BENNETT RESOURCES

Valhalla Gas Exploration and Appraisal Program

EPBC Act Preliminary Documentation 2024/10006

Approved for release	Name	Position	Signature
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EXECUTIVE SUMMARY

Bennett Resources Pty Ltd (BNR) has proposed the Valhalla Gas Exploration and Appraisal Program (Proposed Action) within Petroleum Exploration Permit 371 (EP 371), located in the Canning Basin of Western Australia (WA). This initiative is strictly an exploration and appraisal program, not a production venture, and is scheduled to occur over a seven-year period from 2026 to 2033 (subject to approval timeframes). The Proposed Action involves the construction of up to 20 exploration wells across 10 well pads, supported by infrastructure such as access tracks, camps, water retention ponds and produced wastewater ponds. Any future development or production would require separate environmental approvals.

The Proposed Action was referred under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and designated a controlled action by the Department of Climate Change, Environment, Energy and Water (DCCEEW) due to perceived impacts on listed threatened species and communities, National Heritage Places, and water resources. In response, BNR has conducted extensive environmental surveys, technical assessments, and stakeholder engagement to demonstrate that the proposed activities will not result in significant impacts to Matters of National Environmental Significance (MNES).

In terms of biodiversity, although BNR has identified suitable habitat for the Greater Bilby (*Macrotis lagotis*) within the Proposed Action Area, the presence of individuals has not been confirmed even following extensive survey effort. Pre-clearance surveys and buffer zones will be implemented to mitigate any potential impacts, which are considered negligible. The Northern Blue-Tongued Skink (*Tiliqua scincoides intermedia*), listed as critically endangered, is unlikely to be significantly impacted due to the absence of critical habitat and permanent water bodies in the area. Similarly, the Largetooth Sawfish (*Pristis pristis*) listed as endangered is not expected to be significantly impacted, as the only nearby surface water feature, Mount Hardman Creek, will not be impacted by the Proposed Action, is ephemeral and not considered suitable as critical habitat.

Regarding water resources, groundwater drawdown modelling indicates that impacts will be minimal, limited to a 1 millimetre drawdown within 700 metres of abstraction points, with no surface water features located within this zone. Risks to water quality from drilling and hydraulic fracture stimulation (HFS) activities are considered non-credible or remote due to the presence of multiple geological barriers, mitigation measures and robust engineering controls. Infrastructure such as produced wastewater ponds will also be designed to withstand extreme weather events, including 1-in-100-year and 1-in-200 year rainfall, further reducing the likelihood of unplanned environmental impacts.

In relation to National Heritage, the Noonkanbah Gate is no longer physically present and is currently protected by Traditional Owners, who have confirmed that the Proposed Action will not affect the site. Similarly, there is no credible pathway for the Proposed Action to impact the West Kimberley National Heritage Place (WKNHP), and Traditional Owners, whose lands the Proposed Action is located on, have expressed no concerns regarding impacts to cultural beliefs or heritage values that have been raised by DCCEEW.

BNR and the previous operator have engaged extensively with Traditional Owner groups, particularly the Yungngora and Warlangurru people, since 2012. This engagement has included independent expert reviews of HFS activities, the establishment of Land Use and Indigenous Land Use Agreements, and the provision of employment, training, and community support. Other traditional owners have been classified as interested but not directly relevant, and consequently BNR has ensured that information about the Proposed Action is publicly accessible to these groups through a number of channels.

In conclusion, BNR asserts that the Proposed Action is a temporary, non-production exploration program with no significant residual impacts to MNES. Implementation of mitigation measures reduces to the residual risk to negligible; therefore, no environmental offsets are required, and the Proposed Action aligns with the principles of Ecologically Sustainable Development as outlined in the EPBC Act.

TERMS AND ABBREVIATIONS

Term or Abbreviation	Definition
ALARP	As Low as Reasonably Practicable
API	American Petroleum Institute
ATU	Anaerobic Treatment Unit
BNR	Bennett Resources Pty Ltd
btoc	Below Top of Casing
CoPC	contaminants of potential concern
DCCEEW	Department of Climate Change, Environment, Energy and Water
DMPE	Department of Mines, Petroleum and Exploration
DoH	Department of Health
DoIW	Directory of Important Wetlands
DoW	Department of Water
DPIRD	Department of Primary Industries and Regional Development
DWER	Department of Water and Environmental Regulation
EMP	Environmental Management Plan
EP	Environment Plan
EP 371	Exploration Permit 371
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ERD	Environmental Review Document
ESD	Environmental Scoping Document
GDE	Groundwater Dependent Ecosystem
GHGEMP	Greenhouse Gas Environmental Management Plan
HFS	Hydraulic Fracture Stimulation
HHRA	Human Health Risk Assessment
IESC	Independent Expert Scientific Committee
ILUA	Indigenous Land Use Agreements
km	Kilometre
L	Litre
m	Metre
mg	Milligram
ML	Megalitre (1000000L)
mm	Millimetre
MNES	Matters of National Environmental Significance

Term or Abbreviation	Definition
NT	Northern Territory
OSCP	Oil Spill Contingency Plan
PD	Preliminary Documentation
PER	Public Environmental Review
PGER(E)R	Petroleum and Geothermal Energy Resources (Environment) Regulations
PMST	Protected Matters Search Tool
Qld	Queensland
RIWI Act	*Rights in Water and Irrigation Act 1914*
RFI	Request for Information
RNWS	Raising National Water Standards
RTS	Response to Submissions
SDWK	Shire of Derby / West Kimberley
TDS	Total Dissolved Solids
WA	Western Australia
WAC	Warlangurru People
WIR	Water Information Reporting
WKNHP	West Kimberley National Heritage Place
WMP	Well Management Plan
WQPN 26	Water Quality Protection Note 26
YAC and NAC	Yungngora (Noonkanbah) People

1 INTRODUCTION

1.1 Overview

This Preliminary Documentation (PD) has been prepared to support the assessment of Bennett Resources Pty Ltd.'s (BNR) Valhalla Gas Exploration and Appraisal Program (the Proposed Action), under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in conjunction with the EPBC referral 2024/10006, submitted on 16 September 2024.

1.2 BNR's Position Regarding Proposed Action Impacts in Regard to the EPBC Act

1. The Proposed Action is located on an operational pastoral station that runs approximately 10,000 head of cattle. Operational pastoral stations exert pressures on the land that are consistent with the Proposed Action, such as large water abstraction volumes, clearing for access tracks and noise emissions.
2. The Proposed Action is a deep unconventional gas target with natural geological properties that cause any subsurface risks to be at best non-credible and at worst, highly. Specifically, there are multiple impermeable shale layers separating the surface aquifer and the pressures that exist at >2,000 metres (m) deep are such that any faults that could cause vertical migration are self-sealing.
3. The Proposed Action is not a Gas Development. It is an exploration and appraisal activity only. The wells proposed cannot all be drilled concurrently and as such the activity associated with the footprint is limited in scale and duration.
4. The Proposed Action area has14 previously been subject to fracturing activities under the previous license owner where deep wells into the Laurel formation were drilled and fracture stimulated previously with known technology. This was implemented safely, with no impact to Matters of National Environmental Significance (MNES) and with the support of Traditional Owners and which provided valuable data to this assessment. No approval was sought under the EPBC Act by the previous operator when these activities previously occurred as the action did not trigger MNES at the time.
5. Engagement with the Department of Climate Change, Environment, Energy and Water (DCCEEW) has been ongoing, with initial key engagement in 2020-2021. Engagement was in regard to BNR's position that the Proposed Action was unlikely to have a significant impact to MNES as well as BNR's position not to refer the Proposed Action under the EPBC Act (prior to updated triggers being legislated). BNR did not refer the project at this time and has only since referred due to the change in water trigger.

1.3 Proposed Action Approval Background

The EPBC Act establishes a process for environmental assessment and approval of Proposed Actions that have, will have or are likely to have a significant impact on MNES or on Commonwealth land. Under the EPBC Act, a referral to the DCCEEW is required if the Proposed Action has the potential to cause a 'significant impact' on MNES.

For MNES assessed in accordance with the Significant Impact Guideline 1.1 – Matters of National Environmental Significance (Commonwealth of Australia, 2013), a 'significant impact' is an impact that is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.

The Proposed Action was referred on 16 September 2024 for potential impacts to MNES (EPBC No. 2024/10006). On 28 July 2025, the delegate of the Minister for the Environment determined the Proposed Action to be a 'controlled action', which may impact on the following matters protected under Part 3 of the EPBC Act:

Listed threatened species and communities

- Greater Bilby (*Macrotis lagotis*) – Vulnerable
- Northern Blue-Tongued Skink (*Tiliqua scincoides intermedia*) – Critically Endangered
- Largetooth Sawfish (Pristis pristis) – Endangered

Listed migratory species

- Largetooth Sawfish (*Pristis pristis*) – Endangered

National Heritage Places

- The West Kimberley National Heritage Place (WKNHP)

Water resources (that relate to unconventional gas development and large coal mining development

- Fitzroy River and catchment, river tributaries

To allow the Minister (or delegate) to make an informed decision under Part 9 of the EPBC Act, the Proposed Action is being assessed by PD with further information. This PD addresses the additional information requested in the three (3) Requests for Information (RFI) (**Attachment 14**).

BNR has subsequently updated the PD V3 to include further information requested in the RFIs, where it has been deemed reasonable. Where requests were not deemed reasonable, or not considered relevant to the matter, BNR has provided justifications within its responses to DCCEEW (refer to **Attachment 14**).

2 DESCRIPTION OF THE ACTION

This section provides a description of the action for the purpose of responding to RFI item 5. The table below indicates which section of the PD responds to the RFI.

2.1 Proposed Action Summary

The Proposed Action is to complete an unconventional exploration and appraisal drilling and hydraulic fracture stimulation (HFS) program on Petroleum Exploration Permit 371 (EP 371) in the Canning Basin, within the Shire of Derby / West Kimberley (SDWK) in Western Australia (WA). The intent of the Proposed Action is to evaluate the tight gas resource in the region, which has the potential to offer long-term energy security to Australia. The onshore Canning Basin is an early Ordovician to early Cretaceous aged geological basin that covers ~430,000 square kilometres (km^2) in the West Kimberley region. The Proposed Action is targeting hydrocarbons present from the Laurel through to the Devonian Formations, at depths ranging from 2,000 m to 5,000 m below ground level. The main target is the Laurel Formation, with hydrocarbons present at depths between approximately 2,000 m and 4,000 m below ground level.

EPBC Referral 2024/10006 Section 1.2.1 describes the Proposed Action details. For the purpose of the PD, BNR have clarified the proposed infrastructure and distinguished between construction, operation and decommissioning.

As stated in EPBC Referral 2024/10006 Section 1.2.1, the Proposed Action includes the construction of up to 20 exploration wells on 10 well pads, under two phases.

Initially six (6) wells are to be developed under Phase I and are strategically located to de-risk Phase II drilling activities. If Phase I indicates commercial production is potentially economically feasible, it will be followed by the Phase II drilling program involving up to 14 wells to further refine a potential future development scenario. If Phase I is not economically feasible, the Proposed Action will end after Phase I.

Note that this Proposed Action does not cover gas production. It is an exploration and appraisal program only and is to be undertaken in two phases: exploration, then field appraisal (field appraisal being dependent on successful outcomes from exploration). Should a commercially viable resource be identified, BNR will seek additional approvals as required under both federal and state government legislation.

2.2 Proposed Infrastructure

Key civil infrastructure to support the program includes access tracks and well pads. These are engineered gravel roads and hardstands to support the transport and operation of heavy machinery and equipment to and from the well pad. Post development of the roads and hardstand, lined ponds and sumps will be constructed at the well pads. The only additional infrastructure constructed on the well pads will be the wells (wellheads and Christmas trees), groundwater abstraction and monitoring bores and fencing. Machinery and equipment that will be used on the access track and on the well pad include (but is not limited to) heavy earthmoving equipment, a drilling rig, high-pressure pumps, mixing units, command centre, coil tubing unit (or equivalent) and small camps.

2.3 Construction (Site Preparation)

Site preparation for Phase I and then Phase II if viable resources are found comprises:

- Civil activities, including clearing vegetation and constructing well pads

- Constructing well pad ponds, pits, sumps, and well cellars
- Installing groundwater abstraction and monitoring bores.

Following clearance surveys for flora and fauna, native vegetation will be cleared for each well pad, associated access tracks, and the main workers' camp. Cleared vegetation and topsoil will be stockpiled and used for future site rehabilitation. Once cleared, the well pads will be levelled (or graded), sheeted with gravel (or similar stabilising material) to support compressive loads, or stabilised using cement. Well pads will have a firm subgrade and will be flat with a slight taper to allow for adequate site drainage. Civil works will be undertaken using various heavy and light vehicles. A vehicle-mounted diesel tank will likely be used to refuel these vehicles. At least two surveillance groundwater monitoring bores will be constructed at each site. At least one baseline groundwater bore will be constructed at each well site with data collected from this bore prior to drilling activities commencing. The surveillance monitoring bores are planned to be installed down the hydraulic gradient of the well pads, whilst the baseline bore will be installed upgradient, as per the Western Australian Guideline for Groundwater Monitoring in the Onshore Petroleum and Geothermal Industry (DMP & DoW, 2016). Ponds, sumps, and pits to be constructed include:

- Ponds and sumps:

  Water retention and produced wastewater pond

  Drilling fluid and cuttings 'mud sump'
- Pits:

  Well test flare pit

  Vertical seismic profile pit.

2.4 Operations

Operation activities will only start post completion of the site preparation and construction activities, when roads, hardstands and well pads have been developed, decreasing the risk and likelihood of surface spills or leaks entering any water resources.

2.4.1 Drilling Activities

Drilling activities will comprise:

- Mobilising the drilling package, ancillary services, rig camp, personnel, and supplies
- Conducting drilling activities
- Logging activities
- Ongoing subsurface geology assessments
- Casing and suspending the well or, if required, plugging it.

Once the well pads are prepared, various equipment, packages and supplies will be mobilised to site. A small rig camp will be established on the well pad. The rig camp will have a small number of sleeper units housing around eight people, a generator skid, a lunchroom, a training / meeting room, a toilet block, a mud lab / service contractor office and offices for key personnel.

A main workers' camp will also be established. The main workers' camp will house most of the workforce for the duration of activities under the Proposed Action, and will comprise accommodation units, a kitchen, laundry, dining room, utility (with water storage), ablutions and gym facilities.

All electricity on-site will be generated using diesel-powered generators or natural-gas powered generators.

Potable drinking water will either be trucked to location and stored on-site or sourced from groundwater bores on-site and treated on-site using reverse osmosis units. Any spoil generated during the construction of the water bores will be spread in situ—this practice is identical to installing water abstraction or monitoring bores in other industries.

Toilet facilities will either comprise mobile anaerobic treatment units (ATUs) or septic and leach drain systems. The anticipated average daily wastewater volume is estimated to be <400 L/day at the well pad camp and <2,000 L/day at the main workers' camp. If ATUs are used, treated wastewater will be disposed of through sprinkler surface irrigation systems; sewage sludge will be stored and disposed of in accordance with regulatory requirements.

To support drilling and HFS activities, diesel will be stored in bulk at the well pad. It is expected that storage volumes on-site will be ~75,000 L. A trailered tank or skid-mounted fuel cell will be used for mobile refuelling of equipment (e.g., generators and lighting towers) around the well pad.

A designated storage area will be set up on each well pad for storing chemicals and hazardous materials. In accordance with the Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007, a bunded area will store oil, fuel and hazardous liquid chemicals.

When drilling the petroleum wells, each hole section will be drilled using conventional drilling techniques and a low-toxicity mud system. The cuttings produced from drilling will be stored in the mud sump. As each well section is drilled to the section total depth, a casing string will be run and cemented in place, then pressure tests will be done to verify the integrity of the casing string. Both the casing and cement will be designed to enable future decommissioning. **Figure 2-1** and **Figure 2-2** illustrate the indicative well designs for Phase I and Phase II wells, respectively. The vertical depth may change for each well depending on the formation structure and the target interval chosen, and the horizontal length of any laterals may vary up to 5,000 m maximum length, although they are unlikely to be longer than 3,000 m. Drilling is likely to be conducted 24 hours per day.

Throughout the drilling process, data relating to the subsurface geology will be constantly collected, reviewed and assessed to better understand the geology and to inform drilling decisions. Through this process, specific fault zones concerns will be identified and steps taken, including if required, the cessation of drilling and the shutting in of that well, to ensure potential adverse impacts to the environment are kept as low as reasonably practicable (ALARP).

Once the petroleum wells reach total depth and the target formation is evaluated using wireline logging, the final casing string is cemented in place. This method measures the downhole properties and attributes of the Laurel Formation. If technical issues occur during the drilling activity, contingency activities may be required, which may include restarting (re-spudding) or side-tracking the well. A side-track involves drilling a secondary wellbore away from the original wellbore. This may be done to avoid an unusable or inaccessible section of the original wellbore.

Once complete and if required, the wells will be prepared for perforation, HFS treatment, and well testing. The wells will be suspended before any of these activities are conducted. During suspension, the well pads will be regularly inspected and maintenance works undertaken as necessary.

While the Proposed Action covers exploration and appraisal only, should a commercially viable resource be found, it is recognised that any of these wells may form part of a production program in the future. ISO Standard 16530 – 1:2017 will be adhered to throughout the planning, construction, testing and decommissioning phases to effectively manage well integrity during the

well life cycle. All conditions placed on the approved well management plans and drilling approvals required under Western Australian state legislation will be met. This would ensure that well integrity would be continuously monitored so that any well integrity anomalies or failures could be immediately identified and addressed. The well management plans will address:

- Organisational structure and tasks related to well integrity management
- Well barriers/performance standards
- Monitoring and surveillance requirements
- Annulus pressure management
- Well barrier maintenance requirements
- Risk assessments for well barrier failures
- Reporting and documentation of well integrity activities
- Periodic well reviews.

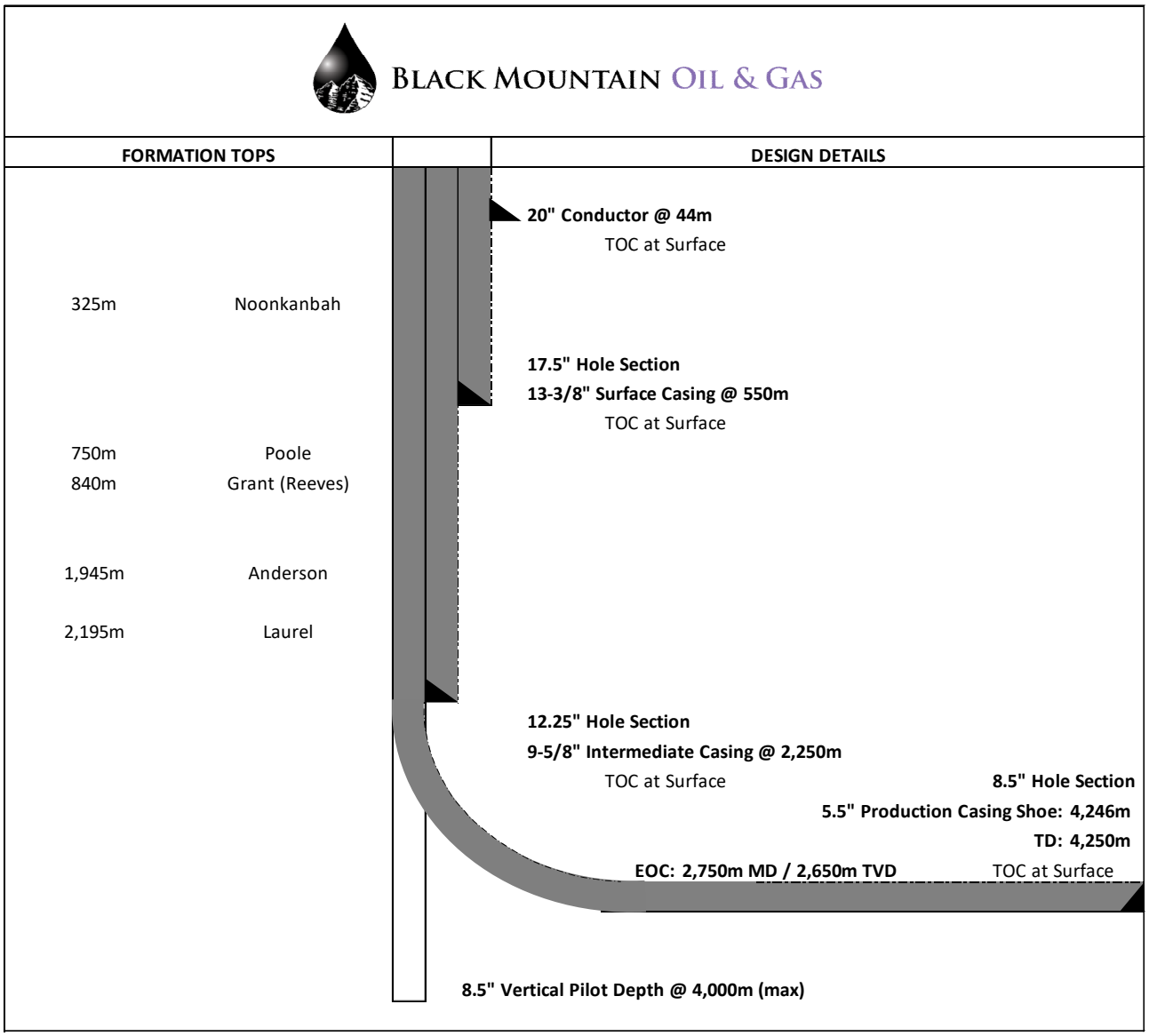

Figure 2-1: BNR Phase I Indicative Well Design

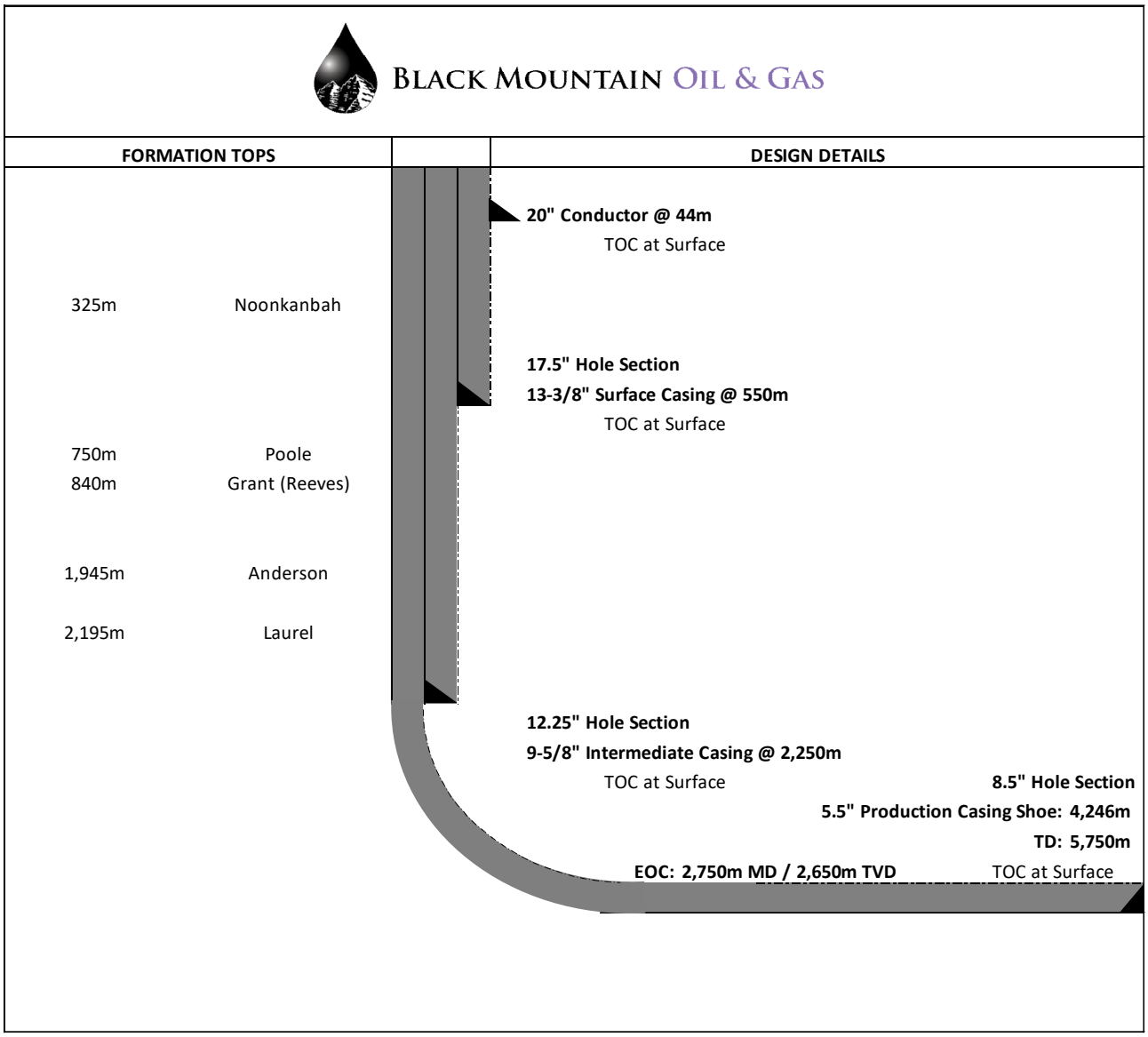

Figure 2-2: BNR Phase II Indicative Well Design

2.4.2 HFS Activities

HFS activities will start only after mandatory monitoring activities have been undertaken in accordance with regulatory requirements.

HFS activities comprise:

- Mobilising HFS spread (equipment), personnel and supplies
- Well perforation and clean-up
- HFS treatment
- Well testing
- Well suspension.

Once the wells are constructed and their integrity is independently[1] validated, the HFS spread, packages, and supplies are mobilised to the site. **Figure 2-3** shows typical surface infrastructure that may be required for the Proposed Action. Approximately 70 personnel are expected to be located at a single well pad during HFS activities. The HFS spread comprises high-pressure pumps, mixing unit (to blend water, proppant, and chemicals), the command centre, and coil tubing unit (or equivalent). All high-pressure surface lines and equipment used (including the wells) will be pressure tested during rig-up to ensure their integrity before HFS commences.

Figure 2-3: Typical HFS Layout

Once the integrity of equipment has been verified, any plugs that have been placed into the well to suspend the well will be removed, with any remnant fluid or cement returned to surface and stored in the mud sump, and the casing perforated to provide access to the target formation. If required, the casing will be perforated at selected intervals, which are currently expected to be 2–100 m apart.

After well perforations are complete and the well is cleaned up, HFS can commence. Water from the water retention pond is pumped into the blenders where the proppants (sand) and HFS chemical additives (dry) are mixed. Chemical additives typically comprise ~2% of the HFS fluid

[1] As per State HFS recommendations.

composition—the system proposed to be used is described in Environmental Review Document (ERD) Appendix A (**Attachment 13**). In accordance with the Western Australian Petroleum and Geothermal Energy Resources (Environment) Regulations (PGER(E)R), the chemical composition of the downhole fluid system will also be assessed by the Department of Mines, Petroleum and Exploration (DMPE).

Once mixed, the downhole fluid system water will be directed into high-pressure pumps where it is then pumped down the well. Each HFS treatment will create hairline fractures in the target formation with the proppant (sand) holding these fractures open, allowing gas to flow to the wellbore. Depending on the well design, the well location and the reservoir response following testing, the wells may receive up to 70 treatments.

Following HFS treatment, the wellbore will be cleaned out with coil tubing (or equivalent), with any remnant fluids or proppant returned to surface and stored in the mud sump. This prepares the well for testing.

The entire well testing manifold from the well to a water retention pond and flare are a closed piping system. During well testing, reservoir fluids, including produced gas, are flowed back to the surface, and directed through three-phase separators (if required) where water, condensate (if present), and gas are separated into their respective phases (**Figure 2-4**). The fate of the three reservoir fluid phases is:

- Gas: any gas is routed to the well test flare, where it is flared off.
- Condensate (liquid): based upon previous characterisation of fluids, low volumes of condensate are expected to be produced (<25 bbl); this will be routed to the well test flare and flared off.
- Water: formation water produced from well testing is stored in a designated double lined wastewater pond and left to evaporate.

In accordance with Water Quality Protection Note 26 (WQPN 26) (DoW, 2013), surface ponds used for short-term containment of wastewater or solids that may leach contaminants, require synthetic membranes and need to meet specific requirements, including:

- All fluid containment liners should have a coefficient of permeability of less than 2×10^{10} m/s
- A minimum thickness of 0.75 mm
- Dual liners
- Leak detection in between liners

All surface produced wastewater ponds will be constructed to meet these requirements. As per WQPN 26 (DoW, 2013), all lined storage compounds should have sufficient freeboard (at least 500 mm) maintained to prevent unintended overflow of water from storms with an average return frequency of at least 20 years, plus capacity to store rainfall resulting from a 90th percentile wet season, after allowing for any evaporative water loss and the effects of any water re-use recovery system.

BNR has utilised standards and guidance documents proposed by the Independent Expert Scientific Committee (IESC) (IESC, 2024a; IESC, 2025) and referencing WA state accepted practices for assessing flood risk and pond design. A water balance assessment and impact assessment (**Section 5.1.2.8**) has been completed based upon an indicative design, noting that on award of a drilling contractor, the assessments will be updated with specific pond designs.

The volume of flowback / produced water is estimated to be in the order of 8 megalitres (ML) per well during the testing phase, however for the purposes of modelling, extremely conservative figures have been used by assuming a 50% recovery of approximately 41 ML per well. An overview of water volumes and proposed uses (site balance) is included in **Section 2.4.3**. Well testing runs for 24-hours a day and is expected to continue for several months. However, at any time during testing, activities may cease to allow equipment to be serviced or a change to occur. BNR has estimated that to collect the required data the well must flow during the period of maximum gas concentration for up to 90 days, which may also occur in stages.

The volume and type of fluid coming back to surface will be monitored and recorded; these data will be essential for determining the quality of the reservoir. **Section 4.2.3** and **Section 4.2.4** have more information about the characterisation of formation water produced from well testing.

Once well testing is complete, the well will be suspended or shut-in, and well test equipment, ancillary services, and personnel demobilised from the site.

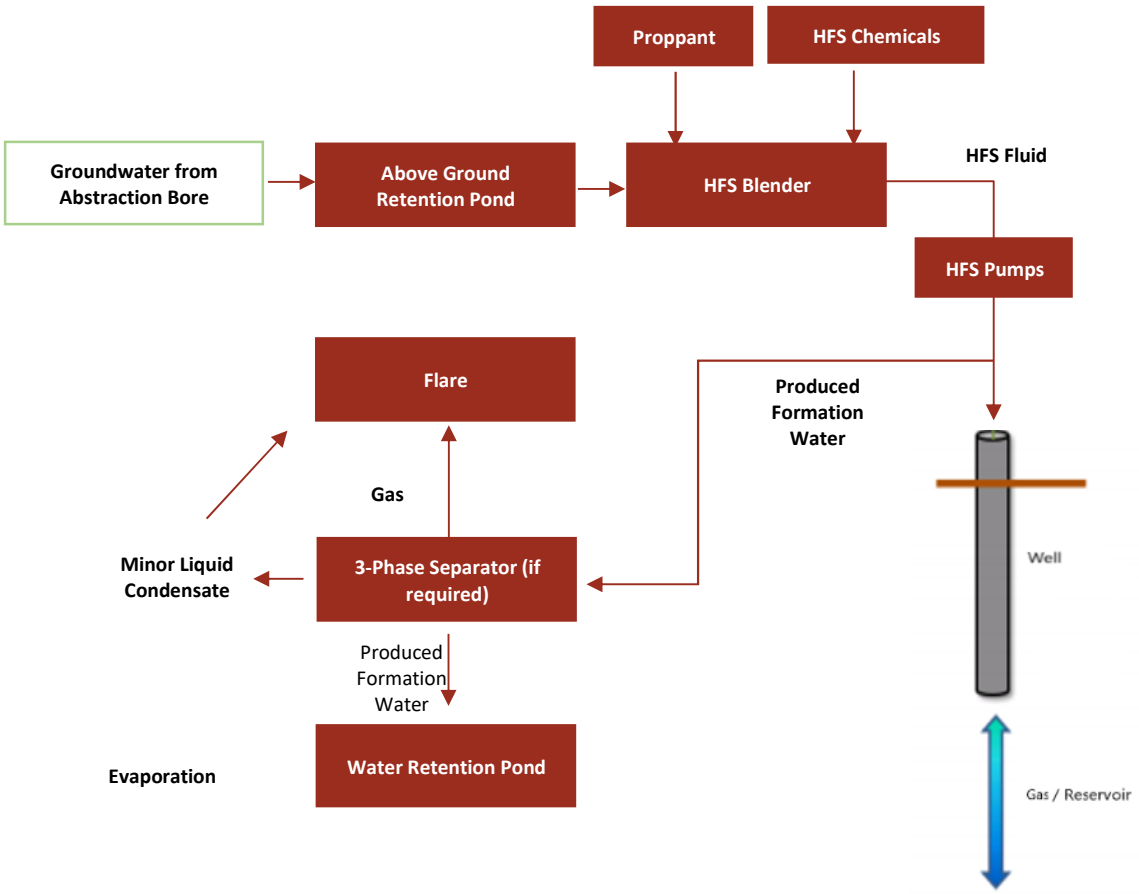

Figure 2-4: Fluids and Gas Cycle During HFS

2.4.3 Water Balance

Indicative site water balances representing the proposed two wells per well pad (**Table 2-1**) and the entire proposed HFS program of 20 wells across 10 well pads (**Table 2-2**) have been provided below to inform the water balance modelling assessed in **Section 5.1.2.8**.

Maximum drilling water use *per well* has been conservatively estimated at 100 ML (calculated at 91 ML, rounded up to 100 ML.

Table 2-1: Site Total Water Balance (based on 2 wells per well pad)

Element	Initial Storage	Initial Volume
Drilling water	Water retention pond[2]	200 ML
Flowback / produced water during HFS Stimulation	Produced wastewater pond	82 ML
Camp	On-site/off-site storage tanks	1.2 ML
Dust suppression / other	Water retention pond	<2 ML
Site total water balance for two wells over multiple years		317 ML

Table 2-2: Site Total Water Balance (entire program x 20 wells over 10 pads)

Element	Initial Volume (per well/one year)	Total Volumes (for 20 wells over 7 years)
Drilling water	100 ML[3]	2,000 ML
Flowback / produced water during HFS Stimulation[4]	41 ML	820 ML[5]
Camp	0.6 ML	12 ML
Dust suppression / other	1 ML	20 ML
Site water balance over 7 years and 20 wells		2,852 ML

2.5 Decommissioning / Site Reinstatement

Decommissioning / Site Reinstatement comprises:

- Suspending or shutting in the wells
- Plugging decommissioned wells permanently with multiple concrete plugs (to ensure the reservoir is sufficiently separated from aquifers and the surface (**Section 2.5.1**)
- Removing all infrastructure from the sites (with the exception of any material as requested by, and agreed with, the pastoral station landholders)
- Sampling pond and sump contents (liquids and solids) to ensure contamination has not occurred, and to address any contamination issues (**Section 2.5.2**)

[2] Fracking of the second well will only occur where the produced wastewater pond has capacity to support the additional produced formation water. Fracking activities (on the same well pad) may be undertaken 1-2 years apart to enable water contents to evaporate.
[3] Refer to Attachment 15 "The sensitivity analysis uses a variety of extraction rates that range from 50% to 300% of the expected extraction rates, with the overall pumping time (182 days) held constant." "For all 36 simulations the modelled drawdowns at each existing bore (see Figure 5-1 for existing bore locations) were 0.01 m or less, which is considered to be less than the resolvable precision of the model and is interpreted to indicate no impact from pumping on existing bores. This suggests that, even with the most conservative conditions, pumping from the proposed bores completed in the unconfined system will not result in any observable impacts to existing bores."
[4] Flowback water will include water present in the reservoir, but mostly comprise water initially pumped into the reservoir during HFS process. Although this water has been "double counted" here in reality, the site balance will likely comprise drilling water (2,000 ML) and flowback water (820 ML).
[5] Note, this figure provides for a 50% recovery over the life of the Program.

- Sampling soil beneath pond liners following their removal, to ensure contamination has not occurred, and to address any contamination issues (**Section 2.5.2**)
- Evaporating, draining if necessary, and backfilling ponds, sumps, and pits (**Section 2.5.2**)
- Ripping and contouring hardstands as required
- Respreading topsoil and stockpiled vegetation

If installed site infrastructure is no longer required after all site activities are completed, then where appropriate, the infrastructure will be demobilised and any areas of disturbance will be reinstated in accordance with any land access agreements (as required under Section 20 of the *Petroleum and Geothermal Energy Resources Act* 1967 (PGER Act), and conditions received through assessment under the EPBC Act. Specifically, it is expected that sites be returned to the pre-industry land use of the pastoral stations dedicated to cattle rearing and as agreed with the pastoral station landholders.

Prior to decommissioning/reinstatement, BNR will sample and analyse pond and sump contents. Residual drilling fluid solid waste and drill cuttings subsoils will be sampled for contaminants of potential concern (CoPC). Soil samples will also be analysed from beneath the produced wastewater pond, sump liners and flare pit to verify contamination from CoPC has not occurred.

Before liners are removed, fluid contained within produced wastewater pond, sumps, and pits will be left to naturally evaporate. The ponds will only have a thin coating of residue and will not comprise a sludge. This residue is then cleaned from the pond liner (scrubbed, contained and removed off-site via small tanks or vacuum trucks given small volumes of residue). Liners are then pulled and disposed of at a relevant waste disposal facility. Management of these wastes will be in accordance with the requirements of the Radiological Council and the Radiation Safety (General) Regulations 1983.

Any previously excavated areas will be reinstated through backfilling with stockpiled topsoil, with any remaining vegetation spread over this area.

2.5.1 Well Decommissioning

If the evaluation confirms the well is not successful, the well will be plugged back with cement as per the regulatory approved well decommissioning program. A preliminary well decommissioning plan will be included in the Well Management Plan (WMP), with the final plan approved by DMPE under the Petroleum and Geothermal Energy Resources (Resource Management and Administration) Regulations 2015 based on the actual results of the drilled well prior to commencement of the well decommissioning process. Specifically, the well-decommissioning objectives and activities that would be undertaken under a typical scenario include the following:

- Install the barrier cement plug (plug #1) above the top of any zones containing moveable hydrocarbons to isolate the well above from the hydrocarbon zone
- Install an intermediate cement plug (plug #2) to isolate any open annulus in the well from the surface
- Install a surface cement plug (plug #3) to permanently isolate the well from the surface environment.

Cement plug thickness is normally a minimum of 30 m for a single barrier and 60 m for common / combination barrier (excluding any length across the zone with flow potential). Once the well is plugged with cement, the wellhead and cellar are left in place, and the drilling package demobilized

from site. Removal of the wellhead and cellar will occur following departure of the rig to coincide with other civil works activity being undertaken at the site.

2.5.2 Produced Wastewater Pond / Sump Decommissioning

Drilling fluids and cuttings will be stored in the mud sump and produced water stored in the produced wastewater ponds. Once the mud sump / produced wastewater pond is no longer required, BNR will allow excess fluids to evaporate from the pond. BNR will then collect a number of samples from within the mud sump / produced wastewater pond (consistent with decommissioning requirements under the *Petroleum and Geothermal Energy Resources (Environment) Act 1967*) and analyse any remnant solid waste for the various characteristics to determine the classification and landfill type that accepts this material. The solids will be removed from the mud sump and where not suitable to be buried in situ (consistent with the Department of Water and Environmental Regulation (DWER) Assessment and management of contaminated sites guidelines (DWER, 2021), will be removed to an appropriate waste disposal facility. The sump / produced wastewater pond liner will be removed when the infrastructure is no longer required and sent for disposal at an appropriate waste disposal facility. On removal of the liners, the soil beneath the liner will be sampled and analysed for potential contaminants. In the event the soil beneath the sump liner is determined as being not suitable to remain in situ, it will be recovered and removed to an appropriate waste disposal facility. The mud sump / produced wastewater pond will then be backfilled using fill remaining from site construction or sourced from deconstruction of the well location as well as the previously removed and tested mud sump solid waste if determined suitable for burial in situ.

Decommissioning will be undertaken following completion of testing at each well site, unless otherwise authorised for continued use, to ensure protection of land, groundwater and surface water values and align with existing land use (noting the existing land is an active pastoral station).

The proposed detailed decommissioning process includes the following steps:

1. **Cessation of Use and Waste Characterisation**

   Upon completion of exploration and appraisal testing, use of the mud sump will cease.

   All drilling fluids, cuttings, flowback fluids and residual liquids will be sampled and classified in accordance with WA waste classification guidelines (DWER, 2019).

2. **Removal and Lawful Disposal of Wastes**

   All contents of the mud sump will be removed.

   Wastes will be transported off-site to an appropriately licensed facility, in accordance with Environmental Protection (Controlled Waste) Regulations 2004 (WA).

   No drilling wastes will be buried or left in situ unless specifically authorised by the relevant regulatory authority.

3. **Liner Removal and Soil Assessment**

   Synthetic liners will be removed and disposed of at a licensed facility.

   The base and walls of the sump / produced wastewater pond will be inspected and sampled to assess potential contamination of underlying soils.

4. **Remediation of Contaminated Land**

   Any contaminated soil will be excavated and remediated or disposed of off-site in accordance with Contaminated Sites Act 2003 (WA) requirements.

Where required, site contamination will be reported to the DWER.

5. **Backfilling and Landform Restoration**

   The sump / produced wastewater pond will be backfilled with clean, suitable material.

   The site will be re-contoured to reinstate pre-disturbance landform and natural drainage patterns, minimising erosion and ponding. Or as agreed in the Land Access Agreement.

6. **Site Reinstatement**

   Topsoil will be replaced where practicable.

   During site reinstatement, it is expected that sites be returned to the pre-industry land use of the pastoral stations dedicated to cattle rearing and as agreed with the pastoral station landholders.

