BEETALOO BASIN KYALLA 117 N2 CIVIL CONSTRUCTION

Environment Management Plan

EP117

Review record

Rev	Date	Reason for issue	Author	Reviewer	Approver
0	08/04/2019	EMP released for acceptance	MK	MH	TB

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1 Executive Summary

The Beetaloo Basin Kyalla 117 N2 Civil Construction Environmental Management Plan (EMP) forms the basis of Origin Energy's (Origin's) application to the Northern Territory (NT) Department of Primary Industry and Resources (DPIR) for the construction of civil related infrastructure to support the drilling, hydraulic fracture stimulation (HFS) and well testing of a future exploration well.

This EMP has been prepared with reference to the *NT Petroleum (Environment) Regulations 2016,* Code of Practice for Petroleum Activities in the Northern Territory and the Exploration Agreements between Origin, Native Title holders and the Northern Land Council (NLC).

The overall objective of the EMP is to ensure that the activities the subject of this EMP are carried out in a manner by which the environmental impacts and environmental risks will be reduced to a level that is as low as reasonably practicable and acceptable. It is noted that this EMP does not seek approval for future exploration activities or potential HFS activities. Approval to commence drilling, stimulating and testing an exploration well will be covered in a separate EMP submission prior to conducting such activities.

This EMP covers a series of low impact civil construction activities required to enable Origin's 2019/20 exploration program. The civil construction program will involve the installation of, or upgrading of, access tracks, camp pad and lease pad.

The activities pertaining to this EMP will occur within the approved subject land area which has been approved by the custodians and the NLC and covered by AAPA Certificate C2019/014. These activities include:

- Establishment of a 4.5 hectare exploration lease pad, a 1 hectare camp pad and a 0.2 hectare soil stockpile area;
- Land clearing required for, and construction of, up to a total 650m of access track;
- Use of existing approved gravel pits to provide material for improving stability and integrity of the access tracks and lease pads; and
- Installation of fencing, gates and grids.

For the preparation of this EMP, a land condition assessment was completed in August 2018 to review the physical, natural and cultural heritage environment of the proposed exploration activities.

The proposed location of civil construction activities is located within *Corymbia* low woodland with a tussock grass understorey. The proposed site has high native grass cover and included numerous species suitable for granivorous birds (seed eaters). Dense leaf litter and numerous logs provide suitable refuge and foraging sites for fauna such as reptiles. This vegetation type is widespread in the tropical savannas of the Northern Territory and may provide habitat for some threatened species such as the Crested Shrike-tit (*Falcunculus frontatus whitei*) (DoTEE, 2014, Ward, 2008). As the level of clearing for the proposed activity is small, no significant impacts on protected flora and fauna are predicted.

There was no evidence of weeds observed during the survey. This suggests the primary controls for this program will therefore be focused on preventing the introduction of weeds and managing weeds promoted through site disturbance.

The archaeology assessment did not identify culturally sensitive landforms or artefacts within the proposed disturbance are. In addition, a sacred site clearance survey coordinated and carried out by the Northern Land Council (NLC) in August and September 2018, was led by their anthropologist and included site visits and consultations with the Native Title holders / custodian. The Sacred Site Avoidance Survey Report / Anthropological Report has been provided to the Aboriginal Areas Protection Authority and informed the issuing of AAPA Certificate C2019/014.

The environmental, heritage and social risks associated with the civil construction activities have been assessed utilising the Origin risk assessment framework. The detailed risk assessment presents the range of potentially impact-causing activities, corresponding mitigation measures and residual risk ratings based on their assessed worst-case consequence and likelihood of occurrence.

Key environmental impacts and risks identified for the program include;

- impacts on flora, fauna and habitat from clearing native vegetation;

- impacts on pastoral land and habitat from bushfire; and

- impacts on to land and surface water from erosion from civil construction activities.

It was considered that with the appropriate controls implemented to mitigate the impacts, there were no residual risks above a rating of medium, with 31 out of the 40 risks identified as being considered low. The medium risks identified were consistent with standard civil construction activities completed across the NT, being the potential for the spread of weeds, erosion and sediment control and the ignition of bushfires from the proposed activities. The assessment demonstrates the risks associated with the activities covered under the EMP can be reduced to as low as reasonably practicable and acceptable.

At completion of activities, and once a determination has been made in relation to decommissioning, a site-specific rehabilitation plan will be developed for each site. Where the site is not able to be handed over to the pastoralist for beneficial use, the site will be rehabilitated back to a safe, stable landform consistent with surrounding land use.

Due to the limited nature of the future exploration activities, community engagement for the 2019/20 exploration installation project has focused on the host Traditional Owners via the Northern Land Council (NLC) and host Pastoralists directly affected by the proposed activity. Detailed community and stakeholder engagement are ongoing and covers Origin's activities on a broader level. Further information on stakeholder engagement is provided in section 5.

2 Introduction

2.1 Purpose

Origin is required to provide a site-based Environmental Management Plan (EMP) for the Kyalla 117 N2 civil works program to the Department of Environment and Natural Resources (DENR) in accordance with the *Petroleum Act 2018*. The civils program is an enabling activity required to drill, stimulate and test an exploration wells on the Kyalla 117 N2 well lease pad.

This EMP has been prepared with reference to the *NT Petroleum (Environment) Regulations 2018*, NT Petroleum codes of practice and the Exploration Agreement(s) between Origin, Native Title Holders and the Northern Land Council (NLC).

The overall objective of the EMP is to ensure that the activities are carried out in a manner by which the environmental impacts and environmental risks will be reduced to a level that is as low as reasonably practicable and acceptable

More specifically, this EMP aims to:

- address regulatory requirements
- provide site-specific impact management strategies to assist Origin in maintaining a positive position in the local community throughout its program
- align with the principles of Ecological Sustainable Development (ESD) through the adoption of responsible development practices that are designed to maximise social benefit, whilst minimising the level of impact on the surrounding ecosystems.
- provide a description of site-specific aspects of the existing environment (physical, biological, social and cultural)
- provide site-specific plans for review, monitoring and rehabilitation
- be a practical and usable document, with environmental management principles that are easily implemented and effective

The ‘site’ is defined as all the work areas including the exploration camp, well pads and access tracks within the cleared subject land area. NOTE Origin reference Kyalla 117 N2, is referred to by NLC and AAPA as CA5.

2.2 Background

Origin holds three petroleum exploration permits in the Barkly region under the Beetaloo Joint Venture with Falcon Oil and Gas. These permits consist of EP76, EP98 and EP117 which cover 18,512 square kilometres (km^2) of largely pastoral leases on the Sturt Plain, part of the Barkly Tableland, within the Northern Territory (Figure 1) and were originally granted by the NT Minister for Mines and Energy under the *Petroleum Act 2014*.

Since becoming Operator of the exploration permits in 2014, Origin has drilled three vertical wells (Kalala S-1, Amungee NW-1, Beetaloo W-1) and one horizontal well (Amungee NW-1H). A successful hydraulic fracture stimulation and production test was undertaken on the Amungee NW-1H well in 2016, highlighting the potential of the Beetaloo Basin as a future unconventional shale development. Upon completion of the 2016 work program, Kalala S-1 and Beetaloo W-1 were suspended and a pressure monitoring commenced at Amungee NW-1H.

Future exploration activity was ceased in September 2016 when the Northern Territory Government announced a moratorium on hydraulic fracture stimulation of unconventional reservoirs pending the outcome of an independent inquiry.

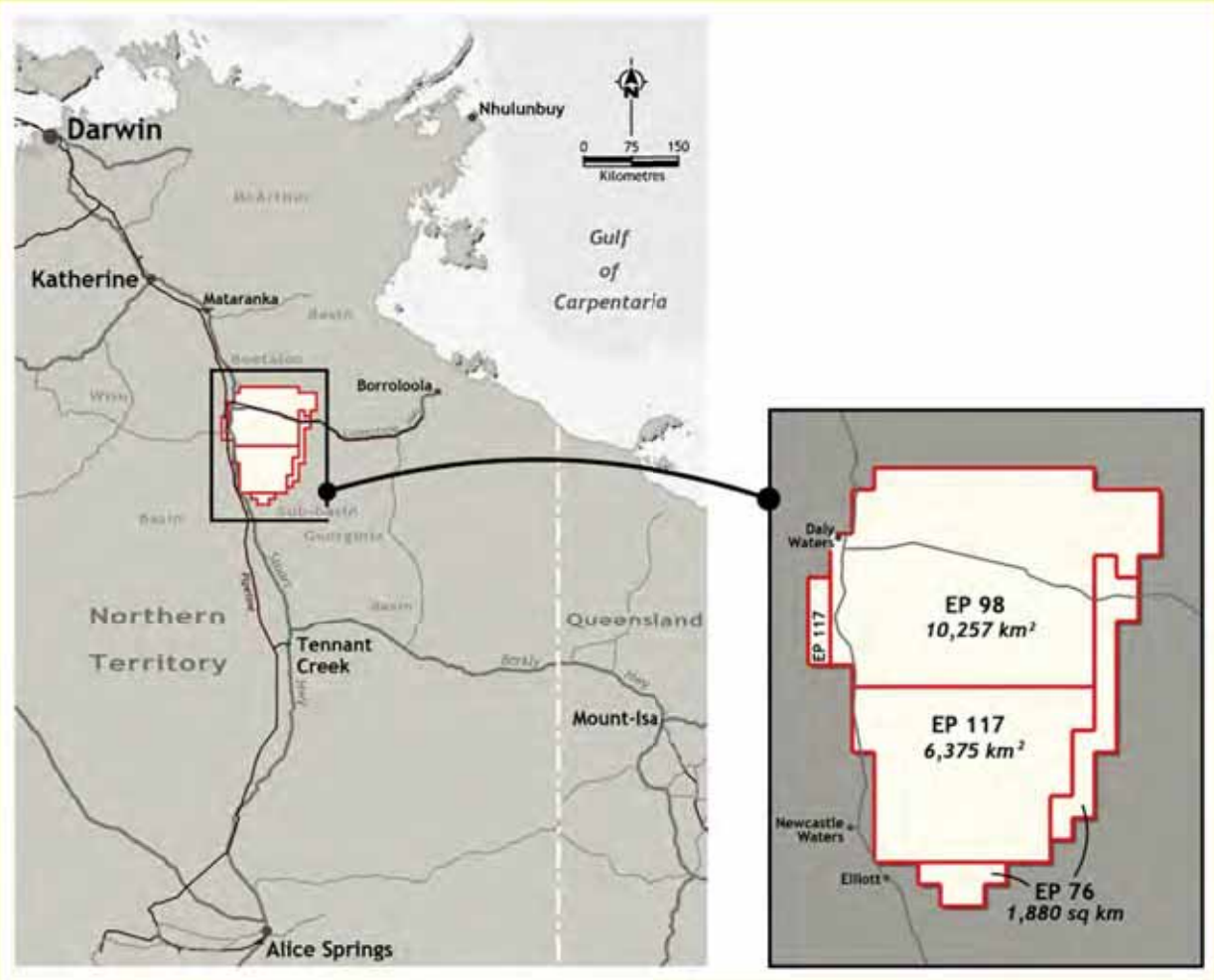
The Inquiry handed down its Final Report to the Northern Territory Government on Tuesday 27 March 2018. The Inquiry concluded that the risks associated with unconventional onshore shale gas extraction in the NT could be appropriately managed provided all the recommendations be adopted and implemented. The NTG subsequently accepted all 135 recommendations and announced the lifting of the moratorium on 17 April 2018. Of the 135 recommendations, 35 were required to be implemented prior to the commencement of exploration, with the remaining recommendations required to be implemented prior to the commencement of production.

This EMP forms the basis of Origin’s application to the DENR for the Kyalla 117 N2 civils construction program. This civils EMP is required to enable the drilling, stimulation and well testing of the Kyalla 117 N2-1 petroleum exploration wells within Origin’s exploration permits. The plan provides an overview of how Origin proposes to manage the environmental risk associated with its activities, including how it will address its regulatory obligations

and relevant Inquiry recommendations that have underpinned the Code of Practice for Petroleum Activities in the NT, which is currently in draft form (referred to herein as the NT Petroleum CoP).

It should be noted that this EMP does not cover the drilling, stimulation and well testing of an exploration well.

Figure 1 Location of Origin Permit Area



2.3 Project Boundary

Origin is proposing to construct civils infrastructure within the Kyalla 117 N2 location required for the drilling, stimulation and testing of an exploration well within the Exploration Permit 117. The boundary of this EMP is defined as the area which may be affected by exploration activities. This includes:

- construction of an access track connecting the existing access track to the new exploration lease pad
- construction of an exploration well lease pad
- construction of a temporary camp lease pad
- upgrade of the access track intersection with the Stuart Highway
- use of existing approved gravel pits

The proposed locations of the infrastructure is within the NLC and AAPA cleared subject land area and is provided in Table 1, Figure 2 and Figure 3. It is noted that the nominated areas for infrastructure may be changed slightly to minimise environmental and heritage impacts (e.g. significant tree or habitat avoidance, or any chance-finds associated with archaeological artefacts). Such modification will be made within the existing surveyed areas.

Table 1 Proposed infrastructure location and disturbance area

Exploration Permit	*Infrastructure Name*	*Station*	*Zone**	*Approx Easting*	*Approx Northing*	*Disturbance Area (ha)*
EP117	*Kyalla 117 N2 well Pad*	*Hayfield/Shenandoah*	*53*	*356175*	*8137500*	*4.5*
EP117	*Camp lease pad*	*Hayfield/Shenandoah*	*53*	*356448*	*8137813*	*1*
EP117	*Stockpile laydown*	*Hayfield/Shenandoah*	*53*	*356435*	*8137500*	*0.2*
EP117	*Access Tracks*	*Hayfield/Shenandoah*	*53*	356192	*8138068*	*0.5*
EP117	*Stuart highway intersection upgrade*	*Hayfield/Shenandoah*	*53*	356400	*8137620*	*0.4*
					Total Disturbance Area (Ha)	**6.6**

** Universal Transverse Mercator (UTM) geographic coordinate system is Geocentric Datum of Australia (GDA) 94.*

2.4 Project Proponent

The proponent for the project is Origin as the operator. The key Operator contacts for this plan are provided below. Origin representatives can be contacted on 1800 052 630 or Community.feedback@originenergy.com.au.

Name	**Title**
Tracey Boyes	General Manager- Beetaloo and Growth Assets
Matthew Hanson	Project and Operations Manager
Stephanie Stonier	Corporate Affairs Manager
Matt Kernke	Environment Specialist

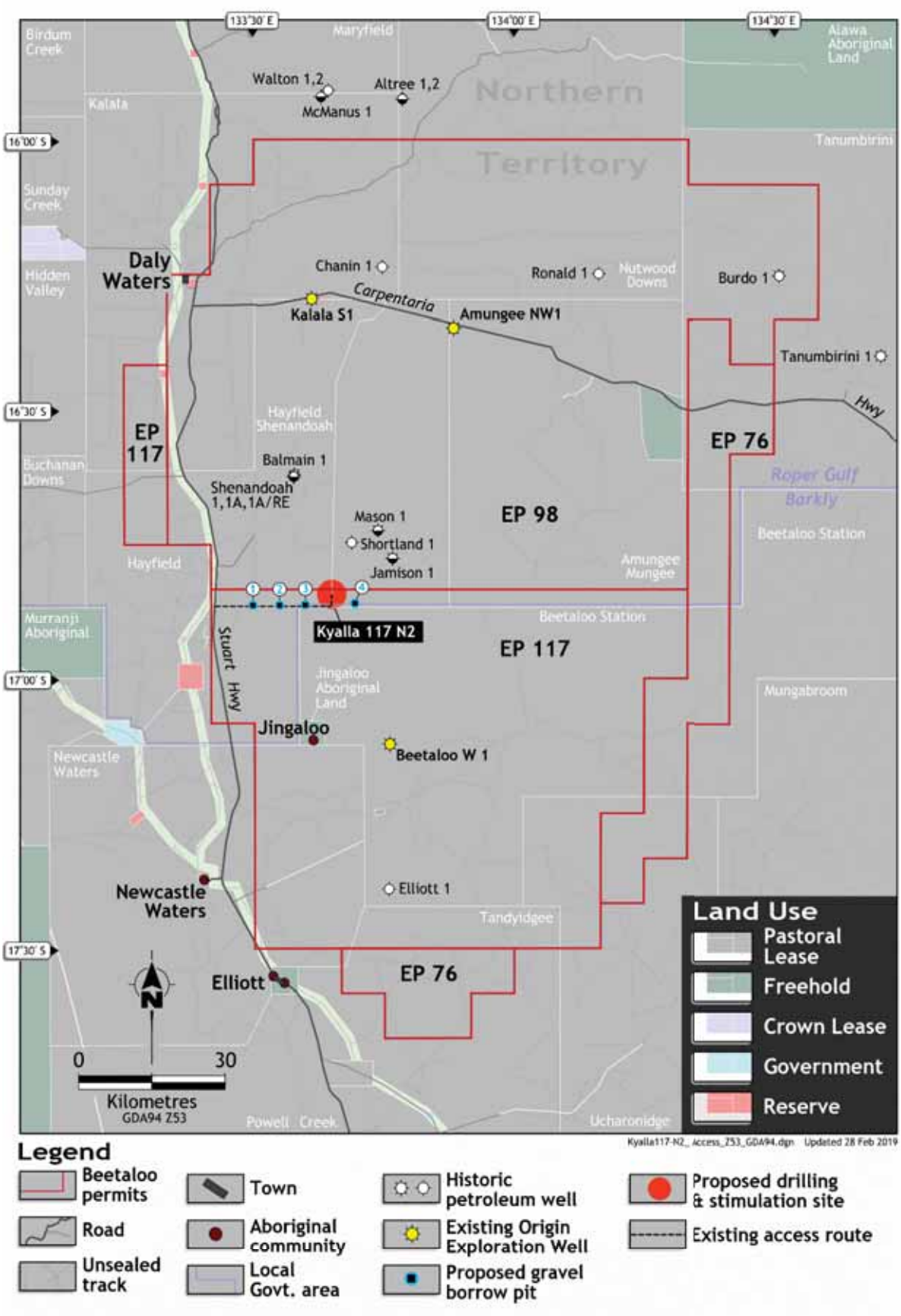


Figure 2 Location of proposed activities within Origin's Exploration tenure

Figure 3 Site location map

2.5 Broader Exploration Project

Origin's Beetaloo Basin tenure is in the early stages of exploration and appraisal. Future activities are focused on proving the technical and commercial viability of the resource through the strategic placement of wells within the most prospective areas and / or formations.

As illustrated in Figure 4, Origin is in the early stages of its nine-well exploration programme which is intended to better understand the potential of the resource including the technical and commercial viability of the underlying source rocks.
The Kyalla 117 N2 lease pad and associated infrastructure will be constructed to enable the drilling, stimulation and well testing of an exploration well. The first of these wells is planned to be drilled in 2019 and is referred to as the Kyalla 117 N2-1 well. Exploration activities in 2020 and beyond will be informed by the well results of the 2019 campaign.

In addition to the potential environmental risks associated with the civils components, broader considerations of the cumulative impacts associated with future drilling and stimulation activities have been included in this assessment.

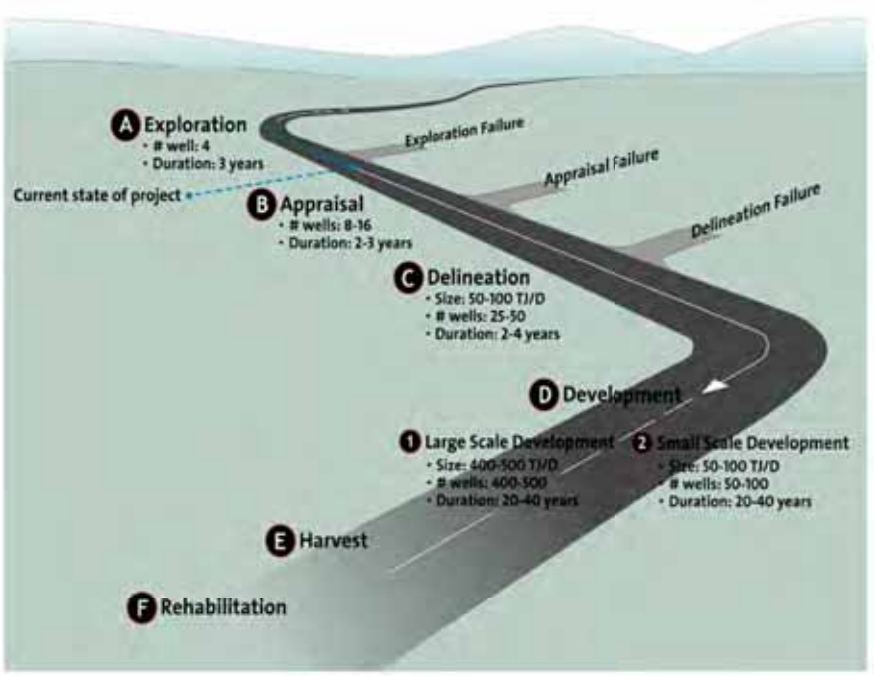


Figure 4 Conceptual Beetaloo Basin project pathway from exploration to development

3 Environmental Legislation and other Requirements

The following section provides an overview of the relevant regulatory requirements, codes of practice and agreements that apply to the activities covered under this EMP. This is the first step in defining the context of the project and provides an overview of the minimum standards and governance framework for any Petroleum related controlled activity.

3.1 Regulatory Framework

In the NT, the granting and administration of exploration permits and associated petroleum activities rests with the Minister for Primary Industry and Resources under the Petroleum Act 1984. In order to commence an activity or a stage of an activity which is carried out, or proposed to be carried out, in connection with a technical work programme for a petroleum interest and that has, or will have, an environmental impact or environmental risk (a **regulated activity**) an environment management plan (**EMP**) must be approved by the Minister for Environment and Natural Resources in accordance with the *Petroleum (Environment) Regulations 2016*.

Alongside the EMP assessment and approval process under the Petroleum (Environment) Regulations 2016, the Northern Territory Environment Protection Authority (NT EPA) administers the *Environmental Assessment Act*

1982; which allows for proposals to be assessed as to whether a proposal has the potential to have a significant effect on the environment and if so, whether assessment by way of public environment report or environmental impact statement is required.

A range of Territory and Commonwealth legislation, agreements, operating consents, guideline's and codes of practice are relevant to the activities described in this EMP. These are summarised in Table 2, Table 3 and Table 4.

Table 2 Key Legislation

NT Legislation	Administered By:
Petroleum Act 2016, Petroleum (Environment) Regulations 2016 · Provides legal framework for petroleum exploration and to development within the Territory. · The *Petroleum (Environment) Regulations* 2018 provides requirements that regulated activities are carried out in a manner consistent with the principles of ecologically sustainable development, and by which the environmental impacts and environmental risks of the activities are identified and reduced to an acceptable level. · Provides guidance for the content of environmental management plans	Department of Primary Industry and Resources (Petroleum Act) and Department of Environment and Natural Resources Petroleum (Environment) Regulations
Aboriginal Land Act 1978 · Provides for access to Aboriginal land, certain roads bordered by Aboriginal land and the seas adjacent to Aboriginal land. · Provides that a person shall not enter onto or remain on Aboriginal land or use a road unless he has been issued with a permit to do so in accordance with *Part II Entry onto Aboriginal land* of the Act. · The Land Council for the area in which Aboriginal land or a road is situated may issue a permit to a person to enter onto and remain on that Aboriginal land or use that road subject to such conditions as the Land Council thinks fit.	Land Council established by or under the Aboriginal Land Rights (Northern Territory) Act 1976 of the Commonwealth.
Bushfires Management Act 2016 and associated Regulations · Provides for the protection of life, property and the environment through the mitigation, management and suppression of bushfires, and for related purposes. · The Bushfire Management Act outlines the responsibilities for managing bushfire in the vicinity of Origin's activities and prohibits the lighting of fires during Fire Danger Periods (flaring is exempt from this requirement) · The Regulations outline infringement notices and prescribed amounts for certain acts relating to lighting fires.	Bushfires NT, Department of Environment and Natural Resources
Control of Roads Act 1953 · Provides for the administration and control of roads, including the maintenance of roads, construction and opening and closing of roads. · The use of any Road Bores will require a permit to work within a road reserve from the Department of Transport.	Department of Infrastructure, Planning and Logistics
Dangerous Goods Act 1998 and Regulations · Provides for the safe storage, handling and transport of certain dangerous goods.	NT Worksafe, Department of the Attorney-General and Justice
***Environmental Assessment Act 1982* and associated Regulations** · Provides for the assessment of the environmental effects of development proposals and for the protection of the environment. · Ensures to the greatest extent practicable that each matter which could reasonably have a significant effect on the environment is fully examined and considered. · Where activities are likely to have a significant impact on the environment, than a notice of Intent is required to be completed and submitted.	Northern Territory Environmental Protection Authority, Department of Environment and Natural Resources
Environmental Offences and Penalties Act 2011 · Establishes penalties for certain offences under prescribed Acts (such as an environmental offence) and for related purposes.	Department of Environment and Natural Resources

NT Legislation	Administered By:
***Heritage Act 2011* and associated Regulations** Legislation requiring Origin to assess and mitigate the potential impacts on cultural heritage within the NT including. · Sets the process by which places become heritage places. · Allows for interim protection of places. · Sets out the process for getting permission to do work to heritage places. · Declares classes of places and objects of heritage significance to be protected. · Provides for heritage agreements to encourage the conservation, use and management of heritage places and objects. · Regulates work on heritage places and objects. · Establishes enforcement and offence provisions.	Heritage Branch, Department of Tourism, Sport and Culture
***Northern Territory Aboriginal Sacred Sites Act 1989* and associated Regulations** Origin is required to obtain AAPA certificates for all exploration activities. The Legislation establishes a procedure for the protection and registration of sacred sites, through: • providing entry onto sacred sites and the conditions to which such entry is subject • procedures for avoidance of sacred sites when developing and using land • establishing an Authority for the purposes of the Act • procedures for the review of decisions of the Authority by the Minister, and for related purposes.	Aboriginal Areas Protection Authority (AAPA); Minister for Environment and Natural Resources
Public and Environmental Health Act 2011 and Associated Regulations · To monitor, assess and control environmental conditions, factors and agents, facilities and equipment and activities, services and products that impact on or may impact on public and environmental health. · Outlines requirements for camps, specifically waste and wastewater (sewage and greywater) management · Provides conditions preventing pollution of water courses and water supplies in the Northern Territory. Wastewater treatment systems may be subject to requirements under the Public Health Act and regulations.	Department of Health
Territory Parks and Wildlife Conservation Act 1976 (TPWC Act) and associated Regulations · Provides for the protection, conservation and sustainable utilisation of wildlife. · Provides protection of listed threatened species for which · Origin must consider whether it's activities have the potential to impact directly or indirectly on a listed threatened species or place covered under this Act.	Flora and Fauna Division of the Department of Environment and Natural Resources
Waste Management and Pollution Control Act 1998 and associated Regulations · Provides for the protection of the environment through encouragement of effective waste management and pollution prevention and control practices and for related purposes. · Outlines the requirements for "listed wastes" which require specific licences for the transportation and disposal of certain prescribed wastes, including tracking and reporting requirements. · To facilitate the implementation of National Environment Protection Measures established by the National Environment Protection Council (Northern Territory) Act. · Section 12 of the Act places obligation on a person to ensure they take all practicable measures to prevent or minimise pollution when undertaking an activity that could cause pollution and environmental harm. · Waste produced within Origin's exploration activities will need to be managed in accordance with this act. This includes using licenced waste transportation companies, tracking listed wastes and disposing of wastes at licenced facilities	Northern Territory Environmental Protection Authority, Department of Environment and Natural Resources
Water Act 1992 · Provides for the investigation, allocation, use, control, protection, management and administration of water resources, including extraction of groundwater, waste water management and water pollution.	Water Resources Division, Department of Environment and Natural Resources

NT Legislation	Administered By:
· Provides for water allocation plans, beneficial uses within Water Control Districts, drilling licences, bore construction permits, water extraction licences, waste discharge licences, fees and charges, and penalties for offences against the Act. · The use of groundwater for stimulation activities (including supporting works) within the Beetaloo Basin is required to comply with the Water Act · Act prohibits wastewater reinjection and surface water extraction for stimulation activities.	
Weeds Management Act 2001 · Protects the Territory's economy, community, industry and environment from the adverse impact of weeds. · Identifies declared weeds (those which must be controlled) and provides a framework for weed management which forms the basis of Origin's Weed Management Plans.	Weed Management Branch, Department of Environment and Natural Resources
Work Health and Safety (National Uniform Legislation) Act 2011 · Provides for a balanced and nationally consistent framework to secure the health and safety of workers and workplaces. · Provide a mandated level of protection to workers from exposures associated with chemical handling and storage	NT WorkSafe, Department of the Attorney-General and Justice
Commonwealth Legislation	**Administered By:**
Aboriginal and Torres Strait Islander Heritage Protection Act 1984 · Provides for the preservation and protection of places, areas and objects from injury or desecration of particular significance to Aboriginal people in accordance with Aboriginal tradition.	Department of the Environment and Energy
Aboriginal Land Rights (Northern Territory) Act 1976 · Provides for the granting of Traditional Aboriginal Land in the Northern Territory for the benefit of Aboriginal people, and for other purposes.	Department of Prime Minister and Cabinet
Australian Heritage Council Act 2003 · Establishes the Australian Heritage Council which is the principal adviser to the Australian Government on heritage matters. · The Council's major role is to assess the heritage values of places nominated for the National Heritage List and the Commonwealth Heritage List, and to advise the Minister on promotion, research, education, policies, grants, conservation and other matters. · The Council also makes assessments under the *EPBC Act*, and performs any other functions conferred on the Council by the *EPBC Act.*	Department of the Environment and Energy
Environment Protection and Biodiversity Conservation Act 1999 · Provides for the protection of the environment and conservation of biodiversity, particularly species and places of national significance. · Invoked only if a development is likely to have environmental impacts of national significance.	Department of the Environment and Energy
National Environment Protection Council Act 1994 · The object of this Act is to ensure that, by means of the establishment and operation of the National Environment Protection Council: a) people enjoy the benefit of equivalent protection from air, water or soil pollution and from noise, wherever they live in Australia; and b) decisions of the business community are not distorted, and markets are not fragmented, by variations between participating jurisdictions in relation to the adoption or implementation of major environment protection measures. · Provides national standards for ambient air quality, movement of controlled wastes, and contaminated sites. · The Commonwealth, the States, the Australian Capital Territory, the Northern Territory and the Australian Local Government Association have entered into an Agreement known as the Intergovernmental Agreement on the Environment setting out certain responsibilities of each party in relation to the environment.	Department of the Environment and Energy
National Greenhouse and Energy Reporting Act 2007	Department of the Environment and Energy

NT Legislation	Administered By:
· An Act to provide for the reporting and dissemination of information related to greenhouse gas emissions, greenhouse gas projects, energy consumption and energy productions of corporations. · All direct and indirect emissions from Oriign's activties are required to be reported to NGERS annually**.**	
Native Title Act 1993 · Provides for the recognition and protection of native title for Indigenous peoples. · Establishes ways in which future dealings affecting native title may proceed and to set standards for those dealings. · Establishes a mechanism for determining claims to native title. · Provides for the validation of past acts, and intermediate period acts, that have been invalidated because of the existence of native title.	Prime Minister and Cabinet

Table 3 Codes of Practice and Relevant Guidelines

Codes of Practice
Code of Practice for Small On-site Sewage and Sullage Treatment Systems and the Disposal or Reuse of Sewage Effluent (NT Department of Health, 2014) · Provides guidance for the management of effluent. · It is noted that Territory Health Services will issue any amendments to the above Code on an annual basis.
Code of Practice for Petroleum Well Operations in the Northern Territory · Mandatory code of practice for the Petroleum industry to ensure that petroleum activities in the Northern Territory are managed according to minimum acceptable standards to ensure that risks to the environment can be managed to a level that is as low as reasonably practical (ALARP) and acceptable.
Guidelines
API Guidance Document –HF3, Practices for Mitigating Surface Impacts Associated with Hydraulic Fracturing · Describes a series of practices currently used in the oil and natural gas industry to minimize surface environmental impacts—potential impacts on surface water, soils, wildfire, other surface ecosystems and nearby communities—associated with hydraulic fracturing operations.
AS 1940: The storage and handling of flammable and combustible liquids, 2004 Provides guidance for the operation and handling of flammable and combustible liquids.
Best Practice Erosion and Sediment Control (International Erosion Control Association, 2008) · Facilitates the identification of those issues that should be considered when formulating and evaluating strategies for best practice erosion and sediment control. · Facilitates best practice stormwater management. · Facilitates active avoidance or minimisation of soil erosion resulting construction activities. · Facilitate best practice soil and sediment control management on sites.
Bores, drilling and dams · Provides information on water drilling licences, bore construction permits, licensed drillers and other information regarding drilling water bores in the NT. · https://nt.gov.au/environment/waterhttps://nt.gov.au/environment/water/bores-drilling-and-dams/about-water-drilling-licences
ISO 31000 Provides an internal standard for the identification, assessment and management of risk. Origin's risk management process are based upon ISO 31000.
Guideline for the Preparation of an Environmental Management Plan (DENR, 2018) · Details the environmental protection measures to be included in Environmental Management Plans. · -includes changes emanating from the recommendations of the NT Hydraulic Fracturing inquiry

Guideline for Groundwater Monitoring Bores for Exploration Petroleum Wells in the Beetaloo sub-basin (DENR 2018) · Technical guidance for the onshore gas industry establishing the minimum expectations in relation to groundwater monitoring requirements. · Requires the establishment of control and impact monitoring bores prior to undertaking stimulation activities.
Northern Territory Natural Resource Management Plan 2016-2020 (Territory Natural Resource Management, 2016) · Describes the management direction for the NT's natural resources for the five-year period and beyond. · Four regional plans provide an overview of the current land condition, use and threats, key areas to monitor and improve approaches, and the level of coordination that occurs across key organisations responsible for implementing actions.
ISO 19011: Guidelines for auditing management systems, 2018 · Provides guidance on environmental auditing to a certifiable standard.
Leading Practice Sustainable Development Program for the Mining Industry (Australian Government, 2016) · The LPSDP provides guidance to the mining industry through a series of handbooks including: · Airborne Contaminants, Noise and Vibration · Biodiversity Management · Community Engagement and Development · Hazardous Materials Management · Risk Management · Water Stewardship · Working with Indigenous Communities.
Minimum Construction Requirements for Water Bores in Australia (National Water Commission, 2012) · Developed by the National Uniform Drillers Licensing Committee, this document outlines the minimum requirements for constructing, maintaining, rehabilitating, and decommissioning water bores in Australia.
Northern Territory Land Clearing Guidelines (NRETAS, 2010) · Clearing must be carried out in accordance with Land Clearing Guidelines.
Northern Territory Noise Management Framework Guideline (NT EPA, 2018) · Provides guidance to the community and industry about the noise regulatory framework as it applies in the NT.
Weed Management Planning Guide - Onshore Shale Gas Development Projects (DENR, 2018) · Provides guidance to the industry about the weed management planning required to undertake Onshore Shale Gas Developments in the NT.

Table 4 Relevant agreements and operating consents

Agreements	Administered By:
Native Title Petroleum Exploration Agreement (between the Host Traditional Owners and Origin Energy [Falcon Oil and Gas) · Includes clauses for the protection of sacred sites, objects and sensitive areas related to Aboriginal activities in the area, including cultural, hunting and foraging activities. Site clearance will occur prior to any on ground activities. The Native Title Agreement also includes clauses for the protection of the environment and rehabilitation.	Northern Land Council
AAPA Certificates · The most current clearance certificates issued for the Origin exploration program as referenced within this EMP.	Aboriginal Areas Protection Authority
Access agreement · A negotiated access agreement formed between a resource company and a private pastoralist relating to the rights over 'access land'.	DPIR
Apply for permit to work within a road reserve · Road bores are usually used for road construction and maintenance work, however application to access water in the bores can be made to the Department of Transport for approval. · Approval to access the bore will be dependent on the bore having sufficient capacity to meet future needs for road construction and maintenance.	Department of Infrastructure, Planning and Logistics (DIPL)

3.2 Referral Assessment

Approval for the proposed action has considered the need for referral under the NT Environmental Assessment Act and the Commonwealth Environmental Protection and Biodiversity Conservation Act. Impacts associated with the proposed activity will be largely centred on vegetation clearing, bushfires, introduction of weeds and erosion and sediment control.

3.2.1 NT Environmental Assessment Act

In the NT, proposed actions that have the potential to have a significant effect on the environment require environmental impact assessment (EIA) under the Environmental Assessment Act. In such cases, a Notice of Intent (NOI) is required to be submitted to the NT Environmental Protection Agency outlining the relevant information to allow a decision on whether the proposed action requires a Public Environmental Report (PER) or an Environmental Impact Statement (EIS). Where the environmental impacts of the proposed activity are not significant, a PER or EIS will not be required.

An assessment of whether the proposed activity requires a NOI was undertaken in accordance with the NT *Referring a Proposal to the NT EPA* guideline. A summary of the relevant environmental factors is included in Table 5.

No significant impacts on any of the NT environmental factors and objectives are anticipated. Origin does not believe the activity is required to be assessed under the Environmental Assessment Act.

3.2.2 Commonwealth Environmental Protection and Biodiversity Conservation Act

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1997* (EPBC) an action that has, will have or is likely to have a significant impact on Matters of National Environmental Significance (MNES) must be referred to the Australian Government Minister for the Environment (the Minister) for assessment.
A self-assessment in accordance with the EPBC Act was undertaken under this EMP. The environment and heritage assessment confirmed that no significant impacts to EPBC listed threatened species, threatened ecological communities or migratory species were likely. The proposed program will not require referral under the EPBC Act.

Table 5 Assessment against environmental factors and objectives

Environmental Factors	Project Specific Environmental Factors	Environmental Objectives at Risk	Receiving Environment	Impact Description	Mitigation Measures	Potential significant effect on an environmental factor?	Assumptions
Land	Terrestrial Flora and Fauna	Protect NT's flora and fauna so that biological diversity and ecological integrity are maintained.	Corymbia spp open woodland with mixed Terminalia spp. shrubland over low tussock grassland (Triodia bitextura)	6.6 Hectares of clearing of a non-threatened or endangered vegetation communities consisting of: Corymbia spp open woodland with mixed Terminalia spp. shrubland over low tussock grassland (Triodia bitextura). The Sturt Hwy intersection also includes minor patches of Lancewood and Bullwaddy. Activity not expected to Impact on threatened/endangered flora and fauna	•Field ecological survey •Avoidance of high value vegetation communities •Land clearing as per NT Land Clearing Guidelines. •Weed management plan	No-Activity unlikely to result in significant impacts on high valued vegetation communities or threatened flora and fauna or areas essential habitat.	Assessment based upon field surveys. Threatened fauna may be present in the area which were not identified during the surveys
	Terrestrial Environmental Quality	Maintain the quality of land and soils so the environmental values are protected	Corymbia spp open woodland with mixed Terminalia spp. shrubland over low tussock grassland (Triodia bitextura)	No significant erosion impacts or risks are anticipated.	•Land clearing as per NT Land Clearing guidelines. •Construction to commence in dry season. •All disturbed areas to be rehabilitated.	No- Assessment indicates activity unlikely to result in significant impacts from increased erosion and sediment releases	Assumes internationally accepted erosion and sediment controls are sufficient to manage risk of erosion within the NT
	Landforms	Conserve the variety and integrity of distinctive physical landforms so that environmental values are protected.	Low relief area, <1% slope on tertiary lateritic red sands	•Clearing and levelling (minor) of a 6.6 hectare area to accommodate a lease pad, camp pad and access tracks.	Infrastructure located on flat ground Minimal cutting and filling required Pad and road design consistent with surrounding landform	No- no major modification to the surrounding landform is predicted.	Assessment is based upon field ecology scouting.
Water	Aquatic Ecosystems	Protect aquatic ecosystems to maintain the biological diversity of flora and fauna and the	•Located ~200km from any Groundwater Dependent Ecosystems.	No significant impacts or risks anticipated.	•Groundwater extraction modelled within sustainable yields •No surface water extraction	No- activities are not anticipated to impact on the environmental factor	•Modelling based on known and assumed properties of Aquifer

Environmental Factors	Project Specific Environmental Factors	Environmental Objectives at Risk	Receiving Environment	Impact Description	Mitigation Measures	Potential significant effect on an environmental factor?	Assumptions
		ecological functions they perform	• Activity not located within close proximity to any major flow paths, wetlands or permanent watercourses.		•Location of lease pad away from GDE's, wetlands, permanent streams or major watercourses and flow paths. •Erosion and sediment control plan to be implemented		• Assumes internationally accepted erosion and sediment controls are sufficient to manage risk of erosion within the NT
	Inland Water Environmental Quality	Maintain the quality of groundwater and surface water so that environment values including ecological health, land uses, and the welfare and amenity of people area protected.	Cambrian Limestone Aquifer- Gum Ridge Formation	No significant impacts or risks on pastoralist bores from groundwater extraction anticipated.	•All groundwater take to be licenced with yield within sustainable recharge levels	No- Assessment indicates activity unlikely to result in significant impacts to ground water	Assessment based on hydrological information collected during drilling and assumed transmissivity and storage values
	Hydrological processes	Maintain the hydrologic regimes of groundwater and surface water so that environmental values are protected.	•Cambrian Limestone Aquifer- Gum Ridge Formation • Activity not located within close proximity to any major flow paths, wetlands or permanent watercourses.	No significant impacts or risks anticipated.	•Groundwater extraction modelled within sustainable yields •No surface water extraction •Location of lease pad away from GDE's, wetlands, permanent streams or major watercourses and flow paths. •Design of lease pads to avoid impacts to overland flow	No- Assessment indicates activity unlikely to result in significant impacts to ground water or surface water	•Modelling based on known and assumed properties of Aquifer
Air	Air Quality and Greenhouse Gases	Maintain air quality and minimise emissions and their impact so	Rural environment with minimal	No significant impacts or risks anticipated.	• Activity intensity low, with no local sensitive receptors	No- Assessment indicates activity unlikely to result in significant impacts	Estimates of greenhouse gas generation using estimates from

Environmental Factors	Project Specific Environmental Factors	Environmental Objectives at Risk	Receiving Environment	Impact Description	Mitigation Measures	Potential significant effect on an environmental factor?	Assumptions
		that environmental values are protected	industrial or urban inputs		•dust suppression to be utilised to minimise dust generation •Equipment to be compliant with relevant pollution control device requirements and maintained to minimise emissions	to air quality of greenhouse gas generation	Transport Authorities Greenhouse Group
People and communities	Social, economic and cultural surroundings	Protect the rick social, economic, cultural and heritage values of the Northern Territory	Rural communities, pastoralists and traditional owners	Positive social, economic and cultural impacts associated with use of local employment	•All civil activities undertaken by NT businesses •Stakeholder engagement plan. • Land access approvals •NLC clearances and AAPA certificates for all activities.	No- low intensity activity not anticipated to negatively impact on factor	All relevant Traditional Owners are engaged by NLC.
	Human health	Ensure the risks to human health are identified, understood and adequately avoided and /or mitigated	Remote rural environment	No impact to human health anticipated from civil construction activities	•Low intensity activity with nuisance (dust) likely to be the main issue associated with civil construction activities •Limited exposure sources and receptors	No- low intensity activity with limited sources and receptors.	None-

3.3 The Independent Scientific Inquiry into Hydraulic Fracture Stimulation in the Northern Territory

On 16 April 2018, the NT Government announced the lifting of the moratorium on hydraulic fracturing of onshore unconventional gas reservoirs within the NT. The lifting of the moratorium was made with the endorsement of the 135 recommendations handed down by the Inquiry. Of these recommendations, 35 were required to be implemented before the commencement of further exploration activities. The remainder are required to be implemented prior to production approvals being granted.

One of the key recommendations of the Inquiry was the development of a series of codes of practice that prescribe minimum requirements for undertaking onshore unconventional gas activities.

All relevant recommendations and associated Code of Practice requirements have been considered in the development of this EMP.

3.4 Alignment with the Principles of Ecologically Sustainable Development (ESD)

This EMP is consistent with the principles of ESD through the adoption of responsible practices that are designed to maximise social benefit, whilst minimising the level of impact on the surrounding ecosystems. The ESD principles as defined in the Petroleum (Environment) Regulations are as follows:

- Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;
- If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;
- The principle of inter-generational equity – that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;
- The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making;
- Improved valuation, pricing and incentive mechanisms should be promoted.

Origin's exploration activities align with the principles of ESD through the following:

- The exploration activities are an essential step in defining a potential future commercial resource which can generate sustainable, long-term benefits to the local community, to the Barkly region generally and more broadly into the rest of the NT.
- Complying with NT Codes of Practice and industry best practice to reduce any risk to the environment and communities to an acceptable level. Noting the Inquiry Panels Final Report Statement that "provided that all of the recommendations made in this Report are adopted and implemented in their entirety, not only should the risks associated with an onshore shale gas industry be minimised to an acceptable level, in some instances, they can be avoided altogether" (Scientific Inquiry into hydraulic fracturing in the Northern Territory 2018);
- The activities the subject of the EMP do not constitute threats of serious or irreversible environmental damage and there is no impact on the conservation of biological diversity and ecological integrity
- Beyond royalty payments to the NT Government (as owner of the natural resource), and payments to Native Title Holders (as per Exploration Agreements) and host pastoralists (as per Access and Compensation Agreements), Origin seeks to maximise broad-based local participation in education, training, employment and enterprise opportunities engendered by its presence.
- Prioritising the use of local employment to deliver exploration activities;
- Obtaining sacred site clearances from host Traditional Owners through open engagement custodians and the Statutory Representative body - the Northern Land Council (NLC); and
- Obtaining Land Access Agreements with host pastoralists.

4 Description of the regulated activity

The following section provides a description of the activities that are covered under this EMP. The proposed civils construction activities are an enabler for additional exploration activities (drilling, stimulation and well testing) which will be addressed in a separate EMP submission.

The activities subject to this EMP are:

- Construction of a 4.5-hectare (ha) lease pad and associated lease pad infrastructure
- Construction of a camp pad (1 ha)
- Construction of a stockpile area (0.2 ha)
- Construction of up to 650m of access track connecting the existing access track to the lease pad (0.5-hectare).; and
- Upgrade of the access track intersection with the Stuart highway (0.4 ha)

A description of each of the proposed activities is provided in the following section, along with the core management strategies for certain environmental aspects.

4.1.1 Exploration well lease and camp pads

An exploration well lease pad and camp pad will be constructed to support the exploration activities. The exploration well lease pad will be 4.5ha in size and include provision for up to 20m firebreaks to reduce the potential risk to infrastructure. The lease pads will be engineered to allow heavy vehicles, the drilling rig and associated equipment to manoeuvre and operate safely. The schematic of the anticipated well lease pad design is provided in Appendix B.

The camp pad will be approximately 1ha in size and includes an irrigation area to irrigate effluent from temporary camps used during the drilling, stimulation and well testing. The irrigation area will not be used during civil construction activities.

An additional 0.2 hectare stockpile laydown yard will be constructed to store excess topsoil and vegetation from the lease pad if required.

The location of lease and camp pads have been chosen to minimise any risk associated with the future drilling, stimulation and well testing activities. Field ecological and cultural heritage clearances have been obtained for the proposed sites. There are no areas of high conservation or habitat value or areas of cultural significance in the vicinity of the proposed project area. Approximate separation distances to the nearest environmental and community receptors are:

- 20km from the Stuart Highway,
- 21km from the nearest homestead
- 29km from the nearest community
- 71km from the closest conservation area (Bullwaddy Conservation area)
- 50 km from the closest major watercourse (Newcastle Creek)
- 16km from the closest pastoralist bore

Each pad will be cleared of vegetation and stripped of up to 150mm of topsoil, with the topsoil stockpiled around the edge of the site. The topsoil will be used to create a bund to prevent wastewater from leaving the site in the event of a tank failure. The bund will be of an appropriate height to contain the volume of the largest wastewater storage tank on site. Additional topsoil will be stored on the stockpiled area.

The lease pads will be levelled and compacted, with gravel added to the lease pads to aid forming the working surface. The compacted surface will also minimise the infiltration of any spills and allow for material recovery.

The pads will be constructed with a 1-degree fall terminating at a purpose-built stormwater retention pond to manage rainfall that falls on the lease. The retention pond will only be in operation during stimulation and well testing activities, with the pond being removed at other times. Any stormwater collected will be beneficially used onsite (for dust suppression within the activity area) or tested prior to release outside of the approved activity area (i.e. surrounding area).

An 8m^3 cellar will be constructed on the proposed lease to accommodate the wellhead equipment and blow-Out Preventer (BOP). The cellar will have a conductor casing installed with an auger and will be lined with cement. The cellar itself will be fenced at all time to exclude fauna ingress.

Controls:

- Infrastructure will be located and constructed in accordance with the Petroleum CoP
- Infrastructure located to avoid
    - areas of high conservation or habitat value, along with areas of cultural significance.
    - interfering with surface water flow pathways, drainage lines and watercourses
    - impacts to visual amenity and nuisance (light, dust and noise)
    - impacts on sensitive receptors such as pastoral leaseholders and the community.
- Land condition assessment completed to identify and avoid constraints, including field ecology and cultural heritage surveys.
- Weed surveys completed
- Weed management plan developed and will be implemented with all equipment washdown and certified prior to mobilisation.
- Weed officer nominated
- An erosion and sediment control plan will be developed and implemented.
- Clearing predicted to occur during periods of low erosion risk
- Clearing activities to align with the NT Land Clearing Guidelines
- Topsoil to be stripped up to 150mm to preserve soil structure
- Clearing area restricted to the minimum required for the activity
- Construction on sloped areas avoided.
- Cellar to be fenced to prevent fauna ingress.
- Spotter catcher utilised for clearing of high-density vegetation

4.1.2 Drilling sump

A drilling sump will be constructed on the cleared lease pad to support drilling operations. Drilling sumps are engineered to store drilling fluids, muds and drill cuttings.

An overview of the anticipated sump design is provided in Appendix B. The sump surface will be rolled and compacted, with a Coletanche liner installed. Coletanche is a composite liner consisting of 5 different layers composing of:

- A highly resistant anti-root film able to withstand puncturing by vegetation or rough substrates
- Glass fleece which ensures dimensional stability
- A non-woven geotextile reinforced structure which is highly resistant to tearing, and puncturing
- A elastomeric bitumen binder ensures that the geotextile is waterproof and resistant to ageing
- A coating of sand ensures that workers can move on the surface in all weather conditions in order to carry out maintenance work. It also provides a rough surface which allows coverage of the membrane by soil

The coletanche liner product data sheet is provided in Appendix B. Coletanche was selected based upon the following:

- Easily installed and shaped to fit sump geometry
- High resistance to tearing/puncturing and to hydrostatic pressures
- Low water permeability, with a 6.10^{-14} m/s permeability
- Can withstand high temperature fluctuations

The entire lease pad will be fenced to prevent stock and fauna from accessing the sump.

Controls:

- The drilling sump will be lined with an impermeable liner (Colentanche)

4.1.3 Access tracks

The majority of access tracks used to access the site have been previously approved under the Kyalla 117 N2 Water Monitoring Bore EMP. The new disturbance covered under this EMP is restricted to the construction of a total of 650m access track linking the existing approved access track to the new lease and upgrading the intersection with the Stuart Highway. A schematic of the access track and intersection upgrade is provided in Appendix B.
Access tracks will be constructed with provisions for a 6m formed surface as per the NTG Standard Drawings (CS3003) for Typical Cross Section for Rural Environment – Pastoral Access Road 2 (refer Appendix A with a 2m road shoulder to accommodate spoon drains.
The new access track will not cross any major waterways or creeks

It is anticipated that the new disturbance associated with access track and intersection constructed would be approximately 0.9 ha.

The access tracks will be gravelled and regularly maintained to ensure continued access to the site.

Controls:

- Access to the lease pad will primarily be via the existing access tracks
- New access track construction to be kept to a minimum; in accordance with the NTG Standard Drawings (CS3003) for Typical Cross Section for Rural Environment – Pastoral Access Road
- Land clearing undertaking in accordance with the NT Land Clearing Guidelines.
- Land condition assessment completed to identify and avoid constraints, including field ecology and cultural heritage surveys.
- Erosion and sediment control plan to be developed and implemented
- Access tracks to comply with the NT Performance and Design standards for Northern Territory (2017) Government Roads and NT Typical Cross Sections For Urban and Rural Environments
- A traffic management plan will be implemented and road corridor permit will be obtained from DPIL to manage all works within the Stuart Highway corridor.

4.1.4 Gravel Pits

Gravel will be sourced from existing approved gravel pits located in Table 6. The existing approval for these pits was made under Kyalla 117 N2 Water Monitoring Bore EMP. Gravel pits will be constructed to an area of 50x50m, with an anticipated depth of 3m. It is anticipated that up to 10,000m3 of gravel will be required for the lease pad and new access track.

Upon cessation of activities, the gravel pits will be recontoured back to a stable, safe and non-polluting form. Topsoil will be reinstated across the gravel pit and natural revegetation used as the primary vegetation reinstatement measure.

Table 6 gravel pit locations

Exploration Permit	*Station*	*Zone**	*Approx Easting*	*Approx Northing*
EP117	*Hayfield/Shenandoah*	*53*	*340044*	*8134587*
EP117	*Hayfield/Shenandoah*	*53*	*345516*	*8134625*
EP117	*Hayfield/Shenandoah*	*53*	*350881*	*8134097*
EP117	*Hayfield/Shenandoah*	*53*	*360929*	*8135028*

Controls:

Gravel pits will:

- be backfilled and re-contoured to minimise water retention
- have topsoil reinstated to allow for natural revegetation.
- be left stable and safe for wildlife and the community.

4.1.5 Fly Camps

Due to the remote location of the activity, temporary portable fly camps will be used to support the activity. The fly camps will consist of a series of caravans (or similar) with all wastewater, sewerage and rubbish being removed from site for offsite disposal routinely.

All fly camps will be located in existing disturbed areas and will not require additional clearing.

4.2 GHG Emissions

Total greenhouse gas (GHG) emissions generated during civil activities are anticipated to be approximately 547.5tCO2e (tonnes of Carbon Dioxide equivalent) for the duration of the activity. As outlined in Table 7, the majority of emissions are associated with land clearing.

Table 7 Civil Activity Greenhouse Gas emissions estimation

Activity	Approximate volume	Approximate tCO2e^	Estimate methodology and assumptions
Land Clearing	6.6 Ha	507	Transport Authorities Greenhouse Group Greenhouse Gas workbook for Road Projects: Appendix E Vegetation Emission Methodology
Diesel combustion- during civil activities	25KL of diesel	40.5	Diesel estimated using historic civil and water bore drilling multiplied by NGERS emission factor.
Total		547.5	

^ Based on Global Warming Potential (GWP) of 25tCO2e/tCH4 (Clean Energy Regulator 2016)

Controls:

Fly camps will be:

- Temporary, self- contained with all wastes removed from site routinely
- Be located in existing disturbed areas

4.3 Water Supply and Use

It is estimated that approximately 20ML of water will be used to support the civils construction program over a 3-month period. This water will be used for the construction of roads (~10ML), the lease pads (8ML) and for dust suppressions (~2ML). Approximately 0.1ML of Drinking water will be sourced and trucked in to site from Darwin.

All groundwater will be sourced from the Gum Ridge formation, with a contingent supply to be sourced from the Anthony Lagoons formation if required.

Water sourced for the civils operation will be extracted from the existing control groundwater monitoring bore (RN040895) that was installed on the Kyalla 117 N2 site to monitor baseline groundwater quality prior to the commencement of future drilling and stimulation activities.

A water extraction licence will be obtained covering the proposed water take under this EMP. The current water extraction licence application is for 140ML each year for the 2019/2020 and 2021 period. Groundwater extraction volumes will be recorded and submitted to the Water Resources division: water.regulation@nt.gov.au and in accordance with the requirements of the relevant groundwater extraction licence.

Using the information available from groundwater bore records and previous exploration drilling activities, a prognosis of stratigraphic depths has been compiled for Kyalla 117 N2 lease site. The nearest groundwater bores to Kyalla 117 N2 are RN27940 and RN27941, located 16km to the northeast and RN34480 located 17km to the northwest. All three bores were constructed across the CLA with reported yields of 2.5 L/sec for RN34480 and 10L/sec for RN27940 and RN27941. Pumping tests were undertaken on RN27940 and RN27941 to determine sustainable bore yields and aquifer hydraulic parameter, transmissivity (T). Reported T values for the two bores were 8,161m^2/day (RN27940) and 851m^2/day (RN27941) indicating a CLA has a very high permeability at this location.

