Sturt Plateau Pipeline

Air Quality and Greenhouse Gas Assessment

APA SPP Pty Ltd

Level 12, 80 Ann Street, Brisbane QLD 4000

Prepared by:

SLR Consulting Australia

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Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
1.0	22 August 2024	K Lawrence	G Starke	K Lawrence
2.0	15 October 2024	K Lawrence	N. Calder	K Lawrence

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.

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Executive Summary

APA SPP Pty Ltd (APA) is proposing to construct the Sturt Plateau Pipeline (the SPP) approximately 80 km north of Elliott, in the Roper Gulf region of the Northern Territory (NT), to transport appraisal gas from Tamboran B2 Pty Ltd's (TBN) Sturt Plateau Compression Facility (SPCF) development sites in the Beetaloo Sub-basin to the Amadeus Gas Pipeline (AGP).

The SPP is approximately 37 km in length and will be buried for its entire length, other than at surface facility locations at each end of the pipeline. It crosses the Stuart Highway approximately 35 km south of Birdum and is proposed to be installed by horizontally boring under the Stuart Highway.

The Project's construction footprint comprises:

- the construction right of way (CROW) for the Sturt Plateau Pipeline
- construction footprints for the Shenandoah Facility and Sturt Plateau Facility
- the temporary construction camp, and
- additional work areas (including truck turnarounds, vegetation storage, horizontal bore entry and exit locations, and line pipe storage areas) required to facilitate construction.

The construction footprint will be located within the larger Project Area 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.

To support construction of the SPP, gravel will be sourced from a borrow pit within the Project Area and water will be sourced from new water bores within the Project Area and existing water bores outside of the Project Area.

The construction works, including mobilisation, are anticipated to take approximately 6 months, with an expected construction rate of approximately 1.1 km/day.

SLR was contracted to prepare an air quality and greenhouse gas (GHG) assessment for the construction and operation of the SPP (the Project) to inform the environmental referral being prepared for the Project for submission to the NT Environment Protection Authority (EPA).

Air Quality Impact Assessment

The key emissions to air expected to result from Project construction activities are fugitive emissions of particulate matter from earthworks, wind erosion of disturbed areas and stockpiles and wheel-generated dust. Temporary elevations in local particulate levels are most likely to occur when construction activities are undertaken during periods of low rainfall and/or windy conditions.

Where diesel-powered mobile machinery and vehicles are being used, localised elevations in ambient concentrations of combustion-related pollutants may also occur, however any potential for the relevant impact assessment criteria for these pollutants to be exceeded at surrounding sensitive areas will be negligible given the separation distances involved and was not considered further.

Once constructed, air emissions from the Project will be minimal and no potential for adverse air quality impacts at surrounding sensitive areas was identified.

For this assessment, the *IAQM Guidance on the Assessment of Dust from Demolition and Construction* developed in the United Kingdom by the Institute of Air Quality Management

(IAQM, 2024) was used to provide a qualitative assessment method. The IAQM method uses a four-step process for assessing dust impacts from construction activities:

- **Step 1**: Screening based on distance to the nearest sensitive receptor; whereby the sensitivity to dust deposition and human health impacts of the identified sensitive receptors is determined.
- **Step 2**: Assess risk of dust effects from activities based on the scale and nature of the works, which determines the potential dust emission magnitude, and the sensitivity of the area surrounding dust-generating activities.
- **Step 3**: Determine site-specific mitigation for remaining activities with greater than negligible effects.
- **Step 4**: Assess significance of remaining activities after management measures have been considered.

Potentially sensitive receptors within 5 km of the proposed SPP corridor were identified through a desktop study. This analysis identified that the nearest sensitive receptors (existing residences) are located approximately 3 km from the proposed pipeline corridor. No national parks, conservation areas or other potentially sensitive ecological receptors were identified in the vicinity of the proposed construction activities.

Given this, and using the IAQM approach, it was concluded that there is a negligible risk of adverse soiling or health impacts during the pipeline earthworks and construction phases. On that basis, standard dust mitigation measures are anticipated to be appropriate to manage dust emissions during the construction works.

To confirm that the controls are adequately controlling dust emissions from the construction works to protect construction staff from unnecessary exposure to elevated dust levels, it is recommended that visual inspections of dust levels be performed on a daily basis, particularly during the peak earthwork’s phases. If dust is seen travelling off-site, water should be applied to suppress dust and/or activities modified until conditions improve.

Given the remote nature of the surrounding area, ambient air quality monitoring using dust gauges or real-time PM_{10} monitoring equipment is not considered to be required during the construction phase.

GHG Assessment

The calculation of Greenhouse Gas (GHG) emissions from the construction and operation of the Project has been performed in a five-stage process:

1. Definition of the Project boundary
2. Identification of GHG emission sources within the Project footprint during construction and operation
3. Identification of emission calculation methods and emission factors for each source
4. Identification of the activity data for each emission source required for the calculations
5. Calculation of estimated GHG emissions

No significant Scope 1 or scope 2 emission sources have been identified for the Project operations. There will be minor intermittent losses of gas during pigging operations, otherwise emissions via the pipeline vent will only occur in emergency situations or rare maintenance events. The Project will need to monitor and report operational fugitive emissions from leaks and venting in line with APA’s reporting requirements for their managed networks and associated regulations.

The SPP will transport appraisal gas for the first 1-2 years, after which it will transport gas from a production lease, should Tamboran be successful in obtaining a lease. GHG emissions associated with the extraction, other transport and end use of appraisal and production gas that will be transported by the SPP will be accounted for as part of the gas production environmental assessments and have not been addressed in this assessment.

It is noted however, that the Project will result in a reduction in upstream GHG emissions that will otherwise occur if the Project does not proceed, and the appraisal gas is instead vented. If the appraisal gas is flared at the wellhead, there will be no significant net change in upstream GHG emissions compared to it being combusted for heat or electricity generation, however the energy benefits will be realised, rather than being lost to the environment.

The estimated scope 1 and 3 GHG emissions for the Project construction are presented in **Table ES-1**. No electricity will be sourced from the grid during construction; hence scope 2 emissions have not been considered.

Table ES-1 Estimated Scope 1 and 3 GHG Emissions for the Project - Construction

Scope/Source	Estimated Annual Emissions (t CO_2-e)			
	CO_2	CH_4	N_2O	Total
Scope 1				
Land clearance *	15,360			15,360
Diesel – construction equipment	1,349	1.9	3.9	1,355
Diesel – generators	326	0.5	0.9	327
Petroleum based oils and greases	4.9	0.0	0.0	4.9
Total Scope 1	**17,040**	**2.4**	**4.8**	**17,047**
Scope 3				
Diesel - 3rd party transport of equipment to site	392	0.4	2.2	394
Production and supply of diesel consumed *	415			415
Production and supply of oils and greases consumed *	6.8			6.8
Embodied energy of steel used in construction *	5,771			5,771
Embodied energy of copper used in construction *	1.4			1.4
Embodied energy of concrete used in construction *	9.1			9.1
Total Scope 3	**6,595**	**0.4**	**2.2**	**6,597**
* Emission calculations/factors do not provide breakdown by gas; all emissions allocated as CO_2.				

The emissions estimates indicate the following:

- The main source (90%) of estimated scope 1 emissions associated with the Project construction is vegetation clearance, which were calculated using the Carbon Emissions Estimate Calculator (DEPWS, 2023).
- The combustion of diesel in the construction equipment and machinery (8%) and for power generation at the camp (2%) are the only other significant contributors to the estimated Scope 1 emissions.

- The main source (88%) of estimated Scope 3 emissions associated with the construction phase is the embodied energy within the key materials of construction, specifically the steel pipelines.

For the year of construction, the contribution of the Project's scope 1 emissions to national and NT GHG emissions is estimated at 0.004% and 0.10% respectively.

Emissions reduction initiatives have been identified to minimise the GHG footprint of the Project and will be explored further during detailed design. The preliminary GHG emission estimates will also be reviewed and updated as the Project design is refined and further, more robust activity data becomes available. In the interim, the emissions inventory will be used to provide guidance on the key potential GHG emission sources associated with the Project, so that appropriate monitoring and mitigation measures can be targeted to these activities.

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Acronyms and Abbreviations

µg/m^3	micrograms per cubic metre
AGP	Amadeus Gas Pipeline
AQMS	air quality monitoring station
AWS	automatic weather station
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalents
CROW	construction right of way
EPA	Environment Protection Authority (NT)
GHG	greenhouse gas
GJ/kL	gigajoules per kilolitre
g/m^2/month	grams per square metre per month
GWP	Global Warming Potential
ha	hectares
HFC	hydrofluorocarbon
IAQM	Institute of Air Quality Management (UK)
ICE	Inventory of Carbon and Energy
IPCC	Intergovernmental Panel on Climate Change
km	kilometres
km^2	square kilometres
m	metres
NEPM (Ambient Air)	*National Environmental Protection (Ambient Air Quality) Measure, 2021*
NGA Factors	National Greenhouse Accounts Factors
NGER Act	*National Greenhouse and Energy Reporting Act, 2007 (Cth)*
NGER Scheme	*National Greenhouse and Energy Reporting Scheme*
NGO	non-governmental organisation
NO	nitric oxide
N_2O	nitrous oxide
N_2O_5	nitrogen pentoxide
NO_2	nitrogen dioxide
NO_X	oxides of nitrogen
NPI	National Pollutant Inventory
NT	Northern Territory
$PM_{2.5}$	particulate matter with an aerodynamic diameter up to 2.5 µm
PM_{10}	particulate matter with an aerodynamic diameter up to 10 µm

PFC	perfluorocarbon
SF_6	sulfur hexafluoride
SO_2	sulfur dioxide
SPCF	Sturt Plateau Compression Facility
SPP	Sturt Plateau Pipeline
t	tonne
TBN	Tamboran B2 Pty Ltd
t CO_2-e	tonnes of carbon dioxide equivalents
TJ	terajoules
TJ/day	terajoules per day
TSP	total suspended particulates
UNFCCC	United Nations Framework Convention on Climate Change
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

1.0 Introduction

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 SPP Pty Ltd (APA) is proposing to construct the Sturt Plateau Pipeline (the SPP) to transport gas from Tamboran B2 Pty Ltd's (TBN) 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 pipeline will be buried for its entire length. Horizontal boring is proposed to facilitate the construction of the Project under the Stuart Highway.

The Project's construction footprint comprises:

- the construction right of way (CROW) for the Sturt Plateau Pipeline
- construction footprints for the Shenandoah Facility and Sturt Plateau Facility
- the temporary construction camp, and
- additional work areas (including truck turnarounds, vegetation storage, horizontal bore entry and exit locations, and line pipe storage areas) required to facilitate 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 Project will occur within this Project Area, however the exact pipeline 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.

To support construction of the SPP, gravel will be sourced from a borrow pit within the Project Area and water will be sourced from new water bores within the Project Area and existing water bores outside of the Project Area.

This air quality and greenhouse gas (GHG) assessment for construction and operation of the SPP (the Project) has been prepared to inform the environmental referral being prepared for the Project for submission to the NT Environment Protection Authority (EPA). This report presents the scope, methodology, inputs, assumptions and key findings of those assessments.

1.1 Assessment Requirements

The assessment requirements for GHG emission sources in the NT are set out in the *Environmental Factor: Atmospheric Processes – Greenhouse Gas Emissions* published by the NT EPA in August 2023 (NT EPA, 2023). There is currently no similar guidance document published by NT EPA for air quality assessments.

Under the *Environmental Factor: Atmospheric Processes – Greenhouse Gas Emissions*, a proponent is to refer a proposal to the NT EPA if its emissions exceed:

- For an industrial proposal: 100,000 tonnes carbon dioxide equivalent (t CO_2-e) of Scope 1 emissions in any financial year over the life cycle of a proposal, or
- For a land use proposal: 500,000 t CO_2-e (Scope 1) generated from a single clearing action, or cumulatively from multiple land clearing actions on a property over time.

Scope 1 emissions estimates must include all emissions caused as a direct result of the proposal, inclusive of, but not limited to, stationary energy, fugitives, and emissions associated with transport. In addition, the guideline notes that proposals should not be split into separate referrals to avoid consideration of GHG emissions.

Operation of the SPP, in isolation, will result in minimal GHG emissions and will not trigger the annual threshold of 100,000 t CO_2-e Scope 1 emissions (see **Section 4.4**). GHG emissions associated with the extraction and processing of gas from the Beetaloo Basin that will be transported via the SPP, however, are expected to trigger the threshold. Given the comparatively minimal emissions associated with operation of the SPP, it is most appropriate that a detailed assessment of GHG emissions associated with the extraction, transport and end use of the gas be performed as part of the gas production project's environmental assessment process. This GHG assessment therefore focuses on the construction of the SPP to identify key potential GHG emission sources and opportunities to manage and minimise emissions.

1.2 Air Quality and GHG Assessment Objectives

The objectives of the air quality impact assessment are to:

- Characterise the existing air quality environment at the Project location and identify environmental values and sensitive receptors that will potentially be affected by the Project.
- Identify the potential key sources of air emissions associated with the Project based on their potential for impacts on air quality.
- Identify air emissions mitigation and management measures proposed to be incorporated into the design, construction and operation of the Project.
- Present an assessment of potential impacts on off-site air quality associated with the Project.

