays.
DIPL	Department of Infrastructure Planning and Logistics
Evening	The time period of 7:00 pm to 10:00 pm
Night-time	The time period of 10:00pm to 7:00am Monday to Saturday or 10:00pm to 9:00am on Sundays and public holidays.
Noise Management Guideline	Northern Territory – Noise Management Framework Guideline
NT	Northern Territory
NT EPA	Northern Territory Environment Projection Authority
PPV	Peak particle velocity
Project Area	The development envelope for the Project comprising a 500 m wide corridor for the proposed pipeline, land for surface facilities at the start and end of the pipeline and the temporary construction camp.
The Project	The Sturt Plateau Pipeline Project
SLR	SLR Consulting Australia Pty Ltd
SPCF	Sturt Plateau Compression Facility
SWL	Sound Power Level
Tamboran	Tamboran B2 Pty Ltd
WMPC Act	Northern Territory of Australia Waste Management and Pollution Control Act 1998
US FHA	The United States Department of Transportation Federal Highway Administration

1.0 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by APA SPP Pty Ltd (APA) to conduct a noise and vibration assessment associated with the construction phase of the proposed Sturt Plateau Pipeline Project (the Project).

This report documents the predicted noise emissions associated with representative pipeline construction phases, and construction vibration associated with horizontal boring of the pipeline under the Stuart Highway[1]. Recommended mitigation measures have been documented where applicable.

A high-level noise assessment of potential impacts to fauna has also been undertaken as part of this assessment.

Operational noise from the pipeline is expected to be very limited and associated with infrequent safety and maintenance activities for the pipeline (ie pigging would be undertaken periodically to assess the integrity of the transmission pipeline, with minor amounts of venting to occur to facilitate this activity). Accordingly, operational noise has been omitted from this study.

Regarding the vibration assessment supporting this study, the assessment only considers construction vibration impacts to the Stuart Highway, and does not include any assessment regarding the potential risk of settlement or subsidence from the horizontal boring process under the Stuart Highway.

A glossary of terminology is provided in **Appendix A** to assist the interpretation of this report.

2.0 Project Description

The Beetaloo Sub-basin, located 500 km south-east of Darwin in the Northern Territory (NT), covers 28,000 km^2 and is estimated to contain 500 trillion cubic feet of gas (P50 gas-in-place resource as estimated by industry). It is in the early stages of its development, with several producers proposing to undertake additional development work to verify gas production quantities and ultimately sell the gas to commercial markets.

APA is proposing to construct the Project to transport appraisal gas from Tamboran B2 Pty Ltd's (Tamboran) Sturt Plateau Compression Facility (SPCF) development sites in the Beetaloo Sub-basin to the Amadeus Gas Pipeline (AGP). The AGP is a transmission pipeline that extends from the Amadeus Basin in the south of the Northern Territory to Darwin, in the north. It transports natural gas to Darwin, Alice Springs and regional centres, principally to fuel power generation.

The Project is currently proposed to be a steel pipeline 300 mm in diameter commencing on NT Portion 7026 and extending west until it reaches the AGP located on NT Portion 1077. Nominal length of the pipeline is expected to be 37 km dependent upon the final alignment. The design Depth of Cover is a 750 mm deep for the majority of the pipeline. The design Depth of Cover for the Stuart Highway crossing is a minimum of 2,200 mm. The design Depth of Cover for unsealed road crossings, drainage lines and floodplains is 1,200 mm. Depth in other areas will depend on the Safety Management Study which will identify risks associated with the ongoing operation of the pipeline.

[1] Pipeline horizontal boring under the Stuart Highway is the only activity with the potential of producing measurable or perceptible vibration levels at an assessable structure. The identified residential sensitive receptors and commercial facilities are 2.95 km or greater from the proposed pipeline route.

Construction of the pipeline will use typical construction methods for modern gas pipelines and will involve the following key steps:

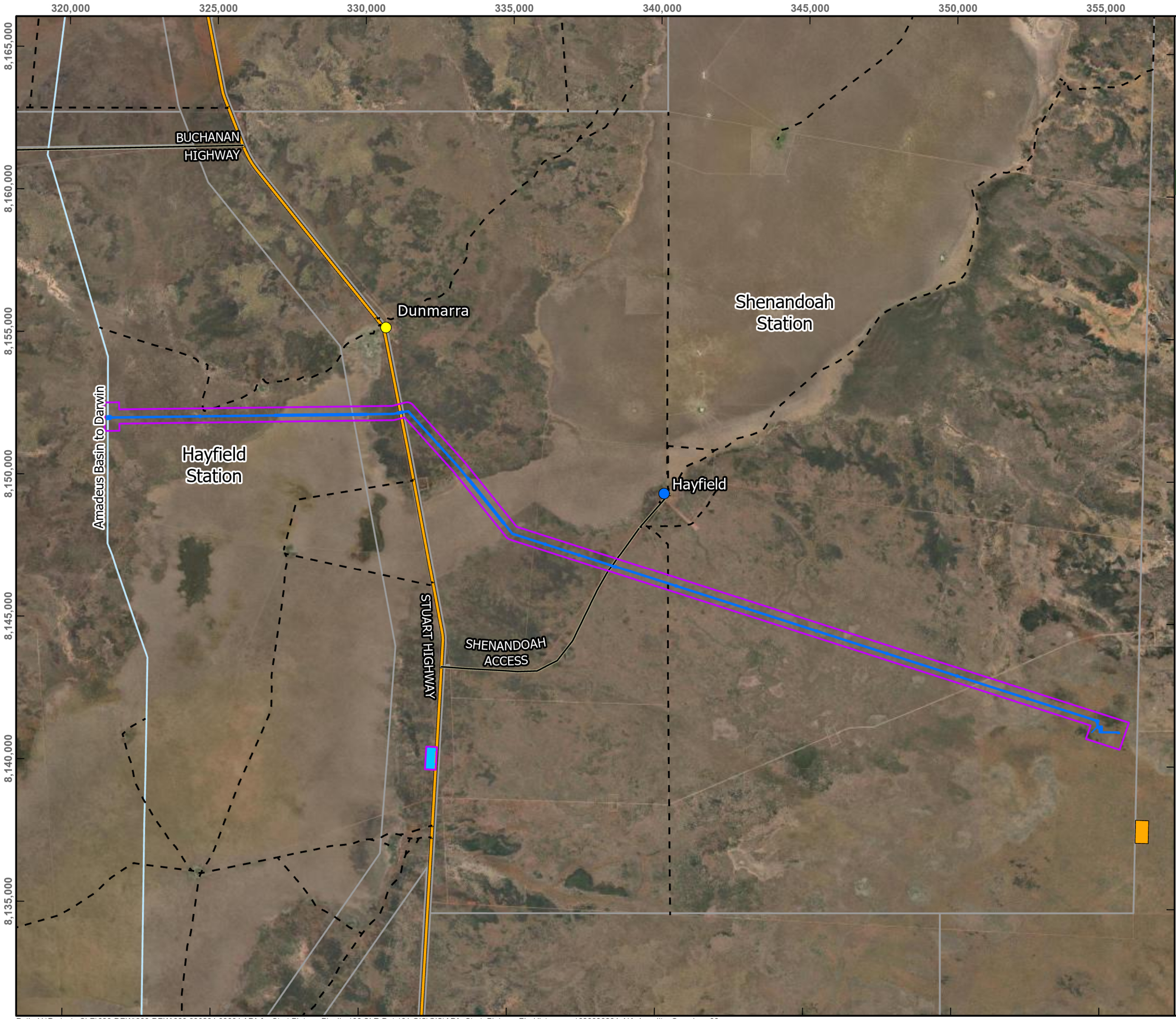
1. Preliminary **survey works** (including geotechnical surveys, installation of temporary gates in fences)
2. **Vegetation clearing and grading** of the construction right of way (CROW)
3. **Stripping and stockpiling** of topsoils.
4. **Delivery of pipe** lengths to the CROW and unloaded onto skids ready for welding. **Bending of pipes** to follow landforms.
5. **Welding, coating of welds and non-destructive testing**. Pipe lengths are welded together into 'strings', joints are cleaned and coated with a protective coating to prevent corrosion and then tested to ensure quality.
6. **Excavation** of the trench and any bell holes in which to lay the pipe
7. **Lowering the pipeline** strings into the trench and welding strings together.
8. **Backfilling** the trench with excavated material.
9. Crossing watercourses, roads by open cut trench, horizontal boring methods.
10. **Installing pipeline markers** at fences, road crossings and other locations and installation of permanent gates in fences, where required.
11. Testing the structural integrity of the pipeline by **hydrostatic testing**. **The testing** of the pipeline involves pressurising the pipeline using water to pressures above the Maximum Allowable Operating Pressure for the pipeline. This provides assurance of the integrity of the pipeline prior to any introduction of gas.
12. Installing permanent gates in fences, where required.
13. **Reinstatement and rehabilitation** of the construction footprint, undertaken progressively with the aim of returning the land to its previous productivity.

Horizontal boring is proposed to facilitate the construction of the Project under the Stuart Highway.

