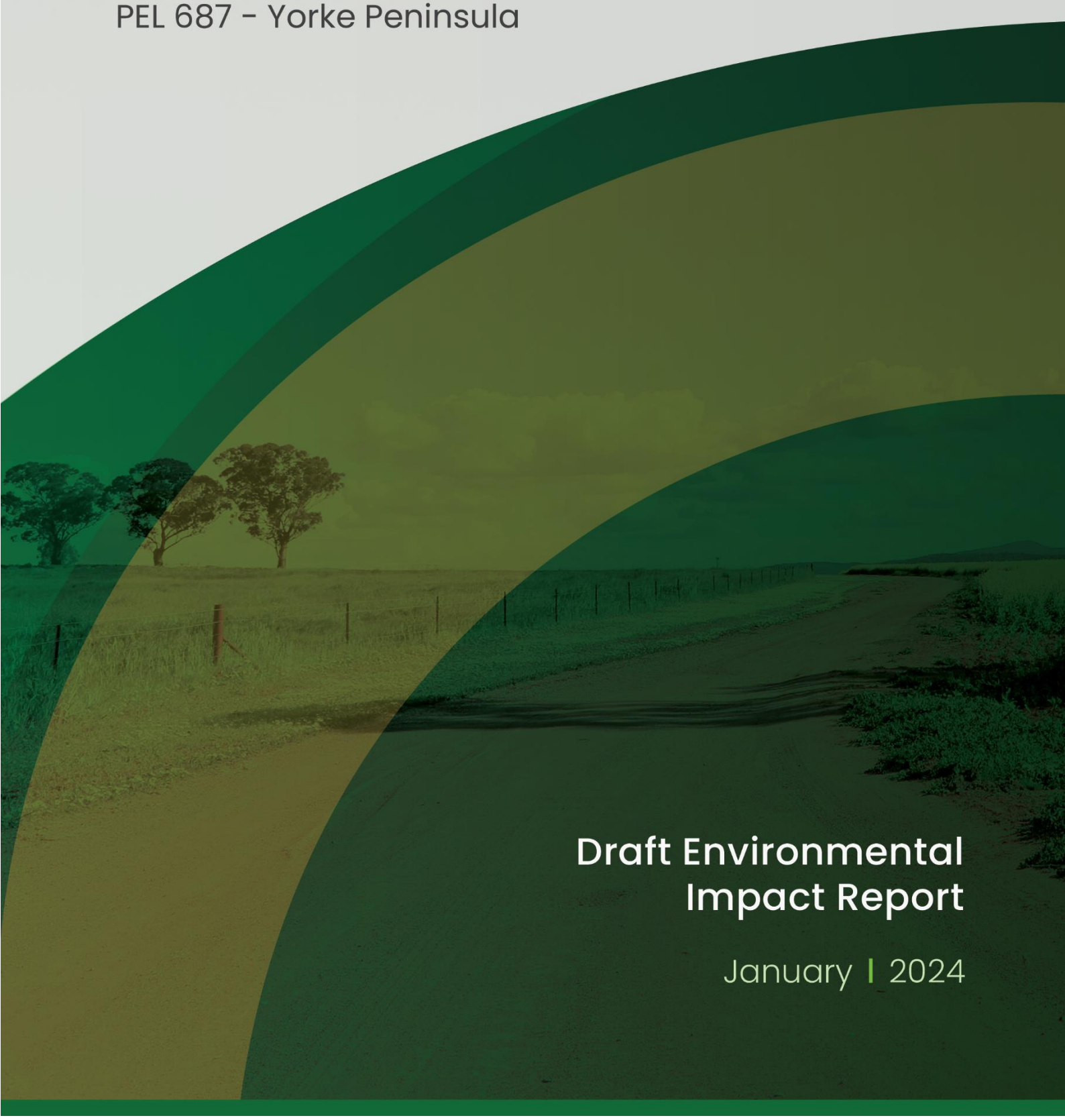
Gold Hydrogen

Natural Hydrogen Exploration
Low impact on-road geophysical activities

PEL 687 - Yorke Peninsula



Draft Environmental Impact Report

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Summary

Gold Hydrogen Ltd (Gold Hydrogen) is exploring for natural hydrogen generated from geological processes occurring in parts of the Earth's crust. As a replacement for carbon-based fuels, naturally occurring hydrogen (also known as 'gold' or 'white' hydrogen) offers significant cost and emissions advantages relative to other sources of hydrogen production, with the potential to be a clean, low-cost energy source into the future.

Gold Hydrogen holds Petroleum Exploration Licence (PEL) 687, which covers large sections of Yorke Peninsula and Kangaroo Island. This Environmental Impact Report (EIR) has been prepared under the *Petroleum and Geothermal Energy Act 2000* to cover geophysical operations in the Yorke Peninsula component of PEL 687.

Background

PEL 687 covers known occurrences of natural hydrogen on Yorke Peninsula and Kangaroo Island which were discovered during the 1920s and 1930s during hydrocarbon exploration activities, including at the Minlaton Oil Syndicate Bore 1 (also known as Ramsay Oil Bore 1) east of Minlaton.

Gold Hydrogen's exploration program (the 'Ramsay Project') aims to initially validate the natural hydrogen occurrences of the 1920s and 1930s and prove that natural hydrogen is present within PEL 687 on Yorke Peninsula; and demonstrate that natural hydrogen is present in sufficient volumes to be extracted for commercial use.

Gold Hydrogen's recently completed two well exploration program confirmed the presence of natural hydrogen and helium in the Ramsay Project area. The next stage of the project (and the subject of this document) is to acquire seismic survey data to identify other areas in the permit to conduct further exploration drilling.

Scope

This EIR and the accompanying SEO cover activities involved with geophysical operations using existing roads within PEL 687 on Yorke Peninsula. These activities would have minimal requirements to access private land[1].