The objectives of the GHG assessment are to:

- Identify and quantify key Scope 1, 2 and 3 GHG emissions associated with the construction and operational phases of the Project in accordance with relevant NT and national regulatory guidelines.
- Assess the potential significance of the GHG emissions from the Project in the context of current NT and national GHG emission levels.
- Identify practicable and economically feasible mitigation measures to minimise and manage GHG emissions and ensure energy use efficiency for different stages of the Project life cycle.

1.3 Study Approaches

1.3.1 Air Quality Assessment

In the absence of NT-specific air quality impact assessment guidelines or ambient air quality criteria, the air quality impact assessment has been prepared with reference to the following documents:

- *The National Environment Protection Measure (NEPM) for Ambient Air Quality* (NEPC, 2021), hereafter the 'NEPM Ambient Air'
- *The Approved Methods for the Modelling and Assessment of Air Pollutants* (NSW EPA, 2022)
- The United Kingdom Institute of Air Quality Management's *Guidance on the Assessment of Dust from Demolition and Construction* (IAQM, 2024)

The key tasks undertaken as part of the air quality impact assessment were:

- Characterisation of the existing air quality environment at the Project location and identification of environmental values and sensitive receptors that will potentially be affected by the Project.
- Identification and characterisation of the potential key sources of air emissions associated with the Project.
- Assessment of the potential air quality impacts associated with the Project, considering the nature, scale and duration of air emissions anticipated to occur during the construction and operation of the project, and the sensitivity of the receiving environment to those emissions.
- Identification of air emissions mitigation and management measures to be incorporated into the design, construction and operation of the Project to avoid adverse off-site air quality impacts.

No significant sources of air emissions are anticipated during the operational phase of the Project. The focus of the air quality impact assessment is therefore on the construction phase, with the key emissions to air associated with the construction period anticipated to be fugitive dust, or particulate matter.

As the Project Area is relatively remote and given the temporary and variable nature of construction works, a detailed air dispersion modelling study is not considered to be warranted or appropriate to assess air quality impacts from the Project. Instead, a qualitative risk-based assessment has been performed as outlined in **Section 6.1**.

1.3.2 GHG Assessment

The key tasks undertaken as part of the GHG Assessment were:

- Identification of potential GHG emission sources associated with the construction and operational phases of the Project.
- Estimation of the key Scope 1, 2 and 3 GHG emissions in tCO_2-e per annum resulting from the Project construction and operations.
- Assessment of the potential significance of the GHG emissions from the Project in the context of current and predicted National and NT GHG emission levels.

- Identification of practicable and economically feasible mitigation measures to minimise and manage GHG emissions and ensure energy use efficiency for:
  - Different stages of the Project life cycle (e.g. construction, operations); and
  - Individual Project activities (e.g. fixed plant, fuel source, roads/vehicles).

1.4 Limitations

The key limitations of the air quality and GHG assessment are identified as follows.

- The detailed Project design is still being finalised and there is potential for changes to the construction schedule and equipment specifications to occur. Such changes, however, are not expected to have a material impact on the air quality impact assessment given the qualitative nature of the assessment approach and the distances to the nearest off-site sensitive receptors.
- The accuracy of the following data sets used in the GHG emission estimation:
  - Estimated equipment numbers and hours of operation used to estimate fuel consumption rates during the construction phase, which have been used in the calculation of Scope 1 and Scope 3 GHG emissions associated with the Project.
  - The accuracy of published emission factors used to estimate GHG emissions associated with the construction and operation of the Project

Where possible, conservative assumptions have been made to address uncertainties.

- The representativeness of the air quality data sourced from Katherine and Daly Waters used in this study to characterise background air quality. The background data used are expected to be conservative overestimates of pollutant levels at the Project Area.

2.0 Project Description and Construction Schedule

2.1 Project Location

The SPP is approximately 37 km in length, commencing on Lot 7026 (Shenandoah Perpetual Pastoral Lease) and extending west, via Lot 7513, to the AGP located on Lot 1077 (both Hayfield Perpetual Pastoral Lease) (see **Figure 1**). The Stuart Highway runs between Shenandoah and Hayfield Perpetual Pastoral Leases. The highway has an approximate 200 m wide road corridor (100 m either side of the road centreline) in the vicinity of where the SPP is proposed to cross, and the SPP is proposed to be bored horizontally under the Stuart Highway.

2.2 Project Description

2.2.1 Overview

The Project is designed to provide a Maximum Daily Quantity (MDQ) of 40 terajoules per day (TJ/day) of gas with future potential expansion of the pipeline capacity to 125 TJ/day. The initial purpose of the Project is to avoid appraisal gas being lost to the atmosphere and instead to be used to support the current gas supply in the NT. Subject to Tamboran successfully obtaining the required regulatory approvals, and confirming gas quantity and quality, the Project will facilitate production gas being transported from the Beetaloo Basin into the AGP. This gas will then be able to support supply to both the NT as well as to other areas of Australia.

The pipeline will be designed in accordance with Australian Standard (AS) 2885, with a design life of 40 years. It will be constructed of high strength steel line pipe and will typically be fabricated from 18 m individual pipe lengths. The pipe lengths will be factory coated with dual layer fusion bonded epoxy or similar for corrosion protection purposes except at each end to allow welding. Post welding, the uncoated weld margins will be grit blasted and coated with hand or spray applied epoxy.

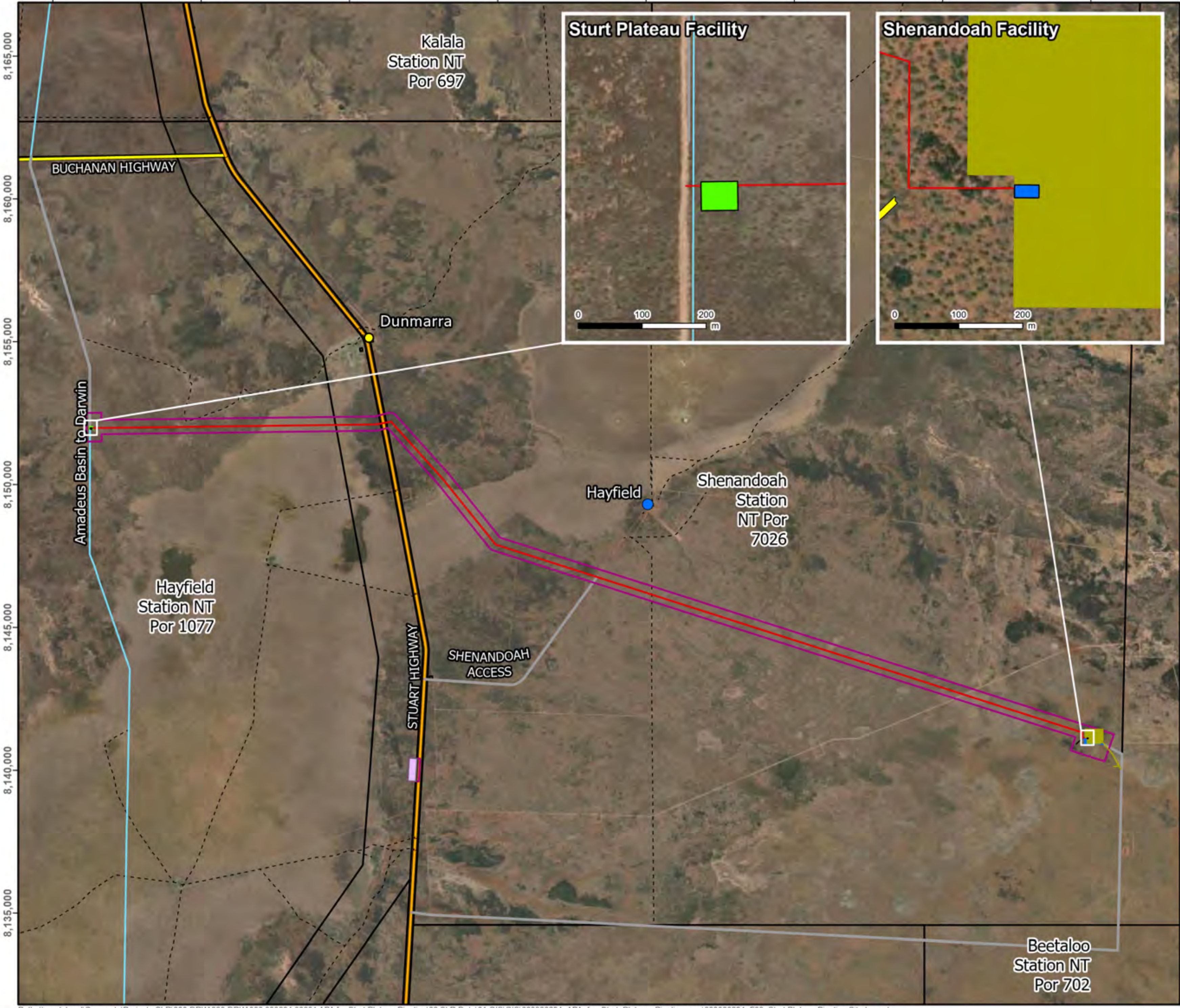
The pipeline will be buried for its entire length other than at surface facility locations. All surface facilities will be bounded by security fencing. Pipeline marker signs will also be installed along the length of the pipeline to indicate the pipeline location, in accordance with AS 2885.1.

Minimum depths of cover (measured from top of pipe to natural ground level), based on AS 2885 requirements, will be generally 750 mm. At locations where the pipeline is potentially exposed to increased erosional forces, such as watercourse crossings and floodplains, additional protection will be provided by increased depth of cover. The pipeline will also be buried deeper beneath roads.

APA STURT PLATEAU PIPELINE ENVIRONMENTAL APPROVALS

STURT PLATEAU PIPELINE SITE LAYOUT

FIGURE 1



LEGEND

Project Elements
- Proposed Pipeline Alignment
- Cathodic protection anode bed
- Temporary Construction Camp and Laydown Area
- Sturt Plateau Facility
- Shenandoah Facility
- Tamboran's Sturt Plateau Compression Facility

Existing Infrastructure
- Roadhouse
- Homestead
- Access Track
- Existing Gas Pipeline

Road Category
- National Highway
- State Arterial
- Local
- Cadastre
- Project Area

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:	10/15/2024
Drawn by:	CP
Reviewed by:	MN

SLR

Path: \\au.slr.local\Corporate\Projects-SLR\680-DRW\680-DRW\680.030294.00001 APA for Sturt Plateau Pipeline\06 SLR Data\01 GIS\GIS\680030294_APA_for_Sturt_Plateau_Pipeline.aprx\680030294_F03_Sturt Plateau Pipeline Site Layout

The Project will require the construction of surface facilities to support the operation of the pipeline. These will comprise the following:

- The Shenandoah facility (receipt), immediately adjacent to Tamboran's proposed SPCF, consisting of a:
  - Tie-in flange to the gas production facilities and shut-down valve
  - Pig launcher
  - Pipeline vent (only used in emergency situations or rare maintenance events)
  - Station Remote Terminal Unit (RTU) and communications system
  - Cathodic protection anode bed
- Sturt Plateau facility (delivery), where the proposed pipeline intersects with the existing Amadeus Gas Pipeline (AGP), including a pig receiver and hot tap connection onto AGP.

2.2.2 Construction Methods

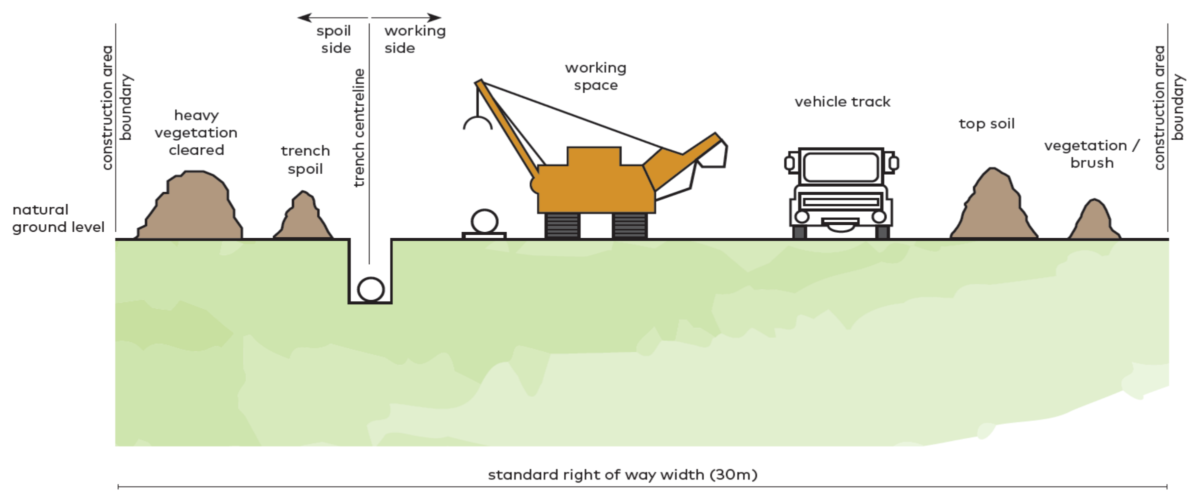
Construction of the pipeline will use typical methods for modern gas pipelines. The construction sequence is shown in **Figure 2** and will involve the following key steps:

- Preliminary survey works (including geotechnical surveys, installation of temporary gates in fences)
- Clearing of vegetation and grading the CROW
- Stripping and stockpiling of topsoil
- Delivery of 18 m pipe lengths to the CROW and welding into 'pipe strings'
- Non-destructive testing and coating
- Excavating a trench and any necessary bell holes in which to lay the pipe
- Lowering the pipeline strings into the trench and welding strings together
- Backfilling the trench with excavated material
- Crossing watercourses, roads by open cut trench, horizontal boring or HDD methods
- Installing pipeline markers at fences, road crossings and other locations as required by AS 2885
- Testing the structural integrity of the pipeline by hydrostatic testing
- Installing permanent gates in fences, where required
- Rehabilitating the CROW.