Pipeline construction activities will occur either from KP 0 to KP 37 or KP 37 to KP 0. Consequently, the working side of the CROW will be located to the north of the pipeline alignment if pipelaying commences at KP 0 or to the south of the pipeline alignment if pipelaying commences at KP 37. The direction of pipelaying will be dependent upon weather and site conditions at the commencement of construction.

Further, the development envelope for the Project comprises a 500 m wide corridor for the proposed pipeline, along with land for surface facilities at the start and end of the pipeline, and the temporary construction camp. This development envelope is referred to as the Project Area. The pipeline alignment will occur within this Project Area, however the exact alignment is yet to be finalised. For the purpose of this assessment, this Project Area has been defined as a 250 m lateral distance either side of the proposed pipeline alignment.

Figure 1 shows the proposed pipeline alignment together with the surrounding area and assessed receptors (receptors being documented further in **Section 4.0**).



APA STURT PLATEAU PIPELINE ENVIRONMENTAL APPROVALS

LOCALITY OF THE PROJECT - OVERVIEW

FIGURE 1

LEGEND

- Project Area
- Pipeline Construction ROW
- Temporary Construction Camp
- Homestead
- Roadhouse
- Tamboran Resources Camp
- Existing Gas Pipeline
- Cadastre

Road Category

- Pastoral - National Highway
- Pastoral - Secondary
- Pastoral - Local

Service Layer Credits:
Earthstar Geographics, Maxar

0 2.5 5 km

Coordinate System:	GCS GDA 1994
Scale:	1:180,000 at A4
Project Number:	680.030294
Date Drawn:	14-Oct-2024
Drawn by:	CP

SLR

Path: H:\Projects-SLR\680-DRW\680-DRW\680.030294.00001 APA for Sturt Plateau Pipeline\06 SLR Data\01 GIS\GIS\APA_Sturt_Plateau_FireHistory.aprx\680030294_NA_Locality_Overview_06

3.0 Noise and Vibration Criteria

3.1 Environmental Noise Regulation and Management

Although any noise impacts from the construction phase of the project would be temporary in nature, and not permanent, the key requirements for the management of noise emissions and the control of noise pollution are guided by NT legislation and are outlined below.

3.1.1 Waste Management and Pollution Control Act

The pollution from noise can be defined as the unwanted sound which may unreasonably intrude on daily activities. The extent of potential annoyance or discomfort caused by noise pollution depends on the type, timing, duration and frequency of noise or if the disturbance is not typical for the receiving noise environment.

The *Waste Management and Pollution Control Act 1998* (WMPC Act) provides requirements to manage noise pollution and its effects in the NT. The key objectives of the WMPC Act, as they relate to noise include:

- Prevention of pollution;
- Reducing the likelihood of pollution occurring; and
- Effectively responding to pollution.

The construction of the proposed pipeline would be subject to the general environmental duty under section 12 of the WMPC Act which requires that:

a person who:

(a) conducts an activity that causes or is likely to cause pollution resulting in environmental harm or that generates or is likely to generate waste; or

(b) performs an action that causes or is likely to cause pollution resulting in environmental harm or that generates or is likely to generate waste;

must take all measures that are reasonable and practicable to:

(c) prevent or minimise the pollution or environmental harm; and

(d) reduce the amount of waste.

3.1.2 NT Noise Management Framework Guideline

The Northern Territory Environment Projection Authority (NT EPA) is the main regulator to manage and control noise under the provisions of the WMPC Act. The NT EPA's *Northern Territory – Noise Management Framework Guideline*[2] (Noise Management Guideline) provides information and technical guidance to assist the implementation of the WMPC Act, including:

- Prescribing noise levels to determine whether a particular noise source has caused or is causing environmental harm and/or environmental nuisance and whether the general environmental duty has been complied with.
- Definitions of reasonable and practicable as they relate to the prevention or minimising pollution or environmental harm.

[2] Northern Territory Environment Protection Authority, 2018. North Territory Noise Management Framework Guideline, version 0.1, dated September 2018.

- Enforcement of the WMPC Act through requirements such as a notice to conduct an environmental audit program or the issue of the pollution abatement notice.

The Noise Management Guideline is also referenced within Section A3.3 of the NT Governments '*Code of Practice: Onshore Petroleum Activities in the Northern Territory*' (31 May 2019) which states:

> "*Noise assessment, planning and management associated with petroleum activities shall comply with the Northern Territory Noise Management Framework Guidelines published by the Northern Territory Environment Protection Authority.*"

Under Section 3.3 of the Noise Management Guideline, noise levels for '*construction activities*' are required to achieve prescribed noise levels at noise sensitive receptors. In Section 3.3, Table 3.7 of the Noise Management Guideline, recommended standard hours for construction work are stipulated so as to;

> "*protect the amenity of people during times they are most likely to be impacted (i.e. impact on sensitive noise receptors*"
>
> "*Residents are usually most annoyed by work at night-time as it has the potential to disturb sleep. Noise from work on evenings, Saturday afternoons, Sundays and public holidays can also be annoying to most residents as it may interrupt leisure activities.*"

The Noise Management guideline standard hours for construction work are provided in **Table 1**.

Table 1 Noise Management Guideline – Recommended Standard Hours of Work

Work type	Recommended standard hours of work	Notes
Normal Construction	7:00 am to 7:00 pm Monday to Saturday 9:00 am to 6:00 pm on Sundays or public holidays	Construction activities occurring before or after the recommended standard hours of work will incur a regulatory response in accordance with Section 2.2.4 of Noise Management Guideline.

Source: Northern Territory – Noise Management Framework Guideline 2018, Table 3.7.

The Noise Management Guideline stipulates recommended assigned construction noise level limits based on the premises type (i.e. residential and commercial/industrial). Construction noise limits applicable to residential receptors are reproduced in **Table 2**, and applicable to construction projects of greater than 3 week's duration.

Table 2 Noise Management Guideline – Recommended Assigned Construction Noise Levels for Airborne Noise at Residential Premises

Descriptor	Recommended assigned construction noise level at residences $L_{Aeq\ (15min)}$	Notes
Construction projects of greater than 3 weeks' duration – the quantitative assessment method is used for these projects (see Section 3.3.5.2 of the Noise Management Guideline)		
Monday to Saturday 7:00 am to 7:00 pm Sundays and public holidays 9:00 am to 6:00 pm	Recommended assigned noise affected level: RBL + 10 dB	The recommended assigned noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the recommended assigned noise affected level, proponents should apply all feasible and reasonable work practices to meet the recommended assigned noise affected level. Proponents should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
Outside recommended standard hours	Recommended assigned noise affected level: RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. Proponents should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the recommended assigned noise affected level, proponents should negotiate with the community.

Source: Northern Territory – Noise Management Framework Guideline 2018, Table 3.8.

Assigned construction noise level limits are shown below in **Table 3**, having been derived with reference to the Noise Management Guideline including the minimum assumed rating background noise levels as stated in Table 3.4 of the Noise Management Guideline.

Table 3 Assigned Construction Noise Level Limits – Residential Noise Sensitive Receptors

Time of day	Minimum assumed rating background noise level (dBA)	Minimum project construction noise levels ($L_{Aeq,15min}$ dBA)
Day	35	45
Evening	30	35
Night	30	35

Day period: 7:00 am to 7:00 pm Monday to Saturday or 9:00 am to 6:00 pm on Sundays and public holidays.
Evening period: 7:00 pm to 10:00 pm Monday to Saturday or 6:00 pm to 10:00 pm on Sundays and public holidays.
Night period 10:00 pm to 7:00 am Monday to Saturday or 10:00 pm to 9:00 am on Sundays and public holidays.

For proposed 6:00 am to 6:00 pm pipeline construction hours, both the day and night-time period noise limits for residential noise sensitive receptors warrant assessment.

For the Tamboran Camp, which is not a Project owned camp, in lieu of applicable noise limits for a workers accommodation receptor type being stated in the Noise Management Guideline, the residential noise limits are applied to this receptor.

With regard to other receptor types identified in this study (see **Section 4.0**), **Table 4** outlines applicable assigned construction noise levels used in this study.

Table 4 Recommended Assigned Noise Levels for Airborne Noise at Commercial and Industrial Premises

Category	Land Use	Recommended Assigned Construction Noise Levels
One	Industrial premises	External: $L_{Aeq(15\ min)}$ 75 dBA
Two	Offices, retail, outlets	External: $L_{Aeq(15\ min)}$ 70 dBA
Three	Other businesses that may be very sensitive to noise such as theatres and child care centres [*Note, such a receptor type has not been identified in the project study area*]	See section 3.3.5.2 which refers to AS2107

Source: Northern Territory – Noise Management Framework Guideline 2018, Table 3.10.

3.2 Vibration Criteria

Guidance on vibration criteria for the Stuart Highway has been drawn from AS 2187-2:2006. **Table 5**, as reproduced from AS 2187-2:2006, provides recommended ground vibration limits for control of damage to '*unoccupied structures of reinforced concrete or steel construction*'. According to this classification, a Peak Particle Velocity (PPV) vibration threshold of 100 mm/s would apply to public roads such as the Stuart Highway.