7. **Verification, Monitoring and Closure**

   Post-decommissioning inspections and validation sampling will be conducted to demonstrate compliance with approval conditions.

   Decommissioning will be completed prior to site suspension or progression to any subsequent development phase, unless otherwise approved to be retained for subsequent development phases.

Mud sumps / produced wastewater ponds will not be retained, abandoned or capped in situ in a manner that could cause pollution or environmental harm, consistent with the objects of the *Environmental Protection Act 1986* (WA) (EP Act).

2.6 Location and Boundaries

The location of the Proposed Action is as stated in the EPBC referral 2024/10006 **Section 2.6**. The address is Calwynyardah-Noonkanbah Rd, Mount Hard, Shire of Derby/West Kimberley, Western Australia, in EP 371. The Proposed Action Area is situated in the West Kimberley district (**Figure 2-5**) and is located on Crown Land, zoned for pastoral use. Traditional Owners hold a pastoral lease over the Proposed Action Area.

The Proposed Action Area (in accordance with figures generated in the EPBC Portal) comprises a total area of ~210.91 ha, which includes all well pads, access tracks, camp and the existing road (Calwynyardah-Noonkanbah Road, an existing gravel road which branches south from the sealed Great Northern Highway). The estimated disturbance footprint for the well pads, access tacks and small camps (within well pad disturbance footprint) is ~106.14 ha[6] (according to the EPBC Portal projection). Access to the camp and well pads for personnel, machinery and equipment is via the already existing Calwynyardah-Noonkanbah Rd and access tracks (**Figure 2-5**).

[6] The disturbance footprint slightly differs from the state disturbance footprint given the need to clearly align the disturbance footprint with road reserves and public roads (following discussions with DCCEEW). This does not represent an increased are of native vegetation to be cleared.

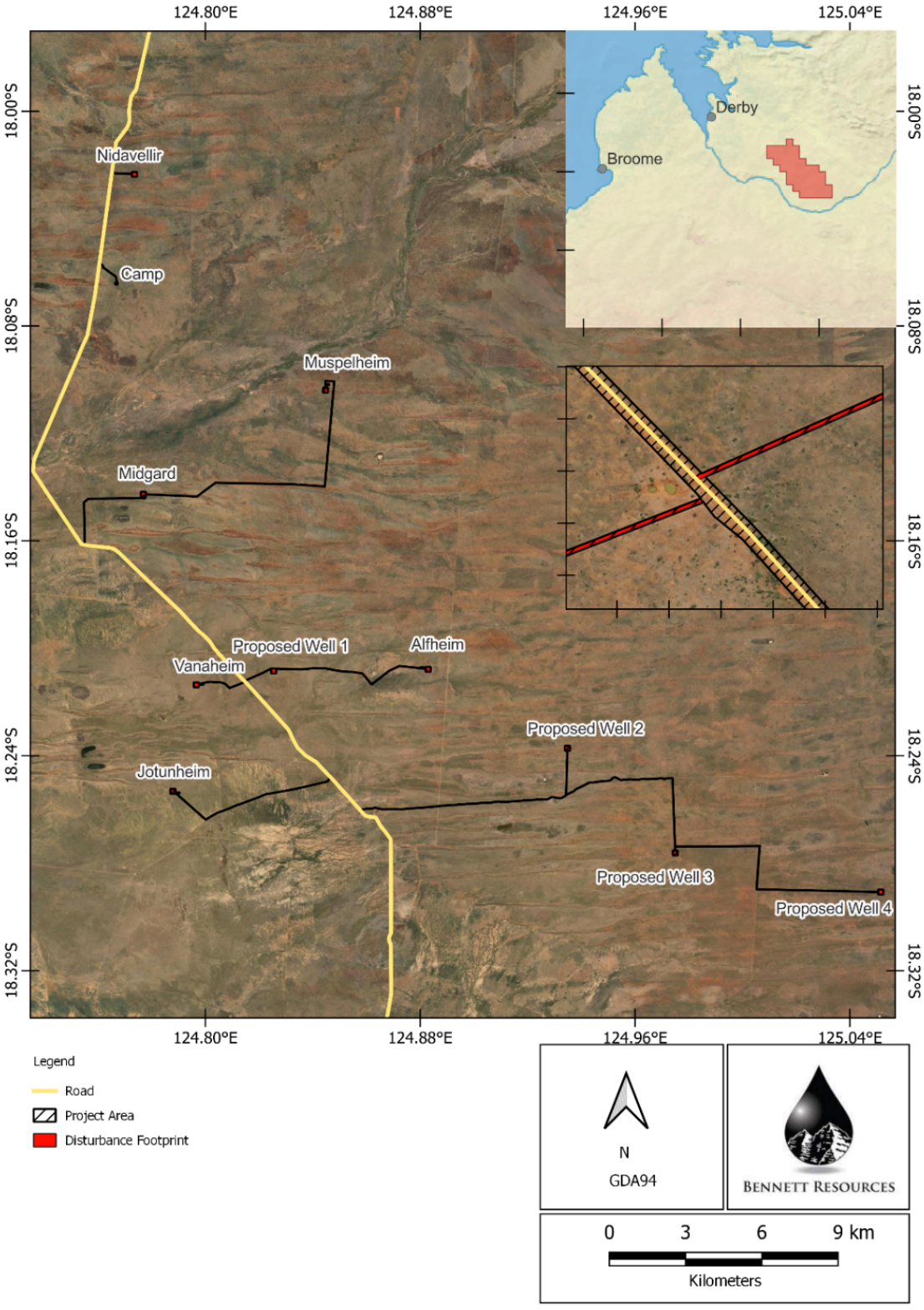

Figure 2-5: Proposed Disturbance Footprint (small camps located on well pads within the disturbance footprint)

2.7 Layout

BNR has not completed detailed design of the well pads. Once the Proposed Action is approved, a detailed design of each well pad will be completed, including the location and dimensions of all ancillary infrastructure and equipment. Well pad design is dependent on which drilling rig is to be selected for use and subsequent placement of the wells on each well pad. Location of the monitoring bores is dependent on location of the well and produced wastewater pond, which will be discussed with and approved by the DWER. However, the parameters or rules where they must be installed are included within this PD.

Notwithstanding the well pad design, BNR can confirm that all the activities and infrastructure associated with the Proposed Action will be located within the approved disturbance footprint, with the potential for environmental monitoring equipment to be located outside of the disturbance footprint to ensure environmental performance of the Proposed Action is sufficiently monitored.[7] An *indicative* layout showing well pad infrastructure is included in **Figure 2-6**.

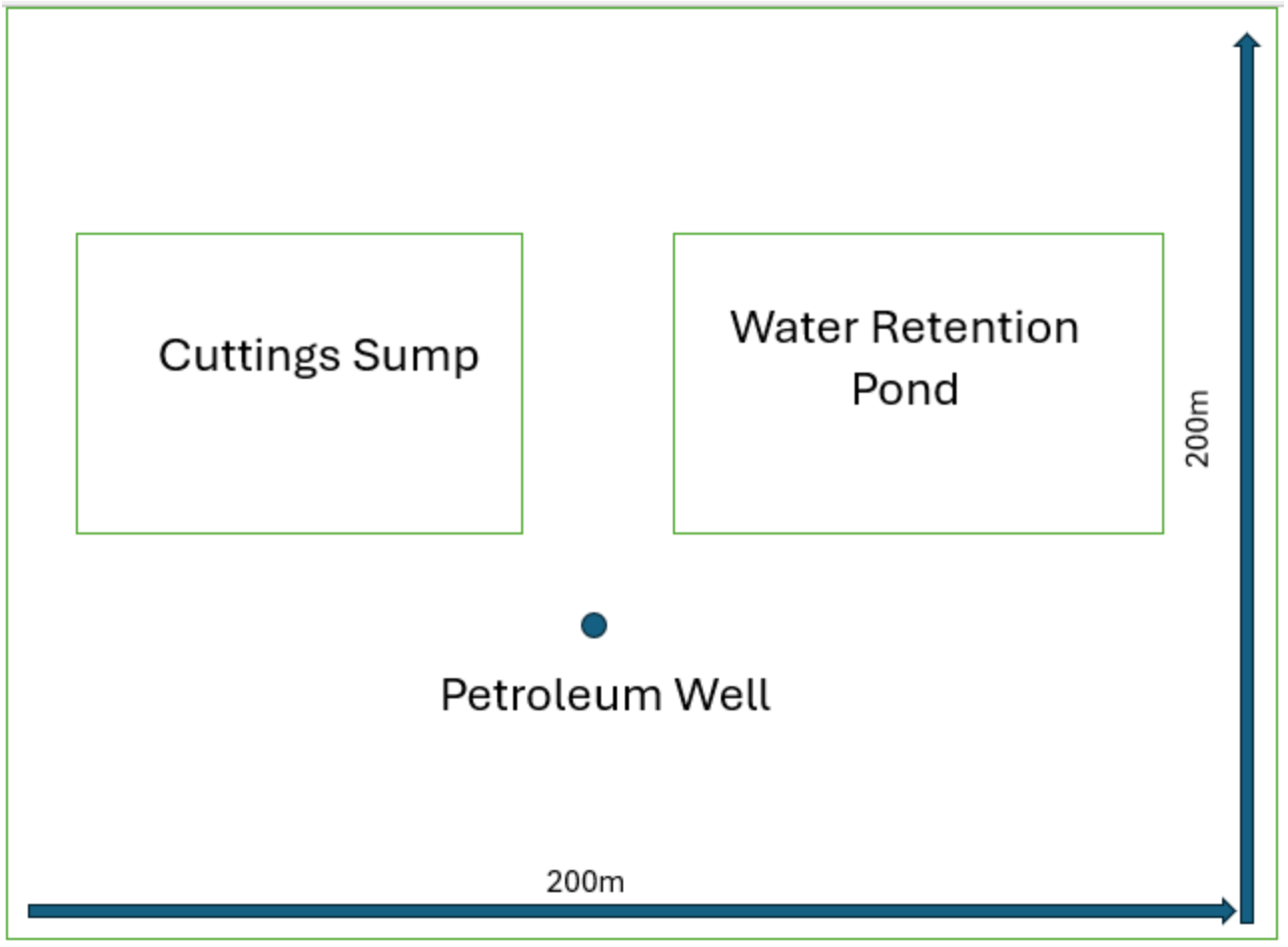

Figure 2-6: Indicative Well Pad Layout

[7] As directed and agreed with DWER and DMPE.

2.8 Timing and Duration

The timing of the Proposed Action is highly dependent on the State and Commonwealth Environmental approvals processes. The intent is to complete both Phase I and Phase II in 7 years. At the time of writing this PD, the estimated dates are 01/06/2027 – 01/06/2034.

Although the Proposed Action is expected to occur over an overall duration of approximately 7 years, it will be implemented as a progressive, well-by-well drilling program, due to drill rig and personnel constraints, regional weather and local conditions at each well pad. Up to two exploration wells may be drilled consecutively at each well pad.

Once BNR has received approval under the EP Act and EPBC Act, BNR will commence seeking secondary approvals under other pieces of State Legislation including the PGER Act, *Rights in Water and Irrigation Act 1914* (RIWI Act) and Planning and Development Acts. BNR will then start to engage partners to support the detailed design and execution of the activity; this will involve completing detailed well engineering, civil engineering and reviewing available materials and equipment.

2.9 Rehabilitation

If installed site infrastructure is no longer required after all site activities are completed, then where appropriate, equipment will be demobilised and any areas of disturbance will be reinstated in accordance with any land access agreements (as required under Section 20 of the PGER Act).

Topsoil is to be respread, and rehabilitation sites actively monitored to ensure they meet the required completion criteria. Specifically, completion criteria will be developed to ensure that rehabilitation is conducted to enable long-term land use to continue.

Rehabilitation completion criteria are documented in an Environment Plan (EP) that is required to be accepted by DMPE under the PGER Act prior to activity commencing. This will be monitored and reported on annually to multiple state government agencies, including DCCEEW.

Please note at the time of writing this PD, an EP has not been developed with rehabilitation completion criteria given BNR is still progressing through primary approvals.

Where exploration activities are successful and retaining existing infrastructure can minimise the environmental impact of future development, infrastructure will be maintained in a care and maintenance state under the PGER Act, regulated by DMPE.

2.10 Alternatives

The Proposed Action is an exploration and appraisal program. The key intent of the Proposed Action is to gather information to inform future development concepts of which specific options analysis can be conducted. Consequently, BNR does not believe that the nature of the Proposed Action requires a detailed alternative analysis process to be completed as per the RFI (**Attachment 14**) and has included our description of key alternatives considered during the initial exploration Proposed Action definition and design over 5 years ago:

- Vertical versus horizontal well design
- Staging the program
- Well testing philosophy
- Well pad selection.

2.10.1 Vertical Well Versus Horizontal Well Design

The benefit of horizontal well design is in reducing surface impact, multiple wells can be clustered on a single well pad, which allows multiple subsurface targets to be tested. BNR has chosen a horizontal well design to limit the environmental footprint associated with this Proposed Action. As a result, BNR has halved the surface impact by using up to 10 well pads for up to 20 exploration and appraisal wells. However, should a vertical well be considered preferable for appraisal purposes, horizontal drilling may not occur at all well pads or for all wells.

2.10.2 Staged Approach

As detailed in **Section 2**, BNR has separated the Proposed Action into two phases. The initial phase (Phase I) is to identify the minimum number of wells and spacing throughout the Proposed Action Area to confirm that commercially viable resources are present. This should be achieved through the drilling of six wells. At the completion of Phase I, if the outcomes of the exploration and appraisal program and subsequent economic modelling indicate commercial production is not feasible, Phase II (up to 14 wells) will not be undertaken. By minimising the number of wells required to achieve Phase I objectives, BNR has minimised the potential impacts if Phase II is not implemented.

2.10.3 Well Testing Philosophy

The main options or alternatives to reduce environmental impact associated with this Proposed Action relate to the well testing operations and the ability to prevent or reduce flaring activities. As detailed in the Greenhouse Gas Environmental Management Plan (GHGEMP) (**Attachment 13** – Appendix R) for the Proposed Action, BNR is continuing to investigate alternatives to flaring gas during well testing. The practicability and feasibility of implementing these alternatives will be further clarified as the design progresses.

The GHGEMP is intended to be dynamic and may be updated to reflect changes in management practices and the natural environment over time. It will be reviewed on a 5-year cycle. This approach will allow flexibility to adopt new approaches / management measures. The effectiveness and relevance of trigger level and threshold contingency actions will be evaluated on an annual basis, and any amendments to response actions will be completed on an as-needed basis.

2.10.4 Well Pad Selection

Multiple constraints must be considered when locating well pads, including environmental sensitivities, proximity to social receptors, native title boundaries, and geological prospectivity. BNR conducted ecological surveys and heritage surveys to understand the potential environmental and cultural sensitivities that have the potential to be impacted. Based on this data, BNR re-aligned access tracks to prevent impacts to conservation significant species, surface waters and cultural heritage.

Optimal well pad selection enables environmental impacts to be minimised, as they have been for this Proposed Action. The entire area of proposed surface disturbance has been covered by flora and fauna surveys as well as detailed heritage surveys. In addition, BNR intends to undertake further pre-clearance surveys to ensure impacts are avoided.

The geological prospectivity of an area is identified by acquiring and interpreting seismic data. This data enables geological prospects to be mapped and the subsequent well locations and appropriate design to be identified. For this Proposed Action, the underlying geological formations were studied to understand the depth and thickness of the target Laurel Formation, as well as the depth of various formations to useable aquifers. This information is calibrated to data collected

from petroleum wells drilled near the Proposed Action Area, which provides more accurate information on the formation depths.

3 STAKEHOLDER ENGAGEMENT

This section provides details on engagement with Traditional Owner groups. It defines the methods, definitions and tests that were used to classify stakeholders into suitable groupings that would enable robust practical and high-quality engagement to occur. This information is closely linked to **Section 5**, which discusses the potential direct and indirect impacts associated with the Proposed Action.

3.1 Key Stakeholder Identification

To guide BNR's classification of stakeholder relevance, a number of pieces of legislation and guidelines were reviewed to inform the definition of relevance and guide the subsequent tests that should be applied. As identified by DCCEEW in the RFI (**Attachment 14**) (and statement of reasons), the Interim Engaging with First Nations People and Communities on Assessments and Approvals under the EPBC Act states that:

> "Proponents should ideally engage directly and actively with the relevant First Nations people"

However, no guidance is provided regarding the classification of relevance. Further to this, no definition is provided in the interim guidelines nor the EPBC Act as to how to delineate who is relevant to the Proposed Action and who is merely interested.

Under the Western Australian State Approvals processes, DMPE provides the following definition of stakeholder relevance to support stakeholder engagement for petroleum activities (DMIRS, 2022):

> *'any person or organisation whose functions, interests or activities may be affected by the proposed activities.'*

Given that this definition is consistent with the *Offshore Petroleum and Greenhouse Gas Storage Act 1999* definition of stakeholder relevance through which the powers of the EPBC Act are conferred (and under which these very definitions have been subject to recent case law), BNR adopted this definition to inform which stakeholders were classified as relevant to the Proposed Action. All other stakeholders were classified as "Interested". The method for engagement and engagement effort for these two stakeholder groups is detailed in **Table 3-1**.

Table 3-1: Stakeholder Definition, Engagement Method, and Effort

Category	Definition	Engagement Method	Engagement Effort
Relevant Stakeholder	*'Any person or organisation whose functions, interests or activities may be affected by the proposed activities'*.	Active direct engagement, face to face, workshops, community sessions, provision of independent expert analysis (outside of Proponent influence).	High
Interested Stakeholder	All other interested parties not deemed to be relevant.	Passive indirect engagement. Provision public information via • Black Mountain Energy's website • the EPA's website • DCCEEW's website • the Derby Public Library • Fitzroy Crossing Public Library • Broome Public Library • State Library of Western Australia. • 2-month public comment period (via regulatory approval processes)	Low

3.1.1 Relevant Stakeholders

To inform which stakeholders were relevant to the Proposed Action, BNR classified relevant stakeholders as those whose interests, functions and activities had the potential to be impacted (directly or indirectly) by the Proposed Action. All credible impacts and indirect impacts associated with the Proposed Action were identified, modelled and mapped. These were all identified as being limited to the Proposed Action Area.

The Proposed Action Area is within the SDWK in the broader West Kimberley region. It is characterised by semi-arid rangelands, which are areas of open country used by pastoralists and Traditional Owners for various activities, including grazing cattle and hunting and collecting bush foods.

The Proposed Action overlays:

- Two pastoral stations (leased Crown land)—Blina Station and Noonkanbah Station
- Two registered Native Title groups—the Warlangurru People (claim application WAD509/2015, also known as the Warlangurru 1 claim) and the Yungngora (Noonkanbah) People (determination application WAD6229/1998, also known as the Yungngora Native Title Determination) (National Native Title Tribunal, 2025)

Consequently, BNR classified Relevant Stakeholders associated with the Proposed Action to be:

- Warlangurru People (WAC)
- Yungngora (Noonkanbah) People (YAC and NAC)
- Blina Station
- Noonkanbah Station.

3.1.1.1 Interested Stakeholders

BNR did not identify Traditional Owner groups located outside the Proposed Action Area as relevant stakeholders for this assessment, as these groups do not have interests, functions, or cultural responsibilities that extend into, or interact with, YAC/NAC or WAC country and BNR are certain there are no credible pathways (refer to impact pathways assessed in **Section 5.1**) for potential impacts from the Proposed Action to intersect any other Traditional Owners lands. This is consistent with the EPA Assessment 1800 (EPA, 2026). While BNR acknowledges that neighbouring groups may express views regarding the Proposed Action, BNR's consultation with YAC/NAC and WAC has consistently indicated that these groups consider themselves the appropriate decision-makers for their own country.

This context is important, as DCCEEW's position in paragraph 110 of the Statement of Reasons appears to rely on comments from the Kimberley Land Council suggesting that BNR did not engage with all relevant stakeholders. BNR considers this conclusion inconsistent with the stakeholder engagement principles that emphasise long-term, transparent, and trust-based relationships. Over many years, BNR has maintained ongoing engagement with the Traditional Owners of the country on which the Proposed Action is located. Their views differ from those expressed by DCCEEW and the Kimberley Land Council.

Recent engagement has reaffirmed that Traditional Owners are well informed about the direct and indirect impacts of the Proposed Action, given their involvement since activities commenced in 2012. They have continued to express the view that they are best placed to assess the impacts on their country and consider it important that the government recognises and respects the stakeholder engagement processes undertaken by BNR. Traditional Owners have also noted that while neighbouring communities may have an interest, they are located at significant distances from the Proposed Action Area, and that the Proposed Action and all potential impacts are confined to YAC/NAC/WAC land. YAC, NAC and WAC have emphasised that they speak for their own country in accordance with their cultural responsibilities.

BNR acknowledges the rights of Traditional Owners to make decisions regarding their country and recognises that cultural authority is place-based. For this reason, Traditional Owner groups outside the Proposed Action Area have been categorised as interested stakeholders rather than Key Stakeholders. These groups were provided with access to all Proposed Action information through multiple publicly available channels, including the Black Mountain Energy website, the DCCEEW website, the Derby Public Library, Fitzroy Crossing Public Library, Broome Public Library, the State Library of Western Australia, and the EPA website.

The proposed action was subject to State-based consultation requirements EPA Assessment number 2281, including statutory notification and invitation for submissions. This process:

- Was publicly advertised (available for a public review for a period of 8 weeks from 12 August 2024, closing on Monday, 7 October 2024).
- Was not geographically limited to mapped development boundaries.
- Allowed any individual, organisation, or Traditional Owner group to lodge submissions.

Importantly, the State consultation framework does not restrict participation to overlapping Native Title holders. As such, Traditional Owner groups with cultural, historical, or kinship connections extending beyond the defined Proposed Action Development Envelope were afforded equal opportunity to engage.[8]

[8] This includes BNR's State response to public comments, which addresses all submissions from the public, including members of the public not directly impacted by the Proposed Action.

Future public consultation on the PD is also legislated and will also extend beyond the defined Proposed Action Development Envelope and will be afforded equal opportunity for interested persons to submit their objections to the Proposed Action on the basis of impacts to MNES identified under the EPBC Act.

BNR is confident that this satisfies Commonwealth expectations that consultation consider cultural connection and authority, not based solely on tenure or spatial overlap.

3.2 Historical Traditional Owner Engagement

BNR has been granted approval to summarise the views and expressions of the Traditional Owners shared during consultation and subsequent engagement.

Consultation with Traditional Owners has occurred in accordance with the Interim Engaging with First Nations People and Communities on Assessments and Approvals under the EPBC Act (DCCEEW, 2023) and has engaged with the Traditional Owners and communities respectfully and effectively, ensuring:

- Cultural safety and respect
- Building and maintaining trust
- Engaging early and often
- Enduring suitable timeframes and respect of all cultures and opinions
- Ensuring material is presented in a suitable format.

Consultation with relevant Native Title groups has occurred at a pace dictated by the Traditional Owners and translators have been used where required. This has allowed Traditional Owners time to digest the information provided, discuss it with their community, and make informed decisions. Engagement with the Yungngora Community (Yungngora and Warlangurru people) started in 2012 and has followed two engagement phases:

- Planning phase
- Inform / consult phase.

During the planning phase, a ‘Gas Roadmap’ document was developed with the Yungngora Community. This document sought to set environmental, cultural/social, and economic objectives for the native title groups through the exploration, appraisal, and development of the tight gas resource. The Gas Roadmap process was used to guide community engagement through the various stages of field development, including exploration and appraisal.

During the Inform/Consult phase of engagement, an independent specialist review process was used to enable the Yungngora Community to make an informed decision about HFS activities on EP 371. This process provided access to advice from independent experts in the fields of groundwater, petroleum engineering, HFS-specific risks, and community engagement with Traditional Owners.

The Yungngora people selected their own independent specialists, who were given access to all relevant approvals documents and who reviewed the proposed activities, specifically HFS activities. The previous operator provided funding for the review, but the reviews were undertaken independent of that petroleum company unless requested by the community. The process ran for approximately seven months and included collaborative risk workshops, community meetings and information sessions with the community.

Independent specialist reviewers presented the outcomes of their review to the community and demonstrated that the 2015 HFS program would have very low risk to the environment and social values. After the presentation was complete, the community voted overwhelmingly to support the tight gas program, which included HFS activities.

Ongoing engagement has been formalised through separate land use agreements with the native title groups. Specifically, BNR has separate land use agreements in place with Yungngora and Warlangurru native title groups. Amongst other things, these agreements provide for the support of the Yungngora and Warlangurru people in the future grant of tenure required for the further development of gas resources in the area. The agreements include financial and other benefits to the native title groups and include structured processes for managing cultural, heritage, and environmental matters. The agreements also focus on employment and training opportunities for the Traditional Owners."

In addition to formal stakeholder engagement with the relevant native title groups, BNR submitted the state ERD to the EPA. The ERD was made available for public review over an eight-week period, from 12 August 2024 to 7 October 2024. During this time, ANY individual or group had the opportunity to submit formal comments to BNR. On 9 December 2024, EPA Services within the DWER provided BNR with a summary of the public submissions received. BNR subsequently responded to these submissions, and its responses were considered as part of the state's environmental assessment process. The public submissions and BNR responses will be published by the EPA.

Through the Commonwealth process, BNR will publish the PD for public review upon approval by the Minister or their delegate. This process once again ensures that ANY individual or group not previously identified as relevant stakeholders has the opportunity to review the document and provide formal comments.

3.3 Stakeholder Consultation Overview

For further information regarding stakeholder consultation, refer to **Table 3-2**.

Table 3-2: Stakeholder Consultation Overview

Stakeholder	Method of Engagement	Date of Engagement	Summary of Engagement
Office of Water Science (DCCEEW)	Teams	10 February 2026	The meeting was to provide the proponent an opportunity to raise any queries as a result of the comments provided by DCCEEW (on DP V2) and for Office of Water Science to answer any technical questions regarding said queries.
Office of the Appeals Convenor	Teams	4 February 2026	Introduction meeting and overview of state appeals process.
DCCEEW	Teams	Fortnightly 2025 / 2026	Fortnightly meeting to discuss issues / queries and align deliverables.
DCCEEW	Teams	5 June 2025	BNR discussed the DCCEEW Request for Information scope, asked clarifying questions on next steps with DCCEEW personnel.
DMPE	In person	22 May 2025	BNR met with DMPE leadership and provided a Proposed Action and company update.
NAC	In person	20 May 2025	BNR attended a training school session being held in Noonkanbah and interactively connected with community members. A Proposed Action update was provided.
EPA	In person	19 May 2025	Traditional Owners and BNR hosted an EPA delegation. The EPA delegation viewed existing well pads, viewed future drilling locations and interacted extensively with YAC & WAC Traditional Owners).
NAC	In person	19 May 2025	BNR representatives hosted morning tea for anyone in community to attend. Morning tea was well attended by YAC, WAC and NAC board members and community members and was very interactive. A NAC director provided an address and BNR provided a Proposed Action update and answered questions.
YAC & NAC	In person	16 May 2025	BNR attended a combined YAC & NAC board meeting and provided a Proposed Action update. Next steps were discussed and questions answered. Board members expressed strong support for progressing the Valhalla.
EPA	In person	13 May 2025	BNR met with the EPA Chair and EPA Services staff. Proposed Action status and next steps discussed.
WAC	Phone call	9 May 2025	BNR spoke to WAC representative regarding the upcoming EPA delegation visit and provided a Proposed Action update and an update on the State and Commonwealth approval status.
YAC/NAC	Email	30 April 2025	BNR sent YAC/NAC DCCEEW Request for Information materials and noted the Traditional Owner engagement questions.
YAC/NAC	Email	22 April 2025	BNR received email from YAC/NAC confirming directors' availability for EPA delegation visit.
YAC/NAC	Phone call	2 April 2025	BNR called and spoke to YAC/NAC CEO and provided an overview and update on the approval process with the EPA and DCCEEW.
WAC	Phone call	25 Feb 2025	BNR notified WAC leadership that a new WAC site inspector for Valhalla well pads is starting.

Stakeholder	Method of Engagement	Date of Engagement	Summary of Engagement
WAC	Email	22 Jan 2025	BNR received confirmation from WAC board providing consent for invitation to be extended to the EPA Chair and EPA delegation to visit Noonkanbah and the Proposed Action Area.
YAC	Email	13 Dec 2024	BNR received email confirmation from YAC Chair & CEO confirming support and approval for EPA Chair and EPA delegation to visit Noonkanbah and the Proposed Action Area.
DCCEEW	Email	9 Dec 2024	BNR received acknowledgement of submitted EPBC Referral.
EPA Services	Email	9 Dec 2024	BNR received a letter from EPA Services which provided a summary of submissions relating to the public review of the ERD for the Valhalla Proposed Action.
DCCEEW	Phone calls, emails, and meetings	Nov 2024 to 9 Dec 2024	BNR was in regular contact with DCCEEW regarding the Referral process.
DMPE	In person	22 Nov 2024	BNR met with DEMIR's Market Development and Coordination Division to provide an introduction to the Canning Basin and Valhalla.
Ministers	In person	21 Nov 2024	Traditional Owners and BME met with the Minister for Environment and the Minister for Mines and Petroleum.to provide a Proposed Action overview and discuss issues to date. Traditional Owners spoke about their aspirations for their communities and their support for the Proposed Action.
EPA	In person	20 Nov 2024	Traditional Owners and BME met with the EPA Chair and EPA Services staff and discussed the Valhalla Program. Traditional Owners spoke about their aspirations for their communities and their support for the Proposed Action.
EPA Services	Email	21 Oct 2024	BNR received an email with redacted public comments on the ERD.
Bunuba	In person	17 Oct 2024	BNR met with members over lunch (including some Bunuba board members) in Fitzroy Crossing. Bunuba members provided a community update and BME provided a Proposed Action update.
YAC	In person	16 Oct 2024	BNR representatives took YAC Rangers out to Asgard for water sampling and an introduction to environmental science.
WAC	In person	16 Oct 2024	BNR representatives were invited to provide a Proposed Action update at WAC community meeting (board members and community members in attendance).
YAC	In person	16 Oct 2024	BNR representatives were invited to provide a Proposed Action update at YAC community meeting (board members and community members in attendance). A Proposed Action update was provided along with an introduction to environmental science session.
EPA	Teams	14 Oct 2024	BNR representatives met with EPA Services on next steps and questions.
Bunuba	Email	8 Oct 2024	BNR exchanged email with Bunuba representative on getting together. Bunuba member asked about ERD materials, and they were steered to BME (BNR's) website for access to all ERD materials.
DCCEEW	Email	4 Oct 2024	BNR received notification from DCCEEW of the withdrawal of the originally submitted Referral.

Stakeholder	Method of Engagement	Date of Engagement	Summary of Engagement
DCCEEW	Email	9 Sept 2024	BNR made payment for Referral lodgement. Receipt received.
DCCEEW	Email	27 Sept 2024	BNR received invoice notification for updated Referral submission.
DCCEEW	Teams	3 Sept 2024	BNR met with DCCEEW staff to discuss submission and ask questions around the guidelines.
DCCEEW	Teams	31 Aug 2024	BNR meet with DCCEEW representatives to answer questions around referral submission and our approach.
YAC/NAC	Phone call	30 Aug 2024	BNR received a phone call from YAC/NAC chair. Chair offered a community update which included a community member passing. A Proposed Action update was provided.
DCCEEW	Email	28 Aug 2024	BNR received information from DCCEEW on how to withdraw the original Referral.
WAC	Phone call	27 Aug 2024	BNR representative called WAC representative to provide a company and Proposed Action update and received a general community update, as well as discussing possible dates to visit Noonkanbah.
YAC/NAC	Phone call	27 Aug 2024	BNR representative called YAC/NAC CEO and provided a company and Proposed Action update and received a general community update.
EPA	In person	5 Aug 2024	BNR representative met with EPA chair and EPA Services staff to discuss the Proposed Action and ask/answer questions.
WAC	Email	7 Aug 2024	BNR contacted the WAC community to notify them of upcoming well check and maintenance program. Support given.
YAC	Email	7 Aug 2024	BNR contacted the YAC community to notify them of upcoming well check and maintenance program. Support given.
DCCEEW	Email	29 July 2024	DCCEEW representatives noted receipt of referral.
EPBC Referral	Email	24 July 2024	BNR received notification of 'Receipt of Referral' and that the proposed action has been published on the Department's website for public consultation.
EPBC Portal	Email	24 July 2024	BNR received notification that the Valhalla Gas Exploration and Appraisal Program has progressed to Referral Decision and the department is still continuing to assess the application.
EPBC Portal	Email	24 July 2024	BNR received notification that the Valhalla Gas Exploration and Appraisal Program has received the decision of Referral Validation – outcome of Referral Valid.
DMPE	In person	23 July 2024	Traditional Owners from the Proposed Action Area met with DMPE leadership to provide introductions, share aspirations for their community. BNR representatives provided a company and Proposed Action update.
Minister	In person	23 July 2024	Traditional Owners with BNR in attendance, met with the minister for Police, Road Safety, Tourism. The Traditional Owner delegation, along with their legal representative, addressed their aspirations for their community and its future. Area challenges were specifically discussed. Traditional Owner strongly advocated for Valhalla. BNR representative provided a company and Proposed Action update and noted concern around the approval timeframe.

Stakeholder	Method of Engagement	Date of Engagement	Summary of Engagement
Minister	In person	22 July 2024	Traditional Owners, with BNR in attendance, met with the Minister for Education, Aboriginal affairs, Citizenship and Multicultural Interests. The Traditional Owner delegation, along with their legal representative, addressed their aspirations for their community and its future. Area challenges were specifically discussed. Traditional Owners strongly advocated for the Valhalla Proposed Action. BNR representative provided a company and Proposed Action update and noted concern around the approval timeframe.
Blina Station	Phone call	17 July 2024	BNR representative notified Blina Station of upcoming survey work.
DCCEEW	Teams	16 July 2024	BNR representative met with DCCEEW persons for some Proposed Action clarification questions.
YAC/NAC	Phone call	16 July 2024	BNR representative spoke to YAC/NAC CEO to discuss Proposed Action efforts and upcoming Perth visits.
YAC/NAC	Email	16 July 2024	Traditional Owners and community notified of upcoming on-ground survey work. Details provided. Support received.
WAC	Phone call	28 June 2024	BNR representative checking in with a Traditional Owner member who was grieving.
DWER	Email	24 June 2024	BNR received acknowledgement of uploading of ERD package.
EPBC / DCCEEW	Email	20 June 2024	BNR receive notice that more information was required on the referral application.
YAC/WAC	Email	20 June 2024	BNR received letters of support from WAC and YAC board members to show support for the Valhalla Program
EPA	In person	21 May 2024	BNR representative met with EPA deputy chair and EPA Services staff on Proposed Action, next steps and challenges.
YAC, WAC NAC	In person	13-16 May 2024	BNR representative visited the Noonkanbah community to provide a Proposed Action update inspect existing well pads with community members.
Bunuba	In person	16 May 2024	BNR representative member with new Bunuba CEO for introductions, an overview on the company and the Proposed Action.
Government	Phone call	24 April 2024	BNR representative met with senior advisor to Hon Madeleine King, MP. A company and Proposed Action introduction. Attention brought to the referral process.
DCCEEW	Teams	18 April 2024	BNR representatives met with DCCEEW staff to provide feedback on the state and federal environmental approval processes.
DMPE	Teams	18 March 2024	BNR representative met with DMPE leadership to provide a Proposed Action update, a company update and code of practice status.
EPA	Teams	14 March 2024	BNR representatives met with EPA Services staff to discuss approval process and next steps.
DPC	In person	13 March 2024	BNR met with representatives from DPC (Department of Premier and Cabinet). BNR provided a Proposed Action update and shared concerns on the approval timeline.

Stakeholder	Method of Engagement	Date of Engagement	Summary of Engagement
DMPE	In person	12 March 2024	BNR representatives provided an update on Proposed Action and technical workflows.
DWER	Email	27 Feb 2024	BNR was notified of the DWER/EPA's plan to notify Traditional Owners on the public notification of the referral.
DPC	Phone call	19 Feb 2024	BNR representative met with Principal Policy Advisor to Minister for Mines and Petroleum to provide a Proposed Action overview and note challenges.
Bunuba	In person	28 Nov 2023	BNR representative met with Bunuba directors & CEO in Fitzroy Crossing for general catch-up. Proposed Action update provided and responses to their questions.
Bunuba	In person	27 Nov 2023	BNR representative met with Bunuba directors & CEO in Fitzroy Crossing for general catch-up. Proposed Action update provided and responses to their questions. The Nov 27th and 28th meetings had some same and different attendees.
Bunuba	Email	7 Nov 2023	BNR representative contacted & communicated with Bunuba CEO for a catch-up and engagement.
DoC	Email	5 Sept 2023	Authorisation for data from bore YG2/18 to be disclosed to the DWER.
DCCEEW	Teams	10 Aug 2023	Earlier advice from the Commonwealth had been that this Proposed Action was not required to be referred. BNR has continued to engage with DCCEEW to reiterate that the environmental impacts associated with the Proposed Action do not result in any direct or indirect mechanisms that would cause a significant impact to MNES protected under the EPBC Act.
Bunuba	Email	9 Aug 2023	BNR representative connect with new CEO and provide an introduction and expressed a desire and request to connect.
DCCEEW	Email	12 July 2023	BNR representative notified of EPBC self-assessment and requested a meeting.
EPA Services	Teams	5 July 2023	BNR representatives met with staff from EPA Services to discuss ERD and next steps.
DWER	In person	12 June 2023	Validation of groundwater monitoring data. BNR advised that data already provided from monitoring bores AB1S, AB1D, VNB4S and VNB4D, plus data from the YG2/18 well, would be acceptable providing drilling and completion data or results from a camera down hole could be provided.
DMPE	Teams meeting	13 April 2023	BNR met with DMPE to discuss Proposed Action and approval processes.
YAC	In person	28 March 2023, YAC Board meeting and AGM	Participation in the meetings and provision of a Proposed Action update.
EPA Services	Teams meetings	2 Feb 2023 8 Feb 2023 1 Mar 2023 5 July 2023	Discussions on components of draft ERD to be updated and improved, including options to revise DE size and address flora and fauna survey requirements. BNR advised demonstrating uniformity of vegetation associations to better validate survey results (covering the whole proposed disturbance footprint) and reduce uncertainty.

Stakeholder	Method of Engagement	Date of Engagement	Summary of Engagement
DWER	In person meeting	12 June 2023	Validation of groundwater monitoring data. BNR advised that data already provided from monitoring bores AB1S, AB1D, VNB4S and VNB4D, plus data from the YG2/18 well, would be acceptable providing drilling and completion data or results from a camera down hole could be provided.
DMPE	Teams meeting In person meeting	13 April 2023 19 September 2023	Discussion on Proposed Action and approval processes.
Department of Health	Email	03 Jan 2022 10 Jan 2022	BNR requested a brief review of the Human Health Risk Assessment (HHRA) that was internally prepared while waiting for the consultant peer review. Department of Health (DoH) responded and agreed with BNR's conclusion that no further HHRA is required.
Shire of Derby-West Kimberley	Email	23 Dec 2021	BNR provided an overview of petroleum activities planned to be undertaken within EP371 in 2022. Offered the opportunity to provide more information should it be required
Blina station pastoralists	Email	23 Dec 2021	BNR provided an overview of petroleum activities planned to be undertaken within EP 371 in 2022. Offered the opportunity to provide more information should it be required
WAC AGM	In Person	6-8 Dec 2021	BNR attended the WAC Annual General Meeting BNR discussed various regulatory approvals including Valhalla exploration drilling Program. BNR thanked WAC and YAC for their support during the Heritage Survey. BNR provided an overview of the new Covid Policy. General community sponsorship and future ranger programs and other sponsorship opportunities.
EPA	Email	25 Nov 2021	Formally notified that the subsidiary BNR had changed address and that the parent company had changed name and address.
EPA	Meeting	24 Nov 2021	Discussed ERD structure with EPA Services, including the new EPA ERD and Environmental Management Plan (EMP) guidelines, and the development of the HHRA. EPA stated that BNR should address worker accommodation/health and provide justification whether it is in scope of this referral or not. Actions included: • BNR to formally notify the EPA of BNR's address change • BNR to keep the current structure of the ERD, and address the guideline changes where necessary • BNR to arrange peer review of the HHRA • BNR to address worker health.
YAC AGM	In Person	22-24 Nov 2021	BNR attended the YAC Annual General Meeting and discussed various regulatory approvals including the Valhalla exploration drilling program. BNR thanked YAC for their support during the Heritage Survey. BNR provided an overview of the new Covid Policy. General community sponsorship and future ranger programs and other sponsorship opportunities.

Stakeholder	Method of Engagement	Date of Engagement	Summary of Engagement
EPA	Email	12 Nov 2021	EPA Services confirmed a HHRA was required and that it should come to one of two outcomes: • Identifies health risks, receptors, etc., and their mitigation; or • Identifies there are no health risks/receptors, etc.
Department of Communities	Email	08 Nov 2021	Enquired if the Yungngora Community groundwater bore data for the Poole Sandstone aquifer (provided by the Department) could be made publicly available in the ERD. The Department declined. As an action, BNR have compared the data and instead summarised similarities/differences without disclosing any data.
EPA	Meeting	22 Oct 2021	Discussed Environmental Scoping Document (ESD) progress with EPA Services. No actions arose.
DAWE	Meeting	20 Oct 2021	Provided an update on the referral and provided the results from the flora and fauna survey to confirm that no significant impacts to MNES would occur as a result of the Proposed Action. Presented the proposed Odin seismic survey.
DoH	Email	19 Oct 2021	Discussed the requirement for a HHRA. DoH stated that if the Proposed Action is not within two km (end of lateral extent in all directions) of a potable water source or sensitive receptor, then a HHRA is not needed.
EPA	Phone	13 Oct 2021	Discussed progress of the ESD and relevant decision-making authorities to discuss HHRA.
WAC & YAC	In Person	12-18 Oct 2021	Part 2 – Cultural, ethnographic and archaeological heritage survey via transects and helicopter by Deep Woods Surveys personnel with YAC & WAC representatives
WAC & YAC	In Person	10-16 Sep 2021	Part 1 – Cultural, ethnographic and archaeological heritage survey. The survey was completed by Deep Woods Surveys personnel with YAC & WAC representatives
EPA	Phone	08 Jul 2021	Provided comments on EPA's final draft of the ESD.
Department of Planning, Lands and Heritage (DPLH)	Email	18 Jun 2021	Received approval from DPLH for the temporary installation of an air quality monitoring station within an Aboriginal heritage site.
SDWK	Phone	16 Jun 2021	Requested if Shire approval was required for installing traffic monitoring equipment on the gravel Calwynyardah–Noonkanbah Road. Shire confirmed via email that BNR could install the equipment. BNR action included sharing the baseline traffic monitoring with the Shire post-survey.
Blina Station manager	Phone and email	14 Jun 2021	BNR provided locations of proposed air quality monitoring stations for the air quality and GHG monitoring program, prior to site installation that month.
YAC	Email	14 Jun 2021	BNR requested approval to install air quality monitoring stations within the Noonkanbah Station as part of the Valhalla baseline air quality and GHG monitoring program. Approval granted.
Department of Communities	Email	09 Jun 2021	Requested drinking water data from the groundwater bores monitored at the Yungngora Community, to obtain information from the deeper aquifers.