To assess the potential impact on groundwater levels at the nearest groundwater bores caused by cumulative groundwater extraction from the CLA at Kyalla 117 N2 for civil and future drilling and HFS activities, a simple analytical model was generated using the Theis (1935) analytical solution. The model was generated using the following inputs;

- 16km to the nearest groundwater bore
- Continuous discharge of 25L/sec (2.16ML/d) for 30 days (conservatively above the predicted total water take)
- T value of 851 m^2/day (lower value from 2 nearest bores used for conservatism)
- Storativity (S) of 0.00056 (reported for CLA in Fulton & Knapton (2015))

The modelling predicts no drawdown at the nearest bores after 30 days of continuous pumping with a 0.1m drawdown radius extending to 10km from Kyalla117 N2. The modelling indicates there would be no impact on the nearest groundwater users due to extraction from the CLA at Kyalla 117 N2 for exploration activities.

Controls:

- ✓ Water use will be minimised to only cover what is needed to perform the activity
- ✓ Water extraction rates for the Civil activities under this EMP will be restricted to <20ML
- ✓ Surface water will not be used during exploration activities.
- ✓ All water takes for petroleum activities will be licenced in accordance with the NT Water Act provisions.
- ✓ Water will not be extracted within 1km of an existing pastoralist bore.
- ✓ Impacts on pastoralist bores are not anticipated.

4.4 Chemicals

Fuels and chemicals are anticipated to be utilised during the civils work program. The majority of chemicals and fuels area associated with diesel and minnow volumes of oils, coolants and degreasers used to undertake routine field servicing. The estimated fuel and chemicals to be used are:

- Diesel (field storage up to 5000L at a time)
- hydraulic oil, coolant and engine oils (minor field storage volumes up to 250L each)
- degreasers and domestic cleaning chemicals (<50L of each).

Controls:

- ✓ Any refuelling or field servicing to not be within 100m of a watercourse
- ✓ All wastes oils, coolant, chemicals and contaminated material to be removed from site and disposed of at an approved facility by a licenced waste contractor in accordance with the NT Waste Management and Pollution Control Act.
- ✓ Double lined diesel storage tanks to be used
- ✓ All chemical field storages to have secondary containment
- ✓ Chemical storage areas to be inspected routinely, with uncontaminated stormwater removed from site to be disposed of at a licenced facility.

4.5 Waste Management

Waste management methods for the proposed exploration program are summarised in Table 8. Wastes are managed in accordance with the internationally accepted guide for prioritising waste management practices with the objective of achieving optimal environmental outcomes. Waste will be managed in accordance with the following hierarchy principals:

1. **Avoid:** eliminate the generation of wastes through design modification
2. **Reduce**: reduce unnecessary resource use or substitute a less resource intensive product or service.
3. **Re-use**: reuse a waste without further processing
4. **Recycle**: recover resources from a waste
5. **Treatment:** treat the waste to reduce the hazard of the waste prior to disposal
6. **Disposal**: disposal of waste if there is no viable alternative.

The volume of civil's related waste is likely to be small, in the order of less than a 1000kg in total. All wastes, specifically listed wastes (as described in Schedule 2 of the Waste Management and Pollution Control (Administration) Regulations (1998)) generated as part of the regulated activity will be removed from the proposed

activity area, for disposal or recycling at a licensed facility authorised to receive those wastes (as summarised in the NT Listed Waste Company Summary spreadsheet). Waste transfer certificates will be retained and provided to DENR upon completion of the project.

It is anticipated that all civil generated waste requiring disposal will be small, requiring up to 5 tonnes of material to be disposed/recycled of at the Katherine landfill. Where the Katherine landfill cannot take recycle or dispose of a waste, alternative disposal facilities within the Territory or interstate will be utilised.

Controls:

- ✓ Origin will follow the waste management hierarchy to prioritise the prevention of creating wastes.
- ✓ Waste will be managed in accordance with the NT Waste Management and Pollution Control Act
- ✓ Listed wastes will be tracked and disposed of at a licenced facility by approved transporters.

Table 8 Waste and disposal methods

Activity	Indicative volumes	Disposal Method
Sewage, grey and storm water	2000L per day of grey and sewerage wastewater	All Sewage to be collected and transported offsite at a licenced disposal facility. Grey water disposed of on-site in accordance with Department of Health requirements. All stormwater will be released to grade in compliance with the following: • is uncontaminated with hydrocarbons or other chemicals • is not released to watercourses or waterways • the release will not cause environmental harm (soil erosion or vegetation damage). • All contaminated stormwater will be captured and disposed of offsite at a licenced facility.
Food waste, paper and plastic	**10kg/day**	**Disposal:** Collected in dedicated waste bins for transport to an approved landfill
Glass and cans	**1kg/day**	**Recycled:** Collected in separate waste bins for recycling at an offsite facility
Chemical bags and cardboard packaging materials	**<100kg in total**	**Recycled:** Compacted and collected at rig site for transport to a licenced recycling centre
Scrap metals	**<1 tonne total**	**Recycled:** Collected in designated skip for recycling at an approved location
Used chemical and fuel drums	**<0.5 tonnes total**	**Recycled:** Collected in designated skip for recycling at an approved location
Chemical wastes	**<100kg total**	**Re-use/disposal** Collected in approved containers for disposal at approved landfill or returned to supplier or recycled
Timber pallets	**<1 tonne total**	**Recycled:** Recycled at an approved facility.
Vehicle tyres	**<1 tonne total**	**Disposal:** Disposed of at an approved landfill
Oily rags, oil contaminated material,	**<100kg total**	**Recycled/ Disposal**: Oil from machinery or encountered during drilling will be collected

Activity	Indicative volumes	Disposal Method
filters and other hydrocarbon material		in suitable containers for disposal at approved landfill or recycled at an approved recycling facility.

4.6 Weed Management

Exploration activities are undertaken in accordance with Origin's Beetaloo Weed Management Plan (WMP). This plan has been developed in accordance with the Weed Management Planning Guide: Onshore Shale Gas Developments Project. Weed surveys have confirmed the proposed area of activity has an extremely low presence of weeds. Efforts will therefore focus on both eliminating the potential introduction weeds into the region and preventing the spread of existing weeds.

Routine weed inspections will be undertaken of disturbed areas. Where a weed outbreak is identified, management measures will be implemented in consultation with DENR as per the WMP.

Controls:

Weed control strategies will include:

- ✓ A Weed Management Plan (WMP) has been developed and submitted to DENR
- ✓ A dedicated weed officer responsible for overseeing weed management activities
- ✓ Selection of civil construction equipment from local suppliers- with equipment sourced from Queensland the least preferred option.
- ✓ All equipment brought onto the exploration permit shall be washed down and certified clean prior to entry.
- ✓ Equipment will be inspected and certified where movements are proposed to clean areas.
- ✓ Monitoring and maintenance activities will be undertaken pre-and post-wet season to identify and treat weed infestations.

4.7 Rehabilitation

Once a determination has been made to decommission an asset, a site-specific rehabilitation plan will be developed for each disturbed area. Transfer of ownership of an asset to a pastoralist for beneficial use will be the priority rehabilitation strategy. This will primary be for water extraction bores, viable gravel pits, access tracks and lease pads which may represent a potential asset to the pastoralist. Before considering a transfer of ownership, the following will be considered:

- Undertaken an assessment of the current status of the asset and whether it can be beneficially used by the local pastoralist. Where a beneficial use is anticipated, identify works required to be undertaken to ready the asset for transfer (i.e. any repairs, site remediation, equipment removal etc.)
- Obtain written consent from the pastoralist agreeing to take the ownership of asset and document any stipulated liabilities
- Where an asset cannot be beneficially utilised, the site shall be rehabilitated using assisted natural regeneration back to a safe, stable, non-polluting landform consistent with surrounding land use. This may include
  - Removal of all weeds and contaminated materials/ wastes
  - Re-spreading of stockpiled topsoil
  - Reshaping the site to as close to natural form as possible
  - Ripping or scarifying any compacted surface
  - Spreading seed of suitable local native species determined through analogue sites representative surrounding vegetation communities.
  - Liaise with the DENR to confirm the rehabilitation strategy
- Any seed supply and rehabilitation services will be sourced using Indigenous suppliers as a priority.

- Where rehabilitation is required, rehabilitation success criteria shall be developed and submitted to DENR as a part of the final rehabilitation plan. Rehabilitation site success is identified in comparison to analogue sites with the same pre-disturbed vegetation and soil units.
- Success criteria for areas requiring rehabilitation shall be included in the rehabilitation plan submitted to DENR. It is anticipated that the success criteria shall be measured with regards to the following measurement criteria (as agreed with DENR in the final rehabilitation plan):
    - Landholder and DENR agree in writing that the land supports the pre-disturbance land use
    - Soil suitability and stability is equivalent to the surrounding soil unit
    - No subsidence or erosion evident for at least 5 years
    - A minimum of 80% foliage cover and diversity of analogue sites is maintained in the rehabilitated sites for at least 3 years
    - Maintain a density of habitat structures (litter cover, fallen woody material and hollow logs etc.) similar to analogue sites.
    - Maintenance is no greater than that required for the land prior to its disturbance.

Where a site is rehabilitated, monitoring will be undertaken annually to assess the rehabilitation success and determine where additional remedial works are required.

4.8 Monitoring program

The monitoring programs to be implemented as a part of the Kyalla 117 N2 civil program are summarised in Table 9. The data collected during these programs is designed to collect data to validate the measurement criteria outlined in Section 7.5.

Table 9 Kyalla 117 N2 Monitoring Program Summary

Program	Monitoring locations	Parameter	Frequency	Method	Monitoring criteria
Groundwater Monitoring Program	Kyalla 117 N2 Control monitoring bores^	Water Level	Continuous	Level logger	Section 7.5.3
Erosion and sediment control	All areas that have been disturbed/ utilised by Origin activities	Visual inspection of infrastructure and erosion and sediment controls to detect the presence of erosion and sedimentation from infrastructure	Pre and post wet season	Visual inspections	Section 7.5.1
Weeds	All areas that have been disturbed/ utilised by Origin activities	Visual inspection of disturbed areas pre and post wet season- as per Origin's Weed Management Plan	Pre and post wet season.	Visual inspections	Section 7.5.5
Rehabilitation	All rehabilitated areas	Inspection of all rehabilitated areas for vegetation cover, weeds,	Annually	Visual inspections	Section 7.5.4

Program	Monitoring locations	Parameter	Frequency	Method	Monitoring criteria
		erosion and sedimentation.			

^ the closest landholder bore is >16km from the extraction bore located on the Kyalla 117 N2 lease pad. Monitoring will therefore be restricted to these bores.

4.9 Proposed contractors and equipment list

The civil construction program will occur 7 days a week from the hours of 6am to 6pm. The contractors and list of equipment is provided in Table 10.

Table 10 Contractor equipment list

Task	Contractor	Crew List	Equipment and Machinery
Civil Activities			
Civil Construction	Out tender	2 x Origin Supervisors (HSE + Construction) 1 x Project Manager/Project Engineer (Contractor) 1 x Site superintendent (Contractor) 6 x Plant operators 2 x Truck drivers 2 x Fencing contractors 1 x Surveyor	Excavator x 2 Dozer x 2 Grader x 2 Roller x 2 Water Cart x 2 Haulage trucks (Water and/or gravel) Bob cat (Fencing contractor) 3 x Light 4wd vehicles

4.10 Timeframes

The civil construction activities are likely to commence between May and June 2019. Following the completion of the civils program, the drilling, stimulation and well testing of Kyalla 117 N2-1 will likely commence activities from June 2019 onwards. The drilling, stimulation and well testing program is outside of the scope of this EMP.

Table 11 Anticipated activity dates

Activity	Estimate Start Date
Civil Construction Works (This EMP)	May – June 2019
Drilling (not covered under this EMP)	June- August 2019
Stimulation (not covered under this EMP)	July- September 2019
Well Testing (not covered under this EMP)	August 2019-August 2020

5 Description of the existing environment

A Land Condition Assessment (LCA) was completed in August 2018 to gather baseline information on the current ecological environment within the proposed lease areas and associated access tracks.

A summary of the LCA is provided as follows, with the full LCA included in Appendix C

5.1 Physical Environment

5.1.1 Climate

The climate of the permit areas is arid to semi-arid, with rainfall decreasing in frequency and quantity from north to south. The climate is monsoon influenced, with a distinctive wet and dry season experienced through the year.

Rainfall in the north of the permit area is recorded at 681 mm at Daly Waters. The southern portion of the permit area records an average annual rainfall of 536 mm at Newcastle Waters and 602 mm listed at Elliott. Approximately 90% of the rainfall occurs during the Wet Season between the months of December to march.

The area is characterised by a net precipitation deficit of between -1800 to -2150mm per year.

5.1.2 Geology

The Beetaloo Basin comprises a thick sequence of flat-lying mudstone and sandstone formations (Roper Group) that were deposited between 1,500 and 1,430 million years ago (Ma). The Roper Group is estimated to reach 5,000 m in thickness in the centre of the basin and with the exception of the north and eastern margins occurs at an average depth of about 500 m. The Roper Group is overlain by the Georgina Basin (630 – 497 Ma), which includes widespread basalts and a thick limestone sequence that forms the Cambrian Limestone Aquifer (CLA), a significant water supply aquifer. The Georgina Basin is capped by Cretaceous mudstone and sandstone (145 – 66 Ma) and recent alluvial and laterite deposits.
The Kyalla Formation, dominated by grey and black siltstone and shale, is separated from the Velkerri Formation by the Moroak Sandstone. The Kyalla and Velkerri formations share some similar characteristics, although the Kyalla Formation is neither as thick or as enriched in organic carbon. Organic richness within the Kyalla Formation is generally confined to the lower member; the target of the 2019 Kyalla 117 N2-1 exploration well. The middle and upper Kyalla members provide an effective geological barrier to any HFS in the organic rich lower Kyalla. The effectiveness of geological barriers to fracture height growth can be assessed with geomechanical data from core analysis, wireline log data and modelling.

5.1.3 Soils

The Sturt Plateau bioregion covers an area of 103,857 km and comprises undulating plains on sandstones, with mostly neutral sandy red and yellow earth soils (ANRA, 2008).

The soil types located within the plateau range from the very strongly leached lateritic soils of the Tertiary land surface to the calcareous deserts soils and desert loams in the southern drier areas.

The lateritic plains, located within EP98 and the northern part of EP117, are classed as very strongly leached soils of the Tertiary land surface. The three main soil types located within the permit area, include:

Tertiary Lateritic Red Earths, which occur on the gently undulating topography. The soil profile can be described as:

- **A-Horizon** Grey-brown sandy loam
- **B-Horizon** Reddish brown sandy clay loam
- **C-Horizon** Red-brown to red light clay, overlying heavy ferruginous gravel and massive laterite

Tertiary Lateritic Red Sands, which occur on gently undulating to undulating topography of the Tertiary Lateritic Plain, formed from sandstones and complex parent materials of the deep sandy soils. The soil profile can be described as:

- **A-Horizon** Grey-brown to brown sand
- **B-Horizon** Brown sand
- **C-Horizon** Red-brown to yellow-brown sand overlying pisolitic ferruginous gravel and massive laterite. Altered colouring of highly siliceous parent sandstone is only evident in the mottled and pallid zones.

Tertiary Lateritic Podzolic Soils, formed on the gently undulating topography over a variety of rocks. These soils are located in the northern section of the Barkly Basin. The soil profile can be described as:

- **A-Horizon** Grey sand
- **B-Horizon** Yellowish-grey sand
- **C-Horizon** Yellow-grey sandy loam with ferruginous gravel overlying massive laterite, mottled and pallid zones.

Other areas of Black Soil Plains are located within the Barkly Tablelands, including EP76, the southern part of EP117 and a small section of EP98.

Geotechnical investigations have confirmed the proposed lease sites consist of red silty sand with some gravel pieces. The surface soils collected during the field survey indicated the soils were slightly acidic (ph range of 5.0

to 6.2) across the permit area. A dispersion test was also undertaken on the samples which indicated that the soils were non-dispersive and maintained their shape when submerged in water.

Table 12 present the erosion risk rating based on average monthly rainfall using the rating system provided in the IECA (2008) Table 4.4.2 for Daly Waters. The construction activities are anticipated to commence following the wet season from April 2019 onwards. The overall risk of erosion is considered very low.

Table 12 Erosion Risk Rating based on average monthly rainfall at Daly Waters

-Item	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	165.4	165.4	120.1	23.6	5.0	5.6	1.5	1.7	4.9	22.5	59.4	110
Erosion Risk*	H	H	H	VL	VL	VL	VL	VL	VL	VL	M	H

** E = Extreme (>225 mm); H = High (100+ to 225 mm); M = Moderate (45+ to 100 mm); L = Low (30+ to 45 mm); VL = Very Low (0 to 30 mm)*

5.1.4 Topography, Surface water and Drainage

The proposed Kyalla 117 N2 lease sites all fall within the Wiso River Basin. The topography of the two sites have low relief and surface water flow ultimately drains in a south and south westerly direction. The Wiso River Basin covers the southern half of EP98 (south of the Carpentaria Highway) and the majority of EP76 and EP117 and is internally drained by Newcastle Creek and a number of small ephemeral creeks. Newcastle Creek is approximately 60km to the south of the lease pad and ultimately flows into Lake Woods, which is located south of Newcastle Waters Station. Lake Woods covers an area of inundation of approximately 50,000 ha in normal rainfall years, extending to 80,000 ha in exceptionally wet years, after which it can retain water for several years (HLA, 2005). Lake Woods is described as a major quasi-permanent surface water body in the region, although some semi-permanent and many ephemeral waterholes are located across the permit area (HLA, 2006b).

There are no major creek in the proposed area that are likely to potentially be impacted by the proposed activities. A number of small ephemeral streams (Stream Order 1 and 2) are located along the existing access tracks. The streams are overland flow paths that only flow for a short period during the wet season. During heavy wet seasons, large areas of the internal drainage systems are flooded, with the proposed area likely to remain dry as it is higher than the surrounding areas.

During the wet season, it is likely the broader region could experience widespread surface flooding, to a depth of 30 cm, which has previously been identified by debris being collected on fence lines (HLA, 2005). The design of the lease pads will divert any overland flow around the lease.

5.1.5 Hydrogeology

Within the project boundary, groundwater use is primarily from the Cambrian Limestone Aquifer (CLA) with minor, localised use from other formations where shallower groundwater is intersected or where the CLA is not saturated. This includes;

- overlying Cretaceous sediments where it is saturated in the central-south of the Beetaloo Basin;
- the Antrim Plateau Volcanics in the north-west, and;
- the Bukalara Sandstone in the north-east.

Table 13 summarises the hydrostratigraphy of the Beetaloo Basin. A schematic of the proposed future exploration well in the context of the underlying geology Kyalla 117 N2 site is provided in Figure 5.

Across parts of the Beetaloo Basin, undifferentiated Cretaceous deposits form the uppermost aquifer are targeted for stock use. Notably, a basal sandstone unit immediately overlying the CLA produces yields of up to 5 L/s. Shallow, perched groundwater has also been recorded in the laterised zone within the permit area with groundwater levels recorded between 1 and 6 mbgl. These systems are dynamic with periodic saturation resulting from recharge during the wet season with no documented groundwater use. The CLA, comprising the Gum Ridge Formation and the Anthony Lagoon Beds, is an extensive regional aquifer system that forms the principal water resource in the Beetaloo Basin. Limestone in the CLA is commonly fractured and cavernous; regionally bore yields of up to 100 l/s have been recorded from this aquifer. Approximately 80% of groundwater bores drilled in the basin screen the CLA and the aquifer supplies water for the pastoral industry and local communities including Elliot, Daly Waters, Larrimah and Newcastle Waters. The CLA contains a significant but largely undeveloped groundwater resource with the sustainable yield from the Georgina Basin estimated to be in the order of 100,000 ML/year (NALWTF, 2009). Existing groundwater use in the Beetaloo Basin is estimated at 6,000 ML/year.

The Antrim Plateau Volcanics underlies the CLA in the north and central part of the Beetaloo Basin. Across much of the Basin it consists of sequences of massive basalt flows with negligible primary porosity. In the north-west of the Basin, where the formation is shallow and fractured, it forms a marginal aquifer, however reported use is primarily from a sandstone sequence at the contact with the Gum Ridge Formation. There is no reported use within the three petroleum exploration permits held by Origin.

The Bukalara Sandstone forms a localised, fractured and weathered aquifer where it outcrops beyond the north-east margin of the Beetaloo Basin. The formation consists of quartz sandstone with shale interbeds and probable enhanced permeability in these areas due to jointing within the sandstone. No use is reported from the formation away from the northeast margin of the Beetaloo Basin where it is discontinuous and at considerable depth,

The regional groundwater flow direction in the CLA is north-west toward Mataranka, where the aquifer discharges into the Roper River and supports significant groundwater dependent ecosystems including the Roper River at Elsey National Park and Red Lily/57 Mile Waterhole. These discharge features occur around 100 km north-west of the Beetaloo Basin. Dry season flow in the Roper River has been gauged at 95,000 – 126,000 ML/yr and provides an estimate of the magnitude groundwater discharge from the CLA. Large decadal changes in the discharge to the Roper River suggest that most recharge input occurs close to the discharge zone (i.e. beyond the Beetaloo Basin region). Groundwater recharge mechanisms to the CLA are poorly characterised but are likely to be dominated by infiltration through sinkholes and preferential recharge through soil cavities.

Limited information exists on the hydrogeological characteristics of the Roper Group sequence as it occurs at depth within the Beetaloo Basin. Sandstone dominated formations may behave as aquifers, however, drilling results suggest these formations have limited potential as groundwater resources due to their depth, low permeability and high salinity. Groundwater in the Roper Group is highly saline and contrasts with the shallower, utilised aquifers in which groundwater is generally of drinking water quality.

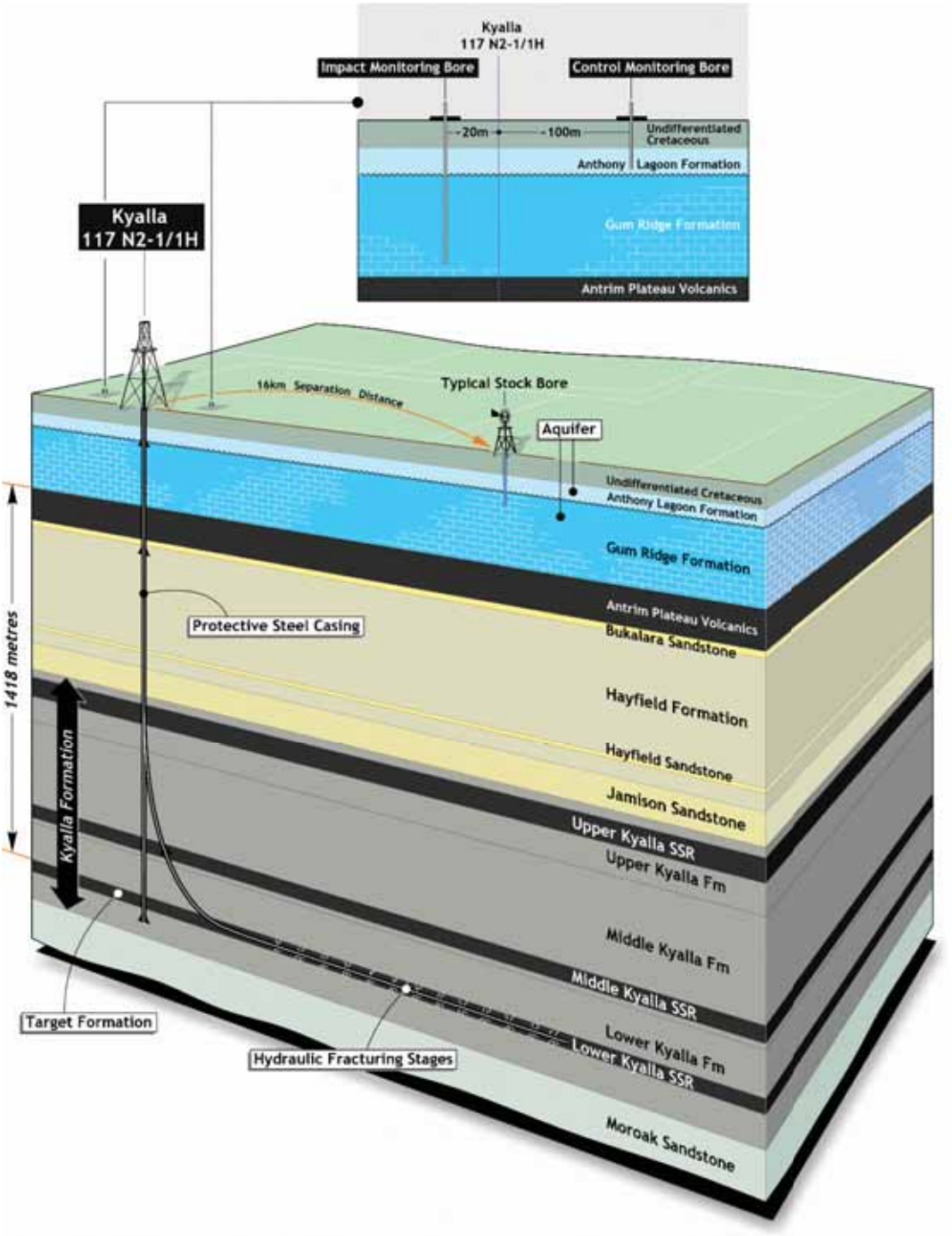


Figure 5 anticipated hydrogeological sequences at the Kyalla 117 N2 site

Table 13 Summary of Beetaloo Basin Hydrostratigraphy

Province	Period/Age	Formation		Aquifer Status	Thickness (m)	Yield (L/s)	Ave EC (□s/cm)
CARPENTARIA BASIN	CRETACEOUS 145 – 66 Ma	Undifferentiated		*Local Aquifer*	0 - 130	0.3 - 4	1,800
GEORGINA BASIN	CAMBRIAN 497-630 Ma	Cambrian Limestone Aquifer (CLA)	Anthony Lagoon Beds	REGIONAL AQUIFER	0 – 200	1 - 10	1,600
			Gum Ridge Formation	REGIONAL AQUIFER	0 – 300	0.3 - >20	1,400
		Antrim Plateau Volcanics		REGIONAL AQUITARD	0 – 440	0.3 - 5	900
		Bukalara Sandstone		*Local Aquifer (not regionally connected)*	0 – 75	0.3 - 5	1,000
BEETALOO BASIN (ROPER GROUP)	NOT KNOWN	Hayfield Mudstone		REGIONAL AQUITARD	0 – 450	-	32,000
		Jamison Sandstone		*Local Saline Aquifer*	0 – 150	-	138,000
	MESO-PROTEROZOIC 1,430-1,500 Ma	Kyalla Formation		REGIONAL AQUITARD	0 – 800	-	-
		Moroak Sandstone		*Local saline aquifer*	0 – 500	0.5 - 5	131,000
		Velkerri Formation		REGIONAL AQUITARD	700 – 900	-	-
		Bessie Ck Sandstone		*Local Aquifer (not regionally connected)*	450	0.5 - 5	-

5.2 Biological Environment

5.2.1 Bioregions

Two bioregions occur within the Origin permit areas:

- the Sturt Plateau bioregion; and
- the Mitchell Grass Downs bioregion.

The 2019 proposed lease sites all fall within the Sturt Plateau Bioregion which comprises undulating plains on sandstone, with predominantly neutral sandy red and yellow earth soils. Dominant vegetation associations included extensive areas of Lancewood (*Acacia shirleyi*) - Bullwaddy (*Macropteranthes kekwickii*) vegetation and associated fauna, including the Spectacled Hare-Wallaby (*Lagorchestes conspicillatus*). Land condition in the bioregion is moderate to good but is threatened by impacts from weeds, feral animals, pastoralism and changed fire regimes.

5.2.2 Vegetation Communities

Vegetation communities within the permit areas have been ground-truthed during baseline assessments in 2004, 2006 (HLA, 2006; 2006c), 2010, 2014, 2016 (AECOM, 2011; 2014; 2016) and more recently in August 2018. The August 2018 survey focused on the full extent of areas to be impacted by Origins proposed exploration activities.

The proposed infrastructure location has been evaluated through detailed habitat assessments which included identification of vegetation community, dominant flora species at each strata, habitat condition, disturbance factors (fire, weeds, erosion, feral fauna species), and fauna attributes (e.g. tree hollows, logs, grass cover, mistletoe abundance). The area of the proposed activity (specifically the Kyalla 117 N2 site) is characterised as *Corymbia* low woodland/*Terminalia* (mixed) sparse shrubland/*Chrysopogon* (mixed) low tussock grassland. This vegetation community is considered regionally extensive and not subjected to extensive clearing. A summary of the survey of the proposed Kyalla 117 N2 site has been summarised in Table 14.

The approximate 30 km of existing access track to be used during the program is predominantly surrounded by the same vegetation unit as Kyalla 117 N2, with patches of Bullwaddy and Lancewood, including at the proposed entrance off the Stuart Highway, as well as a very minor stands of Melaleuca low open wood and mixed acacia woodlands.

5.2.3 Flora

A total of 805 plant species have been recorded within the wider region, and during the August 2018 survey 28 dominant flora species were identified. As the survey was conducted during the late dry season, grasses and other annual species were difficult or impossible to identify due to the lack of inflorescence or because they had already died-back.

No Commonwealth or NT threatened plant species were identified as occurring by the Protected Matters Searches or NRM Infonet search. One species, the prostrate, herbaceous vine *Ipomoea argillicola*, is listed as Near Threatened under Section 29 of the *Territory Parks and Wildlife Conservation Act 2000* (TPWC Act) and could potentially occur in the project sites, although has not been reported in previous and current surveys. The NT flora data base shows that this species has been recorded from the Bullwaddy Conservation Reserve and at locations surrounding the area in previous searches (AECOM, 2015).

The region supports fragmented stands of Bullwaddy, which is listed under the TPWC Act as 'Least Concern', which refers to species that are either widespread or common and cannot be categorised as Critically Endangered, Endangered, Vulnerable, Near Threatened or Data Deficient. However, Bullwaddy is significant in terms of the habitat it provides for a range of native species. The extent of Bullwaddy in the permit area is far more extensive than that indicated by the NT Herbarium records.

5.2.4 Weeds

Regional Weed Management Plans (RWMP) have been developed for areas of the NT, with the Barkley and the Katherine RWMP overlapping Origin's Beetaloo exploration tenure.

The weeds species of high risk of introduction or spread through Origins activities are listed in Table 15. These high-risk weeds have been determined through consideration of the following criteria:

- weed species that has been confirmed in the area within the relevant RWMP or through field surveys
- weed species listed in a RWMP that is in close proximity to Origin tenure
- weed species is at risk of introduction through the use of machinery sourced from other regions in the NT or from other states.

Weed baseline surveys were completed by AECOM in August 2018 covering all proposed access tracks and lease pad areas. These surveys were completed with the DENR Weed Officer.

No weeds were identified along the existing access track or proposed infrastructure areas. *Parkinsonia aculeata* (Parkinsonia) and *Calotropis procera* (Rubber Bush) has been previously identified along/in close proximity to the Beetaloo W1 exploration well access track; which is approximately 30km south of the proposed areas. Parkinsonia is considered a Weed of National Significance (WoNS), which are weed species that are the focus of national management programs for the purpose of restricting their spread and/or eradicating them from parts of Australia.

The absence of weeds suggests good habitat condition in the areas of the proposed activity. Primary controls for this program will therefore be focused on preventing the introduction of weeds and managing any weeds promoted through site disturbance.

Additional information on the full list of weeds and control measures for the development are provided in the Beetaloo Weed Management Plan**.**

Table 14 Kyalla 117 N2-1 Condition Description

Site ID	Kyalla 117 N2-1	Habitat photos at central point of survey site (August 2018)
Location	-16°50' 29.01, 133°39' 0.16	   
Landform and soil	Plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils	
Habitat type	*Corymbia* low woodland	
Vegetation Community	*Corymbia* low woodland/*Terminalia* (mixed) sparse shrubland/*Chrysopogon* (mixed) low tussock grassland This vegetation community is considered regionally extensive and not subjected to extensive clearing.	
Dominant flora species	Canopy dominated by *Corymbia dichromophloia, Eucalyptus setosa*. Shrub layer including *Acacia ancistrocarpa, Alphitonia pomaderroides, Brachychiton paradoxus.* Ground layer species include *Triodia bitextura*	
Habitat condition	Good condition with evidence of recent grazing. Vegetation appeared to have been heavily burnt in recent years. No evidence of hollow bearing trees and logs. The habitat contained moderate to high refuge opportunities in the form of dense leaf litter, tussock grass cover, and woody debris. Good continuous cover adjoining adjacent woodland habitat and regionally extensive. No evidence of weeds or feral animals.	**Additional Habitat Photos across survey site (August 2018)**
Potential Listed Threatened Species	Grey Falcon, Northern Shrike-tit, Plains Death Adder, Gouldian Finch.	
Weeds	No *Weeds of National Significance present*	

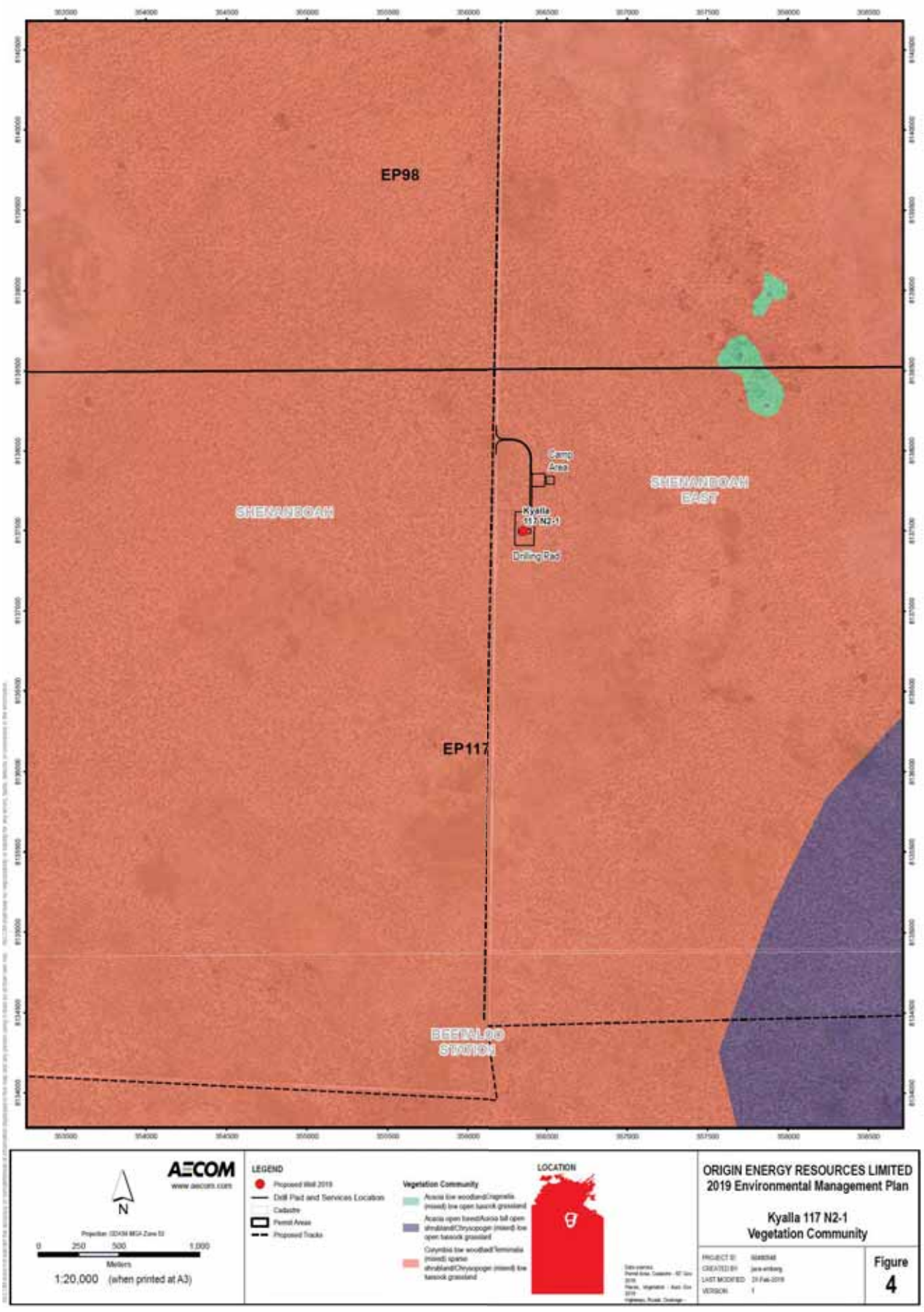


Figure 6 Vegetation communities surrounding the proposed Kyalla 117 N2 Lease pad

Table 15 High priority weeds to be managed or prevented within the permit area

Scientific Name	Common Name	Status	Priority reason
Acacia nilotica	Prickly Acacia	Class A, WoNS	Mapped in the exploration lease within the Katherine RWMP
Andropogon gayanus	Gamba Grass	Class A WoNS	Mapped in the exploration lease within the Katherine RWMP
Calotropis procera	Rubber Bush	Class B and C	Mapped in the exploration lease within the Barkly RWMP
Hyptis suaveolens	Hyptis	Class B and C	Confirmed within exploration lease during previous weed Origin surveys
Jatropha gossypiifolia	Bellyache Bush	Class A, WoNS	Mapped in the exploration lease within the Katherine RWMP
Parkinsonia aculeata	Parkinsonia	Class B and C, WONS	Confirmed within exploration lease during previous weed Origin surveys and Mapped in the exploration lease within the Katherine RWMP
Prosopis pallida	Mesquite	Class A and C, WONS	Mapped in the area surrounding exploration lease within the Katherine and Barkly RWMP
Themeda quadrivalvis	Grader Grass	Class B and C, WoNs	Mapped in the area surrounding exploration lease within the Katherine RWMP. High potential introduction through sourcing of equipment from Katherine area.
Xanthium occidentale	Noogoora Burr	Class B and C	Weed Management Branch – Mapping data DLRM databases (DLRM *et al* 2018)
Parthenium hysterophorus	Parthenium	Class A and Class C, WoNS	Potential introduction through equipment sourced from QLD.

5.2.5 Fauna

Previous surveys and database searches indicate that the exploration area is an important area for a diverse array of fauna. The NT Fauna database provides records for the following fauna species (excluding migratory birds): 32 species of mammal, 198 species of birds, 96 species of reptiles and 19 species of frogs. Surveys undertaken elsewhere within the region have recorded:

- 78 bird, 33 reptile, 11 mammal and six frog species in the Bullwaddy Conservation Reserve (PWCNT, 2005)
- 148 bird, 47 reptile, 21 mammal and six frog species in the Junction Stock Reserve and nearby Newcastle Waters (Fleming et al., 1983)
- 157 bird species within the project area as determined by a search of the Birds Australia bird atlas database (Birds Australia, 2010).

The Eucalypt/Corymbia woodland at these proposed locations provides habitat for a range of species. The areas has high native grass cover and included numerous species suitable for granivorous birds (seed eaters). Dense leaf litter and numerous logs provide suitable refuge and foraging sites for fauna such as reptiles. Many of the sites have a high density of hollow-bearing trees that provide important habitat for many fauna species. Although most of the species found in this vegetation type are widespread in the tropical savannas of the Northern Territory, some such as the threatened Crested Shrike-tit (*Falcunculus frontatus whitei*) are rare and known to utilise this habitat (DoTEE, 2014, Ward, 2008).

In the broader area, Savanna grasslands and open woodland provide suitable habitat for species such as Emu (*Dromaius novaehollandiae*) and Australian Bush Turkey (*Ardeotis australis*. Drainage lines and seasonally inundated grasslands may also provide habitat for migratory species during the wet season and are breeding areas for frogs. The proposed activity will have limited the disturbances in these areas.

The location of the infrastructure has been placed to minimise the clearing on areas of high value habitat (such as large hollow-bearing trees) to reduce any impact to native wildlife within the permit area. Due to the regional extensiveness of the vegetation communities and limited scale of disturbance, impacts to fauna have been assessed as unlikely.

5.2.6 Significant Fauna

A search of the DotEE Protected Matters database of nationally significant fauna (PMST), the NT Government fauna database (NRM Infonet), and records from the Atlas of Living Australia (ALA) was undertaken for the proposed lease areas and access tracks. The search results indicate the potential presence of 20 fauna species listed as threatened under the EPBC Act and/or the TPWC Act. These included ten birds, eight mammals and two reptiles.

The likelihood assessment of species occurrence is based on the availability of suitable habitat within the permit area, records in the vicinity and distributional data. Therefore, many of the threatened and migratory fauna species indicated in databases as 'occurring' or 'likely to occur' have been assessed as *unlikely to occur* within the proposed lease areas. As some areas in the proposed lease area have not been subject to intensive survey and some species are very cryptic, a conservative approach has been taken to assess species presence. A full description of each species, their distribution and habitat associations are outlined in the AECOM Land Condition Report (Appendix C)

No core habitat for threatened fauna was identified at the sites. However, some species may possibly occur and are known to occur in the wider landscape. Threatened species that may possibly occur include:

- Gouldian Finch *Erythrura gouldiae* (E-EPBC Act, VU-TPWC Act)
- Crested Shrike-tit (northern) *Falcunculus frontatus whitei* (VU-EPBC Act, NT-TPWC Act)

Research has shown that critical components of suitable habitat for the Gouldian Finch include suitable nesting trees during the breeding season (particularly *E. tintinnans*, *E. brevifolia* or *E. leucophloia*), a water source and a diverse range of favoured annual and perennial grasses (DoE, 2015). No nesting habitat was recorded during the surveys and it is unlikely this species breeds in close vicinity of the sites. During the wet season Gouldian Finches move from breeding habitat on hillsides with suitable trees down to lower lying areas where they forage on perennial grasses such as *Triodia* sp., *Alloteropsis semialata*, and *Chrysopogon fallax* (Palmer *et al*. 2012). Some of the perennial grasses were recorded during recent surveys so potential foraging habitat is present; however, there are limited records in the vicinity of the sites suggesting it is not an important area for this species.

The Crested Shrike-tit lives in dry Eucalypt forests and woodland where it feeds on insects from the canopy and also under bark (Ward, 2008). It has been recorded in wet Melaleuca open woodlands, woodlands dominated by Nutwood (*Terminalia arostrata*), Bloodwoods with flaky bark and ironwood (DoE, 2014, Ward, 2008). In the NT, nesting has been recorded from September through to January and nests are built in terminal branches at the top of trees (Ward *et al*., 2009). The stronghold of this species is north of this location and only one old record exists near Borroloola. Although it is possible this species may be present in the area, it is unlikely to represent an important area for this species and the impact of the proposed activities, given their size, would be small.

The Grey Falcon (*Falco hypoleucus*) is a widespread species listed as Vulnerable in the NT that is considered possibly to be present in the study area. The Painted Honeyeater (*Grantiella picta*) has been known to occur in the study area, however, given it does not breed in the NT it would only be present intermittently for foraging. Based on the field assessment there was no breeding habitat recorded, and depending on grass seed and water availability it is unlikely the study area comprises core habitat for this species.

5.2.7 Feral and Pest Animals

Feral animals known to occur within the region include:

- Pig (*Sus scrofa*)
- Wild Dog (*Canis lupus familiaris*)
- Feral Cat (*Felis catus*)
- Cane Toad (*Bufo marinus*)
- Horse (*Equus caballus*)

- Donkey (*Equus asinus*)
- Water Buffalo (*Bubalus bubalis*)
- Camel (*Camelus dromedarius*)
- Black Rat (*Rattus rattus*)
- Domestic Cattle (*Bos Taurus*)

During the August 2018 survey evidence of cattle grazing in present or 1-2 years previously was recorded and in previous surveys of the permit area cat tracks were observed as the only non-native species recorded but based on records many species, especially Dogs/Dingo, Pigs and Cane Toads will be present in permit area. The disturbance from cattle within the proposed sites were considered to have resulted in less than 5% damage or no damage at all.

5.3 Fire Regime

Fire is a natural occurrence in most Australian ecosystems and plays an important role in their ecology. Fire is generally excluded from Mitchell grasslands by pastoral management in order to maintain forage throughout the dry season (HLA, 2005) whereas fire is more frequent in the Sturt Plateau.

Fire disturbance was evident at Kyalla 117 N2 during the ecological surveys, with evidence of an intensity 4 (some trees and shrubs killed) and Height 1-4 m fire present 1-2 years previously. It was noted that the site showed evidence of fire disturbance and were showing signs of regrowth and recovery.

5.4 Environmental and Cultural Sensitivities

5.4.1 Native Title

Two Native Title claims have been determined as non-exclusive and one Indigenous Land Use Agreement (ILUA) are current over the permit areas (see Table 16).

Table 16 Native Title and IULA Agreements Current for the Permit Areas

Type	Well	Name	Summary
Native Title	Kyalla 117 N2-1	NTD21/2010 Shenandoah Pastoral Lease	Native Title exists in parts of the determination area and is held by the Kinbininggu and Bamarrngganja groups
Indigenous Land Use Agreement	All Sites	D12004/014 Jingaloo CLA ILUA	Registered for Community Living Area and Tenure resolution

The Native Title Petroleum Exploration Agreement between Origin and the NLC includes clauses for the protection of sacred sites, objects and sensitive areas related to Aboriginal activities in the area, including cultural, hunting and foraging activities. Site clearance will occur prior to any on ground activities. The Native Title Agreement also includes clauses for the protection of the environment and site rehabilitation.

5.4.2 Archaeology Assessment

An archaeological assessment, involving searches of the NT Heritage Register and Australia Heritage Database and a field survey, have been carried out by AECOM archaeologist, Luke Kirkwood for the exploration sites and associated tracks. It should be noted that this survey covers additional sites that are not in the scope of this EMP.

A search of the NT Heritage Register identified 41 Aboriginal archaeological sites within a 125 km by 125 km area that encompasses the full Proposal area. No archaeological sites are recorded within 15 km of the proposed 2019 lease areas.

A search of the Australia Heritage Database identified that no statutory listed heritage places within the proposed impact areas.

The field survey involved a combination of both pedestrian and helicopter survey of the proposed disturbance areas. During the inspections notes were taken on landform, ground surface visibility and areas of exposure. The aim of the field survey was to identify any surface expressions of Aboriginal archaeological and cultural heritage values within the exploration area. Photographic records were taken at each proposed location.

No culturally sensitive landforms or artefacts were identified during field survey of the lease sites covered under this EMP.

The archaeological assessment is provided in Appendix D.

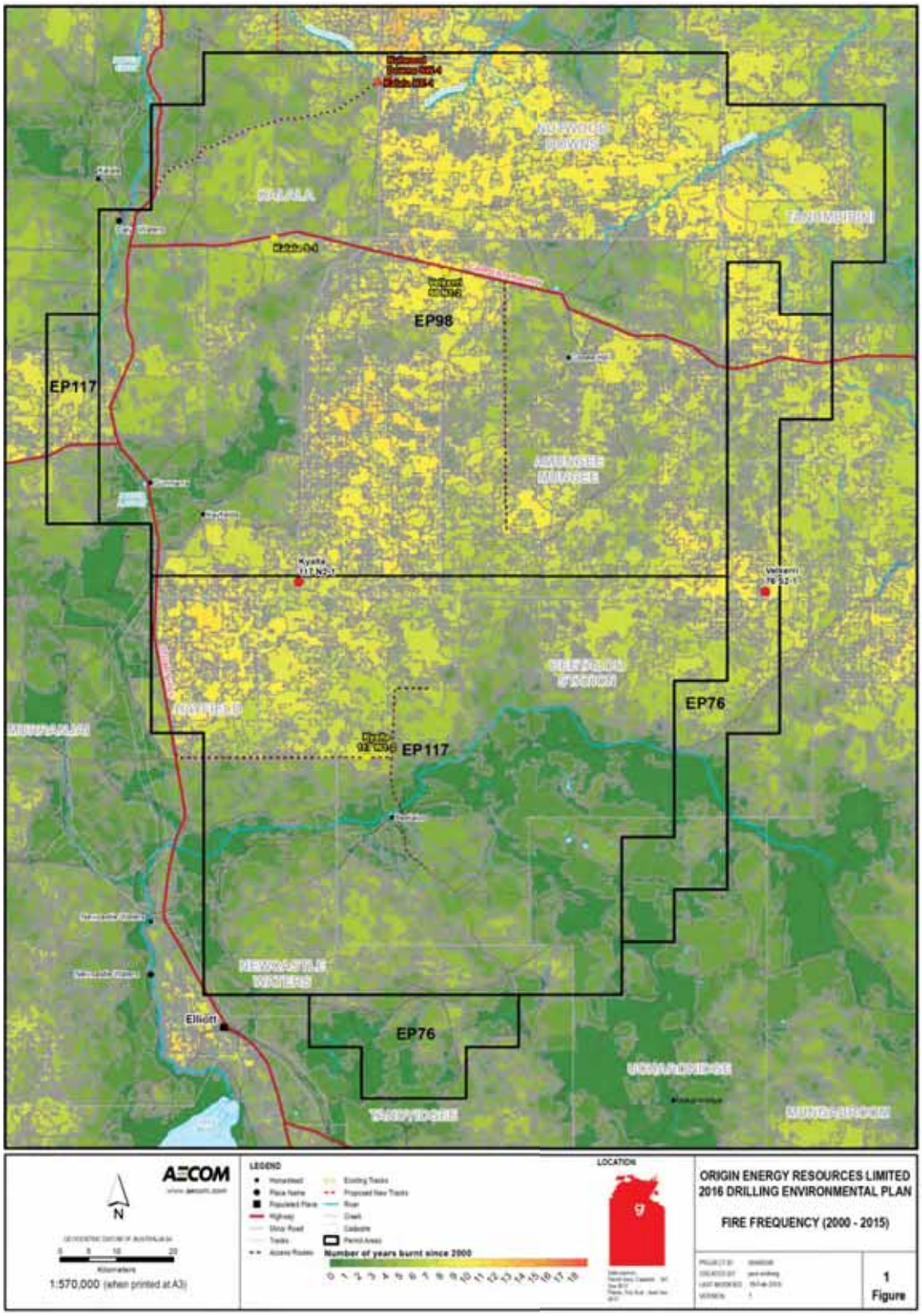


Figure 7 Fire frequency map of the Beetalo Basin

5.4.3 Areas of Cultural Significance

Sacred sites in the study area are primarily associated with drainage lines; natural landform features and stock routes, but there are also concentrations of sites nearby to old homesteads. The distribution of these sites may

reflect historical patterns of Indigenous movements along drainage lines and subsequent development of stock routes on old Indigenous walking trails, or they may merely be indicative of the site clearance work undertaken along roads and tracks in the area. It is suspected that there will be a range of other sites also within the area, either not yet recorded, or known but not reported for cultural reasons.

AAPA clearance certificate C2019/014 have been obtained for the proposed Kyalla 117 N2 site and associated activities. These clearance certificates will be provided to DENR/DPPIR as a part of the submission.

Origin has committed to comply with conditions as prescribed by AAPA for the duration of the program.

5.4.4 Natural Resources

In addition, previous cultural heritage surveys of the permit areas were undertaken with representatives of the traditional owners who identified a number of natural resources of importance to Aboriginal people of the area (Table 17).

Table 17 Natural Resources of Importance in the Permit Areas

Scientific Name	Common Name	Usage
Grewia retusifolia	Emu-berry/Dog's Balls, Turkey Bush and Diddle Diddle	Fruit eaten. Leaves can be boiled, and body bathed in the liquid for treatment of a number of ailments
Marsdenia australis	Bush Banana/Gillibi	Bush 'fruit' eaten when young, as it matures 'fruit' seeds becomes feathery for dispersal in the wind and are not eaten
Pterocaulon sp.		Used for treating flu
Acacia sp.	Acacia	Leaves boiled and used to treat the flu
Acacia holosericea	Soapbush Wattle or strap wattle	Leaves used for washing
	Termite (unknown species)	Mounds pulverised and mixed with water, used to treat diarrhoea

5.4.5 Non-Indigenous Heritage

In 1860 explorer John McDougall Stuart was the first European to penetrate the area now known as the Centre. The first written descriptions of the area come from Stuart during his second attempt to cross the continent from south to north (HLA, 2005).

Development in the area began as pastoral lands with an increased interest in land settlement following the completion of the Overland Telegraph Line in 1873. Most attempts were unsuccessful with the Lancewood-Bullwaddy vegetation found to be impenetrable and the lack of surface water making the land unsuitable for cattle. Daly Waters was thus recognised as one of the last watering stops on the Murranji Stock Route.

It wasn't until the 1930s to 1950s, that the area saw regional economic growth with Daly Waters becoming a significant hub of air and mail services into the Territory. The wartime years saw this role increase with Daly Waters again playing a major role in cross country transport and communication. This role continued until the early 1970s when the airport was closed to commercial traffic. The town and surrounding areas subsequently reverted to a primarily agriculture-based existence following the decline of air travel, but in recent times has seen commercial interest from the exploration for gas in the Beetaloo Sub-basin and the growth of the 'grey nomad' tourism market.

5.4.6 Historic Heritage Assessment

A search of relevant historic heritage registers identified a number of historic heritage sites within a 125 km by 125 km area that encompasses the full proposal area. No previously identified sites are located within 20 km of the proposed lease area. No new sites of historic heritage were identified during the August 2018 surve

5.4.7 Protected or Conservation Areas

There are no conservation reserve, national parks, world heritage places, Commonwealth land or heritage places or critical habitat areas listed under the *EPBC Act* located within or adjacent to the proposed exploration area.

5.5 Social Environment

5.5.1 Social Context

The proposed 2019 work programme will occur within the Barkly Regional Council area, which covers 323,514 km^2. The approximate population is estimated for the Barkly Region of 8,137 people (Barkly Regional Council, 2018).

The potential social and economic effects within the region where exploration activity for 2019 is planned is is considered to be negligible.

The closest neighbouring regional towns and communities identified as being within proximity to Origin's activities include:

- Dunmarra (~30kms)
- Tennant Creek (~290kms)
- Elliott (~80kms)
- Daly Waters (~70kms)
- Newcastle Waters (~60kms); and
- neighbouring pastoral leases of Amungee Mungee and Beetaloo.

In 2014, the Tennant Creek Regional Economic Development Committee (REDC) released the *Tennant Creek and Barkly Region Strategic Action Plan (2014-2016)* identified social and economic development within the region, including oil and gas development. Origin has met with the REDC annually with its most recently project update meeting taking place in Tennant Creek on 27 September 2018.

5.5.2 Pastoral Activity

The current land use in the project area is pastoral with varying stocking rates and varying management practices. Within the permit area there are nine pastoral properties as shown in Table 18. All of the land within the permit area is Leasehold Land. There is one small area of Aboriginal Freehold land known as Jingaloo on EP117.

Table 18 Pastoral properties in the Permit Area

Pastoral Property	Permit Areas		
	EP76	EP98	EP117
Amungee Mungee	✓	✓	✓
Kalala		✓	✓
Tanumbirini	✓	✓	
Beetaloo	✓		✓
Hayfield/Shenandoah		✓	✓
Ucharonidge	✓		✓
Tandyidgee	✓	✓	
Nutwood Downs		✓	
Newcastle Waters			✓

The project area has been subject to pastoral activities for over 150 years (AECOM, 20). The average size of a Station in the Barkly Region is 8,186 km^2 (Bubb, 2004), which is large by global standards.

The proposed Kyalla 117 N2 exploration site is located on the Hayfield Shenandoah Station.

The activity will not have any impact on adjacent Pastoralists.

5.5.3 Other Land Uses in the Area

A range of other land-uses exist in the permit area or in the larger region, including a range of public utilities and facilities. These include the following:

- Tourism – Tourism is an important regional industry with the Sturt Highway being a major thoroughfare for tourists travelling in the area during the dry season. The local townships of Daily Waters, Dunmarra and Elliot provide consumables (food, fuel etc.) and accommodation. A number of heritage areas of importance to regional tourism are located in the broader region, including Elliott, Newcastle Waters and other heritage listed homesteads.
- Road networks – The Stuart Highway and Carpentaria Highway will be used to access the sites. In addition, there are numerous gravel roads connecting properties, and internal property tracks. All properties also have firebreaks on their boundaries and internally.
- Gas pipeline – A gas pipeline runs to the west of the Stuart Highway, along the eastern boundary of EP117 and crosses the boundary of one part of EP98. It also runs parallel with the Carpentaria Highway to the Gulf of Carpentaria, through EP98 and EP76.
- Alice Springs to Darwin Railway – The railway line runs to the west of the gas pipeline and Stuart Highway, and does not cross into any of the permit areas.
- Townships – The townships of Daly Waters and Dunmarra neighbour EP98 to West.
- Conservation areas – including the Bullwaddy Conservation Reserve, which lies within EP98 and Lake Woods and the Junction Stock Reserve just outside the permit area.
- Heritage – There are seven heritage sites within the exploration permit area and a number of heritage areas of importance to regional tourism located in the broader region, including Elliott, Newcastle Waters and heritage listed homesteads.
- Archaeological sites – The permit areas have a long history of Aboriginal association and 41 archaeological sites have previously been recorded within the permit areas, as well as registered sacred sites and areas of significance.