Table 5 AS 2187.2-2006 – Table J4.5(B) – Recommended ground vibration limits for control of damage to structures

Category	Type of blasting operations	Peak component particle velocity (mm/s)
Other structures or architectural elements that include masonry, plaster and plasterboard in their construction	All blasting	Frequency-dependent damage limit criteria Tables J4.4.2.1 and J4.4.4.1
Unoccupied structures of reinforced concrete or steel construction	All blasting	100 mm/s maximum unless agreement is reached with the owner that a higher limit may apply
Service structures, such as pipelines, powerlines and cables	All blasting	Limit to be determined by structural design methodology

This 100 mm/s vibration criterion is also in line with the Australian Coal Association Research Program (ACARP) published document titled '*Effects of Blasting on Infrastructure*' (project reference C14057, dated 20 October 2008) which states a 100 mm/s PPV criterion for '*Public Roads*'. The limit put forward in this document would hold for vibration sources other than blasting.

In absence of an asset specific vibration limit as nominated by the Department of Infrastructure Planning and Logistics (DIPL), this 100 mm/s PPV criterion has been agreed in consultation with APA.

4.0 Sensitive Receptors and Structures

The noise sensitive receptors which have been identified within the project area (in the vicinity of the proposed pipeline route) are listed in **Table 6** and their locality is shown on **Figure 1** (see **Section 2.0**).

It can be seen that the nearest residential receptor (Hayfield Homestead) is located at a distance of approximately 2.7 km north of the proposed Project Area. The Dunmarra Roadhouse, also located at a distance of approximately 2.7 km to the north of the proposed Project Area, has also been considered in this assessment and has been assessed as both a residential (including hotel/caravan park) and commercial receptor noting there are a number of buildings at this roadhouse.

Table 6 Assessed Representative Receptors

Name	Category	X-coordinate[1]	Y-coordinate[1]	Distance from Project Area (km)
Hayfield Homestead	Residential	340,479	8,149,335	2.7
Dunmarra Roadhouse	Commercial/ Residential	330,806	8,155,191	2.7
Tamboran Camp	Workers Camp	356,420	8,137,680	2.85
Temporary Construction Camp[2]	Workers Camp	332,390	8,140,000	7.65

Note 1: UTM: 53 L

Note 2: Project owned receptor, see below discussion.

It is noted that a temporary construction camp will be required to support the construction workers during the duration of the Project construction program. However, this temporary construction camp has not been included as an assessable receptor of the basis of the following:

- The camp will be under the control of the Project construction contractor
- During periods where Project construction works are occurring, the camp will be largely unoccupied.

Regarding the vibration assessment, the only sensitive structure within the study area that has the potential to receive vibration emissions from the Project is the Stuart Highway, with the corresponding activity being horizontal boring under the Stuart Highway.

5.0 Construction Noise Impact Assessment

5.1 Noise Modelling Procedures

5.1.1 Methodology Overview

The key elements of the assessment of noise activities associated with the Project include:

- Defining the assessment scenarios for the construction stages of the Project.
- Development of a SoundPLAN noise prediction model to predict the noise emission levels from the construction phase of the Project.
- Assessment of predicted construction noise levels against the noise assessment criteria adopted for the Project.

- Where required, a range of reasonable and feasible (concept level) mitigation measures would be recommended to manage potential impacts and, where reasonable and feasible, achieve compliance to all relevant noise assessment criteria.

5.1.2 Noise Emission Sources and Model Scenarios

Through consultation with APA, construction phase scenarios with corresponding equipment and stages were developed to support this Assessment. Sound power levels (SWL) were assigned to each construction plant item with reference to either manufacturer noise emission data (where available), historical noise measurements on similar pipeline or civil works projects, or SLR's in-house database of construction noise source emission levels.

A generic noise model was developed to assess the noise emissions from the three (3) most anticipated noise intensive pipeline construction activities, being:

- Scenario 1: Stage 1 Survey and Stage 3 Clear and Grade
- Scenario 2: Stage 6 Pipe Stringing
- Scenario 3: Stage 13 Ditch, Padding and Bedding

An additional fourth scenario has been included to assess noise emissions from the proposed horizontal boring activities under the Stuart Highway. Note there are other proposed construction stages, however in consultation with APA, these construction stages and activities are considered to result in the highest construction noise levels. Therefore, achieving compliance with the noise limits from these assessed stages would inherently result in compliance with the noise limits from the remaining stages. The generic model involved creating a flat-ground noise model and assuming all equipment detailed in **Table 7** were working in a relatively straight line with typical separation distances of up to 200 m for the spread of plant items. From this, a noise emission level for each stage was predicted at various off-set distances to determine a compliance "buffer" distance with regard to the construction limits stated in **Section 3.1.2**. The potential effects of topography and/or vegetation on these noise predictions is discussed further following **Table 7**.

Table 7 Pipeline Construction Scenarios and Modelled Noise Sources

Pipeline Construction Stage	Construction Plant Item	Individual SWL, dBA
Scenario 1: Stage 1 Survey and Stage 3 Clear and Grade		
Stage 1 Survey	2x Utes	92
Stage 3 Clear and grade	1x 26T excavator	106
	2x 14M grader	103
	2x D7 dozer	113
Scenario 2: Stage 6 Pipe Stringing		
Stage 6 Pipe Stringing	1x 30T excavator	106
	1x Skid truck (flat bed style)	108
	1x Vaclift attached to 30T excavator	107
	1x 6-20 Bender	103
Scenario 3: Stage 13 Ditch, Padding and Bedding		
Stage 13 Ditch, Padding and Bedding	3x Rock saw / bucket wheel	110
	2x Excavators (Assume 30T)	106

Pipeline Construction Stage	Construction Plant Item	Individual SWL, dBA
	2x Padding machine	110
	1x Ute	92
Scenario 4: Horizontal boring at Stuart Highway		
Horizontal boring	1x Mini Horizontal boring rig (Ditch Witch JT60 (Typical))	106
	1x Vacuum truck	109
	1x 30T excavator	106

Predicted construction noise levels will inevitably depend upon the number of plant items and equipment operating at any one time and their precise location relative to the receiver(s). Therefore, a receiver will experience a range of values representing “minimum” and “maximum” construction noise emissions depending upon:

- the location of the particular construction activity (ie if the plant item of interest were as close as possible to or further away from the receiver of interest); and
- the likelihood of the various items of equipment operating simultaneously.

The predicted noise levels from each construction scenario assume that all noise sources occur simultaneously and that no special mitigation measures have been employed to limit noise emissions.

Noting the pipeline noise construction assessment has been performed via a flat terrain model, the following discussion is provided regarding potential effects of topography and/or vegetation on the noise predictions and corresponding offset noise buffers.

- **Topographical Effects** – local topography can affect the propagation of noise, especially if the construction works are conducted through areas with steep terrain (typically reducing the noise levels compared to areas of flat terrain). The extent of change in noise level due to topographical effects would be dependent on the level of shielding provided (which is site specific). The actual degree of noise attenuation due to topographical shielding is a function of the frequency spectrum of the noise and the length of the diffracted noise path compared to the direct noise path.

  Noise attenuation due to topographical shielding typically ranges from <5 dBA if line-of-sight between the noise source and receiver location is just obscured (ie rolling hills), to 10 dBA or greater where the topography provides optimal shielding of the sound transmission path (ie steep escarpments or valleys).

  It is also noted that during adverse weather conditions, noise attenuation due to topographical shielding would be less than that expected during neutral weather conditions.

- **Vegetation** – Dense forest increases the amount of sound absorption along the noise propagation path. The increased sound absorption of typical forest vegetation is estimated to be between 5 and 10 dBA per 100 m of propagation distance, depending on density.

Noting the above discussion points, the assessment of pipeline construction noise is considered to be conservative.

5.1.3 Noise Prediction Modelling

SoundPLAN (Version 8.2) computer noise model was used for the prediction of noise levels at defined offset distances, taking into account:

- All noise source sound power levels and frequency spectra.
- Noise propagation variables such as distance attenuation, ground absorption, air absorption etc.
- Default meteorological conditions for the region.

Noise emissions for the construction phase of the Project were predicted using the CONCAWE prediction model. CONCAWE is commonly implemented for environmental noise prediction from industrial facilities. It allows for investigation of effects of wind and atmospheric stability on noise propagation.

The CONCAWE prediction method is specially designed for large facilities and incorporates the influence of wind effects and the stability of the atmosphere. The statistical accuracy of environmental noise predictions using CONCAWE was investigated by Marsh (Applied Acoustics 15 - 1982). Marsh concluded that CONCAWE was accurate to ±2 dBA in any one octave band between 63 Hz and 4 kHz and ± 1 dBA overall.

5.1.4 Meteorological Conditions

In accordance with the Noise Management Guideline, consideration must be given to the effects of prevailing and worst case meteorological conditions (ie wind, temperature, humidity and temperature inversions) on noise propagation from the project.

Consistent with the adjoining Sturt Plateau Compression Facility Noise Impact Assessment[3], the weather conditions used to assess the effect of neutral and adverse meteorological conditions are shown in **Table 8** below.