Stakeholder	Method of Engagement	Date of Engagement	Summary of Engagement
DWER	Meeting	09 Jun 2021	Continued discussion regarding the proposed groundwater monitoring program. The DWER requested that background information on the underlying Poole Sandstone and Grant Group aquifers should be included in the ERD.
YAC Noonkanbah station WAC	In person	7-10 Jun 2021	Provided an update on the Proposed Action and discussed heritage survey requirements for the Proposed Action. Discussed ranger program and sponsorship opportunities (including sponsoring local football team)
YAC and WAC	In person	7-10 Jun 2021	Provided an overview of unconventional drilling activities with independent experts, supported a question-and-answer session.
EPA	Phone	04 Jun 2021	Discussed baseline monitoring requirements from the draft ESD and requested to remove the requirement to sample at each well pad for a period of 24 months and change to sampling representative control sites for a period of 24 months.
DWER	Phone	03 Jun 2021	Arranged a meeting to discuss the DWER's feedback on the proposed Valhalla baseline groundwater monitoring program.
DPLH	Phone	03 Jun 21	Sought advice on the location of a proposed air quality monitoring station on a mythological Aboriginal heritage site (heritage site associated with an Aboriginal myth).
DWER	Email	26 May 2021	Discussed the suitability of the Valhalla baseline groundwater monitoring program, with regard to monitoring control sites only within the Liveringa Aquifer. Questioned that the other deeper aquifers must be discussed.
WA Police	Phone	24 May 2021	Confirmed approval to enter the Yungngora Community to stay overnight during COVID-19 restrictions.
Blina Station manager	Phone and email	19 May 2021	BNR discussed the installation of air quality monitoring stations on Blina Station as part of the air quality and GHG baseline monitoring program. Station manager approved the installation of the equipment on Blina Station and suggested providing help to install these.
Noonkanbah Station manager	Phone	13 May 2021	Discussed the availability of bore logs from pastoral bores on the station; unofficial bore logs could be made available. Re-confirmed that BNR could sample water from the pastoral bores by unscrewing pipes or opening taps. Mentioned that access roads and fence line tracks would be graded at the end of May, and mustering activities would commence early June.
EPA	Meeting	05 May 2021	Met the new EPA Chair and discussed the draft EPA-prepared ESD and BNR's response comments.
EPA	Email	27 Apr 2021	EPA requested a meeting with Matthew Tonts (new EPA Chair) to discuss the Valhalla draft ESD.
EPA	Email	27 Apr 2021	Verified the status on EPA Services' processing of the Valhalla Draft ESD.
Bunuba Dawangarri Aboriginal Corporation (BDAC)	Meeting	31 March 2021	BNR mobilised independent experts from a groundwater and technical perspective to present an overview of HFS activities to the board and answer any questions they had.

Stakeholder	Method of Engagement	Date of Engagement	Summary of Engagement
Blina Station manager	Phone and email	23 Mar 2021	Discussed sampling station bores for the baseline groundwater monitoring program – station accepted. Discussed the availability of a bore log for a bore located on Blina Station. Confirmed that BNR could sample water from that bore by opening the tap.
DWER	Email	22 Mar 2021	Reviewed sampling methodology and locations for baseline control site groundwater monitoring program. Enquired about availability of bore logs and any existing data for any pastoral bores.
Noonkanbah Station manager	Phone and email	08 Mar 2021	Discussed sampling station bores for the baseline groundwater monitoring program – station accepted. Enquired about the availability of bore logs from pastoral bores on the station. Confirmed that BNR could sample water from the pastoral bores.
BDAC	Meeting	17 Feb 2021	BNR met to discuss the Proposed Action subcommittee, provide an overview of the Proposed Action and discussed the opportunity for BNR to provide independent experts to provide information in the form of a community session.
EPA	Email	15 Feb 2021	Discussed monitoring frameworks for dust, volatile organic compounds (VOC), and greenhouse gas (GHG) monitoring. EPA enquired about the justification for the monitoring locations.
EPA	Meeting	08 Feb 2021	Discussed next steps with the EPA and to confirm the baseline monitoring frameworks. BNR action included sending the monitoring frameworks to the EPA with the aim of individually engaging with the relevant EPA branches to confirm each monitoring approach.
EPA	Phone	02 Feb 2021	Discussed baseline air quality monitoring. EPA waiting on suitable branch / personnel to review GHG baseline and confirmation of the objectives of air quality studies that have not progressed. Level of assessment likely released over the next week.

4 DESCRIPTION OF ENVIRONMENT AND MATTERS OF NATIONAL SIGNIFICANCE

4.1 Justification of Surveys

A number of surveys have been completed to support BNR's understanding of the environmental sensitivities and the regulatory approvals. These include:

- Low Ecological Services (2019) Flora and Fauna Assessment – Odin 2D and 3D seismic survey, Fitzroy Basin, Western Australia. Report prepared for Bennett Resources Pty Ltd.
- Eco Logical Australia (2021) Valhalla Flora and Fauna Survey. Report prepared for Bennett Resources Pty Ltd (**Attachment 1**).
- ecologia (2024) Valhalla Gas Exploration and Appraisal Program Targeted Significant Fauna Survey (**Attachment 2**).

BNR notes DCCEEW's comments regarding the validity of the survey and acknowledge that Low Ecological Services (2019) is "outside" of the 5-year window. The purpose of this survey was to provide a reconnaissance level understanding of flora and fauna with the potential to be impacted by the Proposed Action. If this survey cannot be considered by DCCEEW, a more detailed and recent targeted flora and vegetation survey, which was completed by Eco Logical in 2021 has been provided.

Engagement with the Department of Climate Change, Environment, Energy and Water (DCCEEW) in 2020-2021 validated BNR's position that the Proposed Action was unlikely to have a significant impact to MNES and informed BNR's strategy not to refer the Proposed Action under the EPBC Act (prior to updated triggers being legislated) consistent with historical unconventional activities in the Canning Basin. Consequently, initial studies were framed around the WA State requirements and conducted between 21st – 25th November 2019. The study was deemed sufficient to information the WA State process and no further studies were planned until post approvals (noting that the assessment was likely to take a prolonged period of time).

When BNR originally submitted the Referral (application number 02405) on the 20/05/2024 this survey was within the 5-year period (approximately 4.5 years between the survey and the submission date). BNR then withdrew and resubmitted the Referral (application number 02593) on the 16/09/2024. This survey was still within the 5-year period (approximately 4.75 years between the survey and the submission date) and was deemed sufficient for informing the habitat types and likelihood of impact assessments.

During the assessment by DCCEEW and BNR's response to the RFI issued (this PD). The time limits of the two later surveys do fall outside the 5-year period. BNR does believes that these surveys and studies are still relevant as vegetation communities identified would not have changed in this time frame and therefore there would be no new potential impacts to MNES.

4.1.1 General Description of the Environment and MNES

4.2 Current Land Use, Topography, Surface and Groundwater Bodies, Waterways and Vegetation Communities

4.2.1 Current Land Use

The Canning Basin is covered by rangeland ecosystems, with the Proposed Action Area overlaying two pastoral stations (leased Crown Land)—Blina Station and Noonkanbah Station—that are leased for pastoral grazing purposes.

The well locations are remote from residential developments, local tourist attractions and main roads. The closest receptors to the Proposed Action Area include a small number of station homesteads and Aboriginal communities, which are tens of kilometres away.

Existing uses within the Proposed Action Area include pastoral grazing (cattle) and existing petroleum infrastructure. Pastoral activities have been present across the Proposed Action Area since the late 1800s.

Petroleum activities within Exploration Permit EP 371 have occurred since 1995, with various well pads and infrastructure, owned by Bennet Resources Pty Ltd, currently under care and maintenance.

4.2.2 Topography

The Proposed Action Area is within the North Fitzroy Plain Zone, which covers an area of 17,925 km^2 (Tille, 2006). The North Fitzroy Plain Zone comprises floodplains and sandplains (with alluvial and undulating plains) on Permian sedimentary rocks of the Canning Basin with self-mulching cracking clays, red deep sands, red sandy earths and red / brown non-cracking clays. Rangeland land system maps, prepared by Department of Primary Industries and Regional Development (DPIRD), describe the biophysical characteristics of each region and separates these into land systems, which are defined as repeating patterns of topography, soil and vegetation. The Proposed Action Area covers four soil landscape systems (**Figure 4-1**), which are described as (Government of Western Australia, 2021b; Payne & Schoknecht, 2011):

- 331Cm: Camelgooda System: sandplains, swales, and linear sand dunes supporting low Pindan woodlands of acacias and low woodlands of bauhinia and bloodwood with curly spinifex and ribbon grass
- 331Cy: Calwynyardah System: alluvial plains with scalded tracts downslope from lateritic remnants with yellowish loamy soils supporting patchy beefwood-bauhinia low woodlands with curly spinifex and ribbon grass; also, minor hard spinifex grasslands
- 331Dj: Djada System: active floodplains with levees and levee back slopes supporting ghost gum open woodlands with frontage grasses, and cracking clay back plains supporting ribbon grass-blue grass and Mitchell grass grasslands
- 331Ma: Mamilu System: plains and sandplains, deep red sands and yellowish loamy soils on lateritised sedimentary rocks supporting beefwood-bauhinia low woodlands and Pindan acacia shrublands with curly spinifex and ribbon grass.

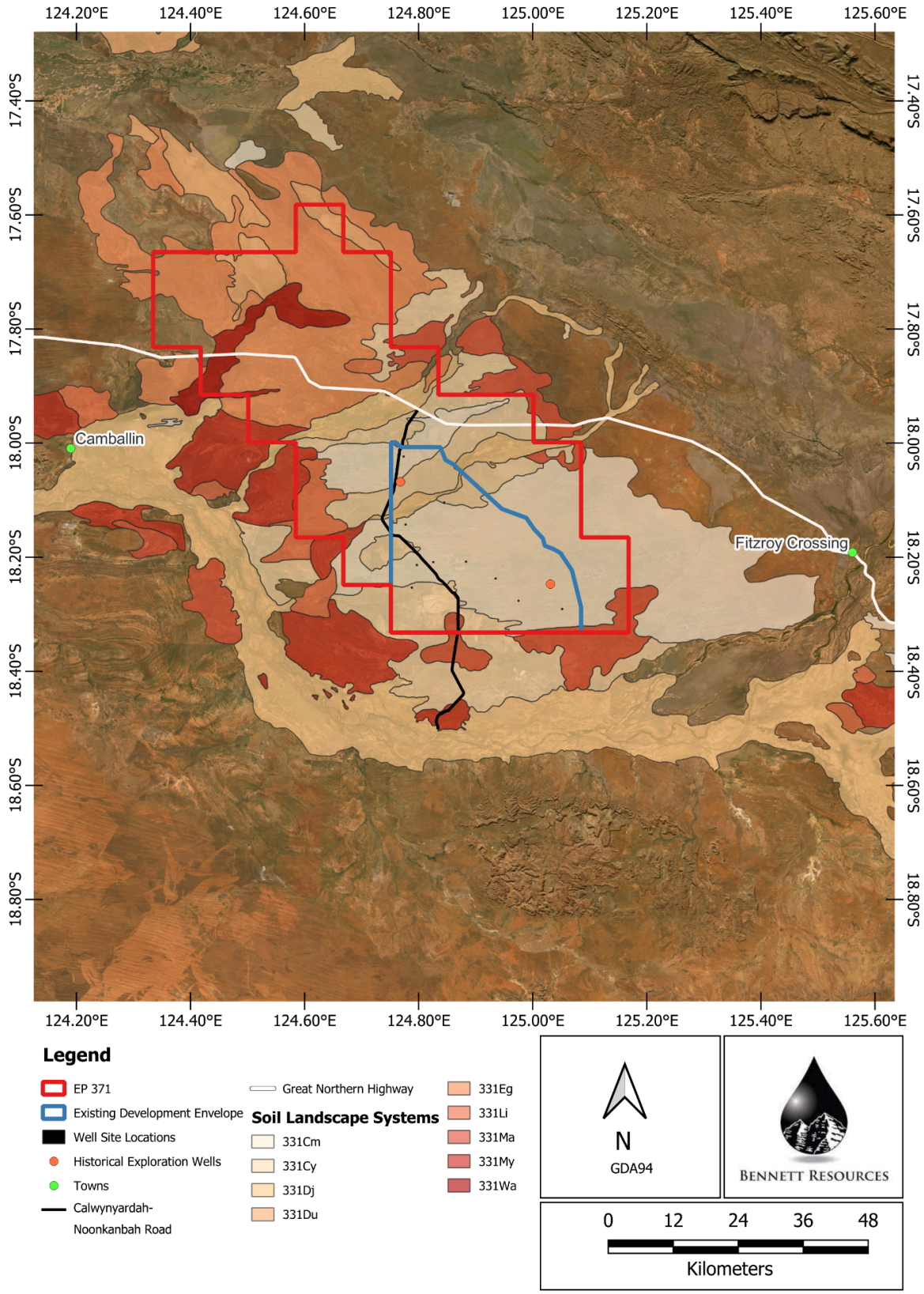

Figure 4-1: Regional Extent of the Soil Landscape Systems Within the Proposed Action Area

4.2.3 Groundwater Bodies – Regional Context

The Proposed Action Area is situated in the Canning Basin region within the Fitzroy River Catchment. The Canning Basin is considered the second largest groundwater resource in Australia after the Great Artesian Basin. It is a large sedimentary basin covering an onshore area >450,000 km^2 (DoW, 2012). The major regional aquifer systems in the Canning Basin are (in order of decreasing age):

- Grant Group (Pool aquifer)
- Liveringa Formation (Liveringa aquifer)
- Wallal Sandstone
- Broome Sandstone.

The two aquifers considered “useable” for other purposes within the Proposed Action Area include the Liveringa and Poole.

4.2.3.1 Grant Group

The Grant Group aquifer comprises several subsurface geological structures, including the Reeves Formation (formerly described as the Lower Grant Formation) and the Poole Sandstone, which is directly above the Grant Group.

The Poole Sandstone and Grant Group are considered to be hydrogeologically similar and are both regarded as good aquifers because of their combined thickness and widespread distribution (Lindsay & Commander, 2005). The Poole Sandstone is mainly fine-grained with some medium to coarse sandstone towards the base. The Grant Group is much thicker than the Poole Sandstone. Available salinity records from the DWER’s Water Information Reporting (WIR) database (DWER, 2021) for the Poole Sandstone range from 200 to 325 milligrams per litre (mg/L) Total Dissolved Solids (TDS), with 86 mg/L TDS for the Grant Group. In other areas of the Grant Group, oil accumulations are known to occur (hydrocarbons have previously been produced from the Grant Group from the Sundown, Boundary, and West Terrace wells at Blina Oilfield, which is north of the Proposed Action Area) (Jonasson, K, 2001).

4.2.3.2 Liveringa Formation

The Liveringa Formation comprises interbedded sandstones, siltstones with lenses, and minor beds of claystone and shale, varying in thickness within the disturbance footprint is approximately 84 m – 196 m. Salinities, where recorded in the WIR database and by the previous operator, are generally <1,000 mg/L TDS in the Liveringa Aquifer but may range from 500–12,400 mg/L TDS (ERD Appendix I (Rockwater, 2016)).

4.2.3.3 Wallal Sandstone

The Wallal Sandstone is present in the west and northwest of the Fitzroy River Catchment but has limited outcrop at the land surface due to overlying formations and a veneer of surficial sediments. This sandstone aquifer is likely to host intermediate-scale flow systems, though very little information currently exists other than from drilling around Derby and Mount Anderson (Gallardo, A, 2018; Smith, R. , 1992). Bore yields can be high in places, with recent investigations reporting bore yields of up to 50 L/second (Stocker, 2015). Groundwater salinity is also fresh in most locations (i.e., TDS of 500–1,000 mg/L). Aquifer pumping tests on the Wallal Sandstone at Mowanjum Station (~95 km northwest of the Proposed Action Area) estimated a transmissivity of

273 m^2/day and a hydraulic conductivity of 4.8 m/day. Buru Energy (Buru Energy, 2012) reports a hydraulic conductivity for the Wallal Sandstone of 44 m/day.

4.2.3.4 Broome Sandstone

The Broome Sandstone aquifer is the principal groundwater resource in West Kimberley (specifically for the Dampier, Broome, and La Grange areas) used for irrigation, stock and domestic supply. Within the Canning Basin, the Broome Sandstone is an extensive, flat-lying aquifer, coarsening with depth, with some siltstone layers and a saturated thickness of up to 200 m near the coast. Generally, the sandstone has high porosity, and bores screened within it are capable of producing up to 60 L/s of low salinity (Paul, R., George, R., & Gardiner, P., 2013). Salinity values for bores located within the Broome Sandstone indicate that TDS values decrease the further inland they are located. Of the 115 bores analysed from the WIR database, 43 bores had a TDS below 500 mg/L, 33 bores had a TDS between 500 and 1,000 mg/L, and the remaining 39 bores had a TDS above 1,000 mg/L (Paul, R., George, R., & Gardiner, P., 2013).

4.2.4 Groundwater Bodies – Localised Context

Data from three petroleum wells drilled on EP 371 by the previous operator (**Table 4-1**) provides a two-dimensional cross-section of the aquifers located within the permit, as shown in **Figure 4-2**.

A detailed summary of these aquifers with reference to local data is provided in the following sections, and ERD Appendix T (**Attachment 13**) outlines additional information regarding key geological intervals through the various aquifers.

Table 4-1: Localised Aquifer Data

Formation	Dominant Lithology	Classification	Elevation – Base of Formation (m AHD)			Thickness (m)	TDS (mg/L)
			Valhalla 2	Valhalla North 1	Asgard 1		
Liveringa	Carbonate and shale	Minor aquifer, aquitard	−84	−196	−171	84–196	500–12,400
Noonkanbah	Shale	Aquiclude	−441	−635	−579	357–439	550–800
Poole Sandstone	Sandstone and shale	Aquifer or aquitard	−524	−715	−695	80–116	300
Grant Group	Sandstone	Aquifer	−1,332	−1,499	−1,240	545–808	800–1,000
Reeves	Sandstone	Aquifer	−1,588	−1,826	−1,606	270–366	No data
Anderson	Sandstone, siltstone, shale	Minor aquifer, aquitard	−1,858	−2,105	−1,790	184–279	70,000–100,000
Laurel	Limestone, shale, siltstone, and sandstone	Minor aquifer, aquitard	<−3,350	<−3,241	<−3,400	1,136–1,610	70,000–100,000

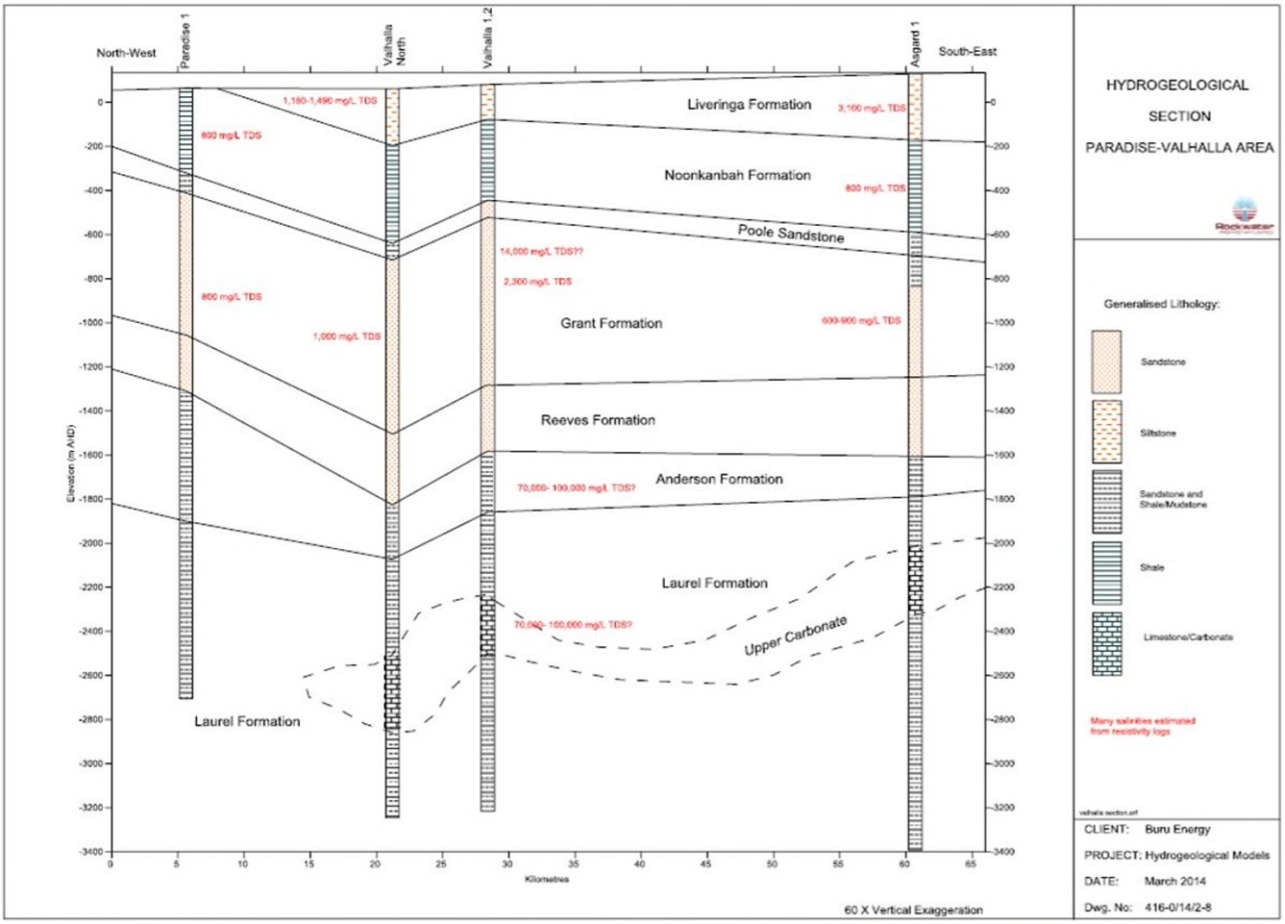

Figure 4-2: Hydrogeological Cross-Section

Figure 4-2 is a simplified cross section of the Proposed Action Area. Presentation of subsurface data this way is appropriate given the availability of three key wells with modern logs Valhalla-1, Valhalla-N-1, and Asgard - 1. BNR acknowledges presentation of this data is limited given the absence of regional sand/shale ratios other than in principally in two dimensions. A more detailed cross section of the subsurface geology is presented in ERD Appendix T (Figure 2) (**Attachment 13**).

In addition to cross sections, semi-regional isochore (based on seismic data tied to wells) maps of key geological intervals along with the proposed locations have also been included in ERD Appendix T (Figure 1a–Figure 1e) (**Attachment 13**). The figures presented therein show the intervals that represent the isochores and associated stratigraphy highlighted. These figures are focused on the Poole aquifer unit (a deltaic sandstone) as well as the non-aquifers of the Grant Group and Anderson formations. For the Grant group Formation, the overall thickness within the development area is between 545 m-808 m. The deepest interval (Anderson) does thin updip but over most of the Proposed Action Area it is over 150 m thick.

The shallowest interval that likely contains potentially economic hydrocarbons is located at 2,600 m to the top of the Grant Formation. Semi regional isochore figures (ERD Appendix T **Attachment 13**) indicate there is 900 m – 1,800 m of section between the shallowest potential HFS zone (2,600 m) and the Grant/Winfred Formation top (Base of the Poole).

4.2.4.1 Liveringa Aquifer

Recharge and Discharge Mechanisms

Groundwater recharge to the Liveringa Aquifer is believed to be mainly from rainfall on outcrop areas (Lindsay & Commander, 2005). During the Fitzroy River integrated ground and surface water hydrology assessment conducted between 2008 and 2011, monitoring of the Liveringa Aquifer and surface alluvial waters associated with the Fitzroy River indicated a strong connection between the river and the aquifer. This Proposed Action was led by the then WA Department of Water (DoW) with funding provided by National Water Commission under the Raising National Water Standards (RNWS) program. The multilevel piezometers that were installed at three sites on Noonkanbah Station as part of the DoW and RNWS Proposed Action showed a groundwater response to high river flow events (Lindsay & Commander, 2005). This, and comparatively low groundwater salinities measured in these piezometers compared with other regional bores, suggests some recharge to the aquifer by floodwater.

Infiltration to the Liveringa Formation (and subsequent aquifers) from rainfall will be retarded by clay, shale and siltstone layers, both above and below the water table. Water is likely to take 70–300 days to travel from the ground surface to the water table ERD Appendix I (Rockwater, 2016) (**Attachment 13**).

Aquifer Connectivity (Surface Water/Groundwater Interaction)

As detailed in **Table 4-1** and shown in **Figure 4-2**, the Liveringa Aquifer and Poole Sandstone (associated with the Grant Group) are separated by the Noonkanbah (shale) Formation. The Noonkanbah Formation is considered an aquitard, comprising siltstone, limestone and minor sandstone (Lindsay & Commander, 2005), and it is a geological barrier (at least 357 m thick) between the Liveringa and Poole Sandstone aquifers. Consequently, within the Proposed Action Area the surface aquifer (Liveringa) is geologically separated from the Poole Sandstone (and subsequently, the targeted Laurel Formation).

Water Chemistry

BNR completed a local groundwater characterisation field study to review the quality of the Liveringa Aquifer within the Proposed Action Area using historical groundwater data. The local groundwater characterisation study focused on several bores near the Proposed Action Area, namely:

- AB1D
- AB1S
- VNB4S
- VNB4D.

These bores were considered suitable for providing appropriate historical baseline data because:

- AB1D, AB1S, VNB4S and VNB4D are located upgradient of previous historical petroleum activities conducted in EP 371 (**Figure 4-14**).
- These four are screened within the Liveringa Aquifer and although the bore logs are not available for the monitoring bores, schematics are available for these bores (**Figure 4-14**).
- BNR validated bore schematics by placing a camera down hole in July 2023. All four were shown to be intact and suitable for the purposes of collecting baseline groundwater samples. Details of this assessment, as well as photos from the down hole camera, form part of ERD Appendix G (**Attachment 13**). A summary of these recordings is:

AB1S

- Stick-up: 0.5 m
- Standing water level: 23.070 metres below top of casing (m btoc)
- Screened interval: 30.8-36.3 m btoc
- Bottom of casing: 36.3 m btoc
- Some white build-up on lower ~5 m of casing walls

AB1D

- Stick-up: 0.7 m
- Standing water level: 21.780 m btoc
- Screened interval: 67.0-76.6 m btoc
- Bottom of casing: 76.6 m btoc
- Ant ingress and some ant material build-up on walls from 20 m btoc

VNB4S

- Stick-up: 0.5 m
- Standing water level: 30.686 m btoc
- Screened interval: 36.6 m btoc
- Bottom of casing: 42.3 m btoc
- No or minor build-up on casing walls

VNB4D

- Stick-up: 0.7 m
- Standing water level: 30.956 m btoc
- Screened interval: 66.9-78.3 m btoc
- Bottom of casing: 78.4 m btoc
- Minor build-up on casing walls

VNB4S / VNB4D and AB1D / AB1S are located on the northwest and southeast of the proposed disturbance footprint, respectively (**Figure 4-16**), thus providing geographical coverage across the Proposed Action Area.

- Groundwater flow is westerly (**Figure 4-14**), thus providing water quality at different hydrogeological gradients.

The local groundwater characterisation study on the four bores into the Liveringa was undertaken over five years (two of the four bores continued to be monitored for a further two years). The number of sampling events undertaken at each bore location and the data results are detailed in ERD Appendix J (**Attachment 13**). BNR has mapped specific CoPC over the sampling period in **Figure 4-3** to **Figure 4-13**. The CoPC selected to be presented here are relevant because they are the indicator constituents used to determine if any release from petroleum activities (including drilling or HFS fluids) has occurred. These are consistent with those identified by the 'Groundwater Monitoring in the onshore petroleum and geothermal industry – Guideline' (DMP & DoW, 2016).

Except for the April 2016 sampling event, long-term data analysis indicates that groundwater chemistry influenced by the geology is stable.

Table 4-2: Summary of Groundwater Monitoring Bores Sampled

Location	Bore Name	Number of Sampling Events	Total Sampling Duration
Asgard 1 well pad	AB1D	23	>5 years
	AB1S	23	>5 years
Valhalla North 1 well pad	VNB4D	21	>5 years
	VNB4S	21	>5 years

Figure 4-2 to **Figure 4-12** show data from ongoing monitoring of bores in the Liveringa Aquifer in accordance with Buru Energy's and BNR's *Groundwater Baseline and Surveillance Monitoring Program*. One anomalous reading can be seen across all tested elements from VNB4S from samples taken on 19 April 2016. The causes of the anomalous results were immediately examined. BNR determined that that:

- The VNB4S water bore was the reference bore located upstream of the well pad, so the cause of the result was highly unlikely to be attributable to historical subsurface activities; and
- The VNB4S water bore was the first bore sampled on that day and it was possible that the bore pump and hose had not been adequately purged prior to sampling commencing.

A resampling of the bore was subsequently undertaken on 10 May 2016. When tested by SGS Australia, it showed that the range of values for BTEX, chloride and other constituents were within the range of values previously observed. During the development of this document, BNR engaged with the DWER to discuss these outcomes and BNR came to the decision that the anomalous reading would not impact baseline groundwater data.

Baseline methane levels within the Liveringa indicate some natural variation, however it is otherwise considered stable. As detailed in **Figure 4-13**, increased methane concentrations were recorded in 2018 and 2019 before sampling in 2021 indicated levels had returned to baseline levels. On further investigation, all bores sampled in this area between 2018 and 2019 experienced an increase in methane levels, including those bores located hydraulically upgradient (in consultation with the DWER (AB1D/S and VNB4D/S)) in a location that would enable the previous operator to differentiate between activity-related and natural occurring events. This area experienced, flood events followed by heatwaves in 2018, resulting in mass cattle death across the Noonkanbah Station. As the Liveringa is believed to be mainly recharged from rainfall on outcrop areas (Lindsay & Commander, 2005), it is possible that these events caused increased organics through surface recharge, which produced the increased dissolved methane readings. Additional constituent analysis has determined this is not associated with the previous operator's activities.

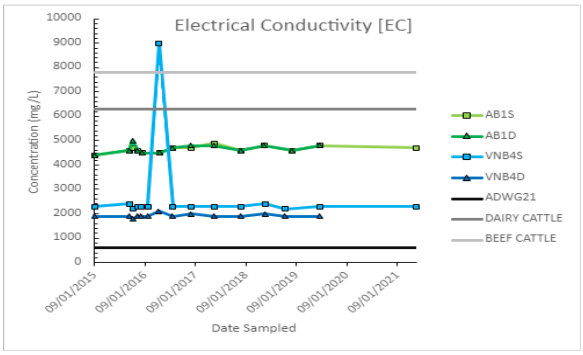

Figure 4-3: Electrical Conductivity [Liveringa]

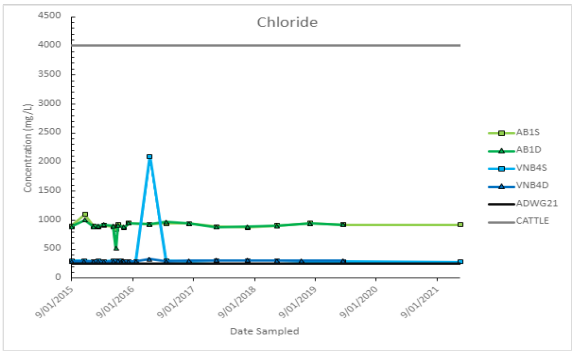

Figure 4-4: Chloride [Liveringa]

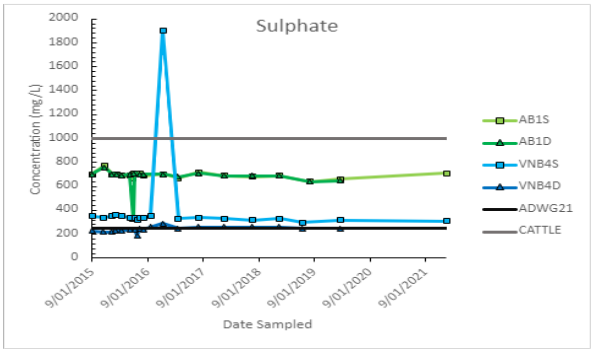

Figure 4-5: Sulfate [Liveringa]

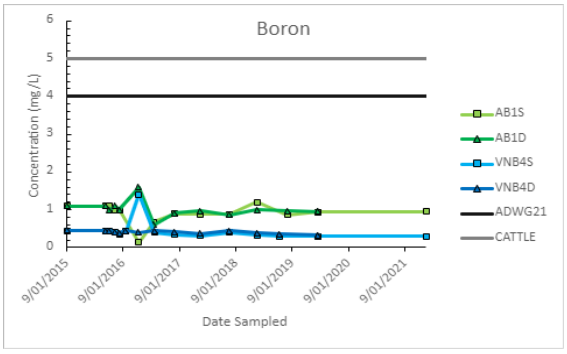

Figure 4-6: Boron [Liveringa]

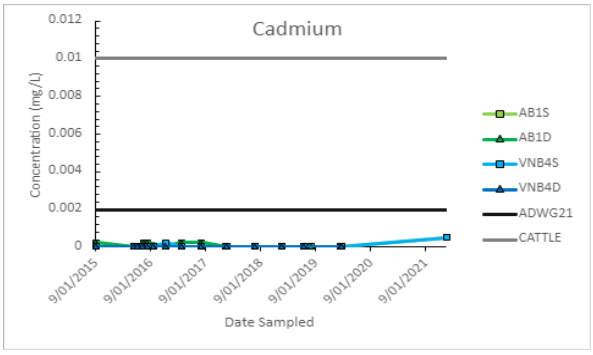

Figure 4-7: Cadmium [Liveringa]

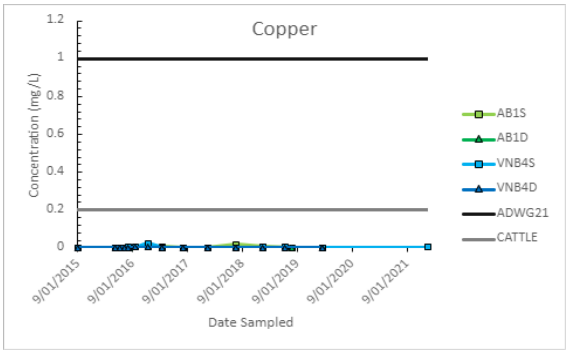

Figure 4-8: Copper [Liveringa]

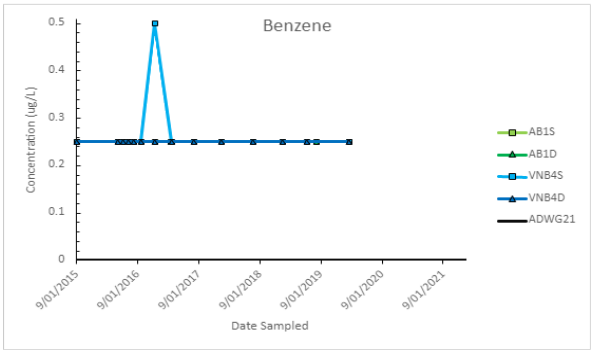

Figure 4-9: Benzene [Liveringa]

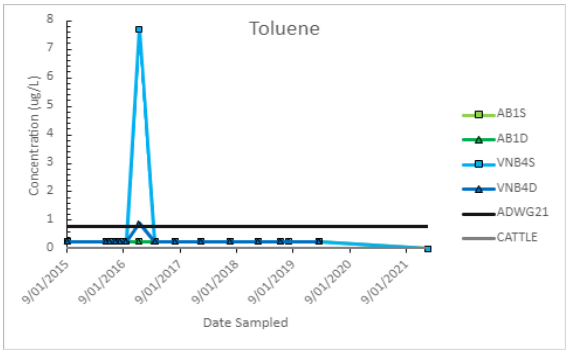

Figure 4-10: Toluene [Liveringa]

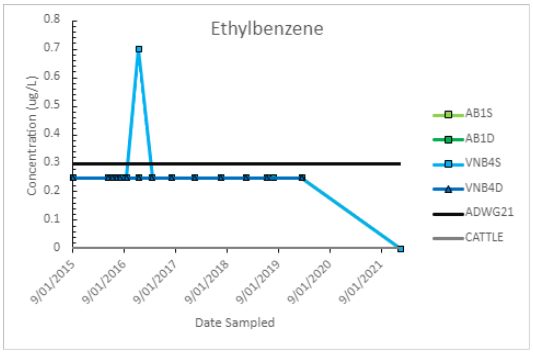

Figure 4-11: Ethylbenzene [Liveringa]

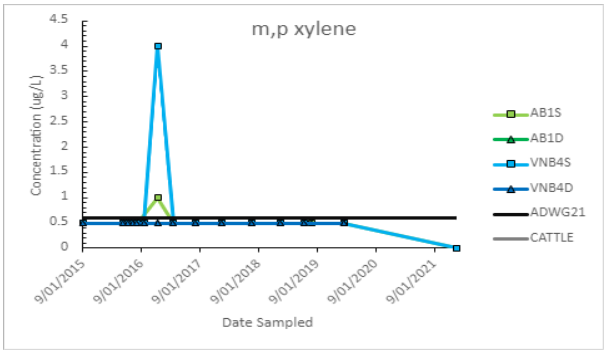

Figure 4-12: Xylene [Liveringa]

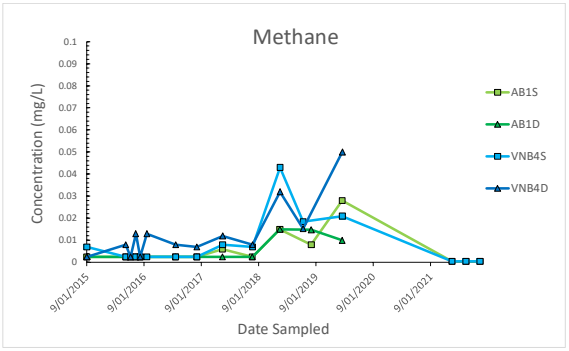

Figure 4-13: Methane [Liveringa]

Figure 4-14: Location of VNB4S / VNB4D and AB1D / AB1S and Proximity to Existing Infrastructure

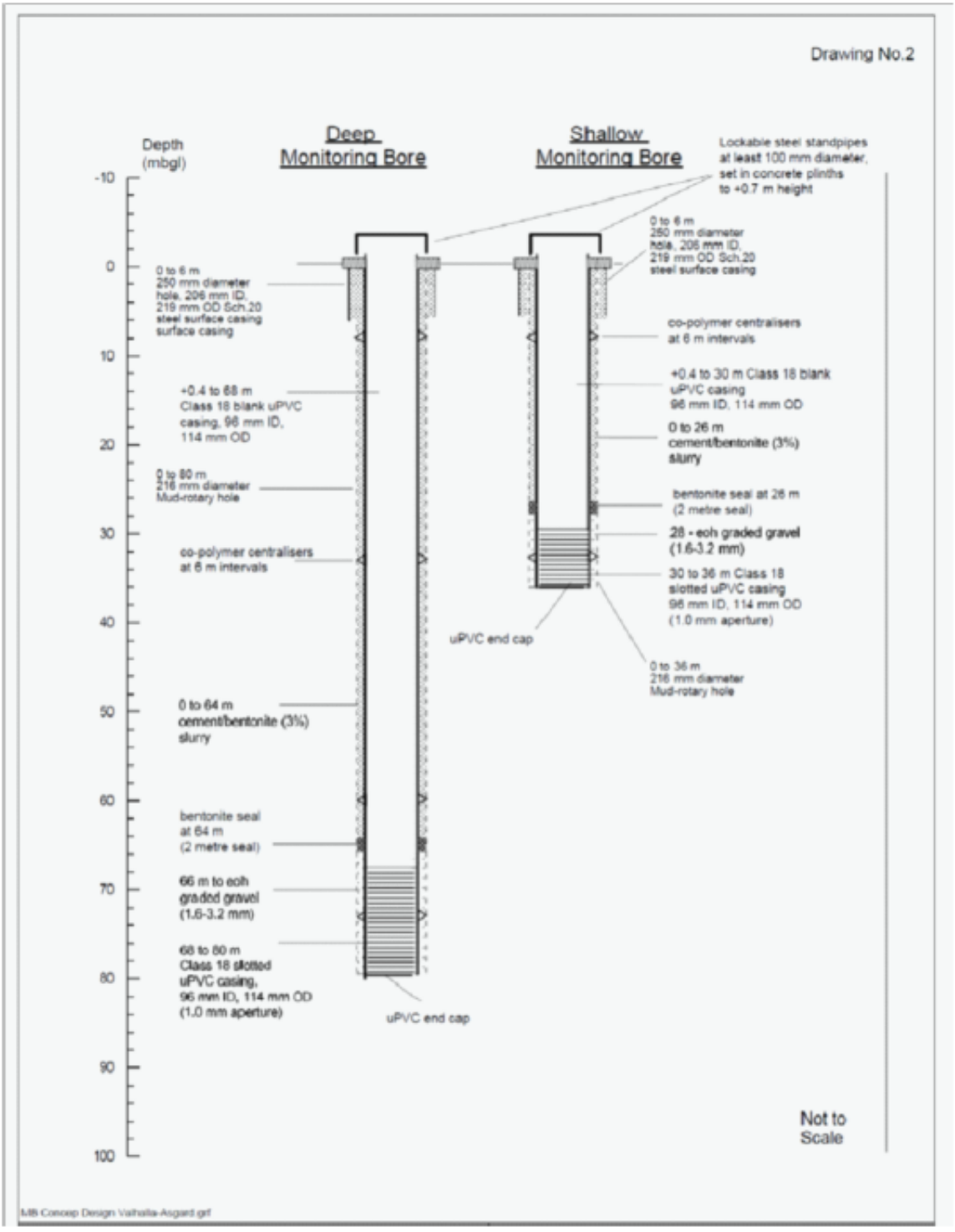

Figure 4-15: Schematic of the Asgard and Valhalla North Groundwater Monitoring Bores

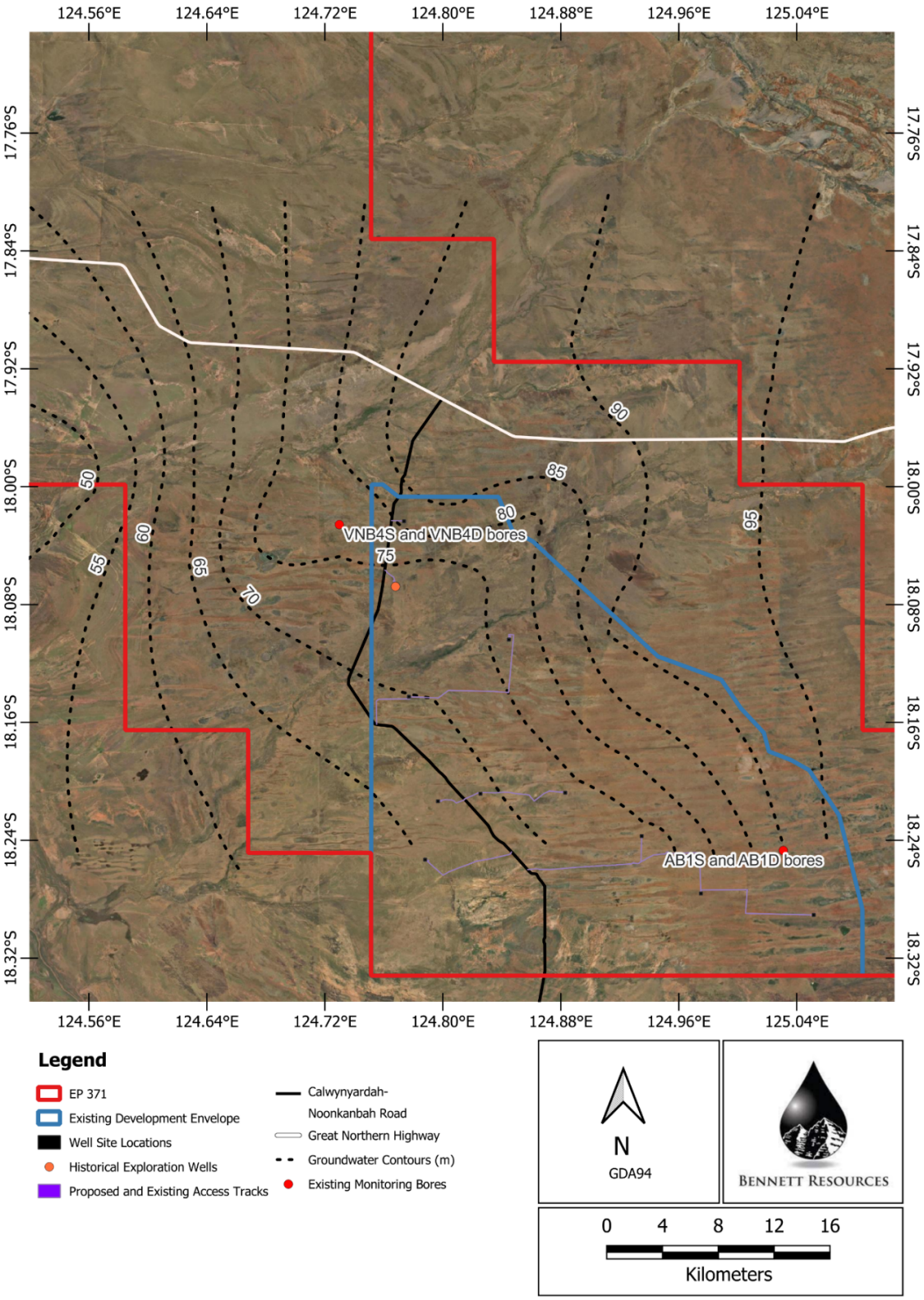

Figure 4-16: Location of Liveringa Groundwater Sampling Bores for Local Groundwater Characterisation and Groundwater Contours

Local and Regional Use

Groundwater is used for licensed and unlicensed water abstraction in the region. Unlicensed abstraction is likely to include domestic and stock watering, both of which extract relatively minor volumes of groundwater. In accordance with the RIWI Act, the DWER allocates water use via groundwater licences within the sustainable volume available for a groundwater resource. The DWER has determined that the Canning–Kimberley groundwater area has an allocated limit of >300,000 ML/year (DoW, 2014), of which only 0.9 GL (4.3%) is licensed within the Liveringa Aquifer (Harrington & Harrington, 2015).