The following are excluded from the scope of these documents:

- the portion of PEL 687 located on Kangaroo Island
- activities in reserves established under the *National Parks and Wildlife Act 1972* or exploration activities immediately adjacent to a Marine Park established under the *Marine Parks Act 2007.*

A number of other areas that would specifically be avoided by Gol Hydrogen's exploration activities were identified in Gold Hydrogen's drilling EIR (Gold Hydrogen 2023). These would also be avoided by the proposed geophysical operations. These include Wardang Island Indigenous Protected Area, Native Vegetation Heritage Agreement areas, land where access has not been agreed with the landowner,

[1] There may be occasions where access to private land is required, subject to landowner approval (e.g. to re-use the existing laydown used for the Ramsay 1 and 2 drilling program, or to place receivers on private land (if required)). Gold Hydrogen may also approach landowners with whom they have a relationship about the potential to record data along a short seismic line on their land. Gold Hydrogen has consulted landowners where survey activities may be undertaken on their property for the initial survey. Any access to private land would be subject to access agreement with the landowner.

land in close proximity to towns or sensitive receptors, areas of high-quality native vegetation, significant wetland areas and areas of identified cultural heritage significance.

Land Use and Environment

Yorke Peninsula is one of Australia's most important primary production regions. Agriculture is the dominant land use, mainly comprising broadacre cropping of wheat, barley, lentils and canola and sheep farming. Yorke Peninsula is also a popular holiday destination, particularly over the warmer months. Tourist attractions include beaches, coastal towns and national parks. Other land uses include conservation, mining and renewable energy generation.

Yorke Peninsula is characterised by an undulating plain of generally low relief. Soils mainly consist of loam over clay, shallow calcrete or calcareous loams. There is very little drainage definition and many surface water catchments terminate in landlocked saline lakes, which are particularly common near the west coast and in the south of the Peninsula.

Groundwater is used for stock and domestic supply across southern Yorke Peninsula in areas where salinity levels are suitable. Groundwater in shallow aquifers is generally brackish, except in the south-west, where fresh groundwater is found. Deeper aquifers are generally brackish to saline. Depth to groundwater is typically over 20 m in the central and eastern part of PEL 687, but is much closer to the surface along the west coast and in the area south and west of Minlaton and Yorketown.

There has been widespread native vegetation clearance across the peninsula and the majority of PEL 687 is cleared agricultural land. Large tracts of vegetation occur only in the south-west of the PEL, with native vegetation elsewhere typically present as isolated patches in paddocks and on roadsides. A number of threatened flora and fauna species have been recorded in PEL 687, and are generally associated with areas of remnant vegetation or the coast.

Maitland is the largest population centre within PEL 687. Other population centres include Price, Ardrossan, Port Victoria, Port Vincent, Stansbury, Minlaton, Yorketown, Coobowie, Edithburgh, Warooka, Point Turton and Marion Bay. There are also numerous localities with smaller permanent populations.

The Yorke Peninsula component of PEL 687 is located on the traditional lands of the Narungga people. Archaeological evidence of their ties to the land and water is recorded in numerous entries for Aboriginal heritage within the area of PEL 687 in the central archives (including the Register of Sites and Objects) administered by Aboriginal Affairs and Reconciliation.

The licence area on Yorke Peninsula is within the area of the Narungga Nation native title claim. This claim was determined in March 2023 by agreement with the State and recognises the claimants as native title holders for native title land in the claim area.

Environmental Impact Assessment

This EIR assesses the potential impacts posed by hazards that may result from geophysical operations using existing roads. The risk assessment contained in this EIR indicates that potential impacts are generally short-term and localised, the level of risk is generally low, and the activities can be adequately managed to prevent unacceptable environmental impacts. In particular:

- Potential impacts to land use and property management are expected to be very limited for the proposed operations, as they will utilise existing roads and tracks and will have minimal requirement to access to private land. If access to private land is required, consultation with landowners would be undertaken to ensure that the location, management and timing of

activities minimise the potential for impact. Land access agreements would be agreed and put into place before any activities are undertaken on private land.

- A traffic management plan would be developed in consultation with the relevant road authority to ensure that road hazards from operation of slow-moving survey vehicles on public roads is appropriately managed. Impacts from survey-related transport movements (e.g. mobilisation) would generally be short-term.
- Operation of vibroseis units would not impact the surface of the road. On sealed roads, measures such as the use of rubber mats between vibroseis plates and the bitumen surface would be implemented to ensure there is no damage. Similar surveys have previously been carried out on public roads without damage to the road surface.
- The proposed activities will not impact native vegetation. Impacts to native fauna from disturbance or vehicle collisions are likely to be relatively insignificant due to the existing presence of road traffic, the short-term nature of the activities and the limited extent of significant fauna habitats.
- The potential for impact to cultural heritage is expected to be very low for the proposed operations as they will utilise existing roads and tracks and will have minimal requirement to access to private land. Consultation would be carried out with the Narungga Nation Aboriginal Corporation if activities are located in areas where there is potential to impact cultural heritage, and a cultural heritage survey would carried out if required.
- The potential for spills or leaks of fuels, oils or chemicals would be mitigated by implementing appropriate storage and handling of fuel and chemicals, use of appropriate secondary containment and immediate clean-up and remediation of any spills.

A range of management measures that will be implemented are listed in the EIR and will be incorporated into the accompanying Statement of Environmental Objectives.

Stakeholder Consultation

Gold Hydrogen is committed to early, genuine and transparent engagement with the Yorke Peninsula community. Gold Hydrogen takes seriously its responsibility to provide the community with timely, accurate, accessible information and opportunities to learn more about natural hydrogen and the proposed exploration activities in PEL 687.

Gold Hydrogen has undertaken extensive stakeholder consultation regarding its activities to date. This has included broad engagement during the development of Gold Hydrogen's drilling EIR and SEO and focused engagement before and during the recently completed two well exploration program in the Minlaton / Port Vincent area. Targeted consultation regarding proposed geophysical operations using existing roads is being undertaken with Yorke Peninsula Council and the Department for Infrastructure and Transport.

Drafts of this EIR and the accompanying SEO will be made available on Gold Hydrogen's website for a period of public comment. The EIR and SEO will be updated in response to this phase of engagement and then formally submitted to DEM for further review and consultation under the formal PGE Act consultation process.

Gold Hydrogen is confident that with the implementation of the management measures outlined in the EIR, the proposed exploration activities do not present a significant level of environmental risk.

1. Introduction

Gold Hydrogen Ltd (Gold Hydrogen) is operator and 100% working interest owner of Petroleum Exploration Licence (PEL) 687, which covers large sections of Yorke Peninsula and Kangaroo Island (refer Figure 1-1).