Figure 2 Pipeline Construction Sequence

The area used for construction is referred to as the construction right of way (CROW). The CROW is made up of the nominal 30 m easement together with Additional Work Space (AWS) that is used during construction on a temporary basis to facilitate construction. An indicative cross section of the pipeline CROW is shown in **Figure 3**.

Figure 3 Indicative Cross Section of Construction Right of Way



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.

The pipeline road crossing under the Stuart Highway will likely be a horizonal bored crossing, which will allow traffic to continue to use the road while the crossing is being installed. The final crossing methodology will consider any technical requirements, such as permit conditions, of the infrastructure owner. Unsealed roads will typically be crossed using open cut trenching methods.

2.2.3 Construction Camp

The construction workforce will be accommodated in a temporary construction camp during the construction phase of the Project (location shown in **Figure 1**). The construction camp is expected to house a total of 133 people at its peak.

The construction camp will provide the following facilities and services:

- Accommodation.
- Offices and first aid facilities.
- Kitchen and dining.
- Laundry and ablution blocks.
- Recreational areas.
- Water supply and use.
- Power supply.
- Diesel / fuel storage and use.
- Vehicle and plant wash-down facilities (biosecurity).
- General laydown area.
- Wastewater treatment and management.
- Waste management facilities.

The construction camp will be supplied with power from diesel generators (gensets).

2.3 Construction Schedule

The anticipated construction period is approximately 6 months, running from late July 2025 to December 2025, as outlined in **Table 1**.

Table 1 Indicative Construction Schedule

Element	2025					
	July	Aug	Sep	Oct	Nov	Dec
Site mobilisation						
Construction						
Commissioning						

3.0 Air Quality Impact Assessment

3.1 Environmental Values

The air is a critical component of our environment and can be affected by pollution. Air pollution can negatively affect environmental values relevant to air quality, including:

- human health and wellbeing
- aesthetics of the environment
- the health and biodiversity of ecosystems
- agricultural use of the environment.

Human health impacts caused by air pollution can include respiratory problems such as coughs, bronchitis or asthma; and cardiovascular problems such as heart failure, arrhythmias and strokes. Environmental aesthetics may be affected by odour, haze, smog and dust. Pollutants can also affect the health and growth of animals and plants, potentially changing natural ecosystems and causing adverse impacts on agricultural crops.

3.2 Identified Potential Project Air Emissions

3.2.1 Construction Phase

The key emissions to air expected to result from Project construction activities are fugitive emissions of particulate matter from earthworks, wind erosion of disturbed areas and stockpiles and wheel-generated dust.

The following construction activities have therefore been considered in assessing potential air quality impacts for the Project:

- Land clearing, earthworks and construction of infrastructure associated with the pipeline
- Haulage of material for construction from areas of excavation (trench and borrow pits) to work areas and spoil dumps, including unloading and grading
- Horizontal boring under the Stuart Highway
- Construction of ancillary infrastructure (ie camps, laydowns).

Temporary elevations in local particulate levels are most likely to occur when construction activities are undertaken during periods of low rainfall and/or windy conditions. The impact of elevated dust emissions is dependent upon the potential for particulates to become and remain airborne prior to being deposited as dust or experienced as an ambient particulate concentration. A number of environmental factors may affect the generation and dispersion of dust emissions, including:

- Wind direction - determines whether dust and suspended particles are transported in the direction of the sensitive receptors
- Wind speed - determines the potential suspension and drift resistance of particles
- Surface type - more erodible surface material types have an increased soil or dust erosion potential
- Surface material moisture - increased surface material moisture reduces soil or dust erosion potential

- Rainfall or dew - rainfall or heavy dew that wets the surface of the soil reduces the risk of dust generation.

Where diesel-powered mobile machinery and vehicles are being used, localised elevations in ambient concentrations of combustion-related pollutants may also occur, however any potential for the relevant impact assessment criteria for these pollutants to be exceeded as a result of the proposed activities is negligible. Fugitive dust emissions are generally considered to have the greatest potential to give rise to downwind air quality impacts at construction sites.

3.2.2 Operational Phase

Once constructed, air emissions from the Project will be minimal. The most significant source of dust is likely to be from light vehicle movements on unsealed roads associated with routine inspections and other maintenance activities. There will also be minor emissions of combustion products from the vehicles and any mobile plant used during inspection and maintenance activities.

The potential for any potential adverse air quality impacts at surrounding sensitive areas will be minimal, and air emissions during operations have not been considered further.

3.2.3 Identified Pollutants of Concern

3.2.3.1 Particulate Matter

Fugitive emissions of particulate matter will be generated by the proposed construction activities. From a health and nuisance impact perspective, particles are classified primarily by size, as TSP (total suspended particulates), PM_{10} (particulate matter with an aerodynamic diameter up to 10 µm) and $PM_{2.5}$ (particulate matter with an aerodynamic diameter up to 2.5 µm).

Human health effects of dust tend to be associated with particles with an aerodynamic diameter of 10 µm or less ($\leq PM_{10}$). These smaller particles tend to remain suspended in the air for longer periods and can penetrate into the lungs. The $PM_{10-2.5}$ fraction (coarse fraction) is termed “thoracic particles”. These particles are inhaled into the upper part of the airways and lung. $PM_{2.5}$ particles are fine particles that are inhaled more deeply and lodge in the gas exchange region (alveolar region) of the human lung and are termed “respirable dust”.

Given that particulate emissions from the proposed Project will mainly be associated with vegetation clearing and excavation activities, material handling works, wind erosion and wheel-generated dust from haul roads, with minimal emissions associated with fossil fuel combustion, the potential for significant releases of particulates in the $PM_{2.5}$ size fraction is very low.

Emissions of TSP have the potential to result in nuisance impacts due to increased rates of dust deposition in the surrounding area.

3.2.3.2 Products of Combustion

Pollutants emitted from the combustion of diesel in fixed and mobile plant and equipment used during the construction phase, including the diesel gensets, will include the following:

- **Oxides of nitrogen (NO_X)**: NO_X is a mixture of gases that are composed of nitrogen and oxygen. Two of the most toxicologically significant compounds are nitric oxide (NO) and nitrogen dioxide (NO_2). Other gases belonging to this group are nitrous oxide (N_2O) and nitrogen pentoxide (N_2O_5). The majority of NO_X (90 to 95%$_{(v/v)}$) generated by the combustion of fossil fuels is in the form of NO, with NO_2 contributing the remaining 5 to 10%$_{(v/v)}$ along with traces of N_2O. The NO reacts in the atmosphere to form NO_2 as the plume travels downwind.
- **Carbon monoxide (CO)**: CO forms due to incomplete combustion of carbon in fuels (e.g. petrol, wood, coal, natural gas).
- **Sulfur dioxide (SO_2)**: Emissions of SO_2 from fossil fuel combustion are directly proportional to the sulfur content of the fuel.
- **Particulate matter**: Small quantities of $PM_{2.5}$ particulate matter are formed during combustion, from carry-over of non-combustible trace constituents in the fuel and lubricating oil and as products of incomplete combustion.
- **Volatile Organic Compounds (VOCs)**: VOCs is a collective term used to describe organic carbon-based compounds with the ability to enter the atmosphere as a vapour. Due to the ubiquitous nature of organic compounds emitted from natural and anthropogenic processes, there is a myriad of organic compounds that fall under the definition of VOCs. The environmental, human-health and amenity (i.e. odour) impacts of ambient concentrations of VOCs depend on the composition of the gases, hence there are no ambient air quality criteria for “Total VOCs”, only for selected key individual VOC constituents.

As mentioned in **Section 3.2.1**, any potential for the relevant impact assessment criteria for these pollutants to be exceeded at surrounding sensitive areas will be low, with fugitive dust emissions generally considered to have the greatest potential to give rise to downwind air quality impacts from construction sites.

3.3 Regulatory Framework and Assessment Criteria

The Northern Territory Government has not published any guidance or objectives for the assessment of air quality in the Northern Territory. In the absence of territory-specific environmental protection regulations, reference has been made to the air quality standards set out in the Ambient Air NEPM (NEPC, 2021) and the NSW Approved Methods (NSW EPA, 2022).

The air quality standards prescribed in the Ambient Air NEPM are reviewed and updated periodically to reflect the latest public health research, with the current standards for the pollutants of interest in this study reproduced in **Table 2** (NEPC, 2021). There are no criteria specified in the Ambient Air NEPM for TSP or deposited dust, which are associated with nuisance (amenity) impacts, rather than health impacts. The impact assessment criteria for TSP and deposited dust set by NSW EPA have therefore been referenced.

It should be noted that the objective of the Ambient Air NEPM is to provide a representative measure of regional air quality in major population centres, rather than for the standards to be used as project-specific targets. However, although the Ambient Air NEPM is not considered strictly applicable to construction projects, it is recognised that projects should work towards achieving the Ambient Air NEPM standards.

Table 2 Adopted Air Quality Criteria for Particulate Matter

Indicator	Averaging Period	Ambient Air NEPM Monitoring Criteria		NSW Approved Methods Impact Assessment Criteria
		Standard	Goal from 2025	
TSP	Annual			90 µg/m^3
PM_{10}	24 hours	50 µg/m^3		50 µg/m^3
	Annual	25 µg/m^3		25 µg/m^3
$PM_{2.5}$	24 hours	25 µg/m^3	20 µg/m^3	25 µg/m^3
	Annual	8 µg/m^3	7 µg/m^3	8 µg/m^3
Deposited Dust				2 g/m^2/month (incremental) 4 g/m^2/month (cumulative)

3.4 Receiving Environment

3.4.1 Topography and Land Use

The Project is located in generally flat terrain, with no significant topographical features or complex terrain that will affect the dispersion of air pollutants from the work areas. The flat terrain, and sparse vegetation along much of the route, also means that no significant screening of dust sources is anticipated.

3.4.2 Climate and Meteorology

The SPP corridor is located over 300 km inland from the northern coastline of Australia in the Beetaloo Basin. The climate of the Beetaloo Basin varies from in the north around Katherine being dry tropical savanna, to warm desert in the South near Tennant Creek.

The nearest meteorological monitoring station to the Project with long-term climate statistics available operated by the Bureau of Meteorology (BoM) is the automatic weather station (AWS) located at Daly Waters Airstrip (ID 014626), approximately 50 km north-northwest of the Project Area. Rainfall, temperature and solar radiation data from the Daly Waters Airstrip AWS are summarised in **Table 3**.

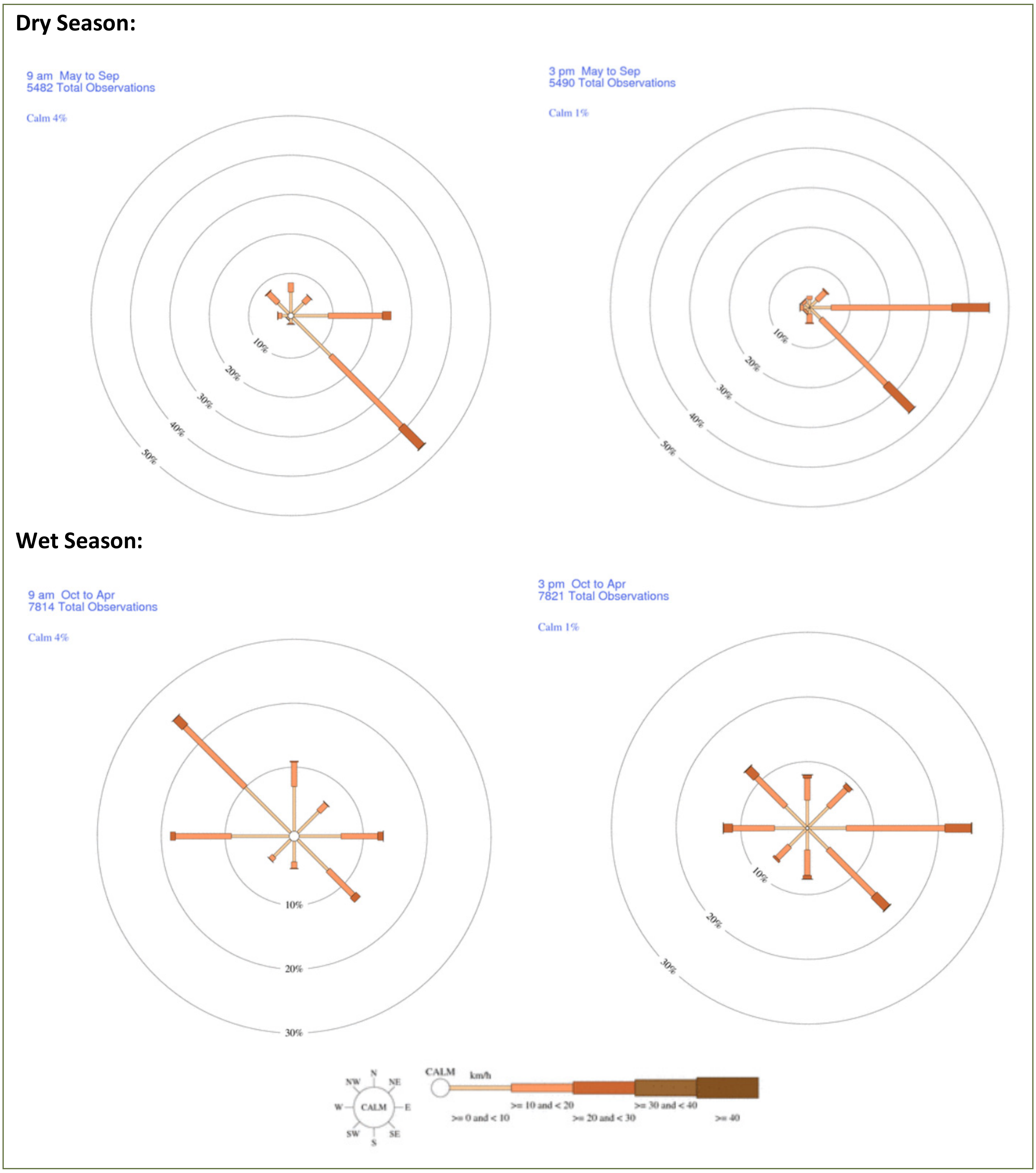
As shown by the data summaries, the area experiences hot summers and warm winters. Rainfall is very low during the dry season (May to September), with most rainfall originating from monsoonal systems that approach from the north during the wet season (November to March). The inter-annual variability of rainfall (variation of rainfall from one year to the next) is high (DAWE, BoM, CSIRO, GA, 2020).