A search of the DWER's Water Register licensing database (DWER, 2021) for licensed users within the Proposed Action Area identified only one other water licence targeting the Liveringa, as detailed in **Table 4-3**. BNR currently has a single groundwater licence but has extracted little to no water during the yearly care and maintenance program for its assets on EP 371. Although most of the water abstraction within the broader region is licensed, unlicensed water use of the Liveringa Aquifer does occur, including for livestock bores (pastoral activities) (Harrington & Harrington, 2015). The nearest groundwater user outside the Proposed Action Area is the Yungngora Community, ~18 km south. However, unlicensed groundwater extracted for community bores is typically from deeper aquifers.

A review of existing pastoral bores was undertaken to understand the distance from the Proposed Action. Based upon publicly available information, currently operating pastoral bores are at least 1.5 km from the disturbance footprint. These bores are only used for stock watering purposes with no irrigation, human consumption or other purposes identified.

Table 4-3: Summary of Groundwater Abstraction Licences Within the Proposed Action Area That Target the Liveringa Aquifer

Licence Number	Issue Date	Expiry Date	Allocation (ML)	Owner
174685	05 Oct 2020	04 Oct 2030	309	Main Roads Department
179134(7)	24 Apr 2024	23 Apr 2034	102.8	Bennett Resources Pty Ltd

4.2.4.2 Poole Sandstone (Grant Group)

The Poole Sandstone is considered part of the Grant Group—therefore, BNR has focused on the Poole Sandstone as the key aquifer of importance from the Grant Group.

Recharge and Discharge Mechanisms

Recharge to the Poole Sandstone occurs at the aquifer outcrops and shallow sub crops in the centre of the catchment following intense wet season rainfall. Recharge rates are estimated between ~13 and 70 mm/year (Taylor, et al., 2018). Interpretation of environmental tracers in groundwater, particularly carbon-14 and Terri genic helium-4, indicate long residence times for the Poole Sandstone aquifer. Mean residence times of >30,000 years were estimated for several groundwater samples collected from very deep parts of the aquifer (>500 m) at distances as short as 10 km from their outcrop or sub crop. Elsewhere, the aquifers are confined by the Noonkanbah Formation (Harrington & Harrington, 2015).

Infiltration to the Poole Sandstone within the Proposed Action Area is not expected because the Noonkanbah Formation (a shale aquitard) overlies this formation. No outcrops or shallow sub crops are known to occur within the Proposed Action Area. This is consistent with **Figure 4-17**, which indicates that the Poole Sandstone is shallower both east and west of the Proposed Action Area.

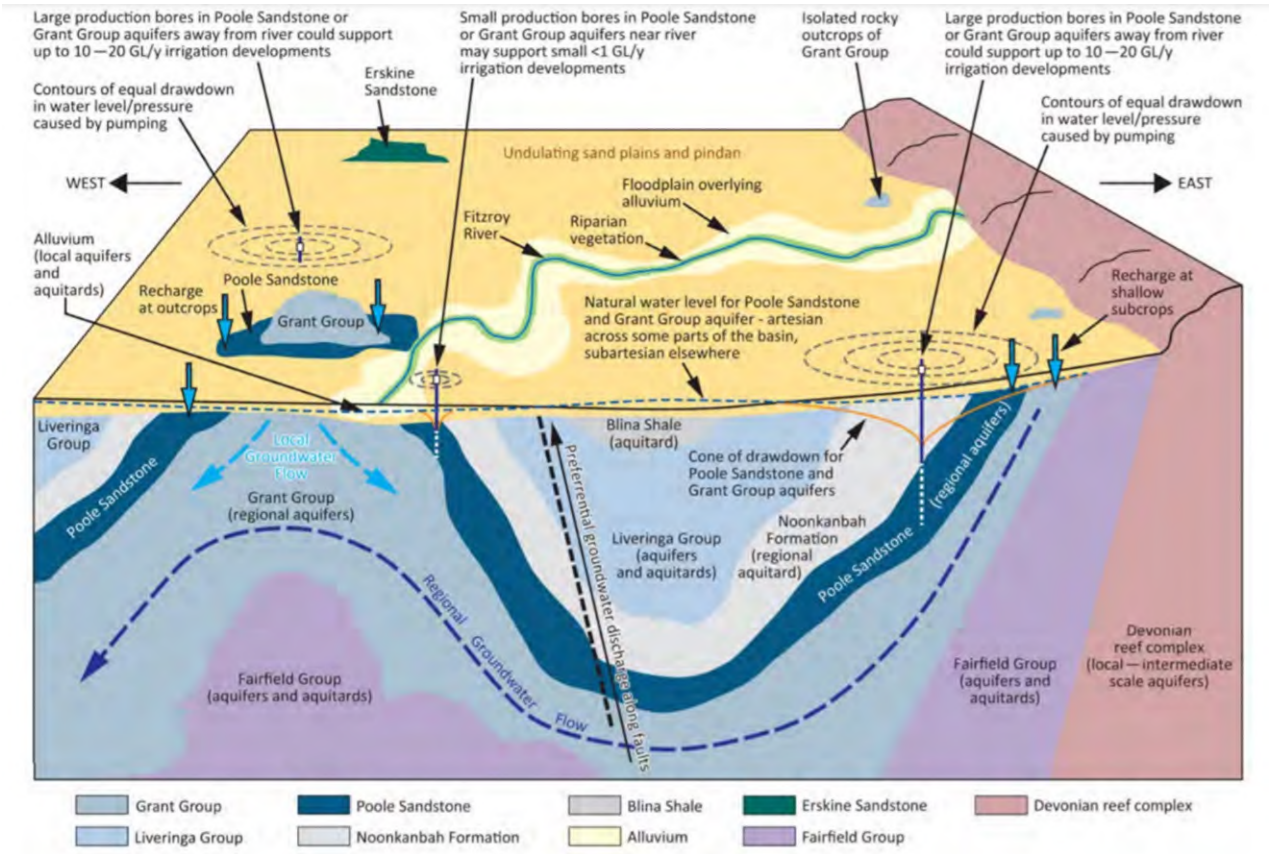

Figure 4-17: Conceptual Schematic Diagram of the Regional Groundwater Flow Process and Positioning of the Poole Sandstone (taken from Figure 5-3 in (Taylor, et al., 2018))

Aquifer Connectivity (Surface Water/Groundwater Interaction)

As detailed in **Table 4-1**, the Liveringa and Poole Sandstone aquifers are separated by the Noonkanbah shale Formation. The Noonkanbah Formation is considered an aquitard, comprising siltstone, limestone and minor sandstone (Lindsay & Commander, 2005), and is a geological barrier (at least 357 m thick) between the Liveringa and Poole Sandstone aquifers. Beneath the Grant Group, the Anderson Formation comprises a shale layer that acts as a confining seal between the Grant and lower formations (such as the targeted Laurel Formation). The Anderson Formation provides a geological barrier that is between 184 m and 279 m thick.

Water Chemistry

BNR has developed a series of groundwater studies to inform and support both the environmental impact assessment within the PER and the ongoing monitoring and management of groundwater during the Proposed Action. Given the depth to the Poole Sandstone (-571 m) and the confinement of the Poole Sandstone within the Proposed Action Area, BNR used water quality data from groundwater users that are both licensed and unlicensed to extract groundwater from the Poole Sandstone, including the Yungngora Community and the town of Fitzroy Crossing.

BNR has been provided with data from the Yungngora Community's YG2/18 bore, which was constructed in 2018. The bore completion log for the Yungngora Community indicates that the total depth of the bore is 497 m and screens were installed between 398 and 497 m below ground level (**Figure 4-18**) (Australian Bore Consultants, 2019).

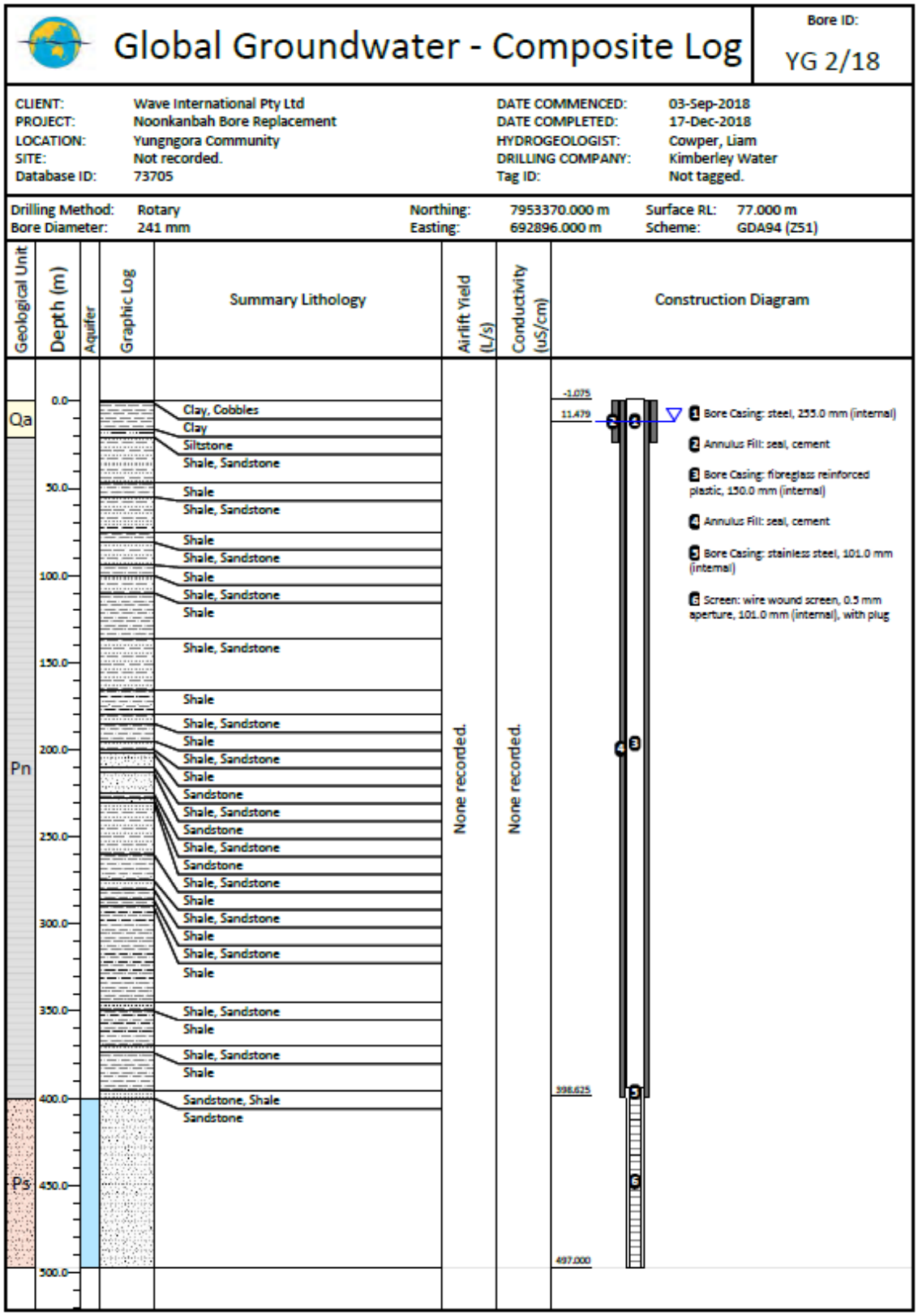

Figure 4-18: Drilling Log of the YG2/18 Bore

Data is collected from this bore as part of a larger monitoring program with all data tested and reported separately. Water quality data available for YG2/18 between April 2018 and April 2023 was reviewed to better understand the water chemistry of the Grant Group within the Proposed Action Area. All the components tested from YG2/18 (for example, fluoride, chloride, nitrate, sulfate, sulfur, etc.) are lower than acceptable levels (from an aesthetic perspective), with two exceptions. In April 2023, TDS were 820 mg/L (aesthetic acceptable level is 600), and sodium levels are higher than the aesthetic acceptable level of 180 mg/L on several occasions. For example, in April 2023 sodium levels were 250 mg/L, in November 2022 they were 220 mg/L and in April 2021 they were 190 mg/L.

Table 4-4: Yungngora Community Bore (Grant Group) Groundwater Quality

Parameter	Bore YG2/18	
	Minimum–Maximum	Median
Conductivity at 25 °C (mS/m)	890-990	*930*
Turbidity (Nephelometric turbidity unit)	0.1-0.2	*0.1*
pH (pH units)	7.6-8.6	*8.3*
Aluminium	0.04-0.22	*0.2*
Barium	0.03-0.04	0.03
Boron	0.001-0.27	0.01
Fluoride	0.5-0.9	*0.6*
Iron	0.02-0.15	*0.03*
Manganese	0.030-0.042	*0.040*
Nitrate as nitrogen	0.0-0.1	*0.0*
Nitrite as nitrogen	0.05	*0.05*
Uranium	0.001	

A summary of data for key CoPC for the Poole Sandstone monitored at Fitzroy Crossing is provided below in **Table 4-5**. Comparing the Yungngora Community and Fitzroy Crossing data, the data indicates that the Poole Sandstone overall produces fresher water than the Liveringa Aquifer, as demonstrated by lower chloride concentrations and lower EC/TDS. Sulfate concentrations within the Poole Sandstone were also substantially less than those observed in the Liveringa, but cadmium and copper concentrations were comparable. Long-term data analysis indicates that groundwater chemistry influenced by the geology is stable within the Poole Sandstone.

The town of Fitzroy Crossing sources water from the Fitzroy Crossing Water Reserve PDWSA. These production bores are located in hard cemented sandstone on joints or faults within the Poole Sandstone. The production bores range from ~30–60 m deep (DoW, 2008). **Table 4-5** lists the water quality of this groundwater source (range and median values, all in mg/L unless stated otherwise). **Figure 4-19** shows the location of the Grant Group bores.

Table 4-5: Fitzroy Crossing Groundwater Quality (DoW, 2008)

Parameter	Bore 3	
	Minimum–Maximum	Median
Conductivity at 25 °C (mS/m)	37–50	*42*
Turbidity (Nephelometric turbidity unit)	<0.1–6.6	*<0.1*
pH (pH units)	6.75–7.07	*6.91*
Aluminium (unfiltered)	<0.008–0.67	*<0.008*
Barium	0.095	
Boron	0.1	
Dieldrin	<0.001–0.02	*0.008*
Fluoride	0.2–0.25	*0.25*
Iron (unfiltered)	<0.003–0.34	*<0.003*
Manganese (unfiltered)	<0.002–0.065	*<0.002*
Nitrate as nitrogen	0.63–0.75	*0.7*
Nitrite as nitrogen	<0.002–0.005	*<0.002*
Uranium	0.001	

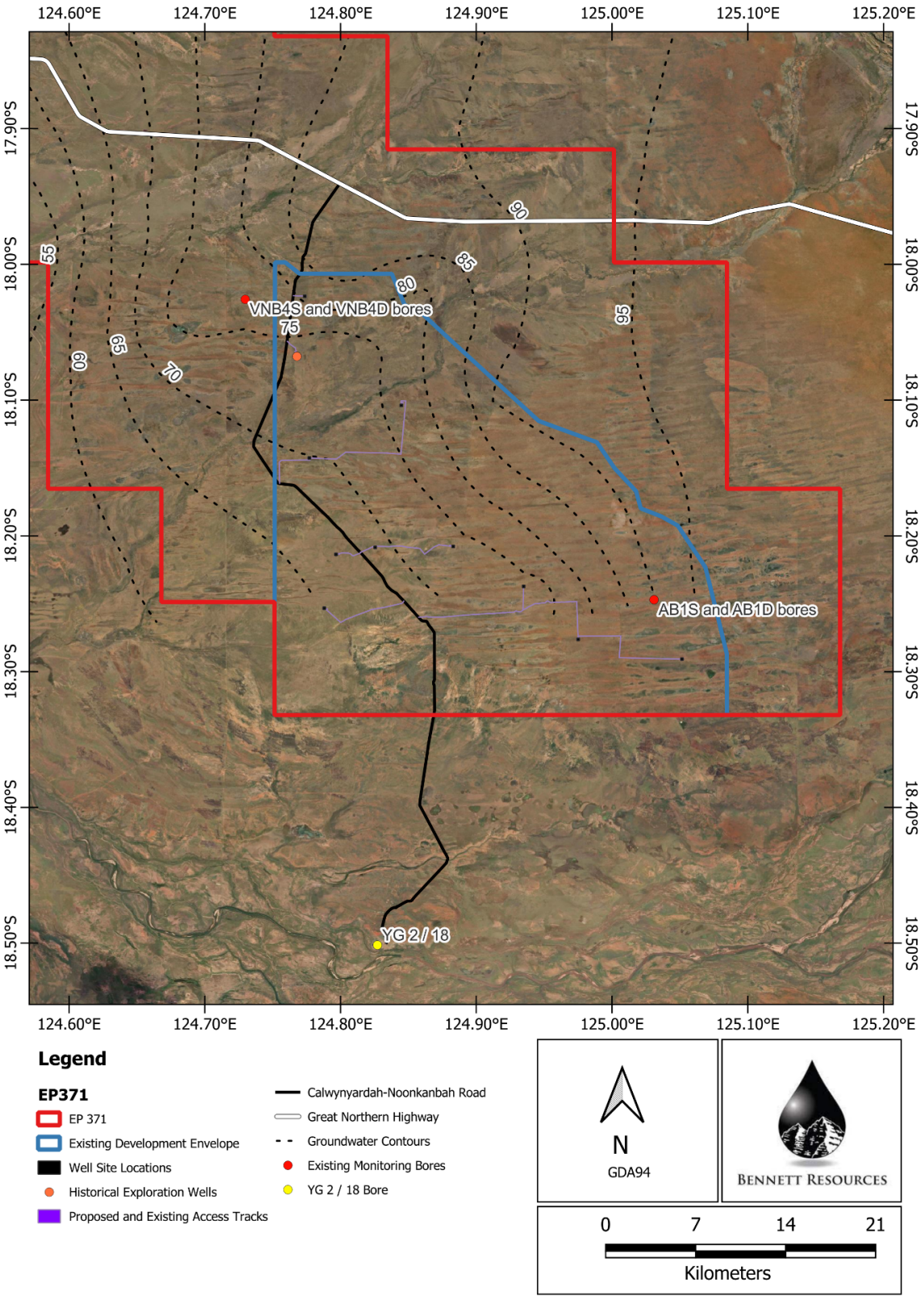

Figure 4-19: Location of Grant Group Sampling Bore for Local Groundwater Characterisation

Local and Regional Use

Within the broader Canning–Kimberley area, the Grant Group comprises ~13.6 GL (67.4%) of the total water allocation within the proclaimed groundwater area (>300,000 ML/year (DoW, 2014)). Although there are multiple licences to take water from within the Grant Group (including the Poole Sandstone), these are associated with other oil and gas operators, mining operators, Main Roads, communities, and the local shire. Some water abstraction within the broader region is unlicensed for uses such as livestock and domestic bores (pastoral activities), tourist activities and Aboriginal community bores (Harrington & Harrington, 2015).

Table 4-6 summarises the groundwater abstraction licences within the Grant Group, near the Proposed Action Area. Locally, there are three known users of groundwater from the Poole Sandstone, near the Proposed Action Area—the Yungngora Community, and the towns of Camballin and Fitzroy Crossing.

The known locations of pastoral bores within the Proposed Action Area are plotted on **Figure 4-20**. The nearest pastoral bore is located at least 1.5 km away from any proposed groundwater abstraction points (well pads).

Table 4-6: Summary of Groundwater Abstraction Licences Within the Grant Group, Near the Proposed Action Area

Licence Number	Issue Date	Expiry Date	Allocation (ML)	Owner	Targeted Aquifer	Proximity to the Proposed Action Area
181107	04 Jun 2021	15 Jan 2027	10	Buru Energy Pty Ltd Origin Energy West Pty Ltd	Grant	Covers the Proposed Action Area and EP 371 entirely. No known abstraction bores operating within the Proposed Action Area
165723	14 Sep 2020	13 Sep 2030	99	Main Roads	Grant	~9.5 km east of Proposed Well pad 4; ~9.5 km north of Nidavellir
65339	18 Oct 2018	12 Nov 2024	50	Water Corporation	Grant	~65 km west of Nidavellir
65334	23 Jul 2019	23 Jan 2027	300	Water Corporation	Grant	~58 km east of Proposed Well pad 4
111188	06 Apr 2017	05 Apr 2027	30	Jarlmadangah Burru Aboriginal Corporation	Grant	~85 km west of Nidavellir
175441	03 May 2017	28 Feb 2022	25	New Standard Onshore Pty Ltd	Grant	~72 km south of Proposed Well pad 3
175572	03 May 2017	28 Feb 2022	0.15	New Standard Onshore Pty Ltd	Grant	~72 km south of Proposed Well pad 3
177201	20 Jun 2013	30 Jun 2022	4.5	Kunawarritji Aboriginal Corporation	Grant	~72 km south of Proposed Well pad 3
179509	14 May 2021	13 May 2031	15.5	WA Department of Education	Grant	~58 km east of Proposed Well pad 4
179757	12 Jan 2015	11 Jan 2025	5.475	SDWK	Grant	~58 km east of Proposed Well pad 4

Licence Number	Issue Date	Expiry Date	Allocation (ML)	Owner	Targeted Aquifer	Proximity to the Proposed Action Area
179796	18 Sep 2014	17 Sep 2024	0.35	New Standard Onshore Pty Ltd	Grant	~72 km south of Proposed Well pad 3
200028	28 Jun 2017	27 Jun 2027	2	India Bore Diamond Holdings Pty Ltd	Grant	~25 km north of Nidavellir
200952	19 May 2019	20 Feb 2028	10	Gibb River Diamonds Limited	Grant	~52 km north of Nidavellir
201114	19 May 2019	27 Mar 2028	350	Gibb River Diamonds Limited	Grant	~52 km north of Nidavellir
205296	22 Dec 2020	19 Sep 2024	1.5	West Kimberley Diamonds Pty Ltd	Grant	~65 km north-northwest of Nidavellir
206454	12 Oct 2021	11 Oct 2032	50	Burgundy Diamond Mines Limited	Grant	~43 km north-northeast of Nidavellir

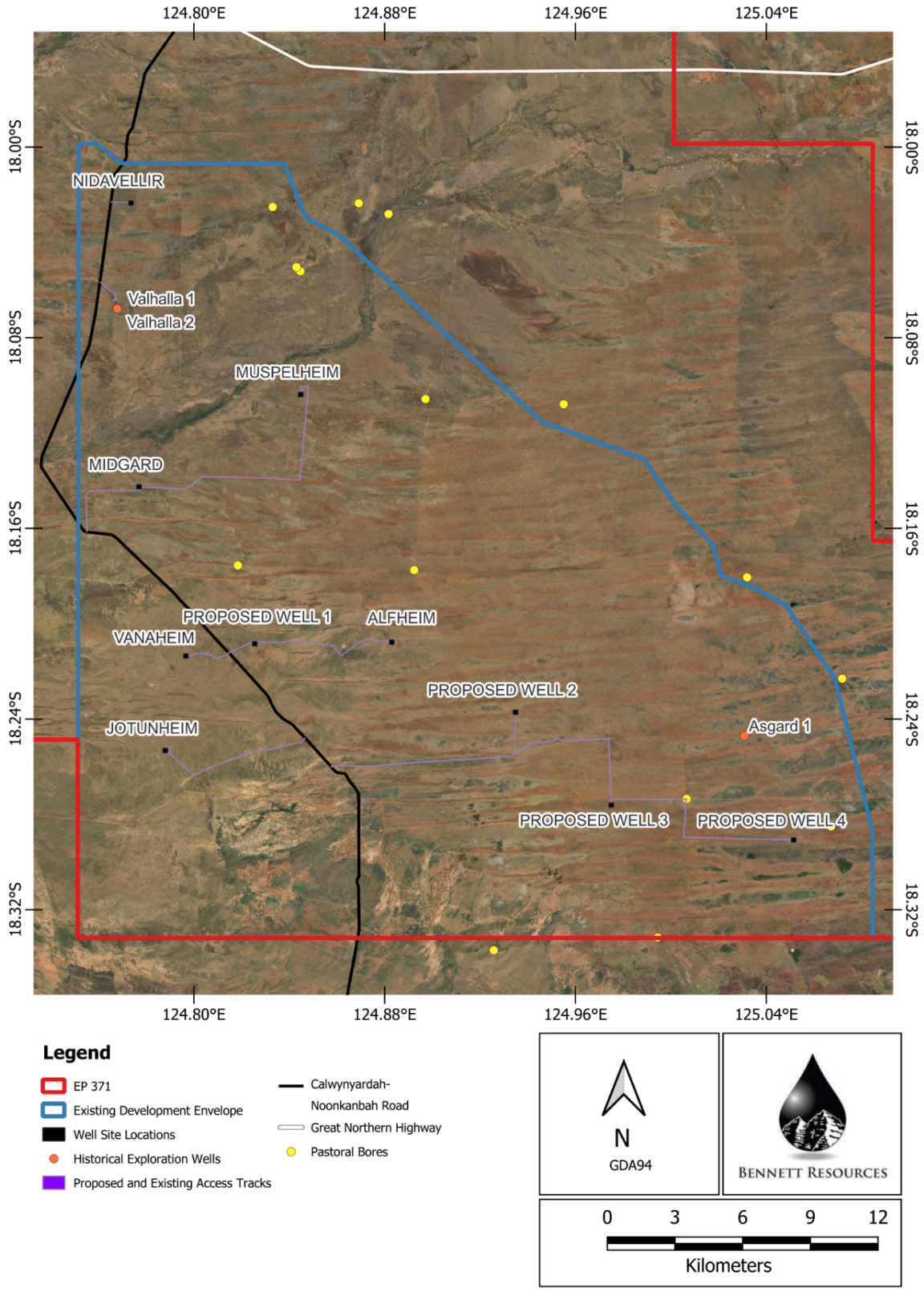

Figure 4-20: Location of Known Pastoral Bores Within the Proposed Action Area

Hydrology

Please refer to EPBC Referral 2024/10006 Section 3.4.1 which provides further description regarding these groundwater systems including (but not limited to):

- Recharge and discharge mechanisms
- Aquifer connectivity (surface water/groundwater interaction)
- Local and regional use.

For further detailed information on groundwater aquifers, including connectivity, refer to **Sections 4.2.3**, **4.2.4** and **4.2.5**.

4.2.5 Surface Water and Waterways (Including Mount Hardman Creek)

The Proposed Action Area does not intersect any Ramsar wetlands or Wetlands of National Significance within the Directory of Important Wetlands (DoIW). The Camballin Floodplain (Le Lievre Swamp System) is the closest DoIW system to the Proposed Action Area (~37 km from the western boundary of the Proposed Action Area). Three recognised surface waterbodies are present within or surrounding the Proposed Action Area:

- Fitzroy River, ~16 km south of the Proposed Action Area
- Mount Hardman Creek, crossing the Proposed Action Area (but the proposed disturbance footprint has been designed to avoid this creek)
- Mount Wynne Creek, north of the Proposed Action Area.

Figure 4-21 shows all the surface water features of the Proposed Action Area and areas surrounding them.

Mount Hardman Creek and ephemeral feeders are located within the physiographic region known as North Fitzroy plains (Lindsay & Commander, 2005). The North Fitzroy Plains consist principally of eolian sand and gravel, underlain by lateritised sandstone and mudstone of the Noonkanbah Formation and Liveringa Group (Lindsay & Commander, 2005). The ephemeral creeks are associated with small, internal drainage depressions consistent with others in the region (Lindsay & Commander, 2005). Eco Logical (2021) described these ephemeral waterways as occurring in sandy loams, clay or clay loams. The underlying formations are recharged mainly from rainfall on areas of outcrop, and locally from surface runoff and leakage through alluvium.

Mount Hardman Creek comprises limestone tableland and intricately dissected beveled ridges; separated by plains and rocky karst surfaces with box valleys (BoM, 2021). The creek is non-perennial and only flows following large rainfall events. This indicates that, conceptually, groundwater influence is limited to maintaining areas of isolated surface water expressions until rainfall events result in the connection of these surface water expressions causing the creek to flow. Normalised Difference Wayer index (NDWI) analysis indicates that Mount Hardman Creek does not retain water through the dry season. Specifically, in September 2024, no surface water was detected, indicating the absence of persistent aquatic habitat during dry season (**Attachment 6**).

Claypans are likely prevalent throughout the Proposed Action Area. However, with the exception of Mount Hardman Creek, no known claypans or wetlands are located in or within close proximity of the Proposed Action Area, which has been fixed to remove the uncertainty of impacts to surface sensitivities the closest well pad to Mount Hardman creek is ~1 km.

Table 4-7 lists the distance of these features to the proposed well locations; they are shown in **Figure 4-21**.

Table 4-7: Surface Water Bodies Within the Fitzroy Catchment

Well Pad Name	Closest Water Body
Alfheim	~13.5 km southeast of Mount Hardman Creek
Jotunheim	~15 km south of Mount Hardman Creek ~26 km north of Fitzroy River
Midgard	~2.5 km southeast of Mount Hardman Creek
Muspelheim	~1 km southeast of Mount Hardman Creek
Nidavellir	~7 km southeast of Mount Wynne Creek ~10 km north of Mount Hardman Creek
Proposed well pad 1	~10.7 km south-southeast of Mount Hardman Creek
Proposed well pad 2	~18.7 km southeast of Mount Hardman Creek
Proposed well pad 3	~25 km southeast of Mount Hardman Creek ~27 km north of Fitzroy River
Proposed well pad 4	~24 km north of Fitzroy River
Vanaheim	~10 km south of Mount Hardman Creek

The Fitzroy River Catchment spans ~94,000 km^2, which is >20 per cent of the Kimberley region. The Fitzroy River generally flows between November and May following seasonal rainfall and has large but short duration floods (<two months in a wet year). Due to the long dry season, many of the tributaries of the surface fluvial system draining into the Fitzroy River are ephemeral streams or swale washes. The Fitzroy River contracts to pools with very low flows from about June to October (DoW, 2006). Ecologically, permanent pools are important refuges for aquatic species, enabling them to survive the harsh dry season.

Salinity levels in the Fitzroy River have not been routinely measured. However, some records are available from five stations from 1996 to 2005. Wet season salinity levels are usually of <250 mg/L TDS compared to dry season levels, which range up to 900 mg/L TDS (Vogwill, 2015). The river is fresh (<500 mg/L TDS) between Fitzroy Crossing and Noonkanbah, it is marginal (500–1,000 mg/L TDS) between Noonkanbah and Myroodah Station (~51 km west of the Proposed Action Area), and fresh from Myroodah to Willare (20 km south of Derby). Dry season river water salinity can be interpreted to reflect the salinity of the groundwater, because the contribution from surface run-off is negligible and the river flows are supported by baseflow. The brackish stretch of river at around the Yungngora Community may reflect the baseflow contribution both from the alluvial aquifer, and possibly from the Noonkanbah Formation, over which the river flows along that section. There may also be an influence of the Blina Shale upstream from Noonkanbah (Lindsay & Commander, 2005). The results from five historical sampling stations show that the salinity of river water often exceeds the desirable potable water limit of 500 mg/L during the dry season.

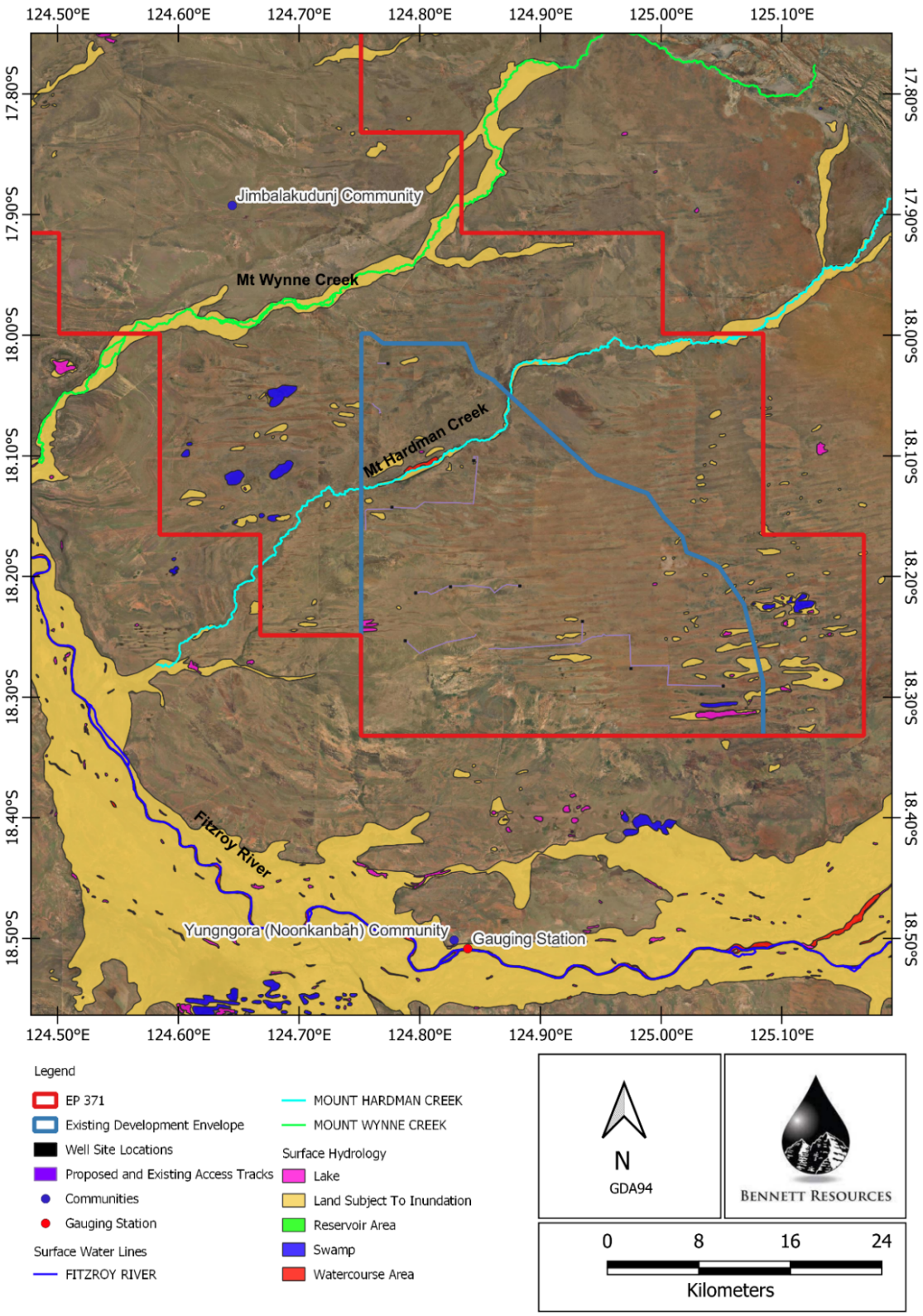

Figure 4-21: Surface Waters Within and Surrounding the Proposed Action Area

4.2.5.1 Groundwater Dependent Ecosystems

Knowledge of groundwater dependent ecosystems (GDE) within the Fitzroy River Catchment is limited and a search of the Groundwater Dependent Ecosystems Atlas (BoM, 2021) and Geomorphic Wetland Mapping System (Government of Western Australia, 2025), as recommended by (Doody TM, Hancock PJ, Pritchard JL , 2019), for GDEs within the Proposed Action Area indicates that, Mount Hardman Creek is the closest moderate potential GDE within close proximity, being approximately ~1 km north of the Proposed Action Area. Other small low potential GDEs are present with in the Proposed Action Area according to the Geomorphic Wetland Mapping System (Government of Western Australia, 2025).

Mount Hardman Creek comprises limestone tableland and intricately dissected bevelled ridges; separated by plains and rocky karst surfaces with box valleys (BoM, 2021). The creek is non-perennial and only flows following large rainfall events. This indicates that, conceptually, groundwater influence is limited to maintaining areas of isolated surface water expressions until rainfall events result in the connection of surface waters and the creek flows.

FitzCAM—a community group comprising representatives from the key Traditional Owner groups of the Fitzroy River Catchment, pastoralists, irrigators, recreational fishers and catchment residents—developed a draft table of assets known to be water-dependent features (Harrington & Harrington, 2015). These assets included:

Lake Gladstone, the largest permanent freshwater wetland in the Central Kimberley bioregion, providing a refuge for vulnerable species freshwater springs such as Udialla Springs and Honeymoon Springs Mallallah Swamp and Sandhill Swamp, which are potentially important waterbird habitats.