Gold Hydrogen is exploring for natural hydrogen generated from geological processes occurring in parts of the Earth's crust. As a replacement for carbon-based fuels, naturally occurring hydrogen (also known as 'gold' or 'white' hydrogen) offers significant cost and emissions advantages relative to other sources of hydrogen production, with the potential to be a clean, low-cost energy source into the future. As part of this exploration process, Gold Hydrogen is planning to conduct geophysical operations to obtain seismic data to help identify areas of interest for further activities.

Exploration for natural hydrogen is regulated under the *Petroleum and Geothermal Energy Act 2000* (PGE Act). This Environmental Impact Report (EIR) has been prepared to cover exploration geophysical surveys (seismic surveys) for natural hydrogen carried out using existing roads in the Yorke Peninsula component of PEL 687.

1.1. Background

Gold Hydrogen's PEL 687 covers known occurrences of natural hydrogen on Yorke Peninsula and Kangaroo Island which were discovered during the 1920s and 1930s during hydrocarbon exploration activities.

Historically, oil and gas exploration activities were undertaken on Yorke Peninsula in the 1930s by entrepreneurial drilling syndicates which were often funded by local farmers. In 1931 the Minlaton Oil Syndicate Bore 1 (Ramsay Oil Bore 1) was drilled and high levels of hydrogen were detected in gas samples, later determined by laboratory analysis to be approximately 80% at depths of up to 500m (refer Plate 1-1 and Plate 1-2).

Plate 1-1: Location of Ramsay Oil Bore 1

Plate 1-2: Collecting gas from the Ramsay Oil Bore 1 near Minlaton in 1931
(Source: SADEM photograph N001671).

Gold Hydrogen commenced exploration for natural hydrogen in 2023 and has undertaken the following activities:

- **Airborne gravity-magnetic surveys of PEL 687**, undertaken in March-April 2023 to measure and capture natural variations in the strength and other characteristics of the Earth's gravity and magnetic fields. This information will assist Gold Hydrogen geoscientists to understand the subsurface geological structures in the PEL 687 licence area.
- **Non-invasive soil gas surveys** carried out by Gold Hydrogen and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in the southern portion of Yorke Peninsula in April 2023. These surveys were designed to detect very small amounts (parts-per-million) of natural hydrogen in near-surface soil, generated from various geological processes that could be occurring in parts of the Earth's crust.
- **Exploration well drilling**. Gold Hydrogen plans to drill up to five exploration wells[2], with the first two wells, Ramsay-1 and Ramsay-2, drilled in October-November 2023.

Gold Hydrogen's recently completed two well exploration program confirmed the presence of natural hydrogen and helium in the Ramsay Project area. Based on the results of these wells, additional geophysical operations are now required to delineate additional areas of interest within PEL 687.

The next stage of the project (and the subject of this document) is to acquire seismic survey data using existing roads, to identify other areas in the permit for undertaking further exploration drilling.

1.2. Gold Hydrogen Company Profile

Gold Hydrogen is an ASX-listed company focused on the discovery and development of world class natural hydrogen gas in a potentially extensive natural hydrogen province in South Australia. Gold Hydrogen is headquartered in Brisbane, Queensland.

The combined natural hydrogen permit area of the Gold Hydrogen group is approximately 75,332 km^2. Gold Hydrogen holds one granted petroleum exploration licence (PEL 687) and its two 100% owned subsidiary companies (White Hydrogen Australia and Byrock Resources) hold an additional seven applications for natural hydrogen exploration licences within South Australia.

Gold Hydrogen is also the preferred applicant for four gas storage exploration licence applications (GSELA) covering an additional 8,107 km^2 within the renewable energy zone of PEL 687 of the Yorke Peninsula region of South Australia.

[2] Detail on exploration drilling activities is provided in Gold Hydrogen (2023) *Natural Hydrogen Exploration Drilling and Well Testing, PEL 687 - Yorke Peninsula Environmental Impact Report, August 2023.*

Figure 1-1: Location of PEL 687 on Yorke Peninsula

1.3. About this Document

This document has been prepared to satisfy the requirements of an EIR under the PGE Act. It has been prepared in accordance with current legislative requirements, in particular Section 97 of the Act and Regulation 10 of the *Petroleum and Geothermal Energy Regulations 2013*.

Table 1-1 gives a brief outline of the content and structure of each section of this EIR.

Table 1-1: Environmental Impact report outline

Section	Title	Content
1	Introduction	• Introduces the purpose and format of this document • Provides background, resource and operations information
2	Legislative Framework	• Provides a brief description of the relevant legislation and the assessment and approval process
3	Description of Activities	• Describes proposed activities in detail
4	Description of the Environment	• Describes the existing physical, biological and social environment of PEL 687 on Yorke Peninsula
5	Environmental Impact Assessment	• Outlines the environmental assessment methodology and results of environmental impact assessment
6	Environmental Management Framework	• Outlines Gold Hydrogen's management system and relevant management strategies
7	Stakeholder Consultation	• Documents Gold Hydrogen's consultation approach and activities undertaken for development of the EIR and SEO
8	References	• Lists reference material used in the preparation of this document
9	Abbreviations and Glossary	• Lists definitions of abbreviations and terms used in this document
Appendix A	Flora and fauna Information	• Provides a list of species listed under the *Environment Protection and Biodiversity Conservation Act 1999* and *National Parks and Wildlife Act 1972* that may occur in the region
Appendix B	Summary of issues raised – stakeholder consultation undertaken by Gold Hydrogen	• Provides details on stakeholder comments on the EIR and SEO and Gold Hydrogen responses
Appendix C	Summary of issues raised – formal PGE Act Consultation undertaken by DEM	• Provides details on stakeholder comments on the EIR and SEO and Gold Hydrogen responses

1.3.1. Scope of the EIR and SEO

This document (and the accompanying Statement of Environmental Objectives (SEO)) covers the activities that would be involved with undertaking geophysical operations using existing roads within PEL 687 on Yorke Peninsula. These activities, which are described in Section 3, would have minimal requirement to access to private land.

It is possible that additional seismic surveys involving more extensive access to private land may be required in the future (subject to landowner access agreement). This EIR (and the accompanying SEO)

would be revised to cover the scope of these future seismic surveys before they are undertaken, with further stakeholder consultation undertaken during the revision process.