Table 8 Meteorological Conditions – Neutral and Adverse

Parameter	Neutral Weather	Adverse
Temperature	30ºC	20ºC
Humidity	70%	90%
Pasqual Stability Class	D	F
Wind Speed	0 m/s	2 m/s (Source > Receiver)

5.2 Construction Noise Assessment

Construction noise levels associated with the four (4) nominated pipeline construction scenarios have been predicted at various off-set distances, and are shown in **Table 9**. **Table 9** also presents the offset noise buffer distance for each stage to comply with the nominated day 45 dBA L_{Aeq}, and evening and night-time 35 dBA L_{Aeq} construction noise level limits applicable to residential receptors and the Tamboran Camp, and 70 dBA L_{Aeq} construction noise level limits applicable to Category Two commercial receptors.

The predicted construction noise levels assume propagation over flat, soft ground (i.e. open grassland) to a typical receiver and are presented for neutral and adverse weather conditions. As such, the results presented in **Table 9** should be used as a 'guide' in determining off-set buffers distances associated with pipeline construction works.

As noted in **Section 2.0**, pipeline construction activities will occur either from KP 0 to KP 37 or KP 37 to KP 0. Consequently, the working side of the CROW will be located to the north of the pipeline alignment if pipelaying commences at KP 0 or to the south of the pipeline

[3] SLR report reference '*620.040921.00001 Sturt Plateau Compressor facility Noise Assessment Report 20240618*', dated 18 June 2024.

alignment if pipelaying commences at KP 37. Further, the Project Area, for which the pipeline alignment will occur within, covers a 500 m wide corridor (defined as a 250 m lateral distance either side of the proposed pipeline alignment). This noise assessment has assumed a worst case approach in applying the offset noise buffer distances to the outer most edge of the Project Area.

It is anticipated that pipeline construction works would occur during the period of 6:00 am to 6:00 pm, therefore covering the end of the night-time period[4] and majority of the daytime period[5]. Predicted noise levels have been assessed against these corresponding time period noise level limits.

Neutral weather predictions are applicable to the broader day-time period works, while adverse weather predictions are provided to assess noise levels during the early morning period (ie prior to 7:00 am), and/or temperature inversions occur after 7:00 am or prior to 7:00 pm and therefore during the daytime period.

Finally, the night-time noise level limit off-set distances (for neutral and adverse weather) are presented to provide further guidance should it be necessary to complete any of the construction stages during this more sensitive period (ie pressure testing).

Within **Table 9**, the following noise prediction colouring has been utilised:

- **Red (greater than 45 dBA)** – represents a noise level at a given distance that exceeds all nominated construction noise level limits (day, evening and night).
- **Orange (between 36 and 45 dBA)** – represents a noise level at a given distance that achieves the day-time construction noise level limit, however exceeds the evening and night-time construction noise level limits.
- **Green (Less than or equal to 35 dBA)** – represents a noise level at a given distance that achieves all nominated construction noise level limits (day, evening and night).

Table 9 Predicted Pipeline Construction Offset Noise Buffer Distances

Offset Distance	Pipeline Construction Stage and Corresponding Predict Noise Level (dBA L_{Aeq})							
	S1: Stage 1 Survey & Stage 3 Clear and Grade		S2: Stage 6 Pipe Stringing		S3: Stage 13 Ditch, Padding and Bedding		S4: Horizontal boring at Stuart Hwy	
	Neutral	Adverse	Neutral	Adverse	Neutral	Adverse	Neutral	Adverse
100 m	63	64	59	60	64	66	59	60
200 m	55	59	51	55	56	61	51	54
300 m	50	54	46	50	51	56	46	50
400 m	46	51	42	47	47	53	42	47
500 m	43	49	39	45	45	50	39	45
600 m	41	47	37	43	42	48	37	42
800 m	37	43	33	39	38	44	33	39
1,000 m	34	41	30	36	35	41	30	36
1,200 m	31	38	28	34	33	39	27	34

[4] Night-time period – The time period of 10:00 pm to 7:00 am Monday to Saturday or 10:00 pm to 9:00 am on Sundays and public holidays

[5] Daytime period – The time period of 7:00am to 7:00pm Monday to Saturday or 9:00 am to 6:00 pm on Sundays and public holidays

Offset Distance	Pipeline Construction Stage and Corresponding Predict Noise Level (dBA L_{Aeq})							
	S1: Stage 1 Survey & Stage 3 Clear and Grade		S2: Stage 6 Pipe Stringing		S3: Stage 13 Ditch, Padding and Bedding		S4: Horizontal boring at Stuart Hwy	
	Neutral	Adverse	Neutral	Adverse	Neutral	Adverse	Neutral	Adverse
1,400 m	29	36	26	32	30	37	25	32
1,600 m	27	35	24	30	28	35	23	30
1,800 m	25	33	22	29	26	33	21	28
2,000 m	23	32	20	27	24	31	20	27
2,200 m	22	31	19	26	23	30	18	25
2,400 m	20	29	17	25	21	28	16	24
2,500 m	20	29	17	24	20	28	16	23
3,000 m	16	26	14	21	17	24	12	20
3,500 m	13	24	11	18	13	21	10	17
4,000 m	11	21	<10	16	10	18	<10	15
4,500 m	<10	19	<10	14	<10	16	<10	12
Distance to comply with nominated construction noise level limit								
Day-time – 45 dBA L_{Aeq}	425 m	675 m	325 m	500 m	500 m	675 m	325 m	500 m
Evening/Night-time – 35 dBA L_{Aeq}	900 m	1,600 m	675 m	1,100 m	1,000 m	1,600 m	675 m	1,050 m

Regarding the 70 dBA L_{Aeq} construction noise level limits applicable to Category Two commercial receptors, the predicted noise levels presented in **Table 9** indicate an offset distance of less than 100 m would be sufficient to achieve this limit for all predicted pipeline construction scenarios.

With respect to the results presented in **Table 9**, and applying the buffer distances for the various scenarios and noise level limits to the proposed pipeline alignment whether that be commencing from KP 0 or KP 37 and accounting for the wider 500 m overall Project Area, the offset noise buffer figures presented in **Appendix B** indicate neither of the identified residential receptors, or the Tamboran Camp are located within these buffers. Notwithstanding this finding, general noise mitigation and management measures are provided in **Section 7.0** for consideration during the construction phase of the Project.

Consideration for potential cumulative noise impacts with noise emissions from the adjoining Tamboran SPCF located on the Sturt Plateau is discussed below. The proposed SPCF is located at the eastern end of the Sturt Plateau Pipeline, with the nearest non-project receptor being Hayfield Homestead, located approximately 17 km to the northwest (the Tamboran Camp is a project-owned receptor for the proposed compression facility). With reference to the predicted pipeline construction noise levels in **Table 9** for at an offset distance of 2.7 km, being the distance Hayfield Homestead is from the Project Area, the highest predicted noise level is 26 dBA L_{Aeq} from Scenario 1 (Stage 1 Survey and Stage 3 Clear and Grade) under adverse weather. This is 9 dB below the most stringent noise limit being the 35 dBA L_{Aeq} noise limit applicable to the 6:00 am to 7:00 am/9:00 am construction period depending on the day of the week. Cumulative noise impact (above the most stringent 35 dBA L_{Aeq} night time noise limit) is not predicted when the noise emission from the proposed compression facility (or associated construction work) is at or below 34 dBA L_{Aeq} at this receptor (Hayfield Homestead). A noise level of 34 dBA L_{Aeq} from the construction, or operations of compressor facility located 17 km away is extremely unlikely. Therefore cumulative noise impacts from these two (2) projects is not expected.

6.0 Construction Vibration Assessment

The following section addresses the potential vibration impacts associated with the construction of the Project. Based on the construction fleet developed in consultation with APA, the anticipated dominant sources of vibration emissions from the construction phase of the Project are outlined in **Table 10**.

Table 10 Construction Vibration Intensive Equipment and Associated Works Areas

Vibration Intensive Equipment	Work Location
JT60 Horizontal Directional Drill Rig (Typical)	Boring under Stuart Highway

In practice, accurate prediction of ground vibration level is difficult to achieve due to the dependence of vibration transmissibility of the intervening soil between the source and receptor. Therefore, it is standard practice to maintain adequate separation distance or 'safe' working distance where possible and/or monitor vibration levels for sensitive receptors during vibration intensive construction. The safe working distances provide a simple and conservative guide to site personnel to manage the likelihood of vibration impacts to sensitive receptors, however they do not overrule the numerical vibration limits detailed in **Section 3.2**.

6.1 Methodology

Prediction of vibration levels from the proposed source listed above has been conservatively based on the following methodology:

- Tunnelling – British Standard (BS) 5228-2:2009 *Evaluation and measurement for vibration in buildings - Part 2* (plus 2014 Amendment), specifically Table E.1 '*Empirical predictors for groundborne vibration arising from mechanized construction works*', with the calculation formulas used in this assessment reproduced below:

Tunnelling (groundborne vibration)

$$v_{res} \leqslant \frac{180}{x^{1.3}}$$

Safe working distance calculations for the JT60 Horizontal Directional Drill have applied the 5% probability of exceedance scaling factors.

