

11 August 2020

Hannah Stevens,
Senior Environmental Officer (Assessment)
Department of Environment and Science
400 George Street, Brisbane
QLD, Australia, 4000

Re: Response to the Department of Environment and Science’s Information Request

Dear Hannah,

We refer to the Information Request issued by the Department of Environment and Science (**DES**) to Capricorn Energy Pty Ltd (**Capricorn**) under section 140 of the *Environmental Protection Act 1994* in response to the application to amend environmental authority EPPG00651913. The purpose of this letter is to provide a response to the further information requested.

Information Request

DES Request 1. Monitoring

Sample quality control and assurance has not been described in the application. The Aquifer Injection Management Plan (AIMP) must include but not be limited to:

- *information relating to the proposed sample quality control program;*
- *details of laboratory analysis;*
 - *the inclusion of blanks, duplicates, triplicates, rinsates,*
 - *sample preservation, and*
 - *chain of custody.*

Provide a revised AIMP that includes, at least, the additional detail identified around proposed quality control and assurance measures.

Capricorn response

Section 9.3.4 of the Aquifer Injection Management Plan (AIMP) identifies that samples will be collected in accordance with the Monitoring and Sampling Manual (DES, 2018). The AIMP has been updated to specifically include sample quality control and assurance, inclusive of the items identified above (refer Attachment A).

DES Request 2. Water Quality

Section 9.4.11. of the supporting information describes the extraction phase following a period of storage in the aquifer.

Provide further details of the proposed aquifer residence time and how the appropriate time was/will be determined.

Capricorn response

The following scientific publications were reviewed to identify push-pull test residence times during previous treated CSG water injection trials undertaken in Queensland:

- Prommer et al. (2018) Deoxygenation Prevents Arsenic Mobilization during Deepwell Injection into Sulfide-Bearing Aquifers
- Rathi et al. (2017) Multiscale Characterization and Quantification of Arsenic Mobilization and Attenuation During Injection of Treated Coal Seam Gas Coproduced Water into Deep Aquifers
- Prommer et al. (2016) Geochemical Response to ReInjection

Shut-in periods between injection and extraction varied from 2 to 64 days in those trials. However, the residence time in the aquifer of the water includes the time since injection and is therefore longer than the shut-in period. Despite the short periods of the shut-in, the effects of the different treatments imparted on the injected water could be ascertained and modelled.

In addition,

- Wallis, I. and Pichler, T. (2018) Generating false negatives and false positives for As and Mo concentrations in groundwater due to well installation. Science of the Total Environment 631:723-732, August 2018; and
- Morris, R. (2017) Spatial and temporal scale influences on conceptual model development – examples from CSG water injection studies. Australasian Groundwater Conference 2017

identify anomalies in groundwater chemistry induced during the drilling process due to the mixing of drilling fluids with the native groundwater and aquifer mineralogy. The mixing of native groundwater with a different fluid in the presence of the rock minerals during drilling is akin to the geochemical reactions that would occur during aquifer injection. The papers elucidate the rapidity at which geochemical reactions can occur.

Despite the short shut-in periods of the previous trials and the rapidity at which the reactions may occur, a minimum residence time of 30 days will be employed during the Capricorn trials. This is considered sufficient time to ensure that potential geochemical reactions will occur.

The AIMP has been updated to identify this duration (refer section 7.3 of attachment A).

DES Request 3. Management of unsuitable water

Section 9.4.6. of the supporting information describes how the digital monitoring process will stop injection until the water quality becomes compliant, in the event any parameters exceed their identified EA limit.

Further information is requested regarding the management of water that is unsuitable for injection, specifically, what will happen to the water in the process line should it require further treatment.

Capricorn response

The digital control system will be configured to ensure that water is automatically diverted back to the pond before the water is non-compliant. Table 9 of the AIMP identifies the proposed compliance limits, the target water quality, and the treatment system setpoints to ensure the limits are not exceeded.