The following are excluded from the scope of this EIR and the accompanying SEO:

- the portion of PEL 687 located on Kangaroo Island
- activities in reserves established under the *National Parks and Wildlife Act 1972* or exploration activities immediately adjacent to a Marine Park established under the *Marine Parks Act 2007.*

In addition, Gold Hydrogen's Environmental Impact Report for exploration drilling (Gold Hydrogen 2023) identified a number of other areas that would specifically be avoided by drilling operations. These areas, which are listed below, would also be avoided by the proposed geophysical operations (noting that the scope described in Section 3 would naturally avoid most of these areas):

- Wardang Island Indigenous Protected Area
- Native Vegetation Heritage Agreement areas (established under the *Native Vegetation Act 1991*)
- land where access has not been agreed with the landowner
- land in close proximity to towns or sensitive receptors
- areas of high-quality native vegetation and significant wetland areas
- areas of identified cultural heritage significance.

This document has been written to cover activities in a broad geographical area. As discussed in Section 2.1.4, prior to the commencement of any geophysical operations, additional operational specific and technical detail for activities for individual operational programs, including specific locations for operations must be provided to the Department for Energy and Mining (DEM) under the activity notification / approval requirements of the PGE Act, including a demonstration that the activities are covered by (and are compliant with) an applicable SEO.

2. Legislative Framework

This chapter briefly describes the legislative framework that currently applies to activities regulated under the *Petroleum and Geothermal Energy Act 2000* in South Australia.

2.1. Petroleum and Geothermal Energy Act

The legislation governing onshore exploration for natural hydrogen in South Australia is the *Petroleum and Geothermal Energy Act 2000* (PGE Act) and *Petroleum and Geothermal Energy Regulations 2013* (PGE Regulations). This legislation is administered by the DEM.

Key objectives of the legislation include:

- to create an effective, efficient and flexible regulatory system for exploration and recovery or commercial utilisation of petroleum and other regulated resources
- to minimise environmental damage from the activities involved in exploration and recovery or commercial utilisation of petroleum and other regulated resources
- to establish appropriate consultative processes involving people directly affected by regulated activities and the public generally
- to protect the public from risks inherent in regulated activities.

The Act and Regulations are objective-based rather than prescriptive. An objective-based regulatory approach principally seeks to ensure that industry effectively manages its activities by complying with performance standards that are cooperatively developed by the licensee, the regulatory authority and the community. This contrasts with prescriptive regulation where detailed management strategies for particular risks are stipulated in legislation.

Regulated resources, as defined in Part 1 of the Act, are:

- a naturally occurring underground accumulation of a regulated substance
- a source of geothermal energy, or
- a natural reservoir.

A reference in the Act to petroleum or another regulated substance extends to a mixture of substances of which petroleum or other relevant substance is a constituent part. Regulated substances as defined in Part 1 of the Act are:

- petroleum
- hydrogen sulphide
- nitrogen
- helium
- carbon dioxide
- any other substance that naturally occurs in association with petroleum; or
- any substance declared by regulation to be a substance to which the Act applies.

The PGE Regulations declare hydrogen, hydrogen compounds and by-products from hydrogen production to be regulated substances under the PGE Act.

Regulated activities, as defined in Section 10 of the Act, are:

- exploration for petroleum or another regulated resource
- operations to establish the nature and extent of a discovery of petroleum or another regulated resource, and to establish the commercial feasibility of production and the appropriate production techniques
- production of petroleum or another regulated substance
- utilisation of a natural reservoir to store petroleum or another regulated substance
- production of geothermal energy
- construction of a transmission pipeline for carrying petroleum or another regulated substance
- operation of a transmission pipeline for carrying petroleum or another regulated substance.

2.1.1. Statement of Environmental Objectives

As a requirement of Part 12 of the Act, a regulated activity can only be conducted if an approved Statement of Environmental Objectives (SEO) is in force for the relevant activity. The SEO outlines the environmental objectives that the regulated activity is required to achieve and the criteria upon which achievement of the objectives is to be determined.

The SEO is developed on the basis of information provided in an EIR (unless activities are classified as 'high impact' as discussed below in Section 2.1.3).

2.1.2. Environmental Impact Report

In accordance with Section 97 of the Act, an EIR must:

- take into account cultural, amenity and other values of Aboriginal and other Australians insofar as those values are relevant to the assessment
- take into account risks to the health and safety of the public inherent in the regulated activities
- contain sufficient information to make possible an informed assessment of the likely impact of the activities on the environment.

As per Regulation 10 of the Regulations, for the purposes of an EIR, a licensee must provide:

- a description of the regulated activities to be carried out under the licence (including their location)
- a description of the specific features of the environment that can reasonably be expected to be affected by the activities, with particular reference to the physical and biological aspects of the environment and existing land uses
- an assessment of the cultural values of Aboriginal and other Australians which could reasonably be foreseen to be affected by the activities in the area of the licence, and the public health and safety risks inherent in those activities (insofar as these matters are relevant in the particular circumstances)
- if required by the Minister – a prudential assessment of the security of natural gas supply

- a description of the reasonably foreseeable events associated with the activity that could pose a threat to the relevant environment, including information on:
  - events during the construction stage (if any), the operational stage and the abandonment stage
  - events due to atypical circumstances (including human error, equipment failure or emissions, or discharges above normal operating levels)
  - information on the estimated frequency of these events
  - an explanation of the basis on which these events and frequencies have been predicted
- an assessment of the potential consequences of these events on the environment, including information on
  - the extent to which these consequences can be managed or addressed
  - the action proposed to be taken to manage or address these consequences
  - the anticipated duration of these consequences
  - the size and scope of these consequences and
  - the cumulative effects (if any) of these consequences when considered in conjunction with the consequences of other events that may occur on the relevant land (insofar as this is reasonably practicable); and
  - an explanation of the basis on which these consequences have been predicted
- a list of all owners of the relevant land
- information on any consultation that has occurred with the owner of the relevant land, any Aboriginal groups or representatives, any agency or instrumentality of the Crown, or any other interested person or parties, including specific details about relevant issues that have been raised and any response to those issues, but not including confidential information.

2.1.3. Environmental Significance Assessment and SEO Consultation Requirements

The EIR is submitted to DEM and an Environmental Significance Assessment is undertaken in accordance with criteria established under Section 98 of the Act[3], to determine whether the activities described in the EIR are to be classified as 'low', 'medium' or 'high' impact. Following this classification, a corresponding SEO is prepared, reflecting the impacts and measures identified in the EIR or other assessments that may be required as determined by the classification. The SEO will outline the environmental objectives that must be achieved and the criteria on which achievement of the objectives is to be assessed.

