

Onshore Petroleum Activity – NT EPA Advice

ORIGIN ENERGY B2 PTY LTD (ORI11-3) – ENVIRONMENT MANAGEMENT PLAN (EMP) FOR THE AMUNGEE NW DELINEATION PROGRAM EP98

BACKGROUND

The Minister for Environment, Climate Change and Water Security has formally requested under section 29B of the *Northern Territory Environment Protection Authority Act 2012* (NT EPA Act) that the Northern Territory Environment Protection Authority (NT EPA) provide advice on all Environment Management Plans (EMPs) received under the Petroleum (Environment) Regulations 2016 (the Regulations).

That advice must include a recommendation on whether the EMP should be approved or not, supported by a detailed justification that considers:

- whether the EMP is appropriate for the nature and scale of the regulated activity to which the EMP relates (regulation 9(1)(b))
- the principles of ecologically sustainable development (regulation 2(a)), as set out in sections 18 to 24 of the *Environment Protection Act 2019* (NT)
- whether the EMP demonstrates that the activity will be carried out in a manner by which the environmental impacts and environmental risks of the activity will be reduced to a level that is as low as reasonably practicable and acceptable (regulation 9(1)(c))
- any relevant matters raised through the public submission process

In providing that advice, the NT EPA Act provides that the NT EPA may also have regard to any other matters it considers relevant.

ACTIVITY

Subject	Description
Interest holder	Origin Energy B2 Pty Ltd
Petroleum interest(s)	Exploration Permit 98
Environment Management Plan (EMP) title	Amungee NW Delineation Program EP98
EMP document reference	ORI11-3
Regulated activity	<p>The EMP proposes an exploration and appraisal program in EP98, located approximately 60 km east-southeast of Daly Waters in the Beetaloo Sub-basin and located on the Amungee Mungee and Shenandoah East perpetual pastoral leases. The regulated activity includes:</p> <ul style="list-style-type: none"> • acquisition of 2D seismic data (60 linear km / 31.66 ha area of clearing) • civil construction of 4 well pads and associated infrastructure (75.2 ha area of clearing: well pads (7.5 ha per site), access tracks (13.5 linear km / 18.9 ha area of clearing), camp pads (1.2 ha per site), laydown areas (0.5 ha per site), helipads (0.5 ha per site), firebreaks (4 ha per site) and gravel pit (3.5 ha)) • drilling, hydraulic fracture stimulation and well testing of up to 12 wells • site decommissioning and demobilising
Public consultation	Public consultation on the EMP was required under regulation 8A(1)(b) was undertaken from 18 July 2022 to 15 August 2022

NT EPA ADVICE

1. Is the EMP appropriate for the nature and scale of the regulated activity (regulation 9(1)(b))

Information relating to the nature and scale of the regulated activity is provided in the EMP in a clear format. Table 1 provides an overview of the key components of the regulated activity and worst-case scenario values. The proposed work program is scheduled to take place from 2022 – 2027.

Table 1: Key components of the proposed Amungee NW Delineation Program

Component/aspect	Proposed
AAPA certificate	C2022/002
Total area of EP98	1,030,000 ha
Total area of surface disturbance	106.86 ha
Seismic lines	60 km (31.66 ha)
Number of well pads	4 (7.5 ha)
Number of exploration wells	12 (3 wells per well pad)
Groundwater extraction licence	GRF10285 (175 ML/annum)
Groundwater usage	430 ML (107.5 ML per well pad (total))
Water extraction/monitoring bores	16 (4 per well pad)
Gravel pits	1 (3.5 ha)
Extended production testing	135 days per well (average)
Camp	~70 person camp per well pad
Peak traffic movements	44 vehicles per day
Average traffic movements (first 6-9 months)	10-15 vehicles per day
Average traffic movements (remaining 6 months)	3-4 vehicles per day
Volume of drilling mud and cuttings generated	~2250 m ³ per well pad
Water used for stimulation	25 ML per well (10-30 stages)
Flowback volume generated	7.5 ML per well
Flowback/wastewater volume (final predicted for offsite disposal)	0.5 ML per site
Enclosed wastewater tank capacity	16.5 ML (wet season) or 5.3 ML (dry season)
Open treatment tank capacity	5.3 ML (wet season) or 15.9 ML (dry season)
Greenhouse gas emissions	522,172 tCO ₂ -e (total) ¹

The Amungee Delineation Area is located around the existing Amungee NW site, which contains the Amungee NW-1H well drilled and stimulated in 2015/2016. The proposed exploration and appraisal program will target the Velkerri shale resource at four “step out” locations surrounding the existing Amungee NW well pad. The twelve proposed wells are intended to confirm the technical and commercial feasibility of the Velkerri dry gas shale resource for potential future development.

This EMP links to two active Origin EMPs for the Amungee area:

- **ORI7-2** (approved 15 July 2021): covers the extended production test of the existing Amungee NW-1H well.

¹ The Greenhouse Gas Abatement Plan includes 16 wells as it also covers the 4 wells in the ORI10-2 EMP (Amungee Multiwell Drilling, Stimulation and Well testing Program, approved 19 May 2022)

- **ORI10-2** (approved 19 May 2022): covers the expansion of the existing Amungee NW site, the drilling, hydraulic stimulation and extended production testing of the Amungee NW-2H and Amungee NW-3H wells, and extended production testing of the existing Amungee NW-1H well.