Annual and seasonal 9 am and 3 pm wind roses compiled by the Bureau of Meteorology based on long-term observations from the Tindal RAAF AWS near Katherine are presented in **Figure 4**. Wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points (degrees from north). The bar at the top of each wind rose diagram represents winds blowing from the north (i.e. northerly winds), and so on. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds. Thus, it is possible to visualise how often winds of a certain direction and strength occur over a long period, either for all hours of the day, or for particular periods during the day.

Table 3 Rainfall and Temperature Statistics – Daly Waters Airstrip

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall (mm)													
Mean	**167.3**	**188.1**	**110**	**20.8**	**6.2**	**2.9**	**2.6**	**0.3**	**1.8**	**21.3**	**52.9**	**116.8**	**677.5**
Lowest	15	12.1	0	0	0	0	0	0	0	0	0.3	0.2	225.9
10th Percentile	54.4	39.5	12.7	0	0	0	0	0	0	0	12.3	34.4	373.8
Median	138.4	156.3	82.4	6	0	0	0	0	0	7.3	37.3	81	654.2
90th Percentile	310.1	334.4	253.2	50.6	16.9	6.7	4.3	0.3	5.4	56.9	123.9	238.6	977.6
Highest	576	575.2	353.8	224.6	67.4	71.8	56.9	9.4	19.1	114.2	246	634.8	1182.2
Temperature (°C)													
Mean	**35.8**	**35**	**34.9**	**34.1**	**31.3**	**29**	**29.1**	**31.3**	**35**	**37.6**	**38.2**	**37.5**	**34.1**
Lowest	31.8	31.5	31.5	30.7	28.2	25.3	26	29.1	32.5	34.1	34.4	33.6	32.3
10th Percentile	33.8	32.6	32.8	31.9	29.6	26.8	27.5	29.8	33.5	35.8	36.5	35.3	33
Median	36	34.8	34.5	34.3	31.1	29.2	29.1	31.1	34.9	37.8	38.3	37.6	34
90th Percentile	38.1	37.5	38	36.3	33.5	30.7	30.7	33.4	36.8	39.1	39.8	39.3	35.3
Highest	39.7	38.5	39.5	37.8	34.9	32.8	32.8	34.4	37.2	40.1	40.7	41.5	35.9
Solar Radiation (°C)													
Mean	**23.3**	**22.7**	**22.9**	**21.8**	**19.7**	**18.5**	**19.4**	**21.9**	**24.1**	**25.3**	**25**	**24**	
Highest monthly mean	26.8	26.2	26.3	23.7	21.3	19.8	20.6	23.8	26.2	27.8	28.2	27.2	
Lowest monthly mean	18.4	18.4	17.7	19.4	17.3	15.6	17.5	20.2	21.4	22.7	20.9	20.3	

Figure 4 Annual and Seasonal Wind Roses – Tindal RAAF Station (1985 - 2016)



The seasonal 9 am and 3 pm wind roses indicate that:

- During the dry season, winds predominantly blow from the east to southeast directions.
- Winds are more variable during the wet season, predominantly blowing from the northeast quadrant in the morning and the east to southeast in the afternoon.
- Winds are lighter in the morning than in afternoon, and there is a relatively low percentage of calm conditions.

3.4.3 Sensitive Receptors

Fewer than 500 people live in the Beetaloo GBA region, with around 1,400 in the Beetaloo GBA extended region, over 700 of whom are Aboriginal and/or Torres Strait Islander people. More than 90% of the land area is perpetual pastoral leasehold (DAWE, BoM, CSIRO, GA, 2020).

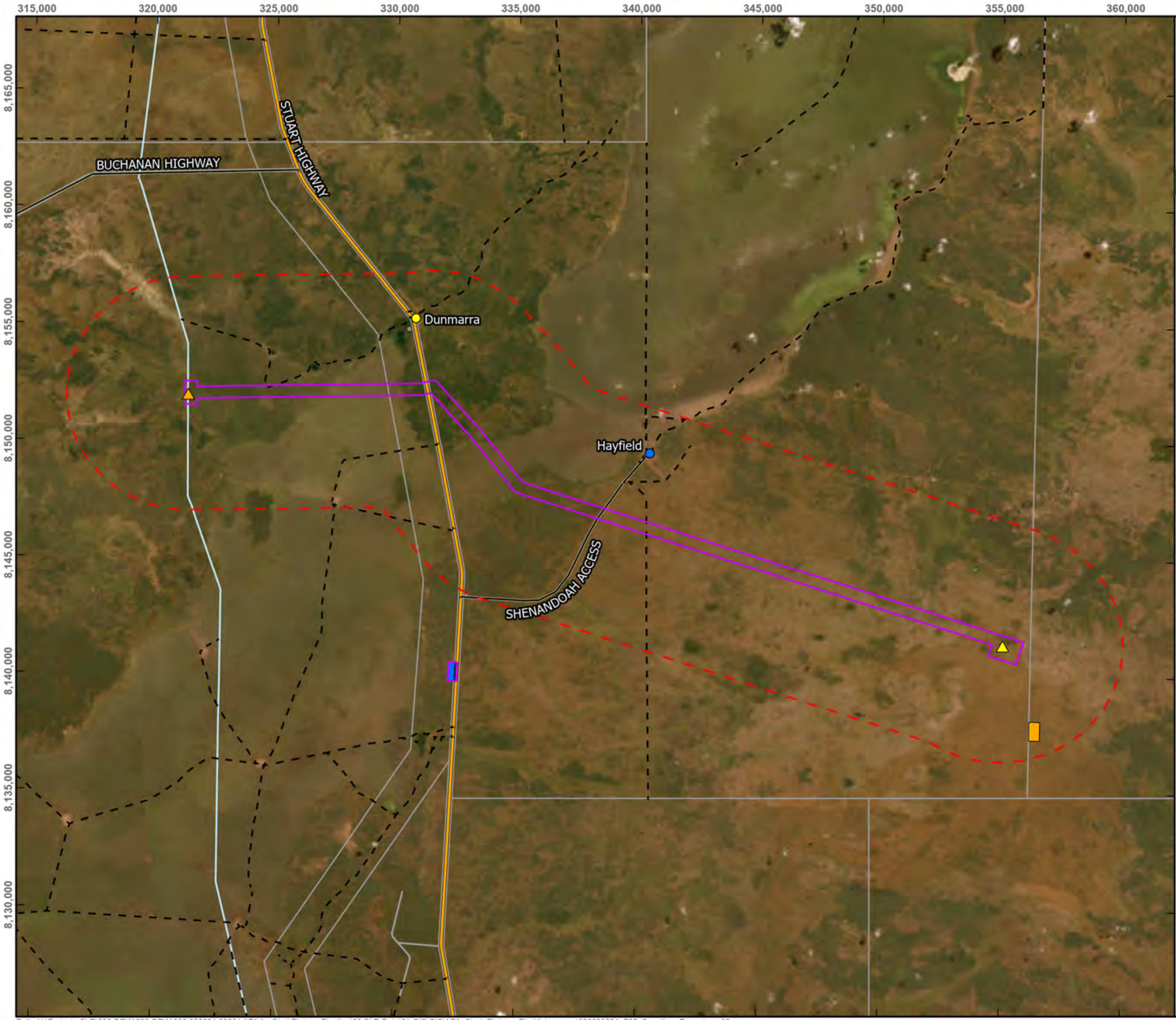
Potentially sensitive receptors within 5 km of the proposed Project Area were identified through a desktop study. Their locations are shown in **Figure 5**, with further details provided in **Table 4**. The temporary construction camp is shaded as it is a Project-owned receptor.

Table 4 Locations of Nearest Sensitive Receptors

Receptor ID	Easting (km)	Northing (km)	Distance and Direction from Proposed Construction Areas
Hayfield	304,380	8,149,570	3 km northeast of pipeline corridor
Dunmarra	330,730	8,155,200	3 km north of intersection with Sturt Highway
Tamboran's Camp	356,420	8,137,680	3.3 km south-southeast of eastern end of pipeline corridor
Temporary Construction Camp*	332,390	8,140,000	9 km southwest of pipeline corridor
* Project-owned receptor			

As shown in **Figure 5** and **Table 4**, the nearest identified sensitive receptors (existing residences) are located more than 2.5 km from the Project Area.

No national parks, conservation areas or other potentially sensitive ecological receptors have been identified in the vicinity (i.e. within 50 m of the work areas or transport route) of the proposed construction activities.



APA STURT PLATEAU PIPELINE ENVIRONMENTAL APPROVALS

SENSITIVE RECEPTORS WITHIN 5KM OF PIPELINE

FIGURE 5

LEGEND

- Project Area
- Temporary Construction Camp
- Shenandoah Facility
- Sturt Plateau Facility
- Existing Gas Pipeline
- Homestead
- Roadhouse
- 5km Project Buffer
- Tamboran Resources Camp
- 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:	1:220,000 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_F05_Sensitive_Receptors_06

3.4.4 Existing Air Quality

A desktop review of the local area showed that there are no significant potential anthropogenic dust emission sources in the local area, and the region is very sparsely populated. A review of the National Pollutant Inventory (NPI) database to identify reporting facilities in the region showed that the closest facilities reporting for the 2022/23 reporting year located over 300 km away. Vehicle emissions from the Stuart Highway are not expected to have any measurable impact on local air quality. The main sources of air pollutants affecting background air quality in the project area are therefore identified as natural windblown dust, dust storms and bushfires.

The nearest ambient Air Quality Monitoring Station (AQMS) is located in Katherine, approximately 275 km northwest of the Project Area. This AQMS was commissioned in September 2020 by the Katherine Town Council under a performance agreement with the NT EPA and monitors ambient levels of PM_{10} and $PM_{2.5}$.

In addition, ambient air quality monitoring was performed from September 2022 to November 2023 at five locations across the Beetaloo Sub-basin as part of the Strategic Regional Environmental and Baseline Assessment (SREBA) for the Beetaloo Sub-basin commissioned by the Department of Environment, Parks and Water Security (DEPWS) (GHD, 2024). This included a monitoring site located at BoM's Daly Waters Airstrip AWS, approximately 50 km north-northwest of the Project Area. Two compliance standard beta-attenuation monitors (EBAMs) were located at this site to measure ambient PM_{10}, $PM_{2.5}$ concentrations, along with a dust deposition gauge to record monthly dust deposition rates.

Ambient PM_{10} and $PM_{2.5}$ concentrations recorded by the Katherine AQMS are summarised in **Table 5**. While the Katherine AQMS is located a significant distance from Project Area, the more urbanised environment surrounding Katherine AQMS means that the particulate levels reported by that AQMS are likely to provide a conservative overestimate of background levels at the Project Area.

The results of the 1-year baseline air quality monitoring program at Daly Waters are summarised in **Table 6**.

As shown in **Table 5**, the annual average PM_{10} concentrations recorded in Katherine complied with the Ambient Air NEPM standard in all years for which data is available. The annual average PM_{10} concentration measured in Daly Waters during 2022-2023 (**Table 6**) was also in compliance with Ambient Air NEPM standard, and was notably lower than the levels recorded in Katherine. The annual average $PM_{2.5}$ concentrations recorded in Katherine, however, exceeded the Ambient Air NEPM standard in all three years, although the annual average $PM_{2.5}$ concentration recorded during 2022-2023 in Daly Waters was again notably lower and well below the Ambient Air NEPM standard.

The maximum recorded 24-hour average PM_{10} and $PM_{2.5}$ concentrations recorded in Katherine also exceeded the relevant Ambient Air NEPM standard in all three years. The number of exceedance days ranged from 6 - 10 per annum for PM_{10} and 15 - 19 per annum for $PM_{2.5}$. The 24-hour average PM_{10} and $PM_{2.5}$ concentrations recorded in Daly Waters during 2022-2023 were notably lower, with only three exceedances of the 24-hour average standard for $PM_{2.5}$ and no exceedances of the PM_{10} standard recorded.

At both monitoring locations, peak particulate levels were generally recorded in the dry season (as shown in **Figure 6** for the Katerine site), as would be expected given the lower soil moisture contents and increased bushfire risk during these months.