The proposed activities covered under this plan have been specifically designed to avoid impacts to these receptors.

6 Stakeholder Engagement

The NT Petroleum (Environment) Regulations define *stakeholder* as meaning:

(a) a person or body whose rights or activities may be directly affected by the environmental impacts or environmental risks of the regulated activity proposed to be carried out; or

(b) an agent or representative of a person or body mentioned in this paragraph (a).

Origin's directly impacted/affected stakeholders have, and continue to be, consulted in a respectful, open and consistent manner. This has been the case since 2014, when Origin assumed operatorship of EP98, EP117 and EP76.

Origin's consistent approach to stakeholder engagement has been to ensure that those persons and/or groups directly impacted/affected and/or influenced by permit commitments, have received Origin's full attention. Origin views the understanding of these consenting stakeholders and their informed consent of critical importance and relevance during these early stages of limited small-scale exploration activities.

For the purpose of this EMP, Origin identifies its stakeholders, in compliance with the Petroleum (Environment) Regulations as:

- **host Traditional Owners** recognised as the Native Title holders and / or claimants in Table 13 and their representative the Northern Land Council as described in Exploration Agreements between the parties for EPs 117, 76 and 98;
- **host Pastoralists** recognised as the nine Pastoral Lease Stations in Table 18 above.

Origin also recognises and engages - where appropriate and acceptable - with the following list of stakeholders:

- Northern Territory community and residents
- Federal Government; Departments, Members of Parliament and Opposition Spokespersons
- Northern Territory Government; Departments; Members of Parliament and Opposition Spokespersons
- Local Government Agencies
    - Katherine Town Council

    - Barkly Regional Council
    - Roper Gulf Regional Council
    - Regional Economic Development Committees
- Northern and Central Land Councils
- Environmental Protection Authority
- Aboriginal Areas Protection Authority (AAPA)
- National, State and Local Media (Print, TV and Radio)
- Australian Petroleum, Production and Exploration Association (APPEA)
- Northern Australia Development Office (NADO)
- Northern Territory Cattlemen's Association (NTCA)
- Industry Capability Network (ICN)
- Chamber of Commerce NT
- Business Council of Australia
- Minerals Council
- CSIRO / GISERA
- NGOs
- Darwin Major Business Group (DMBG)
- Energy Club Northern Territory (ECNT)
- Indigenous Business Network NT (NTIBN)
- Katherine Mining Services Association (KMSA)

During engagement to date, Origin has shared information and data in relation to the four existing wells as well as Origins plan to complete an additional five wells in order to comply with the work programme commitment to the Northern Territory government.

All activities to date have had the written consent of the pastoral leaseholders who, as with Origin, do not hold exclusive rights of over shared land.

Land Access Agreements (LAAs) with the host Pastoralists for the activities contained in this EMP has been obtained for the 2019 work programme.

Origin has not received objections from leaseholders or Native Title claimants in the area of the planned exploration activity.

In accordance with Schedule 1, Part 3, Section 9(1)(a) of the Petroleum (Environment) Regulations, a list of directly impact stakeholders and their engagement is provided at Appendix E.

6.1 Community Engagement

Stakeholder (directly impacted) and community engagement for the 2019 work programme has been held with host Traditional Owners and host Pastoralists directly affected by the proposed activity. Origin's proposed exploration program has been clearly communicated to interested parties, with several written submissions and video presentations prepared for the NT Inquiry. Information included in Origins submission to the NT Inquiry is publicly available at https://frackinginquiry.nt.gov.au/submission-library

Native Title holders / custodians completed Sacred Site Clearance Surveys in August / September 2018 for nine potential locations where Origin is proposing to undertake activities covered under this EMP. The formal NLC Sacred Site Avoidance Report / Anthropological Report dated 15 November 2018 was provided to the Aboriginal Areas Protection Authority in order for them to process Origin's AAPA Applications for the Kyalla 117 N2

exploration areas and associated infrastructure. The AAPA certificate C2019/014 was subsequently granted covering all of Origin's proposed activities.

Origin recognises the growing community interest in ensuring onshore natural gas development takes place in a safe and environmentally sound way. Origin is committed to delivering operational excellence (which encapsulates its health, safety and environmental performance) and complying with legislative and regulatory frameworks.

6.2 Ongoing Stakeholder Engagement

For the purposed of the activities covered under this EMP, Origin's ongoing stakeholder engagement is:

- Pastoral Lease holders (Host Pastoralists) - Frequency and type of engagement as per Access Agreements including but not limited to :
    - Monthly check in and update (email and telephone)
    - Face-to-face meetings (minimum six monthly) or as required pending activity
    - Provision of formal documentation and information as required and / or requested (also as per notifications clauses within the Access Agreement)
- Native Title Holders (host Traditional Owners) - Frequency and type of engagement as per Exploration Agreements including but not limited to
    - Annual work plan meetings (x7) April 2019
    - Provision of 2020 potential programme (June 2019)
    - Sacred Site Clearance and Avoidance Field Surveys (September 2019)

The level of engagement with community groups outside of the directly affected members will increase as the level of certainty around the commerciality of the resources within the Beetaloo Basin increases. Careful, timely and considered engagement is required to avoid boom and bust type situations created through unnecessary hype or speculation.

7 Environmental Risk Assessment

7.1 Origin's Risk Management Approach

Origin utilises a robust risk management process for all its activities to achieve the following key outcomes:

- Risks are understood, eliminated or reduced and controlled to an acceptable level.
- Controls are owned, assured and continuously reviewed for effectiveness.
- All activities are compliant with regulatory standards and are guided by best practice,
- Origin and its stakeholders are confident in the way activities are conducted to manage risks, and
- The approach aligns with the findings of the NT inquiry final report and associated recommendations (as implemented via the various Codes of Practice or legislation)

Risk management processes are mandated through the Origin Risk Management Policy and Directive, which includes a risk rating toolkit that is utilised from the Board through to frontline activity owners (Figure 8). The toolkit considers the requirements of ISO 31000 and addresses risk identification, assessment and management.

Assessment of risk is completed using Origin's Risk Matrix (Figure 9) to assess and rate risks by assessing the combination of frequency of occurrence and the severity of the outcome of a potential event, including a worst case scenario event. This allows quantification of a risk and determination can then be made about whether the risk can be accepted, or whether further mitigation is required.

Origin risk management processes requires regular assessment of underlying (unmitigated) risk from an activity, the residual risk once controls are applied, the effectiveness of controls (provided in Table 19) and the likelihood and consequence of a risk event. A risk is either accepted in accordance with strict delegations of authority or the activity does not proceed.

In addition, the risks associated with unconventional gas developments activities have been thoroughly investigated and reported by the NT Inquiry. A series of risks and recommended mitigation measures were outlined to reduce the likelihood of any impacts to an acceptable level. These recommendations have been incorporated into various Codes of Practice and changes in legislation to ensure a high level of environmental protection across the industry. This ensures risks are assessed and mitigated in a consistent manner, to provide

greater certainty to the community that the risks associated with exploration activities are being reduced to an acceptable level.

Table 19 Risk control effectiveness definition

Rating	Explanation
Effective	• Controls are well designed and address the root cause/s of the risk • Controls are recognised industry best practice • All controls operate at the required level • All controls are within the power of Origin, with few external factors beyond control • Ongoing monitoring required
Can Be Improved	• Majority of controls are well designed and address the root cause/s of the risk • Majority of controls operate at the required level • Some controls are outside the power of Origin, with multiple external factors beyond control • Ongoing monitoring required • Certain controls can be improved or have elements below industry best practice.
Must Be Improved	• Most controls are not well designed and do not address the root cause/s of the risk. • Most controls are not operating to the required level. • A large number of controls are outside the power of Origin, with multiple external factors • The majority of controls require improvement and are well below industry best practice.

7.2 Risk Acceptance Threshold and ALARP

A risk can be considered to have been reduced to 'as low as reasonably practicable' (ALARP) when all reasonably practicable control measures (both preventative and mitigative) have been identified and implemented to reduce the risk of identified events. A key element of demonstrating ALARP is that good practice is followed, where good practice is defined as the recognised risk management practices and measures that are used by competent organisations to manage well understood hazards arising from their activities. This definition incorporates good practice as defined in codes and standards, and a consensus of good practice within the industry. ALARP is not a final position over the life of an asset or project.

The practicability and the reasonability of control measures can change over time due to changes in technology (that can make measures more readily available), industry standards (that can commoditise once-cutting-edge technology) and the socio-technical landscape (that can modify societal expectations).

In the NT context, ALARP and the definition of acceptable risk levels was a key feature of the NT Inquiry Final Report. For each aspect, acceptability criteria were defined, with recommendations outlined to reduce the potential risk to below the acceptable level. With the adoption of all recommendations by the NTG, the new Codes of Practice and associated regulatory changes provides a high level of inherent protection to ensure activities are undertaken in a safe and consistent manner.

Through adoption of the recommendations of the NT Inquiry (along with other risk management and legislative requirements), Origin can demonstrate all environmental impacts and environmental risks associated with its activities will be reduced to a level that is as low as reasonably practicable and acceptable.

Figure 8 Origin's risk tool kit which describes the approach to identify, assess, control, treat and accept risks

Origin Risk Rating Toolkit

How to use this toolkit

Step A – describe the risk
Identify and describe the risk in terms of what could happen, its causes and potential effect/impact on Origin's objectives.

Step B – identify and assess controls
Identify and assess existing controls using the Control Assessment Ratings. Consider any related significant incidents, near miss events and assurance activities when assessing controls.

Step C – assess the level of consequence
Decide on the level of consequence that best represents the risk. Determine the highest credible consequence level in all relevant consequence categories in the Risk Matrix, taking into account current control assessment.

Step D – assess the likelihood of the risk
Determine the likelihood level in the Risk Matrix that represents the chance of the risk occurring at each consequence level identified, taking into account current control assessments.

Step E – determine a level of risk
Use the Risk Matrix to determine the level of risk.

Step F – determine the priority for risk treatment and approval
Using the Risk Treatment and Acceptance Criteria, determine the risk treatment required and who can approve/accept the risk at its current level.

Step G – assess the potential maximum consequences
Estimate the potential maximum consequence (plausible worse case level assuming all current controls fail) using the consequence categories.

Control Assessment Ratings

Rating	Explanation
Effective	▪ All controls are well designed and address the root cause/s of the risk. ▪ All controls operate to the required level. ▪ Ongoing monitoring required.
Can be improved	▪ Majority of controls are well designed and address the root cause/s of the risk. ▪ Majority of controls operate to the required level. ▪ Certain controls can be improved. ▪ Ongoing monitoring required.
Needs to be improved	▪ Majority of controls are not well designed and do not address root cause/s of the risk. ▪ Majority of controls do not operate to the required level. ▪ Majority of controls require improvement.

Risk Treatment and Acceptance Criteria

Level of risk	Action required	Acceptance authority
VERY HIGH	▪ Risk treatment must be in place immediately ▪ Review risk quarterly at a minimum	EMT member*
HIGH	▪ Risk treatment must be considered (having regard to current business priorities) ▪ Review risk annually at a minimum	General Manager
MEDIUM	▪ Risk treatment may be considered ▪ Review risk two yearly at a minimum	Group/Asset/ Project Manager
LOW	▪ No risk treatment required ▪ No ongoing review required unless determined by the relevant Group Manager	Site/Activity Manager

* Managing Director acceptance required for risks with a Catastrophic consequence and Likely or above Likelihood

Figure 9 Origin's Risk Matrix

Risk Matrix

CONSEQUENCE	IMPACT ON ORIGIN OPERATIONS – Conduct Business with Due Care: People	IMPACT ON ORIGIN OPERATIONS – Conduct Business with Due Care: Environment and Community	IMPACT ON ORIGIN OPERATIONS – Create Value: EBIT	IMPACT ON ORIGIN OPERATIONS – Create Value: Cash flow	IMPACT ON ORIGIN OPERATIONS – Create Value: NPV	EXTERNAL RESPONSE – Decisions are Subject to Scrutiny: Stakeholder Perceptions	EXTERNAL RESPONSE – Decisions are Subject to Scrutiny: Laws, regulation and civil actions	LIKELIHOOD: 1 REMOTE (<1% chance of occurring within the next year. Only occurs as a '100 year event' or less frequent.)	2 HIGHLY UNLIKELY (<10% chance of occurring within the next year. Could occur within decades.)	3 UNLIKELY (<30% chance of occurring within the next year. Could occur within the next few years.)	4 POSSIBLE (<60% chance of occurring within the next year. Could occur within months to years.)	5 LIKELY (<90% chance of occurring within the next year. Could occur within weeks to months.)	6 HIGHLY LIKELY (Likely to happen multiple times a year)
6 CATASTROPHIC	Multiple fatalities ≥4 or life threatening illness or total permanent disability to a large exposed group (10 or more people)	Extensive permanent damage to endangered species, habitats, ecosystems or area/s of cultural significance Extensive irreversible loss of community livelihood. Long-term social unrest and outrage	>$200m	>$1b	>$1.5b	Multiple stakeholder groups confirming coordinated action, as reflected in media channels with significant reach and influence (eg. scheduled blockade or boycott covered in media for more than 1 week).	Criminal charges against any director or senior executive involving jail or loss of right to manage the company. Public inquiry – requiring considerable resources and Executive Management time. Loss of licence to operate an asset	HIGH	HIGH	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH
5 CRITICAL	1 – 3 fatalities or life threatening illness or total permanent disability to a small exposed group (<10 people)	Extensive long term partially reversible damage to vulnerable species, unique habitats, ecosystems or area/s of cultural significance Extensive reversible loss of community livelihood. Prolonged community outrage.	>$50m - $200m	>$250m - $1b	>$375m - $1.5b	Multiple stakeholder groups mobilising and encouraging others to take action, as reflected in media channels with significant reach and influence (eg. social media campaign calling for protest, escalating over several days).	Criminal charges against any director, senior executive or senior manager not involving jail or loss of right to manage the company. Prolonged major litigation – exposure to significant damages / fines / costs. Suspension / restriction to operate an asset.	MEDIUM	MEDIUM	HIGH	VERY HIGH	VERY HIGH	VERY HIGH
4 MAJOR	Injury or illness to one or more persons, resulting in permanent partial disability	Long term reversible impacts to listed species, habitats, ecosystems or area of cultural significance Significant impacts to community cost of living, business viability or social wellbeing. High levels of community tension.	>$20m - $50m	>$100m - $250m	>$150m - $375m	More than one stakeholder group's opinion or view influencing other stakeholders, reported through media channels with some reach and influence (eg. government comments in national media or in Parliament).	Criminal charges against any employee (not described above) Major litigation – exposure to damages / fines / costs.	MEDIUM	MEDIUM	MEDIUM	HIGH	VERY HIGH	VERY HIGH
3 SERIOUS	Injury or illness to one or more persons resulting in hospitalisation, 5 or more days lost time or alternative / restricted duties for 1 month or more	Serious medium term reversible impacts to low risk species, habitats, ecosystems or area/s of cultural significance Moderate impacts to community cost of living, business viability or social wellbeing. Moderate levels of community tension.	>$5m - $20m	>$25m - $100m	>$37.5m - $150m	More than one stakeholder group offering an opinion or view, reported through media channels with some reach and influence (eg. state based commentary lasting one 24 hour media cycle across internet, print, television, radio).	Non-compliance with conditions of licence to operate an asset or to conduct an activity. Litigation – exposure to damages / fines / costs.	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH	HIGH
2 MODERATE	Injury or illness to 1 or more persons resulting in medical treatment, up to 5 days lost time or alternative / restricted duties for up to 1 month	Moderate short term impacts to common regional species, habitats, ecosystems or area of cultural significance Small scale impacts to cost of living, business viability or social wellbeing. Isolated examples of community tension.	>$1m - $5m	>$500k - $25m	>$750k - $37.5m	A single stakeholder group drawing attention to an incident, issue or approach, conveyed though media channels with potential reach and influence (eg. some social media complaints or local media reports).	Moderate non-compliance with external mandatory obligations or breach of contractual or other legal obligations (not described above). Litigation possible.	LOW	LOW	MEDIUM	MEDIUM	MEDIUM	MEDIUM
1 MINOR	Injury or illness requiring first aid to 1 or more persons, or no treatment (record only)	Minor environmental or community impact - readily dealt with	>$100k - $1m	<$500k	<$750k	A person or organisation within stakeholder group signaling an interest in an incident, event or approach, using channels with limited reach or influence (eg. letter of complaint/commendation).	Minor non-compliance with external mandatory obligations or breach of contractual or other legal obligations.	LOW	LOW	LOW	MEDIUM	MEDIUM	MEDIUM

* Cash Flow - change from expectation over the life of the exposure. EBIT change from expectation over 12 – 18 month period.

7.3 Assessment of scientific uncertainty

The draft NT Petroleum Environmental Management Plan Guidelines (EMP Guidelines) requires an assessment of uncertainty as a part of the risk assessment process. The assessment of potential impacts and effectiveness of controls must demonstrate that the activities are carried out in a manner consistent with the Principles of Ecologically Sustainable Development (ESD) and the Precautionary Principle.

Impact and risk identification must include consideration of uncertainty regarding impacts and risks for the activity where a precautionary approach is appropriate. Uncertainty is high where confidence in the available information is low in identifying risk or the effectiveness of a management control. Additional baseline studies or other safeguards may be required to increase the accuracy of an assessment to determine the acceptability of a risk.

As per the Draft EMP Guidelines, scientific certainty is qualitatively assessed using a generic means of ranking the data available in accordance with Table 20 below. Considerations of uncertainty have been included in the risk assessment discussed in 7.4.

Table 20 Scoring system for Scientific Uncertainty (DEFRA, 2013).

Ranking Scientific Uncertainty	
Score	**Description**
Low (1)	• Comprehensive data with strong evidence in multiple peer reviewed data • Little disagreement between authors or experts • Considerable and consistent on-ground experience and/or monitoring
Medium (2)	• Some or incomplete data available • Evidence provided based on a small number of references • Authors or experts conclusions vary • Limited on-ground experience and/or monitoring
High (3)	• Scarce or no data available; evidence provided in unpublished reports • Few on-ground observations • Authors and experts conclusions vary considerably

7.4 Risk Assessment Outcomes

The environmental, heritage and social risks associated with the civil activities have been assessed utilising the Origin risk assessment framework described in Section 7.1. The detailed risk assessment presents the range of potential impact-causing activities, corresponding mitigation measures and residual risk ratings based on their assessed worst-case consequence and likelihood of occurrence. The assessment also cross referenced the various risk assessment outcomes in the NT Inquiry Final Report, to ensure consistency. Site specific conditions and cumulative impacts have also been considered during the assessment.

There were no residual risks above a medium risk ranking, with 31 out of the 40 risks identified as being considered low. The remaining medium risks identified were consistent with standard civil construction activities completed across the NT, being the potential spread of weeds, erosion and sediment control and ignition of bushfires from the proposed activities.

The level of uncertainty for each risk was also assessed. There was no uncertainty level above low, which is consistent with the knowledge of impacts associated with construction activities.

Table 21 provides a count of the post-treatment environmental risks associated with the civil construction program. A copy of the risk assessment is provided in Appendix F.

Table 21 Count of Post-Treatment Environmental Risks for the Drilling and Stimulation Program

	Residual Environmental Risk Level			
	Low	Medium	High	Very High
Count	31	9	0	0

7.5 Environmental Impacts and Environmental Risk Management Summary

The following section provides a summary of how any environmental impacts risks will be managed. The management summary tables include an overview of the environmental values, outcomes and potential impacts, along with the performance standards, measurement criteria and records for each environmental aspect. For aspects with multiple individual risks, these are summarised in the relevant aspect table with the highest residual risk being used.

Each table includes a statement of the residual risk, scientific uncertainty and ALARP. This is designed to provide certainty that the risks are being reduced to as low as reasonably practicable.

The risk assessment provided in Appendix F should be consulted where an overview of each individual risk is required.

7.5.1 Soils

Table 22 Environmental Values and Outcomes – Soils

Environmental Values	• Suitability and stability of land for existing uses (Erosion and Sediment Controls implemented). • Stability of land to preserve existing water quality, landscapes and ecosystems.	
Environmental Outcomes:	• Avoid, minimise and control, soil erosion and discharge of sediment or soil into waterways or established drainage systems • Minimise disturbance of soil, vegetation and drainage during site activities • Minimise the creation of dust.	
Activity	**Environmental impacts and environmental risks**	**Primary risk management controls**
Civil construction of access track, lease pads and camp pads	• Localised soil contamination • Soil erosion and sedimentation	• Land condition assessment completed to identify and avoid sensitive soil unit. • Erosion control measure to be implemented and maintained as per erosion and sediment control plan (NT-2050-15-MP019). • Fuel, lubricants and chemicals will be stored appropriately in lined and bunded areas and transported, handled and used in accordance with the relevant MSDS. • Spill kits will be in place and clean-up equipment will be onsite and available in relevant areas. • All solid and regulated waste to be removed from the site and disposed of as per the NT WMPCA. • Following completion of the activity, disturbed areas to be restored and/or rehabilitated. • Disturbed areas to be will be monitored for weed infestation, and progress towards specified rehabilitation goals.
Environmental performance standards	• Code of Practice for Petroleum Activities in the Northern Territory Part A- Surface Activities • NT Land Clearing Guidelines. • International Erosion Control Association Best Practice Erosion and Sediment Control (BPESC) standard • Dangerous goods will be stored, handled, separated and signed as required by the NT Dangerous goods Act and Flammable and Combustible Liquids Regulations and AS1940.	

Measurement criteria:	• Land disturbance is equal to or less than 6.6ha. • No incidences of contamination and erosion and sedimentation that result in material environmental harm		
Records	• The extent of disturbances will be recorded within a Geographic Information System • Monitoring for soil erosion pre and post wet seasons to ensure any defect is identified and rectified. • Rehabilitation monitoring undertaken annually until final rehabilitation success criteria has been achieved		
Residual Risk	**Moderate**	**Scientific Uncertainty**	**Low**
ALARP Statement	The risk to soils is predominantly from soil erosion during construction. This is ranked as a "minor" consequence, "possible" likelihood event. The risk mitigation measures outlined in the EMP meet the industry best practice requirements of the NT Petroleum Codes of Practice, NT Land Clearing Guidelines and International Erosion Control Association Best Practice Erosion and Sediment Control (BPESC) standard. Controls above best practice are unlikely to reduce the risk associated with erosion and sediment control further. Based upon the risk being ranked as a moderate and consistent with standard civil activities (regardless of industry), the risk is determined to be ALARP and Acceptable in accordance with the rationale within section 7.2.		

7.5.2 Surface Water

Table 23 Environmental Values and Outcomes – Surface Water

Environmental Values	• Divert clean stormwater away from disturbed areas. • Minimise the release of sediment outside of the approved activity area	
Environmental Outcomes	• Avoid and or minimise and control any potential contamination caused by the discharge of sediment to waterways or established drainage systems. • Contain all potential contaminants for treatment or disposal. • Minimise the impacts on surface water drainage by preserving drainage system integrity and water quality. • Maintain the natural flow regime of the area to avoid pooling or diversion of water away from wetlands	
Activity	Environmental impacts and environmental risks	**Primary risk management controls**
• Access track, camp and drill pad construction • Civil construction and operations – refuelling and equipment maintenance	• Earthmoving equipment altering natural drainage lines or sinks • Access tracks and site pads altering natural surface water flow, creating ponding and or erosion • Contamination or pollution of surface waters through hydrocarbon or chemical spill or leak • Impacts associated with soil erosion such as increased water turbidity	• Erosion and sediment control plan (NT-2050-15-MP019) implemented to reduce offsite release of sediment. • Spill kits provided where hazardous materials are used • Spill response measures shall be implemented for spills or leaks. • Dangerous goods will be stored, handled, separated and signed as required by the Dangerous goods Act and Australian Standards1940. • Refuelling of equipment will not occur within 100m of a water course. • Waste which cannot be recycled will be transported to a designated, approved disposal site in accordance with WPMCA. • No earthworks disturbance to drainage lines proposed • A buffer of 2 km will be maintained between operations and stock water bores. • Surface water will not be used for activities. • No discharges to watercourses. • Treated sewerage waste will be removed from site and disposed of as per WMPCA.
Environmental Performance standards	• Code of Practice for Petroleum Activities in the Northern Territory Part A- Surface Activities • NT Land Clearing Guidelines. • International Erosion Control Association Best Practice Erosion and Sediment Control (BPESC) standard	

	• NT Dangerous Goods Act and Flammable and Combustible Liquids Regulations and AS1940.		
Measurement Criteria	• No use of surface water • No release of fuel, oils or sediment in to watercourses • No spills causing material harm		
Records	• Records of releases, leaks and associated clean ups are to be managed using Origins Incident Management System (OCIS). • Rectification work requirements and actions will be recorded in OCIS. • Monitoring for soil erosion and related issues to be undertaken pre and post wet season.		
Residual Risk	Low	Scientific Uncertainty	Low
ALARP Statement	The risk to surface water is predominantly from soil erosion during construction. This is ranked as a "minor" consequence, "highly unlikely" likelihood event. The risk mitigation measures outlined in the EMP meet the industry best practice requirements of the NT Petroleum Codes of Practice, NT Land Clearing Guidelines and International Erosion Control Association Best Practice Erosion and Sediment Control (BPESC) standard. Controls above best practice are unlikely to reduce the risk associated with erosion and sediment control further. Based upon the risk being ranked as a low, the risk is determined to be ALARP and Acceptable in accordance with the rationale within section 7.2.		

7.5.3 Groundwater

Table 24 Environmental Values and Outcomes – Groundwater

Environmental Values	• Sustainable use of groundwater	
Environmental Outcomes	• To manage exploration activities to prevent over-extraction of groundwater. • Preserve groundwater quantity for potable and stock supplies.	
Activity	**Environmental impacts and environmental risks**	**Primary risk management controls**
• Civil access track, lease pad and camp pad construction	• Over-extraction of groundwater impacts on pastoral leaseholders	• Water extraction licence obtained • Water use restricted to minimum required to complete civil construction activities • All water take as per licence conditions
Environmental performance standards	• NT Water Act	
Measurement Criteria	• No long-lasting change in groundwater levels compared to baseline conditions. Long lasting defined as >5m standing water level decline over 1 year at the extraction point. Monitoring completed as per Section 4.8 • Groundwater take less than the approved 20ML	
Records	• Maintain groundwater monitoring records • Groundwater extraction volumes will be recorded and submitted to the Water Resources division: water.regulation@nt.gov.au and in accordance with the requirements of the relevant groundwater extraction licence.	
Residual Risk	**Low**	**Risk control effectiveness**	**Low**
	The risk to groundwater water is predominantly from unsustainable extraction levels. This is ranked as a "minor" consequence, "highly unlikely" likelihood event. The risk mitigation measures outlined in the EMP meet the industry best practice requirements of the NT Petroleum Codes of Practice and Water Act. Controls above best practice are unlikely to reduce the risk groundwater extraction. Based upon the risk being ranked as a low, the risk is determined to be ALARP and Acceptable in accordance with the rationale within section 7.2, with no further risk reduction warranted.	

7.5.4 Vegetation, Flora, Fauna and Habitat

Table 25 Environmental Values and Outcomes – Vegetation, Flora, Fauna and Habitat

Environmental Values	• Maintain the integrity of significant ecosystems and agriculture productivity. • Maintain habitat elements for native flora and fauna, including species protected by EPBC Act and TPWC Act. • Avoid clearing of high value habitat.	
Environmental Outcomes	• Minimise disturbance to flora and fauna. • Minimise disturbance to sensitive areas.	
Activity	**Environmental impacts and environmental risks**	**Primary risk management controls**
• Vehicle movements • Clearing of vegetation • Rehabilitation	• Disturbance to environmentally sensitive areas and/or flora and fauna species • Loss or endangerment of Threatened species • Loss of habitat • Vehicle collisions with fauna – fauna mortality	• Ecological assessment undertaken to avoid placing infrastructure in environmentally sensitive areas (flora and fauna habitat). • Clearing to avoid large habitat trees. • Spotters to be present when clearing vegetation. • No off-lease driving, • Sumps leases will be fenced. • Personnel will be prohibited from interfering with wildlife. • Adequate fire breaks shall be maintained around infrastructure • Appropriate fuel and chemical handling and storage measures will be implemented. • Fire extinguishers and firefighting equipment will be provided at each site and for vehicles. • Bushfire management plan (NT-2050-15-MP033) implemented. • Driving at dawn and dusk to be avoided • Rehabilitate back to sites natural state once activities are completed (if required).
Environmental performance standards	• Code of Practice for Petroleum Activities in the Northern Territory Part A- Surface Activities • NT Land Clearing Guidelines.	
Measurement criteria	• Vegetation clearing <6.6Ha • No native fauna impacts (injury or fatality) reported in OCIS during civil and drilling and stimulation related activities.	
Records	• Records of disturbance will be maintained within Origin's GIS. • Records of inspections will be maintained. • All incidents will be reported in Origin's OCIS and corrective action initiated.	
Residual Risk	**Low**	**Scientific Uncertainty** / **Low**
ALARP Statement	The risk to vegetation, flora and fauna is predominantly from land clearing activities. This is ranked as a "moderate" consequence, "Highly Unlikely" likelihood event. The risk mitigation measures outlined in the EMP meet the industry best practice requirements of the NT Petroleum Codes of Practice and NT Land Clearing Guidelines. Controls above best practice are unlikely to further reduce the risk to flora, fauna and habitat. Based upon the risk being ranked as a low, the risk is determined to be ALARP and Acceptable in accordance with the rationale within section 7.2, with no further risk reduction warranted.	

7.5.5 Weeds

Table 26 Environmental Values and Objectives – Weeds (Biosecurity)

Environmental Values	• Maintain the integrity of significant ecosystems and agricultural productivity	
Environmental Outcomes	• Avoid the introduction of weeds. • Avoid the spread of existing weeds.	
Activity	**Environmental impacts and environmental risks**	**Primary risk management controls**
• Vehicle and equipment movement • Civil construction activities	• Introduction or spread of weeds.	• Weed desktop and field-based surveys undertaken to identify existing weed areas. • Weed management plan (NT-2050-15-MP030) implemented covering the proposed activities. • Dedicated weeds officer nominated. • All equipment will have certified equipment wash-down completed prior to entry to the field. • New activities will be planned to address prevention of weed or non-indigenous plant spread. • Machinery to be preferentially sourced locally, with machinery sourced from surrounding areas or Queensland being the 2nd and 3rd preferred option respectively. • Pre and post wet (May/ November inspections and periodic audits will be conducted to identify and report weed outbreaks. • Weeds will be actively controlled • Major equipment moves will be planned from weed-free areas to infested areas and not the other way around. • staff members to be appropriately trained. • Ensuring all material imported to or between sites is free of weeds.
Environmental performance standards	• Code of Practice for Petroleum Activities in the Northern Territory Part A- Surface Activities • NT Land Clearing Guidelines. • Weed Management Planning Guide: Onshore Shale Gas Development Projects	
Measurement criteria	• No introduction or spread of declared weeds resulting from Origins activities. • 6 monthly weed inspections completed	
Records	• Records of weed distribution will be maintained within Origin's GIS and if required provided to the Weeds Officer at DENR. • Records of weed inspections will be maintained. • All weed outbreak incidents will be reported in Origin's OCIS and corrective action initiated. • It is noted that under section 9 of the Weeds Management Act that: *'The owner and occupier of land must… within 14 after becoming aware of a declared weed that has not previously been, or known to have been, present on the land, notify and officer of the presence of the declared weed'.*	
Residual Risk	**Medium**	**Scientific Uncertainty** / **Low**
ALARP Statement	The risk of weed introduction and spread of weeds is ranked as a "moderate consequence, "possible" likelihood event. The risk mitigation measures outlined in the EMP meet the industry best practice requirements of the NT Petroleum Codes of Practice and NT Land Clearing Guidelines. Controls above best practice are unlikely to further reduce the risk of introduction or spread of weeds. Based upon the risk being ranked as a moderate and consistent with standard civil activities (regardless of industry), the risk is determined to be ALARP and Acceptable in accordance with the rationale within section 7.2, with no further risk reduction warranted.	

7.5.6 Waste Management

Table 27 Environmental Values and Objectives – Waste

Environmental Values	• Maintain the integrity of ecosystems and agricultural productivity. • Minimise the amount of waste generated on site.		
Environmental Outcomes	• Minimise impacts on soil, surface water, groundwater, sensitive habitat and air quality. • Minimise creation of food sources or habitat for pest species. • Minimise waste generation through reduce, reuse, recycle programs.		
Activity	**Environmental impacts and environmental risks**	**Primary risk management controls**	
• Civil construction works- Lease pad, access tracks and camp pads	• Contaminated land • Encouragement of pest species to waste sites	• Designated waste storage and handling area to be provided onsite. • Removal and disposal of hazardous wastes to be in accordance with the WMPCA • Ensure the availability of spill clean-up equipment for operations. • All sewage from min-camps to be collected and transported offsite • Domestic refuse to be disposed of in accordance with NT WMPCA. No incineration of wastes on site. • Identify and remediate the affected area where applicable in accordance with the National Environmental Protection Measure (NEPM) requirements. • Waste to be removed off site to an appropriate disposal at licensed landfill facility. • Waste Contractors used must have appropriate waste transportation licences	
Environmental performance standards	• Code of Practice for Petroleum Activities in the Northern Territory Part A- Surface Activities • NT Waste Management and Pollution Control Act		
Measurement criteria	• Waste registers maintained for the duration of the project. • Waste transport certificates available for all wastes generated		
Records	• Waste disposal records to be maintained and kept for audit purposes and provided to DPIR/DENR.		
Residual Risk	**Low**	**Scientific Uncertainty**	**Low**
ALARP Statement	The risk from waste is ranked as a “minor consequence, “unlikely” likelihood event. The risk mitigation measures outlined in the EMP meet the industry best practice requirements of the NT Petroleum Codes of Practice and NT Land Clearing Guidelines. Controls above best practice are unlikely to further reduce the risk associated with waste management. Based upon the risk being ranked as a low, the risk is determined to be ALARP and Acceptable in accordance with the rationale within section 7.2, with no further risk reduction warranted.		

7.5.7 Air Quality – Dust and Emissions

Table 28 Environmental Values and Objectives – Air Quality (Dust and Emissions)

Environmental Values	• Rural air environment with qualities conducive to suitability for the life, health and wellbeing of humans.		
Environmental Outcome	• Minimise environmental nuisance at sensitive receptors. • Minimise greenhouse gas emissions.		
Activity	**Environmental impacts and environmental risks**	**Primary risk management controls**	
• Civil construction works- access tracks, lease pads and camp pads	• Dust emissions • Release of atmospheric contaminants from exhausts •	• Reducing the speed of vehicles on dirt tracks to 80km/hr • Monitor road conditions to ensure deterioration with possible increase in dust creation, does not occur and undertake road rehabilitation as required. • Watering of roads when appropriate and agreed with landholders. • All equipment and machinery to be in good working order to minimise vehicle exhaust emissions	
Environmental performance standards	• Code of Practice for Petroleum Activities in the Northern Territory Part A- Surface Activities • NT Land Clearing Guidelines.		
Measurement criteria	• No complaints received for dust/air quality nuisance. • all complaints responded to and closed out		
Records	• All complaints and subsequent actions are to be recorded in Origin's OCIS incident management system.		
Residual Risk	**Low**	**Scientific Uncertainty**	**Low**
ALARP Statement	The risk from dust and fuel combustion on air quality is ranked as a "minor consequence, "unlikely" likelihood event. The risk mitigation measures outlined in the EMP meet the industry best practice requirements of the NT Petroleum Codes of Practice; with site selection being the primary control. Controls above best practice are unlikely to further reduce the risk to air quality. Based upon the risk being ranked as a low, the risk is determined to be ALARP and Acceptable in accordance with the rationale within section 7.2, with no further risk reduction warranted.		

7.5.8 Lighting, noise, vibration and visual amenity

Table 29 Environmental Values and Objectives – Lighting, noise, vibration and visual amenity

Environmental Values	• A rural acoustic, lighting, vibration and visual amenity environment conducive to the wellbeing of the community, including its social and economic amenity, and an individual, including the opportunity to have sleep, relaxation and conversation without unreasonable interference from civil works and water bore drilling operations.	
Environmental Outcomes	• Manage activities in accordance with occupational health and safety guidelines for noise, vibration and light exposure • Minimise nuisance noise and vibration impacts on surrounding communities or exploration workers • Minimise disruption to fauna and stock.	
Activity	**Environmental impacts and environmental risks**	**Primary risk management controls**
• Civil construction activities- Access tracks, lease pads and camp pads	• Nuisance noise impacts on surrounding communities or exploration workers through use of mechanical equipment • Disrupting or altering fauna feeding, breeding or other activities through noise, vibration and lighting from use of mechanical equipment • Interference with pastoral activities if noise, vibration and lighting effects behaviour of stock.	• Lease sites selected to minimise noise and visual amenity impacts on sensitive receptors/ local community during civils and future exploration activities. • 6am to 7pm work, with no night time activities. • Complaints shall be recorded in OCIS, investigated and responded to appropriately.
Environmental performance standards	• Code of Practice for Petroleum Activities in the Northern Territory Part A- Surface Activities • NT Land Clearing Guidelines.	
Measurement Criteria	• No valid nuisance-related complaints received from local communities/pastoralists. • All complaints responded to and, where appropriate, corrective action taken	
Records	• All complaints and subsequent actions are to be recorded in OCIS	
Residual risk	**Low**	**Scientific Uncertainty** / **Effective**
ALARP Statement	The of the activity on local amenity is ranked as a “minor consequence, “unlikely” likelihood event. The risk mitigation measures outlined in the EMP meet the industry best practice requirements of the NT Petroleum Codes of Practice; with the location of the activity being the primary control. Controls above best practice are unlikely to further reduce the risk to aesthetics Based upon the risk being ranked as a low, the risk is determined to be ALARP and Acceptable in accordance with the rationale within section 7.2, with no further risk reduction warranted.	

7.5.9 Bushfires

Table 30 Environmental Values and Objectives – Bushfire

Environmental Values	• Maintain a natural fire regime of the region. • Protection of public, private infrastructure and equipment.	
Environmental Outcomes	• Minimise the risk of causing bushfires from Origin's activities. • Minimise impacts on environmental habitat and fauna, soil erosion, impacts on stakeholders, impacts on culturally significant sites, public infrastructure and community lands. • Ensure proper health and safety plan for activities. • Prevent accidental fire risk and ensure safe storage of chemicals to prevent fire damage.	
Activity	**Environmental impacts and environmental risks**	**Primary risk management controls**
• Civil construction works- access tracks, lease pads and camp pads	• Vegetation degradation. • Loss of fauna and habitat. • Increased erosion and impacts upon soil and surface water as a result of vegetation loss • Damage to or loss of public infrastructure, private infrastructure and equipment or community lands • Damage to or loss of culturally significant sites. • Loss of life.	• Fire extinguishers to be fitted to all vehicles. • Fire response equipment to be available • Bushfire management plan implemented (NT-2050-15-MP033). • Emergency response plan developed and implemented to deal with fire. • Access tracks and roads will serve as firebreaks to limit the spread of fire. • Firebreaks to be constructed around all infrastructure
Environmental performance standards	• Code of Practice for Petroleum Activities in the Northern Territory Part A- Surface Activities. • NT Land Clearing Guidelines. • NT Bushfire Management Act.	
Measurement criteria	• No (0) uncontrolled fires occurring as a result of civil works.	
Records	• All incidents of fire to be recorded in OCIS	
Residual Risk	**Medium** / **Scientific Uncertainty**	**Low**
	The risk of weed introduction and spread of weeds is ranked as a "moderate consequence, "possible" likelihood event. The risk mitigation measures outlined in the EMP meet the industry best practice requirements of the NT Petroleum Codes of Practice and NT Land Clearing Guidelines. Controls above best practice are unlikely to further reduce the risk of introduction or spread of weeds. Based upon the risk being ranked as a moderate and consistent with standard civil activities (regardless of industry), the risk is determined to be ALARP and Acceptable in accordance with the rationale within section 7.2, with no further risk reduction warranted.	

7.5.10 Cultural Heritage and Sacred Sites

Table 31 Environmental Values and Objectives – Cultural Heritage and Sacred Sites

Environmental Values	• Maintain both Indigenous and non-Indigenous cultural heritage values of the region.	
Environmental Outcomes	• Avoid disturbance or damage to Aboriginal cultural heritage artefacts or sacred sites. • Minimise impacts and disruption to activities of Indigenous stakeholders in culturally significant areas. • Ensure adequate background information and training is provided to employees and contractors working in culturally significant areas. • Ensure that the health and safety of employees, contractors and the community is not compromised through management of cultural and environmental awareness.	
Activity	**Environmental impacts and environmental risks**	**Primary risk management controls**
• Civil construction works- access track, lease pad and camp pads •	• Damage to or loss of Indigenous and non-Indigenous cultural heritage artefacts or sacred sites. • Disruption of activities of Indigenous and non-Indigenous stakeholders.	• Cultural Heritage Clearance (and identification of sites of Aboriginal significance in conjunction with NLC and AAPA) have been completed • Heritage surveys completed • Activities will be conducted in accordance with the NLC Agreement and AAPA certificates. • There are no restricted work areas in the vicinity of the proposed activity. • An unexpected heritage finds stop procedure (NT-2050-15-MP029.will be implemented. • Site inductions and icebreakers are to ensure that all personnel are aware of the Code of Conduct prepared for social interactions with the community.
Environmental performance standards	• AAPA Certificates. • NT Bushfire Management Act.	
Measurement criteria	• No (0) unauthorised activities within or access to a Restricted Work Area.	
Records	• A register should be kept of all occurrences of archaeological sites identified during the Project for provision to the NLC, the AAPA and Heritage Branch within DLPE. • Ensure that site personnel and contractors report all new discoveries of archaeological or cultural artefacts. All work must cease and protection measures implemented until the area can be assessed.	
Residual Risk	**Low**	**Scientific Uncertainty** / **Effective**
ALARP Statement	The risk to community from the activity is ranked as a “low” consequence, “remote” likelihood event. The risk mitigation measures outlined in the EMP meet the Native Tittle Act and Sacred Sites Act requirements. Due to the limited nature of the activity and approvals granted (NLC Clearances and AAPA), additional controls are not required. Based upon the risk being ranked as a low, the risk is determined to be ALARP and Acceptable in accordance with the rationale within section 7.2, with no further risk reduction warranted.	

7.5.11 Community

Table 32 Environmental Values and Objectives – Community

Environmental Values	• Maintain and enhance the livelihood and well-being of local communities and towns.			
Environmental Outcomes	• Minimise impacts on the local community and services. • Minimise safety risks to the public and other third parties. • Maintain and enhance partnerships with the local community, including using local contractors and maximising opportunities for local employment and training.			
Activity	**Environmental impacts and environmental risks**	**Primary risk mitigation Controls**		
• Civil construction works- access tracks, lease pad and camp pads	• Damage to third party infrastructure • Loss of visual amenity- pastoralists and tourists • Increased traffic within the region impacts pastoralists and tourists	• Local (NT) employees to be utilised as a priority • Traffic management plan submitted and approved by DPIL • Ongoing stakeholder engagement targeting directly affected parties • Site selected to avoid impacts to pastoralist activities		
Environmental performance standards	• Code of Practice for Petroleum Activities in the Northern Territory Part A- Surface Activities • NT Land Clearing Guidelines • DPIL Traffic Management Plan			
Measurement criteria	• Local (NT) employment used for >90% for the civil campaign • All complaints are responded to and closed out			
Records	• Register should be kept of all incidences relating to access issues, unauthorised access and requirements of pastoralists, recognising that these requirements may change seasonally • OCIS complaint register • Land access agreements closed out at completion.			
Residual Risk	Low	**Scientific Uncertainty**		**Low**
ALARP Statement	The risk to community from the activity is ranked as a “low” consequence, “remote” likelihood event. The risk mitigation measures outlined in the EMP meet the Petroleum (Environment) Regulations stakeholder engagement requirements. Due to the limited nature of the activity, additional controls further reduce the risk to community. Based upon the risk being ranked as a low and are consistent with standard small-scale project activities (regardless of industry), the risk is determined to be ALARP and Acceptable in accordance with the rationale within section 7.2, with no further risk reduction warranted.			

8 Implementation Strategy

8.1 Corporate Environmental Policy

Origin's activities are governed by the Origin Health, Safety and Environment Management System (HSEMS). This system is underpinned by Origins Health, Safety and Environment (HSE) Policy (Figure 10) which is designed to:

> *"Conduct our business in a way that causes no harm to the health and safety of people and has no unforeseen impacts to the environment".*

8.2 Environment, Health, and Safety Management Systems

Origin has a mature HSEMS which contains the policies and procedures that Origin has in place to manage and minimise the impact from its activities. In addition to meeting legal requirements, Origin's activities are also governed by several additional internal directives and risk control directives designed to ensure best practice in environmental risk management.

An overview of the Origin HSEMS and the associated directives is provided in Figure 11.

OUR HEALTH, SAFETY AND ENVIRONMENT POLICY

origin

OUR PRINCIPLE OF DUE CARE

We care about the wellbeing of our people and our impact on the environment.

OUR HSE ASPIRATION

To conduct our business in a way that causes no harm to the health and safety of people and has no unforeseen impacts to the environment.

OUR HSE ACTIONS

We all believe that our HSE aspiration is achievable and we embrace our responsibility for supporting it by:

Always mindful of risk

Recognising that risk is present in every task we do and taking the time to identify and understand these risks and manage them safely and responsibly.

Enabled and accountable

Taking ownership and using our authority, resources, systems and competencies to manage the risks associated with our work. We stop work when confronted by an unknown hazard and proceed only when satisfied we can continue safely and responsibly.

Continuously learning

Being open and transparent about how well we are doing and relentless in learning from our experience to manage our risks. We work together effectively, welcome any feedback and recognise that we can always do better.

Our Compass and HSE Management System set out how we will implement this policy.

Frank Calabria

Frank Calabria
CEO
Origin Energy

Figure 10 Origins Health, Safety and Environment (HSE) Policy

Figure 11 Origins HSEMS Structure

8.3 Roles and Responsibility

The following sections describe in detail the management strategies for specific components of the landscape, such as soil, ground water and vegetation, and the cultural and social environment, in relation to the different impact-causing activities that may occur.

Each management area has been assigned to specific positions within the Exploration team, as follows:

- **Asset Manager** – responsible for the overall operations in the Origins activities in the exploration permit area.
- **Project Manager** – oversees the whole planning and execution of the exploration program and is the person ultimately responsible making all other parties aware of obligations under the HSE guidelines. The Project Manager's role is predominantly office-based. The Project Manager will be responsible for notifying the Minister, the occupier of the land on which the activity is to be carried out and the owner of the land on which the activity is to be carried out (unless the owner is also the occupier).

- **Civil Construction Superintendent** – person based in the field focussed on the undertaking of operations and construction in accordance with the EMP and Origin' HSE Policy. All contractors report to this position, who is responsible to the Project Manager.

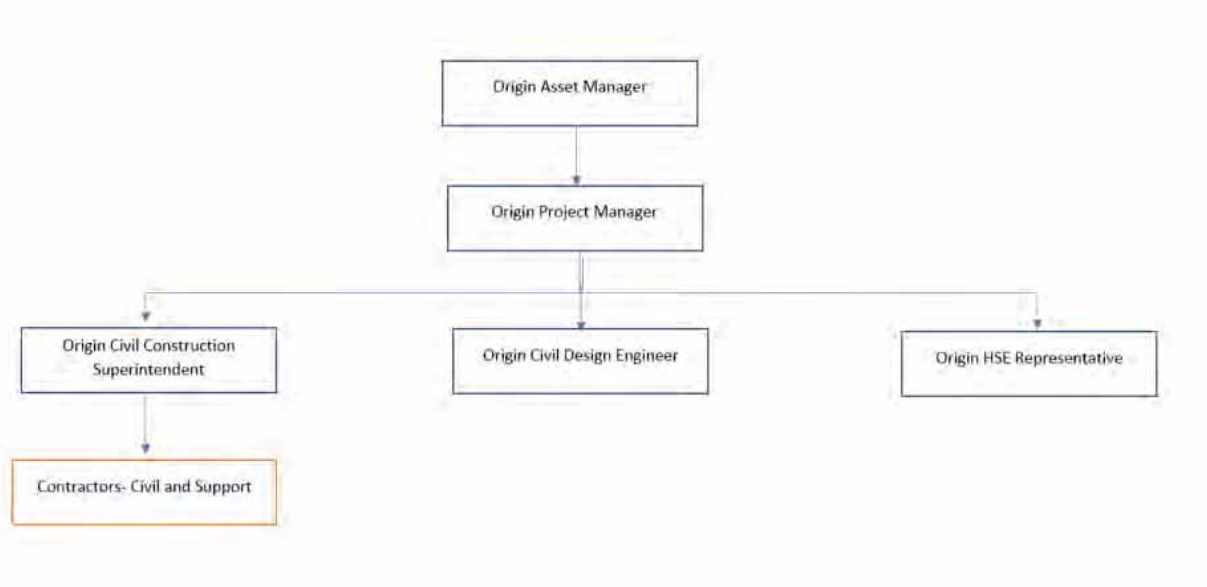
  This role will also cover the role of the Weeds Officer, who will be responsible for:

  - Planning and execution of weed monitoring requirements, including baseline weed assessments and ongoing monitoring both during periods of gas related activities as well as during the target identification period of February to May.
  - Facilitate training of all workers (including contractors) in weed management requirements, with support from the Northern Territory Government Regional Weed Officer - Onshore Shale Gas Development.
  - Oversight of implementation of weed control mechanisms including but not limited to wash-downs and proactive weed control programs.
  - Ensuring all reporting requirements are met.
  - Act as the designated point of contact for and rapidly responding to any civil related complaints and incidents in accordance with the pre-determined strategies in this EMP or relevant ERP.
  - Review and update of WMP's to remain effective in communication with relevant pastoralists and Regional Weed Officer - Onshore Shale Gas Development in consideration of monitoring results and emerging weed issues for both gas and pastoral operations.

- **Civil Design Engineer** – An individual or organisation that provides professional or expert advice in the field of civil engineering and design. They determine the best locations, design, materials and construction techniques for undertaking a project to ensure it meets the needs of the end user.
- **Health Safety and Environment Representative (HSE Representative)** – Origin representative providing guidance and advice to site personnel on the day-to-day management of the environment. This role will also support the nominated Weeds Officer, specifically in the planning and reporting phases.
- **Field Personnel** – All staff including Origin and contractors that are working in the Exploration Permit areas. Each person is responsible for day to day management and reporting of environmental aspects under this EMP.

The organisation chain of responsibility fo the activity is provided in Figure 12.

Figure 12 Origin organisation chain of responsibility



8.4 Training and Awareness

Origin's HSEMS outlines the policies and procedures governing the training and competency of all personnel (staff and contractors) to ensure they can fulfil their obligations under this EMP and the broader Origin HSEMS.

The majority of work undertaken under this will be via contractors under supervision of Origin staff. Assuring the level of training and competency of the selected contractors and supervisors is therefore a major focus of the HSE EMS implementation strategy.

These systems include:

- General Origin HSE induction
- Contractor HSE prequalification process
- Contractor management system
- Site specific inductions
- Task specific training, procedures and competency requirements

Contractors will be required to demonstrate they have appropriate systems, procedures and training to manage specific risks covered under this EMP prior to award. The following aspects will be considered during tender award:

- Maturity of HSE systems and process.
- Previous HSE performance
- Existing procedures and training:
    - Weed identification and management
    - Refuelling procedures
    - Procedures for avoidance of potential fauna habitat and any identified heritage sites
    - Hazardous material and waste management procedures
    - Incident notification and management processes
- Internal training programs
- Internal auditing processes.

All staff and contractors entering the site will be required to attend a site-specific induction. The induction covers the following aspects:

- Regulatory requirements, for the area, including specific conditions on the Exploration Permits, agreements with the NLC and AAPA Authority certificates.
- Environmental considerations and special procedures to be used for environment protection, as well as, protection of archaeological and cultural sites within the permit areas.
- Safety procedures covering the safe use of vehicles, equipment and explosives first aid and HSE in remote area operations.
- Emergency response training
- Landowner sensitivities, including Aboriginal communities and their specific cultural requirements.
- Procedures for handling any culturally or archaeologically sensitive materials that may be discovered.
- Provide training in safe storage and handling of flammable and combustible liquids.

Additional awareness information on environmental and cultural heritage components will be provided at all contractor icebreakers and pre-activity start up meetings- Information will be cascaded via the work instruction including exclusion zones and work restrictions. All restricted work areas provided by native holder custodians and included in AAPA certificates are confirmed with each work party.

8.5 Work instructions

The majority of the work covered under this EMP will be executed by external contractors with Origin oversight. Efforts are therefore focused on effective contractor management, to ensure third parties are compliant with the relevant EMP commitment and contractual requirements; including the requirements of AAPA Authority Certificates. An overview of Origin's EMP implementation strategy is provided in Figure 13.

An instrument referred to as a “work instruction” is the main mechanism that Origin cascades the relevant environmental commitments to each contractor. The work instructions are designed to be a contractual document that outlines the minimum compliance requirements for a specific activity. The work instructions contain:

- Key compliance and system documents;
- A list of compliance commitments and responsible person for a specific activity;
- A list of inspections, procedures and other tools required to implement the content of the EMP;
- Monitoring and reporting requirements;
- Hold points which require a deliverable to be completed prior to entry into a new activity phase (i.e. prior to mobilisation, operation and demobilisation); and
- Maps illustrating the approved disturbance areas and any restricted work areas.

An example of a work instruction is provided in Appendix H. The work instruction forms a critical implementation and assurance tool in that an Origin representative must sign off the “Hold Points” to ensure the various commitments have been achieved. This provides a clear, documented approach to demonstrate compliance.

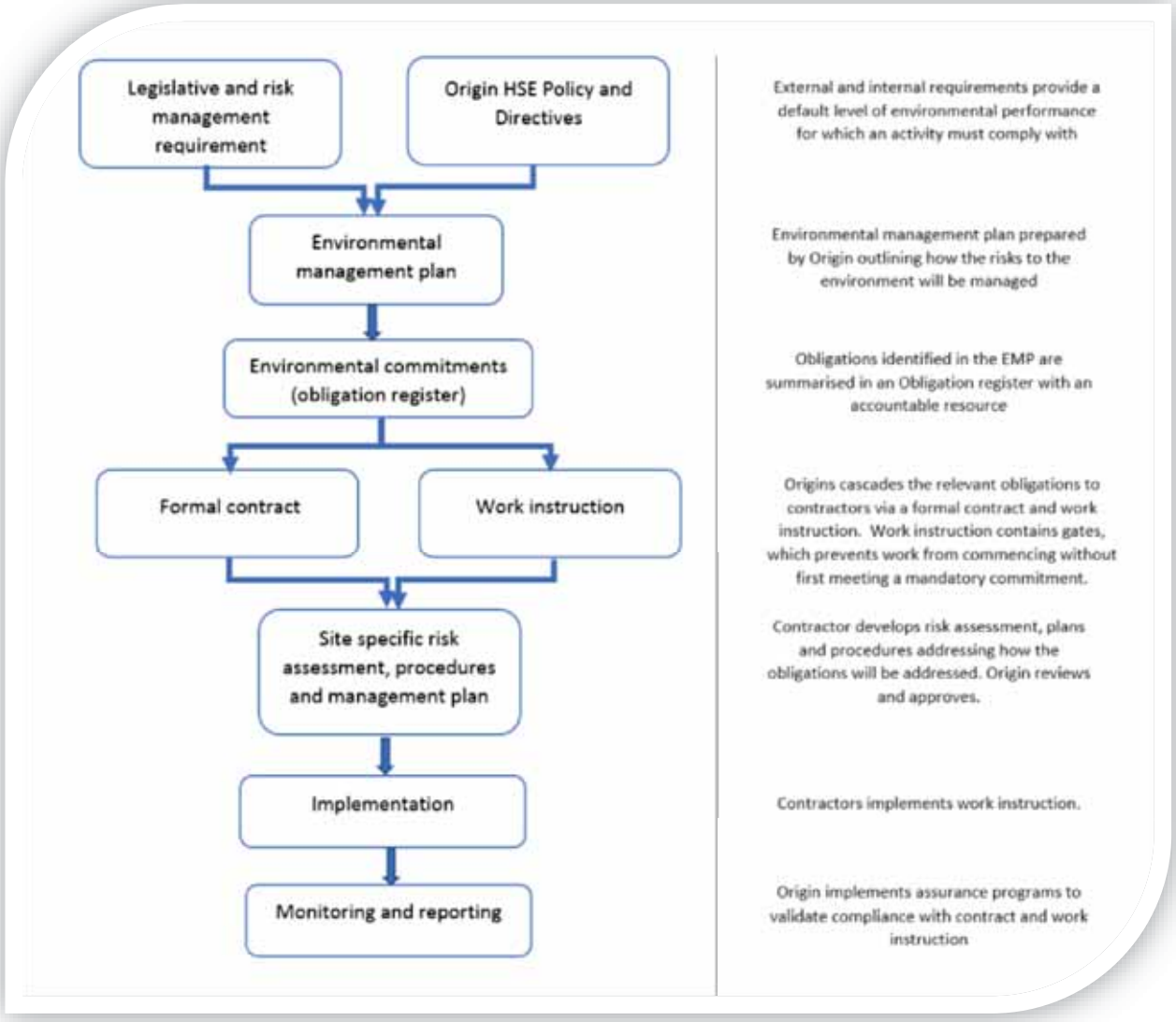


Figure 13 EMP implementation overview flowchart

8.6 Environmental Commitment (Obligations) Register

The responsibility for general environmental monitoring rests with all personnel engaged on the project. More specifically the Origin Project Manager is responsible for monitoring procedures for the civils work program are designed so that appropriate environmental protection/procedures are in place.