The classification also determines the level of consultation DEM will be required to undertake prior to approval decisions being made on the SEO as follows:

- **Low impact activities** do not require public consultation and are subjected to a process of internal government consultation and comment on the EIR and SEO prior to approval.

[3] Criteria for classifying the level of environmental impact of regulated activities are published on the DEM website: https://www.energymining.sa.gov.au/industry/energy-resources/regulation/approvals-process#classification

- **Medium impact activities** require a public consultation process for the EIR and proposed SEO, with comment sought for a period of at least 30 business days.
- **High impact activities** are required assessment and consultation under an environmental impact statement (EIS) under the impact assessed development provisions of the Planning, Development and Infrastructure Act 2016. An SEO for high impact activities must be prepared on the basis of this EIS.

The level of impact of a particular activity is assessed on the basis of the predictability and manageability of the impacts on the environment. Where the environmental impacts are predictable and readily managed, the impact of the activity is considered low. Where the environmental impacts are less predictable and are difficult to manage, the impact of the activity is potentially high.

Once the approval process is complete, all documentation, including this EIR and its associated SEO, must be entered on an environmental register. This public Environmental Register is accessible to the community from the DEM website.

2.1.4. Activity notification / approval process

Prior to commencing a regulated activity, Section 74(3) of the PGE Act requires that:

- The Minister's prior written approval is required for activities requiring high level official surveillance (as per Regulation 19), and
- Notice of activities requiring low level official surveillance is to be given at least 21 days in advance (as per Regulation 18).

The proposed activities would fall in the high-level official surveillance category (as all new licensees are initially high-level official surveillance operators for all activities).

In order to obtain written approval for activities requiring high level official surveillance, an application and notification of activities (in accordance with Regulation 20) must be submitted to the Minister at least 35 days prior to the commencement of activities.

The notification of activities must provide specific technical and environmental information on the proposed activity and include an assessment to demonstrate that it is covered by an existing SEO.

This activity notification and approval process is often referred to as Stage 3 of the approval process under the PGE Act, as it follows licensing (Stage 1) and the EIR and SEO approval process (Stage 2).

The Stage 3 activity notification and approval process provides an additional opportunity for DEM to ensure that the proposed activities and their impacts can be effectively managed and are consistent with the approvals obtained in the EIR and SEO approval process. This is particularly relevant for activities that are conducted under an SEO that applies to a broad geographical area, as it provides site-specific detail that is not usually contained in the generic documents.

The site-specific detail provided would include an environmental assessment report which provides details on site-specific issues and their management and details how the proposed activities will meet the requirements of the approved SEO.

2.2. Other Legislation

A variety of legislation applies to exploration activities. Legislation that is particularly relevant to exploration is listed below (note that this is not a comprehensive list of all applicable legislation) and additional detail on key legislation is provided following the list.

Commonwealth

Aboriginal and Torrens Strait Islander Heritage Protection Act 1984

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

Native Title Act 1993

South Australia

Aboriginal Heritage Act 1988

Crown Land Management Act 2009

Dangerous Substances Act 1979

Environment Protection Act 1993

Explosives Act 1936

Fire and Emergency Services Act 2005

Heritage Places Act 1993

Highways Act 1926

Landscape South Australia Act 2019

Local Government Act 1999

National Parks and Wildlife Act 1972

Native Title (South Australia) Act 1994

National Trust of SA Act 1955

Native Vegetation Act 1991

Planning, Development and Infrastructure Act 2016

Radiation Protection and Control Act 2021

South Australian Public Health Act 2011

Work Health and Safety Act 2012.

Commonwealth Environment Protection and Biodiversity Conservation Act (EPBC Act)

Approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is required for activities that are likely to impact matters of national environmental significance including World Heritage properties, National Heritage places, Ramsar wetlands of international importance, listed threatened species and ecological communities, migratory species, Commonwealth marine areas, the Great Barrier Reef Marine Park, nuclear actions and a water resource in relation to coal seam gas development and large coal mining development.

With regard to operations in PEL 687 on Yorke Peninsula, issues that may trigger approval requirements under the EPBC Act are expected to be readily avoidable. Gold Hydrogen believes that a requirement for approval under the Act is not likely to be triggered for on-road geophysical operations.

Native Vegetation Act

Exploration activities that are approved under the PGE Act do not require approval under the *Native Vegetation Act 1991* for clearance of native vegetation, provided that they are undertaken in accordance with industry standards endorsed by the Native Vegetation Council (NVC) that are directed towards minimising impact and encouraging regrowth of any cleared native vegetation (see Regulation 15 of the *Native Vegetation Regulations 2017*).

If there are no applicable industry standards, or if it is not possible to undertake the operations in accordance with applicable industry standards, the clearance is permitted if undertaken in accordance with a management plan, approved by the NVC, that results in a significant environmental benefit, or if the person undertaking the operations makes a payment into the Native Vegetation Fund of an amount considered by the Council to be sufficient to achieve a significant environmental benefit.

On-road geophysical operations would not impact native vegetation. As noted in Section 1.3.1, Gold Hydrogen also plans to avoid undertaking other exploration activities in areas of high quality or significant remnant vegetation.

Environment Protection Act

The *Environment Protection Act 1993* imposes a general duty of care not to undertake an activity that pollutes, or might pollute, the environment unless all reasonable and practicable measures have been taken to prevent or minimise any resulting environmental harm. Environmental authorisations are required to undertake activities prescribed under the Act.

The Environment Protection Act does not apply to exploration activity undertaken under the PGE Act or to wastes produced in the course of an activity (not being a prescribed activity of environmental significance) authorised by a lease or licence under the PGE Act when produced and disposed of to land and contained within the area of the lease or licence.

Landscape South Australia Act

Drilling of a new water well (e.g. for water sourcing or groundwater monitoring) would require a permit under the *Landscape South Australia Act 2019* (Landscape SA Act). Decommissioning of a water well would also require a permit, or a formal transfer of ownership if it is left in the care and ownership of a third party. As there are no prescribed wells areas in PEL 687, a licence / allocation under this Act for extraction of groundwater is not required[4].

The Landscape SA Act and the Water Affecting Activities Control Policy (N&YLB 2020) also set out a number of water-affecting activities that must not be undertaken without a permit. These are usually avoidable by careful planning and siting of infrastructure to avoid watercourses and surface water features and maintain water flows. The Landscape SA Act also governs the control of declared pest plants and animals.