The EMP demonstrates there is a good understanding of the existing environment. A survey of the proposed activity locations was undertaken in May 2022, but data from previous baseline assessments undertaken in 2004-2021 was also utilised. The EMP proposes the use of multi-well pads and shared facilities (camps, wastewater storage), which reduces clearing requirements. Sensitive receptors are located at a reasonable distance, being 16 km for the nearest homestead, 50 km for the nearest community, 15 km for the nearest major watercourse and 9.5 km for the nearest sacred site. The closest pastoralist bore is 1.1 km, which complies with the required separation distance of 1 km outlined in the Code. The EMP shows an adequate consideration of potential impacts and risks of the regulated activity and proposes appropriate controls, in line with previously approved EMPs. Areas of particular interest in this EMP are the proposed use of seismic charges, reuse of wastewater, wastewater management, greenhouse gas emissions and the use of shared facilities.

The EMP proposes the use of seismic charges to trial their use against the standard vibroseis methods (also proposed as part of this EMP), to determine whether this survey method could increase data quality, whilst lowering vegetation clearing requirements for future activities. Seismic acquisition using small dynamite charges involves the placement of small charges 15-20 m below the ground surface by light 4WD vehicle or equivalent. The explosives will be stored on site in a portable magazine which adheres to Australian Standards. The charges can be placed around vegetation, which will significantly reduce clearing requirements, and the blast will be contained within the subsurface (i.e. no expulsion of earth from the surface). The charges will be offset from sensitive receptors (e.g. pipelines, active cattle yards, water bores, bitumen seal), guided by Australian Standards. When detonated, a short, sharp thud will be heard and a potential small level of vibration may be felt within 1 to 2 kilometres of the charge going off. In the event of a misfire, a new charge will be loaded, offset at approximately 2 m. This will provide replacement data and likely break the plastic seal of the undetonated charge, accelerating bioremediation of the charge. The charges contain millions of freeze-dried microorganisms (along with nutrients) which get activated when submerged in water. These microorganisms bio-transform undetonated charges over a period of typically six months, which ensures they are no longer explosive. After firing, detonation wires will be pulled out and remaining cuttings will be returned down the hole. A cap will be placed 50 cm down the hole, and the hole will be backfilled to ensure load bearing and no surface depression is left that might cause injury to cattle or native fauna.

To reduce fresh water take and minimise the storage and disposal of wastewater, the EMP proposes the reuse of flowback fluid in the stimulation make up fluid. Flowback fluid is anticipated to make up approximately 30% of the stimulation fluid. An analysis of environmental impacts and risks is included in the EMP in accordance with the Code (clause C.7.1.1(b)). A chemical risk assessment was undertaken against observed contaminant levels in flowback fluid recorded during Origin's operations in 2016 and 2021, which concludes that the health risk to workers is low (hazard index of 0.25). Likewise, NORM levels in flowback fluid are significantly lower than the NT Radiation Protection Act trigger limit of 1 mSv/year. Compared to using freshwater only, the use of flowback fluid in the stimulation fluid make-up is anticipated to return water to the surface of higher salinity. Other contaminants in the flowback may increase in concentration as well, but these increases will be influenced by saturation levels and the salinity of the wastewater. The stimulation fluid make-up, as well as the flowback fluid will be monitored in accordance with the Code. This will allow quantification of these predicted changes in water quality.

Wastewater volumes at multi-well pads are generally high, especially with simultaneous or consecutive stimulations. The EMP demonstrates that this is considered in the tank pad design; a water-balance is provided outlining the expected wastewater levels after a proposed simultaneous stimulation of two wells. The maximum volume of flowback fluid expected after a simultaneous stimulation is 9.44 ML, whilst the enclosed wastewater storage capacity on-site is 16.5 ML. The water balance includes consideration of the proposed treatment with mechanical evaporators, which has demonstrated to evaporate up to 16,000 L per day. The use of these enhanced evaporation units doubles the evaporation rate. Origin's Kyalla well site saw a reduction in wastewater volume of

84% over a 13-month period with the proposed wastewater management methods. It was also observed at this site that once salinity begins to reach the saturation point (~300,000 mg/L), bulk salt crystallisation occurs and salt begins to drop out of the solution, which appears to allow evaporation to continue. Based on these observations, combined with the anticipated difference in wastewater quality (Kyalla shale vs. Velkerri shale), it is anticipated wastewater volumes received under this EMP can be reduced by 93% over a 12-month period.

The total emissions for the proposed program assume all wells will be successful and are anticipated to be 522,172 tonnes of CO₂, equivalent (tCO₂-e) and cover emissions from construction, drilling, stimulation and testing and is based on an assumed worst case of 135 day average period for extended production testing per well. The peak emissions will occur in the financial year of 2023-2024 and equal 172,815 tCO₂-e. In accordance with the Greenhouse Gas Emissions Management for New and Expanding Large Emitters Policy (Large Emitters Policy), Origin has updated its existing Greenhouse Gas Abatement Plan (GGAP), outlining how the proposed emissions will be mitigated and managed. Origin's long-term target within the Beetaloo is to have a scope 1 and scope 2 neutral development. Emissions will be offset using credible carbon credit units approved by the Commonwealth Clean Energy Regulator. Offset volumes will be calculated retrospectively, by multiplying the actual emission volumes generated during a financial year with the corresponding financial year offset level. Emissions offset levels will increase year-on-year by 3.7% to result in a linear decrease in residual emission levels to net zero by 2050. The offsets will be secured and retired within 6 months of the end of a financial year.

The EMP proposes the use of shared facilities for camps and wastewater storage, to reduce land clearing requirements. Transfer of wastewater between operating sites will also allow for centralised storage and treatment. The decision to share facilities and infrastructure across well pads will depend on:

- the number of personnel being deployed across activities at any one time
- the capacity of existing infrastructure to absorb additional personnel or waste volumes
- proximity of infrastructure to the regulated activity and whether risks associated with travel between sites (e.g. 10-12 hour days, fatigue) is materially higher than using dedicated infrastructure located at each site, and
- land access authorisation.