The program environmental commitments are outlined in Appendix G are sourced from the risk assessment (Appendix F). The implementation and compliance against these risk controls will be assessed as part of the annual environmental report (refer Section 8.10).

Specific commitments will be to:

- record of information to track performance, including non-conformances and corrective actions.
- inspect and monitor of operational controls on site via regular environmental monitoring.
- assess the level of conformance with objectives and targets detailed in this EMP.

The Operating Company Representative shall undertake random site inspections and direct such action as may be considered necessary to protect, minimise or rectify any environmental concerns.

8.7 Incident Reporting

Incident reporting and investigation provides the mechanism to prevent a recurrence. All personnel are required to proactively report all incidents, near-misses and identification of potential hazards.

Origin utilises an online incident management and reporting system. Any environmental incident, near miss or observation is reported through the online incident reporting system. All personnel are encouraged to report minor events to act as an alert to environmental risks and to maintain a program of continual improvement.

For incidents relating to the transportation of wastes outside of Petroleum tenure, the incident reporting requirements pursuant to section 14 of Waste management and Pollution control Act applies.

8.7.1 Reportable Environmental Incident Reporting

The Petroleum (Environment) Regulations define a reportable incident as an incident arising from a regulated activity that has caused, or has the potential to cause, material environmental harm or serious environmental harm as defined under the Petroleum Act. This also includes any potential or actual damage to a sacred site.

An interest holder must notify (this may be oral or in writing) DPIR and DENR of a reportable incident as soon as practicable but no later than two hours after the first occurrence of the incident or after the time the interest holder becomes aware of the incident.

DPIR can be notified through the DPIR Operations Team Emergency number 1300 935 250.

Any verbal report to DPIR must be followed up by a written report from the Project Manager within 24 hours after giving verbal notice in accordance with the Petroleum (Environment) Regulations to both DPIR and DENR. An initial report about a reportable incident must be given as soon as practicable, but not later than 3 days after the incident occurs, and must include comprehensive details about the following:

I. the results of any assessment or investigation of the conditions or circumstances that caused or contributed to the incident;

II. the nature and extent of the material environmental harm or serious environmental harm that the incident caused or had the potential to cause;

III. any actions taken, or proposed to be taken, to clean up or rehabilitate an area affected by the incident;

IV. any actions taken, or proposed to be taken, to prevent a recurrence of a similar incident.

A final report must be given as soon as practicable but no later than 30 days after the clean up or rehabilitation is complete. This must include a root cause analysis.

8.7.2 Recordable incidents

The Petroleum (Environment) Regulations define a recordable incident as an incident arising from a regulated activity that:

I. Has resulted in an environmental impact or environmental risk not specified in the current plan for the activity; or

II. Has resulted in a contravention of an environmental performance standard specified in the current plan for the activity; or

III. Is inconsistent with an environmental outcome specified in the current plan for the activity; and

IV. Is not a reportable incident.

An interest holder must notify (this may be oral or in writing) DPIR of a recordable incident as soon as practicable but no later than 15 days after the reporting period (agreed period or each 90-day period after the day on which the EMP is approved).

8.8 Monitoring, assurance and non-conformance management

In addition to regular monitoring as set out in this document, audits assessing compliance with this EMP and associated work instructions will be undertaken by Origin during the conduct of the activity. System deficiencies, adverse or potentially adverse environmental conditions arising from site activities may be subject to the issue of environmental non-conformances or corrective action requests. These non-conformances or corrective actions shall be logged, and remedial actions identified and implemented. The status of corrective actions will be tracked and reported annually in the annual environmental report.

Audits of implementation of the EMP commitments will be completed for each activity or at least annually. The results will be included in the annual environmental report.

Table 33 EMP audit Schedule

Audit Type	Scope of Audit	Frequency	Responsibility
Annual Assurance	Compliance against EMP commitments and risk management controls	At least once during the execution of the program	OE HSE Representative

8.9 Emergency Response Plan

An Emergency Response Plan has been developed covering the proposed activities within the EMP. The ERP (NT-2050-15-MP024) provides a broad framework for managing potential emergency incidents to minimise the potential risk to human safety and the environment.

The ERP covers the following aspects pertinent to the drilling and stimulation activities and associated infrastructure:

- Spills and loss of containment
- Bushfires
- Medical emergencies.
- Emergency incident reporting

The ERP will be reviewed annually to ensure the content is continually kept up to date.

8.10 Reporting

Internal and government reporting on performance standards will be carried out by the Origin authorised representative, and distributed to Origin management and the DENR, in accordance with section 35 of the Petroleum (Environment) Regulations. Quarterly and annual reports shall be completed to summarise the compliance with this EMP, whether the environmental outcomes and performance standards in the plan were met and summarise the details of any recordable and reportable incidents.

Table 34 EMP Reporting Schedule

Frequency	Report detail	Recipient
Commencement of construction	A commencement of construction or drilling activity notification	a) the Minister for Primary Industry and Resources b) The occupier of the land in which the activity is carried out c)The owner for the land for which the activity is to be carried out.
Only if required	Incident report summarising reportable incidents	DENR and DPIR
Quarterly	Quarterly incident report summarising recordable incidents during the period	DENR and DPIR

Annual activity report	An annual environmental report will be prepared and submitted to the Minister March each year covering the following: · Summary of the works completed under all EMP's (including this EMP) during the reporting period. · Compliance against environmental outcomes and environmental performance stands in the plan. · A summary of environmental incidents that occurred during the reporting period (i.e. reportable and recordable incidents that occurred). · Any environmental studies or research associated with the activity. · Technical improvements. · Consultation undertaken. · Results of related research or of an ongoing monitoring program, etc.	Origin management DENR

8.11 Record Keeping

The following records shall be retained within Origins Document Management system for a period of 15 years

- records linked to measurement criteria, commitments and statutory reporting requirements;
- induction records;
- waste records;
- hazardous goods manifests;
- fuel usage;
- weed inspections;
- non-compliances and corrective action records;
- internal audits and inspection records; and
- management of change records.

8.12 EMP Review

Implementation of this EMP will be continually monitored and revised as required based on monitoring and audit results, complaints, employee and stakeholder feedback, change to the proposed work program or a material increase in risk level.

A formal review, update and resubmission of this EMP will be undertaken every five years.

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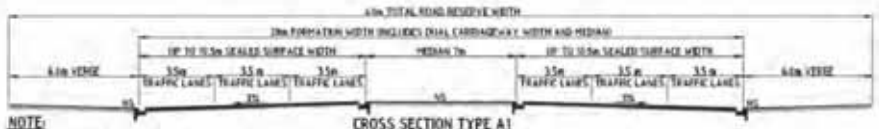
10 Acronyms & Abbreviations

Acronym	Meaning
^{o}C	Degrees Celsius
%	Percentage
AAPA	Aboriginal Areas Protection Authority
ALA	Atlas of Living Australia
ANZECC	Australian and New Zealand Environment Conservation Council
AS	Australian Standard
CAS number	Chemical Abstracts Services number
CDEP	Community Development Employment Program
CEEVNT	Critically Endangered, Endangered, Vulnerable and Near Threatened
CLA	Cambrian Limestone Aquifer
CLC	Central Land Council
CoP	NT Codes of Practice for Petroleum Activities in the Northern Territory
Cth	Commonwealth
DENR	Department of Environment and Natural Resources
DoH	Department of Health (NT)
DPIR	Department of Primary Industries and Resource (NT)
DLPE	Department of Lands, Planning and the Environment (NT)
EPA	Environment Protection Authority (NT)
EIS	Environment Impact Statement
EP	Exploration Permit (e.g. EP76, EP98 and EP117)
EMP	Environmental Management Plan
EPBC	Environmental Protection and Biodiversity Conservation
ERS	Emergency Response Plan
ESCP	Erosion and Sediment Control Plan
GPS	Global Positioning Device
Ha	hectare
HSE	Health, Safety and Environment
HSEMS	Health, Safety and Environment Management System
IBA	Important Bird Area
ILUA	Indigenous Land Use Agreement
ISO	International Organisation for Standardisation
JV	Joint Venture
Km	Kilometre
km^2	Square Kilometres
km/hr	Kilometre per hour
LAG	Local Aboriginal Group

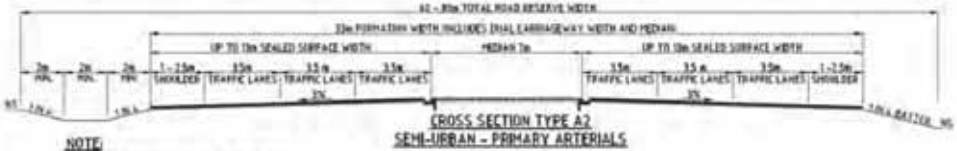
Acronym	Meaning
m	metre
MD	Measured Depth
MNES	Matters of National Environmental Significance
MSDS	Material Safety Data Sheet
mTVD	metre True Vertical Depth
Mm	millimetre
NATA	National Association of Testing Authorities
NEPM	National Environmental Protection Measure
NICNAS	National Industrial Chemicals Notification and Assessment Scheme
NLC	Northern Land Council
NORMs	Naturally Occurring Radioactive Materials
NT	Northern Territory
OHS	Occupational Health and Safety
PER	Public Environment Report
RWA	Restricted Work Area
SIA	Social Impact Assessment
SMS	Safety Management System
SWL	Standing Water Level
TMP	Traffic Management Plan
TO	Traditional Owner
TPWC Act	*Territory Parks and Wildlife Conservation Act*
TSS	Total Suspended Solids
UCS	Unconfined Compressive Strength
WPMC	NT Waste Management Pollution Control Act
WoNS	Weed of National Significance

Appendix A Typical Cross Sections For Urban and Rural Environments (NTG, Sept 2017)



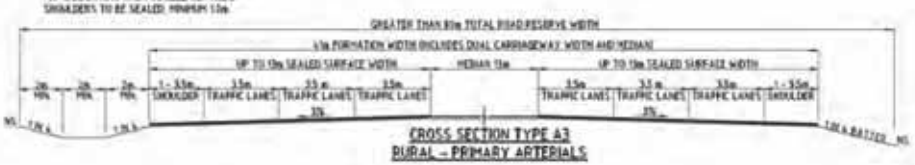
NOTE:
KERB SIDE LANE TO BE MINIMUM 5.0m WIDE DURING STAGE CONSTRUCTION

CROSS SECTION TYPE A1
URBAN - PRIMARY ARTERIALS



NOTE:
TOTAL ROAD RESERVE WIDTH 60 - 80m TO ALLOW FOR SIDE DRAINS AND POSSIBLE SERVICES.
SHOULDERS TO BE SEALED. MINIMUM 1.0m

CROSS SECTION TYPE A2
SEMI-URBAN - PRIMARY ARTERIALS



CROSS SECTION TYPE A3
RURAL - PRIMARY ARTERIALS

URBAN ENVIRONMENT

TYPICAL CROSS SECTIONS - URBAN ENVIRONMENT

ROAD CLASSIFICATION	AUSTROAD CLASS	TYPE CROSS SECTION	FORMATION (DUAL CARRIAGEWAY)	TRAFFIC LANES		SEAL WIDTH (m)	COMMENTS
				WIDTH (m)	SURFACE		
URBAN - PRIMARY ARTERIALS							
URBAN	CLASS 6	TYPE A1	28.0	UP TO 3 x 3.5	SEALED	UP TO 10.5 EACH WAY	KERB SIDE LANE TO BE MINIMUM 5.0m WIDE DURING STAGE CONSTRUCTION TOTAL ROAD RESERVE WIDTH 44m
SEMI - URBAN	CLASS 6	TYPE A2	33.0	UP TO 3 x 3.5 EACH WAY	SEALED	UP TO 10.5 EACH WAY (INCFULL WIDTH SHOULDER SEAL	SHOULDER TO BE SEALED MINIMUM 1.0m. TOTAL ROAD RESERVE WIDTH 60 -80m TO ALLOW FOR SIDE DRAINS AND POSSIBLE SERVICES.
RURAL	CLASS 6	TYPE A3	41.0	UP TO 3 x 3.5 EACH WAY	SEALED	UP TO 14.0 EACH WAY (INCFULL WIDTH SHOULDER SEAL)	SHOULDER TO BE SEALED MINIMUM OF 1.0m. PAVEMENT & SEAL TO EXTEND A MINIMUM OF 1.0m IN TO THE MEDIAN. TOTAL ROAD RESERVE WIDTH GREATER THAN 80m

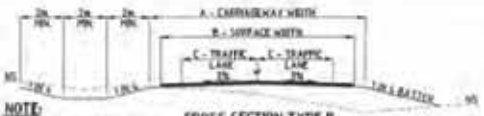
TABLE AS PER THE DEPARTMENT'S POLICY FOR STANDARD ROAD CROSS SECTIONS - APRIL 2015 - VERSION 1.0

URBAN ENVIRONMENT NOTES:

1. REFER TO LOCAL GOVERNMENT GUIDELINES FOR URBAN SUB ARTERIALS (6000-12500 VPD) URBAN DISTRIBUTOR (LESS THAN 6000 VPD) AND URBAN COLLECTOR (LESS THAN 3000 VPD) ROADS.
2. REFER TO DEPARTMENT GUIDELINES FOR URBAN LOCAL AND URBAN SUBDIVISION REQUIREMENTS.

GENERAL NOTES:

1. REFER TO STANDARD DRAWING CS3002 FOR SHEET 1.



NOTE:
PAVEMENT AND SEAL TO EXTEND A MINIMUM OF 1.0m IN TO THE MEDIAN. SHOULDERS TO BE SEALED. MINIMUM 1.0m.

CROSS SECTION TYPE B
RURAL SEALED ROADS

CROSS SECTION TYPE C
RURAL UNSEALED ROADS

RURAL ENVIRONMENT

TYPICAL CROSS SECTIONS - RURAL ENVIRONMENT

ROAD CLASSIFICATION	AUSTROAD CLASS	TYPE CROSS SECTION	A: CARRIAGE WAY WIDTH (m) INCLUDING MEDIAN	C: TRAFFIC LANES		B: SEAL/ GRAVEL WIDTH (m)	COMMENTS
				WIDTH (m)	SURFACE		
RURAL - NATIONAL HIGHWAY	CLASS 1	TYPE B	11.0	2 x 3.5	SEALED	8.0	NATIONAL STANDARDS UNDER REVIEW. SEAL WIDTH MAY BE INCREASED TO 9.0m DEPENDING ON LOCAL ISSUES
RURAL ARTERIAL AND SECONDARY ROADS	CLASS 3	TYPE B	10.0	2 x 3.5	SEALED	6.0	> 1000 VPD - 20 YEAR PROJECTED VOLUMES. SEE NOTE 1
	CLASS 4	TYPE B	9.0	2 x 3.0	SEALED	7.0	> 500 VPD - 20 YEAR PROJECTED VOLUMES. SEE NOTE 1
	CLASS 4	TYPE C	9.0	2 x 3.0	GRAVELLED	6.0	SEE NOTE 2
RURAL - LOCAL	CLASS 5	TYPE B	9.0	2 x 3.0	SEALED	7.0	FOR UNSEALED ROADS A 9.0m CARRIAGEWAY MAY BE APPROPRIATE IF FUTURE SEALING IS FORESEEABLE. SEE NOTE 2.
		TYPE C	8.0	2 x 3.0	GRAVELLED	6.0	
RURAL - SUBDIVISIONS	REFER TO CS3002						REFER TO DEVELOPMENT GUIDELINES BY THE TRANSPORT INFRASTRUCTURE PLANNING DIVISION.
PASTORAL ACCESS ROADS							
PASTORAL 1	CLASS 5	TYPE C	6.0	1 x 6.0	FORMED	-	SINGLE USER ACCESS
PASTORAL 2	CLASS 5	TYPE C	6.0	1 x 6.0	FORMED	-	MULTI USER ACCESS FOR UP TO 3 PROPERTIES
PASTORAL 3	CLASS 5	TYPE C	8.0	2 x 3.0	GRAVELLED	6.0	PROVIDES ACCESS TO GREATER THAN 3 PROPERTIES

TABLE AS PER THE DEPARTMENT'S POLICY FOR STANDARD ROAD CROSS SECTIONS - APRIL 2015 - VERSION 1.0

RURAL ENVIRONMENT NOTES:

1. FOR PREDICATED FUTURE VOLUMES OF 500 - 1000 VPD THE STANDARD WILL DEPEND ON TRAFFIC MIX (NUMBERS OF ROAD TRAINS/CARAVANS/BUSES) AND TOPOGRAPHY AND WILL BE ASSESSED ON A CASE BY CASE BASIS. SEAL WIDTHS MAY ALSO BE INCREASED DEPENDING ON LOCAL ISSUES SUCH AS SEASONAL VARIATIONS (TOURISM) AND ENVIRONMENT.
2. THE DECISION IN REGARD TO SEALED VERSUS GRAVEL STANDARD FOR A PARTICULAR ROAD WILL DEPEND ON FACTORS SUCH AS PROPOSED USE (IE AGRICULTURAL), ENVIRONMENT, PREDICTED USE AND THE LIKE AND SHOULD BE REFERRED TO TRANSPORT INFRASTRUCTURE PLANNING DIVISION.

No	DESCRIPTION	DATE	DRAWN	DESIGNED
0	ISSUED AS A STANDARD DRAWING	SEPT 2017	J.LEESON	S.HAIZI

WARNING
BEWARE OF UNDERGROUND SERVICES
THE LOCATIONS OF UNDERGROUND SERVICES ARE APPROXIMATE ONLY AND THEIR EXACT POSITION SHOULD BE PROVEN ON SITE. NO GUARANTEE IS GIVEN THAT ALL EXISTING SERVICES ARE SHOWN

DRAWN	DESIGNED	CHECKED	DESIGN LEADER	DESIGN SUPERVISOR
J.LEESON	S.HAIZI	S.HAIZI	S.HAIZI	S.JACKSON

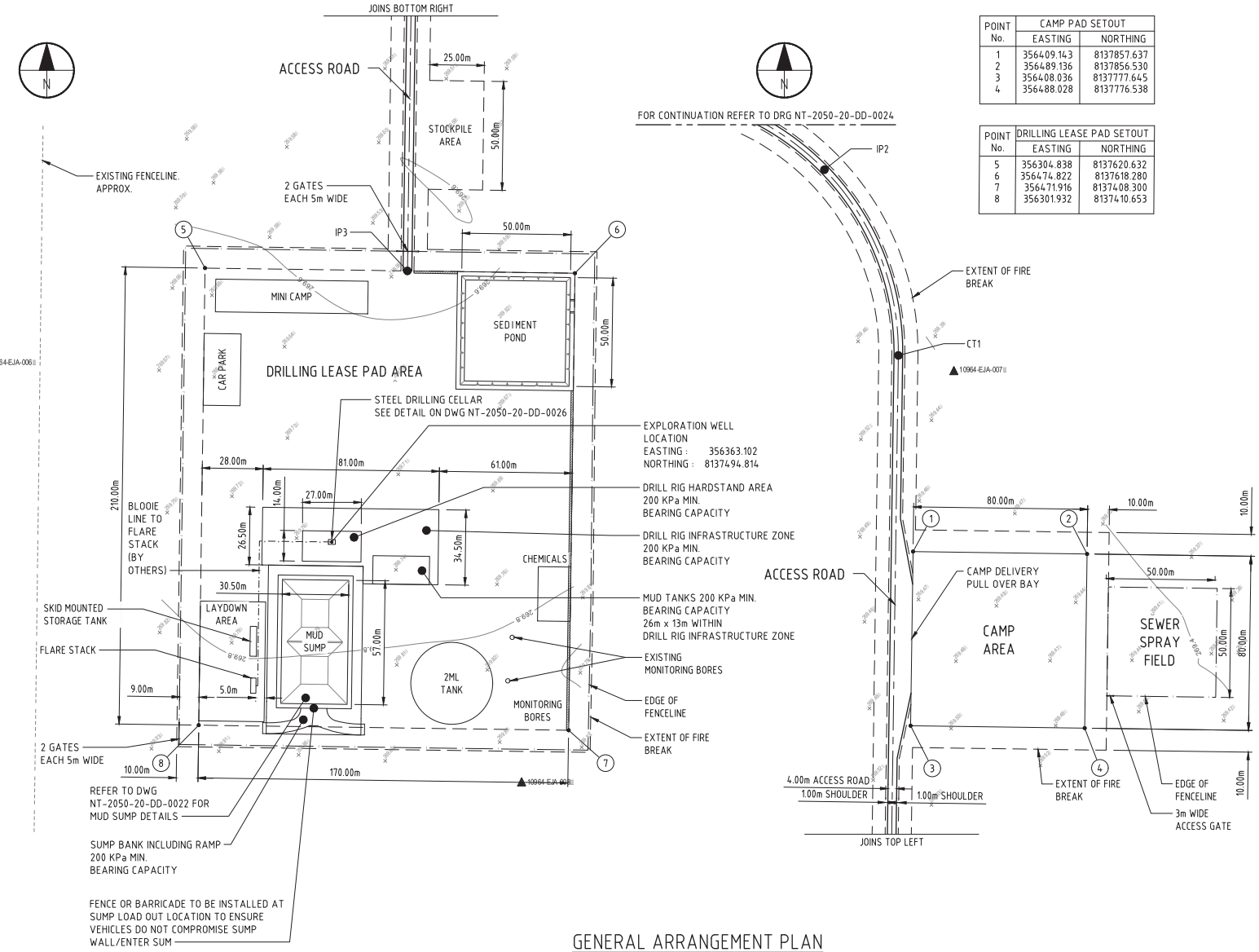
Northern Territory Government

STANDARD DRAWINGS
TYPICAL CROSS SECTIONS

TYPICAL CROSS SECTIONS
FOR URBAN AND RURAL ENVIRONMENTS

FILE No.	ASSET No.	SHEET No.	DRAWING No.	AMEND.	SIZE
-	-	2 of 2	CS3003	0	A1

Appendix B Infrastructure design drawings



POINT No.	CAMP PAD SETOUT EASTING	NORTHING
1	356409.143	8137857.637
2	356489.136	8137856.530
3	356408.036	8137777.645
4	356488.028	8137776.538

POINT No.	DRILLING LEASE PAD SETOUT EASTING	NORTHING
5	356304.838	8137620.632
6	356474.822	8137618.280
7	356471.916	8137408.300
8	356301.932	8137410.653

LEGEND

EXISTING

CONTOURS

PROPOSED

ACCESS ROAD CENTERLINE

EDGE OF PAVEMENT

EDGE OF SHOULDER

EDGE OF FOOTPATH

EXTENT OF CLEARING - (EXTENT OF FIRE BREAK)

EDGE OF FENCELINE

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. REFER TO NORTHERN TERRITORY STANDARD DRAWING C(S)3310 FOR TYPICAL STOCK FENCE DETAILS.
3. SEWER SPRAY FIELD AREA IS NOT TO BE CLEARED. SPRAY PIPES LAID ON EXISTING VEGETATION BY OTHERS.
4. LEASE AND CAMP PAD TO BE COMPACTED TO 120KPA BEARING CAPACITY UNLESS OTHERWISE NOTED.
5. LEASE HARDSTAND PAD TO BE COMPACTED TO 200 KPA BEARING CAPACITY.
6. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH THE APPROVED MANAGEMENT PLAN REQUIREMENTS.
7. NO CONSTRUCTION WORKS ARE TO BE CARRIED OUT OUTSIDE THE APPROVED WORK CORRIDOR BOUNDARIES.
8. CONSTRUCTION FACILITY AREA LOCATIONS TO BE APPROVED BY THE SUPERINTENDENT PRIOR TO WORKS COMMENCING.
9. THE CONTRACTOR IS TO LIAISE WITH SERVICE PROVIDERS AND THE RELEVANT AUTHORITIES TO ENSURE ALL CONSTRUCTION WORKS ARE CARRIED OUT IN ACCORDANCE WITH SERVICE PROVIDERS AND RELEVANT AUTHORITIES REQUIREMENTS.
10. THE CONTRACTOR IS TO CARRY OUT A DBYD AND LOCATE AND MARK SERVICES ON SITE. ANY DAMAGE TO EXISTING SERVICES IS TO BE RE-INSTATED AT THE CONTRACTORS EXPENSE.
11. SIGNAGE TO BE INSTALLED PRIOR TO ROAD USE.
12. REFER TO DRAWING NT-2050-20-DD-0022 FOR MUD SUMP DETAILS AND DRAWING NT-2050-20-DD-0026 FOR PRECAST CELLAR PIT DETAILS .
13. THE NOMINATED AREA BOUND BY SETOUT POINTS D1 TO D4 IS TO BE A UNIFORMLY GRADED PAD.
14. FINISH SURFACE LEVELS ARE TO FOLLOW EXISTING SURFACE LEVELS AS NEAR AS POSSIBLE AND TO THE GRADES SPECIFIED ON THE DRAWINGS.
15. FIREBREAK CLEARINGS AROUND DRILLING LEASE AND CAMP PAD ARE TO BE USED FOR STORAGE OF TOPSOIL AND VEGETATION AS REQUIRED.
16. FOR ROAD SETOUT TABLE REFER TO DRG. NT-2050-20-DA-0022.
17. HARDSTAND AND LEASE PAD FINISHED SURFACE LEVELS TO BE EQUAL OR SMOOTH TRANSITION TO AVOID BATTERS OF STEPS.
18. CAMP PAD AREA CROSSFALL TO BE NO GREATER THAN 1%.
19. NO ESC DEVICE CAN BE INSTALLED IN CRITICAL RIG AREA WITHOUT APPROVAL BY WELLSITE REP.
20. CATTLE PANEL FENCING TO BE INSTALLED AROUND MUD SUMP.

SURVEY CONTROL				
STN	EASTING	NORTHING	RL	DESCRIPTION
10964-EJA-006	356 202.60	8 137 576.49	269.83	SIP
10964-EJA-007	356 427.92	8 137 940.19	269.45	SIP
10964-EJA-008	356 450.30	8 137 384.00	269.94	SIP

GENERAL ARRANGEMENT PLAN

ISSUED FOR CONSTRUCTION

SCALE (m) 0 10 20 30 40 50 1:1000 (A1)

DRAWING NO.	REFERENCE DRAWING TITLE
NT-2050-20-DD-0026	DRILLING CELLAR DETAILS
NT-2050-20-DD-0022	DESIGN DETAILS

REV	DATE	REVISION DESCRIPTION	DRAWN	DWG CHECK	DESIGN	ENG DES CHECK	DE DRAFT SUPER.	DE PROJECT APPROVAL
0	20.03.19	ISSUED FOR CONSTRUCTION	CRD	PCM	PCM	JMJ		

PROJECT APPROVALS - OTHERS

PREPARED FOR ORIGIN BY:

AECOM

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	BY	DATE
DRAWN	CRD	20.03.2019
DWG CHECK	PCM	20.03.2019
DESIGN	PCM	20.03.2019
ENG DES CHECK	JMJ	20.03.2019
DRAFT. SUPER.		
PROJECT APPROVAL		

TITLE
BEETALOO EXPLORATION DRILL CAMPAIGN
KYALLA 117 N2-1
DRILL PAD, ACCOMODATION CAMP AND WATER TANK
GENERAL ARRANGEMENT PLAN

PROJECT NO.
MOD NO.
SCALE 1:1000 @ A1

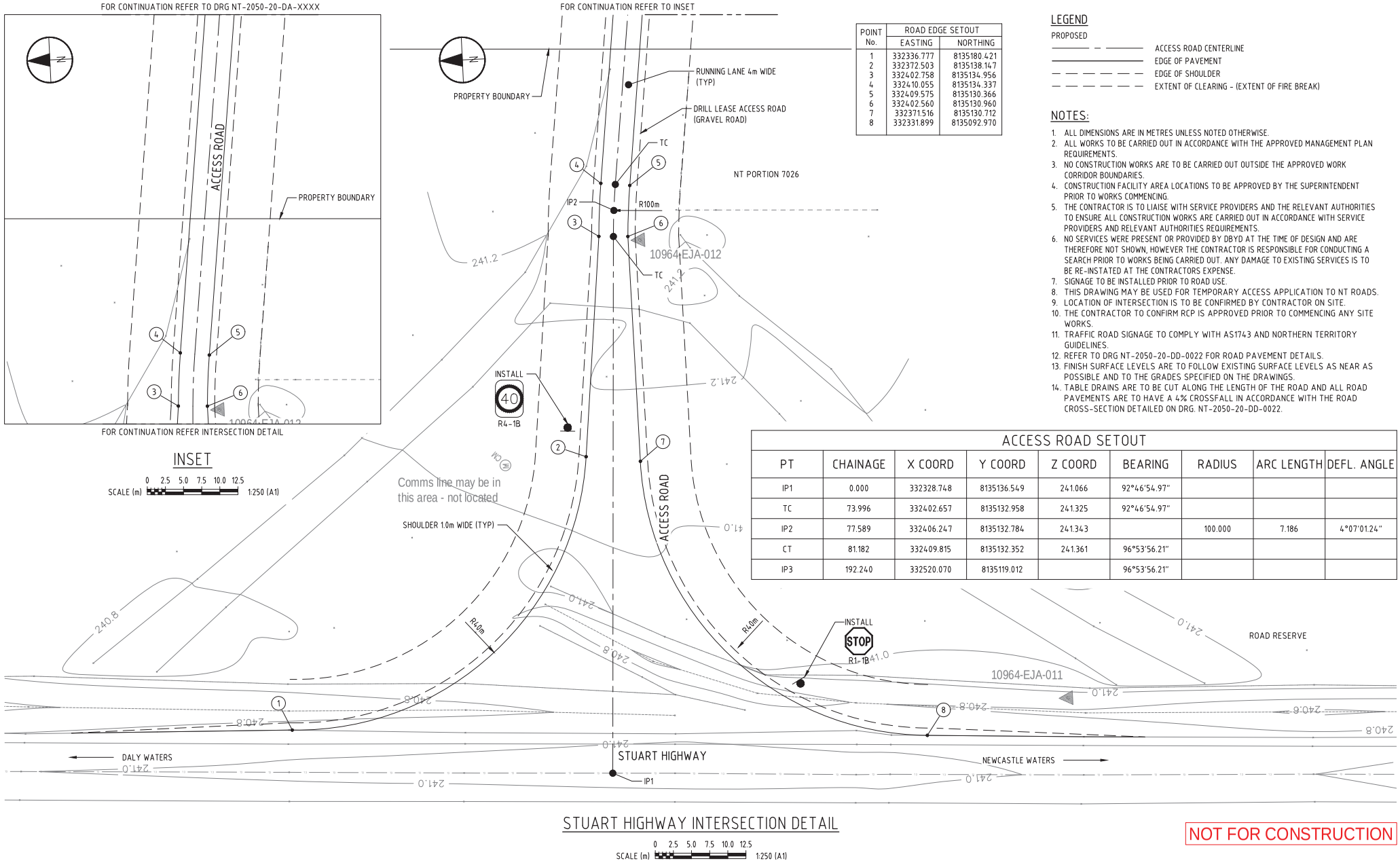
DRAWING NO. NT-2050-20-DA-0022

REVISION 0

CADFILE NT-2050-20-DA-0022.dwg

A1

Wed, 20 Mar 2019 - 12:16pm P:\604XX\60480548\5 CAD\20-SHEETS\KYALLA 117 N2-1\NT-2050-20-DA-0022.DWG Dudley, Calvin



POINT No.	ROAD EDGE SETOUT EASTING	NORTHING
1	332336.777	8135180.421
2	332372.503	8135138.147
3	332402.758	8135134.956
4	332410.055	8135134.337
5	332409.575	8135130.366
6	332402.560	8135130.960
7	332371.516	8135130.712
8	332331.899	8135092.970

LEGEND

PROPOSED

- ACCESS ROAD CENTERLINE
- EDGE OF PAVEMENT
- EDGE OF SHOULDER
- EXTENT OF CLEARING - (EXTENT OF FIRE BREAK)

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH THE APPROVED MANAGEMENT PLAN REQUIREMENTS.
3. NO CONSTRUCTION WORKS ARE TO BE CARRIED OUT OUTSIDE THE APPROVED WORK CORRIDOR BOUNDARIES.
4. CONSTRUCTION FACILITY AREA LOCATIONS TO BE APPROVED BY THE SUPERINTENDENT PRIOR TO WORKS COMMENCING.
5. THE CONTRACTOR IS TO LIAISE WITH SERVICE PROVIDERS AND THE RELEVANT AUTHORITIES TO ENSURE ALL CONSTRUCTION WORKS ARE CARRIED OUT IN ACCORDANCE WITH SERVICE PROVIDERS AND RELEVANT AUTHORITIES REQUIREMENTS.
6. NO SERVICES WERE PRESENT OR PROVIDED BY DBYD AT THE TIME OF DESIGN AND ARE THEREFORE NOT SHOWN, HOWEVER THE CONTRACTOR IS RESPONSIBLE FOR CONDUCTING A SEARCH PRIOR TO WORKS BEING CARRIED OUT. ANY DAMAGE TO EXISTING SERVICES IS TO BE RE-INSTATED AT THE CONTRACTORS EXPENSE.
7. SIGNAGE TO BE INSTALLED PRIOR TO ROAD USE.
8. THIS DRAWING MAY BE USED FOR TEMPORARY ACCESS APPLICATION TO NT ROADS.
9. LOCATION OF INTERSECTION IS TO BE CONFIRMED BY CONTRACTOR ON SITE.
10. THE CONTRACTOR TO CONFIRM RCP IS APPROVED PRIOR TO COMMENCING ANY SITE WORKS.
11. TRAFFIC ROAD SIGNAGE TO COMPLY WITH AS1743 AND NORTHERN TERRITORY GUIDELINES.
12. REFER TO DRG NT-2050-20-DD-0022 FOR ROAD PAVEMENT DETAILS.
13. FINISH SURFACE LEVELS ARE TO FOLLOW EXISTING SURFACE LEVELS AS NEAR AS POSSIBLE AND TO THE GRADES SPECIFIED ON THE DRAWINGS.
14. TABLE DRAINS ARE TO BE CUT ALONG THE LENGTH OF THE ROAD AND ALL ROAD PAVEMENTS ARE TO HAVE A 4% CROSSFALL IN ACCORDANCE WITH THE ROAD CROSS-SECTION DETAILED ON DRG. NT-2050-20-DD-0022.

ACCESS ROAD SETOUT

PT	CHAINAGE	X COORD	Y COORD	Z COORD	BEARING	RADIUS	ARC LENGTH	DEFL. ANGLE
IP1	0.000	332328.748	8135136.549	241.066	92°46'54.97"			
TC	73.996	332402.657	8135132.958	241.325	92°46'54.97"			
IP2	77.589	332406.247	8135132.784	241.343		100.000	7.186	4°07'01.24"
CT	81.182	332409.815	8135132.352	241.361	96°53'56.21"			
IP3	192.240	332520.070	8135119.012		96°53'56.21"			

STUART HIGHWAY INTERSECTION DETAIL

SCALE (m) 0 2.5 5.0 7.5 10.0 12.5 1:250 (A1)

NOT FOR CONSTRUCTION

DRAWING NO.	REFERENCE DRAWING TITLE	REV	DATE	REVISION DESCRIPTION	DRAWN	DWG CHECK	DESIGN	ENG DES CHECK	DE DRAFT SUPER.	DE PROJECT APPROVAL
-	-	B	06.03.19	UPDATES FOLLOWING COMMENTS	CD	-	-	-	-	-
-	-	A	13.02.19	PRELIMINARY ISSUE	CD	-	-	-	-	-

APPROVALS

PREPARED FOR ORIGIN BY:
AECOM
AECOM Australia Pty Ltd
A.B.N 20 093 846 925
www.aecom.com
PROJECT 60480548 BEETALOO EXPLORATION
DRAWING OFFICE DARWIN
PROJECT APPROVALS - OTHERS

origin

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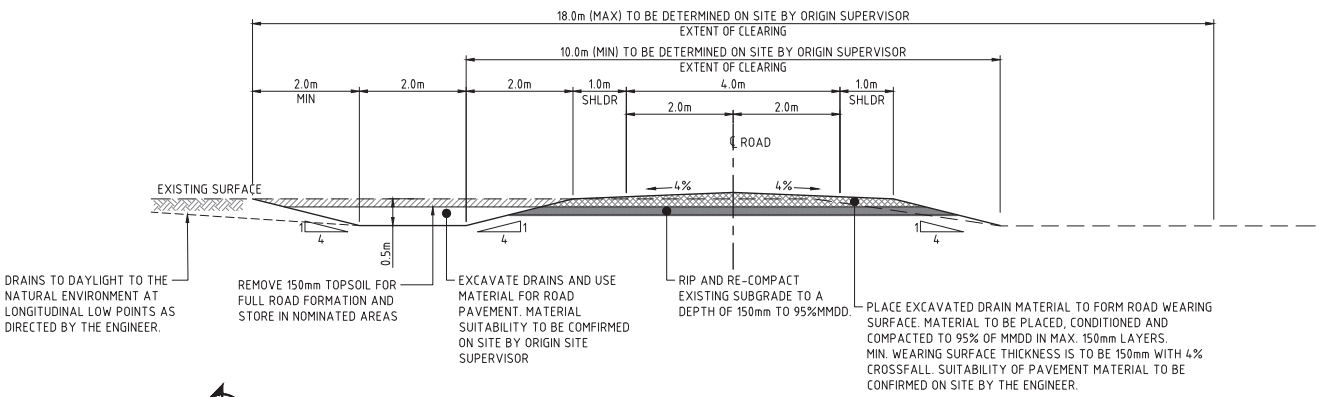
DWG CHECK	-	- . - . -
DESIGN	-	- . - . -
ENG DES CHECK	-	- . - . -
DRAFT. SUPER.	-	- . - . -
PROJECT APPROVAL	-	- . - . -

TITLE
BEETALOO EXPLORATION DRILL CAMPAIGN
STUART HIGHWAY
INTERSECTION DETAIL

PROJECT NO.
MOD NO.
SCALE 1:1000 @ A1
DRAWING NO. NT-2050-20-DD-0021
REVISION B
CADFILE NT-2050-20-DD-0021.dwg
A1

Wed, 06 Mar 2019 - 12:42pm P:\604X\60480548\5. CAD\20-SHEETS\STUART HIGHWAY\NT-2050-20-DD-0021.DWG Dudley, Calvin

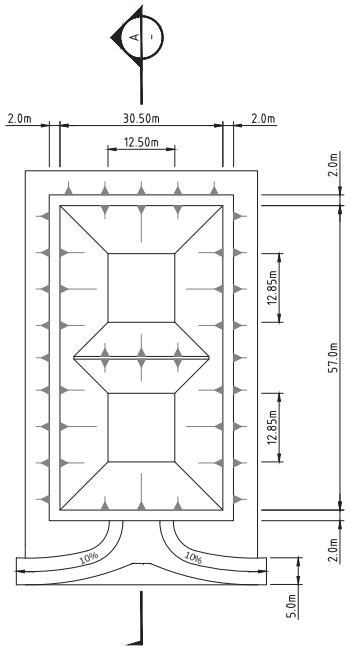


TYPICAL CROSS SECTION - ACCESS ROAD

SCALE (m) 0 0.2 0.4 0.6 0.8 1.0 1:20 (A1)

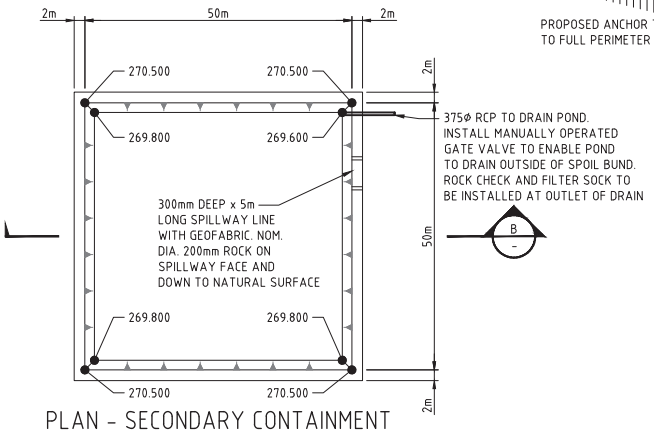
NOTES:

1. ALL UNITS ARE IN MILLIMETRES (mm) UNLESS NOTED OTHERWISE.
2. ENSURE THAT TABLE DRAINS ARE FREE DRAINING.
3. GROUND CONDITIONS AND SUITABLE MATERIALS TO BE CONFIRMED ON SITE BY SUPERINTENDENT.
4. CLEARED VEGETATION TO BE STORED ALONGSIDE NEW ROAD FOR FUTURE REHABILITATION.
5. REFER TO SPECIFICATION FOR COMPACTION REQUIREMENTS.
6. STRIPPED TOPSOIL TO BE STORED IN BERMS ALONGSIDE ROAD.
7. REFER TO SPECIFICATION FOR GENERAL REQUIREMENTS.
8. THE CONTRACTOR IS TO NOTIFY THE ORIGIN SUPERVISOR IF AREAS OF SOFT GROUND ARE ENCOUNTERED OR IF THE SPECIFICATION CANNOT BE ACHIEVED.
9. CLEAR, STRIP 150mm TOPSOIL AND STOCKPILE IN NOMINATED BUFFER ZONE TO ESTABLISH BORROW PITS.
10. REFER TO DRAWING NT-2050-20-DA-0022 FOR SETOUT DETAILS OF MUD SUMP.
11. THIS DRAWING MAY BE USED FOR TEMPORARY ACCESS APPLICATION TO NT ROADS.
12. FAUNA LADDERS TO BE INSTALLED TO MUD SUMP.
13. CONTRACTOR TO PROVIDE CATTLE PANELS FOR FENCING AROUND SUMP WHERE DEPTH IS GREATER THAN 1.5m.
14. FENCE OR BARRICADE TO BE INSTALLED AT SUMP LOAD OUT LOCATION TO ENSURE VEHICLES DO NOT COMPROMISE SUMP WALL/ENTER SUM.
15. TYPICAL CROSS SECTION DESIGNED IN ACCORDANCE WITH NORTHERN TERRITORY STANDARD DRAWING C(S)3003.
16. MUD SUMP VEHICLE OFFLOAD AREA TO BE COMPACTED TO 200 KPa



PLAN - MUD SUMP

Scale N.T.S.

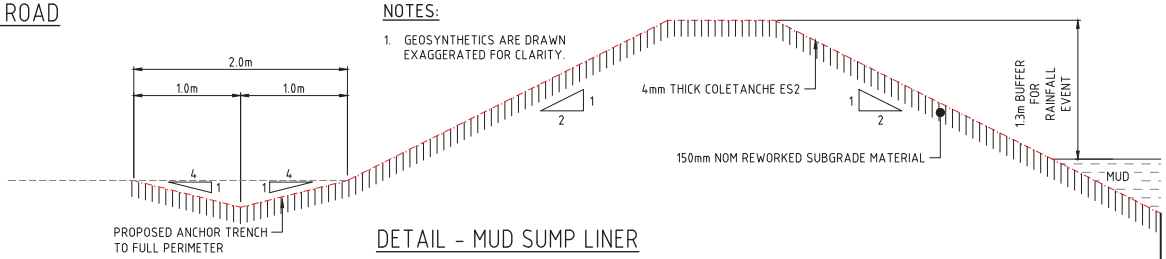


PLAN - SECONDARY CONTAINMENT

Scale N.T.S.

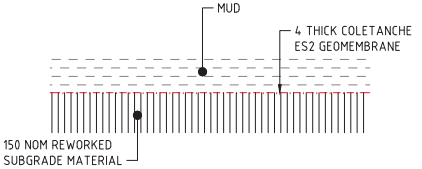
NOTES:

1. GEOSYNTHETICS ARE DRAWN EXAGGERATED FOR CLARITY.



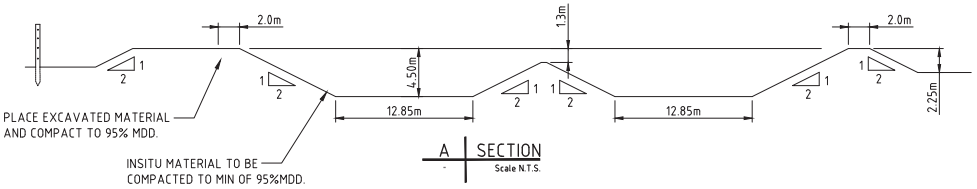
DETAIL - MUD SUMP LINER

Scale N.T.S.

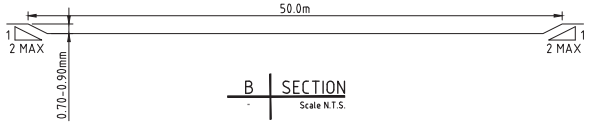


DETAIL - BASE LINER

Scale N.T.S.



A SECTION
Scale N.T.S.



B SECTION
Scale N.T.S.

ISSUED FOR CONSTRUCTION

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NT-2050-20-DA-0022	GENERAL ARRANGEMENT PLAN	0	20.03.19	ISSUED FOR CONSTRUCTION	CRD	PCM	PCM	JMJ		

APPROVALS

PROJECT APPROVALS - OTHERS

PREPARED FOR ORIGIN BY:

AECOM

AECOM Australia Pty Ltd
A.B.N 20 093 846 925
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PROJECT 60480548 BEETALOO EXPLORATION

DRAWING OFFICE DARWIN

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DE DRAFT. SUPER.		
DE PROJECT APPROVAL		

TITLE
BEETALOO EXPLORATION DRILL CAMPAIGN
KYALLA 117 N2-1
DESIGN DETAILS

PROJECT NO.

DRAWING NO. NT-2050-20-DD-0022

REVISION 0

MOD NO.

SCALE 1:1000 @ A1

CADFILE NT-2050-20-DD-0022.dwg

A1

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92130 Issy-les-Moulineaux
France
www.coletanche.com

Prepared: 12/06/2018
Cancels and replaces: 15/01/2018
Code : 1876901
Manufacture source Courchelettes (59-France)
Technical ref: FT AXTER ES2 ASTM

PRODUCT DATA SHEET

COLETANCHE ES 2

DESCRIPTION

COLETANCHE ES 2 is an SBS elastomeric modified bituminous geomembrane.

USE

Moderate level of mechanical resistance, for use an environmental protection and groundworks waterproofing, in particular :
- To cover landfill,
- Hydraulic ponds,
- Containment of Industrial liquid wastes,
- Canals ,
- Contamined land.

Product use must be validated by Axter

APPLICATION METHOD

By torch welding or other similar technique

STORAGE

Rolls must not be stored directly on the ground. Provide suitable supports (blocks, slides, wooden planks) with a minimum height of 35 cm to be placed under the ends of the mandrel.

COMPOSITION

(indicative)

Reinforcement (g/m²) :	Glass mat	50
Reinforcement (g/m²) :	Non-woven geotextile	250
Binder (g/m²) :	Elastomeric SBS	4300
Surface finish (g/m²) :	Sand	250
Under surface finish (g/m²) :	Polyester antiroot film	15

CHARACTERISTICS

		STANDARD	UNITS	AVERAGE	Minimum
Dimensions	Length	-	*m*	80	79
	Width		*m*	5.10	5.01
Thickness (on finished product)		*ASTM D 5199*	mm	4.00	*3.60*
Surface mass		*ASTM D 3776*	kg/m²	4.85	*4.30*
Resistance to tearing	Longitudinal	*ASTM D 4073*	N	825	*619*
	Cross direction			700	*525*
Tensile properties : maximum tensile strength	Longitudinal	*ASTM D 7275*	kN/m	27	*20.3*
	Cross direction			24	*15*
Tensile properties : elongation	Longitudinal		%	50	*35*
	Cross direction			50	*35*
Static Puncture		*ASTM D 4833*	N	530	*477*
Flexibility at low temperature	Longitudinal	*ASTM D 5147*	*°C*	-20	-15
	Cross direction			-20	-15
Water permeability (liquid tightness)		*ASTM E 96*	*m/s*	6.10^{-14}	<
Gas permeability (gas tightness)		*ASTM D 1434-82*	$m^3/(m^2.j.atm)$	2.10^{-4}	<

NOTE: AXTER COLETANCHE INC. may modify the composition and/or utilisation of its products without prior notice. Consequently orders will be filled according to the latest specification.

GENERAL

1. ALL WORK EXCLUDING WORK ASSOCIATED WITH LINER SUPPLY AND INSTALLATION SHALL BE COMPLETED IN ACCORDANCE WITH 'ORIGIN' TECHNICAL SPECIFICATION Q-4522-20-TS-0001 POND EARTHWORKS AND WITH PROJECT SPECIFIC DRAWINGS, PROJECT STANDARD DRAWINGS AND OTHER CONTRACT DOCUMENTATION AS APPLICABLE.
2. ALL WORK ASSOCIATED WITH LINER SUPPLY AND INSTALLATION SHALL BE COMPLETED IN ACCORDANCE WITH 'ORIGIN' TECHNICAL SPECIFICATION Q-4522-20-TS-0002 AND Q-4522-20-TS-0003.
3. THE CONTRACTOR SHALL TAKE OUT ALL APPROPRIATE LOCAL GOVERNMENT AND OTHER AUTHORITY PERMITS PRIOR TO COMMENCING WORK.
4. THE CONTRACTOR SHALL ASCERTAIN THE EXACT LOCATION OF ALL EXISTING SERVICES ON AND ADJACENT TO THE SITE OF THE WORK PRIOR TO COMMENCING THE WORK AND SHALL BE RESPONSIBLE FOR THE COST OF RECTIFICATION OF ANY DAMAGES TO THE EXISTING SERVICES OCCASIONED DURING THE WORK. LOCATIONS OF EXISTING SERVICES IF AND WHERE SHOWN ON THE DRAWINGS ARE APPROXIMATE ONLY. DRAWINGS MAY NOT INDICATE ALL EXISTING SERVICES.
5. THE CONTRACTOR SHALL PROGRAMME WORK AND INCORPORATE APPROPRIATE MEASURES TO MINIMISE DISTURBANCE TO OTHERS BY DUST, NOISE, FLOODING, SERVICES DISCONNECTIONS AND THE LIKE.
6. NOTWITHSTANDING THE EXTENT OF FILLING AND EXCAVATION WORK SHOWN ON THE DRAWINGS, NOTED IN THE SPECIFICATION OR NOTED IN OTHER CONTRACT DOCUMENTS, THE EXTENT OF THE WORK SHALL BE CONFIRMED WITH THE SUPERINTENDENT PRIOR TO COMMENCEMENT OF THE WORK.
7. THE CONTRACTOR SHALL MAINTAIN THE SITE FREE OF RUBBISH AND EXCESS MATERIALS AND SHALL STACK AND/OR STOCKPILE CONSTRUCTION MATERIALS IN A SUITABLE MANNER AS APPLICABLE FOR EACH OF THE INDIVIDUAL MATERIALS.

ENVIRONMENTAL AND SEDIMENT CONTROL NOTES

1. THE CONTRACTOR SHALL AVOID DISTURBANCE OF ENVIRONMENTALLY SENSITIVE AREAS. UNLESS NOTED OTHERWISE IN THE CONTRACT DOCUMENTS, THE CONTRACTOR SHALL INSTALL TEMPORARY FENCING (STAR PICKETS WITH 3 STRANDS OF PLAIN WIRE AND FLAGGING TO SUIT) ALONG THE BOUNDS OF ENVIRONMENTAL BUFFERS. THERE SHALL BE NO ENTRY INTO ENVIRONMENTAL BUFFER AREAS BEYOND THE FENCED BOUNDS UNLESS OTHERWISE APPROVED FOR BY THE SUPERINTENDENT.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE DESIGN, INSTALLATION AND MAINTENANCE OF ALL TEMPORARY EROSION AND SEDIMENT CONTROL DEVICES/MEASURES INCLUDING CUT OFF DRAINS AND BUNDS, REQUIRED DURING THE COURSE OF THE WORK AND UP UNTIL THE WORK IS TAKEN OFF MAINTENANCE.
3. A COPY OF THE PROPOSED EROSION AND SEDIMENT CONTROL PLAN, PREPARED IN ACCORDANCE WITH OTHER CONTRACT DOCUMENTATION, SHALL BE SUBMITTED TO THE SUPERINTENDENT PRIOR TO THE COMMENCEMENT OF WORK ON THE SITE.
4. THE CONTRACTOR SHALL INSTALL ALL SEDIMENT CONTROL DEVICES/MEASURES PRIOR TO COMMENCEMENT OF THE WORK PROPER. DURING THE COURSE OF THE WORK, THE CONTRACTOR SHALL INSTALL FURTHER SEDIMENT CONTROL DEVICES/MEASURES INCLUDING CUT OFF DRAINS AND BUNDS, DEEMED NECESSARY TO CONTROL SEDIMENT RUNOFF.
5. THE CONTRACTOR SHALL INSPECT ALL EROSION AND SEDIMENT CONTROL DEVICES/MEASURES FOR DAMAGE FOLLOWING EACH RAINFALL EVENT. DAMAGED DEVICES/MEASURES SHALL BE REMOVED AND REPLACED, SEDIMENT SHALL BE REMOVED AND ALL ERODED AREAS MADE GOOD.
6. ALL EROSION AND SEDIMENT CONTROL DEVICES/MEASURES SHALL BE CLEANED OUT PRIOR TO SEDIMENT VOLUME REACHING 50% OF THE CONTROL DEVICE/MEASURE CAPACITY.

POND EARTHWORKS

1. EARTHWORKS SHALL GENERALLY BE COMPLETED IN ACCORDANCE WITH 'ORIGIN' TECHNICAL SPECIFICATION Q-4522-20-TS-0001 POND EARTHWORKS AND WITH PROJECT SPECIFIC DRAWINGS, PROJECT STANDARD DRAWINGS AND OTHER CONTRACT DOCUMENTATION AS APPLICABLE.
2. TOPSOIL SHALL BE STRIPPED TO A DEPTH OF 150mm ACROSS THE EXTENTS OF THE WORK AND STOCKPILED FOR REUSE WHERE DIRECTED BY THE SUPERINTENDENT.
3. COMPACTION TESTING SHALL BE COMPLETED IN ACCORDANCE WITH THE SPECIFICATION.
4. THE PREPARED SURFACE/SURFACES TO BE LINED SHALL BE MAINTAINED (MOISTURE CONTENT AND LEVEL OF COMPACTION) UNTIL IMMEDIATELY PRIOR TO LINER INSTALLATION. WHERE INSTALLATION OF THE LINER IS DELAYED DUE TO ANY CAUSE WHATSOEVER AND/OR THE PREPARED SURFACE/SURFACES ARE SUBJECT TO ELEMENTS OF THE WEATHER WHICH RESULTS IN CHANGES IN THE MOISTURE CONTENT, COMPACTION AND INTEGRITY OF THE SURFACE/SURFACES, THE SURFACE/SURFACES SHALL BE REWORKED IMMEDIATELY PRIOR TO THE INSTALLATION OF THE LINER TO ACHIEVE THE SPECIFIED REQUIREMENTS FOR MOISTURE CONTENT, LEVEL OF COMPACTION AND SURFACE INTEGRITY.