In addition, a review of Wetlands of National Significance (DAWE, 2001) was conducted under the Northern Australia Sustainable Yields Project in 2008, which identified that the Camballin Floodplain (Le Lievre Swamp System) and Geikie Gorge were ecologically important where changes in flow regimes occurred (Harrington & Harrington, 2015).

Table 4-8 lists the distances to these ecological sensitivities from the Proposed Action Area, bearing in mind that the distance to the actual proposed disturbance footprint will be greater than these distances.

Table 4-8: Distance of the Proposed Action Area to Water-Dependent Features

Feature	Distance and Direction from the Proposed Action Area
Mallallah Swamp	~9 km south
Sandhill Swamp	~30 km southwest
Camballin Floodplain (Le Lievre Swamp System)	~38 km west/northwest
Geikie Gorge	~70 km east
Honeymoon Springs (fresh water)	~78 km west
Udialla Springs (fresh water)	~114 km west
Lake Gladstone	~177 km northeast

4.2.5.2 Alluvium

Figure 4-23 Supplemental Geology Map is a map of the extent of the alluvium within the Proposed Action Area, based on the solid geology mapping (Stewart et al., 2020). This map shows a laterally extensive deposit of Cenozoic alluvium, with some overlying Quaternary dune sands, in direct lateral connection to the Quaternary alluvium within the Mount Hardman Creek floodplain. As indicated by the dashed line on the map, the Liveringa is separated from the alluvium by the Blina shale throughout the southern part of the Proposed Action Area. Throughout the remainder of the Proposed Action Area, including throughout most of the Quaternary alluvium around Mt. Hardman Creek, the Liveringa appears to be in direct contact with the surficial alluvial deposits. This is consistent with the assumptions built into the groundwater conceptualisation and the numerical model, both of which assume that the aquifer is in direct hydraulic communication with the surface waters in the Proposed Action Area. To reiterate, the conceptualisation of the groundwater system as presented in INTERA, 2024 (ERD Appendix L Groundwater Modeling **Attachment 13**) and the RFI Response (PD **Attachment 3**) does not assume an absence of connectivity between the surface water and groundwater.

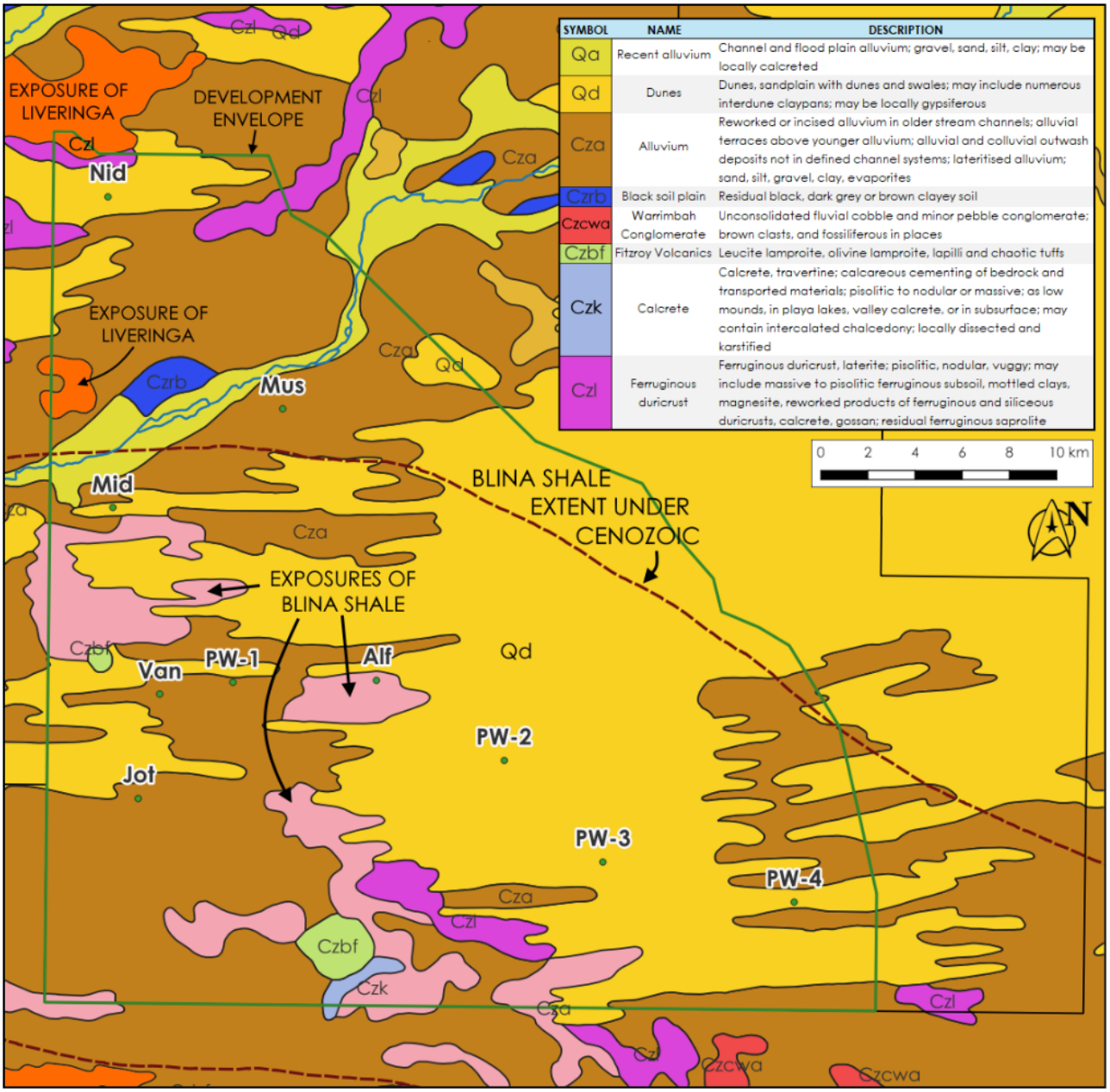

Figure 4-22: Supplemental Geology Map (Stewart et al., 2020)

4.2.6 Vegetation Communities

The Valhalla Flora and Fauna Survey (**Attachment 1**) recorded a total of thirteen vegetation communities were recorded delineated and mapped within the Proposed Action Area generally comprising broad mixtures of *Adansonia gregorii, Corymbia* and *Eucalyptus spp., Atalaya hemiglauca, Bauhinia cunninghamii* and *Erythrophleum chlorostachys* woodland over mixed Acacia, Grevillea, Hakea spp. shrubland over *Triodia* spp. hummock grassland and *Aristida, Eriachne, Eragrostis and Sorghum spp*. tussock grassland. This survey was completed in accordance with the Western Australian state guidelines to support the environmental approvals under the *Environmental Protection Act 1986.*

No EPBC listed flora species or vegetation communities were recorded The Valhalla Flora and Fauna Survey (**Attachment 1**).

Please refer to EPBC Referral 2024/10006 Section 3.1.1 where vegetation communities have previously been detailed.

4.3 Matters of National Environmental Significance (MNES)

4.3.1 Water Resources

It should be noted that the Proposed Action is not an unconventional gas development. It is an early-stage exploration and appraisal Proposed Action not development Proposed Action.

Given the nature of the proposed activity only three water resources (as defined under the EPBC Act) have the potential to be exposed. These are:

- Liveringa aquifer (through abstraction)
- Poole aquifer (from vertical migration of contaminates [deemed non-credible])
- Mount Hardman Creek a moderate potential GDE (from an overflow of produced wastewater pond – deemed not plausible due to engineering controls to account for flooding risks) other ephemeral Low potential GDEs (reliant on wet season rainfall)

The Proposed Action is not within sufficient proximity of any other water resources that would result in any direct or indirect impacts to MNES. Groundwater drawdown is discussed in **Section 5.1.1.1**.

4.3.2 Listed Threatened Species and Communities and Listed Migratory Species

No listed Threatened Ecological Communities are present in the Proposed Action Area.

A 'Likelihood of Occurrence' category was applied to all species identified in the DCCEEW Protected Matters Search Tool (PMST) report to assess the potential for these species to occur within, or in proximity to, the Proposed Action Area. Please refer to **Attachment 7**: Likelihood of occurrence assessment for MNES (Threatened species and communities, Migratory species).

For a description of the listed threatened species and communities, and migratory species please refer to the Assessment of potential impacts to MNES (**Attachment 8**).

Further to the information provided in EPBC Referral 2024/10006, BNR has engaged with subject matter experts to execute further desktop assessment and analysis in regard to RFI item 7a & 7e).

Listed threatened and migratory species listed that require description per the RFI are:

Greater Bilby (Macrotis lagotis) – Vulnerable

The Greater Bilby is a medium-sized burrowing marsupial with long, soft, blue-grey fur over most of the body and white to cream on the belly. It has large ears, a long pointed snout and a black tail with a white tip. It has forelimbs that have three stoutly clawed toes (and two unclawed toes) that enable the Greater Bilby to burrow effectively. The hind limbs are slender. The Greater Bilby grows to 55 cm long with a tail up to 29 cm long and reaches a maximum weight of 2,500 g for males and 1,100 g for females (Johnson, 2008).

The remaining populations of the Greater Bilby occupy three main habitats across Australia: open tussock grassland on uplands and hills, *Acacia aneura* (mulga) woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas (Woinarski, J et al., 2014). Males range more widely than females from their home burrows, and home ranges can vary

considerably in size in different locations. Greater bilbies can use up to 18 of these burrows concurrently over several months, as well as construct a new burrow on average every 2.5 weeks (Moseby, K.E & O'Donnell E, 2003). The mean female home range is 0.18 km^2, and the mean male home range is 3.16 km^2 (Moseby, K.E & O'Donnell E, 2003). There are many active and disused burrows within the home range.

Northern Blue-Tongued Skink (Tiliqua scincoides intermedia) – Critically Endangered

The Northern Blue-Tongued Skink is a large, robust, short-limbed lizard that can reach up to 37 cm in snout-to-vent (SVL) length. It can vary in colour on its upper parts from pale yellow brown through fawn to light grey. It has smooth scales, cross-bands on the back and tail, and a large bright blue and UV-reflecting tongue that it protrudes out of its mouth during defensive displays. The belly varies from yellow and unmarked in the Kimberley to pale and marked in the east of its range (Badiane A, Carazo P, Price-Rees SJ, Ferrando-Bernal M & Whiting MJ, 2018; Shea GM, 1992; Wilson S & Swan G, 2021).

The Northern Blue-Tongued Skink occurs across northern Australia from Eighty Mile Beach in Western Australia (WA), across the southern Kimberley and Top End of the Northern Territory (NT), to approximately the Gregory Downs / Cloncurry area in western Queensland (Qld).

Vegetation associations include riparian forest, vine scrub, monsoon rainforest, pandanus-lined gorges, melaleuca forest, eucalypt woodland and savanna, sparse and dense shrubland, and spinifex and tussock grassland. Most – but not all – detections have occurred near seasonal or permanent water (Shea GM, 1992); (AWC, 2022).

Largetooth Sawfish (Pristis pristis) – Endangered

The Largetooth Sawfish are characterised by their slender shark-like body, flattened head and elongated saw-like snouts, or rostrums, which have varying numbers of teeth along each side depending on species, sex and region. Largetooth Sawfish grow to a maximum length of approximately 700 cm (Commonwealth of Australia, 2015).

Largetooth Sawfish live in freshwater rivers and upper estuarine areas as juveniles, before moving into estuarine and marine areas as adults. The other four species spend much of their lives in estuarine and inshore areas. Largetooth Sawfish are thought to also utilise deepwater habitats. Little is known about adult habitat use for any of the Largetooth Sawfish (Commonwealth of Australia, 2015).

Largetooth Sawfish inhabit the sandy or muddy bottoms of shallow coastal waters, estuaries, river mouths and freshwater rivers, and isolated water holes. The species has been recorded up to 400 km inland (Whitty et al., 2008). Largetooth Sawfish have a shift in habitat utilisation with neonate and juvenile animals primarily occurring in the freshwater reaches of rivers and estuaries and adult animals being found in marine and estuarine environments.

4.3.3 National Heritage

Please refer to the EPBC Referral 2024/10006 Section 4.1.2.3 which gives a detailed description of:

- Noonkanbah Gate on Calwynyardah-Noonkanbah Road
- WKNHP associated with the Fitzroy River.

5 ASSESSMENT OF IMPACTS

5.1 Water Resources That Relate to Unconventional Gas Development and Large Coal Mining Development

It should be noted that the Proposed Action is not an unconventional gas development. It is an early stage exploration and appraisal Proposed Action not development project.

Two potential impact pathways to water resources from the Proposed Action were identified as being the hydrology of a water resource and the water quality of a water resource. To support BNR's environmental approval process, an environmental impact assessment was completed to identify each potential impact source, ecological receptor and exposure pathway associated with the Proposed Action. Each impact pathway has been assessed below and includes mitigation measures, response actions, monitoring requirements and detail in the following sections:

- Hydrology of a Water Resource (**Section 5.1.1**)
- Groundwater Drawdown (Hydraulic Connectivity Between Aquifer and Surface Water **Section 5.1.1.1**)
- Water Quality of a Water Resource (**Section 5.1.2**)
- Subsurface release during HFS (Potential Contamination of Aquifers Through Unplanned Fracture Heights – **Section 5.1.2.1**)
- Subsurface release during drilling (Potential Contamination of Surficial Formations due to Lost Circulation or Well Integrity Issues, Including Casing Failures – **Section 5.1.2.3**)
- Subsurface release during HFS (unplanned) (Potential Contamination of Surficial Aquifers from an accidental release at the surface of drilling fluids, HFS chemicals, liquid hydrocarbons, or produced formation water (**Section 5.1.2.5**)
- Surface Storage Spill (Potential Risk to Site Activities and Infrastructure due to Extreme Rainfall Events – **Section 5.1.2.8**)
- The information in the sections above have been reviewed against the IESC guidelines for preparing proposals and impact pathways (IESC, 2024a; IESC, 2024b). BNR concluded that the impact assessment undertaken is adequate and consistent with these IESC guidelines.

5.1.1 Hydrology of a Water Resource

5.1.1.1 Groundwater Drawdown (Hydraulic Connectivity Between Aquifer and Surface Water)

Groundwater drawdown is not exclusively associated with unconventional drilling activities. This is an impact associated with all water abstracting activities in Australia including those practices used extensively on the operating pastoral station on which the Proposed Action is located. It has been included for completeness.

It should be noted that only one (1) of the 10 well pads are located in close proximity to a surface water feature. This well pad (Muspelheim) is located ~1 km away from Mount Hardman Creek which only flows intermittently (**Table 4-7**). Although the impacts of drawdown are considered conservatively for all wells this should be considered given no other well are within close proximity of a surface water body.

BNR will develop and implement a Monitoring program to ensure no detectable decrease in the health of groundwater dependent ecosystems, compared to baseline, as a result of groundwater abstraction at the Midgard or Muspelheim well pads. This will be developed by BNR, with an independent expert, prior to commencement of any works related to the Midgard and Muspelheim well sites.

Modelling completed by INTERA Geosciences Pty Ltd (**Attachment 3**) indicates the potential groundwater drawdown impacts are limited to 1 mm drawdown at 700 m from the abstraction point. As abstraction points will be located on the well pads themselves, the analysis considers impacts to surface waters within 700 m of the well pad disturbance footprint.

The only identified surface water feature, or system with the potential to comprise a GDE, is Mount Hardman creek located ~1 km away. The drawdown modelling provided by INTERA Geosciences Pty Ltd (**Attachment 3**) has shown:

> *"The results of the Uncertainty Analysis (UA) modelling also indicate that the nearest surface water expression to any of the proposed abstraction bores is at least 1 km from the edge of the modelled zone with a non-zero probability of experiencing a drawdown greater than 0.1 m. Based on the modelling and associated Uncertainty Analysis, there are no reasonable scenarios that indicate any probability of impact to terrestrial GDEs in the Proposed Action Area."*

The Proposed Action is a temporary exploration and Appraisal Program. Water abstraction is required for a limited time for a finite volume of water. Water abstraction is commonplace across the pastoral station on which the Proposed Action lies. On completion of abstraction, modelling indicates a rapid recovery of groundwater level suggesting the Proposed Action will not have a long term impact on the hydrology in the region.

Detailed information regarding the hydraulic connectivity (or disconnect) between aquifers and surface water expressions refer to Item 18 pages 10-12 of Valhalla Gas Exploration and Appraisal Program Select RFI Responses by INTERA Geosciences Pty Ltd (**Attachment 3**).

BNR understands that:

> *"an action is likely to have a significant impact on a water resource if there is **a real or not remote chance or possibility** that it will directly or indirectly result in a change to the hydrology of a water resource."*

Based on the following, BNR does not believe that there is a real chance or possibility that water abstraction can or will result in a long-term alteration to the hydrology of a water resource.

- Water is only abstracted from the Liveringa aquifer.
- Water is abstracted at each well pad as and when required to support the temporary activity (so not all concurrently nor continuously) and abstraction ceases once volumes required to implement the Proposed Action activity have been achieved.
- Drawdown modelling continues to verify with increasingly unrealistic conservative assumptions in place that impacts will only be limited to within 700 m of the well pad.
- Any impacts are temporary with no permanent change expected (consistent with previous drilling programs in EP 371 and existing pastoral water abstraction observations).
- The closest surface water expression (Mount Hardman Creek a moderate potential GDE) is ~1 km away.

- The only well pad located close to a surface water feature (Mount Hardman Creek) is located outside of the modelled 1 mm drawdown contour and is an ephemeral creek.

BNR interrogated the DWER (2023) Study: *'Mapping aquatic groundwater dependent ecosystems in the Fitzroy water planning area'* but note these have been developed through the joining and interrogation of broadscale spatial datasets. Further, the DWER state (DWER, 2023)

> *"Confidence in the accuracy of the water regime attribute is variable across the Fitzroy water planning area."*

Given their absence in confidence of the dataset created, they stated that *'If an aquatic ecosystem had periodic inundation, we considered there was a 'low likelihood' of groundwater interaction occurring* (rating 1[9]).

Through further mapping of GDEs in the Proposed Action Area (Government of Western Australia, 2025), it was identified that no high potential GDE's were located within close proximity of the well pad's (DWER, 2023). One potential aquatic GDE was identified within close proximity (<250 m) of the Muspelheim well pad. This GDE is classified as 'low likelihood' and unlikely to result in groundwater interaction, which is consistent with BNR's understanding of the *entire area* which is subject to seasonal inundation.

Modeling shows that the proximity of this 'low potential' GDE to the Muspelheim well pad will result in an average of approximately 0.8 mm drawdown GDE proximity to Muspelheim modelling results (**Figure 5-1**). Given that seasonal fluctuations of groundwater levels in the region are between 0.2 m and 1 m (Rockwater, 2016), any short-term drawdown is expected to remain within the extent of natural variability and therefore would be indistinguishable from normal seasonal fluctuations. This regional seasonal fluctuation also shows that the ecosystems in the area would be well adapted to the seasonal fluctuations and therefore the impact of a 0.8 mm temporary drawdown will be no different to the seasonal fluctuations.

[9] Rating 1 = unlikely to result in groundwater interaction (DWER, 2023)

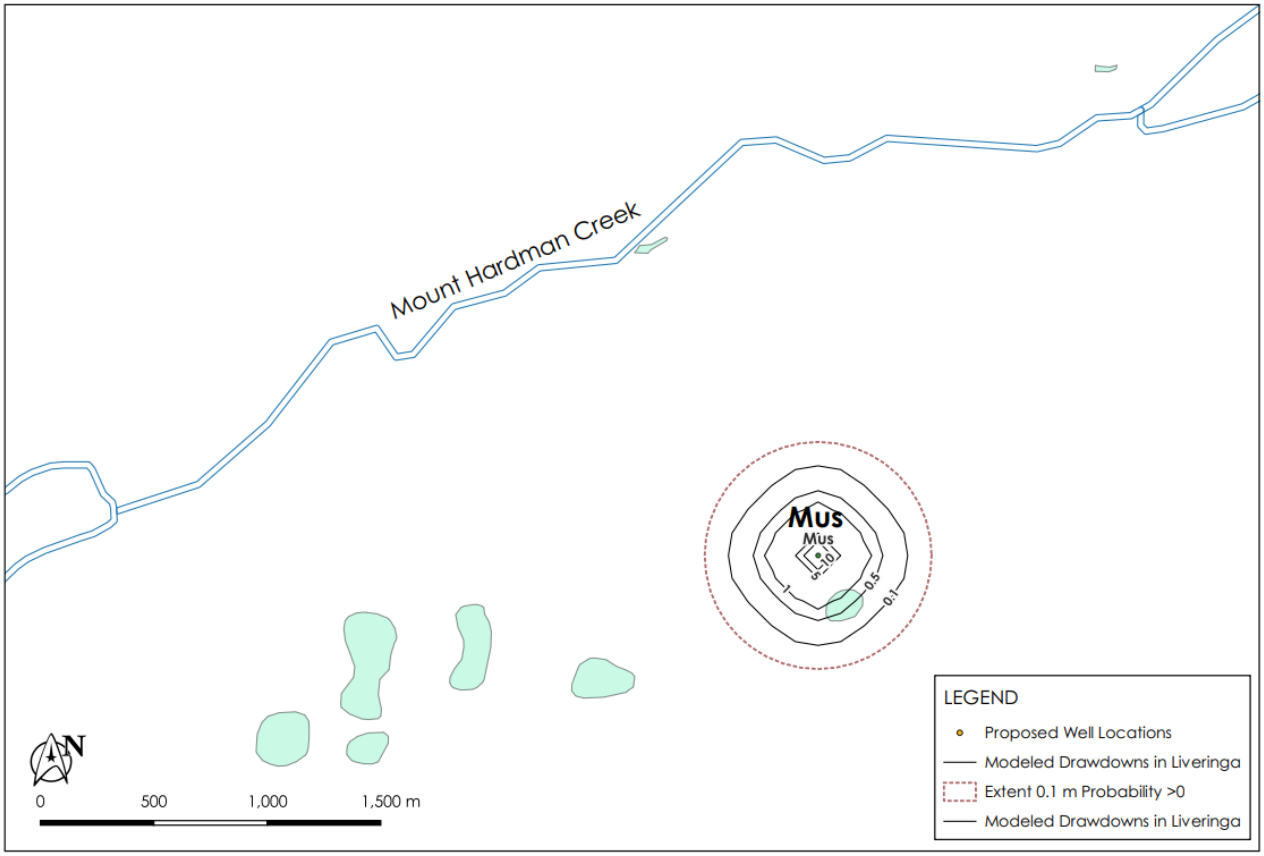

Figure 5-1: GDE Proximity to Muspelheim Modelling Results

Further to this, BNR based the desktop assessments not just on spatial mapping (which included government spatial datasets including those from BoM) but also from data and anecdotal evidence gathered by stakeholders that live work and know the land in this region. FitzCAM—a community group comprising representatives from the key Traditional Owner groups of the Fitzroy River Catchment, pastoralists, irrigators, recreational fishers and catchment residents—developed a draft table of assets known to be water-dependent features (Harrington & Harrington, 2015). A review of these assets did not identify any additional assets within close proximity of the Proposed Action Area as previously identified by BoM data.

Modelling completed to date indicating that a drawdown of 1 mm, 700 m from the Proposed Action Area would be unlikely to expose Mount Hardman creek, which is the closest 'moderate potential GDE (DWER, 2023) – which is defined as "a non-permanent river", is located over 700 m from the abstraction point. Consequently, the modelling provided by BNR including the assessment of impacts to GDE is considered suitable.

BNR engaged with subject matter experts at INTERA Geosciences Pty Ltd to undertake further groundwater drawdown investigations, assessment and modelling to support the response to RFI Items 17, 18, 19 and 20.

Refer to **Attachment 3** Valhalla Gas Exploration and Appraisal Program RFI Responses:

- Item 17 pages 1-10
- Item 18a pages 10-11

- Item 18b pages 11-12
- Item 19 page 12
- Item 20 pages 12-13.

5.1.1.2 Impact Pathways and Mitigation Measures

Site Preparation, Construction, Operation and Decommissioning

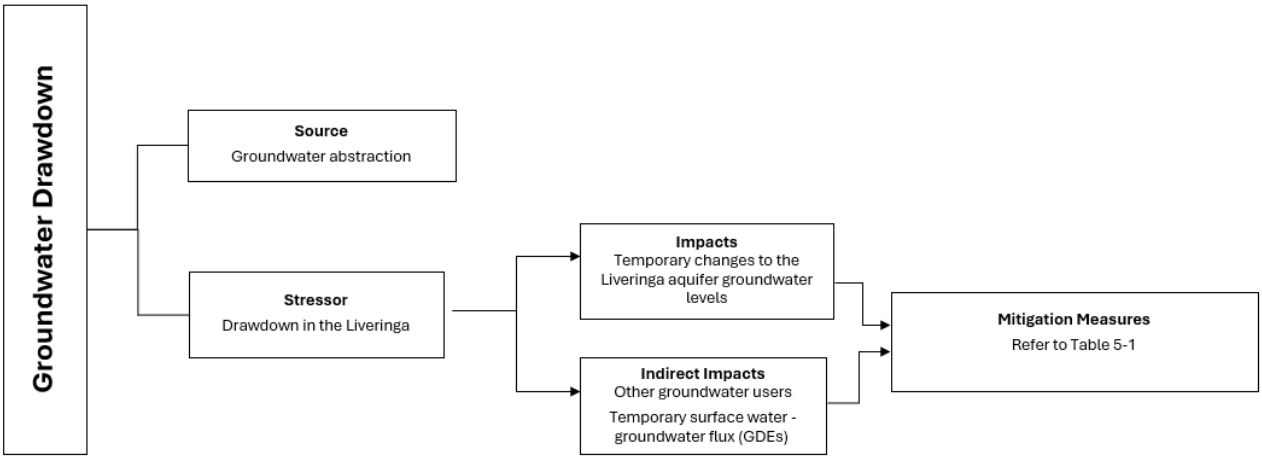

Figure 5-2: Groundwater Drawdown Impact Pathway

Table 5-1: Groundwater Drawdown Mitigation Measures[10]

Potential Impact	**Impacts** • Temporary changes to the Liveringa aquifer groundwater levels (groundwater drawdown) associated with water abstraction **Indirect Impact** • Other groundwater users • Temporary surface water - groundwater flux (GDEs) **Cumulative Impacts** • N/A
Avoid	• Wells are located outside of 2,000 m of a PDWSA. • No abstraction from deeper aquifers (Poole Aquifer).
Minimise	• Water abstraction bores will have meters to monitoring volumes abstracted. • Water abstraction volume meters will be calibrated. • Groundwater licences (and subsequent conditions on construction of the bores and abstraction of water) will be obtained for all abstraction bores in compliance with the *Rights in Water and Irrigation Act 1914* (RiWI Act). • Groundwater Management Plan (GWMP) to monitor and detect drawdown levels for each water abstraction bore.
Rehabilitate	• N/A
Indicators	**Trigger Criteria** • When the groundwater drawdown exceeds modelled extent. **Threshold Criteria** • When groundwater drawdown exceeds modelled extent for multiple monitoring events post cessation of abstraction.
Response Action(s)	**Trigger Level Actions** • Investigate the cause of groundwater levels exceeding the predicted modelled drawdown extent identified in the trigger criteria. • Review groundwater level monitoring data, including QA/QC procedures, to confirm the validity of the results. • Determine if the change in groundwater levels is attributable to the Proposed Action and implement adaptive management measures. • Where the groundwater level exceedance is attributable to the Proposed Action, implement corrective actions this may include: o Re-monitor groundwater levels to confirm recovery. o Cessation of groundwater abstraction until levels return to predicted or baseline averages. o Increased monitoring frequency until levels stabilise. • Where it is determined that exceedance was not caused by the Proposed Action, resume standard water quality or groundwater level monitoring frequency. **Threshold Level Actions**: • Where the threshold exceedance can be attributable to the Proposed Action activities, implement corrective actions this may include: o Extending the monitoring program and increase frequency (to monthly [where quarterly sampling is being undertaken] or fortnightly [where monthly sampling is being undertaken]) until level values recover.

[10] Groundwater Management Plan is currently being updated to reflect Western Australian EPA conditions. The update will also be consistent with the monitoring thresholds described in **Table 5-1**.

	o For Midgard and Muspelheim Wells - Commence GDE health surveys within the groundwater drawdown impact zone of the well. o Continue to implement actions to remediate the exceedance, until groundwater level recovers to the predicted modelled drawdown extent or approval to cease monitoring has been given by the relevant regulator.
Monitoring	• Each well pad will have a single Liveringa control monitoring bore that will be used to monitor groundwater level drawdown. The control bore will be installed upgradient from the well and produced formation water evaporation pond, located as far as possible from the contamination sources (~100 m upgradient). • BNR will develop and implement a Monitoring program to ensure no detectable decrease[11] in groundwater quality of the Liveringa Aquifer and the Grant Poole Aquifer, compared to baseline[12],. As a result of the proposed action prior to commencement of the proposed action. This Monitoring program will be developed by an independent expert. • BNR will develop and implement a Monitoring program to ensure no detectable decrease in the health of groundwater dependent ecosystems, compared to baseline, as a result of groundwater abstraction at the Midgard or Muspelheim well pads. This will be developed by BNR, with an independent expert, prior to commencement of any works related to the Midgard and Muspelheim well sites. • These Monitoring programs will be formalised within the Groundwater Management Plan and will be subject to approval by the Commonwealth Environment Minister, under the EPBC Act.
Frequency	**Liveringa aquifer** • Baseline samples from the Liveringa will be collected quarterly from the control bore for a year prior to conducting drilling activities to gather seasonal variation over a single a year (i.e. captures seasonal groundwater high post wet season, and seasonal groundwater low post dry season). • Surveillance samples will be collected quarterly in accordance with a Groundwater Management Plan. • If groundwater level threshold exceedance occurs monitoring frequency will be increased to monthly in accordance with the Groundwater Management Plan.
Reporting	• Reporting under the EPBC Act will be in accordance with relevant approval conditions. • If it is determined that a groundwater level have exceeded the predicted extent and will have a significant impact to MNES the event will be reported to DCCEEW compliance branch. • An Annual Compliance Report will be submitted in accordance with approval conditions
Residual Significant Impact	Groundwater drawdown impacts associated with abstraction is limited to 1 mm within 700 m of the abstraction source. This will not result in any exposure to surface water features and localised water levels will rapidly recover following cessation of temporary abstraction activities. Modelling to date has not considered recharge mechanisms prevalent in the Kimberley, thus any direct abstraction impacts will diminish rapidly. As such BNR does not believe that there is a real chance or possibility that the Proposed Action will result in any long-term impact to hydrology.
Proposed Outcome	No significant drawdown of the aquifer following completion of the Proposed Action that is considered outside seasonal fluctuations (or the predicted modelled extent).

[11] Detectable - The smallest statistically discernible effect size that can be achieved with a monitoring strategy designed to achieve a statistical power value of at least 0.8 or an alternative value.
[12] Baseline - Initial conditions measured before disturbance associated with the proposal, which is used for comparison with data collected during and after disturbance to identify and measure changes in conditions.

5.1.2 Water Quality of a Water Resource

BNR acknowledge that like all Actions, environmental risks are present for the Proposed Action that could result in changes to the water quality of a water resource. However, the risks associated with the Proposed Action are not planned impacts and controls and mitigations in place ensure that all risks are either non-credible (as there is no credible impact pathway once mitigations are implemented) or highly unlikely (a remote possibility) for the events to occur during the Proposed Action's lifetime (such as extreme rainfall events).

These risks are also subject to WA EPA Assessment and given the "water resources" definition under the EPBC Act is sufficiently broad BNR believes this process to be an exact duplication of state process which comprise multiple State protective legislative frameworks (so each of these risks are subject the same risk assessment four (4) times, for the same receptors, using the same models that provide the same outcome).

The three (3) events that could result the change in water quality of a water resources include:

- Potential contamination of aquifers through unplanned fracture heights (non-credible risk due to existing geological conditions)
- Potential contamination of surficial formations due to lost circulation or well integrity issues, including casing failures (event is no different to those associated with conventional drilling activities)
- Potential risk to site activities and infrastructure due to extreme rainfall events (event is no different to those associated with conventional drilling activities).

For completeness and at DCCEEWs request, BNR have included the following additional impact pathways:

- Surface release during HFS (unplanned) (Potential Contamination of Surficial Aquifers from an accidental release at the surface of drilling fluids, HFS chemicals, liquid hydrocarbons, or produced formation water (**Section 5.1.2.5**)
- Accidental surface release - drilling fluids, HFS chemicals, liquid hydrocarbons 5.1.2.6
- Accidental surface release – wastewater ponds (leaks) 5.1.2.7

BNR does not believe that with the mitigations in place that credible impact pathways exist where the Proposed Action can or will result in a significant change to the water quality of a water resource that would result in a significant impact to a MNES.

All of these events have preventative controls and recovery mitigations in place. When considered in conjunction with the natural geology, the likelihood of a significant water contamination event (detailed in **Table 5-2**) resulting in contamination of a water resource is un-real or a remote possibility only.

BNR acknowledges IESC and Department advice regarding baseline monitoring requirements and has committed to demonstrating contamination as being an unreal or remote possibility by implementing a monitoring program that will be developed by an independent expert. The Monitoring program will be developed to ensure no detectable decrease[13] in groundwater quality of the Liveringa Aquifer and the Grant Poole Aquifer, compared to baseline[14],. This program will be

[13] Detectable - The smallest statistically discernible effect size that can be achieved with a monitoring strategy designed to achieve a statistical power value of at least 0.8 or an alternative value.
[14] Baseline - Initial conditions measured before disturbance associated with the proposal, which is used for comparison with data collected during and after disturbance to identify and measure changes in conditions.

formalised within the Groundwater Management Plan, implemented prior to any activity which BNR considers to be consistent with IESC and Department advice.

Table 5-2: Proposed Action Contamination Event Risk Characterisation

Spill Event	Mitigation Measures	Activity				Event Summary
		Site Preparation Operations	Drilling Operations	HFS Operations	Site Reinstatement	
Loss of diesel during refuelling	**Section 5.1.2.5**	X	X	X	X	A spill event such as this is anticipated to result in a volume of <100 L being released to the ground.
Loss of diesel from on-site diesel storage tank	**Section 5.1.2.5**		X	X		Based on the volumes of hydrocarbon and hazardous material types anticipated for use during the Proposed Action, the impact evaluation is based on a full release of a 75 m^3 diesel tank.
Loss of minor volumes of hydrocarbon or chemicals during storage and handling	**Section 5.1.2.5**		X	X		Various hydrocarbons and chemicals are required for the Proposed Action. These will generally be stored in 10 L tins, 200 L drums, and 1,000 L intermediate bulk containers. Based on the loss of an entire container during transport or handling, this type of spill event is anticipated to result in a volume of <1,000 L being released to ground.
Loss of drilling fluids due to circulation issues or well integrity failure	**Section 5.1.2.4**		X			During drilling activities, a small amount of the drilling fluid and associated chemical additives may be lost to the environment down hole as a fugitive discharge (filtrate loss) or via in the event of failed well integrity. There is also a risk that during drilling, fluid returns may be lost to the formation where porous/cavernous geological formations are intersected and where the casing has not yet been installed and cemented in place.
Loss of HFS fluid at the surface during HFS operations	**Section 5.1.2.6**			X		During HFS, some small amounts of HFS fluid may leak from the lines when the fluid is pumped to the well head. Surface line leaks may occur given the fluid's pressure contained in the lines. Based upon a worst-case scenario, this type of spill event is anticipated to result in a volume of <500 L being released to ground.
Loss of well control	**Section 5.1.2.4**		X			During drilling activities, there is the potential for an underbalanced well or equipment failure to result in a loss of well control (i.e. failure of multiple barriers). Given the target formation is "tight" rock, the likelihood of a loss of well control scenario is low with situation required to release reservoir fluids. It is reasonable to estimate that a well could be controlled within 4 weeks based upon on-site access to well control expertise and equipment.

Spill Event	Mitigation Measures	Activity				Event Summary
		Site Preparation Operations	Drilling Operations	HFS Operations	Site Reinstatement	
						With the anticipated negligible volume of condensate produced (well under <4 m^3/day from past well testing) with the gas, and as the most likely direction of gas flow is vertical, the liquid hydrocarbon component, if present, is expected to volatise or disperse via a mist and vaporise into the atmosphere.
Loss of formation water produced during well testing	**Section 5.1.2.6**			X		Produced formation water from the Laurel Formation has been characterised by the previous operator of EP 371 through the analysis of multiple water samples at a NATA-accredited laboratory. In summary, the produced formation water in the water retention ponds is very high in salt (3–5 times the salt concentration of sea water), not toxic to fauna or humans, and heavy metals are at very low levels. To understand the potential release volumes associated with a release of produced formation water, BNR has evaluated the produced formation water system and identified that piping or connection points were the most likely source for a release of this fluid. Based on guidance for understanding the magnitude of other similar events, and given the HFS activities are continuously supervised, a maximum credible spill volume was based on the transfer rate × 15 minutes. When including pumping rates, this equates to an instantaneous spill volume of ~50 m^3.

5.1.2.1 Potential Contamination of Aquifers Through Unplanned Vertical Fracture Heights

International peer-reviewed studies have found that hydraulic fracturing in shale and tight gas formations affects a very limited portion of the entire thickness of the overlying bedrock and is unable to create direct hydraulic communication between target zones and shallow aquifers through induced fractures (Fisher & Warpinski, 2012; Davies, Mathias, Moss, Hustoft, & Newport, 2012). The review by Davies et al. (2012) was based on analysing the data acquired from several thousand shale gas HFS in the United States (US). This data reported a maximum vertical fracture length of 588 m (Davies, Mathias, Moss, Hustoft, & Newport, 2012).

The comparison of nearly 4,000 tops of micro seismic fractures to the maximum groundwater depths across four major US shale formations showed that in no cases did the fracture zones reach overlying aquifers. A separation of over 800 m remained between the local aquifers (Fisher & Warpinski, 2012), with only one per cent of these fractures being >350 m high (Davies, Mathias, Moss, Hustoft, & Newport, 2012). A further study by Davies et al. (2012) in the United Kingdom

found that hydraulic fractures remain well confined to the target interval, even in the presence of faults.

As it relates to faults and fault seal for the Proposed Action, all significant faults in the development area are downthrown to the west and formation juxtaposition would place the proposed Laurel and Anderson unconventional reservoirs against Laurel or older units updip. Given the current data, there is unlikely to be any significant juxtaposition against younger (Grant or Poole) units updip. In addition, conventional HFSs are not considered long-term deformations. Once pumping stops, within minutes fractures close. Further, after a stimulation, the well is flowed back, and the local stimulated rock volume is depressurized as the load water is produced. There is no expectation of high pressures to remain above the local geopressured gradient beyond the time during which the wells are undergoing their stimulation.

With regard to stress orientation, all faults are closed and pose no geomechanical hazard for upward propagation of fracturing fluids or hydrocarbons into the recognized aquifers as the activation energy required to dilate faults or fractures in tension is higher than overburden, which means the fracture growth would rotate to horizontal before opening such faults in tension.

The unconventional resources within the Laurel have permeabilities between 10nd to 17md and are predominately self-sealing without HFS. Historical HFS activities for the Asgard and Valhalla wells exhibited total stress heights of between 400-600 m but exhibited more downward growth development than upward. While there are faults in the section, geomechanical data supports that the faults will not open from HFS. Any stimulation zone will fall within the top of the Laurel formation (that is approximately 2,100 m and more likely over 3,200 m deep). Consequently, a significant thickness separation is present between the targeted zone and surface aquifers.

In summary, well analysis of the stratigraphy (rock layering) indicates:

- The top of the Laurel Formation zones of interest for HFS treatment is approximately 2,100 m and more likely over 3,200 m deep.
- There is ~1,800 m separation between the targeted Laurel Formation and the surface Liveringa Aquifer, of which ~1,100 m is impermeable hard rock.
- Located directly above the Laurel Formation, the Anderson Formation is a shale layer that acts as a confining geological seal for hydrocarbon migration and therefore would act as an immediate thick containment barrier of impermeable hard rock to unplanned vertical growth of fractures.

The proposed vertical extent of the fracture envelope in the Laurel Formation is expected to be ~150 m. It is deemed not plausible, physically, for induced fractures to create a hydraulic connection between the deep shales and other tight formations and overlying potable aquifers such as the Poole Sandstone aquifer. This is determined based upon limitations to fracture height growth and potential fault slip, as discussed in the HFS Scientific Inquiry (Inquiry, 2018). Because there is ~1,800 m separation between the targeted Laurel Formation and the surface Liveringa Aquifer, at least 600 m separation between the Laurel Formation and the Grant/Poole Sandstone aquifers, and as the predicted vertical extent of fractures for the activities is ~150 m, the risk vertical fractures reaching the aquifers is extremely low.

Based on available seismic data and previous reviews of the area, the potential for geomechanical hazards in the Proposed Action Area is considered low. Seismic activity will continue to be monitored and evaluated through ongoing geomechanical assessment and microseismic monitoring as wells are constructed. Microseismic monitoring has the ability to tell us the time, location and magnitude of microseismic events. During hydraulic stimulation, microseismic monitoring can be used to determine the fracture geometry and azimuth, identify out-of-zone

events, evaluate fracture complexity and intensity, optimise injection strategies and staging, estimate stimulated reservoir volume, understand fracture development and stimulation effectiveness. This enables the detection of unplanned microseismic activity that may indicate a change to geomechanical assessment assumptions. Consequently, based on the available scientific information, and given the significant separation between the targeted Laurel Formation and the Liveringa Aquifer, BNR does not believe that contamination of usable aquifers through unplanned fracture heights is a credible risk for the Proposed Action.

BNR understands that:

“an action is likely to have a significant impact on a water resource if there is a real or not remote chance or possibility that it will directly or indirectly result in a change to the water quality of a water resource.”

Given:

1. Multiple impermeable geological barriers exist between the targeted laurel reservoir and overlying aquifers to prevent vertical migration.
2. The top of the Laurel Formation zones of interest for HFS treatment is approximately 2,100 m and more likely over 3,200 m deep.
3. There is ~1,800 m separation between the targeted Laurel Formation and the surface Liveringa Aquifer, of which ~1,100 m is impermeable hard rock.
4. The pressures at the drilling depths indicate faults are self-sealing.
5. Significant data exists for deep unconventional gas.