Noise levels of the project are in alignment with the NT Noise Management Framework Guideline, adopting a quiet to very quiet intrusiveness noise level. Based upon field noise monitoring verification completed for operations in Queensland, noise impacts are not anticipated to occur 1.2 km from construction activities, 0.75 km from seismic operations, 1.75 km from drilling operations, 2.6 km from cementing operations and 3.5 km from stimulation activities. There are no sensitive receptors within 15 km of the site, therefore no noise impacts are anticipated.

The level of detail and quality of information provided in the EMP is sufficient to inform the evaluation and assessment of potential environmental impacts and risks, and meets the EMP approval criteria under Regulation 9(1)(b).

2. Principles of ecologically sustainable development (regulation 9(2)(a))

2.1 Decision-making principle

The EMP adequately assesses the environmental impacts and risks associated with the regulated activity and outlines appropriate avoidance and mitigation measures. Of the 83 risks identified, 71 are assessed as "low" if carried out in accordance with the mitigations and controls proposed in the EMP. Wet season contingencies and controls are proposed to mitigate potential erosion and sediment impacts associated with wet season transport and traffic impacts on major arterial roads. These controls have been assessed by NT Government agencies and are deemed adequate.

Buffer zones are applied to pipelines (100 m), existing pastoral water bores (250 m), the Carpentaria Highway hard seal (100 m) and active cattle holding yards (250 m) to minimise the impacts from the seismic charges. As the blast zone is underground, there will be no visible surface disturbance from

the seismic charges, and pre- and post-wet season inspections will be conducted for erosion and sediment control. Additionally, Origin will work with the pastoralist leaseholder to ensure the seismic data acquisition activity has no impact on cattle mustering.

An analysis of environmental impacts and risks was conducted regarding the reuse of flowback fluid in future stimulation activities. Whilst it is anticipated that reusing flowback fluid for stimulation fluid make-up will increase the salinity and level of contaminants in the water returned back to surface, this will not result in an increase in risk of the regulated activity as the management of flowback fluid does not change based on salinity or contaminant level. The stimulation and flowback setup is a fully closed system from flowback tank to blenders, to downhole and then back to the flowback tank. Additionally, the wells are designed with multiple casing and cement strings to protect aquifers, and well integrity is monitored. In the multiple years of wastewater tank monitoring conducted by Origin, no material level of fauna interaction with flowback wastewater has been detected, which confirms that there is a limited exposure pathway. The EMP adequately analyses environmental impacts and risks associated with the proposed reuse as required by the Code, and demonstrates these are ALARP and acceptable.

The number of enclosed and open wastewater tanks present on well pads will vary depending on the season. Open treatment tanks are converted to enclosed tanks through the installation of lids, and vice versa. This allows for a compact tank pad size, while also accounting for the change in controls between the wet and dry seasons. The total available open and enclosed tank capacity is anticipated to be 128% of the predicted flowback generated per site, and will be enough to store the total volume of wastewater stored at any time. Further to the requirements in the Code, Origin will ensure enclosed tanks have enough capacity to store a 1:1000 year dry season rainfall occurrence for all open wastewater tanks operating on site which further reduces the risk of overtopping. The on-site pumping capacity for wastewater transfer is 138 ML/day (6 pumps at 23 ML/day), allowing for a timely transfer of water under treatment to enclosed storage prior to a significant rainfall event. The tank pad will be compacted and bunded so it can accommodate 6 ML of water, which will be able to contain the spill from a tank failure. Wastewater treatment is expedited through the use of mechanical evaporators, which will see the wastewater volumes reduced by 93% over a 12-month period.

The proposed greenhouse gas emission offset levels for the project result in a linear decrease in residual emission levels, achieving net zero by 2050. This is in line with the NT Government's expectations for new large emitting projects to reduce and manage emissions in a way that enables development to occur while contributing to the Territory's emissions target of net zero greenhouse gas emissions by 2050.²

Infrastructure and facilities may be shared between well pads, so that clearing requirements can be reduced. Considerations for sharing infrastructure include the capacity and proximity of the infrastructure and facilities. Given the proposed activities will be undertaken in both wet and dry season, the EMP considers controls for wet season wastewater and chemical transport. Wastewater transport providers will be licenced under the NT *Waste Management and Pollution Control Act 1998*, and no transportation of wastewater or chemicals will be undertaken during the wet season unless a risk assessment undertaken prior to the transportation demonstrates the risk is as low as reasonably practicable (ALARP) and acceptable. Wet season transport of wastewater will not be done:

- on tracks that are not safe for transportation of vehicles
- through flooded waterways
- on unsealed tracks for 24 hours following a >20 mm rainfall event.

Additionally, transport of wastewater and chemicals during rainfall events will be avoided, and chemicals will not be unloaded during rain events. After a >20 mm rain event, or when the integrity of any unsealed road may be compromised due to prolonged rainfall, each unsealed access track

² https://depws.nt.gov.au/_data/assets/pdf_file/0008/1041938/ntg-large-and-expanding-emitters-policy-2021-version-1.1.pdf

proposed to be used for wastewater or chemical transportation will be inspected to ensure the integrity of the road surface is sufficient to allow the safe passage of the proposed transport vehicle.

The interest holder has demonstrated ongoing stakeholder engagement in the EMP as required by the Regulations with identified, directly affected stakeholders. The EMP was also made available for public comments (18 July 2022 to 15 August 2022).

2.2 Precautionary principle

The NT EPA considers there is a low threat of serious or irreversible damage from the regulated activity. The interest holder's investigations into the physical, biological and cultural environment provide a satisfactory scientific basis to assess potential environmental impacts and risks, and to identify measures to avoid or minimise those impacts and risks and address scientific uncertainty.