6.2 Vibration Results and Assessment

The calculated safe working distance in **Table 11** is recommended to achieve the vibration criterion detailed in **Section 3.2**, and therefore the avoidance of damage to the Stuart Highway.

Table 11 Safe Working Distance for Stuart Highway

Vibration Sensitive Receptor	Criterion PPV (mm/s)	Minimum safe work offset distance from activity (m)
		JT60 Horizontal Directional Drill (Typical)
Stuart Highway	100	1.6 m

Utilising information supplied by APA, it has been identified that the Stuart Highway is to be a nominal 2.2 m from the drilling path throughout the operation (ie 2.2 m nominated pipeline depth of cover to the top of the pipe). As this distance is greater than the aforementioned minimum working distance of 1.6 m, vibration intensive works associated with horizontal boring under the Stuart Highway are expected to be compliant.

7.0 Construction Noise and Vibration Mitigation Recommendations

7.1 General Noise Management

As no exceedances of the most stringent night-time noise level limit of 35 dBA $L_{Aeq,15min}$ have been predicted, specific noise mitigation measures, such as equipment noise attenuation or silencers, are not warranted. However, it is good practice to be aware of some general measures that can be adopted to limit noise emitted from the pipeline construction works.

The Noise Management Guideline sets out numerous practical recommendations to assist in mitigating construction noise emissions. The noise control strategies which are outlined in the Noise Management Guideline may be considered for the pipeline construction works, however need to be cognisant of the limited receptors adjacent to the Project and that the identified receptors at approximately 3 km offset to construction works.

Community notification practices

- Adjacent noise receptors informed about the nature of the construction stages and the duration of noisier activities.
- Providing contact details on a site board at the front of the site, and maintain a complaints register suited to the scale of works.

Operational (work place) practices

- Target construction works during the daytime period where the most relaxed noise limit occurs.
- Turn off plant that is not being used.
- Ensure plant is regularly maintained
- Arrange the work site to minimise the use of movement alarms on vehicles and mobile plant.
- Involvement of workers in minimising noise.

Handling complaints

- Handle complaints in a prompt and responsive manner.
- If a justified complaint arises about noise from an identified work activity, review and implement, suitable noise mitigation and/or management measures where feasible and reasonable.

7.2 General Vibration Management

It is recommended that the following vibration mitigation and management measures be implemented by APA to reduce the vibration risk from these planned works to as low as practicable:

- Conduct a photographic condition survey of the Stuart Highway. This would be used to identify existing defects (namely rutting, potholes, longitudinal or transverse cracking etc in the road) prior to the works commencing.

- Plant operators undertaking horizontal boring and excavation works are informed of the vibration risks and have adequate experience/skill to minimise vibration from machinery impact.
- Be aware of the potential for the 30 T excavator claw/bucket to result in vibration spikes if it impacts the road/structure/ground with force. High vibration levels can also result from dragging the excavator work piece in close proximity to the road with downwards force (ie catching an edge of the road that is not intended, or free to move).

8.0 Noise Assessment on Fauna

The effect of noise from human activities on fauna is increasingly a subject of concern in the community when proposing developments such as new infrastructure, mines or industrial developments. The potential effects of noise on wildlife include physical damage to hearing, increased energy expenditure or physical injury while responding to noise, interference with normal animal activities and impaired communication. Ongoing impacts of these effects might include habitat loss through avoidance, reduced reproductive success and increased mortality.

While noise impacts on people are commonly regulated, there are no government policies or other widely accepted guidelines as to noise levels or thresholds that may have an adverse effect on wildlife. One reason for the lack of guidelines is that noise effects on most wildlife species are poorly understood (Larkin et al. 1996, Brown 2001; Ocean Studies Board 2003, summarised in AMEC 2005). The lack of understanding of noise effects on wildlife is understandable when the following points are considered:

- Response to noise disturbance cannot be generalised across species or among genera. Studies of one species cannot be extrapolated to other species.
- Hearing characteristics are species-specific. For example, noise impacts on humans are determined using a frequency weighting filter (A-weighting) which corresponds to human hearing characteristics, determined through laboratory testing. The frequency-dependent hearing characteristics of animals cannot be determined in this way.
- When studying of noise effects on animals it can be difficult to separate noise effects from other sensory disturbing effects (eg visual or olfactory cues).
- Experimental research in a laboratory is not always applicable in a natural setting.

As with humans, an animal's response to noise can depend on a variety of factors, including noise level, frequency distribution, duration, duration, number of events, variation over time, rate of onset, noise type, existence and level of ambient noise, time of year, and time of day. The animal's location, age, sex, and past experience may also affect their response to noise.

The United States Department of Transportation Federal Highway Administration (US FHA) review summarises the sensitivities of various groups of wildlife to noise as follows:

- Mammals < 10 Hz to 150 kHz ; sensitivity to -20 dB
- Birds (more uniform than mammals) 100 Hz to 8-10 kHz; sensitivity at 0-10 dB
- Reptiles (poorer than birds) 50 Hz to 2 kHz; sensitivity at 40-50 dB
- Amphibians 100 Hz to 2 kHz; sensitivity from 10-60 dB.

Despite the difficulties associated with assessing noise impacts on animals, studies have been done that can assist in drawing some general conclusions. The literature in the field has been collated in a number of reviews including AMEC 2005 (noise from mining operations), Dawe and Goosem 2008 (road traffic noise impacts, an Australian study), Manci et al. 1988 (effect of aircraft noise and sonic booms), and US FHA 2004 (road traffic noise impacts).

With reference to these aforementioned studies, it is clear that noise can have adverse affects on wildlife, with different species being more or less sensitive to noise. As with humans, extremely high noise levels can result in hearing damage or other physiological effects. At lower noise levels, it seems likely that animals avoid anthropogenic noise sources and prefer to occupy areas further from noise sources.

On the basis of this literature, and noting the difficulties inherent in assessing noise impacts on fauna, the following conclusions are drawn:

- Adverse impacts on fauna are highly unlikely at L_{Aeq} noise levels below 50 dBA, and unlikely at L_{Aeq} noise levels below 65 dBA.
- Long-term adverse impacts on fauna are unlikely to arise from short duration, high noise events. These events may however result in a short-term startle response.
- Very high maximum noise levels may result in hearing loss or other long-term physiological effects. The threshold of hearing damage is likely to be species and frequency dependent, and as with humans, damage may be cumulative over time.
- It is difficult to state a conclusive level above which damage might occur, or a “safe” level for fauna. Considering the available research, in conjunction with typical maximum levels for human comfort when blasting, a peak noise level of 125 dB (Linear) is proposed as an indicative level above which fauna hearing damage may occur. This proposed level is indicative only, and does not imply that there is no risk of hearing damage below this level.

With reference to the Project, it is considered that fauna in areas exposed to noise levels less than 65 dBA L_{Aeq}, during any time of the day, evening or night are unlikely to experience adverse impacts. The corresponding offset noise buffer distance from pipeline construction works to achieve this target is 100 m applicable to all predicted pipeline construction scenarios.

9.0 Conclusion

SLR has conducted a noise and vibration impact assessment of the key construction phases of the Sturt Plateau Project.

A noise model was developed to assess the noise emissions from the four (4) most noise intensive pipeline construction activities, being:

- Scenario 1: Stage 1 Survey and Stage 3 Clear and Grade
- Scenario 2: Stage 6 Pipe Stringing
- Scenario 3: Stage 13 Ditch, Padding and Bedding
- Scenario 4: Horizontal boring under the Stuart Highway.

The noise model was utilised to predict construction noise off-set buffers to achieve the applicable noise limits onto assessed receptors applicable for the proposed 6:00 am to 6:00 pm construction hours, for different weather conditions as summarised below:

- Scenario 1: Stage 1 Survey and Stage 3 Clear and Grade:
    - Night-time (6:00 am to 7:00 am) 35 dBA L_{Aeq} noise limit – 900 m for neutral weather, 1,600 m for adverse weather.
    - Day-time (7:00 am to 6:00 pm) 45 dBA LAeq noise limit – 425 m for neutral weather, 675 m for adverse weather.

- Scenario 2: Stage 6 Pipe Stringing:
  - Night-time (6:00 am to 7:00 am) 35 dBA L_{Aeq} noise limit – 675 m for neutral weather, 1,100 m for adverse weather.
  - Day-time (7:00 am to 6:00 pm) 45 dBA LAeq noise limit – 325 m for neutral weather, 500 m for adverse weather.
- Scenario 3: Stage 13 Ditch, Padding and Bedding:
  - Night-time (6:00 am to 7:00 am) 35 dBA L_{Aeq} noise limit – 1,000 m for neutral weather, 1,600 m for adverse weather.
  - Day-time (7:00 am to 6:00 pm) 45 dBA LAeq noise limit – 500 m for neutral weather, 675 m for adverse weather.
- Scenario 4: Horizontal boring under the Stuart Highway:
  - Night-time (6:00 am to 7:00 am) 35 dBA L_{Aeq} noise limit – 675 m for neutral weather, 1,050 m for adverse weather.
  - Day-time (7:00 am to 6:00 pm) 45 dBA LAeq noise limit – 325 m for neutral weather, 500 m for adverse weather.