BNR considers that there is no credible risk of vertical migration occurring as a result of the Proposed Action. Historical HFS activities at the Asgard and Valhalla wells demonstrated greater downward fracture growth than upward propagation, and available geological data indicates that upward migration toward overlying aquifers is non-credible.

5.1.2.2 Impact Pathways and Mitigation Measures

Site Preparation

Not applicable, no HFS activities during site preparation.

Construction, Operation and Decommissioning

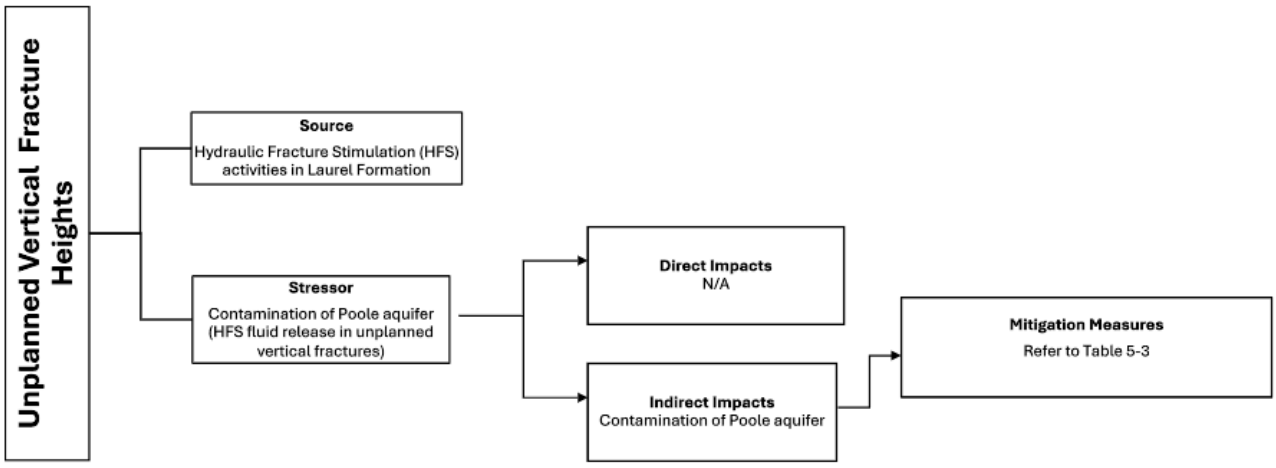

Figure 5-3: Unplanned Fracture Heights Impact Pathway

Table 5-3: Unplanned Fracture Heights Mitigation Measures

Potential Impact	**Direct Impact** • N/A **Indirect Impact** • Contamination of Poole aquifer as a result of unplanned vertical fracture heights. **Consequential Impacts** • N/A **Cumulative Impacts** • N/A
Avoid	• Siting the Proposed Action Area to avoid PDWSAs, including ensuring proposed wells are more than 2 km from proclaimed PDWSAs. • Ensuring that a minimum 600 m separation distance is maintained between the upper extent of the HFS zone and the lowest extent of the Poole Sandstone Aquifer.
Minimise	• A site specific geomechanical risk assessment will be undertaken to inform future field design, well design and subsequent mitigations to enable risks are continually reduced to as low as reasonably practicable. • A site specific geomechanical risk assessment will be completed after each well has been constructed and prior to any HFS taking place, for each exploration well. • Hydrostratigraphically log each petroleum well during drilling and undertake geophysical interpretation of groundwater aquifers to validate site specific hydrogeological information prior to HFS Activities. • An early warning system (Geomechanical monitoring) for detecting geomechanical events will be implemented for the Proposed Action. • Ensuring that a minimum 600 m separation distance is maintained between the upper extent of the HFS zone and the lowest extent of the Poole Sandstone Aquifer.
Rehabilitate	• N/A
Indicators	**Trigger Criteria** • Geomechanical monitoring (early warning system) indicates fracturing that exceeds predicted fracture height (from HFS Modelling), and • Early warning microseismic monitoring system detects a deviating or subsurface event inconsistent with pre-activity assumptions, and • Fracture height exceeds the 600 m vertical separation distance of the Poole aquifer. **Threshold Criteria** • Groundwater monitoring (surveillance bore) detects a change in CoPC concentrations relative to baseline conditions that may indicate potential hydraulic connectivity between the stimulated zone and the Poole aquifer.
Response Action(s)	**Trigger level actions** • Identify the cause of the trigger event • Identify if the trigger event is Proposed Action attributable, complete a localised risk and impact assessment. • Review data, including QA/QC procedures, to confirm the validity of the results • Reassess HFS modelling assumptions and geophysical parameter validate likelihood of vertical migration. If the credibility of vertical migration event has changed based upon available data, and there is a likelihood of a potential for a Poole contamination event: • Consider installing additional baseline Poole Aquifer monitoring bore upgradient of the development envelope and commence monthly groundwater monitoring. • Consider Installing additional surveillance Poole Aquifer monitoring bore downgradient of the development envelope and commence monthly groundwater data collection.

	• Identify the contaminant and a relevant CoPC to inform groundwater sampling requirements. • Conduct multiple samples and where contamination of the Poole Aquifer is not observed over three sampling events cease monitoring of the Poole Aquifer and resume stimulation activities. **Threshold Level Actions** Initiate implementation of contingency measures including: • Where the threshold exceedance can be attributed to the Proposed Action activities: • Suspend HFS execution of the second well at the same wellsite until monitoring results validate that a vertical migration contamination event of the Poole Aquifer has not occurred. • Increase monitoring frequency to fortnightly. • Engage with relevant regulators to discuss frequency of monitoring. • Update the detailed local impact assessment based upon CoPC and water quality parameters to determine any likely worst case local impacts (including proximity to sensitive receptors and duration to exposure). • Consider any additional actions that can be implemented in discussion with regulators to negate impacts associated with the contamination event. • Continue to implement actions to remediate the exceedance until groundwater analyte level recovers or approval to cease has been given by the relevant regulator.
Monitoring	• Monitoring of microseismic and geomechanical events via the early warning system monitoring (microseismic monitoring) throughout HFS activities in accordance with operational requirements. • BNR will implement a Monitoring program that will be developed by an independent expert. The Monitoring program will be developed to ensure no detectable decrease[15] in groundwater quality of the Liveringa Aquifer and the Grant Poole Aquifer, compared to baseline[16],. This program will be formalised within the Groundwater Management Plan, implemented prior to any activity • Poole baseline and surveillance monitoring.
Frequency	• The early warning system (microseismic monitoring) implemented one-month pre and post any HFS activities. • Baseline and surveillance Poole aquifer monitoring monthly until surveillance results indicates no change in CoPC from baseline monitoring data.
Reporting	• Reporting under the EPBC Act will be in accordance with relevant approval conditions. • If it is determined that a groundwater quality have exceeded the predicted extent and will have a significant impact to MNES the event will be reported to DCCEEW compliance branch. • An Annual Compliance Report will be submitted in accordance with approval conditions
Residual Significant Impact	Following implementation of all avoidance, mitigation, and monitoring measures, the residual risk of contamination to the Poole Aquifer from unplanned vertical fracture connectivity is not considered credible. No measurable change to groundwater quality is expected, and any unlikely contamination event through vertical fractures would be rapidly detected and managed through the early warning system and adaptive monitoring program. Consequently, the Proposed Action is not predicted to result in any significant impact to the water quality of the Poole Aquifer or other local groundwater resources.

[15] Detectable - The smallest statistically discernible effect size that can be achieved with a monitoring strategy designed to achieve a statistical power value of at least 0.8 or an alternative value.
[16] Baseline - Initial conditions measured before disturbance associated with the proposal, which is used for comparison with data collected during and after disturbance to identify and measure changes in conditions.

Proposed Outcome	No change to groundwater quality is expected to be attributable to the Proposed Action. The design and implementation of robust avoidance and mitigation measures, including maintenance of appropriate separation distances between the HFS zone and the Poole aquifer, and the development of a site-specific geomechanical risk assessment program to ensure that the likelihood of unplanned vertical fracture event is extremely low. Coupled with the early warning system for geomechanical events, triggered groundwater monitoring, and adaptive surveillance, these measures provide a robust approach to identifying and managing any changes to assumptions should they arise during operations. Consequently, BNR considers that the Proposed Action will not result in any significant impact to the water quality of the Poole aquifer or other local groundwater resources.

5.1.2.3 Potential Contamination of Surficial Formations due to Lost Circulation or Well Integrity Issues, Including Casing Failures

This risk is not specific to unconventional drilling activities. This is a risk associated with all drilling activities. It has been included for completeness.

During all drilling activities, the most sensitive well section is the surface hole section because it penetrates through the surface aquifers that generally have low salinities and thus are most suited for other uses (such as potable water or agricultural uses). Therefore, the loss of drilling fluid circulation (i.e., drilling fluids are released to subsurface formation) is the largest risk to the Liveringa formation during drilling activities. The risk of soil and groundwater contamination from these activities is well understood because onshore exploration and appraisal drilling is undertaken regularly throughout WA and the world. Consequently, there is a standard suite of management measures that will be implemented, including:

- drilling fluid systems for the surface hole sections comprise low-toxicity mud systems
- install and cement a surface casing across the useable aquifers to isolate the aquifer from deeper formations and aquifers (DMPR, 2002).

As detailed in **Figure 2-1**, the surface hole sections are likely to be installed to 550 m, well below the Liveringa Formation. This will ensure that sufficient isolation exists before drilling the next hole section.

As low toxicity drilling fluid is used in this well section, any change in water quality would be limited to fluids that have high biodegradability and low toxicity resulting in a highly localised and temporary impact. Rockwater (2016) was engaged to predict duration of groundwater migration to key sensitivities based on hydraulic conductivity, hydraulic gradients and specific yields. The study (ERD Appendix I **Attachment 13**) concluded that groundwater would take ~16,000 years to move ~32 km. Based on the unlikely event that a lost circulation occurs when drilling the top-hole sections, resulting in drilling fluids being released to groundwater, it is extremely unlikely that due to the migration timeframe and the nature of the low-toxicity mud system used that any change to groundwater quality would be observed.

BNR understands that:

“an action is likely to have a significant impact on a water resource if there is a real or not remote chance or possibility that it will directly or indirectly result in a change to the water quality of a water resource.”

Given:

1. This is a standard drilling risk.
2. Standard practice mitigations are in place through various WA state regulations and guidelines to prevent water quality impacts being realized from this risk, including:

a. drilling top hole section with low toxicity biodegradable fluid systems
b. public chemical disclosure and regulatory assessment processes in place for these fluid systems
c. installation and cementing of a surface casing across the useable aquifers to isolate them from deeper formations and aquifers.

BNR does not believe that there is a real chance or possibility that loss of drilling fluid circulation could result in any water quality impacts above that considered temporary and localized to within close proximity of the petroleum well itself. This risk is not unique to unconventional gas projects and BNR does not believe that this risk fits within the definition of a significant impact under the EPBC Act.

5.1.2.4 Impact Pathways and Mitigation Measures

Site Preparation

Not applicable, no HFS activities during site preparation.

Construction, Operation and Decommissioning

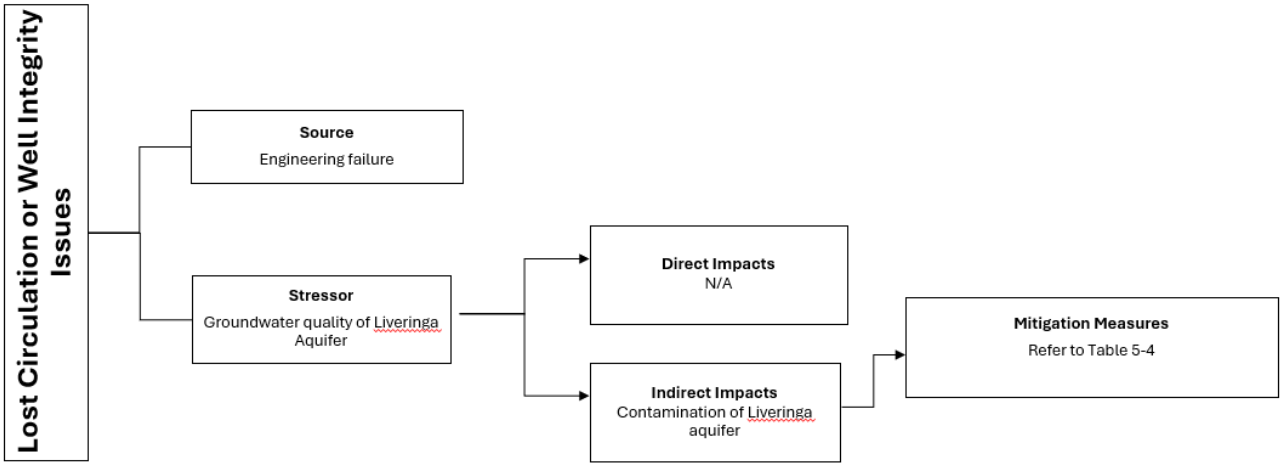

Figure 5-4: Lost Circulation or Well Integrity Issues Impact Pathway

Table 5-4: Lost Circulation or Well Integrity Issues Mitigation

Potential Impact	**Direct Impact** • N/A **Indirect Impact** • Contamination of Liveringa aquifer **Consequential Impacts** • N/A **Cumulative Impacts** • N/A
Avoid	• Use of 'low-toxicity' biodegradable drilling mud systems for drilling the surface section of the petroleum well that intersect the Liveringa aquifer.
Minimise	• Installation and cementing of a surface casing across the useable aquifers to isolate them from deeper formations and aquifers. • Implementing well integrity measures ensure each petroleum well is designed, constructed and managed to mitigate well integrity risks and is consistent with industry standards. • Well integrity assessment by independent certified examiner. • Undertake groundwater monitoring and where required, implement management actions. • Monitor and report any loss of fluids during circulation. • Complete a risk assessment for each proposed well throughout the well lifecycle to ensure that well integrity is maintained. • Comply with relevant Australian and International standards relevant to well construction and well integrity. BNR will also develop a well management plan in accordance with Western Australian Standards. A note on the Well Management Plan (WMP) The objective of a WMP is to ensure the well is designed and managed in accordance with sound engineering principles and industry best practice, including identification of risks. A range of reporting on well operations is required, including daily drilling reports, monthly production reports and well completion reports. Western Australia's State Regulator DMPE's Petroleum Division assesses a WMP having regard for: • Well integrity • Casing and cementing design • Casing seat locations • Barriers within the design to prevent any breach of well integrity including isolation of production zones, aquifers and reservoir formations • Mitigation of subsurface hazards. This applies to items such as: • Rig inspection reports; • Blowout preventers; • Choke manifolds; o barrier tabulations/schematics; • Fluid density; • Downhole safety valves; • Eell kill methods; and • Wellhead and Christmas tree configuration. If any significant variation to a WMP occurs before or during the program, that variation also has to be approved by the DMPE. Circumstances may occur during the drilling of a well where the original plan is no longer viable and Management of Change has to occur. Examples of this might be side-tracking a well or shortening a well above the approved total depth.

Rehabilitate	**N/A**
Indicators	**Trigger criteria** • A well integrity event, or • Loss of fluid circulation event, or • Changes to groundwater quality at the groundwater monitoring bore located downgradient of the petroleum well (Table 3-2, GWMP) attributable to the Proposed Action where they meet the following conditions: o 2 out of 3 successive samples fall outside the mean ± 1 Sigma (SD) limit o 4 out of 5 successive samples fall outside the mean ± 1 Sigma (SD) limit o 8 consecutive points on the same side of the mean **Threshold criteria** • Changes to groundwater at the groundwater monitoring bore located downgradient of the petroleum well (Table 3-2, GWMP) attributable to the Proposed Action where they meet the following condition: 1 sample falls outside the mean ± 2Sigma (SD) limit.
Response Action(s)	**Trigger level actions** • Identify the reason for the event, and if there is a change in water quality determine direct correlation to the Proposed Action activities or natural variation and review management measures with an adaptive management response. • Identify the contaminant and a relevant CoPC that can clearly be associated with the event. • Re-examine water quality monitoring results (QA / QC) to validate data. • Where the trigger exceedance was not caused by the Proposed Action or has not resulted in a change to groundwater quality, resume standard water quality monitoring frequency. • Where the water quality threshold exceedance was caused by the Proposed Action, take steps to remedy the impact (for example cease petroleum activities on-site) re-monitor and increase monitoring frequency (to monthly [where quarterly sampling is being undertaken] or fortnightly [where monthly sampling is being undertaken]). **Threshold level actions** Initiate implementation of contingency measures including: • Review groundwater monitoring data, including QA/QC procedures, to confirm the validity of the results. • Ground-truth and validate water quality monitoring results and investigate to determine and identify the potential cause of any exceedance. Where the cause is identified during ground-truthing and can be rectified immediately, corrective action will be undertaken without delay. Where corrective actions require additional resources or further investigation, appropriate management actions will be scheduled and implemented as soon as practicable. • Where the water quality threshold exceedance was not caused by the Proposed Action, resume standard monitoring frequency. • Where the threshold exceedance can be attributed to the Proposed Action activities implement adaptive management response management guidance. This may include: o Suspend the petroleum activity to enable source of release to be investigated and mitigated. o Installing additional Liveringa monitoring bores upgradient of the wellbore in consultation with the DWER. o Increasing monitoring frequency (to monthly [where quarterly sampling is being undertaken] or fortnightly [where monthly sampling is being undertaken]). o Once response actions have been completed, extend the monitoring program and increase to monthly until groundwater quality values recover. o Continue to implement actions to remediate the exceedance until approval to cease has been given by the relevant regulator.

Monitoring	Each well pad will have three Liveringa monitoring bores installed for each well pad that is: • One control bore upgradient from the well and produced formation water evaporation pond, located as far as possible from the contamination sources (~100m). • One impact monitoring bore within approximately 20 m down-gradient of the produced formation water evaporation pond. • One impact monitoring bore down gradient and within approximately 20 m of the production well/s.
Frequency	**Baseline** • Baseline samples from the Liveringa aquifer will be collected quarterly from at least the upgradient control bore prior to conducting drilling activities (on each well pad) to gather seasonal variation over a single a year (i.e. captures seasonal groundwater high post wet season, and seasonal groundwater low post dry season). • Where impact / surveillance bores are installed prior to drilling activities commencing[17], they will join the baseline sampling program to gather as much data as possible prior to drilling activities commencing. **Surveillance:** • During the implementation of the Proposed Action samples of all Liveringa monitoring bores will be collected quarterly. • Frequencies will be increased in the event a trigger / threshold criteria is exceed as directed by response actions. • Following completion of HFS where no significant variation from baseline is identified, the sampling frequency will drop to a single down gradient Liveringa bore twice a year and continue until the termination criteria is achieved (noting provisions to increase monitoring frequency should trigger or threshold criteria be met.
Reporting	• Reporting under the EPBC Act will be in accordance with relevant approval conditions. • If it is determined that a water quality threshold exceedance the predicted extent and will have a significant impact to MNES the event will be reported to DCCEEW compliance branch. • An Annual Compliance Report will be submitted in accordance with approval conditions.
Residual Significant Impact	Following the implementation of all well integrity and loss of circulation, mitigation, and monitoring measures, the residual risk of groundwater contamination to the Liveringa Aquifer is considered negligible. Further to this, should a release event occur, the drilling fluids are low toxicity, biodegradable and inert such that any release event would not be expected to give rise to a long term or significant water contamination event. No measurable change to groundwater quality is expected, and any unlikely deviations would be detected and managed through adaptive monitoring, early warning systems, and contingency response measures. Consequently, the Proposed Action is not predicted to result in any significant impact to the water quality of the Liveringa Aquifer or other local groundwater resources
Proposed Outcome	The Proposed Action is not expected to result in any change to the water quality of the Liveringa Aquifer, with well integrity measures, adaptive monitoring, and contingency management ensuring that any unlikely deviations are detected and managed.

[17] There are a number of reasons that down gradient impact (surveillance) bores cannot be installed pre activity and meet the 12-month baseline requirements with, the major reason being operational constraints. The location of the wells and the ponds on the well pad are subject to detailed well pad design and engineering. To inform the well pad design and engineering, the drilling rig that will be utilized needs to be contracted, given the rig will determine the layout of infrastructure to ensure that everything is positioned to enable the rig to operate safely. The Rig will not be contracted until all approvals are in place (resulting in multiple dependencies that result in significant time delay). If the impact bores are installed too early, there is the potential for them to be:

1. damaged given well cellar and pond construction requires heavy civil / earthmoving machinery, and
2. mispositioned resulting in them not being optimally placed for identifying contamination events arising from the activity.

5.1.2.5 Potential Contamination of Surficial Aquifers from an Accidental Release at the Surface of Drilling Fluids, HFS Chemicals, Liquid Hydrocarbons, or Produced Formation Water

Site Preparation

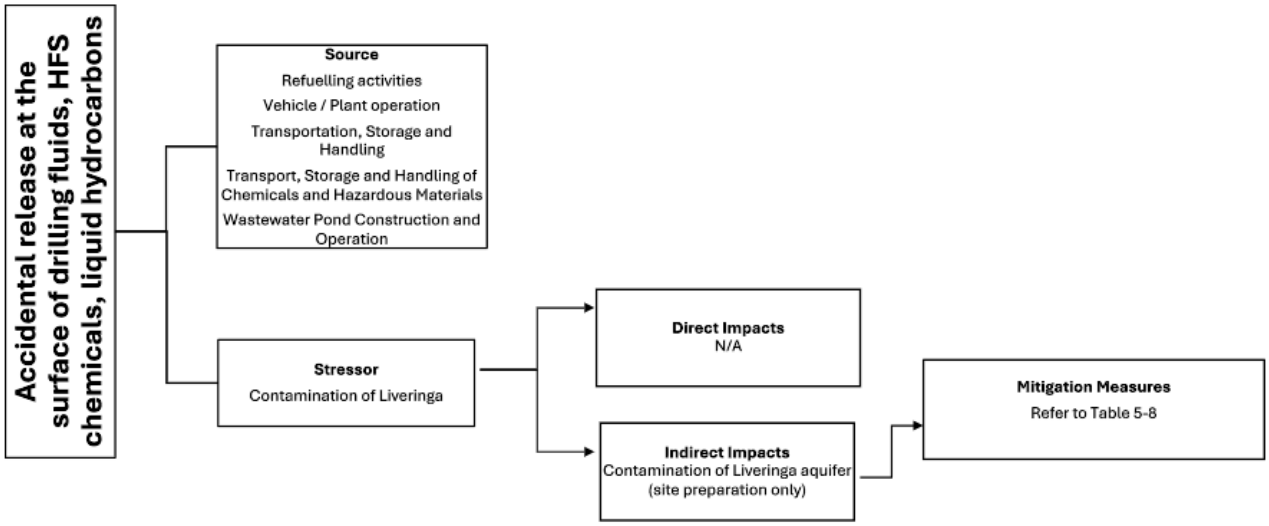

Figure 5-5: Accidental Release at the Surface of Drilling Fluids, HFS Chemicals, Liquid Hydrocarbons During Site Preparations

Site preparation activities include clearing vegetation, establishing access tracks, and constructing well pads. Once cleared, the well pad and access road areas are levelled or graded and sheeted with gravel or similar stabilising material. In some cases, well pads may be cement stabilised to support the compressive loads required for mobilisation of heavy machinery and equipment to support subsequent drilling operations. These works are undertaken using standard civil earthmoving machinery and involve the transport, handling and storage of relatively small volumes of diesel and lubricants required for plant operation. A more detailed description of site preparation activities and processes is provided in **Section 2.3**.

During this early phase of the Proposed Action, compacted hardstands and bunded areas are not yet in place. As a result, any accidental surface spill event has a direct pathway to soil. Credible spill sources during site preparation include refuelling of machinery, hydraulic failures or leaks associated with vehicle and plant operation, and minor spills arising from the transport, storage or handling of fuels and lubricants. The soils in the Proposed Action area comprise deep sands and sandy earths, which allow the distribution of spilled hydrocarbons. Based on standard volumes of hydrocarbon and hazardous material types anticipated for use during civil earthwork activities, an impact evaluation is based on a full (Instantaneous) release of a (450 L (<.045 m^3) portable diesel bowser / tank. A spill event such as this has the potential to affect an area of approximately 316 m^2 with a penetration depth of 0.2 m (calculated using published modelling by Grimaz et al. (2008)). This calculation also assumes that no management or mitigation barriers are in place. Although this scenario represents a highly conservative upper-bound estimate, it provides a useful benchmark for understanding maximum potential impacts.

However, given the nature of these spill events, standard storage, handling and use, mitigation measures will be applied to this activity; therefore, the likelihood of such a spill event occurring is extremely low, and containment and recovery measures will ensure that any soil contamination

would be minimised and recovered quickly and therefore ground penetration to reach the Liveringa aquifer will not occur.

Sources of accidental release on the surface during site preparation have been identified as:

- Refuelling activities
- Vehicle / Plant operation
- Transportation, Storage and Handling

The likelihood of a spill event during site preparation is considered extremely low due to standard industry controls for fuel storage and refuelling activities and mitigation measures outlined in **Table 5-6**. The likelihood of a significant event resulting in a potential impact to water resources is not credible due to the volumes presented and the expected penetration depth of this volume on release only reaching 0.2 m bgl.

Construction, Operation and Decommissioning

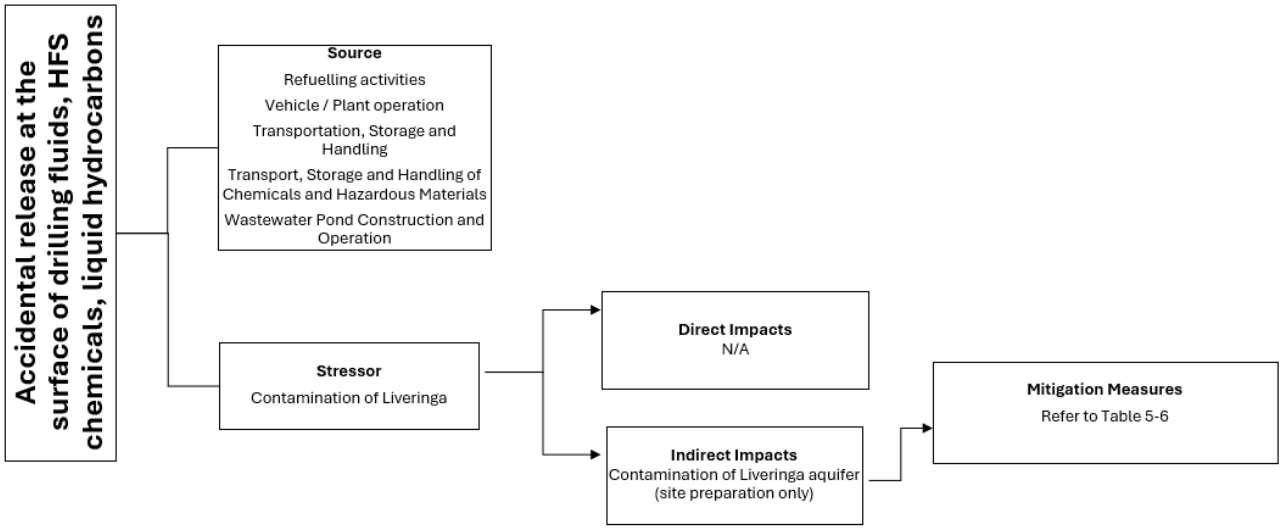

Figure 5-6: Accidental Release at the Surface of Drilling Fluids, HFS Chemicals, Liquid Hydrocarbons During Construction, Operations and Decommissioning

Following completion of site preparation works, the construction and operational phases introduce additional sources of potential surface spills due to the mobilisation of drilling equipment, chemicals, diesel, hydraulic fracturing materials, and produced formation water. However, unlike the site preparation phase, all of these activities occur on constructed, engineered hardstand and roads comprising compacted gravel or stabilised material designed to support heavy equipment and thus act as a barrier that inherently limits infiltration into underlying soils.

Sources of accidental release on the surface during construction, operation and/or decommissioning have been identified as:

- Transport, Storage and Handling of Chemicals and Hazardous Materials
- Produced wastewater Pond Leak

Transport, Storage and Handling of Chemicals and Hazardous Materials

Once well pads are complete, chemicals, drilling additives, HFS materials and diesel are transported to site and stored on the engineered surface. Spills occurring during mobilisation or

storage would likely be confined to the hardstand, where infiltration into underlying soils is avoided. As a result, any spill occurring on the pad presents an incomplete exposure pathway to soil and groundwater.

Transport of hazardous materials to site is conducted in accordance with Safety Data Sheet requirements and the Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007 (Western Australia). The majority of HFS chemicals are transported in solid form, and mixing occurs when on the engineered hardstand, meaning that any spill of solids presents negligible infiltration risk. Liquid chemicals and hydrocarbons transported to site are expected to be contained within 200 L drums or 1,000 L intermediate bulk containers (IBCs), thus are limited in volume by container size. Even in unlikely events such as a truck rollover, spill magnitudes remain comparable to those encountered during site preparation.

The largest potential spill would be from loss of containment of diesel storage, based on the volumes of hydrocarbon and hazardous material types anticipated for use during the Proposed Action, the impact evaluation is based on a full release of a 75 m^3 diesel tank. Although a spill event such as this has the potential to affect an area of approximately 18,900 m^2, the calculation also assumes that no management or mitigation measures or bunding required under Australian Standards are in place.

The extensive industry understanding of surface spill behaviour, combined with established mitigation measures, ensures that any spill occurring during this phase is contained and remediated before it has the potential to penetrate the compacted gravel surface.

Produced Wastewater Pond Operation

Water from the Laurel Formation that was produced during well testing (produced formation water) was characterised by the previous operator of EP 371. The previous operator took multiple water samples and had them analysed at a NATA-accredited laboratory (Buru Energy, 2018); **Table 5-5** lists these results. The results concluded that the produced formation water was very high in salt at three to five times the salt concentration of sea water, which is non-toxic to fauna and humans and recorded very low levels of heavy metals. Naturally occurring radioactive material (NORM) was also detected in the samples, however, the concentrations were well below exposure concentrations identified by the Australian and New Zealand guidelines for fresh and marine water quality (ANZECC and ARMCANZ, 2018) and the Australian Drinking Water Guidelines (NHMRC and NRMMC, 2011 (updated March 2021)).

Table 5-5: Produced Formation Water – Laurel Formation Characterisation

Analyte	Unit	Date	October 2015	October 2015
		On-Site Management Levels	Asgard 1 Pond Post-Well Test	Valhalla North 1 Pond Post-Well Test
Arsenic	mg/L	0.5 [18]	<0.02	<0.02
Barium	mg/L	2 [19]	20	12
Boron	mg/L	4 [19]	9.4	14
Cadmium	mg/L	0.002 [19]	<0.002	<0.002
Chloride	mg/L	30,000	16,000	17,000

[18] Stock water: Australian and New Zealand guidelines for fresh and marine water quality (ANZECC and ARMCANZ, 2018).
[19] Health values: Australian Drinking Water Guidelines 6, Version 3.5 (NHMRC and NRMMC, 2011 (updated March 2021)).

Analyte	Unit	Date	October 2015	October 2015
		On-Site Management Levels	Asgard 1 Pond Post-Well Test	Valhalla North 1 Pond Post-Well Test
Chromium VI	mg/L	0.05 [19]	<0.02	<0.02
Copper	mg/L	1 [18]	<0.02	<0.02
Lead	mg/L	0.1 [18]	<0.02	<0.02
Manganese	mg/L	0.5 [19]	0.15	0.51
Mercury	mg/L	0.002 [18]	<0.0001	<0.0001
Nickel	mg/L	1 [18]	<0.02	<0.02
Selenium	mg/L	0.01 [19]	<0.02	<0.02
Zinc	mg/L	20 [18]	<0.1	<0.1

The produced wastewater pond will be constructed with multiple synthetic liners and a leak detection system capable of early identification of liner compromise. The most credible incident is a minor leak through an upper liner rather than catastrophic failure of both liners. In the event the surface liner integrity fails, leak detection will identify this event and the bottom liner will prevent release to underlying soil. Both liners would have to fail for any soil contamination event to occur.

In conjunction with the pond design, as water chemistry associated with produced formation water is expected to be below concentrations that would cause environmental impacts, any leakage is unlikely to result in a significant change to soil or water quality and can be managed effectively with the mitigation measures outlined in **Table 5-6**.

Activities During Decommissioning

Decommissioning activities involve demobilisation of equipment, refuelling of plant, and removal of chemical and hazardous materials from site. Spill sources therefore reflect those encountered during construction. These activities are conducted predominantly on engineered surfaces, and any accidental releases are expected to be small in volume and readily manageable. Following removal of the hardstand, reinstatement works will be consistent with the initial civil activities (but in reverse) through the use of earth moving equipment. As such, the spill risks are consistent with initial site preparation works.

5.1.2.6 Impact Pathways and Mitigation Measures - Accidental Surface Release - Drilling Fluids, HFS Chemicals, Liquid Hydrocarbons (Site Preparation)

Table 5-6 outlines the mitigation measures for surface releases during site preparation only. Following completion of site preparation, all activities will occur on engineered hardstands. Given the access roads or wellsite hardstand acts as a natural barrier significantly slowing down penetration times and preventing contamination to the underlying aquifer, there is no credible pathway for contaminants from surface releases to migrate to the Liveringa aquifer.

Table 5-6: Mitigation Measures for Accidental Surface Release of Drilling Fluids, HFS Chemicals, Liquid Hydrocarbons During Site Preparation

Potential Impact	**Direct Impact** • N/A **Indirect Impact** • Contamination of Liveringa aquifer (surface spill) **Consequential Impacts** • N/A **Cumulative Impacts** • N/A
Avoid	• All activities undertaken in operational areas.
Minimise	• Spill response equipment on all well sites. • Storage and handling of all chemicals and hydrocarbons as per Safety Data Sheet requirement. • Transport of all dangerous goods and hazardous substances will be in accordance with Safety Data Sheet requirements and the Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007 (Western Australia). • Low-toxicity mud system used in the top-hole section. • All chemicals publicly disclosed.
Rehabilitate	• All contaminated material will be recovered and disposed off-site at an appropriately licenced facility. This includes small spill events off the hardstand as well as contaminated gravel where spills occur on the engineered hardstands.
Indicators	**Trigger criteria** • Spill event occurs that is greater than 1,000 L and does not occur on engineered hardstand, or • Following recovery of contaminated soil, BNR is uncertain if complete recovery of contaminated soil has occurred (i.e. soil continues to show staining under recovered soil) **Threshold criteria** • Exceedance of soil CoPC indicating soil contamination is still present.
Response Action(s)	**Trigger level actions** • Identify the contaminant spilt and a relevant CoPC to support soil sampling (e.g. drilling fluid = salt, Diesel = TRH). • Conduct soil sampling having regard to the identified CoPC and baseline concentrations established prior to site preparation activities. **Threshold level actions** • Recover additional soils around the base of the affected area. • Sample to ensure the identified CoPC has been removed. **Oil Spill Response Actions** • Identification of level of spill (Level 1, 2, 3). • Notify relevant persons in accordance with emergency response procedures. • Control the source of release and stop the flow (if safe to do so). • Put containment measures in place to prevent increased pooling area (such as absorbent pads, earthen bunds etc.). • Recover all liquids (where possible). • Recover all contaminated soil.

	• Complete environmental monitoring / soil sampling (as directed by Trigger and Threshold Actions). • Cease response actions following completion of response efforts.
Monitoring	• Triggered in the event of a spill.
Frequency	• Immediate response action at detection of a spill. • Cease once contaminated soil is removed.
Reporting	• Reporting under the EPBC Act will be in accordance with relevant approval conditions. • If it is determined that a spill will have a significant impact to MNES the spill will be reported to DCCEEW compliance branch. • An Annual Compliance Report will be submitted in accordance with approval conditions.
Residual Significant Impact	During the initial stages of the proposed action (site preparation) any spill event will be limited to the disturbance footprint. Once the access road and engineered well pad is constructed, any larger spill event will on engineered surfaces. Given the nature of the access road and well pad, the exposure pathway for a large surface spill event to penetrate through the engineered surface and into the Liveringa is considered to be unlikely due to the impact pathway being incomplete. No spill event associated with the operations of the Proposed Action will result in a credible or more than remote chance of causing impacts to groundwater quality.
Proposed Outcome	The Proposed Action is not expected to result in any change to the groundwater quality of the Liveringa Aquifer from surface spills. Spill management measures, including engineered hardstands, containment and recovery procedures and adaptive soil monitoring will ensure that any spill events are effectively contained, remediated, and monitored, preventing contamination from reaching the aquifer.

5.1.2.7 Impact Pathways and Mitigation Measures Accidental Surface Release – Produced Wastewater Ponds (Leaks)

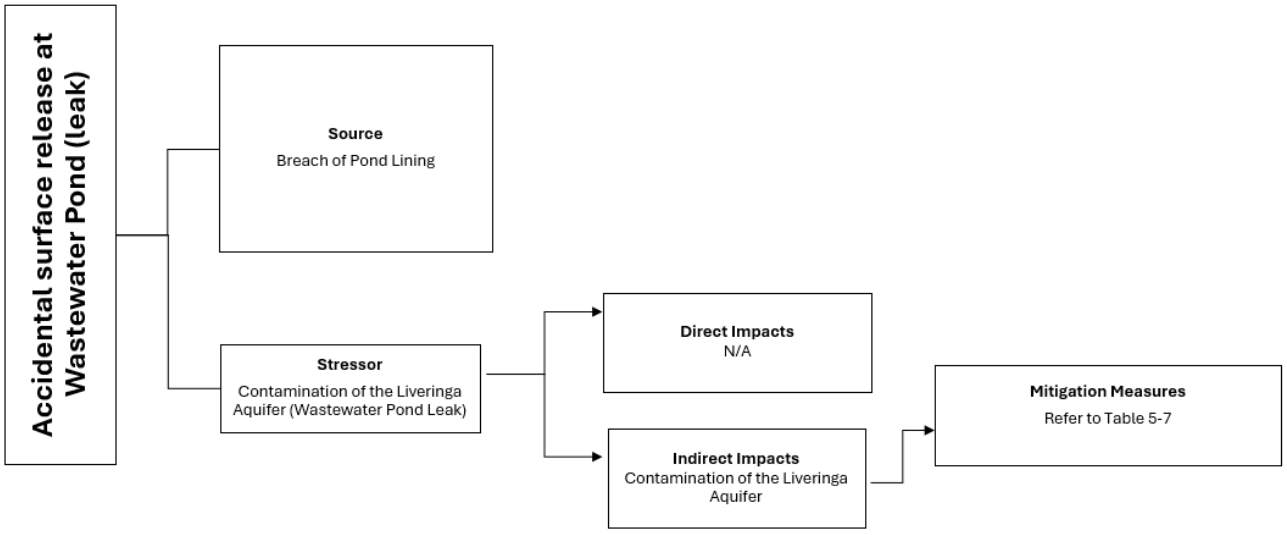

Figure 5-7: Surface Accidental Release of Produced Formation Water (produced wastewater pond leak) Impact Pathway

Table 5-7: Surface Accidental Release of Produced Formation Water (produced wastewater pond leak) Mitigation Measures

Potential Impact	**Direct Impact** • N/A **Indirect Impact** • Contamination of Liveringa aquifer (produced wastewater pond leak). **Consequential Impacts** • N/A **Cumulative Impacts** • N/A
Avoid	• N/A
Minimise	• In accordance with WQPN 26 (DoW, 2013), produced wastewater ponds used for short-term containment of wastewater or solids that may leach contaminants, require synthetic membranes and need to meet specific requirements, including: o all fluid containment liners should have a coefficient of permeability of less than 2 × 1010 m/s o a minimum thickness of 0.75 mm o dual liners o leak detection • Ecotoxicology testing on produced formation water will be conducted at each well pad.
Rehabilitate	• Sampling of subsoil beneath the produced wastewater pond prior to contouring of site.
Indicators	**Trigger Criteria** • Monitoring of leak detection system indicates potential liner integrity failure. • Unexplained water loss from produced wastewater pond exceeding expected seepage/evaporation per water balance monitoring. • Surveillance bore downgradient of the produced wastewater pond detects contamination. **Threshold Criteria** • Down-gradient Liveringa surveillance bores show sustained contamination above baseline levels. • Persistent unexplained water decline.
Response Action(s)	**Trigger Level Actions** • Identify the reason for the change in water quality and determine direct correlation to the Proposal activities or natural variation. • Increasing groundwater monitoring frequency of the surveillance bore downgradient of the Produced water pond (to monthly [where quarterly sampling is being undertaken] or fortnightly [where monthly sampling is being undertaken]). • Determine location of liner integrity failure. • Remove liquid from produced wastewater pond to below failure point (if possible). • Repair / replace liners. • Recommission liner (liner integrity testing to validate fix). • Recommence produced wastewater pond use.

	Threshold Level Actions • Identify if there is a breach to the bottom layer. • Replacement of top layer if no bottom layer breach. • Cease using produced wastewater pond (divert liquid to drilling sump or utilise temporary storage). • Increasing groundwater monitoring frequency of the surveillance bore downgradient of the Produced water pond (to monthly [where quarterly sampling is being undertaken] or fortnightly [where monthly sampling is being undertaken]). • Recover all contaminated soil during decommissioning. • Complete environmental monitoring / soil sampling (as directed by Trigger and Threshold Actions). • Sample soils during decommissioning to ensure the identified CoPC has been removed. • Cease response actions following completion of remediation actions.
Monitoring	• Leak detection monitoring. • Regular inspections of produced wastewater pond levels.
Frequency	• Leak detection monitored weekly during HFS activities. • Standard Groundwater monitoring frequency of quarterly but increased as directed by management actions.
Reporting	• Reporting under the EPBC Act will be in accordance with relevant approval conditions. • If it is determined that a spill will have a significant impact to MNES the spill will be reported to DCCEEW compliance branch. • An Annual Compliance Report will be submitted in accordance with approval conditions.
Residual Significant Impact	Any contamination event associated with produced wastewater pond leaks resulting from an integrity failure would be minimal given mitigations in place to prevent the release and as catastrophic failure of multiple liners is noncredible. As the Proposed Action is an exploration program, the ponds are only used limited time period before the contents are removed and as such the time for integrity failure is limited. Consequently, it is highly unlikely contamination of the Liveringa could occur due to leakage from the produced wastewater ponds.
Proposed Outcome	The Proposed Action is not expected to result in any change to the groundwater quality of the Liveringa Aquifer from produced wastewater pond operations. Engineered pond liners, leak detection systems, limited operational duration, and proactive monitoring ensure that any potential integrity issues are promptly identified and remediated, preventing the release of contaminants.