The risk assessment clearly demonstrates consideration of risk events in the context of the environment in which the regulated activity is conducted and its particular sensitivities, and the spatial extent and duration of the potential impact. Uncertainty in relation to the environmental features was assessed, with no areas of environmental uncertainty identified. The risks of conducting the activity over the wet season are well understood, and the EMP demonstrates adherence to the Code. The reuse of flowback fluid is underpinned by a thorough analysis and assessment of risks and the use of seismic charges will be in accordance with Australian Standards so that threat of serious or irreversible damage from those activities is considered unlikely and potential impacts and risks managed to ALARP and acceptable levels.

The groundwater monitoring program proposed to be undertaken is beyond the requirements of the Code, and includes the collection of groundwater data from pastoralist bores within 10 km of an exploration well. The monitoring program also includes continuous groundwater level logging before, during and 1 month after stimulation. As a precautionary measure, so that the Department receives timely confirmation of aquifer protection during hydraulic stimulation, the NT EPA recommends a condition to undertake the pressure monitoring at intervals and for a duration specified by the Department, with data submitted to the Department in a timely manner.

The NT EPA is of the view that the precautionary principle has been considered in assessing the regulated activity and has not been triggered due to the low threat of serious or irreversible damage existing and the presence of a satisfactory scientific basis to assess potential impacts and risks. In addition, the environmental monitoring commitments in the EMP are compliant with the Code and provide measureable performance standards to ensure that the environmental outcomes are met. The EMP commits to the preparation and submission of an annual environmental performance report, however The NT EPA recommends a Ministerial condition outlining the timing and form of the submission.

2.3 Principle of evidence-based decision-making

A good understanding of the existing environment is demonstrated through a survey of the proposed activity locations undertaken in May 2022, as well as through using data from previous baseline assessments undertaken in 2004-2021. The EMP includes a detailed risk assessment related to traffic impacts and chemical handling. The total volume of traffic associated with the regulated activities is considerably lower than the capacity of the Carpentaria Highway, with any reduction in the level of service considered extremely unlikely. The chemical risk assessment concludes the chosen chemicals have risks that are considered to be low and acceptable. The exposure pathway assessment for stimulation chemicals identified only one partially complete exposure pathway; the on-site release of particulates and vapour during chemical mixing and flowback evaporation. The proposed management measures of chemical and hydrocarbons are satisfactory with secondary containment proposed to be used as well as satisfactory spill response procedures. As a precautionary step the NT EPA recommends a Ministerial condition for this activity relating to the recording of spills.

The proposed environmental outcomes are likely to be achieved based on the best available information on the nature and scale of the activity, and the environment in which the regulated

activity will be conducted. The studies undertaken by the interest holder to inform the EMP affords the interest holder with a detailed and reliable knowledge of the potential environmental impacts and risks and the most appropriate measures for mitigation of those impacts and risks.

The NT EPA is of the view that the evidence-based decision-making principle has been considered in assessing the regulated activity and that in the circumstances, decisions can be based on best available evidence that is relevant and reliable. As data availability on the composition of geogenic compounds in the Beetaloo Sub-basin is scarce in the current stage of exploration, the NT EPA recommends the interest holder be required to undertake a risk assessment of the flowback returned to surface.

2.4 Principle of intergenerational and intra-generational equity

The potential environmental impacts and risks associated with the regulated activity can be adequately avoided or managed through the management measures and ongoing monitoring programs proposed in the EMP.

Protection of cultural interests is achieved through compliance with the requirements of Authority Certificates issued by the Aboriginal Areas Protection Authority under the *Northern Territory Aboriginal Sacred Sites Act 1989* (NT) and the previously completed archaeological assessment at the site to avoid archaeological heritage impacts.

The use of shared facilities and the seismic charges trial will see a reduction in the clearing footprint. The proposed rehabilitation, to be undertaken progressively throughout the life of the activity, is considered to reduce the risks to biodiversity and soil contamination to ALARP and acceptable levels. The proposed reuse of flowback fluid will significantly reduce groundwater take for the proposed activities, as well as total wastewater volume. Reduced wastewater volume shortens the treatment time on-site and reduces the required storage capacity. With less tanks being required for wastewater storage, tank pad sizes (and therefore the clearing footprint) may be reduced.

Total predicted greenhouse gas (GHG) emissions generated by the regulated activity are approximately 522,172 tCO₂-e and assume every well is successful and assume a worst case 135 day average well testing period (per well) The project exceeds the threshold for becoming a large emitter under the Large Emitter Policy and a GGAP has been developed committing to a linear offsetting regime that achieves net zero by 2050.

The NT EPA considers that environmental values will be protected in the short and long term from the activities outlined in the EMP and that the health, diversity and productivity of the environment will be maintained for the benefit of future generations.

2.5 Principle of sustainable use

Exploration activities are necessary to enable commercial appraisal of resources. In the absence of reliable data regarding the shale resource, exploration will take a number of years to complete, in order to assess the viability of the resource prior to production. The use of multi-well pads (three wells per pad) allows this assessment to take place under a reduced clearing footprint. The proposed trial with seismic charges will further reduce the clearing footprint, if demonstrated to be a viable alternative to the conventional vibroseis methodology. Due to the lack of data about the applicability of seismic charges for data acquisition in the Beetaloo, and its environmental benefit, the NT EPA recommends a condition that requires Origin to report on the success of the trial.

The cumulative impact associated with current and future groundwater takes were assessed in the Water Extraction Licence (WEL) GRF10285 statement of reason and addressed in the EMP.³ Origin's WEL represents 0.00124% of the current allowable extraction volume. Any new groundwater bores drilled under this EMP will be added onto this existing licence. The licence is due to expire in 2024, but Origin has committed to renewing the groundwater extraction licence. The anticipated yearly water demand for this regulated activity is less than the yearly entitlement.