The 70 dBA L_{Aeq} construction noise level limits applicable to Category Two commercial receptors requires an offset distance of less than 100 m to achieve this limit for all predicted pipeline construction scenarios.

Appendix B contains a series of maps identifying the pipeline alignment and location of the proposed horizontal boring site, and the corresponding construction noise off-set buffers.

As no exceedances of the most stringent night-time noise level limit of 35 dBA $L_{Aeq,15min}$ have been predicted regardless of whether pipeline construction commence at KP 0 or KP 37 and accounting for the wider 500 m overall Project Area, specific noise mitigation measures, such as equipment noise attenuation or silencers, are not warranted. However, it is good practice to be aware of some general measures that can be adopted to limit noise emitted from the pipeline construction works. The Noise Management Guideline sets out numerous practical recommendations to assist in mitigating construction noise emissions, which have been reproduced in **Section 7.0** of this report.

Potential cumulative noise impacts were investigated with consideration to the noise emission associated with the adjoining Tamboran proposed SPCF located on Shenandoah Station. The nearest non-project receptor (Hayfield Homestead) is located 17 km northwest from the proposed SPCF. With reference to the highest predicted pipeline construction noise at Hayfield Homestead, cumulative noise impact (above the most stringent 35 dBA L_{Aeq} night time noise limit) is not predicted when the noise emission from the proposed compression facility (or associated construction work) is at or below 34 dBA L_{Aeq} at this receptor. A noise level of 34 dBA L_{Aeq} from the construction, or operations of compressor facility located 17 km away is extremely unlikely. Therefore cumulative noise impacts from these two (2) projects is not expected.

A high-level fauna noise assessment has been included in this report. The findings from the associated literature review indicate that fauna (including domesticated mammals) exposed to less than 65 dBA L_{Aeq} are unlikely to experience adverse impacts associated. The corresponding offset noise buffer distance from pipeline construction works to achieve this target is 100 m applicable to all predicted pipeline construction scenarios.

A vibration assessment has been completed for proposed horizontal boring under the Stuart Highway. A vibration criterion for the Stuart Highway has been derived with reference to AS 2187-2:2006 Table J4.5(B) Line 2. This Standard recommends a peak particle velocity (PPV) of 100 mm/s for unoccupied structures.

Based on the minimum working distances nominated in this assessment, the following key points are provided with regard to construction generated vibration onto the Stuart Highway:

- A minimum working distance of 1.6 m is required for the nominated JT60 Horizontal Directional Drill (or similar rated boring rig) to achieve the derived 100 mm/s vibration criterion.

Utilising information supplied by APA, it has been identified that the Stuart Highway is to be a nominal 2.2 m from the drilling path throughout the operation (ie 2.2 m nominated pipeline depth of cover to the top of the pipe). As this distance is greater than the aforementioned minimum working distance of 1.6 m, vibration intensive works associated with horizontal boring under the Stuart Highway are expected to be compliant.

10.0 Bibliography

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Appendix A Acoustic Terminology

APA Sturt Plateau Pipeline – Environmental Approvals

Construction Noise and Vibration Assessment

APA SPP Pty Ltd

Report Number 680.030294.00003

14 October 2024

1. Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that 'noise' often refers to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure. The human ear responds to changes in sound pressure over a very wide range with the loudest sound pressure to which the human ear can respond being ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2 x 10^{-5} Pa.

2. 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dB, which if there is a subscript 'A' is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4,000 Hz), and less sensitive at lower and higher frequencies. Different sources having the same dB level generally sound about equally loud.

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

Sound Pressure Level (dB)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear' or 'Z' weighted.

3. Sound Power Level

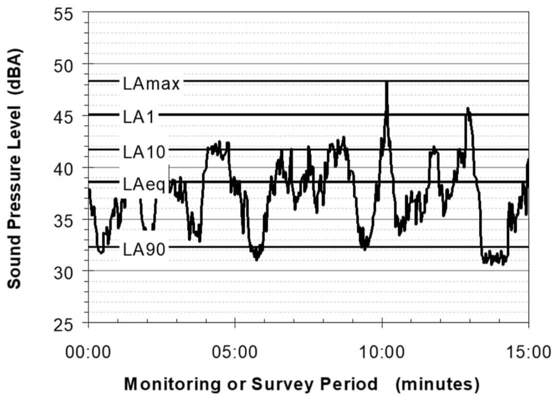
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are also expressed in decibels (dB), but in practice may be identified with a 'w' subscript, e.g. SWL, PWL or L_W, and by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure is similar to the effect of an electric radiator, which is characterised by a power rating but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4. Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

LA1 The noise level exceeded for 1% of the 15 minutes interval.

LA10 The noise level exceeded for 10% of the 15 minutes interval. This is commonly referred to as the average maximum noise level.

LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

LAeq The A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

5. Frequency Analysis

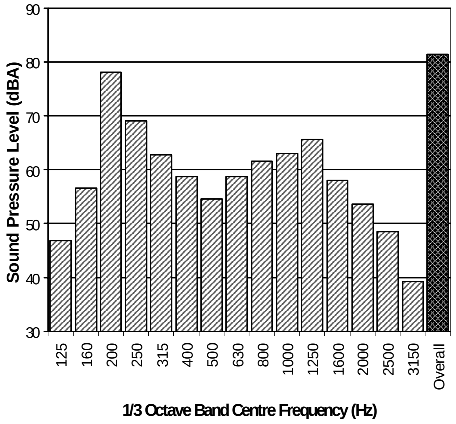
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (three bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



6. Annoying Noise (Special Audible Characteristics)

A louder noise will generally be more annoying to nearby receivers than a quieter one. However, noise is often also found to be more annoying and result in larger impacts where the following characteristics are apparent:

- **Tonality** - tonal noise contains one or more prominent tones (ie differences in distinct frequency components between adjoining octave or 1/3 octave bands), and is normally regarded as more annoying than 'broad band' noise.
- **Impulsiveness** - an impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.
- **Intermittency** - intermittent noise varies in level with the change in level being clearly audible. An example would include mechanical plant cycling on and off.
- **Low Frequency Noise** - low frequency noise contains significant energy in the lower frequency bands, which are typically taken to be in the 10 to 160 Hz region.

7. Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements (ie vertical, longitudinal and transverse).

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/Vo), where Vo is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used.

8. Human Perception of Vibration

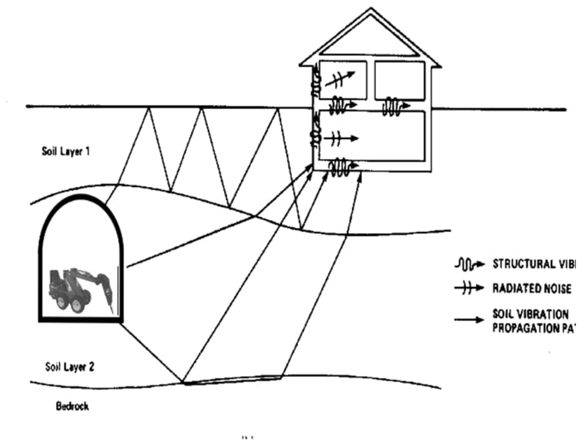
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

9. Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents an example of the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise.