TOPSOIL REINSTATEMENT AND AMENDMENT

1. TOPSOIL SHALL BE PLACED TO ALL DISTURBED AREAS EXCLUDING AREAS OCCUPIED BY PAVEMENTS, SPILLWAYS AND CAPPING MATERIAL OR AS DIRECTED BY THE SUPERINTENDENT.
2. FINISHED EARTHWORKS SURFACES TO RECEIVE TOPSOIL SHALL BE PREPARED IN ACCORDANCE WITH REQUIREMENTS STATED HEREIN.
2.1. FINISHED EARTHWORKS SURFACES (SUBGRADE) TO BE TOPSOILED SHALL BE RIPPED/TYNED TO DEPTHS OF 150mm.
2.2. GYPSUM SHALL BE SPREAD AT THE RATE OF 5t/ha (0.5kg/m2) AND SHALL BE THOROUGHLY WORKED AND MIXED INTO THE LOOSENED MATERIAL/MATERIALS VIA TWO (2) PASSES OF A TWO (2) WAY DISC PLOW/HARROW OR VIA ROTARY HOE.
2.3. FOLLOWING MIXING, THE MATERIAL SHALL BE REQUIRED TO THE PROFILES REQUIRED OF THE FINISHED EARTHWORKS AND SHALL BE COMPACTED TO 95% MINIMUM OF THE MAXIMUM DRY DENSITY FOR THE MATERIAL – STANDARD COMPACTIVE EFFORT.
3. TOPSOIL WORK AND ASSOCIATED SUBGRADE AMENDMENT SHALL BE COMPLETED IMMEDIATELY FOLLOWING THE TRIMMING OF EARTHWORKS.
4. TOPSOIL SHALL BE PLACED TO A DEPTH OF 150mm.
5. TOPSOIL SHALL BE AMENDED BY THE INCLUSION OF 10 t/ha FEEDLOT MANURE, 100 kg/ha UREA AND 2 t/ha GYPSUM OR AS DIRECTED BY THE SUPERINTENDENT BASED ON SOIL ASSESSMENT.
6. GRASS SEED OF THE SPECIES AND MIX COMPOSITION AS DETERMINED BY ORIGIN ENERGY SHALL BE SOWN INTO THE TOPSOIL.

BITUMINOUS GEOMEMBRANE LINER PRODUCT DATA

1. DESCRIPTION – BGM IS AN SBS ELASTOMERIC MODIFIED BITUMINOUS GEOMEMBRANE.
2. USE – EXTREME LEVEL OF MECHANICAL RESISTANCE, FOR USE AS ENVIRONMENTAL PROTECTION AND GROUNDWATER WATERPROOFING (AGGRESSIVE MATERIALS, REINFORCED PRECAUTIONS)
   - RAILWAYS, DIRECTLY UNDER BALLAST
   - DAMS
3. PRODUCT USE MUST BE VALIDATED BY THE MANUFACTURER.
4. APPLICATION METHOD – TORCHED.
5. STORAGE – ROLLS MUST NOT BE STORED DIRECTLY ON THE GROUND. THEY MUST BE LAID SUPPORTED ON CONCRETE BLOCKS, TRESTLES OR TIMBER BEAMS, MIN 35cm HEIGHT, PLACED UNDER MANDREL ENDS.

COMPOSITION	
GLASS MAT	50 g/m²
NON-WOVEN GEOTEXTILE	400 g/m²
ELASTOMERIC SBS	5600 g/m²
SAND	300 g/m²
POLYESTER ANTIROOT FILM	15 g/m²

CHARACTERISTICS

		STANDARD	UNITS	VALUES	TOLERANCE MIN	TOLERANCE MAX
DIMENSIONS	LENGTH		m	[illegible]		
	WIDTH	-	m	5.00	[illegible]	
THICKNESS (ON FINISHED PRODUCT)		ASTM D 5199	mm	5.60	5.32	[illegible]
SURFACE MASS		ASTM D 5994	kg/m²	6.40	6.10	7
RESISTANCE TO TEARING	LONGITUDINAL	ASTM D 4073	N	1035	970	
	CROSS DIRECTION			1025	769	
TENSILE PROPERTIES : MAXIMUM TENSILE STRENGTH	LONGITUDINAL	ASTM D 7275	kN/m	[illegible]	[illegible]	
	CROSS DIRECTION			[illegible]	[illegible]	
TENSILE PROPERTIES : ELONGATION	LONGITUDINAL		%	[illegible]	[illegible]	
	CROSS DIRECTION			[illegible]	[illegible]	
TENSILE PROPERTIES : MAXIMUM TENSILE STRENGTH	LONGITUDINAL	ASTM D 4595	kN/m	[illegible]	[illegible]	
	CROSS DIRECTION			[illegible]	[illegible]	
TENSILE PROPERTIES : ELONGATION	LONGITUDINAL		%	[illegible]	[illegible]	
	CROSS DIRECTION			[illegible]	[illegible]	
STATIC PUNCTURE		ASTM D 4833	N	610	590	
FLEXIBILITY AT LOW TEMPERATURE	SURFACE	ASTM D 5147	°C	-20		
	UNDER SURFACE			-20		
WATER PERMEABILITY (LIQUID TIGHTNESS)		ASTM E 96	m/s	[illegible]		
GAS PERMEABILITY (GAS TIGHTNESS)		ASTM D 1434-82	m³/(m².j.atm)	[illegible]		

BITUMINOUS GEOMEMBRANE LINER INSTALLATION

1. BITUMINOUS GEOMEMBRANE INSTALLATION SHALL BE PERFORMED IN ACCORDANCE TO THE MANUFACTURER'S RECOMMENDATIONS. IF RECOMMENDATIONS ARE IN CONFLICT WITH DESIGN, THE CONTRACTOR TO NOTIFY THE PRINCIPAL IN WRITING FOR CLARIFICATION.
2. THE CONTRACTOR SHALL MONITOR AND ACCEPT RESPONSIBILITY FOR THE QUALITY OF MATERIALS PLACED INTO THE WORK. THE PRINCIPAL WILL REJECT MATERIALS INCORPORATED INTO WORK THAT FAIL TO COMPLY WITH SPECIFIED REQUIREMENTS. THE CONTRACTOR SHALL REMOVE REJECTED MATERIALS FROM THE WORK AND REPLACE WITH MATERIALS OF THE SPECIFIED QUALITY.
3. MEASUREMENT SHALL BE MADE OF THE TOTAL SURFACE AREA IN SQUARE METRES COVERED BY BITUMINOUS GEOMEMBRANE. FINAL QUANTITIES WILL BE BASED ON AS-BUILT CONDITIONS. CONTRACTOR SHOULD MAKE ALLOWANCE FOR BITUMINOUS GEOMEMBRANE IN ANCHOR TRENCHES, DRAINAGE TRENCHES, AND OVERLAPS. HOWEVER, NO ALLOWANCE WILL BE MADE FOR WASTE OR MATERIALS USED FOR THE CONVENIENCE OF THE CONTRACTOR.
4. ROLLS SHALL NOT BE DRAGGED, LIFTED BY ONE END, OR DROPPED. A MANDREL OF SUFFICIENT STRENGTH TO SUPPORT THE FULL WEIGHT OF A ROLL WITHOUT SIGNIFICANT BENDING, SHALL BE USED FOR ALL HANDLING ACTIVITIES. THE DIAMETER OF THE MANDREL SHALL BE SMALL ENOUGH TO BE EASILY INSERTED THROUGH THE CORE OF THE ROLL. CHAINS SHALL BE USED TO LINK THE ENDS OF THE MANDREL TO THE ENDS OF A SPREADER BAR. THE SPREADER BAR SHALL BE WIDE ENOUGH TO PREVENT THE CHAINS FROM RUBBING AGAINST THE ENDS OF THE ROLL. ALTERNATIVELY, A STINGER BAR PROTRUDING FROM THE END OF A FORKLIFT OR OTHER EQUIPMENT MAY BE USED. THE STINGER BAR SHALL BE AT LEAST THREE-FOURTHS THE LENGTH OF THE CORE AND ALSO MUST BE CAPABLE OF SUPPORTING THE FULL WEIGHT OF THE ROLL WITHOUT SIGNIFICANT BENDING.
5. THE LINER SHALL BE PLACED IN A RELAXED STATE SUCH THAT THE MATERIAL CAN RESPOND TO THERMAL CHANGES WITHOUT EXCESSIVE BUCKLING, WRINKLING OR TENSIONING.
6. ONLY THE QUANTITY OF BITUMINOUS GEOMEMBRANE THAT WILL BE ANCHORED AND SEAMED TOGETHER IN ONE DAY SHALL BE DEPLOYED.

RPEQ No. 15853
Name: B-R [illegible]

BGM INSTALLATION (CONTINUED)

7. THE PROCEDURES AND EQUIPMENT USED SHALL NOT ELONGATE, WRINKLE, SCRATCH, OR OTHERWISE DAMAGE THE BITUMINOUS GEOMEMBRANE, OTHER GEOSYNTHETIC LAYERS, OR THE UNDERLYING SUBGRADE. BITUMINOUS GEOMEMBRANE DAMAGED DURING INSTALLATION SHALL BE REPLACED OR REPAIRED, AT THE CONTRACTOR'S EXPENSE AND AT THE PRINCIPAL'S DISCRETION. ADEQUATE BALLAST (I.E., SAND BAGS OR OTHER) SHALL BE PLACED ON THE BITUMINOUS GEOMEMBRANE, WITHOUT DAMAGING THE BITUMINOUS GEOMEMBRANE, TO PREVENT UPLIFT BY WIND. NO EQUIPMENT SHALL BE OPERATED ON THE TOP SURFACE OF THE BITUMINOUS GEOMEMBRANE WITHOUT PERMISSION FROM THE PRINCIPAL. THE METHODS USED TO DEPLOY, BACKFILL, AND BALLAST (TEMPORARY OR PERMANENT) OVER THE BITUMINOUS GEOMEMBRANE SHALL MINIMIZE WRINKLES AND TENSILE STRESSES IN THE BITUMINOUS GEOMEMBRANE. THE BITUMINOUS GEOMEMBRANE SHALL HAVE ADEQUATE SLACK TO PREVENT THE CREATION OF TENSILE STRESS.
8. IN GENERAL, SEAMS SHALL BE ORIENTATED PARALLEL TO THE LINE OF MAXIMUM SLOPE. NO HORIZONTAL WELDS ALONG SLOPES OR WITHIN 1 METRE OF SLOPE TRANSITIONS UNLESS APPROVED BY THE PRINCIPAL. IN CORNERS AND ODD SHAPED GEOMETRIC LOCATIONS, THE TOTAL LENGTH OF THE FIELD SEAM SHALL BE MINIMIZED. SEAMS SHALL NOT BE LOCATED AT LOW POINTS IN THE SUBGRADE UNLESS GEOMETRY REQUIRES SEAMING AT SUCH LOCATIONS AS APPROVED BY THE PRINCIPAL.
9. QUADRUPLE POINT LOCATIONS DUE TO ALIGNED STRIP ENDS ARE NOT ALLOWED. TRIPLE POINT LOCATIONS WILL BE COVERED WITH AN ADDITIONAL BITUMINOUS GEOMEMBRANE.
10. THE BITUMINOUS GEOMEMBRANE SHALL NOT BE ALLOWED TO 'BRIDGE OVER' VOIDS OR LOW AREAS IN THE SUBGRADE. THE BITUMINOUS GEOMEMBRANE SHALL REST IN INTIMATE CONTACT WITH THE SUBGRADE.
11. THE SUBGRADE UNDER THE BITUMINOUS GEOMEMBRANE SHALL CONFORM THE TECHNICAL SPECIFICATIONS.
12. TEMPORARY BALLASTING SUCH AS SAND BAGS OR TYRES SHALL BE PLACED ON THE LINER TO PREVENT WIND DAMAGE OR BRIDGING DURING AND AFTER INSTALLATION. IT SHOULD BE NOTED THAT THIS TEMPORARY BALLASTING SHALL BE OF A SUITABLE CONSTRUCTION TO PREVENT AGAINST DAMAGE OF THE LINER. THE CONTRACTOR SHALL BE REQUIRED TO ENSURE THAT THE SPACING OF THESE SAND BAGS/TYRES ARE APPROPRIATELY DESIGNED (THIS COULD INCLUDE TYING THE SAND BAGS/TYRES TOGETHER IN A HORIZONTAL AND VERTICAL DIRECTION) TO PREVENT AGAINST UPLIFT AND ANY POTENTIAL DAMAGE OF THE LINER. ANY LINER MATERIAL THAT HAS BEEN DAMAGED AS THE RESULT OF WIND OR BRIDGING, IN THE OPINION OF THE PRINCIPAL, SHALL BE REMOVED AND REPLACED AT THE CONTRACTOR'S EXPENSE.
13. ALL PERSONNEL WORKING ON THE LINER SURFACE SHALL WEAR SOFT-SOLED SHOES, AND SHALL NOT ENGAGE IN ANY ACTIVITY WHICH MAY DAMAGE THE LINER.
14. BITUMINOUS GEOMEMBRANE SHALL NOT BE DEPLOYED OR FIELD-SEAMED IN THE PRESENCE OF SIGNIFICANT RAIN, IN AREAS OF PONDED WATER, OR IN THE PRESENCE OF WIND IN EXCESS OF 55 KM/HR. UNLESS AUTHORIZED BY THE PRINCIPAL, NO PLACEMENT OR SEAMING SHALL BE ATTEMPTED AT AMBIENT TEMPERATURES BELOW -25 DEGREES C (-13 DEGREES F) OR ABOVE 40 DEGREES C (104 DEGREES F). AMBIENT TEMPERATURE SHALL BE MEASURED AT A HEIGHT NO GREATER THAN 150 MM ABOVE THE GROUND OR BITUMINOUS GEOMEMBRANE SURFACE. IN MARGINAL CONDITIONS, SEAMING SHALL CEASE UNLESS DESTRUCTIVE FIELD SEAM TESTS, CONDUCTED BY THE QC LABORATORY, CONFIRM THAT SEAM PROPERTIES MEET THE DESIGN REQUIREMENTS.
15. THE CONTRACTOR SHALL NOMINATE A MASTER WELDING SUPERVISOR BEFORE COMMENCING WORK AND SHALL DEMONSTRATE THAT THE MASTER WELDING SUPERVISOR HAS A PROVEN BACKGROUND IN INSTALLATION OF SIMILAR SYSTEMS AND MATERIALS SIMILAR TO THOSE SPECIFIED. ALL PERSONNEL EMPLOYED IN WELDING SHALL BE COMPETENT AND EXPERIENCED IN THE USE OF THE EQUIPMENT. THE CONTRACTOR SHALL ULTIMATELY BE RESPONSIBLE FOR ENSURING THE QUALITY ASSURANCE PROGRAMME IS FOLLOWED.
16. THE CONTRACTOR SHALL BE RESPONSIBLE AND SHALL PROVIDE SUFFICIENT RESOURCES FOR FIELD HANDLING, DEPLOYING, SEAMING, TEMPORARILY RESTRAINING (AGAINST WIND), AND OTHER ASPECTS OF THE DEPLOYMENT AND INSTALLATION OF THE BITUMINOUS GEOMEMBRANE. NO SEAMING SHALL BE PERFORMED UNLESS A MASTER WELDING SUPERVISOR IS PRESENT ON-SITE.
17. EVERY WORKER PERFORMING WELDING OF THE BITUMINOUS GEOMEMBRANE WILL NEED TO DEMONSTRATE A CONDABRI VERIFICATION OF COMPETENCE (VOC) PRIOR TO UNDERTAKING WORKS ON THE FIELD. THE CONDABRI VOC CERTIFICATION AND TESTING WILL BE ADMINISTERED BY THE LEVEL 1 CQC. TRIAL WELD TEST SAMPLES SHALL SUBMITTED TO A THIRD-PARTY INDEPENDENT LABORATORY FOR DESTRUCTIVE TESTING.
18. DESTRUCTIVE TESTING SHALL BE COMPLETED IN ACCORDANCE TO ASTM D 7056 AND ASTM D 2019. NON-DESTRUCTIVE AIR LANCE TESTING SHALL BE COMPLETED IN ACCORDANCE TO ASTM D 4437.
19. CONNECTIONS TO ADJOINING STRUCTURES SHALL BE MADE IN ACCORDANCE WITH THE DETAILS SHOWN ON THE CONSTRUCTION DRAWINGS. CONNECTIONS SHALL BE AT LEAST EQUIVALENT IN STRENGTH TO THE NOMINAL LAP JOINTS AND THE SECURITY OF CONTAINMENT SHALL NOT BE DIMINISHED. LOCAL STRESSES IN THE LINER AT CONNECTIONS SHALL BE MINIMIZED.
20. ANCHOR TRENCHES SHALL BE EXCAVATED IN ACCORDANCE WITH THE DETAILS ON THE CONSTRUCTION DRAWINGS. THE ANCHOR TRENCHES SHALL BE KEPT WELL DRAINED TO AVOID SOFTENING DURING RAIN PERIODS AND MAINTAINED SO AS TO BE DRY, DESICCATE AND CRACK.
21. IN ACCORDANCE WITH Q-4522-20-TS-0003, THE CONTRACTOR SHALL SEEK APPROVAL FROM THE PRINCIPAL PRIOR TO THE COMMENCEMENT OF ANCHOR TRENCH BACKFILLING. ONCE THE ANCHOR TRENCH IS READY TO BE BACKFILLED, IT SHALL BE BACKFILLED IN EARLY MORNING WHEN THE LINER IS AT MAXIMUM CONTRACTION. BACKFILLING SHALL BE CARRIED OUT IN A PLANNED, LOGICAL SEQUENCE TO AVOID OVERSTRESSING OF THE LINER AND MINIMIZE EXPOSURE 'WET WEATHER DAMAGE.
22. ANCHOR TRENCH SHALL BE BACKFILLED WITH FLOWABLE CONCRETE STABILIZED SAND (5% CEMENTITIOUS) AND MIX DESIGN SHALL BE SUBMITTED FOR APPROVAL.
23. A LEVEL 1 CQC IS REQUIRED DURING ALL LINER INSTALLATION, LINER REPAIRS, AND QUALITY COMPLIANCE TESTING. MATERIAL TESTING SHALL BE CARRIED OUT AT RANDOMLY CHOSEN LOCATIONS, IN ACCORDANCE WITH SPECIFIED TESTING REQUIREMENTS AND FREQUENCIES, AND/OR AT LOCATIONS SELECTED BY THE PRINCIPAL.
24. ALL AREAS FOUND TO BE DEFECTIVE SHALL BE REPAIRED AT THE EXPENSE OF THE CONTRACTOR. THE PRINCIPAL SHALL BE NOTIFIED OF DEFECTIVE AREAS PRIOR TO THE REPAIR TAKING PLACE.
25. THE CONTRACTOR SHALL ENSURE A PLAN IS MARKED UP SHOWING THE LOCATIONS OF REPAIRS MADE AND THE TYPE OF REPAIR MADE. THE CONTRACTOR SHALL SUBMIT A MARKED UP DRAWING SHOWING THE LOCATIONS OF THE REPAIRS TO THE PRINCIPAL FOR REVIEW AND APPROVAL.
26. THE ENTIRE SURFACE OF EVERY SHEET OF LINER MATERIAL SHALL BE INSPECTED BY THE CONTRACTOR DURING PLACING TO IDENTIFY ANY TEARS, ABRASIONS, INDENTATIONS, CRACKS, THIN AREAS, OR OTHER DEFECTS.
27. ANY DEFECTS SUCH AS HOLES, TEARS, BLISTERS, LAMINATION, UNDISPERSED RAW MATERIALS OR VISIBLE NON-UNIFORMITY OR BRIGHT AMALGAM BY FOREIGN MATTER WHICH IN THE OPINION OF THE PRINCIPAL IS DETRIMENTAL TO THE LONG SERVICE LIFE REQUIRED OF THE LINER, SHALL BE GROUNDS FOR REJECTION OF THE LINER MATERIAL.
28. WHERE ADDITIONAL FAULTS ARE FOUND, THE PRINCIPAL RESERVES THE RIGHT TO REJECT THE ROLL. THE CONTRACTOR SHALL REPLACE ANY REJECTED ROLLS AND REPAIR ANY DEFECTS TO THE PRINCIPAL'S SATISFACTION AT THE CONTRACTOR'S EXPENSE.

BGM INSTALLATION (CONTINUED)

29. FOLLOWING INSTALLATION OF THE LINER, A DETAILED VISUAL INSPECTION OF THE PRIMARY LINER SURFACE SHALL BE PERFORMED BY THE PRINCIPAL (ACCOMPANIED BY THE CONTRACTOR), TO IDENTIFY ANY DEFECTS IN THE LINER SURFACE CAUSED DURING INSTALLATION. PRIOR TO PERFORMING THE SURVEY, A SURVEY GRID SHALL BE DETERMINED TO ENSURE THAT THE VISUAL SURVEY IS PERFORMED ACROSS 100-PERCENT OF THE LINER SURFACE.
30. ALL LINER WELD SEAMS SHALL BE SUBJECTED TO BOTH NON-DESTRUCTIVE AND DESTRUCTIVE TESTING. DESTRUCTIVE FIELD TESTING WILL BE AT THE INTERVALS LISTED AND ANY LOCATION CHOSEN BY THE PRINCIPAL. THE REPRESENTATIVE SAMPLES OF FIELD SEAMS SHALL BE TAKEN FOR LABORATORY TESTING BY AN INDEPENDENT, APPROPRIATELY QUALIFIED TESTING LABORATORY. WELD AND MATERIAL STRENGTH REQUIREMENTS TO COMPLY WITH MANUFACTURERS RECOMMENDATIONS.
31. NON-DESTRUCTIVE AND DESTRUCTIVE TESTING SHALL BE OBSERVED BY THE LEVEL 1 CQC/L.Q.
32. TRIAL WELDS TESTING SHALL BE CARRIED OUT THE SAME AS DESTRUCTIVE TESTING TRIAL WELDS.
33. TRIAL WELDS TO BE COMPLETED AT BEGINNING OF PROJECT. WELD TO BE CONDUCTED BY MASTER WELDING SUPERVISOR AND SHALL BE SENT TO LABORATORY FOR TESTING.
34. JOINT MUST BE CENTERED IN THE SAMPLE. THE SAMPLE MUST BE AT LEAST 350mm FOR 5 TESTS TO BE CARRIED OUT ON THE SAME SAMPLE. EACH SAMPLE MUST BE CLEARLY IDENTIFIED.
35. NON-DESTRUCTIVE FIELD WELD TESTS SHALL BE CARRIED OUT ON ALL WELDED SEAMS. A FAILED TEST IS ANY LOCATION OF WELDED SEAM THAT HAS LESS THAN 100mm OF CROSS SECTIONAL WIDTH.
36. DESTRUCTIVE TESTS SHALL BE CARRIED OUT AT AN INTERVAL OF EVERY 1000 METRES OF WELDED SEAMS. A PASSING TEST IS EQUAL OR GREATER THAN 90% OF MATERIAL STRENGTH AND FAILURE OF SAMPLE OUTSIDE OF WELD.
37. THE CONTRACTOR SHALL DEPLOY THE BITUMINOUS GEOMEMBRANE PANELS IN GENERAL ACCORDANCE WITH THE LAYOUT DRAWING SPECIFIED. THE LAYOUT DRAWINGS MUST BE APPROVED BY THE PRINCIPAL OR LEVEL 1 CQA PRIOR TO INSTALLATION OF ANY LINER.
38. A BITUMINOUS GEOMEMBRANE FIELD PANEL IS A ROLL OR A PORTION OF ROLL CUT IN THE FIELD. EACH FIELD PANEL SHALL BE GIVEN A UNIQUE IDENTIFICATION CODE (NUMBER OR LETTER-NUMBER). THIS IDENTIFICATION CODE SHALL BE AGREED UPON BY THE LEVEL 1 CQA AND CONTRACTOR.
39. FIELD PANELS SHALL BE INSTALLED IN ACCORDANCE TO THE PRINCIPAL APPROVED WORK METHOD STATEMENT.
40. PANELS SHALL BE SEAMED IN ACCORDANCE WITH THE BITUMINOUS GEOMEMBRANE MANUFACTURER'S RECOMMENDATIONS. IN CORNERS AND ODD-SHAPED GEOMETRIC LOCATIONS, THE NUMBER OF FIELD SEAMS SHALL BE MINIMIZED. SEAMING SHALL EXTEND TO THE OUTSIDE EDGE OF PANELS. THE SEAM AREA SHALL BE FREE OF MOISTURE, DUST, DIRT, AND FOREIGN MATERIAL AT THE TIME OF SEAMING. THE PANELS SHALL OVERLAP A MINIMUM 200mm FOR SEAMING. ENDS AND OVERLAPS MUST BE WELDED ON A HOMOGENEOUS AND CONTINUOUS BASIS, LEAVING A 6mm BITUMEN BEAD ALONG THE SEAM.
41. SEAMS SHALL BE WELDED USING PROPANE TORCHES. THE TORCH-WELDS MUST BE APPROVED ACCORDING TO THE MANUFACTURER'S RECOMMENDATIONS AND PRINCIPAL.
42. BITUMINOUS GEOMEMBRANE TO BE WELDED TO CONCRETE AT INSTALLATION AREAS BY HEATING THE CONCRETE SURFACE AND THE BGM, THEN ROLLING WITH A SMALL ROLLER AND APPLYING HIGH PRESSURE. CONCRETE SURFACE SHALL BE PREPARED BY APPLYING 300 g/m² OF COLD PRIMER (SIAMPRIME) EIF OR APPROVED EQUAL) 24 HOURS PRIOR TO WELDING.
43. ONE QC SAMPLE, 500 MM IN LENGTH, FOR THE ENTIRE WIDTH OF A ROLL, SHALL BE OBTAINED FOR EVERY 9,000 SQUARE METERS (10,000 SQUARE FEET) OF MATERIAL DELIVERED TO THE SITE. SAMPLES SHALL NOT BE OBTAINED FROM THE FIRST METRE OF THE ROLL. THE SAMPLES SHALL BE IDENTIFIED BY MANUFACTURER'S NAME, PRODUCT IDENTIFICATION, LOT AND ROLL/PANEL NUMBER. THE DATE, A UNIQUE SAMPLE NUMBER, AND THE MACHINE DIRECTION SHALL ALSO BE NOTED.
44. ANY PORTION OF THE LINER WITH A FLAW OR THAT FAILS A NON-DESTRUCTIVE OR DESTRUCTIVE TEST SHALL BE REPAIRED BY ONE OF THE FOLLOWING METHODS:
    44.1. PATCHING OR CAPPING FOR HOLES, DEFECTS OR TEARS USED TO REPAIR LARGE HOLES, TEARS, LARGE PANEL DEFECTS, AND DESTRUCTIVE SAMPLE LOCATIONS THAT ARE LESS THAN 2M2 (TOTAL AREA). PATCHES AND REPAIRS ARE TO BE OVERLAID WITH A STRIP OF NEW MATERIAL AND SEAMED (CAP STRIPPED). STRIP SHALL HAVE ROUNDED CORNERS AND EXTEND A MINIMUM OF 200MM BEYOND THE EDGE OF THE REPAIR OR DEFECT AREA. AFTER REPAIRS ARE COMPLETED, THE REPAIRED SEAM SHALL BE NON-DESTRUCTIVELY TESTED.
    44.2. REMOVAL AND REPLACE – USED TO REPLACE AREAS WITH LARGE DEFECTS WHERE THE PRECEDING METHODS ARE NOT APPROPRIATE. ALSO USED TO REMOVE EXCESS MATERIAL (WRINKLES) FROM THE INSTALLED LINER.
    44.3. ONCE THE REPAIR HAS BEEN COMPLETED, FURTHER NON-DESTRUCTIVE OR DESTRUCTIVE TESTING SHALL BE CARRIED OUT.
45. FULL RECORDS OF LINER TESTING AND INSPECTION SHALL BE SUBMITTED PROGRESSIVELY TO THE PRINCIPAL AS THE WORK PROCEEDS. FINAL COMPLETION WILL NOT BE CERTIFIED UNTIL ALL RECORDS HAVE BEEN SUBMITTED AND APPROVED BY THE PRINCIPAL.
    45.1. RECORDS SHALL INCLUDE, BUT NOT LIMITED TO, THE FOLLOWING:
    45.2. CONTRACTOR'S AS-BUILT PANEL LAYOUT DRAWING SHOWING PANEL NUMBERS AND JOINT NUMBERS, TO BE MARKED UP PROGRESSIVELY WITH THE ROLL NUMBER USED FOR EACH PANEL, AND WITH THE LOCATIONS OF SAMPLES TAKEN FOR DESTRUCTIVE TESTING.
    45.3. MANUFACTURER'S ROLL PRODUCTION TEST REPORTS FOR ALL ROLLS USED IN THE WORK;
    45.4. SUBGRADE CERTIFICATION REPORTS;
    45.5. DAILY TEST REPORTS REFERENCED TO JOINT NUMBERS;
    45.6. DAILY TEST WELD FIELD TEST REPORTS REFERENCED TO JOINT NUMBERS, EQUIPMENT IDENTIFICATION, AND OPERATOR, AND INCLUDING WEATHER AND TEMPERATURE CONDITIONS AND ANY ADJUSTMENTS TO EQUIPMENT CONTROLS;
    45.7. NON-DESTRUCTIVE AND DESTRUCTIVE TEST FIELD REPORT AND RECORD OF SUBMISSION FOR LABORATORY TESTING REFERENCED TO JOINT NUMBER;
    45.8. LABORATORY TEST REPORTS TO BE AVAILABLE WITHIN TWO WEEKS OF TESTING; AND
    45.9. RECORD DRAWING INDICATING LINER SEAM LOCATIONS, DESTRUCTIVE TEST LOCATIONS, CAP STRIP LOCATIONS, PATCHES AND ALL REPAIRS FOR THE LINER SYSTEM.

BITUMINOUS GEOMEMBRANE LINER BALLAST ANCHORS

1. BALLAST ANCHORS SHALL BE SOIL ANCHOR PENETRATOR PE9000 OR ENGINEER APPROVED EQUIVALENTS.
2. BALLAST ANCHOR SPACING INTERVALS ALONG BATTER (AS PER DETAIL 1, Q-4522-20-DH-0003):
   2.1. POINT A – EVERY 5 METRES (NEAREST SEAM OVERLAP).
   2.2. POINT B AND C – EVERY 5 METRES (NEAREST SEAM OVERLAP.)
3. BITUSEAL SHALL BE USED BETWEEN THE BALLAST PLATE AND BITUMINOUS GEOMEMBRANE LINER.
4. BALLAST ANCHOR LOCATE AT ANCHOR POINT A (CREST OF DAM) SHALL BE PAINTED WITH HIGH VISIBILITY SAFETY PAINT.

REV	DATE	REVISION DESCRIPTION
0	[illegible]	ISSUED FOR CONSTRUCTION

DRAWING NO. | REFERENCE DRAWING TITLE

MWH | AUSTRALIA PACIFIC LNG | origin

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Oct 6, 2018
Oct 6, 2018

TITLE: CONDABRI CENTRAL
BRINE POND 7
GENERAL NOTES STANDARD CIVIL DRAWING

PROJECT NO: [illegible]
DRAWING NO: Q-4522-20-DH-0001
REVISION: 0
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FILE: Q-4522-20-DH-0001.dwg

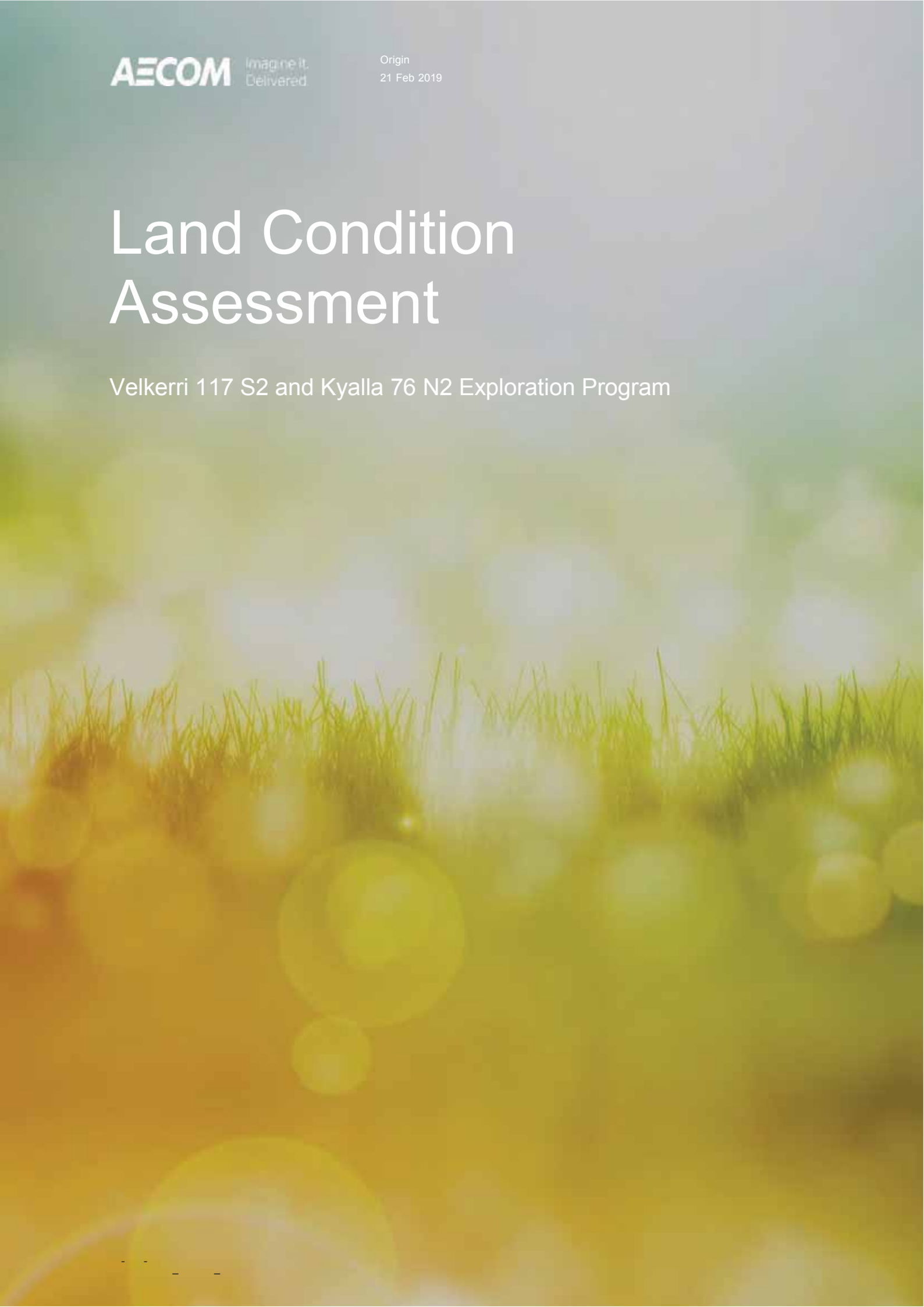
Appendix C Land Condition Assessment

AECOM Imagine it. Delivered.

Origin
21 Feb 2019

Land Condition Assessment

Velkerri 117 S2 and Kyalla 76 N2 Exploration Program



Land Condition Assessment

Velkerri 117 S2 and Kyalla 76 N2 Exploration Program

Client: Origin

ABN: 66 007 845 338

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AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

Quality Information

Document	Land Condition Assessment
Ref	60480548
Date	21-Feb-2019
Prepared by	Alana Court
Reviewed by	Abe Francis

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
0	20-Sep-2018	August 2018 Land Condition Assessment	Alana Court Principal Scientist	
1	21-Feb-2019	Revised for 2019 program	Alana Court Principal Scientist	

Table of Contents

Table of Acronyms

Acronym	Meaning
°C	Degrees Celsius
%	Percentage
AAPA	Aboriginal Areas Protection Authority
ALA	Atlas of Living Australia
AS	Australian Standard
BOM	Bureau of Meteorology
CLA	Cambrian Limestone Aquifer
Cth	Commonwealth
DoH	Department of Health NT
DotEE	Department of the Environment and Energy Cmwlth)
DENR	Department of Environment and Natural Resources NT
DPIR	Department of Primary Industries and Resource (NT
DLPE	Department of Lands, Planning and the Environment NT
EPA	Environment Protection Authority (NT
EP##	Exploration Permit e.g. EP76, EP98 and EP117
EMP	Environmental Management Plan
EPBC	Environmental Protection and Biodiversity Conservation
ESCP	Erosion and Sediment Control Plan
GPS	Global Positioning Device
Ha	hectare
IBA	Important Bird Area
ILUA	Indigenous Land Use Agreement
Km	Kilometre
km^2	Square Kilometres
km/hr	Kilometre per hour
LCA	Land Condition Assessment
m	metre
MD	Measured Depth
MNES	Matters of National Environmental Significance
mm	millimetre
NLC	Northern Land Council
NT	Northern Territory
OHS	Occupational Health and Safety
RWA	Restricted Work Area
TO	Traditional Owner
TPWC Act	*Territory Parks and Wildlife Conservation Act*

Acronym	Meaning
WoNS	Weed of National Significance

1.0 Introduction

1.1 Purpose of this Report

AECOM Australia Pty Ltd (AECOM conducted a land condition assessment (LCA to support Origin Energy's Origin) application to the Northern Territory Department of Environment and Natural Resources DENR for an Environmental Management Plan (EMP) for various exploration activities.

The purpose of the LCA was to gather baseline information to provide an environmental condition assessment to support the proposed exploration activities to be carried out by Origin at two proposed lease sites during 2019/2020.

1.2 Project Boundary

Origin are proposing to undertake a series of activities required to expand their exploration program in the Beetaloo Basin. Origin are targeting two sites for the 2019/2020 exploration program, Velkerri 76 S2 and Kyalla 117 N2. The location and proposed disturbance area are presented in Table 1 and Figure 1.

Table 1 Proposed Lease Area for Exploration Activities and Disturbance Area

Exploration Permit	Well Name	Station	Zone*	Easting	Northing	Disturbance Area (ha)
EP76	Velkerri 76 S2-1	Amungee Mungee	53	435488	8136321	5.25
EP117	Kyalla 117 N2-1	Hayfield/Shenandoah	53	356175	8137500	5.52
EP117	-	Hayfield/Shenandoah	53	332371	8135170	0.5
Total Disturbance Area (Ha)						**11.27 ha**

Universal Transverse Mercator UTM) geographic coordinate system is Geocentric Datum of Australia GDA 94.

^ Existing Origin Leases, previously known as Amungee NW-1h and Beetaloo W-1.

For the purpose of this assessment, the project boundaries were defined as the areas which may be affected by the proposed exploration activities, including:

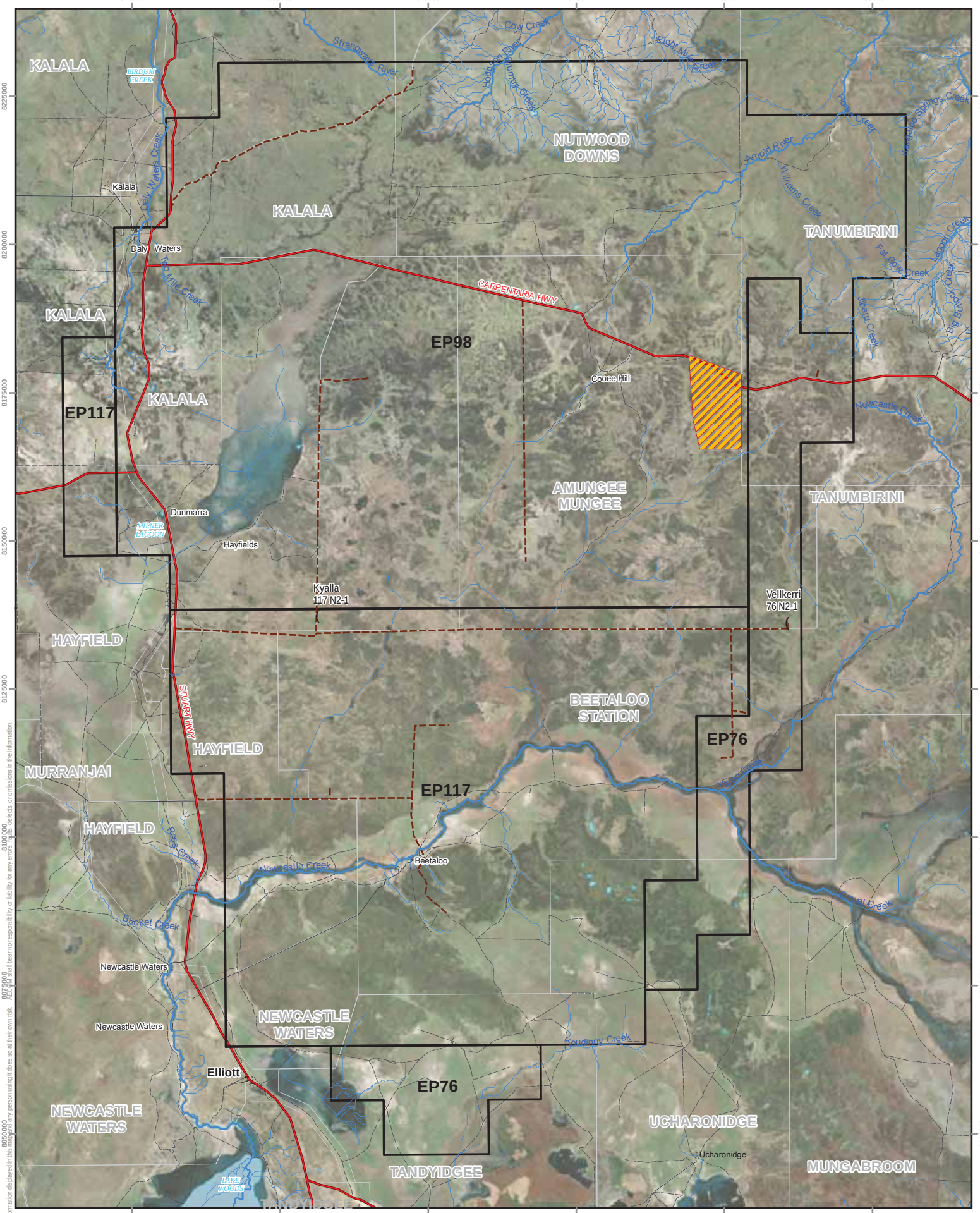
- A 4-ha area around the proposed lease sites including an additional 500 m buffer to allow for future flexibility.
- A 1-ha camp pad.
- A 0.25-ha helipad at the Velkerri 76 S2.
- 650 m long x 8 m wide 0.52-ha) lease pad turn in to Kyalla 117N2 connecting the proposed lease pad to the existing access track.
- 1,100 m long x 8 m wide 0.88-ha) lease pad turn in to Velkerri 76 S2 connecting the proposed lease pad to the existing access track.
- Minor intersection upgrade works at the intersection with the Stuart Highway of approximately 0.5-ha.
- Utilise approximately 107 km of existing access track.

1.3 Scope of works

The scope of work for the LCA involved:

- a review of historical data and reports prepared during the previous Beetaloo onshore oil and gas exploration programs

- a search of the Commonwealth Department of the Environment and Energy DoTEE) Protected Matters database 27 August 2018)
- a search of the NT Natural Resource Management InfoNet Database flora and fauna database) 4 September 2018)
- a search of the Atlas of Living Australia ALA) database for flora and fauna records 2014 and 2016)
- completion of LCA field survey of the proposed exploration lease areas drilling program.
- Preparation of this report.



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GEOCENTRIC DATUM OF AUSTRALIA 94

0 5 10 20

Kilometers

1:570,000 (when printed at A3)

LEGEND

- Proposed Well 2019
- Homestead
- Place Name
- Populated Place
- Major Stream
- Minor Stream
- Highway
- Minor Road
- Tracks
- Access Routes
- Cadastre
- Permit Areas
- Bullwaddy Conservation Reserve

LOCATION

Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage -

ORIGIN ENERGY RESOURCES LIMITED
2019 Environmental Management Plan

Site Location

PROJECT ID	60480548
CREATED BY	jace.emberg
LAST MODIFIED	21-Feb-2019
VERSION	1

Figure 1

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A3 size

2.0 Assessment Method

2.1 Desktop Review

The existing data collected between 2005 and 2016 for the permit areas was mapped based on image interpretation, with ground-truthing of the proposed exploration areas being completed during the field assessment (refer Section 2.2). This information was reviewed prior to the field work to identify the following:

- terrestrial vegetation types and flora and fauna species occurring within the region and with potential to occur within the project area, using existing documents and aerial / satellite imagery.
- terrestrial Commonwealth or Territory listed threatened species or communities identified within the region and with potential to occur within the project area.
- matters of national environmental significance or other matters protected by the Environment Protection and Biodiversity Conservation Act (EPBC Act that are likely to occur within the project area.
- existing weeds or feral animals listed under the EPBC Act, *Weeds Management Act* or the *Territory Parks and Wildlife Conservation Act* and with potential to occur within the project area.

Table 2 provides a chronological list of reports previously compiled for the exploration permit area between 2004 and 2016, in relation to environmental approvals and management support for petroleum exploration activities in the Beetaloo Basin, NT.

The extent of work undertaken since 2004 has enabled a good understanding of the natural and cultural environment, which has been used in assessing the proposed exploration areas within the Permit Area.

Table 2 Summary of existing Environmental Assessments and Reports for the Beetaloo Basin (2004 to 2018)

Date	Report
Sweetpea Petroleum	
Jul- Aug 2004	Baseline land condition assessment
	Site database established
Jul 2005	Exploration EMP finalised and approved
Petrohunter Australia (Partner to Sweetpea)	
Dec 2006	Baseline vegetation assessment
Apr 2007	Drill site assessments
Apr 2007	Annual report
Jun 2007	Update of the existing EMP to include the new Exploration Permit areas
Jul 2007	Drill Site maps
Jul 2007	Supplemental Environmental Management Plan, Drilling Program 2007, Beetaloo Basin, NT
Jul 2007	Soil erosion assessment
Jul 2007	Groundwater quality
July 2007	Emergency Maps
Jul 2007	Environment Heritage Induction Materials
Aug 2007	Site-based Drilling EMP
Falcon Oil and Gas	
Dec 2010	Drill site condition assessments

Date	Report
Jan 2011	Archaeological survey
March 2011	Site-specific drilling EMP
2011	Falcon Shenandoah 1 Stimulation and Testing Groundwater Monitoring
2011/2012	Shenandoah 1 Re-Entry Environment Plan EP
July 2012	EP99 Archaeological Survey, Beetaloo Basin
2013	EP99 Seismic Exploration Environmental Management Plan
2013	Sweetpea 2006 Closeout Environmental Survey
Origin	
2015 and 2016	Beetaloo Basin Environmental and Heritage Assessment and preparation of Approval documentation.
October 2018	Land Condition Assessment

2.2 Field assessment and reporting

The LCA of the proposed exploration lease areas, including access tracks, was conducted on 28 to 29 August 2018 by Principal Environmental Scientist, Abe Francis. The survey involved helicopter and pedestrian survey of the proposed exploration lease areas and access tracks and was accompanied by the AECOM Principal Heritage Consultant, Luke Kirkwood and the Department of Environment and Natural Resource (DENR Regional Weed Officer Onshore Shale Gas Development , Tahnee Hill.

The LCA used rapid assessment techniques, which allowed for large areas to be surveyed over a relatively small period of time. The helicopter provided a good platform to enable the field team a degree of flexibility by allowing an aerial view of the access tracks and proposed exploration lease areas, as well as the ability to land in otherwise remote locations for ground-truthing.

The primary aim of the LCA was to identify and document site condition prior to the proposed activities occurring in the footprint of the two lease areas and proposed access tracks and inform the preparation of the programs Environmental Management Plan EMP .

Following the desktop review, AECOM undertook a condition assessment at each of the nominated sites and access tracks to record site-based characteristics, including:

- the presence of drainage lines and the direction of surface flows
- the distance to the nearest sensitive receptors such as significant vegetation communities or fauna habitats
- soil characteristics and intactness
- terrestrial vegetation community types note that the vegetation descriptions would be based on dominant species for each vegetation structural component
- listed threatened flora species and fauna habitat features, such as hollows, logs and burrows the fauna habitat quality for each mapped vegetation community type would be assessed
- incidental fauna sightings
- the presence of weeds and/or feral animals i.e. indication of scats, tracks, wallows etc.
- general land use description.

For this assessment, the environmental scouting included a 4-hectare area around the proposed exploration areas, plus an additional 500 m buffer to allow for future flexibility for the proposed Origin exploration activities.

A 250 m buffer each side of an existing access track were scouted to allow for locating camps, gravel pits and water supply bores in the future. Where the access tracks were located on a property boundary, the buffer was 500 m out into the property the track was located on.

It is noted that not all of the nominated areas scouted for the exploration areas and/or access tracks will be affected by site activities, but sufficient size was allowed to provide flexibility in the siting of infrastructure and borrow pits, which in turn can be used to minimise environmental and heritage impacts e.g. significant tree or habitat avoidance, Sacred Site/archaeological artefact avoidance .

3.0 Land Condition Assessment

The results of the LCA and desktop review has been summarised in the following sections. The area covered during the assessment is shown in Figure 2. During the helicopter survey, two sites proposed for exploration activities were ground-truthed, along with the proposed access tracks (refer Section 1.2 .

3.1 Climate

The climate of the Origin permit areas can be described as arid to semi-arid, with rainfall decreasing in frequency and quantity from north to south. The climate is monsoon influenced, with a distinctive wet and dry season experienced through the year. The area experiences a wet season during the summer months between October and March, which is dominated by hot and wet conditions. Whilst the dry season during the winter months experiences mild days and cool nights between May to August. September and April are transitional months, with occasional rainfall. The average annual rainfall in the north of the permit area is listed at 680 mm at Daly Waters. The southern portion of the permit area records an average annual rainfall of 535 mm at Newcastle Waters and 608 mm listed at Elliott. Approximately 90% of the rainfall occurs during the Wet Season, and annual totals show moderate variability from year to year.

The maximum rainfall for the permit area occurs during January and February. Daly Waters experience the highest rainfall in the region at this time, with 165 mm during each month, followed by Elliott 133-164 mm during each month and Newcastle Waters 125-130 mm during each month . July and August experience the least amount of rainfall and are the driest months across all three weather monitoring sites, ranging from one to four mm of rainfall. The annual rainfall pattern within the area is highly variable and becomes increasingly unpredictable the further move away from the coast. Drought conditions are known to occur in the region once every ten years Holt and Bertram, 1981).

The land condition assessment was undertaken between 28 and 29 August 2018. The timing of the assessment was such that it fell within the dry season. The Daly Water airstrip station recorded a higher than average rainfall of 590 mm between January to April 2018 wet season compared to the mean rainfall from 1939 to 2018 of 482 mm.

The average annual rainfall experienced across the region which includes the BOM data from Daly Waters Airstrip and Elliot) is shown in Table 3.

Table 3 Annual rainfall 2016-2018

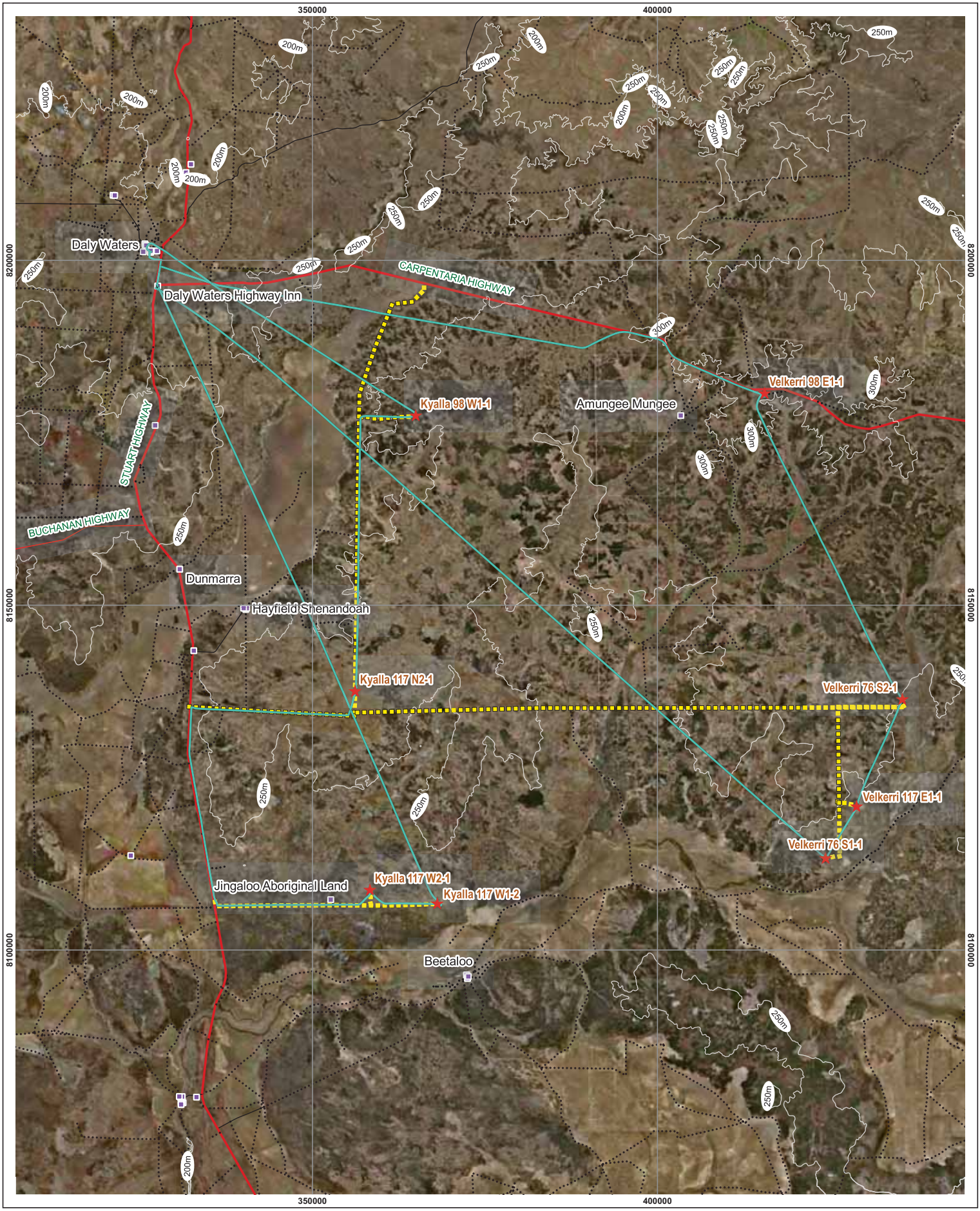
Year	Annual Rainfall (mm)		Months Rain was recorded	
	DW	NW	DW	NW
2016	608	570	12	9
2017	866	607	7	6
2018*	590	270	4	4

DW – Daly Waters Airstrip, NW – Newcastle Waters.

Data sourced from Bureau of Meteorology, Climate Averages for Station 014626 Daly Waters Airstrip recorded from 1939-2018, Station 015131 Elliot recorded from 1949-2018. note 2018 is only current to date October 2018

Due to the timing of the LCA occurring at the end of the dry not all species were able to be identified, however sufficient data was able to be captured to obtain a good understanding of the land condition within the proposed lease areas to help inform required management measures for the protection of the environment.

The proposed lease sites and the short access roads are unlikely to be impacted by the onset of the wet season because they are located outside of the adjacent major flow paths and creeklines within the permit area (refer to Section 3.2 .



LEGEND

- Water Monitoring Wells
- Access Tracks
- Helicopter Survey Transects

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0 0.5 1 1.5 2 km

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Data Sources:
ESRI
Geoscience Australia
Origin

Origin Propose Water Bore Drilling
Heritage Assessment Report
Survey Extent July 2018

PROJECT ID	60480548
CREATED BY	LK
LAST MODIFIED	20-9- 18
VERSION	1

Figure 2

3.2 Topography, Surface Water and Drainage

The permit area is located within three main topographic zones. These are primarily made up of black soil plains in the south, laterite plains in the north and small sections of bedrock hills in the south west and north east of the permit areas Tickell, 2003). The proposed lease areas occur within the lateritic plains. The topography of the two sites have low relief and surface water flow ultimately drains in a south and south westerly direction.

Three main river basins, Roper River Basin to the north, Wiso River Basin in the centre and the Barkly River Basin in the south occur within the exploration permit area Figure 3 . All the proposed lease areas are located within the Wiso River Basin. The Wiso River Basin covers the southern half of EP98 south of the Carpentaria Highway and the majority of EP117 and is internally drained by Newcastle Creek and a number of small ephemeral creeks. Newcastle Creek flows into Lake Woods, which is located south of Newcastle Waters Station.

Lake Woods covers an area of inundation of approximately 50,000 ha in normal rainfall years, extending to 80,000 ha in exceptionally wet years, after which it can retain water for several years AECOM, 2015). Lake Woods is described as a major quasi-permanent surface water body in the region, although some semi-permanent and many ephemeral waterholes are located across the permit area HLA, 2006b) and is listed as a Site of Conservation Significance by the Department of Environment and Natural Resources DENR and is listed on the Directory of Important Wetlands in Australia. Lake Woods is listed as a wetland of national significance in the Directory of Important Wetlands in Australia DIWA: NT013 Lake Woods . The site meets criteria 1, 2, 3, 4, 5 and includes DIWA wetland types: B1, B6, B10, B13 and B14.

Although Lake Woods is located outside of the Exploration Permit Areas, it is fed principally by surface inflow of Newcastle Creek originating more than 160 km north-east on Amungee Mungee Station NTG, undated). During the period of inundation, Lake Woods supports over 100,000 waterbirds including internationally significant numbers of Plumed Whistling-Duck. Numerous bird species nest and feed in the diverse wetland habitat, and the conservation group 'Birdlife International' nominated Lake Woods as an 'Important Bird Area' IBA . The lake also includes the largest area of lignum swamp in the Northern Territory and in tropical Australia (NTG, undated .