The off-specification reject will be diverted back to the pond for reprocessing. The diversion point in the process will be upstream of (i.e. before) the monitoring system. This has been modified in the AIMP process flow diagram (refer Figure 17 of Attachment A).

DES Request 4. Flow meter

Section 9.4.3. of the supporting information describes the use of digital flow meters to record both the flow rate and total volume injected.

Provide additional information is requested in relation to the selection of an appropriate flow meter in consideration of the discontinuous flow. For example, whether it would be susceptible to measurement errors due to inconsistent flow.

Capricorn response

Digital (magflow) flowmeters are commonly used for industrial purposes and are sized for the anticipated range of flows during the engineering design of the surface facilities. The flowmeter(s) will be sized and installed in accordance with manufacturers specifications.

Flowmeters are most accurate when the pipe is flooded (water filled). Since the Hutton Sandstone is artesian, the pipework downstream of the flowmeter will remain flooded (water-filled). Appropriate check-valves will be installed upstream of the flowmeter to ensure that the flow meter always remains flooded. This will ensure the accuracy of the rate and volume measurements despite variable flow rates and intermittent flow.

DES Request 5. Environmentally Relevant Activities

The proposed amendment will involve the operation of additional ERAs. The impacts from these additional activities have not been individually addressed in the supporting information document. Additional information is required to clarify:

- *Identify each of the additional ERAs and thresholds that are proposed*
- *How the additional ERAs required will be carried out*

- *The risk of environmental harm associated with each ERA; and*
- *How the proposed ERAs will be managed to ensure the reduced risk of environmental harm.*

Capricorn response

The following ERAs are considered part of the EA amendment.

Environmentally relevant activity/activities	Clarification
Schedule 3 06: A petroleum activity carried out on a site containing a high hazard dam or a significant hazard dam	Assessment included in the Supporting information Report. Refer section 9, Table 20. Updated AIMP as Attachment A to this RFI response.
Schedule 3 07: A petroleum activity involving injection of a waste fluid into a natural underground reservoir or aquifer	Assessment included in the Supporting information Report. Refer section 9, Table 17 and Attachment C.
Ancillary 08 - Chemical Storage 1: storing a total of 50t or more of chemicals of dangerous goods class 1 or class 2, division 2.3 under subsection (1)(a)	Described in section 4.3 - Injectant treatment system of the Supporting Information Report. Further risk assessed in Attachment B of this RFI response.
Ancillary 64 1 (a) - Water treatment. Desalinating, in a day, the following quantity of water, allowing the release of waste only to seawater - 0.5ML to 5ML	Described in section 4.3 and Figure 4 Process flow diagram of the Supporting Information Report. Further risk assessed in Attachment B of this RFI response.

DES Request 6. Groundwater Dependent Ecosystems (GDEs)

Section 7.11. of the supporting information states that impacts to GDEs are only expected through a change in the physical or chemical characteristics of the aquifer that affects ecosystem function. Therefore, for the trial to impact on GDEs, they must be within the hydraulic impact zone (HIZ) or the water quality impact zone (WQIZ). There is no concluding statement confirming the presence/absence relevant to the project site. In addition, Wetland Info mapping shows areas of low confidence derived Terrestrial GDEs and an area of high confidence derived Terrestrial GDEs to the west of the site. It is unclear whether these have been considered in the amendment application.

Additional information is required as follows:

- *Confirmation whether there are any identified GDEs within the expected HIZ or WQIZ;*
- *If there are GDEs in the HIZ or WQIZ area, what is the extent of potential impacts to these; and*
- *Confirmation as to whether Wetland Info Terrestrial GDE mapping has been considered and what conclusions were drawn from this.*

Capricorn response

The Hutton Sandstone is overlain and underlain by aquitards which will limit the vertical propagation of pressure and the physical transport of water to outside of the Hutton Sandstone. The HIZ and WQIZ will therefore be within the Hutton Sandstone only.