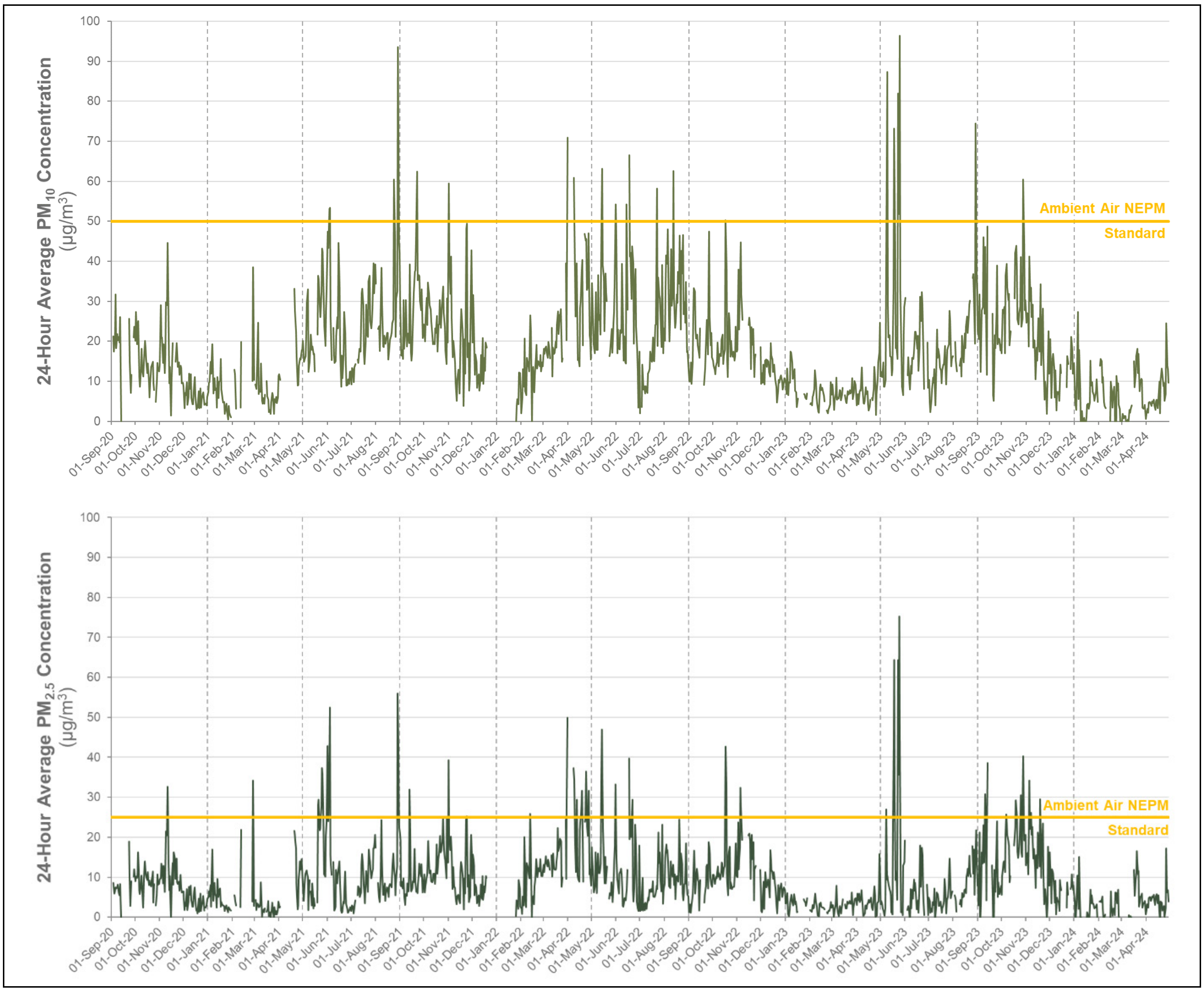
Table 5 Measured Ambient PM_{10} and $PM_{2.5}$ Concentrations - Katherine

Averaging Period / Parameter		Units	Monitoring Year ^			Ambient Air NEPM Standard and Goal
			2021	2022	2023	
PM_{10}						
Annual Average		µg/m³	20.2	22.2	17.1	**25**
24-Hour Average	Maximum	µg/m³	93.6	70.9	96.3	**50**
		date	29 Aug	31 May	25 May	
	No. Exceedances	days	6	10	7	**None allowed**
	70th Percentile	µg/m³	24.2	25.3	20.5	
$PM_{2.5}$						
Annual Average		µg/m³	9.7	11.8	8.5	**8**
24-Hour Average	Maximum	µg/m³	56.0	49.9	75.2	**25**
		date	29 Aug	31 May	25 May	
	No. Exceedances	days	15	19	16	**None allowed**
	70th Percentile	µg/m³	11.0	13.1	9.3	
^ Data for 2020 not summarised as only 4 months of data available						

Table 6 Measured Ambient Particulate Levels – Daly Waters

Averaging Period / Parameter		Units	30 Sep 2022 – 20 Nov 2023	Ambient Air NEPM Standard and Goal
PM_{10}				
Annual Average		µg/m³	8.7	**25**
24-Hour Average	Maximum	µg/m³	41.4	**50**
	No. Exceedances	days	0	**None allowed**
$PM_{2.5}$				
Annual Average		µg/m³	4.8	**8**
24-Hour Average	Maximum	µg/m³	44.0	**25**
	No. Exceedances	days	3	**None allowed**
Dust Deposition rate				
Annual Average		g/m²/month	0.5	**-**
Maximum Monthly Average		g/m²/month	2.9	**4 ***
Nuisance criteria for dust depeosition not included in the Ambient Air NEPM. Guideline adopted from the NSW Approved Methods (NSW EPA, 2022)				

Figure 6 Ambient PM_{10} and $PM_{2.5}$ Concentrations in Katherine (2020 – 2024)



As noted above, and confirmed by the 2022-2023 monitoring data from Daly Waters measured as part of the Beetaloo Sub-basin SREBA, the particulate levels recorded in Katherine are expected to overestimate levels that may be expected in the Project Area due to the influence of anthropogenic sources. However both datasets indicate that during the dry season, natural sources of dust and events such as dust storms and bushfires, will give rise to elevated background levels of particulate matter.

Dust deposition rates measured in Daly Waters during 2022-2023 were low and well below the NSW guideline of 4 g/m^2/month.

3.5 Construction Phase Air Quality Impacts

3.5.1 Fugitive Dust

This section of the report includes the assessment of fugitive dust emissions associated with the construction of the SPP as well as ancillary infrastructure (i.e. camps, laydowns).

For this assessment, the *IAQM Guidance on the Assessment of Dust from Demolition and Construction* developed in the United Kingdom by the Institute of Air Quality Management (IAQM, 2024) was used to provide a qualitative assessment method (refer to **Appendix A** for full methodology). The IAQM method uses a four-step process for assessing dust impacts from construction activities:

- **Step 1**: Screening based on distance to the nearest sensitive receptor; whereby the sensitivity to dust deposition and human health impacts of the identified sensitive receptors is determined.
- **Step 2**: Assess risk of dust effects from activities based on the scale and nature of the works, which determines the potential dust emission magnitude, and the sensitivity of the area surrounding dust-generating activities.
- **Step 3**: Determine site-specific mitigation for remaining activities with greater than negligible effects.
- **Step 4**: Assess significance of remaining activities after management measures have been considered.

Step 1 – Screening Based on Separation Distance

The IAQM screening criteria for further assessment is the presence of a 'human receptor' within:

- 350 m of the boundary of the site; or
- 50 m of the route(s) used by construction vehicles on the public highway, up to 350 m from the site entrance(s).

The IAQM screening criteria for further assessment is the presence of an 'ecological receptor' within:

- 50 m of the boundary of the site; or
- 50 m of the route(s) used by construction vehicles on the public highway, up to 350 m from the site entrance(s)

As presented in **Section 3.4.3,** the nearest non-Project related sensitive receptors to the SPP are located approximately 3 km away from the nearest construction location, regardless of the construction direction option selected. The construction camp, which is considered as being less sensitive to potential dust impacts than a non-Project residential receptor, will also be located more than 3 km from the active construction areas. Thus, based on IAQM screening criteria presented above, no further assessment for human-related impacts is required for the transmission line construction works, and standard dust mitigation measures will be appropriate to manage dust emissions.

3.5.2 Other Air Pollutants

As noted in **Table 4**, the nearest human receptors to the SPP construction works are existing residences located 3 km to the north. Given this, while the exact details and siting of any construction diesel generators required during the works are unknown at this stage, the risk of any off-site adverse air quality impacts associated with emissions of products of combustion from these units is concluded to be negligible

3.6 Operational Phase Air Quality Impacts

As noted in **Section 3.2.2**, once constructed, operation of the SPP will not result any significant air pollutant emissions and therefore air quality impacts from the operation of the SPP are expected to be negligible.

3.7 Monitoring and Management of Air Emissions

To confirm that the controls are adequately controlling dust emissions from the construction works to protect construction staff from unnecessary exposure to elevated dust levels, it is recommended that visual inspections of dust levels be performed on a daily basis, particularly during the peak earthworks phases. If dust is seen travelling off-site, water should be applied to suppress dust and/or activities modified until conditions improve.

Given the remote nature of the surrounding area, ambient air quality monitoring using dust gauges or real-time PM_{10} monitoring equipment is not considered to be required during the construction phase, expect for in the unlikely event of complaints regarding dust nuisance being received. In the event of a dust complaint being received, a targeted dust monitoring campaign will be implemented to verify the issues raised and to assist in managing the effectiveness of dust controls being applied.

No air quality monitoring is required for the operational phase.

4.0 Greenhouse Gas Assessment

4.1 Background

The term 'greenhouse gas' comes from the 'greenhouse effect', which refers to the natural process that warms the Earth's surface. GHGs in the atmosphere absorb the solar radiation released by the Earth's surface and then radiate some heat back towards the ground, increasing the surface temperature.

Human activity, especially burning fossil fuels and deforestation, is increasing the concentration of GHGs in the atmosphere and hence increasing the absorption of outgoing heat energy. Even a small increase in long-term average surface temperatures has numerous direct and indirect consequences for climate.

4.1.1 Scope 1, 2 and 3 Emissions

The internationally accepted method of reporting GHG emissions is to separate the emission sources into three categories, referred to as 'scopes' The three scopes of GHG emissions as per the NGER (Measurement) Determination 2008 (DCCEEW, 2023a), are described below and summarised in **Figure 7**.

Scope 1 emissions

- Direct emissions where the point of emission release is owned/controlled by the organisation or project owner, such as:
    - emissions resulting from fuel combustion, e.g. from petrol fuelled vehicles, gas-fired boilers or diesel generators
    - fugitive emissions during the extraction, production, processing and distribution of fossil fuels (e.g. methane emissions from coal mines, leakage from coal seam gas or natural gas extraction and processing)
    - industrial process emissions, e.g. the use of fuels as feedstocks, leakage of insulating or refrigerant GHGs from switchgear and cooling systems
    - waste emissions, which result from the decomposition of organic material in an on-site landfill or on-site wastewater treatment plant.

Scope 2 emissions

- Indirect GHG emissions that occur inside the project footprint or within the control of the reporting organisation.
    - The main scope 2 emission relates to electricity usage, where the emissions arise principally at an electricity generator, or through the loss of electricity from the electricity transmission network or distribution network.

Scope 3 emissions

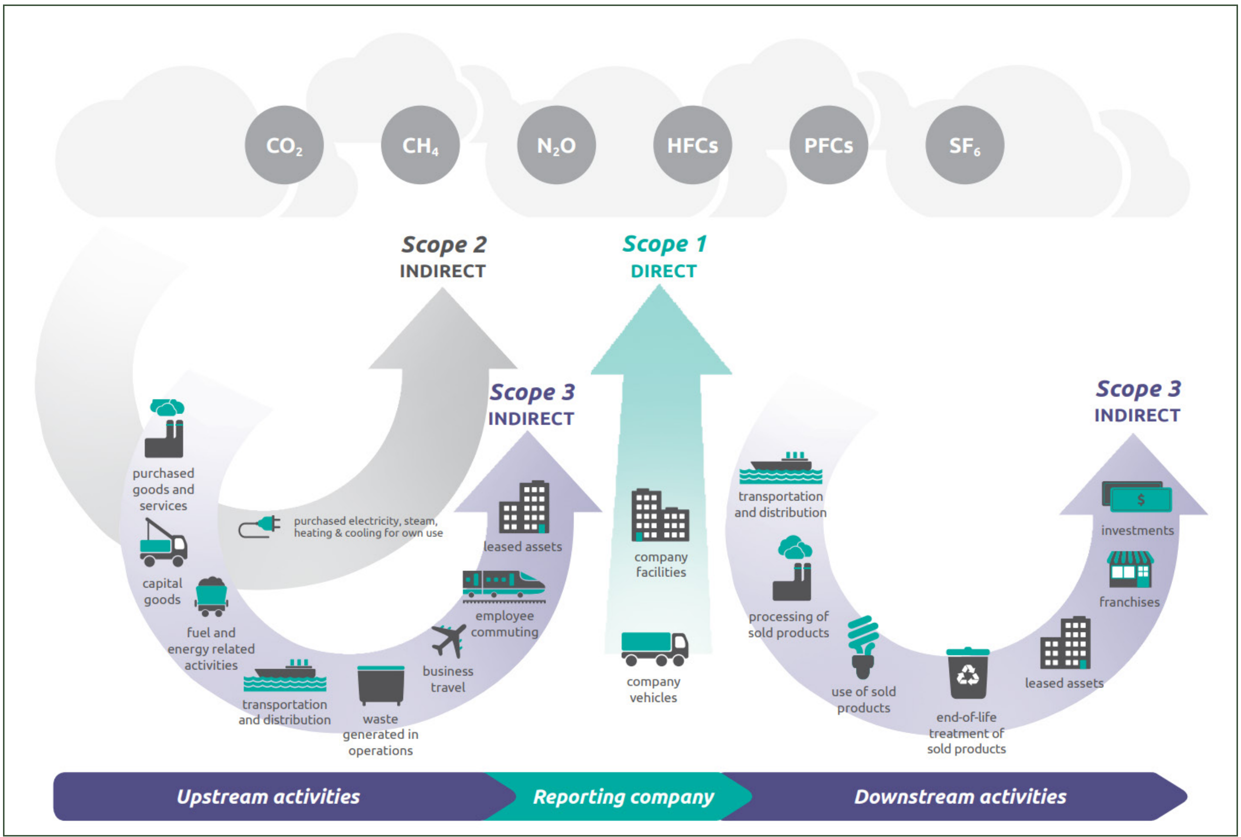
- Other indirect GHG emissions that occur outside the project footprint or control of the reporting organisation. For example:
    - emissions associated with the extraction, production, processing and distribution of fuels used by the project/organisation
    - embodied CO_2-e emissions associated with material of construction and raw materials used by the project/organisation

- emissions associated with the transport, distribution and end use of sold products.