Appendix B Pipeline Construction – Noise Offset Buffer Distance Figure

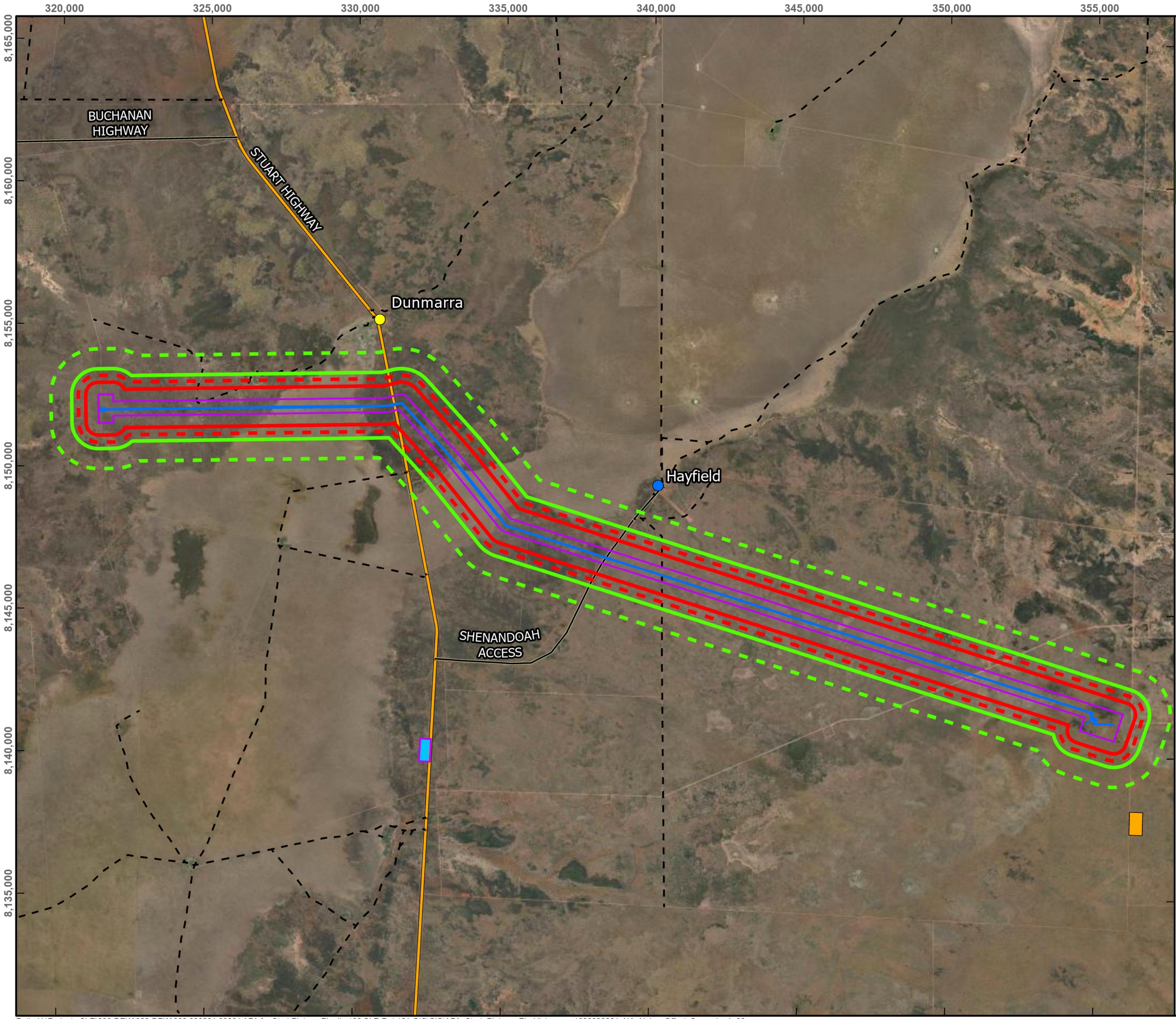
APA Sturt Plateau Pipeline – Environmental Approvals

Construction Noise and Vibration Assessment

APA SPP Pty Ltd

Report Number 680.030294.00003

14 October 2024



APA STURT PLATEAU PIPELINE ENVIRONMENTAL APPROVALS

APPENDIX B: PIPELINE CONSTRUCTION - NOISE OFFSET BUFFER DISTANCE

SCENARIO 1: STAGE 1 SURVEY & STAGE 3 CLEAR AND GRADE

LEGEND

- Project Area
- Pipeline Construction ROW
- Temporary Construction Camp
- Homestead
- Roadhouse
- Tamboran Resources Camp

Noise Offset Buffers

- Adverse - Evening/Night-time (35 dBA LAeq)
- Neutral - Evening/Night-time (35 dBA LAeq)
- Adverse - Day-time (45 dBA LAeq)
- Neutral - Day-time (45 dBA LAeq)

Road Category

- Pastoral - National Highway
- Pastoral - Secondary
- Pastoral - Local

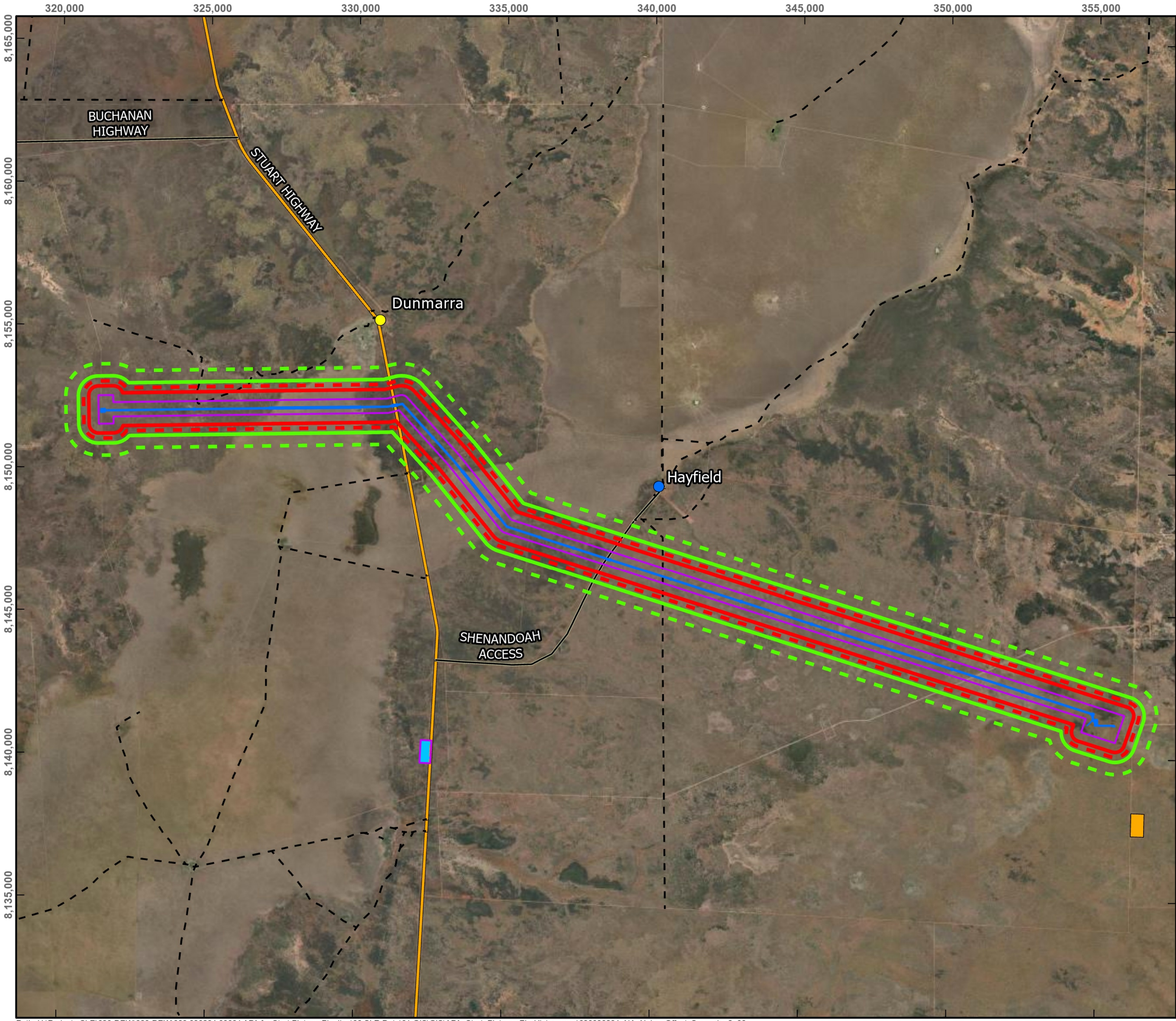
Service Layer Credits:
Earthstar Geographics, Maxar

0 2.5 5 km

Coordinate System:	GCS GDA 1994
Scale:	1:180,000 at A4
Project Number:	680.030294
Date Drawn:	14-Oct-2024
Drawn by:	CP

SLR

Path: H:\Projects-SLR\680-DRW\680-DRW\680.030294.00001 APA for Sturt Plateau Pipeline\06 SLR Data\01 GIS\GIS\APA_Sturt_Plateau_FireHistory.aprx\680030294_NA_Noise_Offset_Scenario_1_06



APA STURT PLATEAU PIPELINE ENVIRONMENTAL APPROVALS

APPENDIX B: PIPELINE CONSTRUCTION - NOISE OFFSET BUFFER DISTANCE

SCENARIO 2: STAGE 6 PIPE STRINGING

LEGEND

- Project Area
- Pipeline Construction ROW
- Temporary Construction Camp
- Homestead
- Roadhouse
- Tamboran Resources Camp

Noise Offset Buffers

- Adverse - Evening/Night-time (35 dBA LAeq)
- Neutral - Evening/Night-time (35 dBA LAeq)
- Adverse - Day-time (45 dBA LAeq)
- Neutral - Day-time (45 dBA LAeq)