³ <http://www.ntlis.nt.gov.au/walaps-portal/report/current/gwel>

As described under section 2.1, the proposed offsetting regime of greenhouse gas emissions is consistent with the NT Government's expectations for new large emitting projects to reduce and manage emissions in a way that enables development to occur while contributing to the Territory's emissions target of net zero greenhouse gas emissions by 2050. To support the NT Government's commitment, the NT EPA recommends the interest holder provide to DEPWS annually the actual scope 1 and scope 2 greenhouse gas emissions reported under the National Greenhouse Energy Reporting Scheme (NGERS) and verified by a registered auditor, compared to predicted emissions in the EMP.

The NT EPA is of the view that the sustainable use principle has been considered in assessing the regulated activity.

2.6 Principle of conservation of biological diversity and ecological integrity

The proposed location for the regulated activity does not include groundwater dependent ecosystems; nor is it within proximity to a declared ecological community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

The regulated activity poses a low risk to the ecosystem within the Stuart Plateau bioregion. Given the relatively small area of impact (approximately 111 ha), and the very large area of similar habitat within the region, the regulated activity does not pose a significant risk to any regional populations of threatened species. No core habitat for threatened fauna was identified in the project area, but seven threatened species potentially occur in the wider landscape. Due to the management strategies outlined in the EMP and the relatively small area of impact, it is unlikely that the regulated activity will pose a risk to the identified threatened species.

Avoidance and mitigation measures identified in the EMP are adequate to reduce risks from, for example, vehicle-strike, dust, erosion and/or spills to ALARP, in relation to potential impacts on biodiversity.

The EMP outlines measures to minimise impacts on environmental values, including the management of threatening processes such as erosion, weeds and fire. The proposed management measures are consistent with the requirements of the Code, the *NT Land Clearing Guidelines*, and the *Weed Management Planning Guideline: Onshore Petroleum Projects*. Specific precautions to ensure interaction with wildlife is avoided are included in the EMP. These include: inspections for fauna presence, speed limits on access roads, above ground tanks with raised walls, and daily checks of infrastructure.

The NT EPA considers that implementation of, and compliance with, the EMP will ensure the conservation of biological diversity and ecological integrity is not impacted by the regulated activity.

2.7 Principle of improved valuation, pricing and incentive mechanisms

The interest holder is required to prevent, manage, mitigate and make good any contamination or pollution arising from the regulated activity, including contamination of soils, groundwater and surface waters through accidental spills.

All stages of the regulated activity, including disposal of waste, commercial purchase of groundwater, and progressive rehabilitation of all disturbed areas to an acceptable standard, are at the cost of the interest holder. The interest holder is required to provide an adequate environmental rehabilitation security bond to indemnify the NT Government. This is based on an assessment by the Department of the estimated rehabilitation cost submitted by the interest holder.

The NT EPA is of the view the principle of improved valuation, pricing and incentive mechanisms has been considered in assessing the regulated activity and is based on the interest holder bearing any environmental costs for the activity.

3. Environmental impacts and risks reduced to a level that is as low as reasonably practicable (ALARP) and acceptable (regulation 9(1)(c))

The interest holder has committed to identified measures to avoid or minimise impacts on environmental values, informed by baseline studies, surveys, and data from previous operations in the area. The EMP systematically identifies and assesses environmental impacts and risks associated with the regulated activity. The key potential environmental impacts considered in the EMP are reduction in productivity and viability of soil (soil erosion), impacted flora and fauna (spread of weeds, accidental ignition of fire, poor rehabilitation), disturbance of culturally sensitive areas such as sacred sites (accidental ignition of fire), and increased nuisance from dust and particulate emissions (all regulated activities, accidental ignition of fire)

The EMP demonstrates why the controls to be implemented are considered ALARP and acceptable. Of the 83 environmental risks identified by the interest holder, 71 are considered 'low' risk, and therefore are ALARP and acceptable. The remaining 12 risks are considered 'medium' and the interest holder has included mitigations to be implemented such that the risks will be managed at levels that are ALARP and acceptable. Specifically:

1. *Soil erosion from cleared areas*: sites will be maintained in accordance with the erosion and sediment control plan, clearing of slopes >2% will be avoided, pre- and post-wet season erosion and sediment control inspections will be conducted, rehabilitation monitoring will be done to assess soil productivity impacts and maintenance completed on areas where erosion is occurring.
2. *Introduction and spread of weeds*: all equipment and vehicles will be washed-down and have a Biosecurity Declaration Certificate prior to access to site, areas of proposed exploration have low weed abundance, activity will be restricted to defined lease and camp pads, 6 monthly weed monitoring will be conducted and any weed outbreaks associated with Origin's activities will be treated.
3. *Accidental ignition of fire from exploration activities*: communication and fire response protocols with pastoralists is established, bushfire awareness is included in site inductions, there are designated smoking areas on-site, firefighting equipment is available and fire breaks will be constructed around the lease and camp pads. There will be a 45 meter separation distance between the flares and surrounding vegetation and ignition sources are placed outside of the hazardous area. A fire tender will be utilised during seismic activities, with a spotter to identify and respond to any ignition events.
4. *Poor rehabilitation*: a site specific Rehabilitation Plan has been developed and will be implemented progressively. Vegetation pushed during seismic line preparation will be placed back over cleared areas immediately after seismic recording. Rehabilitation monitoring will be undertaken to track the progress, and maintenance will be undertaken periodically to fix any defects.
5. *Dust from regulated activities*: water trucks will be used to decrease dust emissions, roads will be maintained to prevent bull dust generation and sensitive receptors are located away from the project area. Routine site inspections and assurance will be undertaken to identify and rectify high dust emissions.