The purpose of differentiating between the scopes of emissions is to avoid the potential for 'double counting', which is where two or more organisations assume responsibility for the same emissions.

Reporting under the NGER Act requires that organisations report scope 1 and scope 2 emissions, but not scope 3 emissions. Scope 3 emissions may be reported voluntarily.

Figure 7 Overview of GHG Protocol Scopes and Emissions



SOURCE: (WRI, 2011)

4.1.2 Global Warming Potentials

GHG emissions are generally reported in terms of carbon dioxide equivalent (CO_2-e). This is to provide a standardised unit for reporting due to different gases having varying effects of global warming impacts or global warming potential (GWP). The GWP refers to the GHG potential to trap heat in the atmosphere for a certain period (generally 100 years), relative to carbon dioxide (with a GWP of one).

At the time of writing, the most recent available *National Greenhouse Accounts Factors* published by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) equates methane (as an example) with a GWP of 28, which means for every tonne of methane emitted, it has the same global warming effect of 28 tonnes of carbon dioxide (DCCEEW, 2024a). As such, gases such as methane or nitrous oxide are relatively potent GHGs.

Table 7 presents the GWPs of the key GHGs that are associated with the Project.

Table 7 GHG Global Warming Potentials

Gas	Chemical Formula	Global Warming Potential (GWP)
Carbon dioxide [a]	CO_2	1
Methane [a]	CH_4	28
Nitrous oxide [a]	N_2O	265
Source: (DCCEEW, 2024a)		

4.2 Policy and Legislation

4.2.1 International Policy and Legislation

The emission of GHGs is governed internationally through several mechanisms including the Intergovernmental Panel on Climate Change (IPCC), United Nations Framework Convention on Climate Change (UNFCCC), the Equator Principles, the Kyoto Protocol, the Paris Agreement and the Glasgow Climate Pact. The function of each of these is as follows:

- The IPCC was established in 1988 and operates to provide decision makers and others interested in climate change with an objective source of information. The IPCC prepares assessment reports based on available scientific evidence and produce guidance documents and recommended methodologies for GHG emission inventories.
- The UNFCCC was established in 1994 following the release of the first technical report written by the IPCC. It comprises 172 countries (parties) that have ratified the Kyoto Protocol. The UNFCCC sets the overall framework for efforts to manage climate change on an international scale.
- The Equator Principles is a risk management framework adopted by financial institutions for determining, assessing and managing environmental and social risk in project finance. It is primarily intended to provide a minimum standard for due diligence to support responsible risk decision-making. The Equator Principles, formally launched in Washington DC in June 2003, were based on existing environmental and social policy frameworks established by the International Finance Corporation (IFC). Since then, the standards have been periodically updated into what is commonly known as the IFC Performance Standards on social and environmental sustainability and the World Bank Group Environmental, Health, and Safety Guidelines. The reviewed fourth iteration of the Equator Principles were published in July 2020 (Equator Principles Association, 2020).
- The Kyoto Protocol was in force as of 16 February 2005 and commits member states to individual, legally binding targets to limit or reduce GHG emissions. Australia, amongst others, forms part of the Annex I Parties and was required to meet national targets for GHG emissions between 2008 and 2012. To achieve their targets, Annex I Parties had to implement domestic policies and measures. A second commitment period was agreed in 2012 for 2013 to 2020, where Australia, as well as 36 other countries, were bound to further reduce GHG emissions by at least 18 % below 1990 levels by 2020.

- The Paris Agreement was established in 2015 and sets in place a durable and dynamic framework for all countries to take action on climate change from 2020. The key objectives of the Paris Agreement included a goal to limit the increase in global temperatures to well below 2 degrees and pursue efforts to limit the rise to 1.5 degrees, as well as a commitment to achieve net-zero emissions, globally, by the second half of the century.
- Glasgow hosted the 26th UN Climate Change Conference of the Parties (referred to as COP26) in October-November 2021. Nations adopted the Glasgow Climate Pact, aiming to turn the 2020s into a decade of climate action and support. The Glasgow Pact refers to a package of decisions agreed to at COP26 covering a range of items, including strengthened efforts to build resilience to climate change, to curb greenhouse gas emissions and to provide the necessary finance for both. Nations collectively agreed to work to reduce the gap between existing emission reduction plans and what is required to reduce emissions, so that the rise in the global average temperature can be limited to 1.5 degrees.

4.2.2 Commonwealth Policy and Legislation

Australia ratified the Paris Agreement in November 2016 and committed to reducing its GHG emissions by 26 – 28% below 2005 levels by the year 2030. On 16 June 2022, the Australian Government lodged an updated Nationally Determined Contribution (NDC) with the UNFCCC as part of Australia's obligations under the Paris Agreement, which commits Australia to a more ambitious target of reducing GHG emissions by 43% below 2005 levels by 2030. It also reaffirmed Australia's commitment to net zero emissions by 2050.

The Australian Federal Government has a range of programs, policies, and tools in place to act on climate change. The key aspects of the federal action on climate change are summarised below.

National Greenhouse and Energy Reporting Act 2007

The NGER Act introduces a single national framework for reporting and disseminating company information about GHG emissions, energy production, and energy consumption. Under the NGER Act, companies that meet threshold levels for GHG emissions, energy consumption or energy production are required to report their GHG emissions annually. The six GHGs that are reported under the NGER Act include the following compounds and groups of compounds:

- carbon dioxide (CO_2)
- methane (CH_4)
- nitrous oxide (N_2O)
- specified hydrofluorocarbons (HFCs)
- specified perfluorocarbons (PFCs)
- sulfur hexafluoride (SF_6).

The current GHG reporting thresholds for individual facilities are as follows:

- emission of more than 25,000 tonnes of carbon dioxide equivalent (t CO_2-e)
- production of 100 terajoules (TJ) or more of energy, or
- consumption of more than 100 TJ of energy per year.

Emissions Reduction Fund

To meet its targets set under the Kyoto Protocol and Paris Agreement, DCCEEW commissioned The Emissions Reduction Fund (ERF). The ERF was developed to provide incentives for Australian businesses, farmers, land holders and citizens to reduce their GHG emissions by adoption of more efficient practices and technologies.

Key elements of the ERF were as follows:

- Crediting emissions reductions that go beyond business-as-usual standards
- Selling emission reductions in the form of Australian Carbon Credit Units (ACCU)
- A Safeguard Mechanism that provides a framework for Australia's largest emitters to measure, report and manage emissions.

As part of the Safeguard Mechanism reforms, ERF projects that solely reduce covered emissions (i.e. those reportable under the Safeguard Mechanism) at Safeguard facilities are no longer able to be registered. Projects that are already registered will continue to generate and sell credits for their existing crediting period, however, are not able to enter into new contracts for Government purchase of ACCUs or extend their crediting period.

Safeguard Mechanism

The Safeguard Mechanism commenced in 2016. It was reformed in 2023 to ensure that covered facilities contribute to meeting Australia's reduction targets, while strengthening their competitiveness as the world moves to net zero. The reforms apply a decline rate to facilities' baselines so that they are reduced predictably and gradually over time on a trajectory consistent with achieving Australia's emission reduction targets of 43% below 2005 levels by 2030 and net zero by 2050 (see below).

The Safeguard Mechanism applies to industrial facilities emitting scope 1 covered emissions (including direct emissions from fugitive emissions and emissions from fuel combustion, waste disposal and industrial process such as cement and steel making) of more than 100,000 t CO_2-e per year, including:

- mining
- oil and gas production
- manufacturing
- transport
- waste facilities.

4.2.3 NT Policy and Legislation

The *Northern Territory Climate Change Response: Towards 2050* (Climate Change Response) identifies the Territory's target to achieve net zero emissions by 2050. The Climate Change Response identifies four key objectives to inform future actions and guide development of mitigation and adaptation strategies:

- achieve net zero emissions
- build a resilient Territory
- unlock opportunities from a low carbon future
- inform and involve all Territorians

In 2020, *Delivering the Climate Change Response: Towards 2050* (OCCDENR, 2020) was developed, which outlined a three-year action plan to guide the NT Government's actions over the following three years to establish the foundations required to deliver an enduring and effective climate change response. The action plan identified priority actions and key deliverables for each of the four objectives listed above. One of the deliverables identified to enable progress against the net zero target was development of a policy outlining the NT Government's expectations for the mitigation and management of emissions from new and expanding large GHG emitters by the end of 2020.

Subsequently, the NT's *Greenhouse Gas Emissions Management for New and Expanding Large Emitters' Policy* (the Policy) was released in 2021 (DEPWS, 2021). The Policy identifies the NT Government's minimum requirements for the management of GHG emissions from new or expanding industrial and land use development projects. Large GHG emitters under this policy are defined as

"either an industrial project (e.g. petroleum, mining, extractive, refining or manufacturing projects) OR a land use project that involve the clearing of native vegetation (e.g. agriculture or horticulture projects) that meet the following emissions thresholds:

Industrial project threshold*:*	*Estimated Scope 1 emissions of 100,000 tCO_2-e in any financial year over the life cycle of a project, not counting emissions generated from land clearing directly associated with the project.*
Land use project threshold*:*	*Estimated Scope 1 emissions of 500,000 tCO_2-e generated from a single land clearing action OR cumulatively from multiple land clearing actions on a 'property' over time."*

A proponent is to determine if their project meets one of the project thresholds by estimating the Scope 1 emissions from their new or expanding project.

For onshore petroleum activities, the industrial project threshold applies cumulatively to Scope 1 emissions from all activities of an interest holder[1] occurring in a financial year and requiring approval under the Petroleum (Environment) Regulations 2016.

Proponents of all new projects and expansions of existing projects subject to the Policy must develop and implement a GHG Abatement Plan (GGAP) tailored specifically for their project.

4.2.4 Greenhouse Gas Emissions Estimation Guidelines

A GHG emission inventory was compiled for the Project based on emission factors and reporting guidelines available in the documents and references described in the following sections.

The Greenhouse Gas Protocol

The GHG Protocol Initiative is a multi-stakeholder partnership of businesses, non-governmental organisations (NGOs), governments and others convened by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). The objective of the GHG Protocol Initiative is to develop internationally accepted GHG accounting and reporting standards for business.

[1] For the purposes of the Policy, a 'petroleum interest holder' is a person or body corporate that holds an exploration permit, retention licence, production licence, access authority or a lease granted under Northern Territory petroleum legislation.

The GHG Protocol comprises two separate but linked standards:

- *GHG Protocol Corporate Accounting and Reporting Standard* (WRI/WBCSD, 2004a) - This document provides a step-by-step guide for companies to use in quantifying and reporting their GHG emissions.
- *GHG Protocol for Project Accounting* (WRI/WBCSD, 2004b) - A guide for quantifying reductions from GHG mitigation projects.

The first edition of the GHG Protocol *Corporate Accounting and Reporting Standard* was published in September 2001. It covers accounting and reporting of the six greenhouse gases covered by the Kyoto Protocol and has been widely adopted by industry, NGOs and government organisations as a basis for GHG accounting and reporting systems.

The latest edition of the *GHG Protocol Corporate Accounting and Reporting Standard* (WRI/WBCSD, 2004a), has been referred to in preparing this assessment.

National Greenhouse Accounts Factors

The National Greenhouse Accounts (NGA) Factors are published annually by DCCEEW and provide methods to help companies and individuals estimate GHG emissions. The NGA Factors draw on the *National Greenhouse and Energy Reporting (Measurement) Determination* 2008. However, they are not published for the purposes of reporting under the NGER Act; instead, they have a more general application to the estimation of a broader range of GHG emissions inventories.

The default emission factors listed in the NGA Factors are estimated by DCCEEW using the Australian Greenhouse Emissions Information System and are determined simultaneously with the production of Australia's National Greenhouse Accounts. This promotes consistency between inventories at company or facility level and the emission estimates presented in the National Greenhouse Accounts.