The AIMP (refer section 4.6.2) has been updated to include Wetland Info terrestrial GDE mapping and associated descriptions. Wetland Info identifies no *known* terrestrial GDEs within 150 km of the site. While low confidence *derived* terrestrial GDEs are mapped adjacent to the drainage lines in the immediate vicinity of the site and hence within the HIZ and WQIZ, these will not be affected by injection as they are hydraulically disconnected by the overlying formations, which are approximately 760 m thick. Similarly, the high confidence derived terrestrial GDEs to the west of the site are not immediately underlain by Hutton Sandstone, and will therefore be hydraulically disconnected from the injection and cannot be impacted. These derived terrestrial GDEs are associated with shallow, local, intermittent unconsolidated alluvial aquifers.

As previously described, the potential for impact to GDEs occurs where:

- The terrestrial GDE is associated with outcrop of the Hutton Sandstone – Wetland Info maps small, disparate stands of derived terrestrial GDEs of low, moderate and high confidence associated with sandstone aquifer with fluctuating intermittent groundwater connectivity in the area of the closest Hutton Sandstone outcrop to the site.
- The Hutton Sandstone at outcrop is within the HIZ or WQIZ – The closest Hutton Sandstone outcrop is approximately 120 km from the site. The median prediction of the HIZ is 80 km and the WQIZ is 100 m from the injection bore and based on continuous injection at 2ML/day for 1 year, which exceeds the likely volume injected.
- The water table is within rooting depth of the vegetation. Eamus et al (2006) Ecophysiology identifies maximum rooting depths in the order of 15 m. The water table depth in the area of outcrop is estimated to be 15 m.

While some terrestrial GDEs are mapped within the Hutton Sandstone outcrop closest to the site, the potential impacts are not predicted to propagate that distance. The injection trials will therefore not impact on terrestrial GDEs. Conclusions to this effect have been added to Sections 8.1.3 and 8.2.3 of the AIMP (refer Attachment A).

DES Request 7. Prescribed matters

The supporting information does not clarify the presence of Matters of State Environmental Significance (MSES) and whether they are relevant to the proposed activity.

Clarify whether MSES are present in or within proximity to the project site and what potential impacts may exist to these areas if they are present.

Capricorn response

Queensland Globe (accessed 28 July 2020) identifies MSES regulated vegetation associated with the drainage line immediately to the north of the Glenaras pond. The trial bore(s) and Glenaras pond are already existing and the treatment system will not be located within the drainage line and will be in compliance with the existing EA conditions. Therefore, there will be no impact to the vegetation associated with the drainage line.

There are no mapped MSES within the outcrop areas of the Hutton Sandstone closest to the site (Queensland Globe, accessed 28 July 2020). MSES will not be impacted by the proposed amendment.

If you have any further questions or require further clarification please do not hesitate to contact Trent Williams, Access Adviser, at 0467 769 429 or trent.n.williams@t29.com.au.

Yours sincerely,



Gerard Ryan
Chief Operating Officer
Galilee Energy Limited

Attachment A – Updated Glenaras Aquifer Injection Management Plan

Attachment B – Environmentally Relevant Activity additional risk assessment

Table 1: Chemical Storage 1: storing a total of 50t or more of chemicals of dangerous goods class 1 or class 2, division 2.3 under subsection (1)(a)