5.1.2.8 Potential Risk to Site Activities and Infrastructure from Flooding due to Extreme Rainfall Events

To understand potential risk to site activities and infrastructure arising from extreme rainfall events, BNR completed a desktop flood risk assessment. Data were obtained through the DWERs WIR website to understand streamflow variation and flood height. Site 802006, located on the Fitzroy River at Noonkanbah (Lat -18.50842693, Long 124.8397398), was the closest gauging station to the Proposed Action Area and subsequently was considered the most appropriate data source for completing this assessment. This station has been collecting stream gauging data since 26 October 1997 and is located 51.07 m AHD.

In January 2023, the Kimberley experienced a one in 100-year flood event. According to news reports, the Fitzroy River reached a “record” height of 15.8 m on 4 January 2023. Reviewing the data gathered by the DWER from Site 802006, a max gauged state of 18.22 m was recorded which subsequently is the figure that will be used for further analysis.

Floods in the Fitzroy tend to disperse either side into the floodplains. Although not exact, for the purpose of this assessment, it is assumed that flooding is regular across the landscape, so that any area lower than 69.29 AHD (51.07 + 18.22) would be subject to flooding. The 10 proposed well pads are shown in **Table 5-8** including the approximate elevation of each site.

Table 5-8: Well Pad Location and Their Approximate Elevation

Well	Latitude	Longitude	Approximate Elevation
Alfheim	−18.207772	124.882912	112 m
Jotunheim	−18.253224	124.787923	73 m
Midgard	−18.14258	124.776958	128 m
Muspelheim	−18.103833	124.844723	137 m
Nidavellir	−18.023477	124.773575	125 m
Proposed Well 1	−18.208448	124.825451	110 m
Proposed Well 2	−18.237182	124.934808	77 m
Proposed Well 3	−18.276184	124.974959	73 m
Proposed Well 4	−18.290737	125.051452	73 m
Vanaheim	−18.213578	124.796585	87 m

As can be seen from **Table 5-8**, all of the well sites are situated at a higher elevation than the assumed flood level of 69.29 m. Noting that Noonkanbah Community is located at 70 m elevation and given that anecdotal evidence indicates that the community, while cut off due to road closures, was not significantly affected by floodwaters in January 2023, the assessment above is considered suitable for informing the level of risk for the Proposed Action.

Water Balance

It should be noted that there are no formal requirements for modelling formation water recovery at a Commonwealth or State level. Following the drilling of a production well, extensive assessment is carried out to evaluate the requirement for and optimization of the hydraulic fracturing process (IESC, 2014).

The rate of flowback water produced by the well can be as much as 1,000 L per minute for a few hours, dropping off to a fraction of that amount over the next few days, with continual decrease over subsequent weeks and typically little flowback after about four to six weeks (Inquiry, 2018). Of the fluid injected, typically 10 to 30 percent of the initial volume (but with reports as low as four percent and as high as 50 percent) flows back to the well and ultimately to the surface for treatment and disposal (Inquiry, 2018).

In addition to flood events, extreme rainfall events have also been assessed via water balance modelling and evaluation. The data used to inform the water balance evaluations is provided in **Figure 5-8** in the modelling report (EHS-Support, 2026) provided in **Attachment 10**.

Rainfall statistics from Fitzroy crossing between 1997 and 2025 indicated the annual average rainfall rate for Fitzroy Crossing over this period was 685 mm. Using the BoM Rainfall IFD data system (BoM, 2026), a rainfall intensity chart was created for Fitzroy Crossing (BoM, 2026). This

chart indicates that the average number of days during the wet season where rainfall of ≥ 100 mm was recorded was three days.

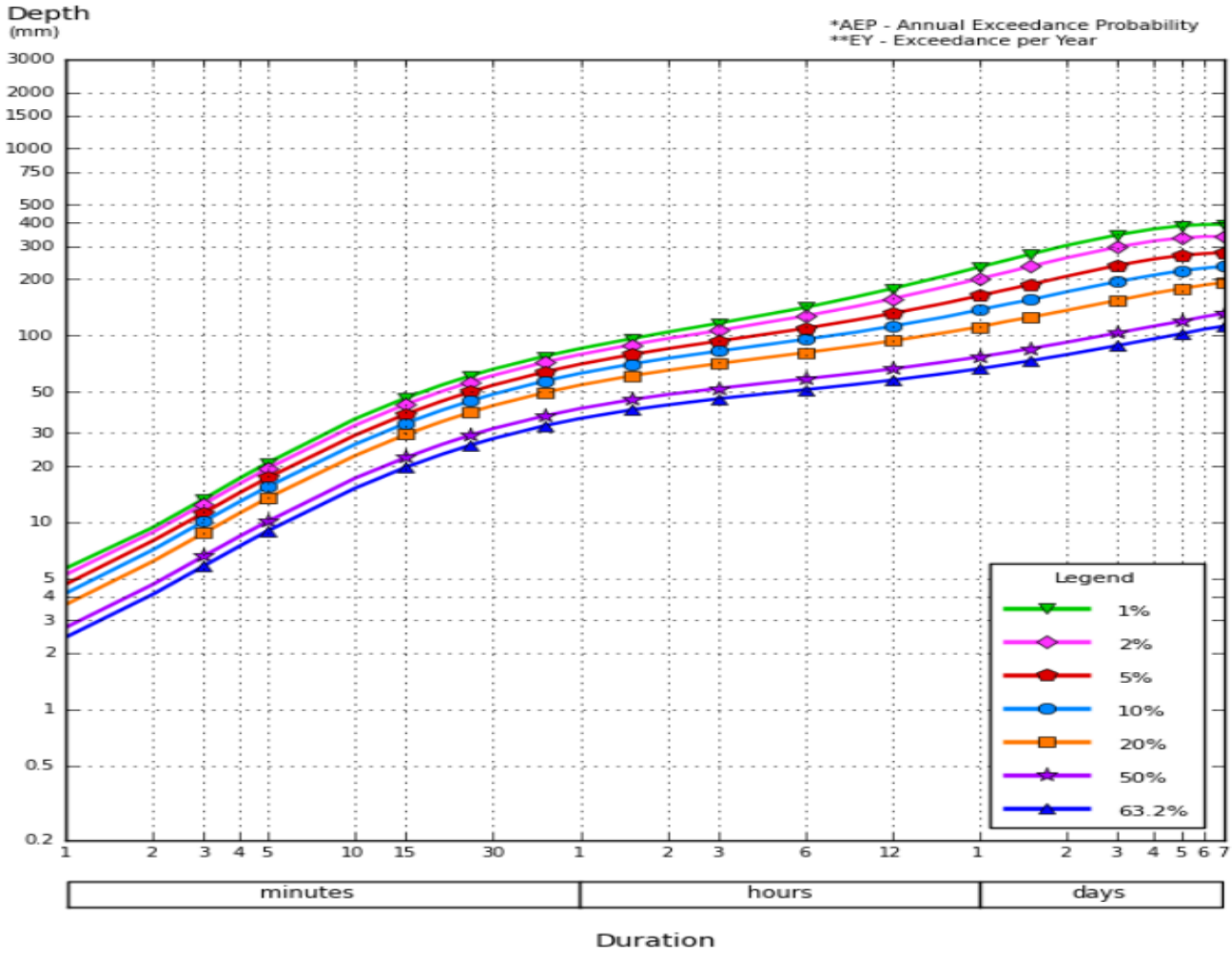

Figure 5-8: Rainfall Intensity Chart – Fitzroy Crossing

While the final design of the mud sump and produced wastewater pond have not yet been confirmed, they are anticipated to have volumes in the order of 5,000 m^3 (500 ML) and 114,400 m^3 (114 ML), respectively. Indicative design parameters for the sump and pond and predicted rainfall volumes based on modelling scenarios (EHS-Support, 2026) used to inform the water balance modelling are provided in **Section 2.4.3**.

A simple water balance assessment was previously provided to support of state EPA assessment and earlier versions of this PD. Based on feedback from DCCEEW and in response to the IESC 2025-160 advice paper (IESC, 2025) an updated water model was completed by EHS-Support in March 2026 to address feedback and advice. The updated modelling serves to provide additional evidence for the impact pathway risk assessment, updates to mitigation measures and strengthening BNR's position that there will be no long-term impacts to surface hydrology and no change to groundwater quality attributable to the Proposed Action.

Specific updates included in the new water balance model accounting for 1.3ºC global warming that has already occurred, aligning climate change parameters with the Wasko C *et al*, 2024

guidelines, as recommended by the IESC (IESC, 2025) and including a 1 in 200-year rainfall event 21 December – 8 January 2023 Tropical Cyclone Ellie (BOM, 2023).

"*As Ex TC Ellie shifted into the Kimberley region exceptionally heavy rain commenced with some locations exceeding 0.5% to 0.05% AEP over 24–72 hour time periods. The rainfall resulting in the largest flooding in modern recorded history in Martuwarra (the Fitzroy River).*"

Due to the lack of formal guidance for water balance modelling for fracking activities and the high uncertainty in actual flowback rates (Inquiry, 2018; IESC, 2014), EHS-Support modelled scenarios for 50%, 60% and 70% well flowback rates against two different case studies:

Water Balance Model Assumptions:

- 90th percentile models are based on 90th percentile rainfall in the wet season and average rainfall for all other months.
- The produced wastewater pond operates as designed and remains free of debris and vegetation that may reduce evaporation rates.
- Two exploration wells per well pad.
- Only one exploration well will be drilled at a time, however two wells on the same well site can be drilled consecutively, with drilling fluids being stored within the sump only.
- Volume of rain is based upon IFD rainfall intensity data with a duration of three days.
- Extreme storm event occurrence is from November to April in the Kimberley (wet season).
- Near term climate conditions is modelled.
- Evaporation rates are modelled.

Cases Modelled:

- Case 1:

  Produced water is stored in the produced formation water pond.

  HFS event will occur within a 12-month period and does not produce formation water.[20]

  Well testing, is the recovery of flowback water after an HFS event and occurs for no more than 90 days.

  Well testing is likely to occur in the dry season: May to October 2027.

After the 90th day the modelling assumes no further accumulation of produced water and the pond level changes in response to rainfall and evaporation only.

- Case 2:

  Two wells on the same well site and the produced formation water pond.

  Produced water from both wells is stored in the produced formation water pond.

  Both wells undergo well testing consecutively over a 180-day period (90 testing days per well).

  Well testing is likely to occur in the dry season: May to October 2027.

After 180 days, the modelling assumes no further accumulation of produced water and the pond level changes in response to rainfall and evaporation only.

[20] A HFS event is when water is pumped into the formation but does not include well testing.

Scenarios Modelled:

- Average rainfall
- Average rainfall with 1 in a 100-year (1% Annual Exceedance Probability (AEP)) storm event in year 1 of HFS[21]. The storm event is assumed to last for 72 hours (3 days) and to occur in May 2027.
- Average rainfall with one in a 200-year (0.5% AEP) storm event in year 1 of HFS. The storm event is assumed to last for 72 hours (3 days) and to occur in May 2027.
- 90th percentile rainfall during the wet season months of November through April, representing an absolute worst case.

Modelling Results:

- Case 1: HFS water from two wells distributed over two years, the pond freeboard limit is not exceeded under any scenario except the worst-case rainfall conditions at 60% HFS recovery, as well as the storm-event and worst-case rainfall scenarios at 70% recovery. The crest level is not exceeded (overflow) for any Case 1 scenario except the worst-case rainfall scenario at 70% HFS recovery.
- Case 2: HFS water from two wells into the pond over 180 days, the freeboard limit is exceeded for the 60% and 70% HFS recovery scenarios, with the exception of the mean-rainfall scenario at 60% recovery. The crest level is exceeded (overflow) in all scenarios except mean rainfall at 70% recovery. At 50% HFS recovery, neither the freeboard nor the crest limit is exceeded under any rainfall scenario.

The 90th-percentile rainfall scenario is considered conservative, as it reflects conditions approaching the historical maximum rainfall for the wet season. Climate-change-related increases in rainfall are not expected to reach this magnitude.

The modelling demonstrates that under average weather conditions and realistic recovery rates that limits are not expected to be exceeded. However, the modelling also clearly highlights that exceedance of limits are based upon a number of key operational parameters being:

- Water recovery volume (or percentages) which is closely monitored for other operational purposes)
- The number of wells and stages stimulated in the same area consecutively,
- Significant rainfall events

The first two of these are under the operational control of BNR, meaning these can easily be adjusted on-site in real-time to ensure that sufficient pond capacity is available. An example being, if high water recovery is present on the first well test, then the second well test will not proceed until calculation based on real time recovery data can confirm available capacity.

The other key input to the water balance model is rainfall and significant weather events. Noting that probability of a 1 in 100 year or 1 in 200 year storm event occurring during the proposed action duration of 7 years is estimated at 6.8% and 3.4%, respectively and based on results from previous HFS activities in the Canning Basin, as well as analogues from similar fields globally of recovery rates of approximately 50%[22], the results from the model, regardless of the scenario presented, do

[21]https://www.bom.gov.au/climate/current/month/wa/archive/202301.summary.shtml#:~:text=Ex%2DTropical%20Cyclone%20Ellie%20brought,Kimberley%20region%20of%20Western%20Australia.
[22] Buru Energy Submission to the Scientific Inquiry into Hydraulic Fracture Stimulation in Western Australia (Buru, 2018)

not provide any additional evidence to indicate that a freeboard of 500 mm is not sufficient when monitoring and mitigation measures proposed (**Table 5-9**) are implemented.

Ecotoxicity and Evapoconcentration

BNR acknowledges the request for information on the evapoconcentration of analytes and the potential ecotoxicology of produced wastewater to understand possible impacts of overflow and contaminant release pathways to surface water, including GDEs. Consistent with DCCEEW's EPBC Act assessment requirements, BNR has considered whether sufficient information has been provided to:

- Identify potential impact pathways
- Assess the likelihood of those pathways occurring
- Determine whether those pathways could lead to significant impacts on MNES

At this stage, the exact evapoconcentration behaviour and ecotoxicity profile of produced wastewater from the proposed activities cannot be fully quantified because drilling and production operations have not yet commenced, and State and Commonwealth environmental approvals are required before drilling or hydraulic stimulation can occur.

However, the information available to date provides a reasonable basis to characterise likely risks. Previous activities within EP 371 demonstrate that the ecotoxicity testing undertaken by Buru in 2018 demonstrated extremely low inherent toxicity (EC50 values of 7,100 mg/L and >200 mg/L), and measured analyte concentrations in flowback water are several orders of magnitude below acute or chronic aquatic toxicity thresholds, as produced wastewater from the Laurel Formation contains low analyte concentrations (**Section 5.1.2.5**, **Table 5-5**).

Given the same geological formation and similar operational conditions, BNR considers it reasonable to expect a comparable ecotoxicological profile for future produced water, with no indicators of significant environmental concern.

In the event of an extreme weather event, the ecotoxicity of the produced wastewater would likely significantly decrease as the produced wastewater is diluted within the pond due to the rainfall event. On the basis that historic ecotoxicity testing demonstrated water produced from the Laurel formation had an extremely low inherent toxicity, any extreme weather event would ensure the ecotoxicity would be further reduced. BNR believes that this is sufficient information to demonstrate risks are inherently low but acknowledge the produced wastewater constituents across reservoirs can change.

To address remaining uncertainties, BNR has committed to ecotoxicology testing of pond water at each well site. Testing will be undertaken by an independent NATA endorsed laboratory using the *Heliocidaris tuberculata* sea urchin fertilisation test or other appropriate methodologies, with results reported annually through compliance reporting to the DMAs. This commitment ensures that any potential ecotoxicity will be directly measured and transparently reported.

Regarding evapoconcentration, the primary environmental concern relates to the potential for overflow and subsequent release. The evapoconcentration of analytes being released to the environment is not considered a credible because:

- Ponds will be double lined, have built in leak detection system between liners and engineered with adequate freeboard. This is consistent with the States HFS Inquiry's

(Inquiry, 2018) conclusion that risks to near-surface aquifers from waste management practices are low where regulatory requirements are met (Finding 30[23]).

- The proposed ponds will be constructed approximately 1 m above surrounding ground level. Therefore, a rainfall event large enough to cause pond overflow would also deliver approximately 500 mm of water across the adjacent land surface. Any overflow leaving the pond would therefore immediately mix with the surrounding water layer, resulting in further dilution.
- Trigger and threshold-based monitoring measures (**Section 5.1.2.9**, **Table 5-9**) will ensure that any unexpected increases in analyte concentrations or pond levels are detected early.
- Extreme rainfall events will be actively monitored and produced wastewater pond operating levels managed to ensure overtopping is not a credible pathway.
- The two potential impact pathways identified have been analysed and shown to be non-credible when mitigation measures are applied, see sections in PD for the detailed assessment:

  Potential Contamination of Surficial Aquifers from an accidental release at the surface of drilling fluids, HFS chemicals, liquid hydrocarbons, or produced formation water (**Section 5.1.2.5**).

  Potential Risk to Site Activities and Infrastructure due to Extreme Rainfall Events (flooding) (**Section 5.1.2.8**).

Having regard to the EPBC Act Significant Impact Guidelines 1.1 (Commonwealth of Australia, 2013), including scale, intensity, likelihood, and duration of potential impacts, BNR considers that the residual risk associated with the potential contamination from overflow of the wastewater pond in an extreme rainfall event is unlikely to result in significant impacts on MNES. Therefore, further characterisation of evapoconcentration processes or ecotoxicological effects is not required at this stage for DCCEEW to undertake its assessment.

Therefore, while exact evapoconcentration and ecotoxicological data are not yet available, the combination of existing formation specific water quality data from EP 371, committed future ecotoxicology testing, and engineering and operational controls that remove overflow events as a credible pathway, provides sufficient information for DCCEEW to understand the potential impact pathways associated with produced wastewater ponds and assess the significance of potential impacts to MNES.

5.1.2.9 Impact Pathways and Mitigation Measures

Site Preparation, Construction and Decommissioning

N/a

[23] The risk of contamination of near surface fresh water aquifers by waste from petroleum drilling operations is low. This is based on the requirement for double or triple lined ponds and waste to be disposed in an approved waste disposal facility (Inquiry, 2018).

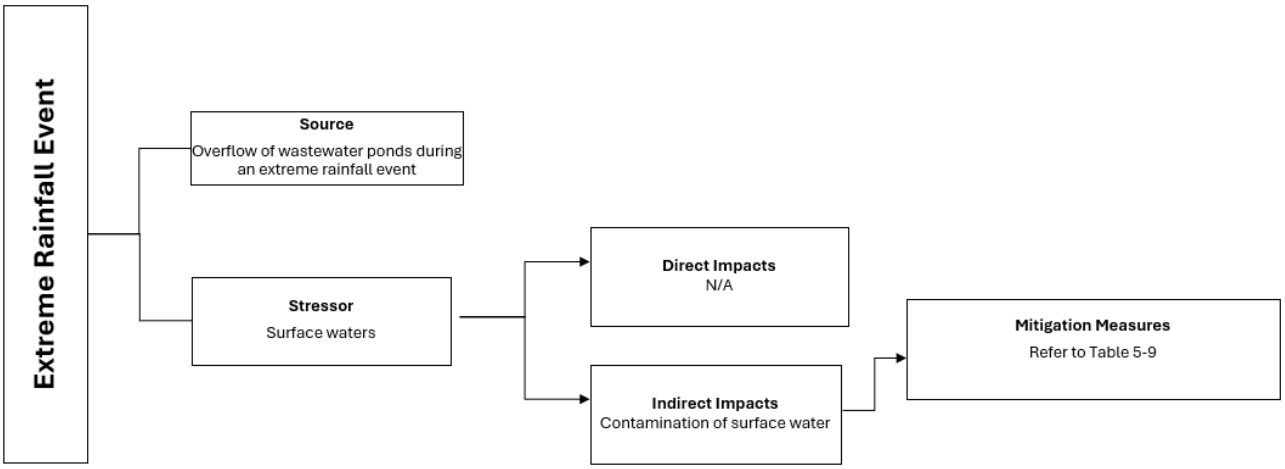

Figure 5-9: Extreme Rainfall Event Impact Pathway

Table 5-9: Extreme Rainfall Event Mitigation Measures

Potential Impact	**Direct Impact** • N/A **Indirect Impact** • Contamination of surface water **Consequential Impacts** • N/A **Cumulative Impacts** • N/A
Avoid	• N/A
Minimise	• Regular inspections of the produced wastewater pond levels as required. • Designed to maintain a minimum 500 mm freeboard to prevent unintended overflow of produced wastewater ponds during high rainfall events. • Monitor water balance across the site during HFS activities having specific regard for water recovery levels. • Where water recovery levels exceed 70% on the first wellsite, review the plan for the second well to ensure sufficient pond capacity remains prior to stimulation. • Manage produced wastewater, to maintain sufficient freeboard (500 mm) to reduce the risk of release to the environment (e.g. pumping). • Continued monitoring of local and regional weather conditions and weather events • Ecotoxicology testing on wastewater will be conducted at each well pad. • Incorporating additional volume in the produced wastewater pond design to account for a 90th percentile wet season as well as a 1 in 100-year and 1 in 200-year storm event, whilst still maintaining a minimum 500 mmm freeboard.
Rehabilitate	• N/A
Indicators	**Trigger criteria** • Water recovery levels exceed 70% for the first well. or • Extreme weather / rain event forecast, or • Extreme weather / rain event, or • Ecotoxicology monitoring shows analyte concentrations in the produced wastewater pond above default guideline values (ANZECC/ARMCANZ, 2020). **Threshold criteria** • Extreme weather / rain event causing produced wastewater overflow.
Response Action(s)	**Trigger Action** • Review forward well plan and ensure sufficient pond capacity exists prior to stimulating the second well. • Implement actions to reduce pond volumes (through mechanical means or other) • Review monitoring data to ensure concentration analyte monitoring were lower or equal to required concentration (ANZECC/ARMCANZ, 2020). • Project Emergency Response Action (flooding). • State Emergency Response Action (flooding). **Threshold Action** • Implement management measures to minimise risk of produced wastewater overflow (this may include pumping out or treatment of produced wastewater), • Review groundwater monitoring results to determine groundwater contamination after overflow event.

	• Implement surface water monitoring program. • Where the water quality threshold exceedance was caused by the Proposed Action, take steps to remedy the impact (for example cease petroleum activities on-site) re-monitor and increase monitoring frequency (to monthly [where quarterly sampling is being undertaken] or fortnightly [where monthly sampling is being undertaken]).
Monitoring	• Ecotoxicology monitoring of analyte concentration in relation to default guideline values (ANZECC/ARMCANZ, 2020). • Monitoring of pond freeboard during HFS activities. • Monitoring of local and regional weather conditions and weather events. • Monitor the Liveringa surveillance wells in accordance with response actions. • Monitor surface waters in accordance with response actions. • Once flooding has subsided, surface waters potentially impacted from produced wastewater pond overflow are to be sampled to validate no Proposed Action attributed CoPC are present in chronic ecotoxicological concentrations.
Frequency	• Weekly monitoring of pond freeboard during HFS activities (increased frequency in the event of large weather event). • Ecotoxicology testing of produced water at each wellsite • Local and regional weather to be monitored daily.
Reporting	• Reporting under the EPBC Act will be in accordance with relevant approval conditions • If it is determined that a produced wastewater pond overflow will have a significant impact to MNES the produced wastewater pond overflow will be reported to DCCEEW compliance branch. • An Annual Compliance Report will be submitted in accordance with approval conditions.
Residual Significant Impact	Any surface water contamination following a flood event cannot be solely attributed to the Proposed Action, noting that surrounding land uses may also contribute contaminants during flooding. In addition, in the event of a flood, the contents of the produced wastewater pond would be significantly diluted by floodwaters, thereby reducing the potential for contaminants to occur at concentrations that could cause a significant impact to surrounding surface waters.
Proposed Outcome	Following implementation of mitigation measures, there is no credible risk of produced wastewater pond overflowing during extreme rainfall or flood events. Produced wastewater pond contents will be effectively managed, with an engineered freeboard, flood allowances, and operational controls ensuring that surface waters and groundwater are not impacted. As a result, the Proposed Action is not expected to cause measurable or lasting changes to surface water quality, hydrology, or groundwater attributable to Proposed Action Activities.

5.2 Threatened and Migratory Species

5.2.1 The Greater Bilby (*Macrotis lagotis*)

Further to the information provided in EPBC Referral 2024/10006, BNR has engaged with subject matter experts at ecologia to execute further assessment and analysis in regard to RFI items 7e and 8). Please refer to **Attachment 4** for the Greater Bilby (*Macrotis lagotis*) responses.

In summary as per **Attachment 4**, the Proposed Action is unlikely to impact any individuals as the species has not been confirmed in the disturbance footprint, as defined by the Guidelines for Surveys to Detect the Presence of Bilbies and Assess the Importance of Habitat in Western Australia (DBCA, 2017). While suitable habitat is proposed to be cleared, clearing of suitable habitat is limited to 13.5 ha. The clearing of pads is disjunct with linear road corridors and when species specific management measures are implemented (Table 10), including no clearing undertaken within 50 m of any identified burrows no clearing undertaken within 75 m of identified

active burrows the risks to bilbies due to the Proposed Action is considered negligible with only a remote chance of occurring.

The Proposed Action is consistent with EPBC Recovery plan for the Greater Bilby *Macrotis lagotis* Instrument 2023 (DCCEEW, 2023). Where it is not expected to have a significant impact to the Bilby or Critical Bilby habitat, management measures have also been put in place in case Bilby burrows are located during a pre-clearing survey.

Table 5-10: Greater Bilby (*Macrotis lagotis*) Mitigations

Potential Impact	**Direct Impact** • Direct impacts from clearing of suitable bilby habitat • Disturbance or destruction of burrows • Disturbance or mortality from vehicle strike. **Indirect Impact** • Noise, light, dust, fire • Introduction of weeds and/or feral animals • Exposure to wastewater. • Fauna entrapment **Consequential Impacts** • Localised reduction in bilby activity or use of habitat adjacent to the disturbance footprint due to repeated disturbance (noise, light, vehicle movement). • Short-term disruption to bilby movement pathways where access tracks or cleared areas intersect preferred foraging routes. **Cumulative Impacts** • Other existing and potential future activities in the region (pastoral use, exploration, fire regimes, predators) may contribute to cumulative pressure on bilby habitat and individuals.
Avoid	• Disturb no more than 34.8 ha of Fauna habitat type 2 for the greater bilby (*Macrotis lagotis*) • No disturbance of occupied burrows. • Disturbance footprint locked to avoid known bilby burrows. • No clearing within 50 m of any burrow; 75 m for active burrows. • Pre-clearance surveys by qualified ecologists with Traditional Owner participation in accordance with Guidelines for pre-clearing searches to locate resident bilbies (DBCA 2018).
Minimise	• Inductions and training include Bilby specific details • If significant fauna including the Bilby are sited during clearing either: o The individual(s) are to be relocated by a licensed fauna handler to similar habitat; or o The individual(s) have been observed by the fauna spotter to have moved on from the area to adjoining similar habitat; or o The fauna spotter considers that the individual(s) no longer occur in the area to be cleared. • Speed limits: 20 km/h in bilby areas; 40 km/h elsewhere. • GIS-mapped burrows used operationally during clearing and construction. • Fauna egress/exclusion systems around ponds and excavations. • Vehicle speed signage in place prior to works being undertaken • Hygiene protocols to prevent weeds/pathogens. o All machinery, vehicles, equipment, and footwear inspected before site entry.

	○ Clean-down conducted if material (e.g. soil, organic debris) is present from outside of the Pastoral Station. ○ All vehicles stay on approved access tracks and approved areas only • Lighting design best practice • Apply water and/or other dust suppressants to exposed surfaces, access tracks, and work areas during construction and operations • Fire breaks are installed prior to high-risk fire periods in accordance with statutory and local government requirements. • Routine site checks for fire preparedness. • Fire breaks are maintained to remain clear of vegetation and obstructions. • No hot works outside of cleared areas
Rehabilitate	Implementation of the progressive rehabilitation achieves the following environmental outcomes: • Rehabilitated vegetation and fauna habitat are self-sustaining. • Soil and water within rehabilitated areas is of a quality that is suitable to support post closure land uses; • Supporting infrastructure including water retention pond(s) is dismantled and removed when no longer required and either disposed of at a licensed landfill or otherwise reused/recycled. • Rehabilitated areas are consistent with the species diversity, abundance and function of native vegetation within comparative reference sites • Rehabilitated landforms are stable and do not cause pollution or environmental harm.
Indicators	**Trigger Criteria** • New bilby burrow detected within 50 m or 75 m of clearing. • Vehicle strike incident involving bilby. **Threshold Criteria** • Any project-attributable bilby mortality. • Any clearing within mapped buffer zones (50 m/75 m buffers).
Response Action(s)	**Trigger level actions** • Notify DBCA. **Threshold Level Actions** • Incident investigation. • Revise fauna procedures if required. • Implement additional controls (spotters, night-time curfews).
Monitoring	• Pre-clearance surveys 7 days before clearing (or as per State and Commonwealth Conditions) • Daily clearing inspections • Daily checks of fauna traps/egress points. • Ongoing monitoring of mapped burrows. • GIS verification before each clearing stage. • Weed and feral predator monitoring (such as the Cane Toad).
Frequency	• Daily during clearing. • Weekly inspections.
Reporting	• Pre-clearance survey report. • Weekly inspection checklist. • Annual Environmental Report (AER). • Incident reports to DBCA as required.

	• Records of predatory and invasive species reported to DBCA as required under the *Biodiversity Conservation Act 2016.*
Residual Significant Impact	Not expected. Residual risk is low with avoidance of occupied burrows and speed limits.
Proposed Outcome	No project-attributable bilby mortality; no net loss of active bilby burrows; maintain viability of local population. No increase in introduced weeds, introduced fauna species and feral predators. No project attributable fires.

5.2.2 The Northern Blue-Tongued Skink (*Tiliqua scincoides intermedia*)

Further to the information provided in EPBC Referral 2024/10006, BNR has engaged with subject matter experts at ecologia to execute further assessment and analysis in regard to RFI items 7e and 9). Please refer to **Attachment 5** for the Northern Blue-Tongued Skink (*Tiliqua scincoides intermedia*) responses.

As stated by ecologia in **Attachment 5**, the Northern Blue-Tongued Skink is distributed throughout Northern Australia and therefore the habitat is not unique to the Proposed Action Area. Most records of the Northern Bule-tongued Skink are within close proximity to permanent or seasonal water bodies. The Conservation Advice for *Tiliqua scincoides intermedia* (Northern Blue-Tongued Skink) (DCCEEW, 2023) describes 'well vegetated creeks and drainage lines' and 'dense thickets within floodplains, grasslands, shrublands, savannas and woodlands' as critical habitat for the species. As the Proposed Action Area does not have permanent or seasonal water bodies it is unlikely that that the Proposed Action will have a significant impact to the Northern-blue tongued Skink or critical habitat for the species. As indicated in **Section 5.1.1.1**, groundwater drawdown is temporary with a 1 mm drawdown 700 m of well pads, the most northern Muspelheim Well pad is ~1 km away from Mount Hardman Creek and therefore does not impact potential critical habitat for the Northern Blue-Tongued Skink would be located. Contamination of groundwater has also undergone impact assessment in **Section 5.1.2** showing that there is no credible pathway that would cause groundwater contamination so significant in magnitude, that indirect impacts to the Northern Blue-Tongued Skink or potential or critical habitat could occur.

The Proposed Action is consistent with Conservation Advice for the (*Tiliqua scincoides intermedia*) Northern Blue-tongue Skink (DCCEEW, 2023) and it is not expected to have a significant impact to critical habitat of the Northern Blue-Tongued Skink.

Table 5-11: The Northern Blue-Tongued Skink (*Tiliqua scincoides intermedia*) Mitigations

Potential Impact	**Direct Impact** • Direct impacts from clearing of critical Northern Blue-Tongued Skink habitat • Disturbance or mortality from vehicle strike. **Indirect Impact** • Noise, light, dust, fire • Introduction of weeds and/or feral animals (including cane toads) • Exposure to wastewater. • Fauna Entrapment • Natural water resource use (including water drawdown) **Consequential Impacts** • Localised reduction in Northern Blue-Tongued activity or use of habitat adjacent to the disturbance footprint due to repeated disturbance (noise, light, vehicle movement). • Short-term disruption to Northern Blue-Tongued movement pathways where access tracks or cleared areas intersect preferred foraging routes.

	Cumulative Impacts • Other existing and potential future activities in the region (pastoral use, exploration, fire regimes, predators) may contribute to cumulative pressure on Northern Blue-Tongued habitat and individuals.
Avoid	• Lock disturbance footprint to avoid known Northern Blue-Tongued skink critical habitat where possible. • Pre-clearance survey of potential critical habitat of Northern Blue-Tongued at the Muspelheim well site. Survey undertaken by qualified ecologists with Traditional Owner participation in accordance with *Survey guidelines for Australia's threatened reptiles* (DoSCWPC, 2011)
Minimise	• Inductions and training • If the Northern Blue-Tongued are sited during clearing either: o The individual(s) are to be relocated by a licensed fauna handler to similar habitat; or o The individual(s) have been observed by the fauna spotter to have moved on from the area to adjoining similar habitat; or o The fauna spotter considers that the individual(s) no longer occur in the area to be cleared. • Speed limits: 20 km/h in potential critical habitat of Northern Blue-Tongued at the Muspelheim well site. • GIS-mapped critical habitat used operationally during clearing • Include a program of groundwater monitoring that is capable of detecting potential preferential groundwater drawdown towards Mount Hardman Creek associated with groundwater abstraction at the Muspelheim well pad • Fauna egress/exclusion systems around ponds and excavations. • Vehicle speed signage in place prior to works being undertaken • Hygiene protocols to prevent weeds/pathogens. o All machinery, vehicles, equipment, and footwear inspected before site entry. o Clean-down conducted if material (e.g. soil, organic debris) is present from outside of pastoral station. o All vehicles stay on approved access tracks and approved areas only • Routine inspections to include sitings or predator and invasive fauna species • Lighting design best practice • Apply water and/or other dust suppressants to exposed surfaces, access tracks, and work areas during construction and operations • Fire breaks are installed prior to high-risk fire periods in accordance with statutory and local government requirements. • Routine site checks for fire preparedness. • Fire breaks are maintained to remain clear of vegetation and obstructions. • No hot works outside of cleared areas
Rehabilitate	Implementation of the progressive rehabilitation achieves the following environmental outcomes: • rehabilitated vegetation and fauna habitat are self-sustaining. • Soil and water within rehabilitated areas is of a quality that is suitable to support post closure land uses. • Supporting infrastructure including water retention pond(s) is dismantled and removed if no longer required and either disposed of at a licensed landfill or otherwise reused/recycled. • Rehabilitated areas are consistent with the species diversity, abundance and function of native vegetation within comparative reference sites

	• Rehabilitated landforms are stable and do not cause pollution or environmental harm.
Indicators	**Trigger Criteria** • Vehicle strike incident involving Northern Blue-Tongued. • Presence of Northern Blue-Tongued species in critical habitat located in the Musphelum well site **Threshold Criteria** • Any project-attributable Northern Blue-Tongued Skink critical habitat mortality.
Response Action(s)	**Trigger level actions** • Notify DBCA • Removal of fauna from site by a qualified fauna handler **Threshold Level Actions** • Incident investigation. • Revise fauna procedures if required. • Implement additional controls (e.g.).
Monitoring	• Pre-clearance surveys 7 days before clearing (or as per State and Commonwealth Conditions) • Daily clearing inspections • Daily inspections of fauna traps/egress points. • Weed and feral predator monitoring species (such as the Cane Toad). • GIS verification before each clearing stage. • Noise monitoring where sensitive receptors are located. • Monitor the health of groundwater dependent vegetation at the Midgard or Muspelheim well pads to detect decrease in health of groundwater dependent vegetation.
Frequency	• Daily during clearing. • Weekly inspections.
Reporting	• Pre-clearance survey report. • Weekly inspection checklists. • Annual Environmental Report (AER). • Incident reports to DBCA as required. • Records of predatory and invasive species reported to DBCA as required under the *Biodiversity Conservation Act 2016.* • Report sightings of cane toads to Cane Toad Management are of the Shire of Derby/West Kimberley (SDWK)
Residual Significant Impact	Not expected. Residual risk is low with exposure to only a small portion of critical habitat and implementation of speed limits and fauna inspections.
Proposed Outcome	No project attributable Northern Blue-Tongued Skink mortality. No increase in introduced weeds, fauna species and feral predators. No project attributable fires.

5.2.3 The Largetooth Sawfish (*Pristis pristis*)

Further to the information provided in EPBC Referral 2024/10006, BNR has engaged with subject matter experts at ecologia to execute further assessment and analysis in regard to RFI items 7e and 10). Please refer to **Attachment 6** for the Largetooth Sawfish (*Pristis Pristis*) responses.

As stated by ecologia in **Attachment 6**, the Largetooth Sawfish are distributed in freshwater rivers and estuaries. Given Mount Hardman Creek, the closest surface water expression is of ephemeral nature and there is an absence of year-round aquatic refuge, the area is considered to provide low-quality, temporary habitat for *Pristis pristis*. As indicated in **Section 5.1.1.1**, groundwater drawdown

is temporary within 700 m of well pads, the most northern Muspelheim Well pad and does not extend to Mount Hardman Creek (~1 km away) where potential habitat for the Largetooth Sawfish would be located. Contamination of groundwater has also undergone impact assessment in **Section 5.1.2** showing that there is no credible pathway that would cause groundwater contamination so significant in magnitude, that indirect impacts to the Largetooth Sawfish or potential or critical habitat could occur.

Therefore, the Proposed Action will not have a significant impact to the Largetooth Sawfish or potential critical habitat associated with the species. The Proposed Action is consistent with Approved Conservation Advice for *Pristis pristis* (Largetooth Sawfish) (DCCEEW, 2014). As there is no critical habitat directly or indirectly impacted by the Proposed Action.

5.3 National Heritage

5.3.1 Noonkanbah Gate

Traditional Owners validate BNR's previous statements[24] that the Proposed Action will not impact on Noonkanbah Gate. The Noonkanbah Gate is no longer physically in place, however the site is protected by rangers through the Commonwealth Government Program. NAC/YAC confirm that the Proposed Action will not negatively impact the heritage site given it is located "too far away" from the site. Improvement of the Noonkanbah Gate site was undertaken with funding from BNR including the provision of signs and access, in addition to the development of social infrastructure for the communities. These provisions were a direct result of the Proposed Action funding that has been provided to the YAC/NAC and the WAC for any sacred sites (of which there were none), and of promoting heritage locations such as the Noonkanbah Gate site.

5.3.2 West Kimberley National Heritage Place

The Proposed Action will have no direct or indirect impacts to the WKNHP. Any impacts on the WKNHP would have to incur from an impact on the Fitzroy River. Impacts to the Fitzroy River would only be possible through an impact to Mount Hardman Creek (a tributary of the Fitzroy River). BNR has undertaken an impact assessment on potential impacts through groundwater drawdown (**Section 5.1.1.1**) and groundwater contamination (**Section 5.1.2**) showing that there is no credible pathway that would cause groundwater contamination so significant in magnitude, that indirect impacts to would occur to surface waters, including Mount Hardman Creek.

BNR understands that RFI item 11 and 14 chiefly relates to cultural heritage beliefs associated with the Rainbow Serpent tradition. As indirect impacts are limited to YAC and NAC lands, BNR has engaged extensively with the relevant Traditional Owners to understand the Proposed Action potential impacts on their cultural beliefs. BNR understands from researching the many different mythical stories and beliefs that the rainbow serpent lives in the surface waters and surface water landscapes, such as rivers, billabongs, water holes and gorges. BNR has assessed impacts to surface waters with the outcome that no surface waters will be permanently impacted by groundwater drawdown (**Section 5.1.1.1**) or contamination (**Section 5.1.2**).

Abstracting water at the well pad for the activity is consistent with existing pastoral operations throughout the pastoral station (i.e., abstracting water for cattle) with drawdown modelling conservatively and conclusively demonstrating that drawdown will not affect any surface water features (i.e., impacts are limited to 1 mm 700 m away) (**Section 5.3.1**), and as such will not

[24] Please refer to the EPBC Referral 2024/10006 Section 4.1.2 National Heritage Place impacts, which describes potential impacts to the WKNHP and Noonkanbah Gate.

indirectly impact the rainbow serpent. details the modelling undertaken explaining groundwater drawdown impacts.

Contamination from vertical migration of fractures has been deemed non-credible given the natural geological conditions being – significant pressures at depths of >2000 m, existing faults being self-sealing and impermeable shale formations separating the targeted reservoir and overlying aquifers. Consequently, the contamination risk (or indirect impact) from a subsurface vertical migration is highly unlikely and by BNR's understanding of the geology, non-plausible. As a contamination event of the deeper aquifer (Poole aquifer) occurred, contamination would then then need to travel through another impermeable shale layer before it entered the surface aquifer. This again is believed by BNR to be a highly unlikely impact pathway or (more realistically) there is no credible pathway.

As the rainbow serpent is associated with surface water features (as described by relevant Traditional Owners), with mitigations in place as well as the natural geological conditions there is no credible pathway in which impact to surface water features from vertical migration (refer to **Section 5.1.2.1**) could impact the rainbow serpent.

On the basis that no direct or indirect impacts have been identified to cultural beliefs associated with the rainbow serpent upon YAC / NAC lands through engagement with relevant Traditional Owners whose land is directly or indirectly impacted by the Proposed Action BNR does not see a pathway for direct or indeed indirect impacts to arise outside of the Proposed Action Area. Thus, impacts to the WKNHP are non-credible.