[4] Note there is also an authorisation in place under s128 of the Landscape SA Act (published in the SA Government Gazette 30 August 2001) to take groundwater for use in drilling, construction and testing of hydrocarbon exploration wells that applies in prescribed wells areas.

National Parks and Wildlife Act

The *National Parks and Wildlife Act 1972* provides for the establishment and management of reserves and the conservation of wildlife in a natural environment. There are a number of reserves established under this Act within and adjacent to PEL 687, the majority of which do not allow access for activities regulated under the PGE Act.

Gold Hydrogen does not propose to conduct activities in any reserves established under the National Parks and Wildlife Act.

Planning, Development and Infrastructure Act

The *Planning, Development and Infrastructure Act 2016* (PDI Act) has special provisions relating to activities carried out under the PGE Act and it only applies in some cases. Activities classified as 'high impact' are required to be assessed under the provisions of the PDI Act. DEM must also refer applications for production tenements or SEOs to the relevant Minister in some cases (e.g. in areas identified in Schedule 14 of the PDI (General) Regulations – refer Section 1.3.1).

Under Section 161 of the PDI Act, the Building Rules apply to some classes of building work carried out under the PGE Act (including buildings for housing / shelter and office accommodation) and building consent must be granted by the council or an appropriate accredited professional.

Aboriginal Heritage Act

The South Australian *Aboriginal Heritage Act 1988* provides protection for all Aboriginal sites, objects and remains across the state. The Act applies to all land and bodies of water and vests the powers to protect and preserve Aboriginal heritage to the Minister for Aboriginal Affairs, who is required to take such measures as are practicable for protecting and preserving Aboriginal sites, objects and remains.

Authorisation is required for any damage, disturbance or interference to Aboriginal sites, objects or remains. Penalties apply for failure to comply.

3. Description of Activities

3.1. Overview of Geophysical Operations

This section provides a general overview of geophysical operations. Section 3.2 provides more detail on the planning and operation of a geophysical survey, with specific reference to the proposed on-road operations that are the subject of this EIR.

3.1.1. Geophysical data acquisition methods

Geophysical data acquisition allows resource explorers to gather information about the location and characteristics of geological structures located beneath the earth's surface. This information is used to assist in identifying areas where hydrocarbons and other natural resources may be present.

Onshore geophysical surveys (seismic surveys) for natural hydrogen are similar to those used for hydrocarbon exploration. These predominantly utilise the principles of reflection seismology to collect geophysical data to help image geological structures below the surface. The methods are largely based around how acoustic / sound waves change their speed (velocity) and direction (reflection and refraction[5]) as they pass through different types of soil and rock. Interpretation of changes in velocity and direction of sound waves as they pass through soil and rock enables geophysicists to determine geological conditions and structures in a given survey area.

Seismic surveys require an energy source to create a sound wave on or near the earth's surface, and receivers to record the reflected waves (refer Figure 3-1).

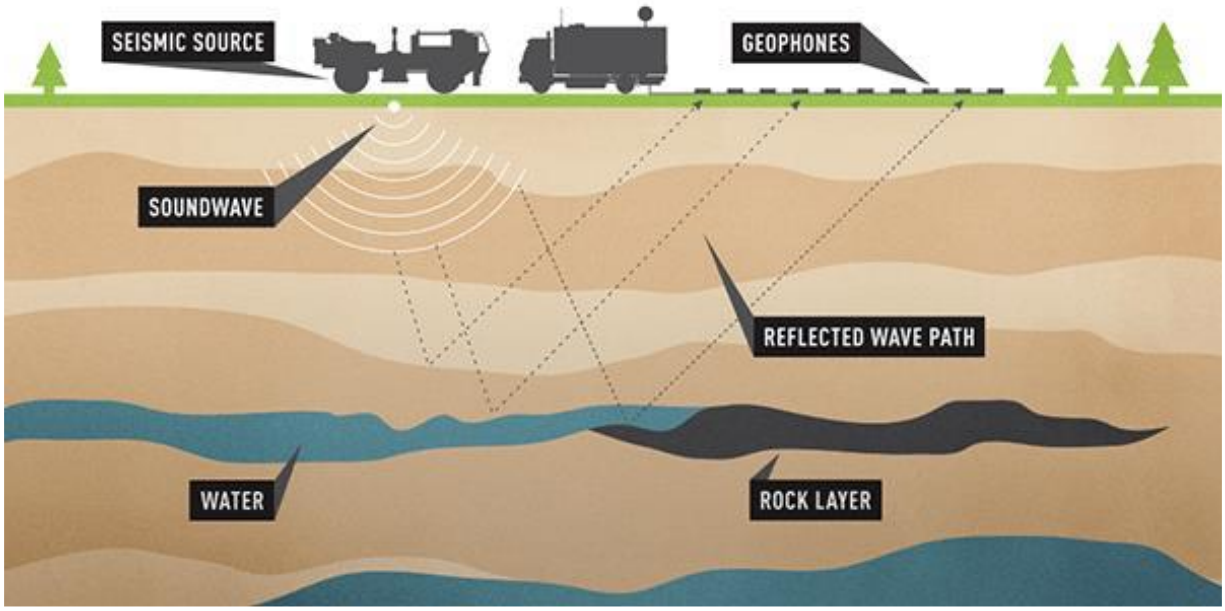


Figure 3-1: Typical onshore seismic survey outline
(Source: APPEA, 2019)

Prior to the 1970s, seismic surveys in Australia used small explosive charges placed on the surface or buried in shallow holes as the energy source to generate sound waves. Other systems to create a controlled seismic 'source point' have been developed over the years including 'vibroseis', which uses

[5] Seismic refraction is the change in direction of a sound wave as it passes from one medium to another

a vibrator on the surface to generate sound waves, and weight drop (or thumper) which uses a heavy weight dropped from a height as the energy source. Source point types are discussed further in Section 3.1.2.

The generated sound waves travel into the earth where they reflect off subsurface geological formations back to the surface. The returning sound waves are recorded by a series of sensors commonly referred to as 'receiver points'. These sensors include receivers such as geophones, accelerometers and fibre optic cables. Receiver point types are discussed in Section 3.1.3.

Source and receiver points are typically laid out in relatively straight lines or multi-line grids (commonly referred to as 'seismic lines'), however survey designs will vary with survey requirements.

The number of source points and their positions are carefully designed to improve the downward-moving sound energy, minimise the energy going in other directions, and minimise impacts to surface and subsurface environments.