Environmental Value	Risk	Cause	Potential Impacts	Unmitigated Risk			Controls	Residual Risk		
				Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
Landforms	Environmental harm causes impacts to landforms, productivity and soils	Ineffective storage of chemicals	<ul style="list-style-type: none"> Land contamination 	Unlikely	Minor	Low	<ul style="list-style-type: none"> All chemicals will be stored in, or serviced by, an effective containment system that meets Australian Standards, where such a standard is relevant. 	Rare	Minor	Low
Biodiversity	No impact or increase of risk to EV from proposed ERA									
Surface Water	Quality and quantity is impacted beyond existing impacts in the region	Spill of chemical or failure of chemical containment	<ul style="list-style-type: none"> Hydrocarbon or chemical spills and/or runoff potentially causing degradation of aquatic habitats and water quality 	Unlikely	Minor	Low	<ul style="list-style-type: none"> All chemical storage and fuel storage will be banded in accordance with the relevant Australian Standards Staff Induction Program Procedures for handling and storing chemicals will be generated prior to activities commencing 	Unlikely	Minor	Low
Groundwater	Groundwater quality and quantity is impacted beyond existing impacts in the region.	Ineffective management and storage of chemicals	<ul style="list-style-type: none"> Hydrocarbon or chemical spills causing contamination of groundwater 	Unlikely	Minor	Low	<ul style="list-style-type: none"> All chemicals will be stored in, or serviced by, an effective containment system that meets Australian Standards, where such a standard is relevant. 	Unlikely	Minor	Low

Environmental Value	Risk	Cause	Potential Impacts	Unmitigated Risk			Controls	Residual Risk		
				Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
Noise and Vibration	No impact or increase of risk to EV from proposed ERA									
Air Quality	No impact or increase of risk to EV from proposed ERA									
Heritage	No impact or increase of risk to EV from proposed ERA									
Waste management	General and Regulated waste causing harm to environment	Ineffective waste management practices	<ul style="list-style-type: none"> Waste incorrectly managed causing unintended environmental harm 	Unlikely	Moderate	Moderate	<ul style="list-style-type: none"> Implementation of Waste and resource management hierarchy as prescribed in the Waste Reduction and Recycling Act 2011. Register of all chemicals stored on site. Wastes are not burned or allowed to be burned on site 	Unlikely	Minor	Low

Table 2: Ancillary 64 1 (a) - Water treatment. Desalinating, in a day, the following quantity of water, allowing the release of waste only to seawater - 0.5ML to 5ML

Environmental Value	Risk	Cause	Potential Impacts	Unmitigated Risk			Controls	Residual Risk		
				Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
Landforms	Environmental harm causes impacts to landforms, productivity and soils	Ineffective land management during RO pad preparation	<ul style="list-style-type: none"> Erosion Degradation of downstream water quality from sediment releases Land degradation Land contamination Land compaction 	Unlikely	Minor	Low	<ul style="list-style-type: none"> Staff Induction Program Site planning constraints methodology Erosion and Sediment Control Implementation Identified existing disturbed site Rehabilitation Plan Implementation 	Rare	Minor	Low
Flora	Flora values are impacted causing environmental harm	Ineffective planning, awareness and flora management during RO pad preparation	<ul style="list-style-type: none"> Clearing/removal of high value plants (prescribed environmental matters, endangered plants, vulnerable plants) Clearing/removal of vegetation communities, specifically ERE, OCRE and/or regulated vegetation Translocation or exacerbation of invasive plants 	Unlikely	Minor	Low	<ul style="list-style-type: none"> Staff Induction Program Site planning constraints methodology Erosion and Sediment Control Implementation Identified existing disturbed site Rehabilitation Plan Implementation 	Unlikely	Minor	Low

Environmental Value	Risk	Cause	Potential Impacts	Unmitigated Risk			Controls	Residual Risk		
				Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
Fauna	Fauna values are impacted causing environmental harm	Ineffective planning, awareness and flora management during RO pad preparation	<ul style="list-style-type: none"> Impacts on threatened species and associated habitat as a result of vegetation clearing Reduced movement opportunities through the creation of barriers within local and regional fauna corridors Changes in fauna behaviour and/or breeding patterns from noise, dust and/or vibration Mortality by exposure, starvation, thirst or predation by other species resulting from entrapment Accidental injury or death during construction activities (e.g. entrapment in open pipeline trenches, vehicle strikes etc) 	Unlikely	Minor	Low	<ul style="list-style-type: none"> Staff Induction Program Site planning constraints methodology Controlled vehicle speed where potential fauna movements may occur Compliance with existing EA conditions 	Unlikely	Minor	Low
Surface Water	Quality and quantity is impacted beyond existing impacts in the region	Failure of high consequence pond used in conjunction with the RO plant	<ul style="list-style-type: none"> Increased impervious areas and associated increased runoff from site potentially causing sedimentation of watercourses and degradation of aquatic habitats and water quality Sedimentation of waters as a result of land disturbance 	Unlikely	Minor	Low	<ul style="list-style-type: none"> Glenaras has been designed, constructed and operated in accordance with relevant industry standards Erosion and Sediment Control Procedure Staff Induction Program Rehabilitation Plan Implementation 	Unlikely	Minor	Low