The 2024 NGA Factors (DCCEEW, 2024a) have been referred to in this assessment.

4.3 GHG Inventory Methodology

4.3.1 Overview of Approach

This assessment was performed as a desktop study. The calculation of GHG emissions from the construction and operation of the Project has been performed in a five-stage process:

1. definition of the project boundary (i.e. the Project footprint)
2. identification of GHG emission sources within the Project footprint during construction and operation
3. identification of emission calculation methods and emission factors for each source
4. identification of the activity data for each emission source required for the calculations
5. calculation of estimated GHG emissions.

The GHG emissions estimated for the Project were compared against the most recent publicly available national and NT GHG emissions to assess their potential contribution to the national and NT emissions inventories and thus their potential impact on Australia's and the NT's ability to meet GHG reduction targets and policies.

Recommendations were then provided for the mitigation and monitoring of key GHG emission sources associated with the Project.

A number of assumptions have been relied upon in compiling the GHG emission inventory for the Project. GHG emissions from the key sources identified for the construction and operation of the Project have been estimated based on the most current available emission factors published for use in reporting GHG emissions, which rely on estimates of the level of intensity of each activity (referred to as activity data). This includes parameters such as projected fuel consumption rates and electricity consumption once the Project is operational. The activity data used in the calculations has been compiled based on the current available Project design information and in consultation with the design team. The basis of the emission estimates and activity data are detailed in the relevant subsections in **Section 4.3.5**.

4.3.2 Boundary Definition

This section defines the boundaries adopted for the GHG emission inventory compiled for the Project as part of this GHG assessment.

The assessment has considered Scope 1, Scope 2 and Scope 3 emissions associated with the construction and operation of the Project.

The geographical boundary set for the emissions considered in the GHG assessment covers the Project footprint, comprising the proposed transmission pipeline corridor, associated surface facilities, construction compounds, construction camp, and borrow pits. Scope 1 and scope 2 GHG emissions associated with the construction and operation of the Project are considered to be within the geographical boundary of this assessment. GHG emissions associated with activities at the Proponent's offices outside the Project footprint during the design, construction and operation of the project were deemed to be outside the geographical boundary of the assessment.

As discussed in **Section 1.1**, GHG emissions associated with the extraction, transport and end use of the gas will be accounted for as part of the gas exploration and production environmental assessments, and has not been addressed in this assessment. It is noted that the initial purpose of the Project is to avoid appraisal gas being 'lost' via venting and flaring, and instead for it to be used to support the current gas supply in the NT.

GHG emissions will also occur during decommissioning of Project infrastructure at the end of its design life (40 years). Future options for the Project infrastructure will vary between life extension, upgrading or decommissioning. Due to the uncertainty regarding the fate of the plant at that time, the GHG emissions associated with the end-of-life phase of the Project and associated infrastructure have not been estimated as part of this study. These emissions will need to be evaluated in detail in the future, once the potential options are understood, and will be factored into the decisions regarding the ongoing operation or decommissioning of the facilities.

4.3.3 Identification of GHG Emission Sources

Construction related GHG emission sources were identified through a review of the Project description. No significant operational phase emissions were identified.

The potential emissions associated with the construction of the Project that were considered in preparing this GHG assessment are listed below. In relation to scope 3 emissions, preliminary estimates have been made based on currently available information. Once detailed design has been completed and suppliers of goods and services are identified, a more comprehensive assessment can be performed to identify the overall value chain impacts.

- Scope 1:
  - land clearing during construction
  - fossil fuel combustion in mobile and fixed plant during construction
  - consumption of oils and greases during construction
- Scope 3:
  - emissions associated with the production and supply of fuels consumed during construction
  - transport of construction materials, temporary infrastructure and consumables to the Project footprint during construction
  - emissions associated with embodied energy in construction materials

Table 8 GHG Emission Sources Included in the Inventory for the Project

Project Activity	Scope 1	Scope 3
Construction		
Vegetation removal	• Loss of carbon stock in areas that will be cleared for construction of the SPP	-
Fuel combustion in land clearing, earthworks and construction equipment	• Emissions from diesel combustion in mobile and fixed equipment, including dozers, excavators, haul trucks etc.	• Emissions associated with production and supply of diesel consumed
Fuel combustion for transport purposes	• Emissions from diesel combustion in light vehicles, trucks, etc transporting staff and equipment within the study area	• Emissions associated with extraction and production of diesel consumed • Emissions associated with 3rd party transport of construction materials, temporary infrastructure and consumables to the Project footprint
Fuel combustion for energy purposes	• Emissions from diesel combustion in on-site power generation plant	• Emissions associated with extraction and production of diesel consumed
Use of oils and greases	• Consumption of oils and greases	• Emissions associated with extraction and production of oils and greases consumed
Materials used for construction	-	• Emissions associated with production and supply of materials of construction
Operations[a]		
Upstream gas extraction and downstream end use	-	*Emissions associated with the extraction, other transport and end use of the gas are outside the boundary of this assessment*
No significant Scope 1 or 2 sources identified for operations		

GHG emissions associated with the following activities/sources were deemed to not be relevant/material to the assessment and were excluded from the emission inventory:

- Fuel consumption in vehicles and other mobile and fixed plant (light vehicles, trucks, pumps, forklifts etc.) during operations will be very minor and the associated scope 1 and scope 3 emissions have been excluded from the emission inventory.
- There will be no significant venting or flaring of gas during the Project operations. There will be minor intermittent losses of gas during pigging operations and emissions via the pipeline vent will only occur in emergency situations or rare maintenance events. These emissions have not been quantified as part of this assessment but will be reportable as part of the regulatory GHG reporting framework.
- No electricity will be sourced from the grid during construction, nor will there be any significant electricity demand as a result of the Project once it is operational. Scope 2 emissions have therefore not been considered further.
- During construction the domestic effluent from the construction camp will be treated in a package wastewater treatment plant that will be installed on site. Given the short duration of the construction phase (approximately 6 months) and relatively small size of the camp (150 persons), any GHG emissions associated with wastewater treatment will not be material to the estimated scope 1 emissions from the construction of the Project and have not been considered further.
- Scope 3 GHG emissions from the treatment and disposal of solid and liquid waste during operation was also assumed negligible and excluded from the inventory.

The construction-related emission sources that were included in the emission calculations are summarised in **Table 8**.

4.3.4 Calculation Methods and Emission Factors Used

4.3.4.1 Scope 1 Emissions

Vegetation Clearing

Whilst the clearing of vegetation (excluding diesel used in the equipment used during clearing) is not a true GHG emission, the net impact of removing the vegetation (which is a carbon sink) is that the removal of CO_2 from the atmosphere by those plants will no longer occur, and the resulting effect is that an equivalent amount of CO_2 will remain in the atmosphere as a result. Hence, clearing of vegetation is categorised as a scope 1 emission.

Disposal of the vegetation will also result in GHG emissions, in addition to those related to the loss of a carbon sink. Where vegetation is reused or left to decompose naturally on site, the rate at which GHGs are emitted is very slow and can be considered negligible. However, if vegetation is disposed of to landfill or combusted (not proposed in this Project), the rate is much higher.

GHG emissions associated with land clearing by a facility are not reportable under the NGER Scheme and no emission calculation methodologies or emission factors are given for GHG emission estimation for land clearing in the *Measurement Determination 2008* or the NGA Factors Workbook. The IPCC's *Guidelines for National Greenhouse Gas Inventories* [(IPCC, 2006) (IPCC, 2019)] provide methodologies for the estimation of carbon loss associated with land use change and the associated loss of CO_2 sequestration due to vegetation removal. However, the methodology involves a number of very high-level assumptions and relatively limited default values for broad vegetation classes across the globe. The resulting estimates therefore have a very high level of uncertainty when applied to specific, localised construction projects in Australia.

To provide an indicative estimate of GHG emissions associated with the carbon sink loss due to land clearing proposed as part of the Project, the Carbon Emissions Estimate Calculator (DEPWS, 2023) has been used in this assessment. This mapping application provides a simplified method to estimate the carbon sink losses associated with land clearing in the NT. The proposed areas to be cleared are imported as geo-referenced shapefiles or drawn onto an online map by the user, and the website provides the GHG estimates in CO_2-e, based on a database into account the carbon that exists in the vegetation at the time of clearing.

Diesel Combustion

Estimates of annual GHG emissions from the combustion of diesel during construction were calculated by multiplying the estimated quantities of diesel to be combusted by a fuel-specific energy content factor and fuel-specific CO_2-e scope 1 emission factors. The emission factors used in the calculations are summarised in **Table 9**.

The emission factors used for the combustion of diesel fuel in the heavy construction equipment are those given for stationary energy use, as the NGA Factors Workbook (DCCEEW, 2024a) states "*No transport factors are provided for vehicles not registered for road use. Stationary energy factors for individual fuel types should be used in these cases*".

Oils and Greases

Estimates of annual GHG emissions from the use of petroleum-based oils and greases during construction were made by multiplying the quantities estimated to be used each year by the relevant energy content factor and CO_2-e scope 1 emission factor. The emission factors used in the calculations are summarised in **Table 9**.

Table 9 Relevant Scope 1 Emission Factors

Emission Source	Energy Content Factor (GJ/kL)	Scope 1 Emission Factors				
		CO2	CH4	N2O	Total	Units
Fuel Use – Stationary (power generation and off-road equipment) [1]						
Diesel	38.6	69.9	0.1	0.2	70.2	kg CO_2-e/GJ
Fuel Use - Transport [2]						
Diesel – Heavy duty vehicles	38.6	69.9	0.1	0.4	70.4	kg CO_2-e/GJ
Oils and Greases [1]						
Petroleum based oils	38.8	13.9	0	0	13.9	kg CO_2-e/GJ
Petroleum based greases	38.8	3.5	0	0	3.5	kg CO_2-e/GJ
1 NGA Factors Workbook 2024, Table 8 (DCCEEW, 2024a) 2 NGA Factors Workbook 2024, Table 9 (DCCEEW, 2024a), Euro III factors						

4.3.4.2 Scope 3 Emissions

Production and Supply of Diesel, Oils and Greases

The scope 3 emission factors used to estimate the CO_2-e emissions associated with the production and supply of diesel, oils and greases used by the Project are shown in **Table 10**.

Construction Materials - Embodied Energy

Construction of the Project will involve the use of steel and concrete, the production and transport of which will result in the emission of GHGs. To account for these Scope 3 emissions, the emission factors listed in the *Inventory of Carbon and Energy* (ICE) database (Hammond & Jones, 2019) shown in **Table 10** were adopted. The ICE database is an embodied carbon database for building materials, and contains data for over 200 materials, broken down into over 30 main material categories, including bricks, cement and concrete, glass, timber, plastics, metals, minerals and stone. The ICE database was created from a large review of the literature. The first version was released in 2005, and it has been updated at periodic intervals with the latest update occurring in November 2019.

Table 10 Scope 3 Emission Factors Used

Fuels, Oils and Greases [1]			
Fuel / Substance	**Energy Content Factor (GJ/kL)**	**Scope 3 Emission Factor**	**Units**
Diesel	38.6	17.3	kg CO_2-e/GJ
Petroleum based oils	38.8	18.0	kg CO_2-e/GJ
Petroleum based greases	38.8	18.0	kg CO_2-e/GJ
Embodied Energy of Construction Materials [2]			
Material	**ICE Database Description**	**Embodied Carbon Emission Factor**	**Unit**
Steel	Steel, UO pipe, world average	3.02	kg CO_2-e/kg
Concrete	35/45 MPa	0.149	kg CO_2-e/kg
1 NGA Factors Workbook 2024, Table 7 (DCCEEW, 2024a) 2 ICE Database V3.0 (Hammond & Jones, 2019)			

In addition to the embodied energy, the scope 3 CO_2-e emissions associated with the transport of these materials by road have also been accounted for using the scope 1 diesel combustion emission factors shown **Table 9** and estimated fuel consumption rates for the delivery of these materials to site.

4.3.5 Activity Data

The methodologies and assumptions used to compile the required activity data for use in the GHG emission calculations are outlined below.

Land Clearing/Flooding

The vegetation clearance areas associated with the Project (30 m wide pipeline corridor and construction camp) were uploaded into the Carbon Emissions Estimate Calculator developed by DEPWS, with a total combined area of 146 hectares (ha) for either construction direction option.

Diesel Consumption

The construction phase fuel use estimates were compiled based on information provided by the Project design team and are summarised in **Table 11**. Estimated diesel consumption rates were provided for construction related activities and for the diesel generator(s) providing power to the camp. As a breakdown between diesel used for transport purposes (i.e. road-registered vehicles) and off-road/heavy construction equipment is not available, the stationary combustion emission factor was used for all fuel use.

Oils and Grease Consumption

In the absence of consumption rates of oils and greases being available for the Project at this stage of the design development phase, indicative consumption rates have been estimated by SLR based on a review of GHG inventories compiled for large construction and mining projects assessed by SLR or published in the public domain, from which the following average scaling factors were derived:

- Petroleum based oils: 1.75% of the diesel consumption volume
- Petroleum based greases: 0.20% of the diesel consumption volume.

The resulting estimated consumption rates are shown in **Table 12**.