The EMP also considers cumulative impacts to groundwater, flora and fauna, greenhouse gases, traffic and social and concludes these have been managed to ALARP and acceptable levels.

The EMP demonstrates how the interest holder will comply with relevant requirements of the Code in undertaking the regulated activity. This includes reference to applicable Australian and international standards that have been adopted for the regulated activity. The EMP cross references relevant sections of the Code that apply to the mitigation and management measures to enable the reviewer to identify and confirm that the proposed regulated activity complies with the Code, and provides management plans that meet the requirements of the Code.

The NT EPA considers that all reasonably practicable measures will be used to control the environmental impacts and risks, considering the level of consequence and the resources needed to mitigate them, and the nature, scale and location of the regulated activity. The NT EPA considers that the environmental impacts and risks will be reduced to a level that is ALARP and acceptable,

considering the sensitivity of the local environment, relevant standards and compliance with the Code.

4. Relevant matters raised through public submissions (regulation 8A)

The EMP was made available for public comment for 28 days from 18 July 2022 to 15 August 2022. A total of 2273 public submissions were received with 2228 (98%) of the submissions originating from the advocacy website GetUp. A total of 58 submissions (2.6%) originated from the NT and the majority (~36%) originated from NSW. All submissions were unique submissions.

All submissions, except for one, were opposed to onshore petroleum development. Submissions raised substantially similar issues as those addressed through the *Scientific Inquiry into Hydraulic Fracturing in the Northern Territory* (HFI) and subsequent implementation of the 135 HFI recommendations, however new matters were raised as well.

Table 2: Consideration of relevant matters raised in public submissions

Theme	Issues raised	Response
Chemicals	<ul style="list-style-type: none"> • Use of rock-dissolving fluoride-containing acid • Consideration of exposure pathways to bats, birds, insects, amphibians and reptiles • Impact of chemicals on human health and environment 	<p>A chemical risk assessment has been completed for all chemicals to be used in drilling and hydraulic fracturing. All chemicals were considered low concern when standard chemical handling, storage and disposal practices were applied. The chemical risk assessment was undertaken in accordance with the Environment Management Plan Content Guideline.</p>
Climate change	<ul style="list-style-type: none"> • Impact on climate change • Impact climate change on Northern Territory • Scope 3 emissions not (adequately) addressed • Lack of a GGAP • Downplay of emissions • Fugitive emissions impact calculation (global warming potential) • Exclusion of wastewater management in estimated GHG emissions (treatment, transport) • Well testing duration (730 days) • Inconsistent emission totals • Inconsistent duration of flaring (average vs. maximum) • Offsetting capacity • Non-credible assertions climate neutrality of gas • Disregard of ESD principles 	<p>The EMP commits to the requirements under the NT Government's Greenhouse Gas Emissions Management for New and Expanding Large Emitters policy. A GGAP has been developed for the regulated activities under this EMP. Emissions have been calculated in accordance with the National Greenhouse and Energy Reporting Scheme (NGERS).</p> <p>The EMP was updated to:</p> <ul style="list-style-type: none"> • include emissions associated with management of wastewater • remove reference to beneficial reuse of gas, which is not allowed for under the current legislation and removal of the proposed well testing duration of 730 days per well. • ensure emission totals are consistent. <p>The EMP is clear maximum flaring period averages 135 days per well.</p> <p>The NT Government's Greenhouse Gas Emissions Offsets Policy is being developed under the Northern Territory Offsets Framework. This policy will guide the use of offsets as a tool to support the decarbonisation of industry in the Territory.⁴ While submissions questioned the credibility of low emission technologies such as carbon capture storage, the EMP itself demonstrates a commitment to minimise emissions to ALARP and acceptable levels and offset residual emissions unable to be avoided or mitigated, in accordance with NT Government's target and policy.</p>
Cumulative impacts	<ul style="list-style-type: none"> • Cumulative impact does not consider other users, water extraction, flora and fauna, and future plans. • Exploration creep • Consideration of Territory Sands water licence • Cumulative waste 	<p>The EMP was updated to provide a description of the cumulative impacts considering activities and users near the permit area for water use and clearing. Future plans depend on the viability of the resource. In the current exploration and appraisal stage, future plans hold no certainty and would heavily impact the accuracy of the cumulative impact assessment if included. The activities proposed are genuine exploration and appraisal activities.</p> <p>Impacts associated with sand mining are regulated under different legislation where it will be required to consider relevant impacts. Similarly, disposal of wastes in another jurisdiction is tightly regulated under legislation of both the originating and receiving jurisdictions.</p>
Flora and fauna (environment)	<ul style="list-style-type: none"> • Lack of baseline assessment (SREBA) • Adequacy of baseline assessment 	<p>A comprehensive Strategic Regional Environmental and Baseline Assessment (SREBA) is being undertaken before granting any production approvals. The baseline assessment undertaken as part of the EMP provides an adequate understanding of the threatened species that may occur in the area of the regulated activities. Implemented mitigation measures, such</p>

⁴ <https://depws.nt.gov.au/environment-information/northern-territory-offsets-framework/greenhouse-gas-emissions-offsets-policy>