Environmental Value	Risk	Cause	Potential Impacts	Unmitigated Risk			Controls	Residual Risk		
				Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
Groundwater	Groundwater quality and quantity is impacted beyond existing impacts in the region.	Failure of high consequence pond used in conjunction with the RO plant	<ul style="list-style-type: none"> Hydrocarbon or chemical spills causing contamination of groundwater Poorly constructed or faulty wells causing inter-aquifer leakage and/or groundwater level changes 	Rare	Minor	Low	<ul style="list-style-type: none"> All chemical storage and fuel storage will be bunded in accordance with the relevant Australian Standards Wells constructed and operated in accordance with relevant codes of practice and in compliance with regulatory standards Staff Induction Program 	Rare	Minor	Low
Noise and Vibration	Increase in noise and vibration impacting on environmental values	Increase in plant and equipment due to RO activities	<ul style="list-style-type: none"> Vehicle and equipment movements Equipment operation 	Rare	Insignificant	Low	<ul style="list-style-type: none"> Staff Induction Program No receptors in vicinity of activities (over 4 km away) Environmental Complaints and Incident Management Plan 	Rare	Insignificant	Low
Air Quality	Increase in air pollution impacting health and wellbeing values	Ineffective planning and construction emissions management	<ul style="list-style-type: none"> Increase in localised air pollution from fuel burning equipment impacting sensitive receptors Increase in regional air quality pollutants impacting sensitive receptors 	Rare	Insignificant	Low	<ul style="list-style-type: none"> Minimising the use of fuel by selecting fuel efficient plant and equipment, operating vehicles and machinery in a fuel-efficient manner (e.g. turning off idling equipment and selecting construction techniques that utilise lower amounts of fuel) Implementing a maintenance plan for all fuel-powered equipment Implementing energy conservation practices by all staff through appropriate training 	Rare	Insignificant	Low

Environmental Value	Risk	Cause	Potential Impacts	Unmitigated Risk			Controls	Residual Risk		
				Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
Heritage	Cultural Heritage values are impacted causing unacceptable harm	Ineffective planning and management of cultural heritage aspects	<ul style="list-style-type: none"> A significant Aboriginal area / place A significant item of Aboriginal cultural significance A significant Aboriginal object / culturally significant item An aboriginal occupation of an area 	Rare	Minor	Low	<ul style="list-style-type: none"> Cultural Heritage Management Plan Implementation 	Rare	Minor	Low
Rehabilitation	Rehabilitation is not successful on completion of activities or as required by Environmental Authority.	Ineffective rehabilitation planning and execution.	<ul style="list-style-type: none"> Erosion Degradation of downstream water quality from sediment releases Loss of topsoil Land suitability changes Land degradation Reduction in agricultural productivity 	Unlikely	Moderate	Moderate	<ul style="list-style-type: none"> Erosion and Sediment Control Procedure Site planning constraints methodology Staff Induction Program Progressing Rehabilitation Plan 	Unlikely	Minor	Low
Waste management	General and Regulated waste causing harm to environment	Ineffective waste management practices	<ul style="list-style-type: none"> Waste incorrectly managed causing unintended environmental harm 	Unlikely	Moderate	Moderate	<ul style="list-style-type: none"> Implementation of Waste and resource management hierarchy as prescribed in the Waste Reduction and Recycling Act 2011. 	Unlikely	Minor	Low