3.1.2. Energy source point types

Vibroseis

Vibroseis is the most common energy source used for modern seismic surveys. The vibroseis system is a truck-mounted system that uses a large oscillating mass (vibrator) to generate acoustic waves of varying frequencies. The vibrator is typically in the form of a large retractable plate (mounted to the underside of a truck) that can be lowered to the ground with pressure applied (see Figure 3-2). The plate is applied to the ground for each vibration (source point), and then raised up as the truck moves to the next source point. Small vibrator pad marks (i.e. shallow indentations on the soil surface) may be left on soil where the vibrator pad was pressed against the ground surface. These indentions are temporary, and they typically naturally rehabilitate within a short period of time.

Vibroseis produces a low energy density, which allows it to be used in sensitive environments, cities and other built-up areas (e.g. the centre of Paris) without damaging buildings or the environment in close proximity to the energy source (APPEA, 2019). Vibroseis trucks typically use large balloon type tyres (or tracks less typically), to lower their surface pressure and footprint (see Figure 3-2).

Figure 3-2: Vibroseis trucks
(Source: Sercel, 2020)

Weight drop (or thumper)

The weight drop system is a simple method used to generate a sound wave. A heavy weight is dropped from a height of several metres onto a base plate located on the ground. When the weight contacts the base plate it generates a 'thump', which imparts a sound energy source into the ground. Weight drops are a common source used for uphole surveys (as described in Section 3.1.4). Weight drop units

are commonly mounted to a small truck or tractor type vehicle (Figure 3-3). As with vibroseis, this method can result in shallow indentations on the ground surface, which are temporary, and typically naturally rehabilitate within a short period of time.

Figure 3-3: Weight drop ('thumper') unit mounted to a tractor

3.1.3. Receiver point types

There are many types of seismic sensors (receivers), such as geophones, accelerometers and fibre optic cables. These sensors convert the extremely small returning sound waves into data that can interpreted by geophysicists. Sensors are typically installed temporarily on the surface (or downhole in some cases). Sensors are typically arranged in linear patterns along seismic lines, but arrangements vary with survey requirements (refer to Section 3.1.4). Sensors can also be installed permanently for long-term monitoring purposes.

Geophones

Geophones located on the surface are typically pushed into the soil surface using small metal spikes to ensure a firm connection with the ground. A range of geophone types are shown in Figure 3-4 and Figure 3-5. Geophones may also be partially buried in small shallow holes for improved sensitivity (Figure 3-5).

Geophones can also be installed 'downhole' in drill holes of varying depths (typically ranging from 10 m to 300 m). Downhole geophones are not being considered for the proposed geophysical operations.

Figure 3-4: Geophone types
(Source: Dean & Sweeney, 2019)

Figure 3-5: Wireless geophone ('node') with sensor installed in shallow hole

3.1.4. 2D and 3D seismic surveys

Seismic surveys can involve collection of two-dimensional (2D) or three-dimensional (3D) data. The initial on-road geophysical operations in PEL 687 will involve collection of 2D survey data. A brief overview of both methods is provided below for context.

2D seismic surveys are conducted along single seismic survey lines with source and receiver points located along the same line. The resulting data creates a simplistic two-dimensional (2D) image representative of a slice through the subsurface structures beneath a particular seismic line (see Figure 3-7).

2D seismic surveys typically involve a series of seismic lines, usually in the order of several kilometres up to 50 km in length, with spacing between lines of approximately 250 m to 5 km (see Figure 3-6). Spacing between source and receiver points along the seismic lines for 2D surveys is typically in the range of 5 m to 50 m.

The 3D methodology is similar to 2D, but instead of a single line of source and receiver points, the source and receiver points are located on dedicated source lines and receiver lines laid out in a grid pattern across a survey area (see Figure 3-6). Receiver points are laid down in parallel 'receiver lines', and the source points are laid out in perpendicular parallel 'source lines' to form a cross-hatched grid. Spacing between 3D seismic lines is typically in the order of 100 m to 400 m.

The grid arrangement of a 3D survey means that source and receiver points are spread across the entire survey area, which allows each receiver point to collect seismic reflections from multiple directions across the survey area (see Figure 3-6). This data can then be analysed to create a more detailed 3D image of the survey area subsurface (see Figure 3-7).