Theme	Issues raised	Response
	<ul style="list-style-type: none"> • Threat to listed species • Habitat fragmentation and edge effects not considered • Impacts to important habitat not adequately addressed. • Monitoring and protection of stygofauna • Wastewater storage in open ponds – fauna access • Threats of flaring to birds • Reliance on seed-bearing topsoil previously cleared for rehabilitation 	<p>as visual checks for fauna (habitat) prior to clearing and avoidance of clearing large trees are deemed adequate to minimise potential harm. As the area of suitable habitat proposed to be cleared is very small compared to the area of remaining suitable habitat for the identified threatened species, it is considered unlikely the proposed regulated activities pose a significant risk to the threatened species. The NTG Flora and Fauna division considered that the proposed activities in the EMP do not pose a significant risk to the environment with implementation of the controls proposed. Claims that stygofauna will be significantly impacted by drilling and hydraulic fracturing are not substantiated. The EMP shows that available studies indicate stygofauna are likely to be present at low abundance at the observed groundwater depth within the project area.</p> <p>Previous operations have not identified any significant interaction of fauna with open wastewater storages. It is highly unlikely that offsite impacts to wildlife will be created as a result of noise, light and traffic. The duration of drilling and stimulation activities is short and lighting levels will be minimised to the level required to complete work safely. There have been no reported instances of birds being incinerated by flares during onshore petroleum activities.</p> <p>The rehabilitation plan shows that if required, additional native seed mix from the area could be respread to speed up the rehabilitation process.</p>
Human health	<ul style="list-style-type: none"> • Impacted pregnancies in proximity to gas industry operations 	<p>There is no complete exposure pathway for the community to gas industry operations, with the nearest homestead at 16 km and the nearest community at 50 km.</p>
Regulation and compliance	<ul style="list-style-type: none"> • Proposed beneficial reuse of appraisal gas • Referral under the <i>Environment Protection Act 2019</i> (NT) (EP Act) and the <i>Australian Government Environment Protection Biodiversity Conservation Act 1999</i> (EPBC Act) • Subjectiveness of self-assessment for EP Act referral • HFI recommendations not implemented by Origin • Commitments to other agreements/inquiries outside of the legislative framework • Absence of long-term waste management policy 	<p>The EMP was updated to remove any reference to beneficial reuse of gas, which is not allowed under the current legislation. The EMP is considered by the NT EPA and a full range of NT government agencies. A self-assessment⁵ against both the EP Act and the EPBC Act was undertaken by the interest holder, concluding no referral is required. Additionally, the NT EPA may “call-in” a project that should be referred.</p> <p>Origin’s EMP is consistent with the regulatory framework established by HFI recommendations implemented for exploration activities.</p> <p>Regulated activities are only permitted if conducted in accordance with the applicable legislative framework.</p> <p>Disposal of wastes in another jurisdiction is tightly regulated through the requirements of both the originating and receiving jurisdictions.</p>
Spills	<ul style="list-style-type: none"> • Wet season transport and storage risks • Trucking of large quantities (90 ML) of wastewater • Lack of acknowledgement of change in risk profile resulting from multiple wastewater movements • No consideration of the impact of the changing climate (extreme weather events). 	<p>The EMP was updated to provide the risk assessment for wet season transport. The risk of overtopping of wastewater tanks is minimised by the use of enclosed tank storage and conservative freeboard levels. A water balance is provided, which confirms that the wastewater tanks will have enough capacity to store and treat the wastewater. Topsoil stockpiles around the lease pad prevent overland flow entering the site in the event of a significant regional flood. Flowback fluid will be treated by means of enhanced evaporation, so that the final disposal volume to be trucked interstate is approximately 0.5 ML per site (2 ML total for the 4 well pads). All proposed wastewater movements (trucking between well pads, trucking interstate, transfer between tanks) have adequate mitigation measures in place to minimise the risk of spills during both dry season and wet season conditions.</p>
Social and cultural	<ul style="list-style-type: none"> • Impacts to cultural heritage • Inadequate/lack of consultation with TOs • Risks to local pastoralists not adequately recognised 	<p>A heritage assessment has been undertaken of the project area and the EMP commits to avoiding areas of cultural heritage. No EMP can be approved without provision of an Authority Certificate issued by the Aboriginal Areas Protection Authority, which sets out any requirements and conditions for preventing impact to sacred sites.</p>