Road Category

- Pastoral - National Highway
- Pastoral - Secondary
- Pastoral - Local

Service Layer Credits:
Earthstar Geographics, Maxar

0 2.5 5 km

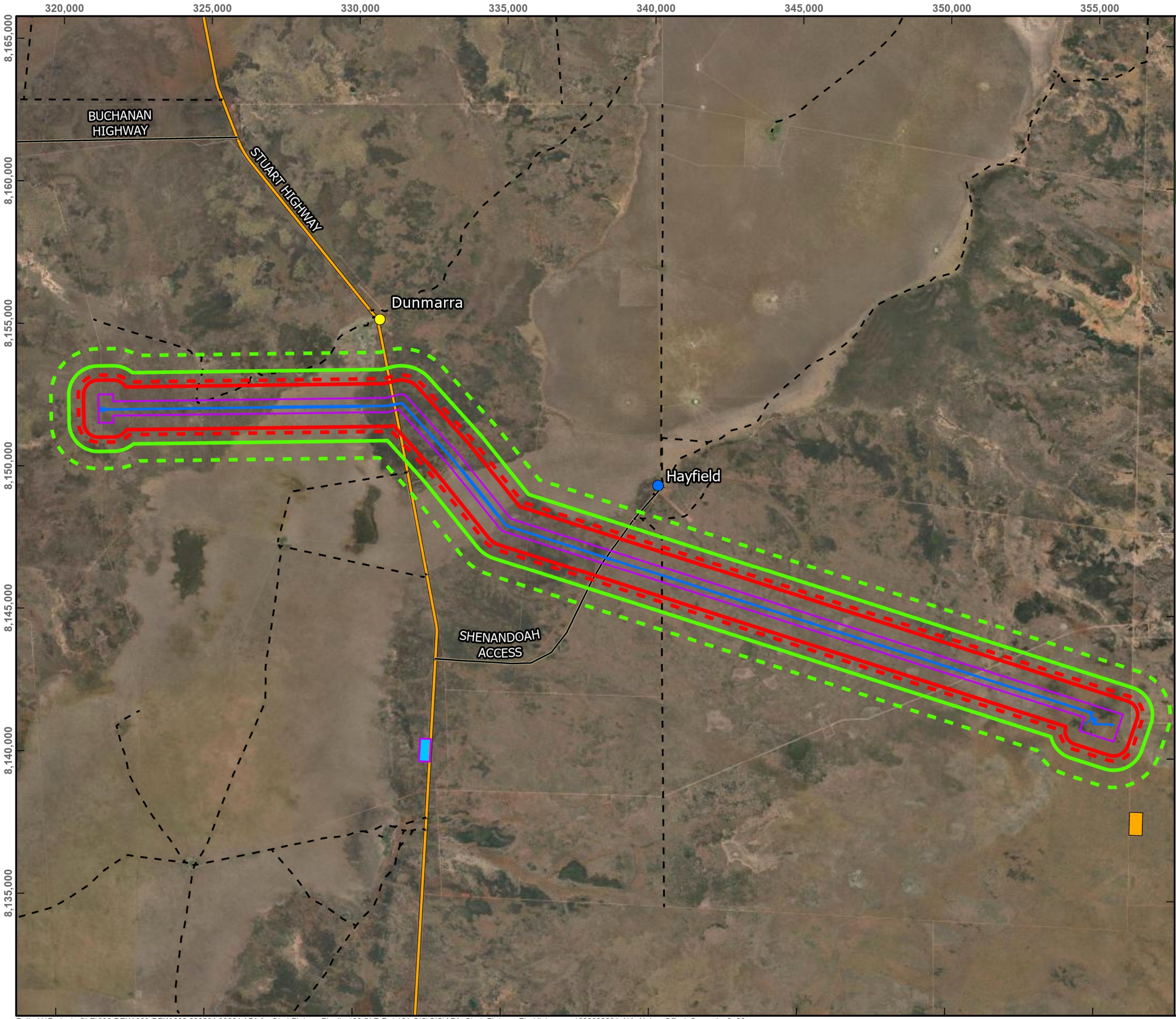
Coordinate System:	GCS GDA 1994
Scale:	1:180,000 at A4
Project Number:	680.030294
Date Drawn:	14-Oct-2024
Drawn by:	CP

SLR

APA STURT PLATEAU PIPELINE ENVIRONMENTAL APPROVALS

APPENDIX B: PIPELINE CONSTRUCTION - NOISE OFFSET BUFFER DISTANCE

SCENARIO 3: STAGE 13 DITCH, PADDING AND BEDDING



LEGEND

- Project Area
- Pipeline Construction ROW
- Temporary Construction Camp
- Homestead
- Roadhouse
- Tamboran Resources Camp

Noise Offset Buffers

- Adverse - Evening/Night-time (35 dBA LAeq)
- Neutral - Evening/Night-time (35 dBA LAeq)
- Adverse - Day-time (45 dBA LAeq)
- Neutral - Day-time (45 dBA LAeq)

Road Category

- Pastoral - National Highway
- Pastoral - Secondary
- Pastoral - Local

Service Layer Credits: Earthstar Geographics, Maxar

0 2.5 5 km

Coordinate System:	GCS GDA 1994
Scale:	1:180,000 at A4
Project Number:	680.030294
Date Drawn:	14-Oct-2024
Drawn by:	CP

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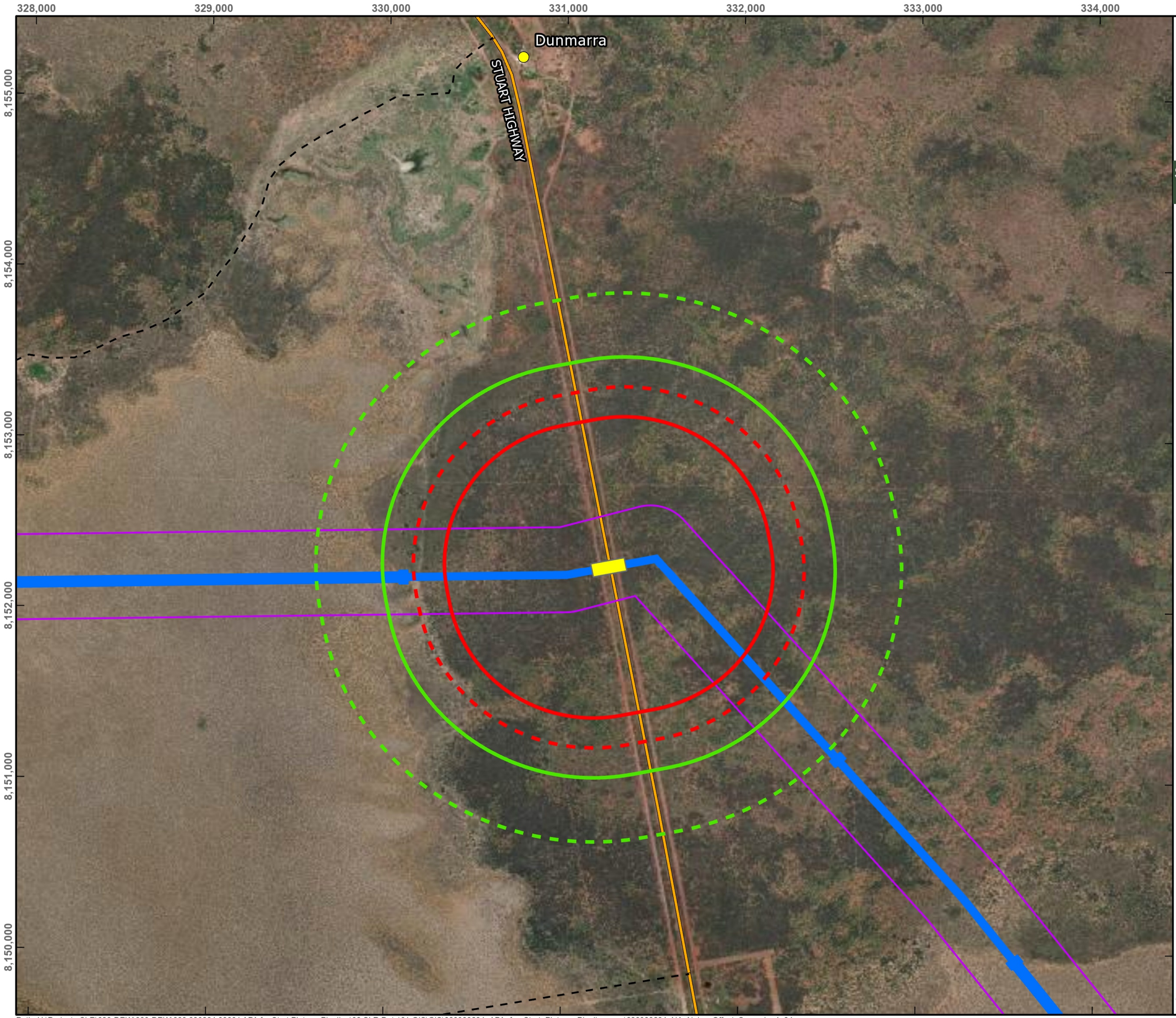

APA STURT PLATEAU PIPELINE ENVIRONMENTAL APPROVALS

APPENDIX B: PIPELINE CONSTRUCTION - NOISE OFFSET BUFFER DISTANCE

SCENARIO 4: HORIZONTAL BORING AT STUART HIGHWAY

LEGEND

- Project Area
- Pipeline Construction ROW
- Horizontal Boring Site
- Roadhouse

Noise Offset Buffers

- Adverse - Evening/Night-time (35 dBA LAeq)
- Neutral - Evening/Night-time (35 dBA LAeq)
- Adverse - Day-time (45 dBA LAeq)
- Neutral - Day-time (45 dBA LAeq)

Road Category

- Pastoral - National Highway
- Pastoral - Local

Service Layer Credits:
Earthstar Geographics, Maxar

0 0.5 1 km

Coordinate System:	GCS GDA 1994
Scale:	1:30,000 at A4
Project Number:	680.030294
Date Drawn:	12-Oct-2024
Drawn by:	CP

SLR

Making Sustainability Happen