Newcastle Creek (Stream Order 4 and a number of small intermittent streams (Stream Order 1 and 2 are located along the proposed access tracks to Velkerri 76 S2 site (refer Figure 3 . The streams only flow for a short period during the wet season, with waterholes forming at the beginning of the dry season. If the wet season is poor, the waterholes will often remain dry, whereas, during heavy wet seasons, large areas of the internal drainage systems are flooded. The stream banks are often lined with a scatter of small trees which highlights them from the surrounding plains.

The two proposed lease pad areas are not located within the major flow pathway of Newcastle Creek and the small intermittent streams. During the wetseason it is likely the region would experience widespread surface flooding, to a depth of 30 cm, which has previously been identified by debris being collected on fence lines HLA, 2005).

Figure 3 Permit Area Surface Water and Drainage

3.3 Land System

Land systems are defined because of their distinct differences from the surrounding areas and by the recurring pattern of geology, topography, soils and vegetation. Land system mapping for the permit area developed is a compilation of the Northern Land Systems scale 1:250 000) and the Southern Land Systems scale 1:1 000 000) Department of Land Resource Management 2013). The data set is made up of the following:

- *Land Systems of the Northern Part of the Northern Territory* is an amalgamation of 16 existing Land System surveys with modifications to some of the original interpretations. This land system dataset is the Northern Territory contribution to Australian Soil Resource Information System (ASRIS national soils database at scale 1:250,000.
- *Land Systems of the Southern Part of the NT* is a compilation of three existing land system surveys and the Atlas of Australian Soils scale 1:2,000,000). It covers the southern part approx 70%) of the Northern Territory. Published maps were made digital and edited to accommodate overlaps, gaps and mismatching boundaries. Where possible, the land system descriptions have been extrapolated into areas covered by the broader scale Atlas mapping.

Using the available information, there are 22 different land systems located within the exploration permit areas. The Velkerri 76 S2 and Kyalla 117 N2 proposed lease area occur within the Beetaloo Land System which is characterised by:

- gently undulating lateritic plains and rises
- lateritic red earths and lateritic podzolic soils
- *Acacia shirleyi* (Lancewood) forest.

3.4 Soils

The dominant soils encountered within the permit area have been derived from ancient rock formations and ancestral soils that were formed during the earlier weathering cycles. The soils are deeply weathered and leached Orr and Holmes, 1984). The soils in the permit area have been influenced by:

- past wetter conditions that formed relict Tertiary plains which comprise highly leached and lateritic soils
- extensive areas of Post-Tertiary Alluvia on which a variety of mature soils formed
- the dissected hilly country that is dominated by skeletal soils or rocky outcrops
- a range of parent materials of residual soils, ranging from basic volcanic and highly calcareous rocks to granitoid rocks and sandstones Christian *et al*, 1951).

The lateritic plains, located within the permit area, are classed as very strongly leached soils of the Tertiary land surface. The three main soil types located within the permit area, include:

- **Tertiary Lateritic Red Earths**, which occur on the gently undulating topography. The soil profile can be described as:

  A-Horizon Grey-brown sandy loam

  B-Horizon Reddish brown sandy clay loam

  C-Horizon Red-brown to red light clay, overlying heavy ferruginous gravel and massive laterite

- **Tertiary Lateritic Red Sands**, which occur on gently undulating to undulating topography of the Tertiary Lateritic Plain, formed from sandstones and complex parent materials of the deep sandy soils. The soil profile can be described as:

  A-Horizon Grey-brown to brown sand

  B-Horizon Brown sand

C-Horizon Red-brown to yellow-brown sand overlying pisolitic ferruginous gravel and massive laterite. Altered colouring of highly siliceous parent sandstone is only evident in the mottled and pallid zones.

- **Tertiary Lateritic Podzolic Soils**, formed on the gently undulating topography over a variety of rocks. These soils are located in the northern section of the Barkly Basin. The soil profile can be described as:

  A-Horizon Grey sand

  B-Horizon Yellowish-grey sand

  C-Horizon Yellow-grey sandy loam with ferruginous gravel overlying massive laterite, mottled and pallid zones.

Geotechnical investigations have confirmed the proposed lease sites consist of red silty sand with some gravel pieces. Although Velkerri 76 S2 test result indicated a higher percentage of gravel content compared to Kyalla 117 N2 both sites should be characterised as red silty sand. The surface soils collected during the field survey indicated the soils were slightly acidic ph range of 5.0 to 6.2) across the permit area. A dispersion test was also undertaken on the samples which indicated that the soils were non-dispersive and maintained their shape when submerged in water. Results from the soil testing is provided in Appendix B.

There are also small sections of the proposed access track that may traverse through Black soil plain country. Black Soil Plains are located within the Barkly Tablelands, including EP76, the southern part of EP117 and a small section of EP98. The soils usually crack widely in the upper profile upon drying and have a loose, self-mulching surface. The soils are neutral to alkaline, calcareous and commonly have depths to one metre Fisher, 2001). The cracking clay soils occur mostly on flat or gently undulating plains 'downs') and are associated with the exposure and weathering of sedimentary or basic volcanic rocks. The Black soils also occur on the more recent depositional landscapes in the form of alluvial clays associated with drainage lines and major river systems.

3.4.1 Erosion Susceptibility

Soil erosion susceptibility varies throughout the permit area, dependent upon the soil types, slope and extent of ground disturbance. Apart from the erosive impact of climatic conditions, soil erosion is influenced mainly by the inherent properties of the soils and the processes which occurred during the formation of the landscapes Aldrick and Wilson, 1992).

Erosion will occur in the permit area if the land is used beyond its capacity, as is seen if land is overstocked or vehicle movements not controlled, for example. The location of proposed lease areas has been examined on the ground, to determine the risk of erosion occurring. Factors considered include the following.

- Soil type – soils with higher clay content are prone to generation of bulldust and are easily eroded by wind and water. Gravelly soils tend to be more robust to disturbance on the scale expected during the exploration program. Both sites reported a soil type of red silty sand.
- Slope – the slope of the site will determine the risk of erosion during rainfall events, with steeply inclined areas a higher risk than small undulations in the landform. All the proposed lease sites were in very flat low relief with a slope of <1%. During the program, the crossings of the access track on the small ephemeral streams and Newcastle Creek will require additional controls.
- Aspect – the position of the access track and pads in relation to the direction of the contour should be considered and creation of tracks across as opposed to parallel with the contour should be avoided.
- Rainfall – Table 4 present the erosion risk rating based on average monthly rainfall using the rating system provided in the IECA 2008) Table 4.4.2 for Daly Waters. The construction activities for all exploration activities is proposed to be commence following the wet season from April 2019 onwards. Most of the soil disturbance activities will be completed prior to the onset of the wet season in November 2019. As such, based on rainfall during the construction period, the overall risk of erosion is considered very low for the Velkerri 76 S2 and Kyalla 117 N2 sites.

Table 4 Erosion Risk Rating based on average monthly rainfall at Daly Waters

-Item	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall mm)	165.4	165.4	120.1	23.6	5.0	5.6	1.5	1.7	4.9	22.5	59.4	110
Erosion Risk	H	H	H	VL	VL	VL	VL	VL	VL	VL	M	H

*E Extreme (>225 mm ; H High (100+ to 225 mm ; M Moderate 45+ to 100 mm ; L = Low 30+ to 45 mm ; VL = Very Low (0 to 30 mm

Based on the sites descriptions and the results from the soil samples, the erosion risk for the proposed lease areas is considered None/Slight erosion risk. This was confirmed during the field survey in August 2018 which reported no evidence of erosion within the proposed lease areas.

Certain sections of the proposed access tracks are likely to encounter more erosion susceptible soils, such as the access track to the southern sites and where streams and Newcastle Creek are crossed (refer Section 3.2). Mitigation measures will need to be established to minimise the risk for erosion along the track and are stabilised leading up to the wet season.

Overall, the main issues to be managed in relation to soils during exploration activities in the permit areas include:

- the generation of bull dust along the access tracks. Noting previous observations have indicated bull dust had formed where the surface crust had been disturbed and then subjected to repeated ground disturbance (AECOM 2015). This was primarily in grassland areas.
- The formation erosion gullies along inappropriately placed tracks and fence lines, where a slope was present. Scolding to bedrock has previously been observed in other areas of the permit, as well as pooling of water in areas of compaction and subsidence.

3.5 Biological Environment

3.5.1 Vegetation Communities

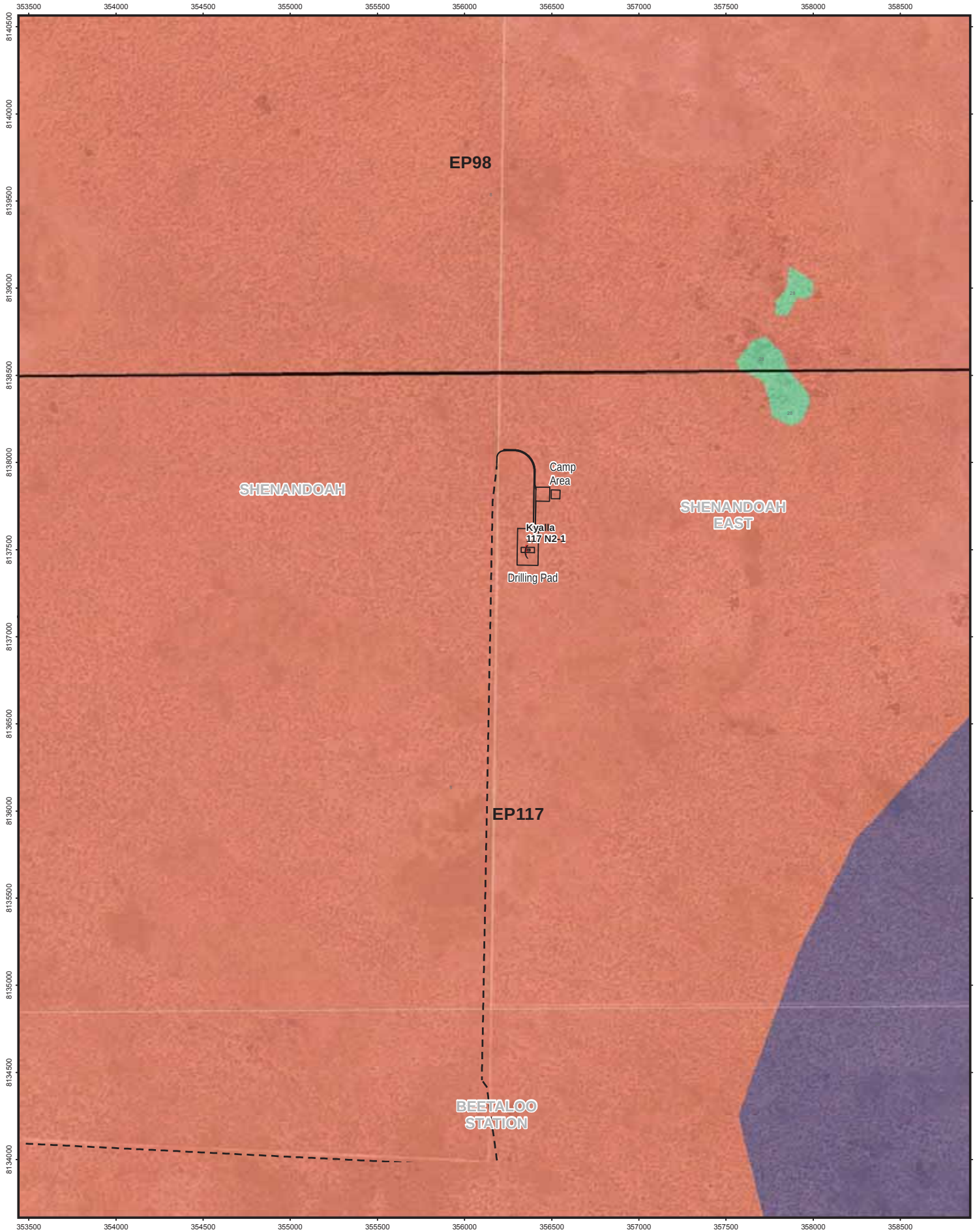
The Interim Biogeographic Regionalisation of Australia is a nationally recognised ecosystem classification system Environment Australia, 2000). Bioregions are large, geographically distinct ecosystems that are distinguished by broad physical and biological characteristics, which can be further classified into Subregions. These regions and subregions are used as the basis for regional comparisons and conservation of flora and floristic communities.

Of the 85 bioregions mapped nationally, 20 occur within the Northern Territory and only two within the Origin permit areas, the Sturt Plateau bioregion and the Mitchell Grass Downs bioregion. The 2018 proposed lease sites all fall within the Sturt Plateau Bioregion which comprises undulating plains on sandstone, with predominantly neutral sandy red and yellow earth soils. Dominant vegetation associations included extensive areas of Lancewood *Acacia shirleyi* - Bullwaddy *Macropteranthes kekwickii* vegetation. Land condition in the bioregion is moderate to good but is threatened by impacts from weeds, feral animals, pastoralism and changed fire regimes.

Vegetation communities within the permit areas have been ground-truthed during baseline assessments in 2004, 2006 HLA, 2006; 2006c), 2010, 2014, 2016 (AECOM, 2011; 2014; 2016) and more recently in August 2018, along with assessments of weeds, habitat, erosion and land condition.

Kyalla 117 N2 vegetation community is described as *Corymbia* spp open woodland with mixed *Terminalia* spp. shrubland over low tussock grassland *Triodia bitextura* . Whereas, Velkerri 76 S2 vegetation community is described as *Eucalyptus/Corymbia spp.* low open woodland with *Iseilema spp.* mixed tussock grassland. Directly to the west and south of Velkerri 76 S2 there is a large stand of Bullwaddy and Lancewood vegetation. Figure 4 and Figure 5 provides the vegetation description of the proposed sites.

It is noted that Lancewood/Bullwaddy communities are important as they represent Gondwanan remnants of the once dominant rainforests of the Australian tertiary period and are limited in distribution PWCNT, 2005). Lancewood forests are the most extensive acacia dominated communities across northern NT.



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Projection: GDA94 MGA Zone 53

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LEGEND

- Proposed Well 2019
- Drill Pad and Services Location
- Cadastre
- Permit Areas

Vegetation Community

- Acacia low woodland/Eragrostis (mixed) low open tussock grassland
- Acacia open forest/Acacia tall open shrubland/Chrysopogon (mixed) low open tussock grassland
- Corymbia low woodland/Terminalia (mixed) sparse shrubland/Chrysopogon (mixed) low tussock grassland

LOCATION

Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage -

ORIGIN ENERGY RESOURCES LIMITED
2019 Environmental Management Plan

Kyalla 117 N2-1
Vegetation Community

PROJECT ID	60480548
CREATED BY	jace.emberg
LAST MODIFIED	21-Feb-2019
VERSION	1

Figure 4

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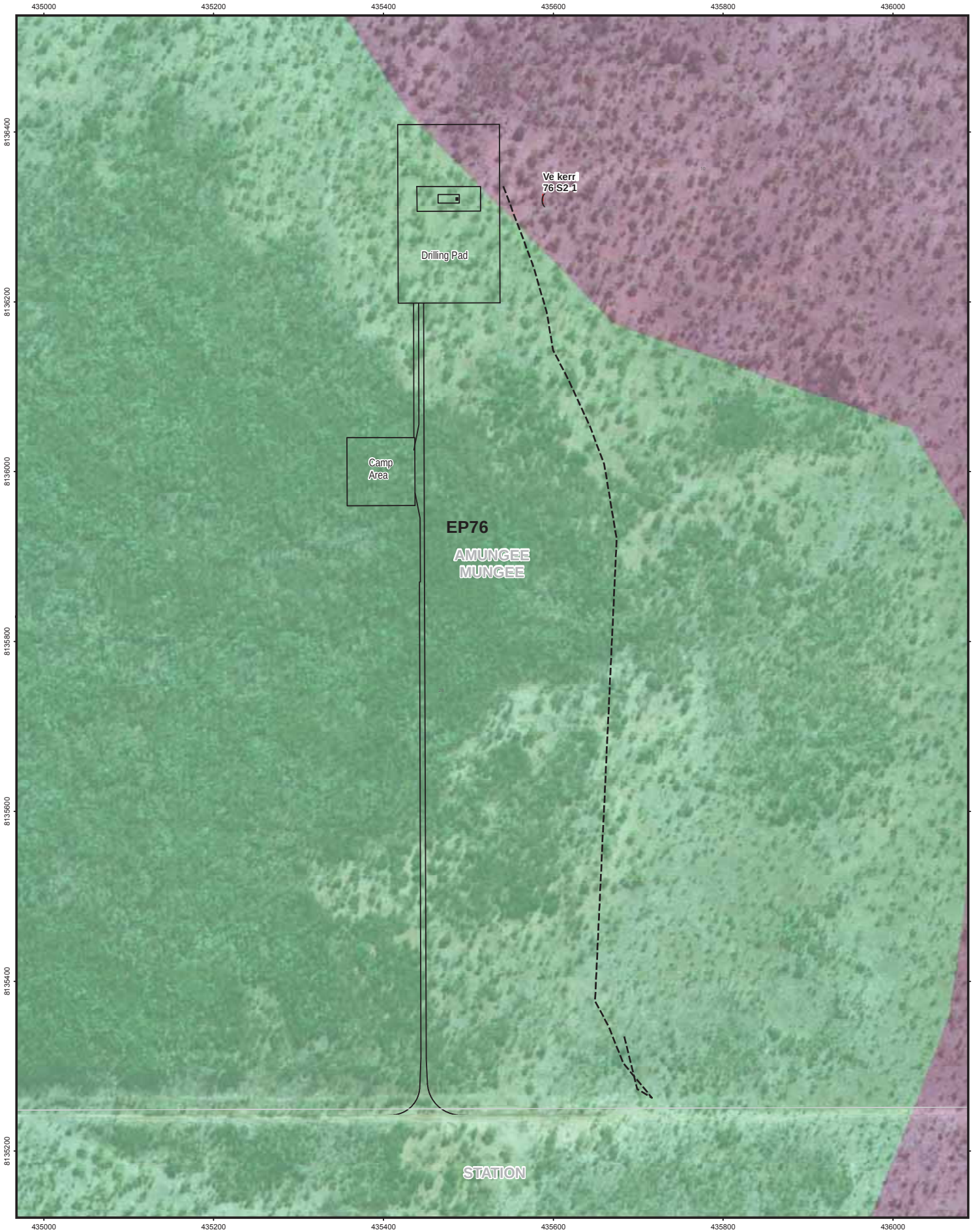
A3 size



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Projection: GDA94 MGA Zone 53

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Meters

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LEGEND

- Proposed Well 2019
- Drilling Pad and Camp
- Cadastre
- Permit Areas
- Proposed Tracks

Vegetation Community

- Acacia low woodland/Eragrostis (mixed) low open tussock grassland
- Eucalyptus low woodland/Eucalyptus (mixed) low open woodland/Iseilema (mixed) tussock grassland

LOCATION

Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage - StreetPro 2019

ORIGIN ENERGY RESOURCES LIMITED
2019 Environmental Management Plan

Velkerri 76 S2-1

PROJECT ID	60480548
CREATED BY	jace.emberg
LAST MODIFIED	21-Feb-2019
VERSION	1

Figure 5

A3 size

Previous exploration activities in the permit area provided some understanding on how the vegetation communities regenerated following clearing and rehabilitation. The rehabilitation monitoring following previous exploration programs were undertake during 2007 and again in 2013 HLA, 2007 and 2013). It was noted that in the first year the success of rehabilitation was greatest in communities with grassland understory primarily due to annual grass growth), whereas woodlands mainly Lancewood and Bullwaddy showed low levels of natural regeneration. By 2013, six years after disturbance the origin seismic lines through the Lancewood were such that there was almost no difference in the canopy height to the surrounding Lancewood communities.

The vegetation throughout the permit area during the August 2018 survey appeared in very good condition with minimal impacts from grazing, fire and erosion.

3.5.2 Flora

A total of 805 plant species have been recorded within the wider region, during the August 2018 survey 10 dominant flora species were identified at Kyalla 117 N2 and Velkerri 117 S2 Appendix C). As the survey was conducted during the late dry season, grasses and other annual species were difficult or impossible to identify due to the lack of inflorescence or because they had already died-back.

No Commonwealth or NT threatened plant species were identified as occurring by the Protected Matters Searches refer Appendix D). One species, the prostrate, herbaceous vine *Ipomoea argillicola*, is listed as Near Threatened under Section 29 of the *Territory Parks and Wildlife Conservation Act 2000* TPWC Act) and could potentially occur in the project sites, although has not been reported in previous and current surveys. NT flora data base shows that this species has been recorded from the Bullwaddy Conservation Reserve and at locations surrounding the area in previous searches (AECOM, 2015 .

The region supports fragmented stands of Bullwaddy, which is listed under the TPWC Act as 'Least Concern', which refers to species that are either widespread or common and cannot be categorised as Critically Endangered, Endangered, Vulnerable, Near Threatened or Data Deficient. However, Bullwaddy is significant in terms of the habitat it provides for a range of native species. The extent of Bullwaddy in the permit area is far more extensive than that indicated by the NT Herbarium records.

3.5.3 Weeds

Weeds remain an increasing threat to the Barkly region's natural assets. This threat is not new and considerable time and effort has already been invested in weed management across the region Department of Land Resource Management, 2015).

Figure 6 and Table 5 provides a list of weed species that are known to occur or likely to occur within the wider exploration Permit Areas.

This information is based on:

- Mapping data provided by the Weed Management Branch, DENR.
- Guidelines for the *Management of the Weeds of Beetaloo 2018* DLRM et al 2018).
- Department of the Environment and Energy DotEE EPBC Act Protected Matters Report database.
- Previous data collected by AECOM in the permit area.

Table 5 NT listed weeds known of likely to occur within the Permit Area

Scientific Name	Common Name	Status	Data Source
Acacia nilotica	Prickly Acacia	Class A and C, WoNS	Weed Management Branch – Mapping data DotEE Protected Matters Report
Alternanthera pungens	Khaki Weed	Class B and C	DLRM databases DLRM *et al* 2018)

Scientific Name	Common Name	Status	Data Source
Andropogon gayanus	Gamba Grass	Class A and C, WoNS	Weed Management Branch – Mapping data
Azadirachta indica	Neem	Class B and C	Weed Management Branch – Mapping data
Cenchrus ciliaris	Buffel Grass	Not declared in NT	DotEE Protected Matters Report
Cenchrus echinatus	Mossman River Grass	Class B and C	DLRM databases DLRM *et al* 2018)
Datura ferox	Fierce Thornapple	Class A and C	DLRM databases DLRM *et al* 2018)
Hyptis suaveolens	Hyptis	Class B and C	Weed Management Branch – Mapping data DLRM databases DLRM *et al* 2018)
Jatropha gossypiifolia	Bellyache Bush	Class B and C, WoNS	Weed Management Branch – Mapping data DLRM databases DLRM *et al* 2018) DotEE Protected Matters Report
Parkinsonia aculeate	Parkinsonia	Class B and C, WONS	Weed Management Branch – Mapping data DLRM databases DLRM *et al* 2018) DotEE Protected Matters Report
Prosopis pallida	Mesquite	Class A and C, WONS	Weed Management Branch – Mapping data DLRM databases DLRM *et al* 2018)
Sida acuta	Spinyhead sida	Class B and C	Weed Management Branch – Mapping data
Sida cordifolia	Flannel Weed	Class B and C	Weed Management Branch – Mapping data DLRM databases DLRM *et al* 2018)
Sida rhombifolia	Paddy's Lucerne	Class B and C	DLRM databases DLRM *et al* 2018)
Tamarix aphylla	Athel pine	Class B and C, WONS	Weed Management Branch – Mapping data
Themeda quadrivalvis	Grader Grass	Class B and C, WoNs	Weed Management Branch – Mapping data
Tribulus terrestris	Caltrop	Class B and C	DLRM databases DLRM *et al* 2018)
Xanthium occidentale	Noogoora Burr	Class B and C	Weed Management Branch – Mapping data

Scientific Name	Common Name	Status	Data Source
			DLRM databases DLRM *et al* 2018)

Note: Declarations under the Northern Territory Weeds *Management Act 2013*:
- a Class A weed is to be eradicated
- a Class B weed is to have its growth and spread controlled
- a Class C weed is not to be introduced to the NT.
  All Class A and B weeds are also Class C.

They survey undertaken in August 2018 of the proposed exploration sites did not identify any weed species. This suggests that the habitat condition in the areas of the proposed sites and surrounding areas were good.

Previous surveys within the Permit Area in 2014, 2015, 2016 and 2018 of drill sites and access tracks have also found that the proposed areas had a low number of weed species which suggests the habitat condition was fairly high in and around the Permit Area. Specifically, three listed species, *Parkinsonia aculeate* (Parkinsonia , *Hyptis suaveolens* Hyptis and *Calotropis procera* (Rubber Bush have been recorded. These records were not located in close proximity to the proposed 2019 exploration sites.

Parkinsonia is considered a Weed of National Significance WoNS , which are weed species that are the focus of national management programs for the purpose of restricting their spread and/or eradicating them from parts of Australia.

Calotropis procera (Rubber Bush (Class B and C) was recorded in close proximity to the Beetaloo access track. It is possible that additional species are present but were present in low abundance or difficult to identify due to stage of growth.

These weed species surveyed within the Permit Area and their corresponding Northern Territory *Weeds Management Act 2013* declarations are listed in Table 6.

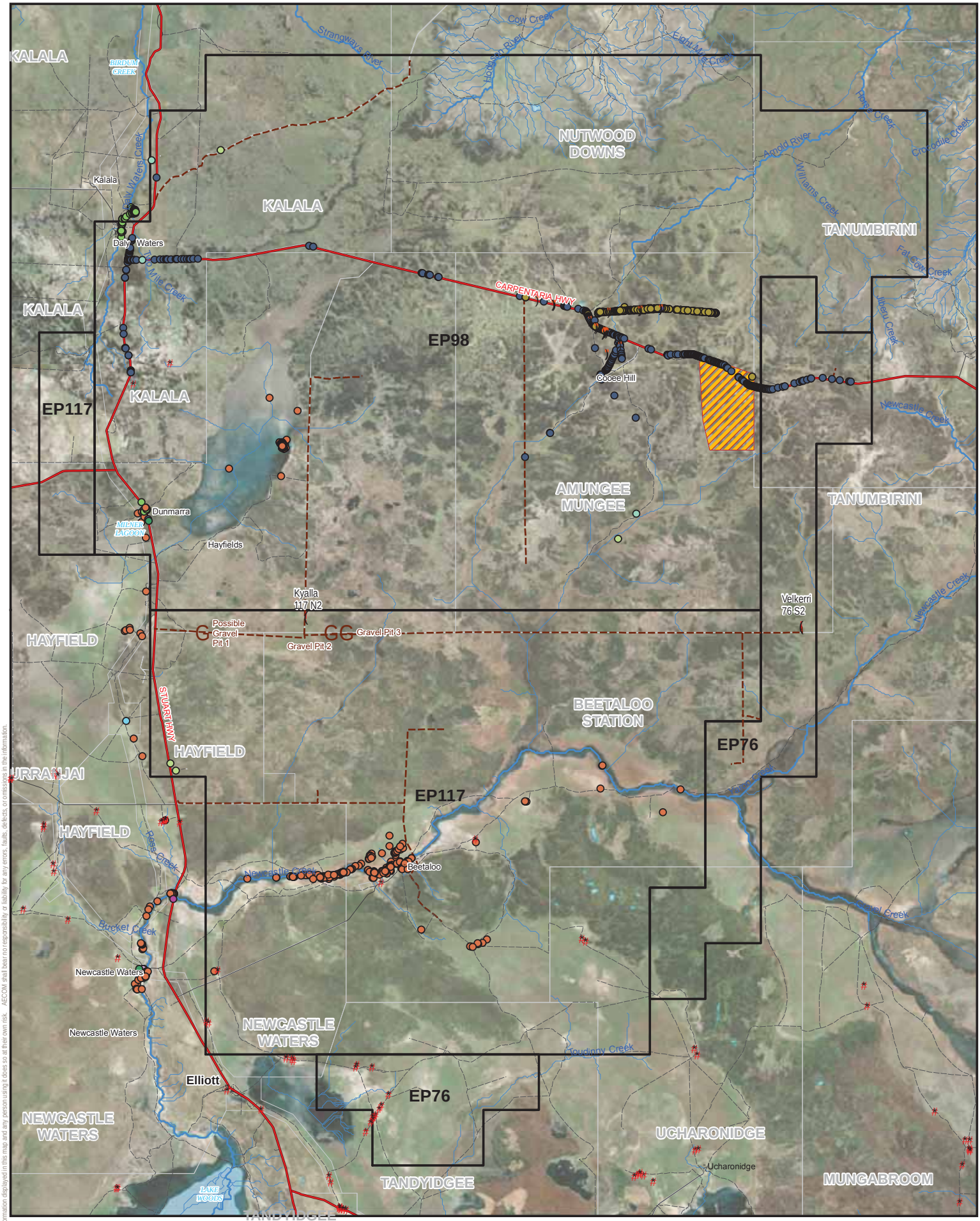
Table 6 Species found within the permit area

Scientific Name	Common Name	Declaration	Where located
Hyptis suaveolens	Hyptis	Class B and C	Beetaloo access track Access track to Velkerri 98-E1-1 site
Parkinsonia aculeate	Parkinsonia	Class B and C, WONS	Beetaloo access track
Calotropis procera	Rubber bush	Class B and C	Close proximity to the Beetaloo access track

In addition to these 18 species a range of annual grass weeds are known to occur along road corridors throughout the region. This includes Buffel Grass, a weed that has the potential to alter fire regimes, which was introduced and cultivated for livestock feed and is useful in soil stabilisation.

The *Guidelines for the Management of the Weeds of Beetaloo 2018* DLRM et al 2018), also identifies a number of introduced plants that have previously been recorded within the proposed permit areas and have been identified as problem weeds in one or more locations across Northern Australia. It is noted that these are not listed under the NT *Weeds Management Act* but could be of concern elsewhere in Australia. Understanding the potential weeds likely to occur within the Permit Area is particularly important when proposed activities include transporting machinery and equipment during the construction process.

The *Barkly Regional Weed Management Plan* provides additional information on regional weed management priorities and management actions to support landholders in their obligations to manage weeds on their land DLRM, 2015).



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GEOCENTRIC DATUM OF AUSTRALIA 94

0 5 10 20
Kilometers

1:570,000 (when printed at A3)

LEGEND

- Proposed Well 2019
- Homestead
- Place Name
- Populated Place
- Major Stream
- Minor Stream
- Highway
- Minor Road
- Tracks
- Access Routes
- Cadastre
- Permit Areas
- Bullwaddy Conservation Reserve

Weed Name

- Athel pine
- Bellyache bush
- Burr - Noogoora
- Gamba grass
- Grader grass
- Hyptis
- Mesquite
- Neem
- Parkinsonia
- Prickly acacia
- Sida - Flannel weed
- Sida - Spiny head
- Gamba Grass
- Rubberbush

LOCATION

Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage - StreetPro 2019

ORIGIN ENERGY RESOURCES LIMITED
2019 Environmental Management Plan

Weeds of the Permit Area

PROJECT ID	60480548
CREATED BY	jace.emberg
LAST MODIFIED	21-Feb-2019
VERSION	1

Figure 6

A3 size

Filename: \\audwn1fp001\Projects\604x\60480548\6. Draft Docs\6.1 Reports\Drilling & Stimulation EMP 2018\LCA\Figures\G60480548_Map_Weeds_20190218_v1_A3.mxd

This plan includes a list of alert weed species. These species are not yet naturalised in the region but have the potential to have a high level of impact to the region should they become established. The likelihood of the species naturalising and spreading in the region is perceived to be high (DLRM, 2015).

The alert species identified the *Barkly Regional Weed Management Plan* are listed in Table 7. If found the program EMP requires the Weed Management Branch to be contacted for identification and disposal.

Table 7 Alert species identified in the Barkly Region

Scientific Name	Common Name	Declaration
Cenchrus setaceum	Fountain grass	Class B and C
Parthenium hysterophorus	Parthenium	Class A and C, WONS
Cryptostegia grandiflora	Rubber vine	Class A and C, WONS

3.5.4 Fauna and Habitat

Previous surveys and database searches indicate that the permit areas are an important area for a diverse array of fauna. The NT Fauna database provides records for the following fauna species (excluding migratory birds : 32 species of mammal, 198 species of birds, 96 species of reptiles and 19 species of frogs. Surveys undertaken elsewhere within the region have recorded:

- 78 bird, 33 reptile, 11 mammal and six frog species in the Bullwaddy Conservation Reserve PWCNT, 2005)
- 148 bird, 47 reptile, 21 mammal and six frog species in the Junction Stock Reserve and nearby Newcastle Waters Fleming *et al*., 1983)
- 157 bird species within the project area as determined by a search of the Birds Australia bird atlas database Birds Australia, 2010).

The proposed exploration sites are all located within similar habitat types consisting primarily of open *Eucalyptus*/*Corymbia* woodland with a tussock grass understorey. There are Bullwaddy/Lancewood communities around the proposed sites and individuals of both species are dispersed throughout. In the wider landscape, including proposed access tracks, additional vegetation types include those associated with drainage lines, grasslands/floodplains and acacia shrublands.

Eucalypt/Corymbia woodland provides habitat for a range of species. The proposed sites had high native grass cover and included numerous species suitable for granivorous birds seed eaters . Dense leaf litter and numerous logs provide suitable refuge and foraging sites for fauna such as reptiles. Although most of the species found in this vegetation type are widespread in the tropical savannas of the Northern Territory, some such as the threatened Crested Shrike-tit *Falcunculus frontatus whitei* are rare and known to utilise this habitat DoTEE, 2014, Ward, 2008). Many of the sites have a high density of hollow-bearing trees that provide important habitat for many fauna species. Avoiding clearing large hollow-bearing trees will reduce the impact to native wildlife within the permit area.

Savanna grasslands and open woodland provide suitable habitat for species such as Emu *Dromaius novaehollandiae*) and Australian Bush Turkey *Ardeotis australis*. Drainage lines and seasonally inundated grasslands may also provide habitat for migratory species during the wet season and are breeding areas for frogs. Limiting disturbances in these areas and avoiding these areas during the wet season would limit impacts on fauna.

3.5.4.1 Threatened Fauna

A search of the DotEE Protected Matters database of nationally significant fauna PMST , the NT Government fauna database NRM Infonet), and records from the Atlas of Living Australia (ALA) was undertaken for the proposed lease areas and access tracks. The search results indicate the potential presence of 15 fauna species listed as threatened under the EPBC Act and/or the TPWC Act Table 8). These included ten birds, eight mammals and two reptiles.

The likelihood assessment of species occurrence is based on the availability of suitable habitat within the permit area, records in the vicinity and distributional data. Therefore many of the threatened and migratory fauna species indicated in databases as 'occurring' or 'likely to occur' have been assessed as *unlikely to occur* within the proposed exploration lease areas. As some areas in the proposed lease area have not been subject to intensive survey and some species are very cryptic, a conservative approach has been taken to assess species presence. A full description of each species, their distribution and habitat associations are outlined in Table 8 below.

No core habitat for threatened fauna was identified at the sites. However, some species may possibly occur and are known to occur in the wider landscape. Threatened species that may possibly occur include:

- Gouldian Finch *Erythrura gouldiae* (E-EPBC Act, VU-TPWC Act
- Crested Shrike-tit northern) *Falcunculus frontatus whitei* (VU-EPBC Act, NT-TPWC Act

Research has shown that critical components of suitable habitat for the Gouldian Finch include suitable nesting trees during the breeding season particularly *E. tintinnans*, *E. brevifolia* or *E. leucophloia* , a water source and a diverse range of favoured annual and perennial grasses DoE, 2015). No nesting habitat was recorded during the surveys and it is unlikely this species breeds in close vicinity of the sites. During the wet season Gouldian Finches move from breeding habitat on hillsides with suitable trees down to lower lying areas where they forage on perennial grasses such as *Triodia* sp., *Alloteropsis semialata*, and *Chrysopogon fallax* Palmer *et al*. 2012). Some of the perennial grasses were recorded during recent surveys so potential foraging habitat is present; however, there are limited records in the vicinity of the sites suggesting it is not an important area for this species.

The Crested Shrike-tit lives in dry Eucalypt forests and woodland where it feeds on insects from the canopy and also under bark Ward, 2008). It has been recorded in wet Melaleuca open woodlands, woodlands dominated by Nutwood *Terminalia arostrata* , Bloodwoods with flaky bark and ironwood DoE, 2014, Ward, 2008). In the NT, nesting has been recorded from September through to January and nests are built in terminal branches at the top of trees Ward *et al*., 2009). The stronghold of this species is north of this location and only one old record exists near Borroloola. Although it is possible this species may be present in the area, it is unlikely to represent an important area for this species and the impact of the proposed activities, given their size, would be small.

The Grey Falcon *Falco hypoleucus* is a widespread species listed as Vulnerable in the NT that is considered possibly to be present in the study area. The Painted Honeyeater *Grantiella picta* has been known to occur in the study area, however, given it does not breed in the NT it would only be present intermittently for foraging. Based on the field assessment there was no breeding habitat recorded, and depending on grass seed and water availability it is unlikely the study area comprises core habitat for this species.

As records of species may be limited in remote areas the precautionary principle has been applied. There are some species that have been assessed as possibly occurring even though their primary habitat is not found within the proposed sites or access tracks. These include species that are associated with ephemeral wetlands, low lying areas that may be seasonally inundated and creeks. During the wet and early dry season these areas may sustain threated species such as wetland birds including migratory species and also the Plains Death Adder *Acanthopis hawkei* .

Table 8 EPBC and TPWC Listed Threatened Species and Likelihood of Occurrence

Species	Conservation Status		Distribution	Habitat	Likelihood of Occurrence
	EPBC	NT			
Birds					
Calidris ferruginea Curlew Sandpiper	Marine Migratory	VU	In the NT this species occurs around Darwin, north to Melville Island and Cobourg Peninsula, and east and south-east to Gove. It has been recorded inland from Victoria River Downs and around Alice Springs Higgins Davies 1996).	Coastal habitats, inland it has been found around lakes, dams and ephemeral/permanent waterholes.	Unlikely suitable habitat not present at survey sites but potential sporadic in wider landscape)
Erythrotriorchis radiatus Red Goshawk	VU	-	Found across most of Northern Australia, in the NT most records are from the Top End but there are records from central Australia (Pizzey Knight, 2012).	Red Goshawks occupy a range of habitats, often at ecotones, including coastal and sub-coastal tall open forest, tropical savannahs crossed by wooded or forested watercourses. In the NT, it inhabits tall open forest/woodland as well as tall riparian woodland Aumann Baker-Gabb, 1991).	Unlikely no records and core habitat absent
Erythrura gouldiae Gouldian Finch	E	VU	Formerly widespread across northern Australia. In the NT they are found in the Top End south past Daly Waters Palmer *et al*., 2012).	Gouldian Finches occupy different habitat types in the breeding and non-breeding season. Breeding habitat consist of hillsides with suitable nesting trees. In the non-breeding season they are found in lowland drainages to feed on suitable perennial grasses Dostine Franklin, 2002).	Possible (sporadic, foraging only, no recent records
Falcunculus frontatus whitei Crested Shrike-tit northern)	VU	NT	This species has a very patchy distribution with records from the Victoria River District to Maningrida. Only one record near Borroloola 1930) Woinarski Ward, 2012).	Occupies wet and semi-arid melaleuca and eucalypt open woodlands. May be associated with bloodwoods with flaky bark and ironwood Ward, 2008).	Possible no records in vicinity although suitable habitat present, very rare

Species	Conservation Status		Distribution	Habitat	Likelihood of Occurrence
	EPBC	NT			
Falco hypoleucos Grey Falcon	-	VU	This species has a widespread distribution and records for this species exist throughout the NT. However, most records are from arid and semi-arid regions (Pizzey and Knight, 2012 .	Grey Falcons inhabit lightly treed inland plains, gibber desserts, sandridges, pastoral lands, timbered watercourses and, occasionally, the driest deserts. Pizzey and Knight, 2012 . Also found also in association with inland drainage systems.	Likely probably not at proposed lease areas but likely in floodplains across the permit area)
Geophaps smithii Partridge Pigeon	VU	VU	Occurs across the Top End of the NT, declined/disappeared from lower rainfall areas Woinarski, 2007).	Found predominantly in open eucalypt forest and woodland with grassy understories Woinarski, 2007).	Unlikely (no records, occurs north of the permit area although some habitat present
Grantiella picta Painted Honey Eater	VU	VU	This species is found throughout eastern Australia but breeding is known from south-eastern Australia (Pizzey and Knight, 2012). This species is rare.	This species specialises on the fruit of mistletoes although it may also forage on nectar and insects Garnett *et al.*, 2011). Numerous large tracts of *Acacia shirleyi* with abundant mistletoes were recorded in the vicinity of the Beetaloo sites.	Possible (records from Barkly Tablelands but none in close vicinity, habitat present, foraging only
Polytelis alexandrae Princess Parrot	VU	VU	Occupies arid lands in Australia where it is patchily distributed Woinarski, 2007).	Found in sand dune habitat, spinifex with eucalypts, and shrubs such as acacias, hakeas, and eremophilas Pizzey and Knight, 2012; Woinarski, 2007 .	Unlikely most records from southern arid region, not primary habitat
Rostratula australias Australian Painted Snipe	CE	VU	In the NT, probably occurs in central and southern area although it also possible occurs in the northern portion of the area Woinarski *et al*, 2007).	These birds prefer a habitat of recently flooded temporary vegetated wetlands during the non-breeding period and brackish temporary freshwater wetlands with minimum vegetation during breeding periods. Birds usually forage in thick, low vegetated areas during the day Curtis *et al*, 2012).	Unlikely (one record, no suitable habitat at drill sites but may be present in the wider landscape during the wet season)
Tyto novvaehollandiae kimberli	VU	VU	Distributed in Northern Australia although not well	This species inhabits tall open eucalypt forest in the NT, especially those associated	Unlikely

Species	Conservation Status		Distribution	Habitat	Likelihood of Occurrence
	EPBC	NT			
Masked Owl northern)			known. In the NT, occurs from Cobourg south to Katherine and the VRD and east to the McArthur River DOTE, 2014	with *E. Miniata* and *E. tetrodonta* Woinarski, 2007 . Also found in riparian and monsoonal forest and rainforest DOTE, 2014)	primary habitat absent
Mammals					
Dasyurus hallucatus Northern Quoll	E	CE	Found throughout most of Northern Australia although now restricted to six main areas Menkhorst Knight, 2011 . In the NT it is found in the Top End as far southeast as Boroloola DOTE, 2014). One previous record from Shenandoah Pastoral Lease unknown date).	Northern Quolls do not have highly specific habitat requirements although the most suitable appear to be rocky habitats Woinarski, 2007). They occur in a variety of habitats across their range, including open forest and woodland. Daytime den sites provide important shelter. Shelter sites include rocky outcrops, tree hollows, hollow logs, termite mounds, goanna burrows and human dwellings.	Unlikely (no recent records, no core habitat
Pseudantechinus mimulus Carpentarian Antechinus	–	VU	Found in QLD and the NT. In the NT it has been reported from the Sir Edward Pellew Island group, and Pungalina reserve near Borroloola.	This species is distributed in rocky habitat including sandstone boulders and outcrops with hummock grasses Woinarski, 2004). In QLD, this species has been recorded on rocky ridges and hill-slopes Lloyd *et al*., 2013).	Unlikely one record but no suitable habitat
Isodon auratus Golden Bandicoot	V	E	This species used to be found across northern, central and western Australia but decline after European settlement Woinarski, 2007). Now only found on Marchinbar Island in the NT and small area of the NW Kimberley Fisher and Woinarski, 1994; Woinarski, 2007).	Previously inhabiting a range of arid and semi-arid habitats, in the NT it occupies heathland and shrubland and hummock grasslands on sandstone, vine thickets and grassy woodlands Menkhorst and Knight, 2011; Woinarski, 2007).	Highly unlikely only persists in NE Arnhemland)

Species	Conservation Status		Distribution	Habitat	Likelihood of Occurrence
	EPBC	NT			
Macroderma gigas Ghost Bat	VU	NT	The species' current range in northern Australia ranges from relatively arid conditions in the Pilbara region of Western Australia to humid rainforests of northern Queensland. A large colony occurs in a series of gold mine workings at Pine Creek, NT. This species have also been recorded throughout the mainland Top End north of approximately 17º latitude.	The distribution of this species is influenced by the availability of suitable caves and mines for roost sites NTG, 2018).	Unlikely no recent records, no suitable cave located near proposed sites
Macrotis lagotis Greater Bilby	VU	VU	This species occurs in south-western Queensland and in arid north-western Australia Western Australia and Northern Territory). This species was previously widespread in arid and semi-arid Australia Pavey, 2009). The most northern records are from Newcastle Waters and Wave Hill Southgate Paltridge, 1998).	In the NT, this species is found on sandy soils dominated by spinifex (Pavey, 2009 . Low shrubs such as *Acacias* and *Melaleucas* are also common in this habitat. Also hummock grassland associated with low lying drainage systems and alluvial areas.	Unlikely no recent records, primary habitat limited in permit area)
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-Tailed Bat	CE	DD	Wide distribution from India through south-eastern Asia to the Solomon Islands, including north-eastern Queensland and the NT. The north-eastern Australian populations are described as the subspecies S. s. nudicluniatus, although it is	Previous specimens have been collected from Open *Pandanus* woodland fringing the sedgelands of the South Alligator River in Kakudu National Park (Friend and Braithwaite, 1986). In the NT, it has also been recorded from eucalypt tall open forests Churchill, 1998)	Unlikely no records and primary habitat not present

Species	Conservation Status		Distribution	Habitat	Likelihood of Occurrence
	EPBC	NT			
			not clear whether this should be applied to the NT population Duncan et al. 1999). There have been very few <5 confirmed records since (McKean et al. 1981; Thomson 1991 . All confirmed records have been from the Kakadu lowlands.		
Trichosurus vulpecula vulpecula Common Brushtail Possum	–	E	Previously widespread in the NT, this species is now found in isolated locations in the southern NT Woinarski, 2007 .	This species occupies riparian habitat in the vicinity of rocky outcrops or slopes (Kerle *et al.*, 1992).	Unlikely no records in the vicinity of the lease area and no suitable habitat
Rattus tunneyi Pale Field-rat	–	V	Inhabiting higher rainfall area including the Top End of the NT Menkhorst and Knight, 2011).	This species favours dense vegetation found along rivers where it occupies burrows in loose colonies Cole and Woinarski, 2002). However, this species can be found in a variety of habitats including woodlands if a dense understorey of grasses is present Menkhorst and Knight, 2011)	Unlikely (one record from 1999 in greater area, primary habitat absent
Reptiles					
Acanthopis hawkei Plains Death Adder	VU	VU	In the NT this species is found in the floodplains of the Adelaide, Mary and Alligator Rivers and the Barkly Tablelands.	Found on flat cracking soils in treeless floodplains where it forages on frogs, reptiles and rats.	Unlikely no records or suitable habitat)
Varanus Mertensi Mertens Water Monitor	–	V	Distributed throughout coastal and inland waters in northern Australia. In the NT found throughout most of the Top	Semi-aquatic species that inhabits vegetation associated with water such as Pandanus and paperbark. Seldom found far away from water Mayes, 2006).	Unlikely*(was confirmed during previous surveys along Newcastle

Species	Conservation Status		Distribution	Habitat	Likelihood of Occurrence
	EPBC	NT			
			End. Decrease in NT population attributed to Cane Toads.		Creek, habitat unsuitable at proposed exploration lease sites

3.5.5 Feral Animals

Feral animals known to occur within the region include:

- Pig *Sus scrofa*
- Wild Dog *Canis lupus familiaris*
- Feral Cat *Felis catus*
- Cane Toad *Bufo marinus*
- Horse *Equus caballus*
- Donkey *Equus asinus*
- Water Buffalo *Bubalus bubalis*
- Camel *Camelus dromedarius*
- Black Rat *Rattus rattus*
- Domestic Cattle *Bos Taurus*

During the August 2018 survey evidence of cattle grazing in present or 1-2 years previously was recorded and in previous surveys of the permit area cat tracks were observed as the only non-native species recorded but based on records many species, especially Dogs/Dingo, Pigs and Cane Toads will be present in permit area. The disturbance from cattle within the proposed sites were considered to have resulted in less than 5% damage or no damage at all.

The Cane Toad is known to be present in the permit area and the Commonwealth DoTEE recognises this species as a 'key threatening process' related to their impacts on biodiversity through predation, competition, land degradation and poisoning. In the Northern Territory, the Cane Toad has been implicated in the decline of several species including a large number of reptiles such as the King Brown Snake and water monitors Smith Phillips, 2006).

Pest predators such as the Cat are most likely common although their abundance is difficult to assess due to their cryptic nature. Introduced predators such as Cats can impact many vertebrates e.g. Dickman, 2009 1996). One of the primary concerns of introduced predators in the site is the impact on EPBC listed species such as reptiles, and ground-dwelling birds. Feral cats are believed to be one of factors that have led to the decline of threatened ground-dwelling bird the Partridge Pigeon Woinarski *et al*. 2007)

Species could be attracted to the increased activities at the site potentially increasing their abundance in the landscape, and their control should be taken into consideration during the proposed activities on site. It is of key importance during all phases of the project that care is taken to ensure that rubbish is securely contained i.e. with suitable lids and removed from the site as soon as possible to discourage attracting any feral animals.

3.5.6 Fire

Fire is a natural occurrence in most Australian ecosystems and plays an important role in their ecology. Fire is generally excluded from Mitchell grasslands by pastoral management in order to maintain forage throughout the dry season HLA, 2005) whereas fire is more frequent in the Sturt Plateau.

Historically, the majority of dry season fires June to September have occurred in the northern half of the permit area, in EP76, EP98 and EP117. At this time of year, the fires are likely to be high intensity (HLA, 2005 . Wet season fires October to May) have occurred within the permit area. These fires are likely to be patchy and of lower intensity, depending on the state of curing of the fuel load.

Bullwaddy and Lancewood communities, which are located throughout the permit area, are fire sensitive and hot fires have the ability to reduce habitat quality for both flora and fauna species. Research suggests that fauna diversity may be impacted by a hot fire, particularly for diurnal reptiles e.g. Legge *et al*., 2008).

Based on field data, fire disturbance was determined as follows:

- Vekerri 76 S2-1 – Fire Frequency 2-3 years previous, Intensity 1 minor scars on some trees/shrubs and Height <1m.
- Kyalla 117 N2-1 – Fire Frequency 1-2 years previous, Intensity 4 some trees and shrubs killed) and Height 1-4 m. It was noted that site appeared to have had a hot fire go through previously with abundance of new Acacia regrowth.

All sites that showed evidence of fire disturbance were showing signs of regrowth and recovery.

3.6 Land Condition Summary

Detailed land condition description and photographs of each of the proposed lease areas (Velkerri 76 S2-1, Kyalla 117 N2-1 are provided in Table 9 and Table 10 below.

Table 9 Velkerri 76 S2 Condition Description

Site ID	Velkerri 76 S2	Habitat photos at central point of survey site (August 2018)
Location	-16°51' 20.13, 134°23' 39.85	   
Landform and soil	Plains and rises associated with deeply weathered profiles laterite) including sand sheets and other depositional products; sandy and earth soils. Trace of cracking clay soils.	
Habitat type	*Eucalyptus/Corymbia low woodland*	
Vegetation Community	Eucalyptus low woodland/low open tussock grassland This vegetation community is considered regionally extensive and not subjected to extensive clearing.	
Dominant flora species	Canopy dominated by *Corymbia dichromophloia*, *Erythrophleum chlorostachys*. Shrub layer including *Eucalyptus sp*. Ground layer species include *Aristida latifolia, Pterocaulon sphacelatum, Triodia bitextura.*	
Habitat condition	Good condition with evidence of recent grazing. Large hollow bearing trees and logs were common in the area. The large hollows provide suitable nesting and shelter for numerous fauna species including reptiles, arboreal mammals, and nocturnal birds. The habitat contained moderate refuge opportunities in the form of dense leaf litter, dense grass cover, and woody debris. Good continuous cover adjoining adjacent woodland habitat. No evidence of weeds or feral animals.	**Additional Habitat Photos across survey site (August 2018)**  
Potential Listed Threatened Species	Grey Falcon, Northern Shrike-tit, Plains Death Adder, Gouldian Finch.	

Table 10 Kyalla 117 N2-1 Condition Description

Site ID	Kyalla 117 N2-1	Habitat photos at central point of survey site (August 2018)
Location	-16°50' 29.01, 133°39' 0.16	   
Landform and soil	Plains and rises associated with deeply weathered profiles laterite) including sand sheets and other depositional products; sandy and earth soils	
Habitat type	*Corymbia* low woodland	
Vegetation Community	*Corymbia* low woodland/*Terminalia* mixed) sparse shrubland/*Chrysopogon* mixed) low tussock grassland This vegetation community is considered regionally extensive and not subjected to extensive clearing.	
Dominant flora species	Canopy dominated by *Corymbia dichromophloia, Eucalyptus setosa*. Shrub layer including *Acacia ancistrocarpa, Alphitonia pomaderroides, Brachychiton paradoxus.* Ground layer species include *Triodia bitextura*	**Additional Habitat Photos across survey site (August 2018)**  
Habitat condition	Good condition with evidence of recent grazing. Vegetation appeared to heavily burnt in recent years. No evidence of hollow bearing trees and logs. The habitat contained moderate to high refuge opportunities in the form of dense leaf litter, tussock grass cover, and woody debris. Good continuous cover adjoining adjacent woodland habitat and regionally extenisive. No evidence of weeds or feral animals.	
Potential Listed Threatened Species	Grey Falcon, Northern Shrike-tit, Plains Death Adder, Gouldian Finch.	

4.0 Conclusion

During August 2018, AECOM undertook a land condition assessment of the two proposed exploration lease areas and access tracks to provide a baseline assessment of ecological conditions in support of Origin Energy's application to the Northern Territory Department of Environment and Natural Resources, including the preparation of an Environmental Management Plan (EMP) for various exploration activities.

The purpose of the LCA was to gather baseline information to provide an environmental condition assessment to support the proposed exploration activities to be carried out by Origin at two proposed lease sites during 2019/2020.

The LCA identified the ecological conditions and documented the site condition prior to Origin commencement of exploration within two of their Permit Areas EP76 and EP117. The information obtained during the initial LCA will assist in determining that at the end of the exploration activities that the lease areas have been rehabilitated back to its natural state.

The proposed exploration program will have a total disturbance of approximately 11.27 ha and will utilise 107 km of existing access tracks.

The desktop review and field survey assisted in identifying the potential environmental risks and impacts to the environment based on the conditions identified on site and has allowed the development of mitigation measures to minimise Origin's impact on the environment.

During the survey of the proposed exploration lease areas, as well as the areas surrounding the proposed access tracks were assessed to be in generally good condition with no to low evidence of weeds, erosion and disturbance from cattle.

The likelihood assessment concluded that no EPBC listed threatened ecological communities or threatened species are likely to be significantly impacted from the proposed exploration program activities.

Overall, the impacts of the vegetation clearing for the proposed lease areas and access tracks are considered minor from a landscape perspective. Surrounding habitat is extensive and most species are mobile and will be able to access surrounding habitat.

The mitigation measures presented in the Drilling and Stimulation EMP would assist in minimising the impacts from Origin's activities on EPBC listed species and communities.