Further to this, the Traditional Owners confirmed that they did not believe the Proposed Action would have any impact on the Fitzroy River or (subsequently) the WKNHP as "it [the Proposed Action footprint] is too far away" and historically there has been "no direct or indirect changes [on WKNHP] from the previous HFS projects on their land. The EPA assessment also considered that the level of consultation undertaken with the Yungngora and Warlangurru was sufficient to inform its assessment, and that the broader cultural significance of the Fitzroy River and related values of the WKNHA was available and documented, without specific consultation with other Traditional Owner groups.

5.3.3 National Heritage Management Principles

National Heritage management principles

2 -The management of National Heritage places should use the best available knowledge, skills and standards for those places, and include ongoing technical and community input to decisions and actions that may have a significant impact on their National Heritage values.

5 -The management of National Heritage places should make timely and appropriate provision for community involvement, especially by people who:

- *a. have a particular interest in, or associations with, the place, and*
- *b. may be affected by the management of the place.*

6 - Indigenous people are the primary source of information on the value of their heritage and the active participation of Indigenous people in identification, assessment and management is integral to the effective protection of Indigenous heritage values.

As detailed in **Section 3**, BNR has actively engaged for many years with YAC / NAC and WAC following on from previous proponents who provided funds to support land management consistent with National Heritage Principles. It should be clear that the process adopted in engaging with the Traditional Owners on whose land the Proposed Action lies, that these principles were applied, and

have been applied for many years. The Traditional Owners are engaged directly with Proposed Action as cultural advisors and Rangers and talk openly with BNR resulting in a number of changes to the Proposed Action such as altering proposed access roads to sites and responding actively to feedback.

6 CONSEQUENTIAL AND CUMULATIVE IMPACTS

To inform the cumulative assessment of the Proposed Action, BNR considered the context of other known developments near the Proposed Action Area. The Proposed Action Area overlays two pastoral stations (leased Crown land)—Blina Station and Noonkanbah Station—who lease the land for pastoral grazing.

6.1 Threatened Species

The key impact to threatened species arising from the Proposed Action (as detailed in **Section 5.2**) is associated with the clearing of native vegetation associated to support construction of access tracks and well pad's. A search of the Plan WA website (DPLH, 2021b) did not identify any other planned developments near the Proposed Action Area. Consequently, the cumulative assessment of impacts to Threatened species is limited to native vegetation clearing associated with the Proposed Action and pastoral activities (including grazing of 10 000 head of cattle).

Understanding the impact from pastoral activities (including grazing of 10 000 head of cattle) is somewhat difficult given the disturbance numbers are not known, nor subject to specific assessment under the EPBC Act. However, given the Proposed Action Area intersects a working pastoral station, BNR understands that the existing pressures on the land include construction of access tracks, grazing of cattle, abstraction of groundwater and operation of vehicles and helicopters to support mustering activities. BNR does not believe that the Proposed Action represents a significant increase in the risk profile of those threats that currently occur across pastoral stations within the Kimberley.

Historically unconventional gas activities have occurred in harmony with the existing pastoral station operations, neither of which suggest undue pressure to MNES identified in this PD.

6.2 Water Resources

A search for licensed water users within the Proposed Action Area identified only one other water licences targeting the Liveringa Aquifer, as detailed in **Table 6-1**. BNR currently has one groundwater licence (GWL179134(7)) but has extracted little to no water during the annual care and maintenance program of its assets on EP 371.

Table 6-1: Summary of Ground Water Extraction Licences Within the Proposed Action Area That Target the Liveringa Aquifer

Licence Number	Issue Date	Expiry Date	Allocation (ML)	Owner
174685	05 Oct 2020	04 Oct 2030	309	Main Roads Department
179134(7)	24 Apr 2024	23 Apr 2034	102.8	Bennett Resources Pty Ltd

Currently, there are ~25 groundwater licences in the wider catchment, with an approximate allocation of <2 GL per year (Harrington & Harrington, 2015). Most groundwater licences are for Aboriginal community bores, some pastoral bores (for diversified activities other than livestock and domestic use), and limited horticultural activities. Unlicensed water use includes livestock and domestic bores (pastoral industry) and Aboriginal community bores.

The nearest licensed groundwater user outside the Proposed Action Area is the Yungngora Community, ~18 km south of the Proposed Action Area. BNR understands that other pastoral bores are prevalent throughout the Proposed Action Area; however, their use and volume of water extracted is not currently known. A review of known pastoral bore locations determined that no

pastoral bore is located within 1.5 km of the well pads and modelling of groundwater abstraction (INTERA Geosciences 2023) has demonstrated no impact to these wells.

The Proposed Action requires water on a per well basis, and continual water abstraction during the activities is not required. Quantitative drawdown modelling (verified by in-field monitoring from previous abstraction activities) indicates that only a short-term drawdown would be experienced near the abstraction bore (<70 m). Given the distance between well pads, and on the unrealistic assumption that water is extracted from all well pads at the same time, there would be no overlap in groundwater depressions.

No pastoral bores are known to be within 1.5 km of the well pads; therefore, there should be no overlap in groundwater depressions associated with pastoral and the Proposed Action use. Even if there was overlap, any cumulative impacts would be limited in duration and cease once water abstraction was complete. Consequently, cumulative impacts across the Proposed Action are not expected.

Understanding the impact from pastoral activities (including water abstraction to support 10,000 head of cattle) is somewhat difficult given the number of abstraction bores and abstraction volumes are not known, nor subject to specific assessment under the EPBC Act. Given the exploration and appraisal activity is a temporary activity, as waster abstraction is only required for a finite period of time (and pastoral activities are permanently abstracting) BNR does not believe that the Proposed Action represents a significant increase in the risk profile of those threats that currently occur across the pastoral station (or broader pastoral stations within the Kimberley).

6.3 National Heritage

No heritage sites have been impacted from historical petroleum activities within EP 371. The Proposed Action's heritage archaeological and ethnographic survey, which resulted in minor modifications to proposed access tracks, a camp and a proposed well pad location, confirmed that the Proposed Action will not result in any impacts to heritage values. Consequently, no cumulative impacts are expected to heritage values. Please note that no credible pathway exists of impact to surface waters (**Section 5**) and therefore Fitzroy River.

7 AVOIDANCE AND MITIGATION MEASURES

7.1 Management and Mitigation

BNR has developed a table of mitigation measures using the DCCEEW – Offsets Mitigation Hierarchy (DCCEEW, 2025) in order to avoid, minimise or reduce impacts where possible. The table of Mitigations includes:

- Performance and completion criteria
- Monitoring and reporting
- Potential risks/threats and residual risks
- Evidence of effectiveness
- Location and timing
- Agency responsible.

A mitigation table has been provided for each impact pathway in **Section 5.1**.

7.1.1 Pre-Clearance Surveys

It has been identified that pre-clearance surveys for threatened species habitat that have the potential to have suitable habitat within the disturbance footprint is required. The species identified with potential for suitable habitat is the Bilby (*Macrotis lagotis*) and Northern blue-tongue skink *(Tiliqua scincoides intermedia*). Pre-clearing surveys will be managed to minimise impacts including the spread of disease, pathogens or invasive species as per **Attachment 10**.

Where significant fauna individuals are identified, ground disturbing activities shall not commence in that location until the finding has been notified to the EPA and DBCA, and:

- the individual(s) have been relocated by a licensed fauna handler to similar habitat; or
- the individual(s) have been observed by the fauna spotter to have moved on from the area to adjoining similar habitat; or
- the fauna spotter considers that the individual(s) no longer occur in the area to be cleared.

To mitigate potential impacts to bilbies and bilby habitat during site preparation, these steps will be implemented prior to clearing in the southern area of the Proposed Action Area where old Bilby diggings were located during the targeted survey (**Attachment 2**).

In accordance with Bilby Survey Guidelines (DBCA, 2017) Box 1 Guidelines for pre-clearing searches to locate resident bilbies Version 2 – September 2018 (DBCA, 2018) a pre-clearance survey of the disturbance footprint will be undertaken prior to clearing to identify any new burrows (within a range of ~75 m):

- Engagement of Traditional Owners and Indigenous ranger groups for pre-clearance survey in accordance with the Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia Version 1 – August 2017 (DBCA, 2017)
- Any previously found identified Bilby burrows and identified active burrows, as well as any new burrows identified in the pre-clearing survey will be mapped using GIS (DBCA, 2018).

Timing of the pre-clearance surveys with be in accordance with the *Guidelines for pre-clearing searches to locate resident bilbies* (DBCA 2018) as well as relevant State and Commonwealth Ministerial Conditions (i.e. if less than two weeks prior to clearing is required).

Northern blue-tongue skink within their critical habitat will also be targeted during the pre-clearance survey by an appropriately experienced ecologist in accordance with *Survey guidelines for Australia's threatened reptiles* (DoSCWPC, 2011). Critical habitat will be mapped on the Project GIS layer which will be utilised to avoid critical habitat during construction operation and decommissioning where possible. A pre-clearance survey report will be prepared and retained as evidence of compliance.

7.1.2 Exclusion Zones and Buffers

There are no exclusion zones within disturbance footprint. Exclusion zones are any areas outside of the approved disturbance footprint. Buffer zones for the Bilby burrows (if found) will be managed by measures such as inductions, GIS boundary layers, surveying and pegging as per **Attachment 10** Table of Mitigation Measures (Flora and Fauna).

7.1.3 Decommissioning and Rehabilitation

As required under the WA PGER(E)R, once drilling and HFS activities are complete, cleared areas that are not required to support the maintenance of infrastructure will be progressively rehabilitated to minimise environmental liability at the end of asset life. Topsoil is to be respread, and rehabilitation sites actively monitored to ensure they meet the required completion criteria. Specifically, completion criteria will be developed to ensure that rehabilitation is conducted to enable long-term land use to continue.

Implementation of the progressive rehabilitation for fauna habitat achieves the following environmental outcomes:

- Rehabilitated vegetation and fauna habitat are self-sustaining.
- Soil and water within rehabilitated areas is of a quality that is suitable to support post closure land uses;
- Supporting infrastructure including water retention pond(s) is dismantled and removed and either disposed of at a licensed landfill or otherwise reused/recycled.
- Rehabilitated areas are consistent with the species diversity, abundance and function of native vegetation within comparative reference sites
- Rehabilitated landforms are stable and do not cause pollution or environmental harm.

Mud sumps and produced wastewater ponds constructed for exploration and appraisal activities are temporary facilities and will be managed and decommissioned in the same manner as conventional drilling operations, in accordance with the Petroleum and Geothermal Energy Resources (Environment) Regulations 2012 (PGER(E)R), relevant waste and contaminated land legislation, and an approved EP. These are detailed in 2.5.2.

7.1.4 Justification

Despite the implementation of proactive management and mitigation measures, the complete avoidance or elimination of environmental impacts is not feasible due to the following constraints such as location of gas reserves, topographical restraints, safety requirements, surrounding land uses e.g. pastoral/grazing activities and existing introduces species.

Although the Proposed Action and disturbance footprint has been designed to avoid and reduce environmental impacts wherever practicable, including but not limited to disturbance footprint minimisation, realignment of disturbance footprint to avoid waterways, habitat buffer zones, weed hygiene and invasive species management measures and implementation of strict control

measures, some residual impact is unavoidable. These impacts are considered necessary and proportionate to the scale and nature of the Proposed Action and will be actively managed and monitored to ensure they remain within acceptable environmental thresholds.

The Proposed Action will continue to implement rigorous monitoring, adaptive management, and post-construction rehabilitation to ensure any residual impacts are contained and progressively reduced over time.

Please refer to **Attachment 10** Table of Mitigation Measures (Flora and Fauna), as well as the impact mitigation tables under each impact pathway in **Section 5.1**, where BNR have used the DCCEEW – Offsets Mitigation Hierarchy (DCCEEW, 2025) in order to avoid, minimise or reduce impacts where possible.

7.2 Translocation Measures (if applicable)

7.2.1 Translocation

BNR does not currently plan to implement broadscale fauna trapping and relocation as part of its Pre-Clearance processes, favouring natural dispersal and encouraging dispersal to adjacent and protected habitat. Translocations often observe higher mortality rates in the initial weeks following release due to predation, starvation, disease, interception with roads, cardiac pathology, reduced reproduction and dispersal from release site. Chronic stress does not directly cause a translocation to fail, however it increases the vulnerability of individual animals to these factors that contribute to translocation failure. Therefore, animal stress should be accommodated within translocation planning and procedures (Dickens et al., 2010).

Further to this, targeted fauna surveys have not identified the presence of species that would benefit from this form of mitigation.

8 MANAGEMENT COMMITMENTS

BNR management will continue manage the Proposed Action in the manner in which upholds our values as a company.

BNR will respect our relevant stakeholders, government agencies and other stakeholders and work collaboratively with them in good faith through the planning execution and decommissioning phases.

BNR will ensure all environmental regulatory approvals are in place to ensure compliance with environmental policy and legislative requirements

BNR will rely on subject matter experts to continue to identify Proposed Action impacts, best practice mitigations and we will balance risk mitigation with corporate targets to ensure that environmental impacts including perceived impacts to MNES are managed to what we consider to be ALARP.

BNR will use the Proposed Action to gather sufficient scientific information to:

- Prove environmental impacts and risks are low
- Lobby government to diffuse emotional rhetoric being applied in the community regarding unconventional gas projects
- Support our annual reports that will be provided to the required government agencies.

BNR will implement all environmental mitigations for each impact pathway as detailed within **Section 5**.

9 ENVIRONMENTAL MANAGEMENT PLANS

9.1 Groundwater Management Plan

A Groundwater Management Plan (GWMP) (**Attachment 11** Groundwater Management Plan). has been developed to manage the environmental risks associated with the Proposed Action for the purpose of managing impacts to groundwater Although the GWMP has not set out in the Template required under the EPBC act as it has been developed and reviewed separated under the state EP Act. BNR was unable to update this document to coincide with this PD given the GWMP must be updated post State Assessment and updating for DCCEEW at this stage risks multiple versions of the same document being approved by different regulators.

However, the groundwater monitoring philosophy, along with clear trigger and threshold criteria are detailed in this plan. BNR plans to use these as the basis for the updated GWMP.

BNR commits to engaging with the Office of Water Science and updating the GWMP plan in line with the commitments in this PD and providing a consistent version to both DCCEEW and EPA prior to commencing any drilling activities and simultaneously to ensure all regulator monitoring and reporting expectations are met.

9.2 Well Management Plan

Currently no well management plan exists for the Proposed Action. A WMP is not an environmental management document and is a technical engineering document that details how well integrity is managed over the lifecycle of well. This document has a very specific format, and it and cannot be “prepared in accordance with the Environmental Management Plan Guidelines – DCCEEW” as requested by DCCEEW as that format does not cover technical engineering documents. It is important to note that all mitigations relevant to MNES that would be captured under a WMP are detailed under each pathway in this PD (**Section 5.1**).

10 OFFSETS

10.1 Residual Impact

It should be noted that the Proposed Action is not an unconventional gas development. It is an early-stage exploration and appraisal Proposed Action not a development project. The Proposed Action has a finite timeframe, is limited to 10 well pad's and occurs on an active pastoral station that runs 10,000 head of cattle. An overview of the residual impacts associated with the Proposed Action is included in **Table 10-1**.

Table 10-1: Residual Impact Statement

MNES	Species / Specific Interest	Residual Impact
Threatened and Migratory Species	The Greater Bilby (Macrotis lagotis)	**No Significant residual impact** A targeted survey did not detect the presence of The Greater Bilby could not be confirmed in the Proposed Action Area. While suitable habitat is proposed to be cleared, clearing of suitable habitat is limited to 13.5 ha. Impacts to habitat within the Proposed Action Area commensurate with existing land uses, given the ubiquitous nature of this habitat and with pre-clearance surveys to ensure direct impacts to the species is prevented, residual impacts are not considered significant.
	The Northern Blue-Tongued Skink (*Tiliqua scincoides intermedia*)	**No Significant residual impact** The Proposed Action Area does not intersect have permanent or seasonal water bodies considered as critical habitat for the species. Impacts to habitat within the Proposed Action Area commensurate with existing land uses, given the ubiquitous nature of this habitat and with pre-clearance surveys to ensure direct impacts to the species is prevented, residual impacts are not considered significant.
	The Largetooth Sawfish (*Pristis pristis*)	**No Significant residual impact** Mount Hardman Creek is not a permanent aquatic habitat, provides low-quality habitat on a temporary basis for this species, and as no direct (or indirect) impacts are expected arise to Mount Hardman creek associated with the Proposed action, BNR does not believe that there is a real chance or possibility that the Proposed Action will result in any impact to the species.
Water Resources	Hydrology	**No Significant residual impact** Groundwater drawdown impacts associated with abstraction is limited to 1 mm within 700 m of the abstraction source. This will not result in any exposure to surface water features, will rapidly recover following cessation of temporary abstraction activities. As such BNR does not believe that there is a real chance or possibility that the Proposed Action will result in any impact to hydrology (**Section 5.1.1.1**) of a water resource.
	Water quality	**No Significant residual impact** No event associated with the Proposed Action will result in a credible or more than remote chance of causing impacts to water quality. Consequently, BNR does not believe that there is a real chance or possibility that the Proposed Action will result in any impact to water Quality (**Section 5.1.2**) of a water resource.
National Heritage	Noonkanbah Gate	**No Significant residual impact** The Noonkanbah Gate is no longer physically in place, however the site is protected by rangers through the Commonwealth Government Program. The Proposed action does not intersect nor will not impact the Noonkanbah gate (**Section 5.3.1**).

MNES	Species / Specific Interest	Residual Impact
	West Kimberley National Heritage Area	**No Significant residual impact** No credible pathway exists by which the Proposed Action could cause any direct or indirect impact to the WKNHP (**Section 5.3.2**).

10.2 Offsets

As detailed in the risk assessments completed in this PD, BNR does not believe that there is a real chance or possibility that the Proposed Action will result in any significant residual impacts that require offsetting. Clearing of vegetation is consistent with the existing pastoral station land use and mitigations in place ensure all direct impacts are prevented and as such any residual impacts are considered non-significant.

Therefore, there are no offsets are identified as being required for the Proposed Action.

11 ECONOMIC AND SOCIAL MATTERS

11.1 Financial Investment

11.1.1 Social Context

There are two main towns in the Fitzroy River Catchment: Derby (population ~3,500) and Fitzroy Crossing (population ~1,300), and 57 smaller Aboriginal communities. Combined, the catchment has a population of about 7,500 (Merrin, L., Addison, J., & Austin, J., 2018). Much of the catchment is subject to native title. Overall, the population has a very high level of socioeconomic disadvantage, with high unemployment. There is a lack of settlement, communications and transport infrastructure in the Fitzroy River Catchment, with no rail network and a sparse road network, most of the catchment is accessed by unsealed minor roads.

Within Noonkanbah Community, two Traditional Owner groups live on EP371: the Yungngora and the Warlangurru. The Community is well informed, engaged, and strongly supportive of the company's activities and the Proposed Action. Through independent consultation, Noonkanbah community has educated themselves on HFS, have monitored operations closely during the previous campaign and are comfortable with the process. A long-standing relationship has been maintained with the community and is built on trust. Letters of support have been provided by the Yungngora and Warlangurru. The following link is an interview with Yungngora elder Thomas Skinner who speaks in support of the Proposed Action. Thomas Skinner lobbied the WA government in support of lifting the moratorium on HFS.

https://www.weeklytimesnow.com.au/news/national/traditional-owners-at-noonkanbah-welcome-fracking/video/3351c52ae84cc7c0f0667a302fafc556

11.1.2 Local and Regional Economic and Social Impacts – Historical

During the previous drilling campaign and the 2025 HFS, 33 workers, approximately 14,000 hours of employment were provided to the Noonkanbah people which included:

- Security and access control – community members were responsible for providing security and access control at all sites for the whole program, in partnership with security specialists. This involved maintaining a 24-hour ranger presence across areas of activities.
- HFS spread – community workers were seconded to service companies during the program and worked alongside service company personnel doing equipment maintenance, loading sand, refuelling, and related jobs.
- Civil works – community members were responsible for maintaining the access tracks and well pads during the program. This included watering to supress dust.
- Camp services – community members worked in the temporary camp during the program.
- Groundwater monitoring – community members supported data collection efforts.

During the program, the staff from the Kimberley Training Institute were on site to train, assess and certify community members. Fifteen people were trained and ticketed in security and in operating excavators, water carts, dump trucks, front-end loaders and bobcats, with 32 tickets awarded during the program. At that time, approximately 400 people (median age 22) live in Yungngora Community (ABS, n.d.). Of the ~240 people who are of working age, >80 per cent are either unemployed or are supported through the Commonwealth funded Community Development Program.

Subsequent to the last drilling campaign and over the last ~10 years Traditional Owner opportunities and community benefits have included:

- Long-term employment of traditional owners for site security tasks (monthly)
- Employment during Heritage (2021) and Seismic (2022) survey programs
- Community sporting and arts sponsorship
- Regular attendance at and sponsorship of catering costs for AGM's, board meetings and community sessions
- Arranging for independent technical experts to visit community and undertake community wide information sessions (Bunuba, Warlangurru & Yungngora)
- Upgrading community lodge kitchen and BBQ area
- Regular visits from BNR-sponsored Traditional Owner liaison officer with indigenous counselling qualifications
- Support of Ranger program
- Targeted survey support (2024)
- Well care & maintenance employment, which includes skilled grader work (annually)
- Football team sponsorship
- NAIDOC Week sponsorship.

Additionally, and over the last ~10 years, the wider region, which includes both traditional and non-traditional owners and businesses, has benefited from initiatives including:

- Helicopter hire
- Heavy equipment hires and supplied services
- Well pad & wellhead maintenance services
- Vehicle rentals
- Purchase of supplies from Broome, Derby and Fitzroy crossing.

These historical and ongoing efforts have created a deep level of trust and Proposed Action support between BNR and the traditional owners.

11.1.3 Local and Regional Economic and Social Impacts – Ongoing

Locally, the Proposed Action aims to provide a socio-economic uplift. Due to remoteness and lack of options the community suffers from limited opportunities to address concerns. The Noonkanbah Community has been waiting over 10 years for this Proposed Action to commence. The Proposed Action offers a solution which includes:

- Creating industry for the Community on country at EP 371
- Providing training and jobs, giving the Community a sense of purpose, and yielding financial ability to improve their way of life

The Community is determined to improve their current circumstances and see themselves as a partner to BNR and BNR's plans for the Proposed Action.

Regionally and nationally, the Proposed Action aims to:

- Support economic development for the communities associated with the Proposed Action Area and EP 371. Note that those living in Noonkanbah include traditional owners other than the Yungngora and Warlangurru who will be given opportunities to benefit from the Proposed Action.
- Train, recruit and contract a local aboriginal, Derby and Fitzroy Crossing workforce.
- Make economic contributions to the region through agreement payments, direct expenditures, and indirect expenditures.
- Contribute by paying taxes.

The Proposed Action will provide an important source of employment and socioeconomic opportunities to the Traditional Owners, Community, as well as SDWK and the West Kimberley region generally. BNR has an Indigenous Land Use Agreement (ILUA) and LAUA in place with the Yungngora and Warlangurru people, respectively. These agreements include a focus on employment and training opportunities and programs, particularly for young people. The BNR will continue to work closely with the Yungngora and Warlangurru people to maximise the opportunities the Proposed Action brings to their communities. As the planned activity (i.e., up to 20 well locations) is greater than the 2012-2015 drilling / HFS campaign, the social economic opportunities are expected to be significantly greater than the numbers shared above (i.e., Traditional Owner employment).

Justification for the Proposed Action includes incentives to balance the Proposed Action impacts by promoting and contributing to increased economic activity and significant social benefits in the region. BNR believes that programs such as these are particularly important for developing the West Kimberley region as unconventional resources occur away from main regional towns, in areas where meaningful employment opportunities are central to addressing economic disadvantages.

12 ECOLOGICALLY SUSTAINABLE DEVELOPMENT

The National Strategy for Ecologically Sustainable Development, endorsed by all Australian jurisdictions in 1992, defines the goal of Ecologically Sustainable Development as: *'development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.'*

The following Ecologically Sustainable Development principles are outlined in Section 3A of the EPBC Act:

a) Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations (the 'integration principle').

b) 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 'precautionary principle').

c) 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 'intergenerational principle').

d) The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making (the 'biodiversity principle').

e) Improved valuation, pricing and incentive mechanisms should be promoted (the 'valuation principle').

Proposed Action implementation of the ecologically sustainable development principles are reviewed in **Table 12-1**.

Table 12-1: Summary of Proposed Action Against Ecologically Sustainable Development

Principle	Project Implementation
Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations (the 'integration principle').	In line with the integration principle, decision-making for the Proposed Action will holistically evaluate economic, environmental, social, and equity considerations, both in the short term and the long term. **Economically**, the Proposed Action has offered economic benefits and will offer ongoing benefits such as job creation, royalties, and growth in local economies and communities. However, as this is an exploration and appraisal program only, the economic benefits only take into account the duration of the Proposed Action which is 7 years. **Environmentally**, the Proposed Action has taken into account the short-term risks such as habitat disruption, and potential environmental events. All pathways are well understood and mitigated through rigorous environmental impact assessments and safeguards. **Socially**, local communities will benefit in the short term through employment, community funding and improved infrastructure Long-term impacts may include loss of community funding if the Proposed Action is unable to gain approval from governments and if outcomes of the program indicate suitable gas reserves are not present. Past and ongoing stakeholder engagement with communities ensures their concerns are addressed throughout the Proposed Action lifecycle and supports social cohesion and legitimacy. Equity considerations and consultation ensures that benefits are fairly distributed by Traditional Owners and communities within the Proposed Action Area. Marginalized or Indigenous communities will not bear environmental or social costs.

Principle	Project Implementation
	BNR believes that through employment, infrastructure updates and community funding the development will improve the well-being of future generations. BNR will ensure that in implements decommissioning plans, environmental rehabilitation plans align with community needs and also align with the transition principles to also ensure the well-being of future generations. In conclusion, applying the integration principle to Proposed Action ensures that decision-making is responsible, forward-looking, and sustainable. It has balanced immediate economic gains with long-term environmental stewardship, social responsibility, and fairness for all stakeholders, both now and for the future generations.
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 'precautionary principle').	The Proposed Action Area has a disturbance footprint of ~106.14 ha. Previous detailed and targeted flora and fauna baseline surveys have been undertaken within the Proposed Action Area and although they indicate that there is potential habitat for some MNES, through implementation of mitigation measures, MNES are not expected to be directly impacted and indirect impacts or residual impacts will not be significant. Previous HFS activities have occurred in EP 371 proving scientific and historic evidence that such activities can be undertaken in a way that will not cause serious or irreversible damage to the environment. BNR plans to leverage this wealth of environmental data and conduct similar studies for the Proposed Action to demonstrate that these activities can be undertaken safely with minimal impact to the environment. As part of its commitment to this principle, BNR commits to undertaking pre-clearance surveys to ensure that MNES will not be directly impacted by the Proposed Action. In addition, groundwater monitoring bores will be installed, and data collected prior to drilling activities commencing. Ongoing monitoring throughout the life of the Proposed Action (and for an agreed period beyond Proposed Action cessation) will quickly identify any issues so that mitigation measures can be undertaken.
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 'intergenerational principle').	Significant environmental impacts to MNES are not expected from the Proposed Action. The Proposed Action has minimised environmental disturbance where practicable to ensure the health, diversity and productivity of the environment are maintained. As stated above, pre-construction surveys are planned to ensure that MNES will not be adversely impacted by the Proposed Action, and that local groundwater monitoring will occur well in advance of drilling activities.
The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making (the 'biodiversity principle').	The areas of vegetation to be disturbed are representative of the surrounding vegetation associations and the wider bioregion. Historical and recent detailed and targeted flora and fauna baseline surveys have been undertaken within the Proposed Action Area and indicate no MNES are likely to be significantly impacted. The whole area of the proposed surface disturbance footprint has been recently surveyed, and the Proposed Action Area is also fixed at the proposed locations. In addition, further pre-clearance surveys are planned be undertaken to ensure MNES will not be directly impacted by the Proposed Action. The Proposed Action occurs on an operational pastoral station and as such is not subject to high conservation status. The Proposed Action falls within the existing risk profile of existing land-use and is not expected to result in any impacts that would cause biological diversity or ecological integrity to be impacted in any way.

Principle	Project Implementation
Improved valuation, pricing and incentive mechanisms should be promoted (the 'valuation principle').	Throughout the Proposed Action development process, reduction of environmental impact has been considered during decision-making and design. For example, the Proposed Action Area has been reduced to ALARP and realigned to prevent direct impacts to ephemeral water features and cultural heritage areas. In siting the final well locations, BNR has considered impacts to MNES and stakeholders Potential impacts to MNES arising from the Proposed Action have been identified and plans put into place to manage them. BNR acknowledges that the cost associated with managing these potential impacts as part of the Proposed Action. Justification for the Proposed Action includes incentives to balance impacts to MNES by promoting and contributing to increased economic activity and benefits in the region. BNR believes that programs such as these are particularly important for developing the West Kimberley region as unconventional resources occur away from main regional towns, in areas where meaningful employment opportunities are central to addressing economic disadvantages.

13 ENVIRONMENTAL RECORD OF THE PERSON PROPOSING TO TAKE THE ACTION

13.1 Person Proposing to Take the Action

Referring party details

Name: Michael Laurent

- Job Title: Chief Operating Officer
- Email: perthoffice@bennettresources.com.au
- ABN/ACN: 73 145 113 186
- Organisation name: Bennett Resources Pty Ltd

Organisation address: Level 4, 225 St Georges Terrace, Perth WA 6000

13.2 BNR Environmental Policy

The Proposed Action will be undertaken in accordance with BNR's environmental policy and framework (**Attachment 9**).

Summary of Bennett Resources Pty Ltd Environmental Policy

Through its Environmental Policy, BNR is committed to achieve the best possible balance between economic development and protection of the environment. BNR is committed to managing environmental matters to achieve long-term environmentally sustainable development.

To achieve this, BNR is committed to:

- Complying with all applicable environmental laws, regulations and requirements and where able, exceeding chose applicable standards for environmental management.
- Establishing. developing and maintaining management systems that are consistent with internationally recognised standards to identify, monitor and control all aspects of its environmental activities.
- Ensuring continuous improvement in its environmental performance including promoting its environmental progress through public reporting.
- Identifying and assessing the potential environmental effects of our activities and manage environmental risks and improvement opportunities.
- Regularly monitoring environmental performance to ensure minimisation and where possible, prevention of negative impacts on the environment.
- Promoting environmental awareness amongst our employees and contractors, ensuring they are aware of their roles and relevant responsibilities for environmental management.
- Developing our people and providing chem with the necessary resources to ensure that sustainable environmental development is an integral part of how we do business.
- Working with local communities and governments to minimise environmental impacts and developing opportunities for involvement in environmental programs.
- Integrating environmental processes into all aspects of our operations.

It is the responsibility of all employees, contractors and suppliers to comply with the requirements *of this policy*.

It is the responsibility of managers and supervisors to ensure this policy is implemented, reinforced and maintained through *active* leadership.

13.3 Legal Proceedings

Bennett Resources Pty Ltd has a satisfactory record of responsible environmental Management.

There are no proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against Bennett Resources Pty Ltd.

14 OTHER APPROVALS AND CONDITIONS

14.1 *Environmental Protection Act 1986*

BNR referred the Proposed Action to the WA Environmental Protection Authority (EPA) under Section 38 of the EP Act on 24 December 2020. On 3 February 2021, the EPA determined that the Proposed Action should be assessed under Section 39a of the EP Act at the level of assessment of Public Environmental Review (PER).

On 4 August 2021, the EPA issued the Environmental Scoping Document (ESD) for public review, which contained the requirements that should be included in this ERD. The ERD was prepared to meet the requirements of the final ESD, which was issued by the EPA on 8 November 2021. In preparing this ERD, BNR completed engagements and studies to address the key environmental factors determined by the EPA, including:

- Flora and vegetation
- Terrestrial environmental quality
- Terrestrial fauna
- Inland waters
- Social surroundings
- Air quality
- Greenhouse gas emissions
- Human health
- Other environmental factors or matters
- Subterranean fauna.

BNR updated the ERD following comment from the DWER and resubmitted this in June 2024, in accordance with the EPAs Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual (EPA, 2021). The ERD was available for a public review for a period of 8 weeks from 12 August 2024, closing on Monday, 7 October 2024. On 9 December 2024, EPA Services at the DWER provided BNR with a summary of public submissions received during the public review period. BNR has addressed these comments in this Response to Submissions (RTS) document as well as responding to further actions requested in the EPA Letter (16 April 2025) requesting further information to the RTS submitted on the 7 February 2025. This document will constitute part of the assessment documentation for the Proposed Action. The EPA prepared an assessment report under s. 44 of the EP Act 1986 (WA) for consideration by the WA Minister for Environment in determining whether to approve the Proposed Action. The report, published in January 2026 as *Valhalla Gas Exploration and Appraisal Program – EPA Report 1800*, includes recommendations and draft conditions for implementation of the Proposed Action. The Report is currently in the appeals process stage under of the WA legislative framework.

Petroleum and Geothermal Energy Resources Act 1967

The WA DMPE is responsible for administering various acts including the *Petroleum and Geothermal Energy Resources Act* 1967 (PGER Act). Under this Act, various subsidiary legislation has been enacted, which requires BNR to seek additional approvals from DMPE before implementing the Proposed Action. This includes Safety Management Systems and Emergency Response Plan, covered by the PGER (Management of Safety Regulations) 2010 which, while not

having a direct relation to potential impacts on the environment, nevertheless assist in mitigating potential impacts through regulating the safety of the site and personnel.

Under the Petroleum and Geothermal Energy Resources (Environment) Regulations (PGER(E)R) 2012, an EP that is required to be accepted by DMPE under the PGER Act for petroleum-related activities, before such activities can commence. The EP must evaluate all impacts and risks that are associated with an activity, and demonstrate that, with the management measures identified, the impacts and risks are reduced to levels that are ALARP. Further to this, the EP must demonstrate that the environmental impacts and risks are acceptable. Included as part of an EP is the requirement to submit an Oil Spill Contingency Plan (OSCP) for approval. An EP cannot be accepted without an approved OSCP. The OSCP covers all spill scenarios associated with the activity.

BNR will manage its wells throughout their lifecycle under a well integrity management system, which includes meeting or exceeding all requirements set forth in the Petroleum and Geothermal Energy Resources (Resource Management and Administration) Regulations 2015, as required by DMPE. Under the Regulations, a WMP that describes the history of all well activities relating to the planning, design, construction, integrity, and management of a well throughout its life cycle must be approved by DMPE. Among other requirements, the WMP must explain the philosophy of, and criteria for, the design, construction, activities and management of the well. The WMP covers the drilling and HFS program and identifies the risks. The WMP adopts a risk-based approach for petroleum exploration and ensures appraisal activities are undertaken in accordance with good oilfield practice to minimise the risk of aquifer contamination. At a minimum, the WMP will:

- Identify and assess all risks associated with the well activity and their resulting impacts
- Establish specific environmental performance objectives and standards against identified risks (including measurement criteria to assess performance of those standards)
- Detail mitigation measures for identified risks, including those where the likelihood of occurrence is low.

Specific design requirements that are documented in the WMP and managed under these regulations include:

- Ensuring the casing grade is selected in accordance with American Petroleum Institute (API) grades
- Designing the well with a minimum required casing string
- Undertaking integrity tests throughout the drilling process, including:

  casing pressure test

  formation pressure integrity test

  cement bond logs
- Reporting arrangements to DMPE, including the results of well logging and pressure tests undertaken during well construction and prior to HFS activities. Reporting of integrity tests will also occur during and after HFS highlighting casing failure / well integrity issues as a potential risk, while recognising that all wells will be constructed to ensure there are two barriers present at all times during drilling activities. Should a well barrier be compromised, the well activity would be suspended, and integrity measures, as documented in the DMPE-accepted WMP, implemented to ensure risk of contamination is ALARP.

In addition to WMPs and seeking approval on the well design construction methodology, BNR will ensure that well integrity is assessed by an independent and certified well examiner approved by DMPE. BNR will follow the relevant Australian and international standards related to well integrity including ISO 165301 and NORSOK D-010.

14.2 *Rights in Water and Irrigation Act 1914*

Any abstraction of groundwater within a proclaimed groundwater area is subject to a licence issued by the WA DWER under the RIWI Act. A cumulative assessment of all abstraction in the groundwater area must be completed to ensure allocation limits are not exceeded; this assessment is done independent of the applicant such that local and regional cumulative impacts are considered. Under a RIWI Act groundwater licence, volumes extracted must be monitored and reported to the DWER annually to confirm compliance with the licence and confirm that abstraction above the licence allocation does not occur.

14.3 *Aboriginal Heritage Act 1972*

The *Aboriginal Heritage Act* 1972 is the regime for the protection and preservation of Aboriginal cultural heritage in Western Australia. BNR is required to ensure that any ground disturbance is undertaken in accordance with the WA *Aboriginal Heritage Act* 1972. Unless acting with the authorisation of the Registrar under Section 16 or the consent of the Minister under Section 18, it is an offence under the *Aboriginal Heritage Act* 1972 for any person to excavate, destroy, damage, conceal or in any way alter any Aboriginal site. BNR has noted developments with the Aboriginal Heritage Act (including the enactment and subsequent repeal of the *Aboriginal Cultural Heritage Act 2021*) to ensure consistency with the Proposed Action and this environmental factor. On 15 November 2023 the *Aboriginal Cultural Heritage Act* 2021 (WA) was repealed, meaning that the previous *Aboriginal Heritage Act* 1972 (WA) was restored, with amendments.

14.4 Monitoring, Enforcement and Review Procedures

A comprehensive suite of monitoring, enforcement and review procedures will apply to ensure that the action is implemented in a manner that protects MNES and complies with any approval conditions issued by the Minister for Environment.

Monitoring is essential to assess compliance with approval conditions and to evaluate the effectiveness of mitigation and management measures for MNES. Proposed monitoring procedures include:

Monitoring Procedures

- Environmental Monitoring Programs: Targeted monitoring of key environmental indicators (e.g., water quality, habitat condition, species presence) will be undertaken in accordance with approved EMPs.
- Baseline and Ongoing Data Collection: Baseline studies will be completed prior to the commencement of the action, with ongoing monitoring conducted during both construction and operational phases.
- Condition Monitoring: Specific monitoring to confirm that mitigation measures are achieving their intended outcomes.
- Reporting Requirements: The proponent will prepare and submit regular compliance and monitoring reports to the Department of Climate Change, Energy, the Environment and Water (DCCEEW), in line with the conditions of approval.

Specific monitoring requirements have been identified in each impact pathway risk assessment refer to:

- **Section 5.1.1.1** – Groundwater Drawdown (Hydraulic Connectivity Between Aquifer and Surface Water)
- **Section 5.1.2.1** – Potential Contamination of Aquifers Through Unplanned Vertical Fracture Heights
- **Section 5.1.2.3** – Potential Contamination of Surficial Formations due to Lost Circulation or Well Integrity Issues, Including Casing Failures
- **Section 5.1.2.5** – Potential Contamination of Surficial Aquifers from an Accidental Release at the Surface of Drilling Fluids, HFS Chemicals, Liquid Hydrocarbons, or Produced Formation Water
- **Section 5.1.2.8** – Potential Risk to Site Activities and Infrastructure from Flooding due to Extreme Rainfall Events

Enforcement Procedures

The EPBC Act provides for a range of enforcement mechanisms to ensure compliance with conditions of approval:

- Compliance Audits and Inspections: The Department may conduct audits or inspections to assess the proponent's compliance with the Act and any approval conditions.
- Statutory Notices: If breaches are identified, the Department may issue directions, infringement notices, or remediation orders under Part 17 of the EPBC Act.
- Penalties for Non-compliance: Significant civil and criminal penalties may apply for failing to comply with approval conditions or for undertaking the action without approval.
- Enforceable Undertakings: In cases of non-compliance, the Minister may accept enforceable undertakings from the proponent as an alternative to litigation.

Review Procedures

Review processes are integral to adaptive management and continuous improvement in environmental outcomes. These include:

- Environmental Management Plan Updates: The EMPs will be reviewed and updated periodically, or as required by new monitoring results or changes in Proposed Action scope.
- Adaptive Management Framework: Management measures will be adjusted in response to monitoring outcomes, scientific research, or unforeseen impacts to ensure MNES are protected.
- Post-Approval Reporting: Annual compliance reports and final project completion reports will be submitted, assessing overall compliance with EPBC conditions and long-term environmental outcomes.

15 OUTCOMES-BASED CONDITIONS

BNR does not believe that conditions are required to support the implementation of this Proposed Action given the residual level of impact **is not deemed significant**. The environmental outcomes should reflect the assessment that:

- Mitigations are in place to prevent all direct impacts (mortality) to Threatened Species
- Mitigations to reduce habitat loss, disturbance and modification
- Mitigations to reduce the introduction of invasive species
- Residual impacts to Threatened Species are not significant
- Groundwater drawdown impacts are temporary and will not intersect with surface water features
- Mitigations are in place for all identified spill events to prevent long-term groundwater contamination occurring and prevent any surface water contamination event occurring.

However, should conditions be required, BNR believe that these should leverage the significant assessment conducted under the State EPA Act:

- Implement conditions required under the Environmental Protection Act 1986 to ensure that no significant impact arise to threatened MNES as a result of the Proposed Action.
- Implement conditions associated with WA State Assessment process under the EPA Act to ensure no detectable decrease in groundwater level in the Liveringa Aquifer within 12 months of the appraisal activities.
- Implement conditions associated with WA State Assessment process under the EPA Act to ensure no *detectable decrease in groundwater quality of the* ***Liveringa Aquifer****.* Implement conditions associated with WA State Assessment process under the EPA Act to ensure *no spill events result in any water quality impact to Mount Hardman Creek.*

16 INFORMATION SOURCES

All information provided in the PD has been either referenced or provided as an attachment. Reliability of information was assessed by BME as well as Subject Matter Experts. References to ERD appendices have been included only where the appendix is cited once within the PD.

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