⁵ As advised by the [Referring a proposal to the NT EPA](#) guidance

Theme	Issues raised	Response
	<ul style="list-style-type: none"> • Informed consent • Economic benefit 	<p>The EMP includes a stakeholder engagement log, which demonstrates that the interest holder has engaged with a range of stakeholders including direct engagement with the relevant leaseholders, Aboriginal stakeholders and the Northern Land Council. Where required, changes to the EMP were made to address concerns raised during the engagements. Onshore petroleum activities cannot commence unless the identified stakeholders have been properly engaged. For Aboriginal stakeholders the processes administered by the Land Councils under the <i>Native Title Act 1993</i> and the <i>Aboriginal Land Rights (Northern Territory) Act 1976</i> serve to ensure that stakeholder engagement is conducted.</p> <p>Northern Territory businesses have been engaged on the scope of Origin's activities through information sessions and tender opportunities covering a range of material supply and support services, such as transport and logistics, accommodation and food, provision of temporary camps and camp services, civil construction work, freight and transport, water bore drilling and environmental and civil consulting.</p>
Uncertainty in regulated activity	<ul style="list-style-type: none"> • Uncertainty and risk of reusing flowback and produced water. • Acceptability decision-making wet season transport • No assessment of impact to surface water flows from pipelines 	<p>The EMP was updated to address the concerns and comply with the requirements of the Code. Pipelines were removed from scope.</p>
Waste	<ul style="list-style-type: none"> • Reliance on WestRex disposal facility in Jackson, Queensland • Assessment of waste to be disposed, description of waste treatment process at facility and assessment of residual risk • Production of 90 ML of wastewater • Quality of flowback fluid (monitoring and publishing) • Drilling waste management 	<p>The WestRex Jackson waste processing, treatment and resource recovery facility is licensed to receive hazardous liquid, solid and packaged chemical wastes, located to service various waste streams originating predominantly from coal seam gas production and related industries.⁶ Disposal of wastes in another jurisdiction is tightly regulated through the requirements of both the originating and receiving jurisdictions. Flowback fluid will be reused where technically feasible, which will reduce the wastewater volumes produced by the regulated activities. Flowback fluid will be monitored as required by the Code, and a report about flowback fluid will be published on the Department's website.⁷ Drilling waste will be managed in accordance with the Code, and the environmental risks, including the risk of overtopping of the drill cuttings sump, are considered ALARP and acceptable. As required by the Code, disposal of drilling muds at a well site is not allowed unless a suitably qualified third party certifies this will not result in environmental harm.</p>
Water	<ul style="list-style-type: none"> • Impact on water availability • Reliance on Water Extraction Licence for analysis of impacts of extraction • Lack of a water allocation plan • Water licence expiry (Jan 2024) • Contamination of aquifers (through drilling fluid losses) • Inadequate monitoring methods (inconsistent with HFI recommendation 7.11) 	<p>The interest holder has obtained a water extraction licence, which included a detailed assessment of resource availability by DEPWS. The Northern Territory Water Allocation Planning Framework outlines how water is allocated outside of a water allocation plan, which notes that contingent allocation rules are applied in the absence of directly related research. A licence decision must consider the water availability, existing and likely future demand for domestic purposes, any adverse effects likely to be created as a result of the activities under the permit and other relevant factors. This supports the sustainability of the proposed water take despite the lack of a water allocation plan. Flowback fluid will be reused where technically feasible, which will reduce the groundwater volumes extracted for the regulated activities. Origin intends to renew the water extraction after its expiry in 2024.</p> <p>Mitigation measures are in place to minimise any spills or leakages from the activity, and the risk of water pollution has been demonstrated to be ALARP and acceptable. Low toxicity drilling fluids are used during drilling through aquifers, to minimise the impact on groundwater quality during drilling. In the event total losses occur (e.g. in cavernous zones expected in karstic formations), drilling fluid systems are reduced back to water to maintain dynamic well control while minimising drilling additive losses to the formation. Groundwater monitoring will be undertaken in accordance with the Code.</p>
Well integrity	<ul style="list-style-type: none"> • Lack of suitable material to satisfactorily repair damaged well casing • Corrosion of wells 	<p>Wells are designed to be operated such that all materials and equipment installed in a well must maintain well integrity for the lifespan of its intended use. Well integrity will be validated before and after hydraulic fracturing operations, and must be maintained at all times. Petroleum wells are designed with multiple barriers, so that a single barrier failure will not lead</p>

⁶ <https://www.westrex.com.au/our-history/our-facilities/>

⁷ <https://depws.nt.gov.au/onshore-gas/onshore-gas-in-the-northern-territory/industry-compliance-and-reporting/flowback-fluid-monitoring-results>

Theme	Issues raised	Response
		to a loss of containment. Complete well integrity failure where all barriers fail is an extremely rare occurrence in contemporary petroleum wells including shale wells.
Traffic	<ul style="list-style-type: none"> Impact from increased heavy vehicles on roads (damage) 	A traffic impact assessment was undertaken, which found that the total volume of traffic will be considerably lower than the capacity of the Carpentaria highway. Large loads will have their own journey management plan outlining proposed controls such as load constraint and speed restrictions.

5. Other relevant matters

The exact timing of each activity is unknown at the time of preparation of an EMP. The NT EPA recommends the interest holder be required by Ministerial condition to submit an updated timetable at regular intervals, as well as regular updates during operational periods.

Ongoing groundwater monitoring is not prescribed in the Code. Whilst the EMP commits to quarterly monitoring of groundwater after stimulation, the NT EPA recommends a Ministerial condition specifying the timing of groundwater monitoring and the form of the groundwater data, and should be inclusive of an interpretive report and the development of site-specific performance standards.

CONCLUSION

The NT EPA considers that, subject to the consideration of the recommended EMP approval conditions, the EMP:

- is appropriate for the nature and scale of the regulated activity
- demonstrates that the regulated activity can be carried out in a manner that potential environmental impacts and environmental risks of the activity will be reduced to a level that is ALARP and acceptable.

In providing this advice the NT EPA has considered the principles of ecologically sustainable development.

RECOMMENDATIONS

The NT EPA recommends that should the EMP for Origin Energy B2 Pty Ltd be approved, the Minister considers approval conditions to achieve the following outcomes:

1. Provision of quarterly timetable updates and weekly activity reports
2. Submission of an annual environmental performance report to DEPWS to demonstrate the interest holder has met environmental outcomes and complied with the requirements set out in the Regulations, the Code, the ministerial conditions and the EMP.
3. Provision of an annual emissions report to DEPWS that summarises greenhouse gas emissions reported under the Australian Government's *National Greenhouse and Energy Reporting Act 2007* (verified by a registered auditor) versus the predicted emissions in the EMP.
4. Recording of all spills in an internal register that includes location, source and volume of the spill and corrective actions to ensure subject land is free from contamination to meet rehabilitation requirements.
5. Groundwater monitoring to be conducted before, during and after hydraulic fracturing and submission of an interpretive report on groundwater quality based on groundwater analytes specified in the Code.
6. Groundwater level/pressure monitoring at impact monitoring bores to support of section 16 of the *Water Act 1992* (NT) and clause B.4.2 of the Code.
7. Flowback fluid risk assessment and reporting to consider the impacts and risks to fauna and potential for soil and water contamination from a loss of containment.
8. Provision of the results of the seismic charges trial (data quality, environmental impact (including tree health and surface disturbance from the release of the charge)).

A handwritten signature in blue ink, appearing to read 'P. Vogel', with a horizontal line underneath.

PAUL VOGEL AM
CHAIRMAN
NORTHERN TERRITORY ENVIRONMENT PROTECTION AUTHORITY

28 OCTOBER 2022