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Appendix A

Field Maps

AECOM
www.aecom.com

Projection: GDA94 MGA Zone 53

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Meters

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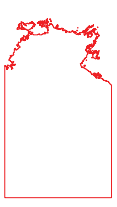
LEGEND

- Proposed Well 2018
- Cadastre
- Permit Areas
- Proposed Tracks
- 4 Ha Boundary
- 500m Buffer

LOCATION



Data sources:
Permit Area, Cadastre - NT Gov 2014.
Places, Vegetation - Aust Gov 2014
Highways, Roads, Drainage -

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Kyalla 117 N2-1

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure
2A

A3 size

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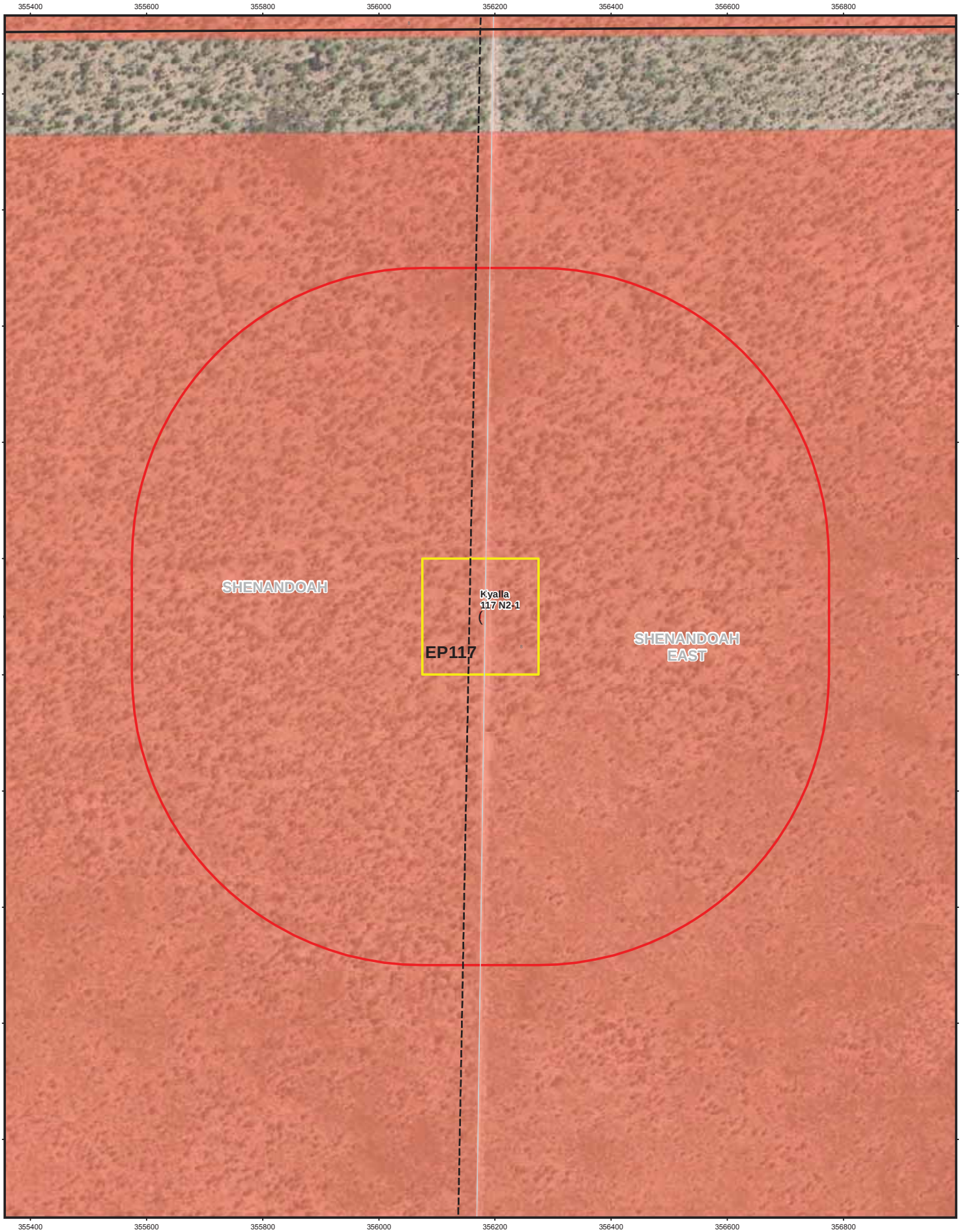

AECOM
www.aecom.com

Projection: GDA94 MGA Zone 53

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Meters

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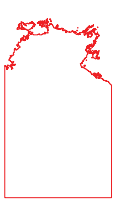
LEGEND

- Proposed Well 2018
- Cadastre
- Permit Areas
- Proposed Tracks
- 4 Ha Boundary
- 500m Buffer

Vegetation Community

- Corymbia low woodland/Terminalia (mixed) sparse shrubland/Chrysopogon (mixed) low tussock grassland

LOCATION



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Places, Vegetation - Aust Gov 2014
Highways, Roads, Drainage -

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Kyalla 117 N2-1
Vegetation Community

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure
2B

A3 size

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Projection: GDA94 MGA Zone 53

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Meters

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LEGEND

- Proposed Well 2018
- Cadastre
- Permit Areas
- Proposed Tracks
- 4 Ha Boundary
- 500m Buffer

Data sources:
Permit Area, Cadastre - NT Gov 2014.
Places, Vegetation - Aust Gov 2014
Highways, Roads, Drainage - StreetPro 2014

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

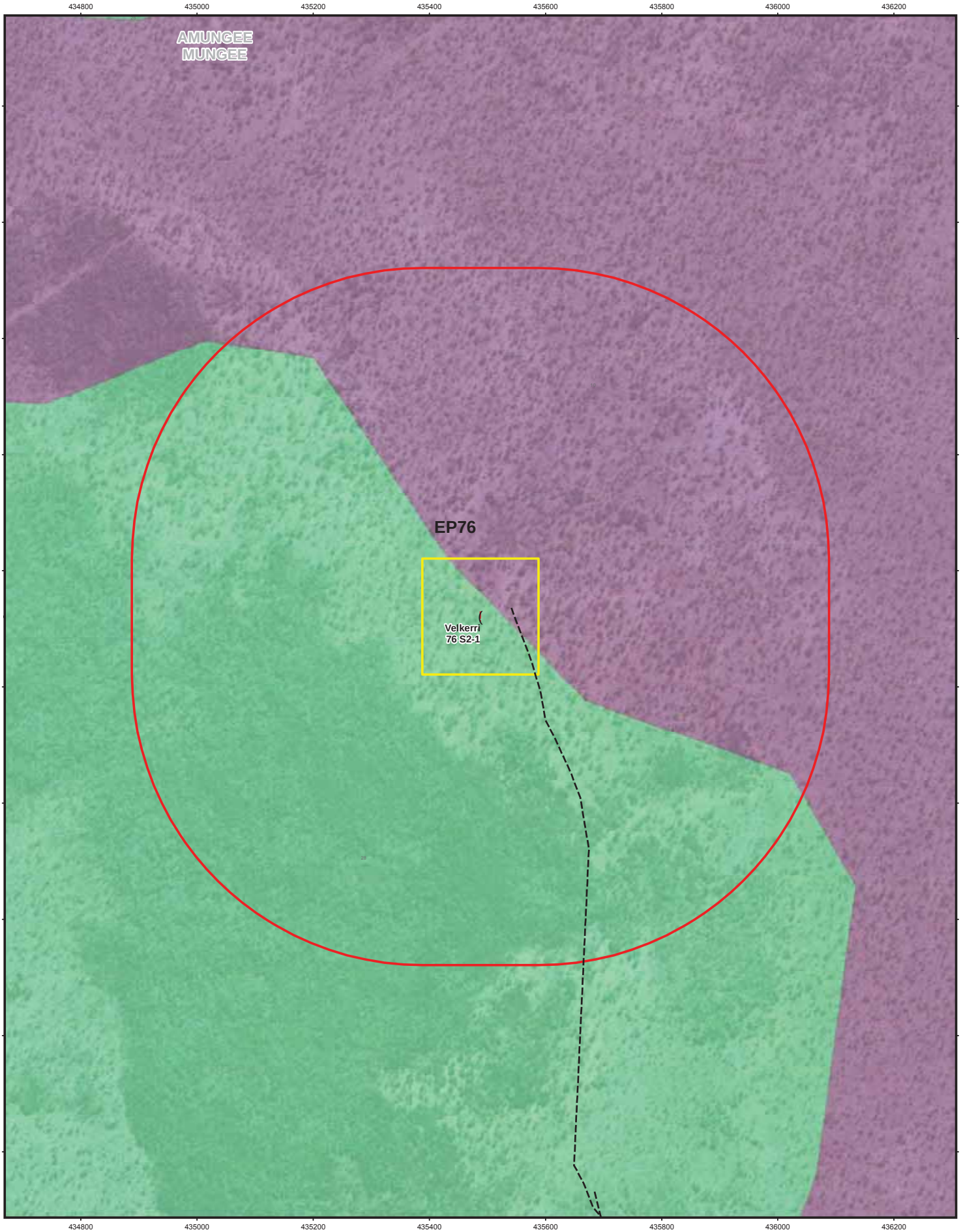
Velkerri 76 S2-1

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure
6A

A3 size

Filename: P:\604x\60480548\4. Tech Work Area\4.99 GIS\02_MXDs\August2018_Scouting\G60480548_Map_Velkerri76S2-1_20180822_v1_A3.mxd



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Projection: GDA94 MGA Zone 53

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Meters

1:6,000 (when printed at A3)

LEGEND

- Proposed Well 2018
- Cadastre
- Permit Areas
- Proposed Tracks
- 4 Ha Boundary
- 500m Buffer

Vegetation Community

- Acacia low woodland/Eragrostis (mixed) low open tussock grassland
- Eucalyptus low woodland/Eucalyptus (mixed) low open woodland/Iseilema (mixed) tussock grassland

LOCATION

Data sources:
Permit Area, Cadastre - NT Gov 2014.
Places, Vegetation - Aust Gov 2014
Highways, Roads, Drainage - StreetPro 2014

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Velkerri 76 S2-1
Vegetation Community

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure
6B

A3 size

Filename: P:\604x\60480548\4. Tech Work Area\4.99 GIS\02_MXDs\August2018_Scouting\G60480548_Map_Velkerri76S2-1_20180822_v1_A3.mxd

Appendix B

Soil Test Results

Kyalla N2-1		5.14	1.5YR 4/6	**Initial Observation** • Sample was fully crumbed when submerged in demineralised water. **Final Observation** • Non-dispersive, particles crumble though water remains clear.
Velkeri S2		5.02	10YR 3/4	**Initial Observation** • Sample was fully crumbed when submerged in demineralised water. **Final Observation** • Non-dispersive, particles crumble though water remains clear.
NOTE: Initial Observation - observation made when the sample was submerged in water Final Observation - observation made after 2 hours				

Appendix C

Flora Species Record, August 2018

Appendix C Flora Species Record, August 2018

Table 11 Flora Species Recorded, August 2018 Field Survey

Family	Genus	Species
Asteraceae	*Pterocaulon*	*sphacelatum*
Caesalpiniaceae	*Erythrophleum*	*chlorostachys*
Combretaceae	*Terminalia*	*canescens*
		arostrata
	Macropteranthes	*kekwickii*
Euphorbiaceae	*Petalostigma*	*pubescens*
Fabaceae	*Acacia*	*ancistrocarpa*
		shirleyi
		sp.
Myrtaceae	*Corymbia*	*dichromophloia*
		drysdalensis
		ferruginea
Poaceae	*Aristida*	*holathera*
	Chrysopogon	*fallax*
	Enneapogon	*lindleyanus*
	Eragrostis	*spartinoides*
	Eriachne	*aristidea*
		ciliata
		nervosa
		sp.
	Heteropogon	*contortus*
	Sarga	*plumosum*
	Schizachyrium	*fragile*
	Sporobolus	*australasicus*
	Themeda	*triandra*
	Triodia	*bitextura*
		sp.
Rhamnaceae	*Alphitonia*	*pomaderroides*
Sterculiaceae	*Brachychiton*	*paradoxum*

Appendix D

DotEE Protected Matters Search Report

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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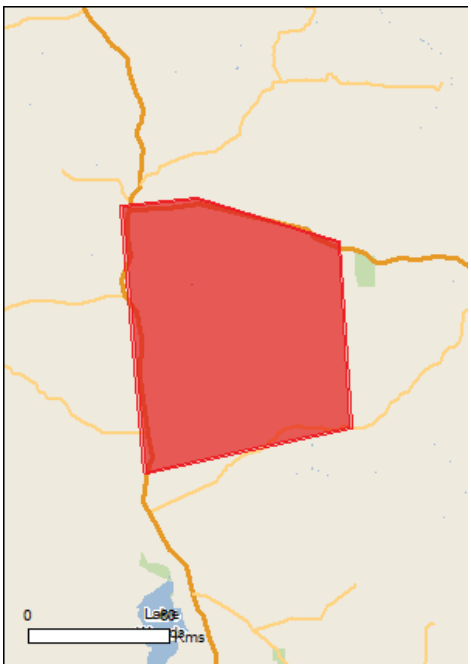
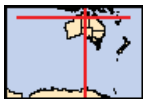


Coordinates
Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	12
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	19
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	15
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat likely to occur within area
Falcunculus frontatus whitei Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat may occur within area
Mammals		
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Acanthophis hawkei Plains Death Adder [83821]	Vulnerable	Species or species habitat likely to occur within area
Elseya lavarackorum Gulf Snapping Turtle [67197]	Endangered	Species or species habitat may occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Reptiles		
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Frew Ponds	NT

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat may occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Bubalus bubalis Water Buffalo, Swamp Buffalo [1]		Species or species habitat likely to occur within area
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Plants		

Name	Status	Type of Presence
Acacia nilotica subsp. indica		
Prickly Acacia [6196]		Species or species habitat may occur within area
Cenchrus ciliaris		
Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Jatropha gossypifolia		
Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Parkinsonia aculeata		
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Vachellia nilotica		
Prickly Acacia, Blackthorn, Prickly Mimosa, Black Piquant, Babul [84351]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-16.305477 133.356741,-16.297568 133.356741,-16.269886 133.641013,-16.428018 134.180716,-17.098628 134.226035,-17.263941 133.447379,-16.305477 133.356741

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix D Heritage Report

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31 March 2019

Matthew Hanson
Beetaloo Project Manager
Origin
339 Coronation Drive
Milton QLD 4064

Dear Matthew

Aboriginal & Historic Heritage Assessment: 2018 Exploration Lease Areas

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was commissioned by Origin Energy Resources Limited (Origin) to conduct a heritage assessment of the proposed exploration lease areas known as Kyalla 117 N2 and Velkerri 76 S2 located within the Beetaloo Basin, Northern Territory.

The assessment consisted of the following:

- A 4.5-ha area around the proposed lease sites including an additional 500 m buffer to allow for future flexibility.
- A 1-ha camp pad.
- A 0.5-ha helipad at the Velkerri 76 S2.
- 650 m long x 8 m wide (0.52-ha) lease pad turn in to Kyalla 117N2 connecting the proposed lease pad to the existing access track.
- 1,100 m long x 8 m wide (0.88-ha) lease pad turn in to Velkerri 76 S2 connecting the proposed lease pad to the existing access track.

The assessment involved a field inspection for the area of proposed works (study area) during August 2018. This reports the results specific to Kyalla 117 N2 and Velkerri 76 S2..

2.0 Existing Data Sources

Information on the location of heritage sites within the study area was obtained from:

- a review of Native Title claims and Indigenous Land Use Agreements over the proposed activity areas
- a review of existing Northern Territory Heritage Register managed by the NT Heritage Branch
- a review of the Sacred Sites Register maintained by the Aboriginal Areas Protection Authority
- a review of past archaeological survey reports and assessments undertaken within the local area.

2.1 Native Title

Native Title exists in parts of the determination area as detailed in Table 1.

Table 1 Native Title & ILUA Agreements

Type	Bore	Name	Summary
Native Title	Kyalla 117 N2-1	NTD21/2010 Shenandoah Pastoral Lease	Native Title exists in parts of the determination area and is held by the Kinbininggu and Bamarrngganja groups
	Velkerri 76 S2-1	NTD17/2010 Amungee Mungee Pastoral Lease	Native title exists in parts of the determination area and is held by The Karranjini group; the Bamarrnganja group

The Native Title Petroleum Exploration Agreement between Permit Holder and the NLC includes clauses for the protection of Sacred Sites, objects and sensitive areas related to Aboriginal activities in the area, including cultural, hunting and foraging activities. Site clearance will occur prior to any on ground activities. The Native Title Agreement also includes clauses for the protection of the environment and rehabilitation.

2.2 Australian Heritage Database

A search of the Australia Heritage Database identified that no statutory listed heritage places within the proposed impact areas.

2.3 NT Heritage Register

A search of the Northern Territory Heritage Register identified no heritage places or artefacts within the proposed impact areas.

2.4 Aboriginal Areas Protection Authority

AAPA clearance surveys by AAPA anthropologist and traditional owners were completed and an Authority Certificate issued to Origin for the proposed exploration works within nine exploration activity locations, including Kyalla 117 N2 and Velkerri 76 S2. The clearance certificate issued for Origin's exploration program include:

- AAPA RA2019/11 (C2019/014) – EP117, EP76 and EP98 within Part NT Portions 701, 702, 1077, 1079, 1513, 5416, 7027 and 7026.

Appendix B presents the current AAPA Clearance Certificate. Origin have committed to comply with conditions as prescribed by AAPA for the duration of the program.

2.5 Previous Archaeological Investigations

The majority of archaeological investigations near the study area have been predominately associated with either linear infrastructure in an alignment parallel to the Stuart Highway or natural gas exploration activities associated with the Beetaloo Basin. Of the assessments of relevance to the study area, the majority of sites identified are artefact scatters composed of raw material commonly found in the immediate area (quartz, silcrete and quartzite).

Table 2 provides a summary of previous archaeological investigations undertaken in the local area.

Table 2 Previous Archaeological Assessments in the Local Area

Researchers	Assessment Type	Locality	Key Findings
Smith, 1986	Excavation	Lake Woods	Insitu artefacts dated to 6,000 years.
Hermes, 1986	Survey	Amadeus Basin to Katherine	Large scale survey for a proposed natural gas pipeline targeting areas of major cultural sensitivity from Daly Waters to Katherine. Thirty-two sites were identified with the majority being artefact scatters associated with watercourses.
Quaternary Archaeological Surveys, 1998	Survey	Stuart Highway to Mataranka Homestead	Large scale survey for a fibre optic cable corridor. Three isolated artefacts and one historic heritage site identified.
Heritage Surveys, 1999	Survey	Daly Waters to McArthur River	Nine archaeological sites identified including rockshelters and artefact scatters.
HLA-Envirosciences Pty Ltd, 2006a, 2006b, 2006c, 2006d, 2007	Survey	Beetaloo Basin	Several archaeological sites identified across the exploration permits including artefact scatters, isolated artefacts and stone cairns.

Researchers	Assessment Type	Locality	Key Findings
AECOM Australia Pty Ltd, n.d., 2011, 2012a, 2012b	Survey	Beetaloo Basin	Several archaeological sites identified as part of seismic line clearance including large artefact scatters (>1 km), quarry sites and isolated artefacts.
AECOM Australia Pty Ltd, 2014	Survey	Beetaloo Basin	One isolated artefact identified as part of an exploration drilling program clearance.
AECOM Australia Pty Ltd, 2016	Survey	Beetaloo Basin	One isolated artefact identified on Newcastle Waters firebreak

3.0 Heritage Assessment

A heritage assessment involving field survey was undertaken by AECOM archaeologist, Luke Kirkwood for the proposal area on 28 to 29 August 2017. The archaeological inspection involved helicopter and pedestrian survey of the proposed exploration area and access tracks.

During the inspection notes were taken on landform, ground surface visibility and areas of exposure. The aim of the inspection was to identify any surface expressions of Aboriginal archaeological and cultural heritage values within the proposal area. Photographic records were taken at each proposed disturbance location.

Results of the inspection are provided in Table 3. Appendix C provides details on ground surface visibility classes and subsurface archaeological potential assessment. Plate1 and Plate 2 present the general context shot of the proposed exploration lease area.

Table 3 Exploration Lease Area Inspection Results

Location	Easting (mE)[a]	Northing (mN)[a]	GSV[b]	GSI[c]	Surface Archaeology	Subsurface Potential	Impact Potential
Kyalla 117 N2-1	356175	8137500	Fair	High	None identified	Low	Low to No Impact
Velkerri 76 S2-1	435488	8136321	Good	High	None identified	Low	Low to No Impact

a GDA94 Zone 53; b GSV = Ground Surface Visibility; c GSI = Ground Surface Integrity

Plate 1 Kyalla 117 N2-1 general context shot

Plate 2 Velkerri 76 S2-1 general context shot

4.0 Identified Archaeological Heritage

No culturally sensitive landforms were identified during the survey of the proposed lease sites.

5.0 Key Findings and Recommendations

The key findings of this heritage assessment are:

- A review of existing heritage data and reports for the study area indicate that no previously recorded heritage sites will be impacted by the proposed works.
- AAPA clearance surveys by AAPA anthropologist and traditional owners have been completed and AAPA Certificate issued to Origin for their current exploration program.

On the basis of the above findings, the following recommendations are made:

- An unexpected heritage finds stop works procedure is to be implemented for the duration of the project.
- Induction of staff on site is to include reference to the wider area having Indigenous heritage values and the stop works procedure.

6.0 References

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AECOM Australia Pty Ltd. (2016). *Beetaloo Road Addendum: Aboriginal & Hsitoric Heritage Assessment*. Unpublished report to Original Energy Resource Limited.

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Yours faithfully

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Appendix A - Legislation

Commonwealth Legislation

Environment Protection and Biodiversity Conservation Act

The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) took effect on the 16 July 2000 (NSW Department of Urban Affairs and Planning, 2000). Under section 26 of the EPBC Act it is stated that:

> *A person must not take on Commonwealth land an action that has, will have or is likely to have a significant impact on the environment.*

Under section 28 of the EPBC Act it is stated that:

> *The Commonwealth or a Commonwealth agency must not take inside or outside the Australian jurisdiction an action that has, will have or is likely to have a significant impact on the environment inside or outside the Australian jurisdiction.*

An action is defined as a project, development, undertaking, activity, series of activities, or alteration. An action will also require approval if:

> *It is undertaken on Commonwealth land and will have or is likely to have a significant impact;*
>
> *It is undertaken outside Commonwealth land and will have or is likely to have a significant impact on the environment on Commonwealth land; and*
>
> *It is undertaken by the Commonwealth and will have or is likely to have a significant impact.*

The EPBC Act defines 'environment' as both natural and cultural environments and therefore includes Aboriginal and historic heritage items. Under the Act, protected heritage items are listed on the National Heritage List (items of significance to the nation) or the Commonwealth Heritage List (items belonging to the Commonwealth or its agencies). These two lists replaced the Register of the National Estate (RNE) which is no longer a statutory list.

Aboriginal and Torres Strait Islander Heritage Protection Act 1984

The Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (the ATSIHP Act) provides for the preservation and protection of places, areas and objects of particular significance to Indigenous Australians. The stated purpose of the ATSIHP Act is the 'preservation and protection from injury or desecration of areas and objects in Australia and in Australian waters, being areas and objects that are of particular significance to Aboriginals in accordance with Aboriginal tradition' (section 4).

Under the Act, 'Aboriginal tradition' is defined as "the body of traditions, observances, customs and beliefs of Aboriginals generally or of a particular community or group of Aboriginals, and includes any such traditions, observances, customs or beliefs relating to particular persons, areas, objects or relationships" (Section 3). A 'significant Aboriginal area' is an area of land or water in Australia that is of 'particular significance to Aboriginals in accordance with Aboriginal tradition' (Section 3). A 'significant Aboriginal object', on the other hand, refers to an object (including Aboriginal remains) of like significance.

For the purposes of the Act, an area or object is considered to be injured or desecrated if:

- In the case of an area:
  - it is used or treated in a manner inconsistent with Aboriginal tradition;
  - the use or significance of the area in accordance with Aboriginal tradition is adversely affected;
  - passage through, or over, or entry upon, the area by any person occurs in a manner inconsistent with
  - Aboriginal tradition;
- In the case of an object:
  - it is used or treated in a manner inconsistent with Aboriginal tradition.

The ATSIHP Act can override state and territory laws in situations where a state or territory has approved an activity, but the Commonwealth Minister prevents the activity from occurring by making a declaration to protect an area or object. However, the Minister can only make a decision after receiving a legally valid application under the ATSIHP Act and, in the case of long term protection, after considering a report on the matter. Before making a declaration to protect an area or object in a state or territory, the Commonwealth Minister must consult the appropriate Minister of that state or territory (section 13).

Northern Territory Legislation

Northern Territory Aboriginal Sacred Sites Act

Provides for the protection of Aboriginal sacred sites through the establishment of different categories of site based on land tenure, including sites on Aboriginal Freehold land. The Act also establishes the Aboriginal Areas Protection Authority (AAPA) as the central administering body which supports Aboriginal custodians in achieving the objectives of the Act. Consultation with the NLC and TO's required and the issue of the AAPA clearance certificates.

The Act establishes a duty-of-care to notify the AAPA of any potential disturbance to Aboriginal sacred sites. It is an offence to desecrate or disturb a site without the approval of the relevant custodians. A register of known sites exists to assist in identifying the likelihood of disturbance and potential need to obtain approval.

Heritage Act

Protects both natural and cultural heritage, including Aboriginal, historic and Macassan heritage. The Act establishes the Heritage Council (consisting of eleven members) and the NT Heritage Register. It sets the process by which places become heritage places and allows for interim protection of places.

It is an offence to remove or damage heritage places or objects or to mislead or obstruct heritage officers regarding the provision of requested information or entry to works, vehicles or premises that are likely to have been involved in an offence against the Heritage Act. Compliance with the requirements of the Act must be adhered to at all times.

Appendix B – AAPA Clearance Certificate

Appendix C – Archaeological Assessment Criteria

Table B1 Ground Surface Visibility (GSV) Rating Scheme

GSV rating	Percentage GSV
No ground surface visibility	0%
Very poor	1-10%
Poor	11-30%
Fair	31-50%
Good	51-70%
Very good	71-90%
Excellent	91-100%

Table B2 Ground Surface Integrity (GSI) Rating Scheme

GSI rating	Definition
Low	Ground surface has been subjected to significant disturbance (e.g. earthworks, excavation). Little to no integrity remains.
Moderate	Ground surface has been subject to moderate disturbance (e.g. native vegetation clearance) but retains a reasonable degree of integrity.
High	An unmodified or minimally modified ground surface.

Table B3 Definitions for Subsurface Archaeological Potential

Subsurface Archaeological Potential	Definition
Low	Areas in which subsurface archaeological materials are unlikely to occur. This may be due to unfavourable environmental conditions and/or prior disturbance(s).
Moderate	Areas in which subsurface archaeological materials may occur. Reasonable environmental conditions exist though high artefact counts/densities are unlikely. Subsurface evidence likely to be the product of random discard events as opposed to repeated or extensive activity by Aboriginal people in antiquity.
High	Areas known or highly likely to contain subsurface archaeological materials. Presence of archaeological materials typically reflects optimal environmental conditions and little to no prior landscape disturbance. High artefact counts/densities are likely.

Table B4 Impact Potential Ranking for Aboriginal Objects

Impact Potential	Definition	Management Action
No Impact	Aboriginal objects will not be affected by the proposed activity.	No action required
Low Impact	The proposed activity is unlikely to disturb, destroy, damage or deface an Aboriginal object or objects.	No action required
Moderate Impact	The proposed activity has reasonable potential to disturb, destroy, damage or deface an Aboriginal object or objects.	Avoid area if possible. If avoidance not an option, test excavate area to determine nature and extent of potential archaeological deposits

Impact Potential	Definition	Management Action
High Impact	The proposed activity will, or is highly likely to, disturb, destroy, damage or deface an Aboriginal object or objects.	Avoid area if possible. If avoidance not an option, test excavate area to determine nature and extent of potential archaeological deposits

Appendix E Stakeholder engagement information

Stakeholder	Method of communication	Date of Correspondence	Summary of information provided	Summary of response	Origin's response	Details of changes made to work program
Hayfield Shanendoah	- Face to Face Meeting - Email Correspondence - Email Correspondence - Email Correspondence - Face to Face Meeting - Email Correspondence / Telephone Comms	- 15 May-18 - 20 Aug 18 - 5 Sep 18 - 24 Oct 18 - 15 Oct 18 - 28 Nov 18 - 15 Oct -18 to Present	- Meeting provided overview of work programme - Early Access Letter of Intent, Potential Well Locations and Coordinates, Work Programme and Schedule & Draft Early Access Agreement to undertake pre-implementation activities - Executed Early Access Agreement - incl Water Bores - Pastoral Leasee notification to complete water monitoring bore construction - Issuance of draft Full Access Agreement (for Drilling and Stimulation activities) - Discussion on agreement terms and update of forward plans - Negotiation of Full Access Agreement for the Kyalla 117 N2 Well	- Pastoral Leasee has executed early access agreement to allow for all pre-drilling activities - Provided Pastoral Leasee with notification of water bore activities on land - Pastoral Leasee in continued in negotiate in good with Origin on the terms of the agreement	Origin has reached an access agreement which covers all scope to support water bore drilling and early survey works - Origin sees negotiations occurring in good faith with imminent execution	No changes made to work program
NLC / Traditional Owners	- Work Program Submission - Face to Face Meeting - Email Correspondence - Sacred Site Clearance Survey (In Field)	- 10 Jul 2018 - 3 Sep 2018 - 3, 4 and 9 Sep 2018 - 10 to 19 Sep 2018	- Locations of all potential areas of disturbance across the permits - All potential area of disturbance across the permits	- The NLC coordinated the Sacred Site Clearance Surveys with Traditional Owners of the respective area(s) - The NLC completed their report and provided the report to AAPA on Friday 2 November	Process of engagement has been followed as per the exploration agreements and awaiting AAPA Certification (as at 5 November 2018)	Origin are awaiting the NLC CoW report after which it will ensure disturbance areas do not clash with cultural heritage,
DPIR	Face to face meeting face to face	Weekly 31/01/2019	Weekly HFI implementation meetings discuss Origins proposed 2019 workplan Presentation summarising Origins proposed workplan in detail.	DENR have provided ongoing advice on the contents of codes of practice and other approvals related information	Information from DPIR has been included in Origin's EMP submissions.	No changes made to work program
DENR	Face to face meeting Face to face email correspondence face to face	Weekly 31/01/2019 22/02/2019 27/02/2019	Weekly HFI implementation meetings discuss Origins proposed 2019 workplan Presentation summarising Origins proposed workplan in detail. Prelodgement of Origin's Kyalla 117 N2 draft EMP for comment DENR discussion regarding content of draft Kyalla 117 N2 EMP	DENR have provided ongoing clarification to changes in policy, codes of Practice and EMP requirements. This includes various recommended changes to EMP format and content.	Origin has adjusted its EMP's to reflect the current Codes of Practice and EMP requirements.	No changes made to work program
AAPA	email correspondence face to face Face to face	09/01/2019 31/01/2019 14/02/2019	Application summarising Origin's 2019 work program and AAPA certificate requirements Presentation summarising Origins proposed workplan in detail. Discussions regarding scope of submission nd additional information/ clarifications	AAPA requested additional information and clarification on the scope of the proposed activities	Origin has provided this additional information and clarified several work program items	No changes made to work program
Environmental Protection Authority	Face to Face	04/12/2018	Discussion on forward 2019 work program and forward approval process	The NT EPA asked several questions about the work program and provided feedback on the assessment process and information they required within the EMP	Origin has acknowledged the discussions and has adopted the recommendations with the EMP	No changes made to work program

Annexure A Code of Conduct for Activities on Hayfield and Shenandoah Stations

1. Definitions

In this Code of Conduct:

Activities	has the meaning given in the agreement to which this Code of Conduct is attached.
Landowner	means A.P.N. Pty Ltd ABN 62 000 742 781.
Origin	means Origin Energy B2 Pty Ltd ABN 45 105 431 525.
WHS Laws	means any relevant Northern Territory or Commonwealth work health and safety legislation and regulations.

2. Petroleum Conduct Rules and Other Protocols

a) Origin will conduct the Activities on the Pastoral Property in accordance with this Code of Conduct for the Activities on Pastoral Property.

b) Origin and the Landowner may agree to such other protocols or rules for accessing the Pastoral Property or carrying out the Activities as they may wish.

c) Origin will undertake such safety or and induction briefings as reasonably required by the Landowner at the time and place reasonably requested by the Landowner.

3. General Principles of Land Care

Origin will carry out the Activities in a manner:

a) so as to minimise any damage or disturbance to the surface of the land within the Pastoral Property; and

b) to seek to ensure that the land is not degraded on completion of the Activities and is left in the same or better condition than when Origin commenced the Activities.

4. Rehabilitation

a) On the sooner to occur of the termination of this Agreement and completion of the Activities in any area of the Pastoral Property, Origin will:

i) have commenced, or commence as soon as practicable, rehabilitation work;

ii) remove all equipment (other than equipment required for rehabilitation and repair work pursuant to this clause 3);

iii) repair all damage to the Pastoral Property caused by Origin as soon as practicable;

iv) re-contour excavations and earthworks affected on the Pastoral Property in such a manner that soil erosion will be minimised as far as practicable;

v) carry out rehabilitation works in accordance with any relevant conditions of the Law, Approvals and Petroleum Title which stipulate requirements for rehabilitation of the effects of the Activities;

vi) repair any damage to any roads caused by Origin to the standard they were in prior to the Commencement Date;

vii) replace excavated base material, subsoil and topsoil in the order that they were removed to reconstruct the soil profile;

viii) reshape all surface disturbance to be consistent with the pre-existing landform (or slightly elevated to allow for soil compaction);

ix) suitably prepare the land surface for the establishment of vegetation;

x) rehabilitate any damage to crops or pastures by reseeding; and

xi) rehabilitate with native species of local provenance where native vegetation has been cleared,

with such works to be completed:

A) in the case of termination of this Agreement, within three months of the termination of this Agreement or as mutually agreed; and

B) in any other case, within three months of completion of the Activities or as mutually agreed in any area of the Pastoral Property.

b) If Origin does not carry out the rehabilitation which is the responsibility of Origin within the timeframe required under this Agreement:

(i) the Landowner may serve written notice upon Origin setting out the rehabilitation required to be carried out under this Agreement within 3 months;

ii) if the rehabilitation is not completed within 3 months after the notice or as subsequently agreed, the Landowner may carry out the rehabilitation; and

iii) Origin must, within 30 days of demand, compensate the Landowner's reasonable expenses and costs of carrying out the rehabilitation under this clause 3.

c) In addition to the above, if Origin leaves any un-rehabilitated areas on the Pastoral Property, the Landowner may provide this Agreement to the Northern Territory in support of the Territory using any security bond held by the Territory for the purposes of the rehabilitation required under this Agreement.

5. Biosecurity

a) Origin acknowledges that the Landowner may undertake particular measures directed toward biosecurity for the Pastoral Property.

b) Where the Landowner notifies Origin of any biosecurity measures for the Pastoral Property Origin will take such reasonable actions as necessary to:

i) ensure that the petroleum activities do not adversely impact on the biosecurity measures; and

ii) minimise the risk of harm to the biosecurity of the Property.

6. Roads

a) Origin will, prior to the Commencement Date, consult with the Landowner to determine the best means of access on existing roads or whether new roads are required. In constructing any new road or track Origin will seek to comply with any reasonable request by the Landowner in respect to the nature and route of the road or track to be constructed subject to the terms of the law, approvals and operational requirements. Origin will also consult with the Landowner on whether any roads will be rehabilitated at the completion of the petroleum activities or whether they will be left to be used and maintained by the Landowner.

b) During the time Origin is undertaking petroleum activities on the Pastoral Property, Origin will maintain all existing and new roads, tracks and access routes it utilises to the same or better standard than such roads were in immediately prior to the Commencement Date and, if the level of Origin's traffic loadings require it, Origin will improve such roads, tracks and access routes to a standard that is consistent with such traffic loadings.

(c) At the end of this Agreement, if the Landowner requests that it do so, Origin will leave for the Landowner's use the roads and tracks that it improved or constructed, unless Origin is required by the Law or any Approval to remove or rehabilitate the areas of the roads and tracks.

7. Use of Roads

When using roads and tracks on the Pastoral Property by vehicle Origin will ensure that Origin's Personnel:

a) drive in a manner suited to, and appropriate for, the conditions then present on the Property such that damage or disturbance to the road or track is minimised;

b) not drive on soft soils in wet conditions; and

c) when on a single or otherwise narrow road, respect the Territory's unwritten rule of pulling off to the side of the road to allow a prime mover or other heavy vehicle to pass.

8. Speed Limits

Origin must ensure that any access to the Pastoral Property by vehicle is carried out within the speed limits applying to the Property as agreed between the Landowner and Origin and confirmed in writing.

9. Stock

Origin will:

a) minimise disturbance or interference to stock on the Pastoral Property;

b) ensure that no dogs or firearms are brought onto the Pastoral Property;

c) not interfere with or enter any land within 500 metres of stock watering points; and

d) immediately report to the Landowner any death or injury to any stock that Origin causes or becomes aware of.

10. Fencing

Where requested by the Landowner for reasons of safety or security Origin will, at its own cost, erect appropriate fencing, of a kind and in a location reasonably requested by the Landowner, around any non-temporary plant or equipment that enters the Pastoral Property.

11. Water

a) If Origin wishes to install a water bore on the Pastoral Property it will consult with the Landowner as to the location of such bore.

b) Origin acknowledges the importance to the Landowner of having constantly available access to potable water for the purposes of the Pastoral Enterprise and agrees as follows:

i) Origin will not use water from a farm dam or bore located on the Pastoral Property and constructed by the Landowner without the prior written permission of the Landowner;

ii) Origin and Pastoralist will discuss the water studies and types of sampling and tests to be carried out during the term of this Agreement including any specific requests or suggestions by the Landowner. At the request of the Landowner, Origin will provide the results of studies and tests of interest (if any) to the Landowner provided such disclosure does not breach confidentiality obligations to third parties; and

iii) to the extent that the availability or quality of water on or under the Pastoral Property is adversely affected by petroleum activities, then as soon as reasonably practicable after Origin becomes aware of the adverse effect or the Landowner gives notice to Origin of the adverse effect, Origin will:

A) take such immediate steps as required by its Approvals and industry standards to mitigate or eliminate the adverse effect; and

B) take such immediate steps as reasonably requested by the Landowner to rectify any issues identified by the Landowner which present a risk of damage or loss to the Pastoral Property or the Pastoral Enterprise which depending on the circumstances may include redrilling a bore and installing a water pipeline) as appropriate.

12. Airstrips

Origin must consult with the Landowner before accessing any of the Landowner's airstrips on the Pastoral Property except in the case of medical or other emergencies.

13. Weeds

a) Origin acknowledges that the importance of weed control and the mitigation against the spread of weeds on the Pastoral Property.

(b) Origin will, at least once before it commences petroleum activities, consult with the Landowner regarding the requirements of the Landowner in respect to weed control and the mitigation against the spread of weeds on the Pastoral Property, including any decontamination, cleandown, blowdown or washdown procedures (where applicable) that exist for the Property.

c) Before any entry on to the Pastoral Property and at reasonable intervals between moving from one distinct part of the Property to another:

i) Origin will ensure that it complies with all reasonable decontamination or washdown procedures that exist for the Property as notified to Origin and any other requirements notified by the Landowner during the consultation mentioned in clause 12 b) above; or

ii) if no decontamination, clean down procedures or other requirements have been notified to Origin then Origin will ensure that all vehicles, boots and equipment are cleaned of all superficial accumulation of dirt or plant or vegetable matter prior to commencing the Activities.

d) Origin will ensure that it takes all reasonable precautions against the introduction of, and remove or eradicate any noxious or declared pests or plants introduced to the Pastoral Property by the Activities.

14. Pastoral Fences

Origin will:

a) not break, cut or damage any fence constructed on or around the pastoral property without first consulting the Landowner;

b) consult with the Landowner in relation to any fence which is broken, cut or damaged; and

c) either repair the fence to the same condition as it was in immediately prior to being broken, cut or damaged, or, at the Landowner's discretion, install a gate to a standard reasonably acceptable to the Landowner.

15. Fire

a) Origin will ensure that Origin’s Personnel take all reasonable precautions to reduce fire risk on the Pastoral Property, adhere to any fire bans and carry fire preventative equipment at all times in accordance with the laws and terms of any approvals, including Origins health and safety plans and emergency response procedures.

b) Origin understands that any fire breaks on the Pastoral Property are an important part of fire prevention and protection and will use reasonable endeavours not to disturb them.

16. Rubbish

Origin will manage garbage, hydrocarbons, waste and refuse in accordance with the terms of the Law and Approvals and is to place any such items in suitable receptacles and remove them from the Pastoral Property each day or as soon as practicable.

17. Abandoned Water Boreholes

a) Origin will consult with the Landowner as to whether water boreholes will be plugged and abandoned or whether the Landowner will seek to use them once they are no longer required by Origin. During this consultation, Origin must notify the Landowner if it is aware of contamination within the bore (for example Uranium). If the Landowner confirms it wishes to use the water bore then:

   i) the water bore will become the property of the Landowner on the expiration of the agreement to which this Code of Conduct is attached or at a sooner date agreed between the parties (**Date of Transfer** ; and

   ii) the Landowner agrees:

      A) to take the water bore and any related equipment in the condition it is in as at the date of transfer; and

      B) to release and indemnify Origin, and hold Origin harmless, from and against any and all claims, costs, losses, penalties, damages, expenses or liabilities incurred by Origin arising out of, or in connection with, the water bore and equipment on or after the date of transfer.

b) If the Landowner does not wish to use the water bore Origin will leave any such water bore capped and in a safe condition according to regulatory requirements.

18. Gates

Unless otherwise requested by the Landowner, Origin will leave all gates as found, whether open or shut.

19. Timber

Origin will not fell trees taller than two metres, strip bark or cut timber without the consent of the Landowner and in accordance with any applicable Law.

20. Identification of Plant and Equipment

Origin will ensure that all plant, equipment and vehicles of any kind which enter the Pastoral Property are clearly identified as being associated with Origin (which may include identification of a Petroleum Contractor).

21. Testing and Sampling Results

At the request of the Landowner, Origin will provide to the Landowner a list of all studies and types of sampling and tests carried out or obtained by Origin in respect to:

a) soil, rocks and surface outcrops;

b) native flora or fauna; or

c) any other feature of the environment (excluding petroleum).

provided such disclosure does not breach confidentiality obligations to third parties.

22. Location of Accommodation Camps

Origin will consult with the Landowner regarding the location of any accommodation camp prior to establishing such a camp and will locate the camp at a mutually agreed location.

23. Work Health and Safety

a) Origin will at all times:

i) ensure that the Activities are carried out in a safe manner;

ii) comply with the WHS Laws to the extent that the WHS Laws are applicable to Origin;

iii) comply with all work health and safety policies and procedures implemented or adopted by the Landowner and notified by the Landowner to Origin as being relevant to Origin's access to the Pastoral Property;

iv) comply with any reasonable instruction from the Landowner relating to work health and safety in respect of Origin's access or use of the Pastoral Property;

v) communicate any issue or concern that it has regarding work health and safety matters in relation to the Pastoral Property or the means of

entering and exiting the Pastoral Property, as soon as practicable, with the Landowner;

vi) if Origin becomes aware of:

A) any death of a person,

B) any serious injury or illness of a person; or

C) any dangerous incident,

that occurs within the Pastoral Property, whether in relation to the Activities or otherwise, it must immediately inform the Landowner; and

vii) maintain all insurances required by the WHS Laws.

b) Where there is any inconsistency or ambiguity between this clause and the WHS Laws, the WHS Laws will prevail.

Appendix F Civils Risk Assessment

Environmental Factor	Impact Description	Risk Source	Unmitigated Consqequence no controls or regulation in place	Codes of Practice	Site specific risk mitigation measures	Residual Risk Rating			Effectiveness of Treatment	Scientific uncertainty	Uncertainty Ranking
						Consequence	Likelihood	Risk Rating			
Groundwater	Contamination of aquifer from surface activities (Chemical and waste storage, handling and spills) impacting a receptor (Groundwater user)	•Storage, handling and transportation of chemicals, fuels and wastes	Moderate	A.4.7 Containment of Contaminants	**Source** All chemical, fuel and waste storage and handling areas to be bunded Licenced waste transporters to be used to transport listed wastes Chemicals to be transported and stored in accordance with the Australian Dangerous Goods Code and NT Dangerous Goods Act. **Pathway** Separation between chemical stores and closest aquifer over 70m, with interbedded clays likely to limit contaminant migration Spill management plan implemented. All transportation of listed wastes and Dangerous goods to be undertaken via licenced contractors. **Receptor** Separation between storage areas and closest aquifer over 70m	2	2	L	**Effective**	The regulatory regime legislating the storage, handling and transportation of dangerous goods and combustible liquids within Australia is mature. - Origin has extensive experience in transporting, storing and managing chemicals and fuels associated with unconventional petroleum drilling and stimulation activities. -EPA Study of Hydraulic Fracturing for oil and gas and its potential impact on drinking water resources (Us EPA 2016) -Scientific Inquiry into Hydraulic fracturing in the Northern Territory (2018) Final Report	Low
Surface Water	Contamination of surface water from surface activities	•Storage and handling of chemicals and fuel	Moderate	A.4.7 containment of contaminants	**Source** All areas where chemicals and fuels are stored will have secondary containment. Weekly inspections will be implemented and spills rectified as soon as practicable. **Pathway** Spill management procedures implemented by contractor **Receptor** Area remote with closest receptor approximately 30km.	1	3	L	**Effective**	The regulatory regime legislating the storage, handling and transportation of dangerous goods and combustible liquids within Australia is mature. - Origin has extensive experience in transporting, storing and managing chemicals and fuels associated with unconventional petroleum drilling and stimulation activities. -EPA Study of Hydraulic Fracturing for oil and gas and its potential impact on drinking water resources (Us EPA 2016) -Scientific Inquiry into Hydraulic fracturing in the Northern Territory (2018) Final Report	Low
		Release of stormwater from activities to surface water	Moderate	A.4.1 Site selection and planning A.4.3 Erosion and sediment control and hydrology	**Source** Erosion and sediment control plan Lease pad located away from watercourses or regional flow paths Contaminated stormwater to be retained onsite, treated and disposed offsite at a licenced disposal facility. Stockpiled debris to be used to discourage water concentration **Pathway** lease pad to be earthen bunded Erosion and sediment control plan implemented. **Receptor** Area remote with closest watercourse approximately 45km.	1	3	L	**Effective**	The understanding of the risks associated with the release of stormwater from construction sites is mature, with international standards providing guidance to manage the risk. -The NT has a range of technical guidance notes covering soil management, erosion and sediment control. this includes the NT Land Clearing Guidelines	Low
		-erosion and sediment releases from lease pads and access tracks	Serious	A.4.1 Site selection and planning A.4.3 Erosion and sediment control and hydrology	**Source** Erosion and sediment control plan Lease pad located away from watercourses or regional flow paths Land clearing to be undertaken in accordance with the NT Land clearing Guidelines. No clearing of vegetation in watercourses proposed. **Pathway** Erosion and sediment control plan implemented. Receptor Lease pad located away from watercourses. Area remote with closest watercourse approximately 45km.	1	3	L	**Effective**	The understanding of the risks associated with the release of stormwater from construction sites is mature, with international standards providing guidance to manage the risk. -The NT has a range of technical guidance notes covering soil management, erosion and sediment control. this includes the NT Land Clearing Guidelines	Low
Surface Water	Changes in surface water hydrology resulting vegetation dieback from ponding and diversions away from natural surface systems with environmental and cultural value	infrastructure located on regional flow path resulting in changes to surface water flow	Serious	A.4.1 Site selection and planning A.4.3 Erosion and sediment control and hydrology	**Source** Erosion and sediment control plan Lease pad located away from watercourses or regional flow paths Land clearing to be undertaken in accordance with the NT Land clearing Guidelines. No clearing of vegetation in watercourses proposed. Lease pads to be designed to divert stormwater around, without impeding natural surface water flows. Stockpiled debris to be used to discourage water concentration **Pathway** lease pads to be designed to reduce impact on overland flows. **Receptor** Area remote with closest watercourse approximately 45km. The lease area is flat, with water to be diverted around the perimeter of the site.	1	2	L	**Effective**	Well understand risk with management strategies within the NT Land clearing Guidelines.	Low

Environmental Factor	Impact Description	Risk Source	Unmitigated Consqequence no controls or regulation in place	Codes of Practice	Site specific risk mitigation measures	Residual Risk Rating			Effectiveness of Treatment	Scientific uncertainty	Uncertainty Ranking
						Consequence	Likelihood	Risk Rating			
Water usage	Unsustainable groundwater extraction impacts landholders and groundwater dependent ecosystems	Over extraction of groundwater for civils,	Serious	B.4.17 Groundwater monitoring	**Source** Groundwater extraction for activities to be restricted to the minimum water required. Exploration well located ~17km from closest extraction point. All water take licenced in accordance with NT Water Act. **Pathway** Drawdown from activity and other users assessed, with impacts to closest receptor determined. **Receptor** Closest receptor ~17km from extraction point.	3	1	L	**Effective**	-US EPA Study of Hydraulic Fracturing for oil and gas and its potential impact on drinking water resources (Us EPA 2016) -Scientific Inquiry into Hydraulic fracturing in the Northern Territory (2018) Final Report	Low
Soil	Loss in long term soil productivity and viability	Soil compaction from access tracks and leases	Moderate	A.4.1 Site selection and planning	**Source** Land clearing undertaken in accordance with NT Land clearing Guidelines. Land condition assessment completed Lease pads to be stripped of topsoil. Areas to be rehabilitated to reduce impacts associated with compaction. **Pathway** Areas to be rehabilitated to reduce impacts associated with compaction. **Receptor** Disturbance area is small, less than 0.005% of total tenure area	2	1	L	**Effective**	Well understand risk with management strategies within the NT Land clearing Guidelines.	Low
		Soil erosion from cleared areas (access tracks, lease pads and camp pads)	Serious	A.4.3 Erosion and sediment control and hydrology	**Source** Land clearing undertaken in accordance with NT Land clearing Guidelines. Land condition assessment completed Lease pads to be stripped of topsoil. Areas to be rehabilitated to reduce impacts associated with compaction. Erosion and sediment control plan implemented. Stockpiled debris to be used to discourage water concentration **Pathway** Areas to be rehabilitated to reduce impacts associated with compaction. **Receptor** Disturbance area is small, less than 0.005% of total tenure area	1	4	M	**Effective**	The understanding of the risks associated with the release of stormwater from construction sites is mature, with international standards providing guidance to manage the risk. -The NT has a range of technical guidance notes covering soil management, erosion and sediment control. this includes the NT Land Clearing Guidelines	Low
		• Disturbance of creek and stream banks.	Minor	A.4.1 Site selection and planning A.4.4 biodiversity Protection	Clearing is not proposed for any creeks or watercourses	1	1	L	**Effective**	Well understand risk with management strategies within the NT Land clearing Guidelines.	Low
			Moderate	A.4.7 containment of contaminants	**Source** all chemicals to have secondary containment **Pathway** Spill management plan implemented. lease pad compacted and earthen bunded preventing offsite release of wastewater and chemical All wastes stored and handled in accordance with NT Waste management and Pollution Control Act **Receptor** Spill management procedures to be implemented by contractors Weekly inspections of secondary containment with spills rectified as soon as practicable. All wastes stored and handled in accordance with NT Waste management and Pollution Control Act	1	3	L	**Effective**	Origin has extensive experience in transporting, storing and managing drilling and stimulation chemicals (including flowback) associated with and unconventional petroleum wells across Australia -US EPA Study of Hydraulic Fracturing for oil and gas and its potential impact on drinking water resources (Us EPA 2016) -Scientific Inquiry into Hydraulic fracturing in the Northern Territory (2018) Final Report Beetaloo Sub-basin -CSIRO regional baseline monitoring program- -Control and impact monitoring bores as per Preliminary guidelines: Groundwater Monitoring bores for Exploration Petroleum Wells in the Beetaloo Sub-basin	Low
			Moderate	A.4.7 containment of contaminants	**Source** Spill management plan All wastes to be transported in accordance with the NT Waste Management and Pollution Control act All Dangerous Goods to be transported in accordance with the NT Dangerous Goods Act and Australian Dangerous goods Code. **Pathway** Spill management plan implemented. **Receptor** Area remote with major urban centres to be avoided.	3	1	L	**Effective**	The regulatory regime legislating the storage, handling and transportation of controlled wastes in the NT and Australia is mature. - Origin has extensive experience in drilling and stimulating unconventional petroleum wells across Australia -EPA Study of Hydraulic Fracturing for oil and gas and its potential impact on drinking water resources (Us EPA 2016) -Scientific Inquiry into Hydraulic fracturing in the Northern Territory (2018) Final Report	Low
	Soil contamination form the disposal of greywater and sewerage from camp activates.	Greywater and sewerage disposal (camps)	Moderate	A.4.1 Site Selection	**Source** All sewerage to be removed offsite in accordance with the NT Waste Management and Pollution Control Act or irrigated as per the NT Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974 **Pathway** irrigation areas to be sized in accordance with the anticipated irrigation volume and quality. **Receptor** Land condition Assessment.	1	2	L	**Effective**	Risks associated with sewerage and greywater disposal are well known, with technical guidance notes for system design available within the NT.	Low

Environmental Factor	Impact Description	Risk Source	Unmitigated Consqequence no controls or regulation in place	Codes of Practice	Site specific risk mitigation measures	Residual Risk Rating			Effectiveness of Treatment	Scientific uncertainty	Uncertainty Ranking
						Consequence	Likelihood	Risk Rating			
Terrestrial Flora and Fauna	• Disturbance to environmentally sensitive areas and/or high valued habitat areas	• Clearing of high valued conservation areas or habitat for infrastructure	Serious	A.4.1 Site selection and planning A.4.4 Biodiversity protection	**Source** Site location avoids areas of high conservation value as a priority. Field ecology scouting undertaken as a part of a land condition assessment to prevent impacts to high conservation value areas. Areas are not considered high conservation value, are not threatened/ endangered, with impacts unlikely to result in fragmentation. Clearing area minimised to minimum area required to safely undertake activity. **Pathway** Land clearing conducted in accordance with NT Land Clearing Guidelines **Receptor** Land condition assessment confirms the proposed area is regionally abundant and not of high conservation value.	2	2	L	**Effective**	Multiple field ecological scouts have been undertaken by AECOM since 2005 Field ecological scouts completed by AECOM in 2018. NR vegetation Maps	Low
		Activity (vehicle and machinery) noise and lighting on well pads and access tracks	Moderate	A.4.1 Site selection and planning A.4.2 Noise	**Source** Site location avoids areas of high conservation value as a priority. Field ecology scouting undertaken as a part of a land condition assessment to prevent impacts to high conservation value areas. Areas are not considered high conservation value, are not threatened/ endangered, with impacts unlikely to result in significant disturbance to threatened/ endangered species. **Pathway** Land clearing conducted in accordance with NT Land Clearing Guidelines **Receptor** Land condition assessment confirms the proposed area is regionally abundant and not of high conservation value.	1	3	L	**Effective**	Risks associated with noise on fauna are well understood.	Low
		introduction and spread of weeds in the area	Major	A.4.5 Weed management	**Source** Weed management plan to be approved by DENR and implemented. Earthmoving equipment to be sourced from NT. The use of earth moving equipment from outside of the not anticipated All equipment and vehicles to be washed down and to have a biosecurity declaration certificate prior to access to site. Areas of proposed exploration have been surveyed and are deemed to have low weed abundance. **Pathway** Equipment to be wash-down and certified. Origin assurance activities to target equipment wash-down certificates to ensure standards are being met. **Receptor** Area is free of weeds and monitoring will be implemented around infrastructure to detect the spread/ introduction of weed species.	2	4	M	**Effective**	Risks associated with weeds are well studied within literature and by the NT DENR Field weed surveys completed prior to and after construction activities.	Low
		Fragmentation of habitat	Moderate	A.4.1 Site selection and planning A.4.4 Biodiversity protection	**Source** Site location avoids areas of high conservation value as a priority. Field ecology scouting undertaken as a part of a land condition assessment to prevent impacts to high conservation value areas. Areas are not considered high conservation value, are not threatened/ endangered, regionally extensive and impacts are unlikely to result in fragmentation. **Pathway** Land clearing conducted in accordance with NT Land Clearing Guidelines **Receptor** Land condition assessment confirms the proposed area is regionally extensive and not of high conservation value. Land clearing pressures form other industries not significant in the area.	2	1	L	**Effective**	The risks associated with habitat fragmentation are well covered in literature. -NT DENR vegetation maps -Field ecological surveys completed across the tenure since 2005; including the subject area.	Low
		Accidental ignition of fire from civil activties	Major	A 4.6 fire management	**Source** Bushfire management plan implemented Bushfire awareness included in site inductions Designated smoking areas onsite. Fire fighting equipment to be available to deal with fires. Fire breaks to be implemented around lease and camp pads Appropriate separation distances between future flares and surrounding vegetation. **Pathway** Fire breaks to be implemented around lease and camp pads **Receptor** Activities will comply with landholder and regional bushfire management plans Area in the vicinity of Kyalla 117 N2 lease has had recent fire activity- reducing the fuel load.	3	3	M	**Effective**	Risks associated with Bushfire well known, with numerous literature and NT Government management plans and technical guidance notes.	Low