Table 11 Estimated Fuel Consumption During Construction

Activity/Purpose	Estimated Total Consumption (kL)
Scope 1 Consumption	
Construction equipment and transport within Project boundary	500
Electricity generation at camp[1]	121
Total Consumption	***620***
Scope 3 Consumption	
Transport of camp infrastructure to/from site [2]	108
Transport of food/fuel to camp [3]	11
Transport of construction materials to site [4]	22

[1] Based on 1.15 kL/day for 105 days

[2] Approximated based on 55 loads each for mobilisation and demobilisation, delivery from Murray Bridge (2,370 km), and a fuel efficiency of 41.5 L/100km for a B-double vehicle (ATAP, 2022)

[3] Approximated based on 100 loads, delivery from Katherine (320 km), and fuel efficiency of 33.8 L/100km for an articulated 6 axle vehicle (ATAP, 2022)

[4] Approximated based on 3 loads/day for 34 days, delivery from Darwin (640 km), and fuel efficiency of 33.8 L/100km for an articulated 6 axle vehicle (ATAP, 2022)

Table 12 Estimated Use of Oils and Greases During Construction

Parameter	Quantity (kL)
Oils	8.8
Greases	1.0

Materials of Construction

Estimated quantities of steel and cement that will be required for the construction of the SPP are presented in **Table 13**.

Table 13 Estimated Quantities of Materials of Construction

Material	Quantity (tonnes)
Steel [1]	1,911
Concrete [2]	61
Copper [3]	0.5
1 Pipeline and station pipe. 2 Station plinths/slabs for piping skids and ancillary equipment 3 Station earth grid cabling, CP and earthing cable for test points, cables for anode beds	

4.4 Estimated GHG Emissions

4.4.1 Construction

The estimated scope 1 and 3 GHG emissions for the Project construction are presented in **Table 14** and **Figure 8**. As noted in **Section 4.3.3**, no electricity will be sourced from the grid during construction, hence scope 2 emissions have not been considered.

Table 14 Estimated Scope 1 and 3 GHG Emissions for the Project - Construction

Scope/Source	Estimated Annual Emissions ($t\ CO_2$-e)			
	CO_2	CH_4	N_2O	Total
Scope 1				
Land clearance *	15,360			15,360
Diesel – construction equipment	1,349	1.9	3.9	1,355
Diesel – generators	326	0.5	0.9	327
Petroleum based oils and greases	4.9	0.0	0.0	4.9
Total Scope 1	**17,040**	**2.4**	**4.8**	**17,047**
Scope 3				
Diesel - 3rd party transport of equipment to site	392	0.4	2.2	394
Production and supply of diesel consumed *	415			415
Production and supply of oils and greases consumed *	6.8			6.8
Embodied energy of steel used in construction *	5,771			5,771
Embodied energy of copper used in construction *	1.4			1.4
Embodied energy of concrete used in construction *	9.1			9.1
Total Scope 3	**6,595**	**0.4**	**2.2**	**6,597**
* Emission calculations/factors do not provide breakdown by gas; all emissions allocated as CO_2.				

Figure 8 Estimated Scope 1 and Scope 3 GHG Emissions for Project Construction

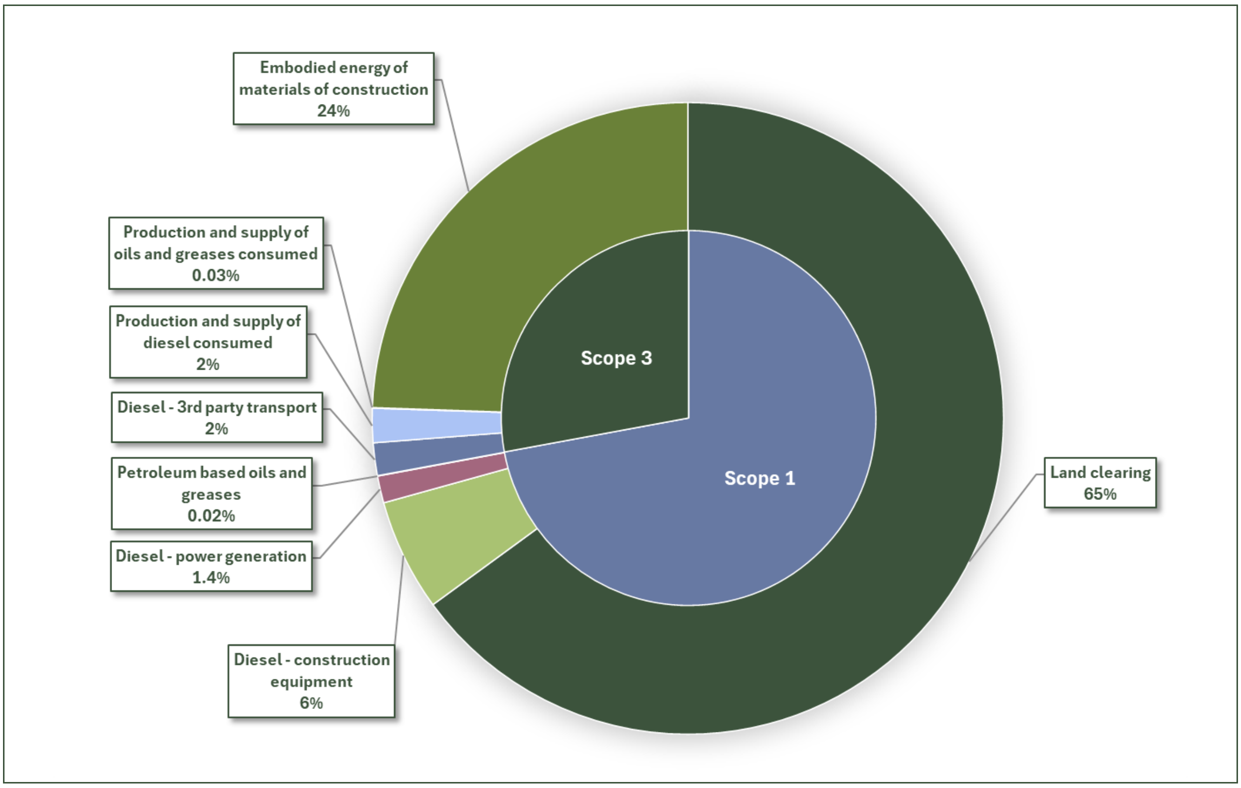


Table 14 and **Figure 8** show the following:

- The main source (90%) of estimated scope 1 emissions associated with the Project is vegetation clearance, which were calculated using the Carbon Emissions Estimate Calculator (DEPWS, 2023) based on a total clearance area of 146 ha.
- The combustion of diesel in the construction equipment and machinery (8%) and for power generation at the camp (2%) are the only other significant contributors to the estimated Scope 1 emissions.
- The main source (88%) of estimated Scope 3 emissions associated with the construction phase is the embodied energy within the key materials of construction, specifically the steel pipelines.

The preliminary GHG emission estimates presented in this report will be reviewed and updated as the Project design is refined, and more robust activity data becomes available. In the interim, the emissions inventory will be used to provide guidance on the key potential GHG emission sources associated with the project, so that appropriate monitoring and mitigation measures can be targeted to these activities.

By working with suppliers to understand the carbon footprint of their products and steps being taken to decarbonise their supply chains, and sourcing materials locally where practicable, Scope 3 emissions associated with Project construction will also be minimised.

4.4.2 Operations

No significant Scope 1 or scope 2 emission sources have been identified for the Project operations. There will be minor intermittent losses of gas during pigging operations, otherwise emissions via the pipeline vent will only occur in emergency situations or rare maintenance events. These emissions have not been quantified as part of this assessment as specific operational data for each release event is required but will be reportable as part of the regulatory GHG reporting framework once the pipeline is operational.

The initial purpose of the Project is to avoid appraisal gas being lost via venting or flaring, and instead for it to be used to support the current gas supply in the NT. In this way, the Project will result in a reduction in upstream emissions that will otherwise occur if the Project did not proceed, and the gas was instead vented. If the appraisal gas was flared at the wellhead, there will be no significant net change in GHG emissions compared to it being combusted for heat or electricity generation, however the energy benefits will be realised, rather than being lost to the environment.

GHG emissions associated with the extraction, other transport and end use of production gas that will be transported by the SPP in the longer term will be accounted for as part of the gas production environmental assessments and are not relevant to this assessment.

4.5 Comparison with National and NT Emissions

For the 2022 reporting year, which is the most recent available data available at time of writing, Australia's total Paris Inventory GHG emissions were reported to be 432.62 Mt CO_2-e, with 16.73 Mt CO_2-e contributed by the NT (DCCEEW, 2024b).

Once operational, GHG emissions from the Project will be negligible. For the year of construction, the contribution of the Project to national and NT GHG emissions is estimated at 0.004% and 0.10% respectively.

The SREBA for the Beetaloo Sub-basin commissioned by DEPWS also included a GHG GHG baseline study (CSIRO, 2022). One of the outcomes of this study was an inventory of the sources and sinks for CH_4 and CO_2 across the Beetaloo SREBA study area, as summarised in **Table 15**. The scope 1 construction emissions of 17,047 t CO_2-e represent 1.5% of the estimated net emissions for the Beetaloo Sub-basin.

Table 15 Inventory of CH_4 and CO_2 Sources and Sinks for the Beetaloo Sub-Basin

Sources	Emission (t CO_2-e/annum) ^		Sinks	Imission (t CO_2-e/annum) ^
	CH_4	CO_2		CH_4
Cattle	1,446,200		Soil	367,640
Termites	77,280			
Fire	150,080			
Elliot Power Station		2,155		
Daly Waters Power Station		1,104		
Sum	**1,525,635**		**367,640**	
Net Emission (t CO_2-e/annum)	**+1,157,995**			
Source: (CSIRO, 2022) ^ Estimated CH_4 quantities reported by CSIRO have been converted from t CH_4/annum to t CO_2-e/annum based on a GWP of 28.				

4.6 Mitigation Measures

As identified in **Section 4.4**, the main sources of direct GHG emissions associated with the Project are anticipated to be associated with vegetation clearing (90%) and diesel combustion (10%). The main source of indirect emissions is the embodied energy within the materials of construction.

The Project will adopt beneficial reuse of the carbon removed in vegetation, with all material cleared during construction to be used in rehabilitation of the construction area.

The following additional emissions reduction initiatives have been identified to minimise the GHG footprint of the Project and will be explored further during detailed design:

- Implementing practices to minimise fuel consumption.
- Minimising clearing and maximising revegetation of disturbed land, where possible.
- Prioritising locally sourced construction materials/supplies by encouraging and (where appropriate) stipulating contractors to utilise local suppliers.
- Investigating if waste material can be reused by another project within the region.
- Regular maintenance of construction plant and ensure compliance with relevant exhaust emission guidelines.
- Switching off plant and equipment when not in constant use and not left idling.
- Planning construction works to ensure minimal movement of plant and equipment.
- Investigating opportunities for the reuse/recycling of construction waste materials and including such in the construction environmental management plan, where feasible.

5.0 Conclusions

5.1 Air Quality Impacts

The key emissions to air expected to result from Project construction activities are fugitive emissions of particulate matter from earthworks, wind erosion of disturbed areas and stockpiles and wheel-generated dust. Temporary elevations in local particulate levels are most likely to occur when construction activities are undertaken during periods of low rainfall and/or windy conditions.

Potentially sensitive receptors within 5 km of the proposed SPP corridor were identified through a desktop study. This analysis identified that the nearest sensitive receptors (existing residences) are located approximately 3 km from the proposed pipeline corridor. No national parks, conservation areas or other potentially sensitive ecological receptors were identified in the vicinity of the proposed construction activities.

Given this, and using the IAQM approach, it was concluded that there is a negligible risk of adverse soiling or health impacts during the pipeline earthworks and construction phases. On that basis, standard dust mitigation measures are anticipated to be appropriate to manage dust emissions during the construction works.

Where diesel-powered mobile machinery and vehicles are being used, localised elevations in ambient concentrations of combustion-related pollutants may also occur, however any potential for the relevant impact assessment criteria for these pollutants to be exceeded at surrounding sensitive areas will be negligible given the separation distances involved.

Once constructed, air emissions from the Project will be minimal and no potential for adverse air quality impacts at surrounding sensitive areas was identified.

5.2 Greenhouse Gas Assessment

No significant Scope 1 or scope 2 emission sources have been identified for the Project operations. There will be minor intermittent losses of gas during pigging operations, otherwise emissions via the pipeline vent will only occur in emergency situations or rare maintenance events. The Project will need to monitor and report operational fugitive emissions from leaks and venting in line with APA's reporting requirements for their managed networks, as well as relevant regulations.

The Project will result in a reduction in upstream GHG emissions that will otherwise occur if the Project did not proceed, and the appraisal gas was instead vented. If the appraisal gas was flared at the wellhead, there will be no significant net change in GHG emissions compared to it being combusted for heat or electricity generation, however the energy benefits will be realised, rather than being lost to the environment.

GHG emissions associated with the extraction, other transport and end use of production gas that will be transported by the SPP in the longer term will be accounted for as part of the gas production environmental assessments once the gas quality and quantity has been established and have not been addressed in this assessment.

For the year of construction, the contribution of the Project's scope 1 emissions to national and NT GHG emissions is estimated at 0.004% and 0.10% respectively. The main sources of direct GHG emissions associated with the Project construction are anticipated to be vegetation clearing (90%) and diesel combustion (10%). The main source of estimated indirect emissions is the embodied energy within the materials of construction.

The above preliminary GHG emission estimates will be reviewed and updated as the Project design is refined, and more robust activity data becomes available. In the interim, the emissions inventory will be used to provide guidance on the key potential GHG emission sources associated with construction of the project, so that appropriate mitigation measures can be targeted to these activities.

6.0 References

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