Environmental Factor	Impact Description	Risk Source	Unmitigated Consqequence no controls or regulation in place	Codes of Practice	Site specific risk mitigation measures	Residual Risk Rating			Effectiveness of Treatment	Scientific uncertainty	Uncertainty Ranking
						Consequence	Likelihood	Risk Rating			
		Poor rehabilitation	Moderate	A.4.8 rehabilitation	A site specific rehabilitation plan will be developed prior to rehabilitation Plan will be developed in consultation with leaseholder and DENR Rehabilitation success criteria developed with ongoing monitoring undertaken to measure success. Maintenance undertaken periodically to fix defects.	2	2	L	Effective	Risks associated with rehabilitation are well known Knowledge of rehabilitation within the beet aloo Basin has been gained based on previous seismic line rehabilitation programs.	Low
	•impacts (direct and indirect) to flora and fauna species, including the loss of threatened or endangered species	• Clearing habitat for infrastructure	Serious	A.4.1 Site selection and planning A.4.4 Biodiversity protection	**Source** Site location avoids areas where threatened flora and fauna are predicted. Cleared areas to be clearly marked to avoid confusion. Field ecology scouting undertaken as a part of a land condition assessment to identify protected flora and fauna Significant disturbance to threatened/ endangered flor and fauna species is not anticipated.. Clearing area minimised to minimum area required to safely undertake activity. **Pathway** Land clearing conducted in accordance with NT Land Clearing Guidelines **Receptor** Land condition assessment confirms the proposed area is regionally abundant and not of high conservation value.	2	2	L	Effective	Multiple field ecological scouts have been undertaken by AECOM since 2005 Field ecological scouts completed by AECOM in 2018. NR vegetation Maps	Low
		• Trapping and drowning of fauna in storage tanks and sumps	Minor	C.5.1 Drilling Materials	**Source** Tanks walls are raised with minimal risk of animals accessing tanks Site manned during operation **Pathway** Lease pads fenced to prevent stock and wildlife access. **Receptor** Lease pads fenced to prevent stock and wildlife access.	2	2	L	Effective	Risks associated with potentially trapping and drowning fauna in storage tanks and sumps are well understood. Origin has extensive experience in managing sumps, ponds and tanks to prevent fauna ingress.	Low
		• Contaminants in water and soil pass through the food chain and bio accumulate in fauna	Minor	A.4.7 containment of contaminants c.5.2 Management of produced water from petroleum wells C.8.2 Spill management plan	**Source** Wastewater management plan Spill management plan Chemical risk assessments- with no chemicals considered above low concern earthen bunding to prevent offsite release of wastewater and chemicals **Pathway** Spill management plan implemented. Lease pads fenced. lease pad bunded preventing offsite release of chemicals **Receptor** Bunding to minimise the risk of offsite release of fluid in the event of a tank or storage failure. .	1	1	L	Effective	A chemical risk assessment and flowback characterisation program for the Amungee Nw 1 well ensure all potential chemicals that are persistent, bio accumulative and toxic are identified and appropriate management strategies implemented. The risks associated with fauna ingestion of chemicals is well known and measure to prevent ingestion (such as fences and separation distances to activity) are deployed as standard practice. Origin has extensive operational experience in drilling and stimulating 1000's of conventional and unconventional petroleum wells with no evidence of impacts on biota from chemicals.	Low
		• Vehicle collisions with fauna – fauna mortality	Minor	A.4.4 Biodiversity protection	**Source** vehicle speed limits to be reduced around areas of high risk of fauna collision Vehicle movements to avoid driving at night. **Pathway** vehicle speed limits to be reduced around areas of high risk of fauna collision **Receptor** vehicle speed limits to be reduced around areas of high risk of fauna collision	1	3	L	Effective	Risks associated with fauna collisions are well known.	Low
		• Activity noise and lighting on well pads and access tracks disturbs fauna	Minor	A.4.1 Site selection and planning A.4.2 noise	**Source** Site location avoids areas of high conservation value as a priority. Activtiy to occur druing 6am-7pm- no lighting required. field ecology scouting undertaken as a part of a land condition assessment to prevent impacts to high conservation value areas. Areas are not considered high conservation value, are not threatened/ endangered, with impacts unlikely to result in fragmentation. **Pathway** Land clearing conducted in accordance with NT Land Clearing Guidelines Lighting levels minimised to the level required to complete work safely. **Receptor** Land condition assessment confirms the proposed area is regionally abundant and not of high conservation value.	1	3	L	Effective	Risks associated with noise and light impacts on flora and fauna are covered extensively in literature.	Low

Environmental Factor	Impact Description	Risk Source	Unmitigated Consqequence no controls or regulation in place	Codes of Practice	Site specific risk mitigation measures	Residual Risk Rating			Effectiveness of Treatment	Scientific uncertainty	Uncertainty Ranking
						Consequence	Likelihood	Risk Rating			
		•Encouragement of feral animals and other pest species increases competition with native species	Minor	A.4.4 Biodiversity protection	**Source** Camp wastes to be stored in a manner that to prevent attracting feral animals All food scraps to be removed from site and disposed of at a licenced facility. **Pathway** Camps to be fenced. **Receptor** Camps to be fenced	1	3	L	**Effective**	The risks associated with encouraging feral animals with inadequate waste management is well understood within literature and government policy.	Low
		introduction and spread of weeds in the area	Major	A.4.5 Weed management	**Source** Weed management plan to be approved by DENR and implemented. Earthmoving equipment to be sourced from NT. The use of earth moving equipment from outside of the not anticipated All equipment and vehicles to be washed down and to have a biosecurity declaration certificate prior to access to site. Areas of proposed exploration have been surveyed and are deemed to have low weed abundance. **Pathway** Equipment to be wash-down and certified. Origin assurance activities to target equipment wash-down certificates to ensure standards are being met. **Receptor** Area is free of weeds and monitoring will be implemented around infrastructure to detect the spread/ introduction of weed species.	2	4	M	**Effective**	Risks associated with weeds are well studied within literature and by the NT DENR Field weed surveys completed prior to and after construction activities.	Low
		fragmentation of habitat	Moderate	A.4.1 Site selection and planning A.4.4 Biodiversity protection	**Source** Site location avoids areas of high conservation value as a priority. Cleared areas to be clearly marked to avoid confusion. Field ecology scouting undertaken as a part of a land condition assessment to prevent impacts to high conservation value areas. Areas are not considered high conservation value, are not threatened/ endangered, regionally extensive and impacts are unlikely to result in fragmentation. **Pathway** Land clearing conducted in accordance with NT Land Clearing Guidelines **Receptor** Land condition assessment confirms the proposed area is regionally extensive and not of high conservation value. Land clearing pressures form other industries not significant in the area.	1	1	L	**Effective**	The risks associated with habitat fragmentation are well covered in literature. -NT DENR vegetation maps -Field ecological surveys completed across the tenure since 2005; including the subject area.	Low
		Poor rehabilitation reduces habitat quality	Serious	A.4.8 rehabilitation	**A** site specific rehabilitation plan will be developed prior to rehabilitation Plan will be developed in consultation with leaseholder and DENR Rehabilitation success criteria developed with ongoing monitoring undertaken to measure success. Maintenance undertaken periodically to fix defects.	2	2	L	**Effective**	The risks associated with habitat fragmentation are well covered in literature. -NT DENR vegetation maps -Field ecological surveys completed across the tenure since 2005; including the subject area.	Low
		Accidental ignition of fire from civil activities	Major	A 4.6 fire management	**Source** Bushfire management plan implemented Bushfire awareness included in site inductions Designated smoking areas onsite. Fire fighting equipment to be available to deal with fires. Fire breaks to be implemented around lease and camp pads Appropriate separation distances between flares and surrounding vegetation. **Pathway** Fire breaks to be implemented around lease and camp pads **Receptor** Activities will comply with landholder and regional bushfire management plans Area in the vicinity of Kyalla 117 N2 lease has had recent fire activity- reducing the fuel load.	3	3	M	**Effective**	Risks associated with Bushfire well known, with numerous literature and NT Government management plans and technical guidance notes.	Low
Cultural Heritage and Sacred Sites	Disturbance of sacred site or culturally sensitive area	• Sites disturbed directly by access track construction or drilling operations	Serious	A.4.1 Site selection and planning	**Source** All areas of the proposed activity to be cleared by NLC AAPA certificates for proposed work program granted prior to commencement. The location of infrastructure has considered proximity to sacred sites. **Pathway** Areas of cultural heritage to be avoided during construction **Receptor** Areas of cultural significance not within 14km of proposed area of activity.	3	1	L	**Effective**	All sites of the proposed activity must have Traditional Owner clearance via the NLC AAPA certificates are required for all activities. Restricted work areas are identified	Low

Environmental Factor	Impact Description	Risk Source	Unmitigated Consqequence no controls or regulation in place	Codes of Practice	Site specific risk mitigation measures	Residual Risk Rating			Effectiveness of Treatment	Scientific uncertainty	Uncertainty Ranking
						Consequence	Likelihood	Risk Rating			
		• Accidental ignition by site activities (civil works, drilling, grinding) or site personnel	Major	A 4.6 fire management	**Source** Bushfire management plan implemented Bushfire awareness included in site inductions Designated smoking areas onsite. Fire fighting equipment to be available to deal with fires. Fire breaks to be implemented around lease and camp pads Appropriate separation distances between flares and surrounding vegetation. **Pathway** Fire breaks to be implemented around lease and camp pads **Receptor** Activities will comply with landholder and regional bushfire management plans Area in the vicinity of Kyalla 117 N2 lease has had recent fire activity- reducing the fuel load.	3	3	M	**Effective**	risks associated with Bushfire well known, with numerous literature and NT Government management plans and technical guidance notes.	Low
		Personnel unauthorised access to restricted work area	Serious	A.4.1 Site selection and planning	**Source** Restricted work areas not located in close proximity to explorational activities All staff to be inducted covering restricted work areas and cultural heritage. Access off lease not permitted. **Pathway** Access off lease not permitted. **Receptor** **Access off lease not permitted.** No restricted work areas within xxkms of proposed activity.	2	1	L	**Effective**	All sites of the proposed activity must have Traditional Owner clearance via the NLC AAPA certificates are required for all activities. Restricted work areas are identified	Low
Community impact	• Loss of visual amenity- landholder and tourists	industrialisation of landscape	Moderate	A.4.1 Site selection and planning A.4.1.1 Well pad specific site selection	Site located away from major roads and not visible Level of clearing for infrastructure small	1	1	L	**Effective**	Risks associated with aesthetic changes due to infrastructure construction are well known and not restricted to the petroleum industry.	Low
		increased traffic	Moderate	A.4.1 Site selection and planning	Traffic management plan to be approved by DPIL Traffic impacts are expected to small and temporary Access route away from the main homestead	2	1	L	**Effective**	Risks associated with increased traffic are well know throughout literature and policy	Low
		Light emissions activities	minor	A.4.1 Site selection and planning	Site located 20km away from the Stuart Highway and nearest homestead- activity is not anticipated to be visible	1	1	L	**Effective**	risks associated with light emission well known with various literature and technical guidelines available to mitigate impacts.	Low
		noise emissions from activities	Minor	A.4.1 Site selection and planning A.4.2 Noise	Site located 20km away from the Stuart Highway and nearest homestead- activity is not anticipated to be visible	1	1	L	**Effective**	risks associated with noise emission well known with various literature and NT noise guidelines available to mitigate impacts.	Low
	Reduction in agriculture productivity	introduction and spread of weeds	Major	A.4.5 Weed management	**Source** Weed management plan to be approved by DENR and implemented. Earthmoving equipment to be sourced from NT. The use of earth moving equipment from outside of the not anticipated All equipment and vehicles to be washed down and to have a biosecurity declaration certificate prior to access to site. Areas of proposed exploration have been surveyed and are deemed to have low weed abundance. **Pathway** Equipment to be wash-down and certified. Origin assurance activities to target equipment wash-down certificates to ensure standards are being met. **Receptor** Area is free of weeds and monitoring will be implemented around infrastructure to detect the spread/ introduction of weed species.	2	3	M	**Effective**	Risks associated with weeds are well studied within literature and by the NT DENR Field weed surveys completed prior to and after construction activities.	Low
		over extraction of groundwater water	Serious	A.4.1.1 well pad specific site selection requirements B.4.17 Groundwater monitoring	**Source** Groundwater extraction for activities to be restricted to the minimum water required. Exploration well located ~17km from closest extraction point. All water take licenced in accordance with NT Water Act. **Pathway** Drawdown from activity and other users assessed, with impacts to closest receptor determined. **Receptor** Closest receptor ~17km from extraction point.	1	1	L	**Effective**	The regional understanding of the CLA is sufficient to understand the risks associated with groundwater extraction. The absence of users and small exploration take reduces the uncertainty of the activity	Low

Environmental Factor	Impact Description	Risk Source	Unmitigated Consqequence no controls or regulation in place	Codes of Practice	Site specific risk mitigation measures	Residual Risk Rating			Effectiveness of Treatment	Scientific uncertainty	Uncertainty Ranking
						Consequence	Likelihood	Risk Rating			
		impact to surface hydrology reduces water capture	Serious	A.4.3 Erosion and sediment control and hydrology A.4.1 Site selection and planning	**Source** Lease pads located away form major watercourses or flow paths Lease pads designed to not disrupt flow paths, with overland flow diverted around lease Infrastructure design in accordance with the NT Land Clearing Guidelines Erosion and sediment Control Plan implemented. **Pathway** **Receptor**	1	1	L	**Effective**	The risks associated with changes in surface hydrology are well known. Guidance notes are available via the NT1 Land Clearing guidelines and BPESC to minimise the impact on surface hydrology.	Low
		Bushfire from accidental ignition by site activities or personnel	Major	A 4.6 fire management	**Source** Bushfire management plan implemented Bushfire awareness included in site inductions Designated smoking areas onsite. Fire fighting equipment to be available to deal with fires. Fire breaks to be implemented around lease and camp pads Appropriate separation distances between flares and surrounding vegetation. **Pathway** Fire breaks to be implemented around lease and camp pads **Receptor** Activities will comply with landholder and regional bushfire management plans Area in the vicinity of Kyalla 117 N2 lease has had recent fire activity- reducing the fuel load.	3	3	M	**Effective**	risks associated with Bushfire well known, with numerous literature and NT Government management plans and technical guidance notes.	Low
		Poor rehabilitation of exploration infrastructure	Serious	A.4.8 rehabilitation	**A** site specific rehabilitation plan will be developed prior to rehabilitation Plan will be developed in consultation with leaseholder and DENR Rehabilitation success criteria developed with ongoing monitoring undertaken to measure success. Maintenance undertaken periodically to fix defects.	2	2	L	**Effective**	Risks associated with rehabilitation are well known Knowledge of rehabilitation within the beet aloo Basin has been gained based on previous seismic line rehabilitation programs.	Low
		disruption of agricultural operations	Moderate	A.4.1 Site selection and planning A.4.2 Noise	All activities require engagement and consent by leaseholders Lease sites located to avoid disruption to agriculture operations and infrastructure Engagement undertaken in accordance with NT Petroleum Act	1	1	L	**Effective**	Origin has extensive experience in co-existing with agricultural users. Consultation with pastoralists is undertaken to ensure impacts on their activities are mitigated.	Low
	Labour competition with local businesses and agricultural procedures	Exploration activities compete with agricultural industry for resources	Minor		Proposed activity is temporary with no major labour requirements Local contractors for existing communities used where available Contracts structure to reduce boom and bust cycle (clear understanding of limited scope of work) All work to be short term with predominantly skilled workforce sourced regionally/interstate	1	1	L	**Effective**	Risks associated with small scale, limited duration projects on local economies are well known. The short nature of the projects reduces the risks of boom and bust type cycles.	Low
Air Quality	Reduction in air quality associated with exploration emissions (civil, Drilling, Stimulating and Well Testing)	Emissions from the combustion of diesel	Minor	A.4.1 Site selection and planning D.5.1 Baseline assessment	**Source** Low emission equipment to be selected All equipment to be maintained in accordance with the manufacturers recommendations. **Pathway** Site located away from receptors. **Receptor** No sensitive receptors within 20km	1	1	L	**Effective**	Risks associated with diesel combustion are well known both within Australia and Internationally. Methods for estimating emissions are available via the National Pollution Inventory	Low
	Increased nuisance dust emissions associated with exploration activities	• Civil construction works	Minor	A.4.1 Site selection and planning	**Source** Water trucks used to decrease dust emissions Reduced speed limits in proximity to homesteads **Pathway** Site located away from receptors. **Receptor** No sensitive receptors within 20km	1	2	L	**Effective**	Origin has extensive experience in managing nuisance emissions of dust during petroleum and construction activities. Strategies for managing dust emissions are well known throughout Australia and the NT.	Low

Environmental Factor	Impact Description	Risk Source	Unmitigated Consqequence no controls or regulation in place	Codes of Practice	Site specific risk mitigation measures	Residual Risk Rating			Effectiveness of Treatment	Scientific uncertainty	Uncertainty Ranking
						Consequence	Likelihood	Risk Rating			
		Bushfire from accidental ignition by site activities or personnel	Serious	A 4.6 fire management	**Source** Bushfire management plan implemented Bushfire awareness included in site inductions Designated smoking areas onsite. Fire fighting equipment to be available to deal with fires. Fire breaks to be implemented around lease and camp pads Appropriate separation distances between flares and surrounding vegetation. **Pathway** Fire breaks to be implemented around lease and camp pads **Receptor** Activities will comply with landholder and regional bushfire management plans Area in the vicinity of Kyalla 117 N2 lease has had recent fire activity- reducing the fuel load.	2	3	M	**Effective**	risks associated with Bushfire well known, with numerous literature and NT Government management plans and technical guidance notes.	Low
Greenhouse Gas Emissions	Unsustainable Greenhouse Gas emissions from the activity	Combustion of diesel for exploration activities	Minor	A.4.1 Site selection and planning	**Source** Low emission equipment to be selected All equipment to be maintained in accordance with the manufacturers recommendations. **Pathway** Site located away from receptors. **Receptor** No sensitive receptors within 20km	1	1	L	**Effective**	The risks associated with greenhouse gas generation through diesel combustion are well documented in literature and domestic/ international greenhouse policy (Such as NGERS and IPCC)	Low
		• Clearing of native vegetation	Serious	A.4.1 Site selection and planning A.4.4 Biodiversity Protection	**Source** Clearing requirements small Site location avoids areas where threatened flora and fauna are predicted.. Field ecology scouting undertaken as a part of a land condition assessment to identify protected flora and fauna Significant disturbance to threatened/ endangered flor and fauna species is not anticipated.. Clearing area minimised to minimum area required to safely undertake activity. Material stockpiled surrouding lease and not burnt **Pathway** Land clearing conducted in accordance with NT Land Clearing Guidelines **Receptor** Land condition assessment confirms the proposed area is regionally abundant and not of high conservation value.	1	1	L	**Effective**	Understanding of GHG emissions from land clearing well documented within literature. Emission estimates using the Transport Authorities Greenhouse Group *Greenhouse Gas Assessment Workbook for Road Projects*	Low
All	Cumulative impacts on groundwater quantify	Groundwater take for civil activities and surrounding land users exceeds the natural recharge rate of the basin	Serious	Water extraction licences under the NT Water Act	Groundwater extraction assessments include an estimate of current extraction levels at a regional scale. No intensive users of groundwater within the region; stock and domestic the major usage. Cumulative impacts consider in Water extraction licence under the NT1 Water Act	2	1	L	**Effective**	The regional understanding of the CLA is sufficient to understand the risks associated with groundwater extraction. The absence of users and small exploration take reduces the uncertainty of the activity	Low
	Cumulative impacts on terrestrial ecology	Clearing for civil related works and existing agricultural activities results in impacts to vegetation communities, fragmentation and poses threat to protected flora and fauna	Serious	A.4.1 Site selection and planning A.4.1.1 Well pad specific site selection A.4.4 biodiversity Protection	Area has limited development with no widespread land clearing pressures from agriculture or other users. Activity is limited in scale and will not material decrease availability of habitat across the region.	2	1	L	**Effective**	The region has low land clearing pressure with no applications for large scale land clearing present. The level of disturbance proposed is small, with field ecological scouting confirming ecological communities present.	Low
	Cumulative impacts on amenity	Civil activities further reduces amenity (visual, noise, traffic and lighting) through additional landscape modification, dust, noise, light and traffic.	Moderate	A.4.1 Site selection and planning A.4.1.1 Well pad specific site selection	Activity is located away from major transportation routes and is not visible from roads. Traffic volumes are anticipated to be small and well below existing industries. A traffic management plan has been submitted to DPIL for approval Low level of development activity within the region, with activity unlikely to cause declines in amenity.	1	1	L	**Effective**	The region is underdeveloped with the activity located away from major transportation routes, homesteads and communities. The activity is of a small size and unlikely to result in any loss of amenity.	Low
	Cumulative impacts on surface water quality	Civil activities in addition to existing surrounding land use (agriculture) reduces surface water quality	Moderate	A.4.1 Site selection and planning A.4.1.1 Well pad specific site selection A.4.3 Erosion and sediment control and hydrology	Area has limited development with no widespread land clearing pressures from agriculture or other users. Activity will largely occur on existing disturbed areas with limited additional clearing.	1	1	L	**Effective**	The region is underdeveloped with the activity located away from major flow pathways with limited topographic variation.. The activity is of a small size and unlikely to result in any material increase in sediment loads to surface waters	Low

Appendix G Environmental Commitment Register

Aspect	Commitment	implementation	Responsibility
Air Emissions	- All equipment and machinery to be in good working order and maintained regularly to minimise vehicle exhaust emissions	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	Contractor
Biodiversity	Leases to be fenced to prevent stock and fauna ingress	1. requirement built into civil scope	Civil Construction Superintendent
Biodiversity	Domestic pets and firearms prohibited.	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	Contractor/ Civil Construction Superintendent
Biodiversity	Driving at dawn and dusk to be minimised	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	Contractor/ Civil Construction Superintendent
Bushfires	A bushfire management plan (NT-2050-15-MP033) must be implemented in accordance with the CoP including: -complying with fire bans fitting fire extinguishers to vehicles and equipment -having access to fire fighting equipment during civil works having an Emergency response plan with contingencies covering fire. -using appropriate firebreaks in accordance with the NT Bushfire management Act and NT1	1. Origin to prepare overarching Bushfire management plan 2. Each contractors to adopt BMP and activity in EMP and operating procedures. 3. Origin to approve EMP and implement assurance activities to ensure compliance	

Aspect	Commitment	implementation	Responsibility
	Land Clearing Guidelines Monitoring bushfires during field campaigns		
Chemicals	-Dangerous goods (chemicals) will be stored, handled, separated and signed as required by the NT Dangerous goods Act and Flammable and Combustible Liquids Regulations and AS1940. -Hazardous goods will have secondary containment and stored in areas away from watercourses. - Refuelling of equipment will not occur within 100m of a water course -Spill kits will be made available where hazardous materials are used and personnel will be trained in correct use.	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	Contractor
Community	Fly camps will only be pursued where the travel time exceeds 2 hours return per day	Requirement built into contract and Origin EMP approval where camps required	Project Manager
Community	All activities to be undertaken in accordance with land access agreements.	1. Requirement built into work instructions issued to contractors-no work to commence without Land Access	Project Manager
Community	Use contractors that have high Indigenous participation in their workforce as much as reasonably practicable.	contractors selected with considerations of an indigenous participation, with specific requirement built into contracts	Project Manager

Aspect	Commitment	implementation	Responsibility
Complaint management	- Complaints shall be recorded in OCIS, investigated and responded to appropriately.	Complaints kept as per Origin's stakeholder management plan.	Project Manager
Cultural Heritage and Sacred Site	Cultural Heritage Clearance (and identification of sites of Aboriginal significance in conjunction with NLC) will be conducted prior to commencement of disturbance activities or operations in any area. AAPA certificates to be obtained prior to commencing activities. Origin will comply with conditions as prescribed by the NLC Agreement and AAPA certificates for the duration of the program.	1. Origin to coordinate NLC clearances and AAPA certificates. 2. Restricted Work Areas (RWA's) and other requirements to be included in site layout and activity design within EMP. 3. RWA's and other requirements to be cascaded to contractors via work Instructions 4. Contractors to include controls regarding RWA and other requirements in EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance during the activity.	Project Manager
Cultural Heritage and Sacred Site	An unexpected heritage finds stops related work activities within the vicinity of the find (within a 500 m radius) for assessment and direction by an NLC representative.	3. Unexpected cultural heritage finds to be included in work Instruction issued to contractors. 4. Contractors to include controls in EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance during the activity.	Contractor/ Civil Construction Superintendent
Cultural Heritage and Sacred Site	All staff and contractors are inducted and that inductions contain the following areas: - Code of Conduct prepared for social interactions with the community and host Traditional Owners -Waste management -Bushfire management -Spill management -Restricted work areas and AAPA activity constraints -Minimising nuisance (dust, noise and light) -Erosion and sediment control	1. Origin to develop Beetaloo general induction or direct the contractor to prepare an activity specific induction covering the environmental and cultural heritage requirements.	Contractor/ Civil Construction Superintendent

Aspect	Commitment	implementation	Responsibility
	-Land clearance requirements .		
Dust	Monitor road conditions to ensure deterioration with possible increase in dust creation, does not occur and undertake road rehabilitation as required.	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	Contractor
Dust	Reducing the speed of vehicles on dirt tracks around sensitive receptors such as homesteads, communities or environmentally sensitive areas	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	Contractor
Dust	- Watering of roads when appropriate and agreed with pastoralists.	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	Contractor
Erosion and Sediment Control	-Erosion and sediment control plan to be developed in accordance with the relevant guidelines such as the International Erosion Control Association best Practice for Erosion and Sediment Control: 1. Stormwater flow across the cleared site will be managed to minimise impacts from erosion and sedimentation. 2. Design all lease pads and access tracks adopting	1. Origin to develop project wide Erosion and sediment Control Plan (ESCP) NT-2050-15-MP030 2. Requirement for contractors to comply with ESCP built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance	Project manager/ Contractor

Aspect	Commitment	implementation	Responsibility
	appropriate controls 3. Avoid areas of overland flow 4. minimise erosion of exposed road surfaces within surface water flow paths through the use of bed level coursings and retention of native vegetation.	activities to ensure compliance.	
Incident Management	Emergency response systems will be in place.	1. Origin to prepare overarching Emergency Response Plan (ERP) NT-2050-15-MP024 2. Each contractors to adopt ERP and bridge to their specific ERP 3. Origin to approve contractor ERP and implement assurance activities to ensure compliance	Contractor/ Civil construction superintendent
Land Disturbance	When sighting infrastructure, comply with the following requirements: 1. Identify and avoid culturally sensitive areas and critical habitats through field scouting (ecological and cultural heritage) 2. Layout of the site and exact siting of infrastructure will be informed by the environmental sensitivities and mitigation measures identified in this EMP.1. 3.ensure that infrastructure located in proximity to a major public road or locations with a high amenity values that has minimised the long term visual amenity. 4.All exploration activities (wells, camps etc.) to be located away from sensitive receptors with lease layouts designed to minimise visual amenity impacts. 5. ,Identify and avoid culturally sensitive areas and critical habitats through field scouting 6. lease areas has considered the minimum	1. Desktop sighting of location to address constraints- includes pastoralist input. 2. Field surveying and final lease orientation of lease with ecologist and Origin construction superintendent to avoid habitat trees and areas of ecological significance- A buffer area around lease included to accommodate NLC changes 3. NLC site clearances undertaken and lease pad 2. Full exploration lease site pegged out with location of monitoring bore determined based on proximity to exploration well location 3. AAPA certificates and archaeological survey completed prior to construction	Project Manager

Aspect	Commitment	implementation	Responsibility
	offset distance of at least 1 km between groundwater extraction bores and pastoral water supply bores. 7. All petroleum infrastructure including, petroleum wells, must have a setback distance of at least 2km from a habitable dwelling, 8. considering impacts of noise and lighting on sensitive receptors. 9. All infrastructure to be pegged out to avoid confusion and limit illegal clearing		
Land Disturbance	Land clearing must; 1. be kept to a minimum 2.avoid areas of high conservation value 3. avoid large habitat trees 4. use spotter catchers (in high density vegetation) 5. avoid clearing and disturbing watercourses 6. comply with the NT1 Land Clearing Guidelines 7.minimise disturbing high risk soils 8. Be less than or equal to the approved 6.6Ha	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	Contractor/ Civil Construction Superintendent
Land Disturbance	Existing gravel borrow pits will be used	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	Contractor/ Civil Construction Superintendent
Land Disturbance	The tracks are designed to minimise their environmental footprint, with standards allowing only sufficient width to enable the safe ingress/egress of the rig and associated equipment, materials and service vehicles.	Tracks to be designed in accordance with	Civil engineer

Aspect	Commitment	implementation	Responsibility
Land Disturbance	Records of disturbed areas to be maintained within GIS	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance. 4. Data to be provided to Origin post disturbance 5. Origin to maintain database of disturbance.	Project Manager
Land Disturbance	Topsoil stripping of camp and lease pads to reduce risks to topsoil and facilitate rehabilitation.	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	Contractor/ Civil Construction Superintendent
Land Disturbance	No off lease driving- traffic to stick to approved lease	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	Contractor/ civil construction superintendent
Rehabilitation	As EMP must have a rehabilitation plan requiring the following: -Anticipated rehabilitation strategy -annual monitoring and maintenance requirements.	Rehabilitation plan built into EMP	HSE Representative
Rehabilitation	All significantly disturbed land not required for ongoing petroleum activities must be progressively rehabilitated within 12 months following the cessation of petroleum activities.	1. Rehabilitation plan built into EMP 2. Rehabilitation to be triggered by annual asset reviews.	Project Manager
Reporting	Vehicle collisions with fauna reported.	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP	Contractor/ Civil Construction Superintendent

Aspect	Commitment	implementation	Responsibility
		3. Origin to approve EMP and implement assurance activities to ensure compliance.	
Reporting	Quarterly incident reports to regulator	Origin to prepare incident reports to regulator during the commencement of an activity.	Project Manager
Reporting	Annual Environmental report prepared and submitted to DPIR	Origin to prepare the annual environment report to DENR/DPIR	Project Manager
Spills	Site to be inspected and confirmed free of waste upon completion of activities	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and inspect areas prior to demobilisation.	Contractor/ civil construction superintendent
Waste	Provide waste tracking certificates to DPIR/DENR	1. Origin to provide waste certificated to DPIR/ DENR upon finalisation of activity	HSE Representative
Waste	Contractors to develop waste management procedures covering the following aspects: 1.Waste which cannot be recycled will be transported to a designated, approved disposal site. 2. Domestic refuse to be disposed of in accordance with NT waste guidelines. No incineration of wastes on site. 3. Waste registers maintained by contractor for the duration of the project. 4. Removal and disposal of hazardous wastes to be in accordance with NT hazardous waste disposal requirements. 5.Designated waste storage and handling area to be provided onsite. 6. Undertake inspection of waste storage areas regularly, or after significant rainfall event (greater than 20 mm in 24-hour period).	1. Requirement built into work instructions issued to contractors 2. Contractors to include waste management procedures requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	Contractor

Aspect	Commitment	implementation	Responsibility
	7Appropriate housekeeping standards will be maintained, and the site will be maintained free of rubbish 8. .Provide waste tracking certificates to origin		
Waste	Ensure the availability of spill clean-up equipment for operations.	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	Contractor
Water resources	Origin to obtain licences for all Water take as per the NT Water Act	1. Origin to obtain licences for all water take used for exploration activities	Project Manager
Water resources	Surface water will not be used for any activities proposed in this EMP or future operations	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	Project Manager
Water resources	Provide water use (including bore location) data to DENR	1. Requirement built into work instructions issued to contractors requiring water data to be kept 2. Origin to provide data to DENR as per licence requirements	Project Manager
Water Resources	Personnel prohibited to interfering with wildlife	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	Contractor/ civil construction superintendent

Aspect	Commitment	implementation	Responsibility
Weed	A project specific weed management plan (NT-2050-15-MP030) must be implemented as a part of the hemp addressing the following NT Weed Management Plan Guidelines: 1. Baseline weed assessments prior to controlled actions. 2. Provision of a dedicated weed officer 3. be consistent with the statutory requirements of other relevant instruments such as the threat abatement plans under the EPBC.	1. Origin to develop project wide Weed Management Plan (WMP) 2. Requirement for contractors to comply with WMP built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	HSE Representative
Weeds	Origin will implement appropriate controls to prevent the spread of weeds including: 1. All equipment will have certified equipment wash-down completed prior to entry to the field. 2..Machinery to be preferentially sourced locally, with machinery sourced from surrounding areas or Queensland being the 2nd and 3rd preferred option respectively. 3.. Major equipment moves will be planned from weed-free areas to infested areas and not the other way around. 4. Ensuring all material imported to or between sites is free of weeds. 5 Weeds will be actively controlled in cleared/ hardstand areas. 6. Staff members and contractors responsible for preventing, identifying and managing weeds to be appropriately trained. 7. Induction material to contain information on weeds	1. Requirement built into work instructions issued to contractors 2. Contractors to include requirements within their own EMP 3. Origin to approve EMP and implement assurance activities to ensure compliance.	Contractor/ civil Construction Superintendent/ HSE Representative

Aspect	Commitment	implementation	Responsibility
Weeds	Weed inspections and reports will be undertaken as per the following: 1. Pre and post wet (February to May) inspections and periodic audits will be conducted to identify and report weed outbreaks. 2. Records of weed inspections will be maintained by Origin	1. Origin to implement weed inspection program	Project manager
Water	Water extraction bore construction permits	1. Origin to obtain bore construction permits prior to undertaking water bore and monitoring bore construction.	Project Manager

Appendix H Environmental Work Instruction

Purpose	This work instruction has been prepared to outline the key environmental management requirements that must be met prior to, during and following activities for the Beetaloo civils program. The environmental requirements are commitments made under the project's Environmental Management Plan (EMP) which is a legally binding document. All site personnel must be made familiar with the environmental requirements detailed in this Work Instruction and associated documents.
Records	The requirements of this document must be checked with the OE Construction Superintendent and Environmental Specialist at relevant stages and retained as a means of demonstrating compliance with the commitments detailed.
Conditions of use	• All site personnel must be made familiar with the environmental requirements detailed in this Work Instruction. • The Environmental Requirements set out in this Work Instruction are to be read subject to the Contractor's obligation under the Contract to comply with all Statutory Requirements. Where a higher or different standard is required by a Statutory Requirement it will prevail over this work instruction. • Any deviation from this document must be approved by the OE Construction Superintendent • All authorisations must be produced in writing. • Compliance with this work instruction must be assessed by the OE Construction Superintendent and OE Environmental Specialist during and post the activity. Any corrective actions must be documented and implemented promptly.
Scope	<u>Exploration well lease and camp pads</u> • 4.5ha well lease pad which includes 20m firebreaks • 1ha camp pad including irrigation area to irrigate effluent from camps, stimulation and well testing. The irrigation a\ rea is to be fenced and not cleared. <u>Drilling Sump</u> • Drill sump to be constructed on cleared lease pad to support drilling operations; engineered to store drilling fluids, muds and drill cuttings • Coletanche liner installed over sump surface to contain all drilling fluids. Coletanche is to be installed as per the provided installation standards. • <u>Gravel Pits</u> • Gravel pits will be sourced from two existing approved locations. Upon cessation of activities, the gravel pits will be recontoured back to a stable, safe and non-polluting form. Topsoil will be reinstated across the gravel pit and natural revegetation used as the primary vegetation reinstatement measure. <u>Fly Camps</u> • Temporary portable fly camps will be used to support activity where required • All sewerage and rubbish being removed from site for offsite disposal routinely. • All fly camps will be in existing disturbed areas and will not require additional clearing. <u>Access Track/Roads</u> • Only access tracks identified in this work instruction shall be used for the activity. For areas where clearing of new access tracks are required. all work will be undertaken under supervision of the OE Construction Superintendent in accordance with this work pack. • All vegetation clearing outside of the approved area is prohibited. <u>General</u> • Water will be sourced from an approved source as directed by OE.

	• If required gravel will be sourced from an existing approved pit with approval from landholder/ DPIR or a new nominated pit as outlined in OE EMP.

Environmental External Approvals	
External Approval	**Reference**
NT Petroleum (Environmental) Regulations	
Beetaloo basin Groundwater Monitoring Bore Installation Program; Environmental Management Plan	NT-2050-15-MP-0014
Kyalla 117 Civils environmental Management Plan	TBC
AAPA Certificate	C2019/014
Land Access Agreement	TBC
Water Extraction Licence	TBC

ENVIRONMENTAL REQUIREMENTS	
	General
1.1	The Contractor must prepare and submit for OE approval an environmental risk assessment of their scope of work and implement necessary control measures to implement the requirements of this work pack.
1.2	The Contractor is to remain within their approved disturbance area unless written approval is given by OE Construction Superintendent and Environmental Specialist.
1.3	A project kick-off meeting must be held between the Contractor and OE prior to works commencing addressing environmental requirements including: Approved disturbance area and requirements of the Origin Disturbance Approval. Site layout (i.e. locations of well lease and camp pads, access tracks, gravel pits and water sources). Environmental management plan obligations as summarised in this work instruction and the Contractor's approved risk assessment. External environmental approvals applicable to the works Environmental features (e.g. waterways, remnant vegetation), environmental sensitive areas and sensitive receptors (e.g. homesteads) in proximity to site. Cultural features, sacred sites and associated exclusion/restriction zones as identified int eh AAPA certificate C2019/014 Relevant details of land access approvals.
1.4	All personnel entering the construction site or associated areas must be instructed on their responsibilities for environmental compliance, controls required by the environment risk assessment and the requirements of this work instruction. This must include site specific information in inductions, training and toolboxes.
	Noise, lighting, dust and emissions

ENVIRONMENTAL REQUIREMENTS	
Management Requirements	
2.1	Any trucks carrying dust generating materials must be covered on public roads or where a sensitive receptor may be impacted.
2.2	Prior to, and throughout construction activities dust control measures, such as water trucks for dust suppression on access tracks, must be implemented where visible dust is produced and where sensitive environmental, cultural or community receptors may be impacted.
2.4	Speed limit on unsealed roads around sensitive features (such as Aboriginal protected areas and landholder homesteads) to be restricted to 40km/hr
2.6	All complaints and subsequent actions are to be recorded in Origin's OCIS incident management system and cascaded to the Origin Construction Superintendent
2.7	Contractor to provide Origin with all fuel usage data upon completion of the activity. Fuel usage data will be reported via the National Pollutant Inventory and National Greenhouse and Energy Reporting scheme
2.8	All exploration activities to be located away from sensitive receptors with lease layouts designed to minimise visual amenity impacts
2.9	Considering impacts of noise and lighting on sensitive receptors
2.10	All complaints to be directed to the OE Construction Superintendent and recorded in Origin's OCIS incident management system
	Water Management
Management Requirements	
3.1	Water to be sourced from an approved, licenced water take point as nominated by Origin Energy Construction superintendent
3.2	No surface water is to be taken for activities under this program
3.3	Volumes of all water used are to be documented and submitted to the OE construction Superintendent
3.5	All works in waterways including temporary barriers and new or modified bed level crossings must meet the requirements of the project specific Erosion and Sediment Control Plan (ESCP).
3.6	No discharges of waters permitted to watercourses
3.7	Water accumulated in construction areas must not be discharged within 50m of any waterway. Where de-watering is required, appropriate measures should be undertaken to avoid creating erosion and limit sediment movement into the environment. Any stormwater must not contain hydrocarbon or chemical contamination.
3.10	Land clearing to be undertaken in accordance with the NT Land clearing Guidelines.
3.11	No clearing of vegetation in watercourses proposed.
3.12	Lease pads to be designed to divert stormwater around, without impeding natural surface water flows.
3.13	Stockpiled debris to be used to discourage water concentration
	Land Management
Management Requirements	
4.1	The locations for all activities must be approved by OE Construction Superintendent prior to construction.

ENVIRONMENTAL REQUIREMENTS	
4.2	Appropriate measures should be employed to prevent surface damage to roads including limiting track access during wet weather and avoiding tracking of material on to sealed public roads.
4.3	All construction vehicles must remain on designated access roads and tracks and within the defined construction areas and associated work or accommodation sites. Actions to ensure this should include at a minimum workforce education, signs, boundary markers and fences, as appropriate.
4.4	All areas to be cleared will be surveyed and pegged to ensure the location is within the approved disturbance areas covered in the EMP.
4.5	All clearance shall be undertaken in accordance with the NT Land Clearing Guidelines. The location of the lease shall take into consideration the following: Clearing will avoid large trees where possible Spotter catcher to be present during all clearing activities Cleared debris to be mulched and respread over cleared area aligned down the contour or in a manner appropriate for the safe disposal of runoff Any remaining debris must not be stockpiled close to existing vegetation or the monitoring bores due to bushfire risk
4.6	All disturbed areas shall be surveyed with figures of land clearing retained.
	Soil, Erosion and Sediment Control
5.1	An erosion and sediment control plan detailing site management requirements must be prepared by a qualified (CPESC) and experienced person and approved by the OE Construction Superintendent prior to commencement. This plan shall be general and include measures covering new access tracks, lease pads and gravel pits in alignment with the OR ESCP provided. Erosion and sediment control requirements may be confirmed and documented onsite inspection by the construction superintendent.
5.2	Erosion and sediment control devices must be installed as necessary and remain in place, be maintained (e.g. removal of silt build up, modifying or re-establishing failed structures), to ensure effectiveness until the area has been effectively rehabilitated following completion of construction.
	Flora and Fauna
6.1	Disturbance limits must be clearly marked out onsite including labelled survey pegs, flagging etc. and the site disturbance limits communicated to all site personnel.
6.2	The Contractor should ensure clearing is restricted to the minimum necessary to carry out the required activities, within the approved construction area. Retention of vegetation, selective clearing, and trimming of branches is the priority.
6.3	All vehicles, plant and equipment are to remain within designated access tracks/roads and must abide by speed restrictions and limits.
6.4	Prior to commencement of clearing works an inspection must be conducted by an OE Construction Superintendent of the areas to confirm preparation has complied with work instruction requirements.
6.5	Any vegetation clearing activities must have a spotter present during works to identify any fauna that could be impacted by the activities. If fauna are found during works, activities must cease to allow the animal to leave of its own accord or a licensed spotter catcher must attend to relocate the animal.
6.6	Placement of temporary worksite fencing shall be used (where appropriate and approved) to prevent fauna ingress into work area; specifically open pits and sumps..

ENVIRONMENTAL REQUIREMENTS	
6.7	Permanent fencing shall be placed around the lease pad upon installation to prevent fauna and stock access. The design of fencing shall be approved by the landholder as advised by the OE Construction Superintendent.
6.8	All personnel must be informed about the risks of fauna injury and death and trained on what to do if they see an injured animal (e.g. stop the work, report to supervisor, call an AS HSE Advisor or the Fauna Spotter Catcher to attend)
6.9	Firearms, interference with fauna and domestic pets are prohibited to be taken onto the project area,
	Culturally Sensitive Areas and AAPA requirements
Management Requirements	
7.1	The Contractor must not access any areas or conduct any works that are not permitted under this Environmental work instruction. The approved disturbance area is specifically detailed in the construction maps, disturbance approval and through the worksite transfer.
7.2	The contractor shall ensure compliance with any AAPA certificate requirement (C2019/014) and area restrictions
7.3	The contractor shall train staff via the site induction and toolbox any location of culturally sensitive areas where access is prohibited/ restricted.
7.4	Any unexpected heritage finds stops related work procedure to be followed where a suspected cultural heritage find is identified. Members of civil crews to be familiar with the content of the unexpected finds procedure and the signs of a potential suspected find.
7.5	Contractor shall ensure all staff members display appropriate behaviours outside of work hours.
7.6	Site inductions are to ensure that all personnel are aware of the Code of Conduct prepared for social interactions with the community
7.7	All questions from the community regarding Origin's activities of which are not general in nature (such as on Hydraulic fracturing, community engagement, environmental impacts etc.) should be politely directed to the OE Construction Superintendent.
	Weed and Pest Management
Existing Environment	
The following weed species have been identified in the project area. The contractor shall be familiar with the potential location Parkinsonia (Class B and Weed of National Significance; WoNS) located along Beetaloo access track Hyptis (Class B) Located along Beetaloo Access and Velkerri 98-E1-1 Access track Rubber bush identified in close proximity to Beetaloo Access track.	
Management Requirements	
8.1	The contractor is to be familiar with the contents of the Origin Weed Management Plan, NT Weed Management Handbook, Regional Weed Management Plans (Barkly and Katherine) and Statutory Weed Management Plans
8.2	Contractor to nominate responsible field personnel for compliance with Weed Management Plan. This person (s) must be appropriately trained and experienced in weed management and identification.
8.3	Machinery shall be sourced locally where possible. No equipment that has been used interstate is permitted without prior approval form OE Construction Superintendent in writing.
8.4	Weed management requirements to be communicated to all personnel via site induction and toolbox talks. Attendance records are to be documented, retained and submitted to the OE Construction Superintendent.

ENVIRONMENTAL REQUIREMENTS	
8.4	Prior to commencement of construction in any area, the area shall be inspected by the contractor and Construction Superintendent (nominated Weed Officer) to identify any restricted invasive plants and WoNS located within the disturbance area.
8.5	All vehicles, machinery, plant and equipment and demountable must be cleaned and declared free of biological material before being allowed access to site. Any machinery, vehicles and equipment not accompanied by an approved Biosecurity Hygiene Declaration must not be allowed onto site. Any loads brought to site must be accompanied by a Weed Hygiene Declaration.
8.6	The Contractor must treat or remove and dispose of weed species (inclusive of all WoNS), and all classes of State listed species as per the *Origin Weed Management Plan* within the Construction area prior to commencement, and at all times throughout the construction period in accordance with the requirements of the Weed Management Plan: NT-2050-15-MP0016, NT Weed Management Handbook and the following NT Statutory weed management plans. Weed Management Plan for Athel pine (*Tamarix aphylla)* Weed Management Plan for Mesquite (*Prosopis spp.*) Weed Management Plan for Prickly Acacia (*Acacia nilotica*) Weed Management Plan for Bellyache Bush (*Jatropha gossypiifolia*) Weed Management Plan for Neem (*Azadirachta indica*) Weed Management Plan for Gamba Grass (*Andropogon gayanus*) Weed Management Plan for Grader Grass (*Themeda quadrivalvis*). Weed control must be undertaken by a suitably experienced person and verified by the OE Construction Superintendent (weed officer) prior to construction.
8.7	A copy of the valid inspection report is to be kept within the vehicle at all times. Any vehicles/equipment found without a valid inspection report must be directed to leave site immediately and must undergo inspection and wash down.
8.8	Any vehicle plant or equipment that has come into contact with weeds must be washed down, re inspected and a new Vehicle/Equipment Inspection Report issued before moving into an area that has been cleared of weeds or entering another property.
8.9	All loads (including quarry materials (e.g. gravel, sand, soil), stock and domestic water, mulch, hay, seed, livestock) sourced from outside the project area must have a valid Weed Hygiene Declaration for the load. The weed hygiene declaration should be completed by the supplier and provided to OE Construction Supervisor prior to unloading.
8.10	Upon identification of any declared weed species- the OE Construction superintendent shall be notified as soon as practicable (but within 24hrs).
	Reinstatement
9.1	All disturbed areas must be reinstated on completion of construction. Reinstatement must include as a minimum: Remove all waste and surplus materials (including domestic waste, contaminated material etc.). Reinstate drainage lines, install any permanent erosion control devices and reinstate contour banks/diversion banks. Re-spread of mulched vegetation around lease (outside of fenced monitoring bores) aligning with contours to prevent runoff
9.2	On completion of construction the Contractor must undertake a joint inspection with the OE Construction Superintendent, complete the Field Inspection Checklist (Q-LNG01-15-AQ-0514) and close out all type A and B action items.
	Dangerous Goods and Hazardous Materials

ENVIRONMENTAL REQUIREMENTS	
10.1	Appropriately sized and type of spill kits must always be available onsite. Personnel trained in the use of the spill kits available onsite must be present throughout works.
10.2	In the event of a spill: STOP WORK Make safe Prevent further spillage Notify your supervisor immediately and the OE construction Superintendent (verbally, then in writing) within 4 hours Exclude access (include stock access) until cleaned up Disposed of waste appropriately- ensuring all transport and disposal is in accordance with the NT Waste Management and Pollution Control Act
10.3	No chemical or fuel storage is allowed within 100m of any drainage line or in any location where a release could affect a sensitive environment. All fuels and chemicals must be stored in bunded areas and comply with relevant Australian Standards.
10.4	Fuel storage, chemical stores, generators and maintenance and refueling areas must have impermeable secondary containment to 110% of the total stage capacity as per the relevant Australian Standards.
10.5	All plant, equipment and vehicles are to have daily prestart checks, an up to date maintenance schedule and undergo regular inspections. Records are to be kept of all checks and maintenance.
10.6	All scheduled maintenance activities must be undertaken at designated workshop areas. Temporary bonding, drip trays or impermeable matting must be used to prevent spillage from any in field refueling or maintenance of plant and equipment, or any other activity that could result in spillage of a chemical, fuel, lubricant or other contaminant to soil. Refueling must be at least 100m away from any drainage line.
	Waste Management
11.1	Prior to commencement the Contractor must identify waste streams to be produced during the works and identify opportunities to reduce, reuse and recycle waste. Provide suitable waste receptacles and arrange for waste removal by an approved NTG waste contractor for disposal to a licenced facility.
11.2	All waste must remain within the designated work area and be secured at all times with appropriate storage and segregation.
11.3	Waste must not be burned nor buried on site.
11.5	All wastes (including any surplus materials) must be removed from site at completion of works by licensed waste transport or for disposal at a licensed facility as per the NT Waste management and Pollution Control Act.
11.6	All listed wastes specified in Schedule 2 of the *Waste Management and Pollution Control (Administration) Regulations* must be transported by a licensed contractor and disposed of at a licensed facility.
11.7	All sewage generated on-site must be contained and removed off site for disposal by a licenced transporter at an appropriately licensed facility.
11.8	Grey water from kitchen and showering facilities will be managed in accordance with Part 6 of the DoH Code of Practice for *Small Onsite Sewage and Sullage Treatment Systems and the Disposal or Reuse of Sewage Effluent, 2014*. Alternatively, all grey water will be removed from site.
11.9	The Contractor must maintain up to date details of all waste sub-contractors undertaking waste management and transportation services. The details of all wastes generated, and their disposal location must be forwarded to the OE Construction Superintendent
	Bushfire
12.1	The lighting of fires is prohibited

ENVIRONMENTAL REQUIREMENTS	
12.2	Fire extinguishers to be fitted to all vehicles.
12.3	Fire response equipment to be available to respond to a fire (such as civil equipment to install fire breaks).
12.4	Emergency response plan to be developed and implemented by contractor- referencing relevant content with OE ERP fire.
12.5	Responsible persons for implementing components of ERP to be identified and receive appropriate training and resources to fulfill requirements of plan.
12.6	Bushfire prevention and risks to be included in site induction and toolbox training material.
12.7	Establish firebreaks around water bore infrastructure (4 m fire break in accordance with NT requirements); noting maximum disturbance area of lease and firebreak is 50x50m (no additional clearing is approved).
	Complaints, Incidents and Reporting
13.1	All incidents, complaints and non-conformances with environmental requirements must be reported in writing within as soon as practicable to the OE Construction Superintendent.
13.2	Reporting of incidents and non-conformances must include: The name and telephone number of the Contractor's contact person The location of the emergency or incident (Property Name, Infrastructure ID, GPS coordinates in decimal degrees) The date and time that the emergency or incident occurred The date and time when the incident was reported Details of the nature of the event and the circumstances in which it occurred The estimated quantity and type of any contaminants involved in the incident, and the area affected, and/or the number of individuals and species of fauna affected Description of the circumstances surrounding the incident including: Activities occurring at the time the incident took place Equipment being used at the time the incident took place or that were involved in the incident Controls in place at time of incident Description of scene when incident occurred Weather and environmental conditions Contractor responsible for the site and relevant personnel present A description of the immediate and potential impacts from the emergency or incident A description of whether stock and/or wildlife were exposed to any contaminants released and measures taken to prevent access for the duration of the emergency or incident Any sampling conducted or proposed, relevant to the emergency or incident Photographs of the location where the incident occurred and surrounding environment Landholder details and details of any communication with the landholder Immediate actions taken to control the impacts of the emergency or incident and how environmental harm was mitigated at the time of the emergency or incident Whether further examination/root cause analysis is required and if so, the expected date by when this examination will be completed and reported as agreed with the OE Environmental Specialist.
13.3	On completion of the works, information, reports and registers must be provided to the OE Construction Superintendent, including but not limited to;

ENVIRONMENTAL REQUIREMENTS	
	Completed reinstatement checklists and action close out records Waste generation and transported data Fauna collisions/ interactions Fuel and water use quantity data (Incident, complaint and non-conformance reports Surveyed disturbance area

Environmental Hold Points- Origin to complete

PRE-CONSTRUCTION		
Activity Approval	Environmental Management Plan approval	OE Environmental Specialist
Security Bond	Security bond lodged and paid to DPIR	OE Environmental Specialist
AAPA/NLC Approval	AAPA Certificates Approved for location of construction works and submitted to DPIR	OE Project Manager/ Date
Landholder Access Approval	Signed Landholder approval page submitted to DPIR	OE Project Manager
Environmental Risk Assessment	Contractor's environment risk assessment approved.	OE Construction superintendent/ Date
Kick off Briefing	Kick off meeting conducted between the Contractor and OE personnel prior to works commencing addressing environmental requirements.	OE Construction superintendent/ Date
Site induction	Site induction completed addressed summarizing the requirement of this work pack- including environmental and AAPA related conditions.	OE Construction superintendent/ Date
Project erosion and sediment control plan	Contractor to complete project specific ESCP plan aligned with Origin ESCP prepared by a CPESC qualified person	OE Construction superintendent/ Date
Weeds	Contractor to prepare activity specific Weed management plan to be developed outlining how the Origin WMP will be implemented.	OE Construction superintendent/ Date
Bushfires	A fire management plan at a project level must be developed as part of the EMP. This shall align with Origins BMP.	OE Construction superintendent/ Date
Water source	Water Extraction Licence and take points defined.	OE Construction superintendent
SITE ESTABLISHMENT		
Limit of works	Area to be surveyed and demarcated to outline disturabance footprint.	OE Construction Superintendent / Date
Kick off Briefing	Environmental Work Instruction briefing, and site inspection conducted prior to works commencing.	OE Construction Superintendent / Date
Training and competency	All relevant training has been completed for the following: 1. Site inductions	

	2. Weed management 3. Bushfire/ fire fighting 4. Spill response 5. Cultural heritage awareness and AAPA conditions	OE Construction Superintendent / Date
AAPA and Landholder Approval conditions	Areas of cultural sensitivity and landholder conditions have been clearly identified and communicated to personnel.	OE Construction Superintendent / Date
Weed Management	Weed inspection completed and any weed control undertaken	OE Construction Superintendent (Weed Officer) / Date
Spill Kits	Spill kits of the appropriate size and type are located on site.	OE Construction Superintendent / Date
CONSTRUCTION		
Clearing	Spotter to be utilized during clearing activities to identify fauna.	OE Construction Superintendent / Date
AAPA and Landholder Approval conditions	Compliance with conditions as prescribed by the NLC Agreement and AAPA certificates for the duration of the program.	OE Construction Superintendent / Date
Work area	Clearing confirmed to be restricted to approved areas within the demarcated areas	OE Construction Superintendent / Date
Sump construction	Coletanche liner installed as per installation instructions.	
Hazardous material and waste management	All chemicals, fuels and wastes stored away from watercourses in accordance with EMP requirements.	OE Construction Superintendent / Date
Erosion and sediment controls	Erosion and sediment controls confirmed to be installed correctly and operating as per ESCP	OE Construction Superintendent / Date
Work Area fencing	All lease pads, camp pads, stockpile areas to be fenced.	OE Construction Superintendent / Date
Sumps and Pits	Open sumps and pits which represent a hazard to fauna fenced at all times.	
Bushfire prevention	All firefighting equipment present and functioning as per BMP	OE Construction superintendent/ Date
Routine inspections	Weekly routine inspections completed against requirements of Work Instruction	

		OE Construction superintendent/ Date
Records	All required records and monitoring to be competed as per guidelines and obligations	OE Construction superintendent/ Date
General competency	Contractors demonstrate they are aware of their requirements relating to requirements of Work Instruction which include: • Restricted areas or requirements of AAPA certificates • Weed management practices • Incident reporting requirements • Waste management requirements	OE Construction superintendent/ Date
COMPLETION		
Work area completion	Area left tidy, free of waste and fenced	OE Construction Superintendent / Date
Erosion and sediment control	All erosion and sediment controls functioning properly.	OE Construction Superintendent / Date
Environmental reporting	All environmental reports (, incident report, weekly inspections etc.) and records (water use volume, diesel use, waste disposal volumes and certificates etc.) have been submitted.	OE Construction Superintendent / Date
Reinstatement	All requirements of Work Instruction complied with- all non-compliances document	OE Construction Superintendent / Date
Scope Complete	Project completed as per scope and no remaining issues, open actions or defects. All records submitted.	OE Construction Superintendent / Date