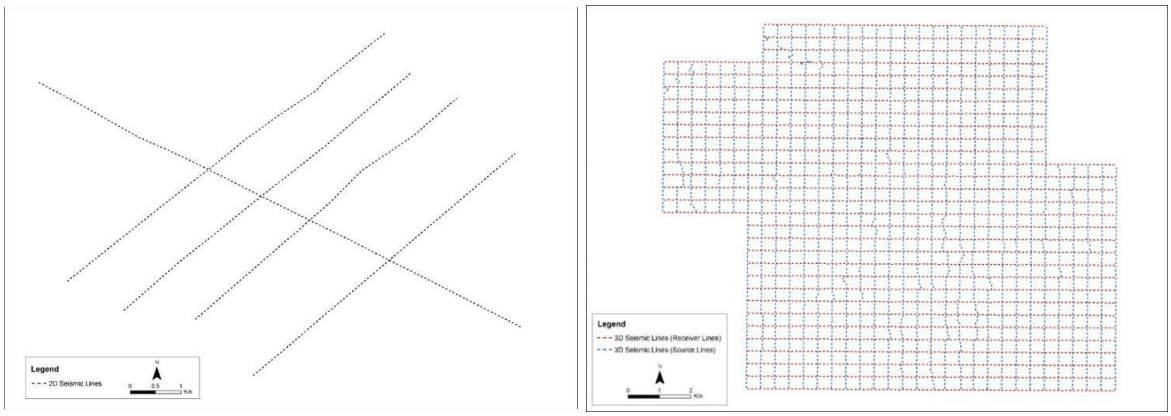


Figure 3-6: Comparison of 2D and 3D seismic survey design

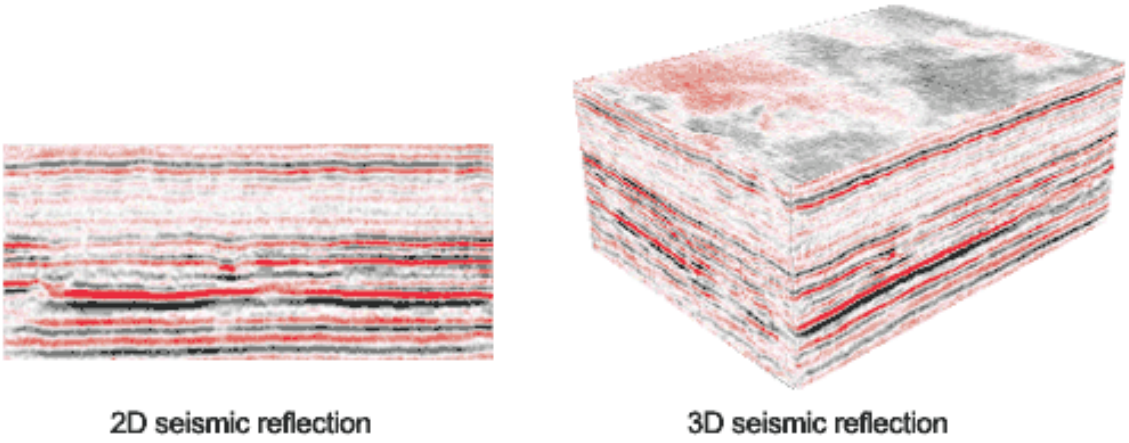


Figure 3-7: Comparison of 2D and 3D seismic survey images
(Source: Mari and Chapellier, 1999)

Geophysical operations can also involve the use of 'upholes' to record and calibrate seismic survey data. Uphole methods use geophones placed down drill holes and the energy source is typically a weight drop (as described in Section 3.1.2). Uphole surveys are not being considered for the proposed geophysical operations.

3.1.5. History of seismic surveys in the licence area

Several seismic surveys have been previously undertaken in the south-eastern portion of PEL 687 (see Figure 3-8). Three seismic lines (totalling 59 km in length) were recorded in 1982, which provided usable data (including data in the vicinity of the Ramsay Project). Seismic data was also collected by Beach Petroleum in 1966 along a number of lines which followed roads, however as this data is in the form of paper printouts, it is not useful for modern re-interpretation.

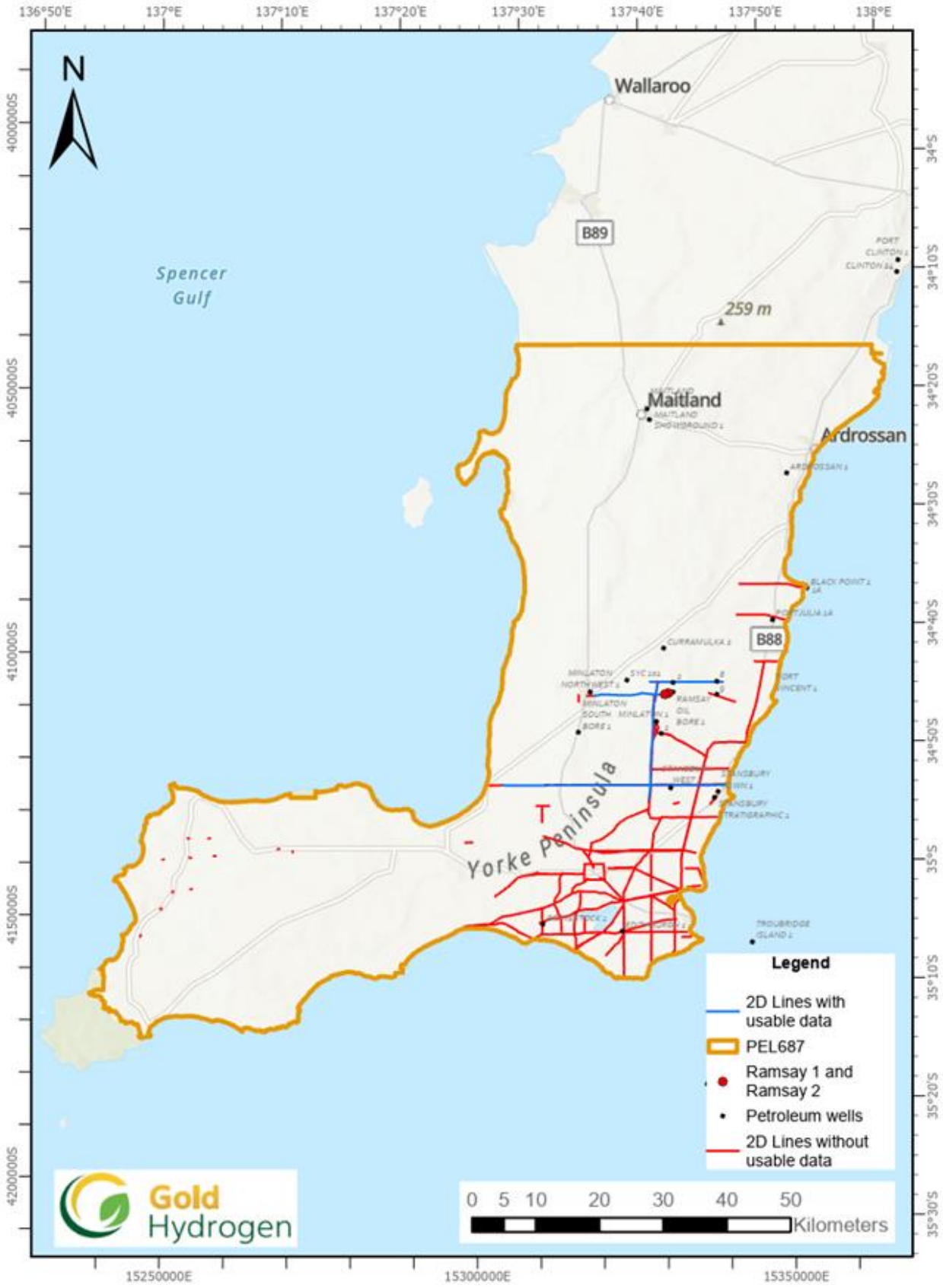


Figure 3-8: Previous seismic surveys in PEL 687

3.2. Description of Seismic Survey Planning and Operation

The following sections provide a description of the planning and operation of a seismic survey, with specific reference to the proposed operations using existing roads that are the subject of this EIR.

3.2.1. Survey Planning

Once a seismic survey program is proposed, the survey area is evaluated using a range of methods and desktop tools to identify and avoid sensitive areas and constraints. Typical desktop tools and resources include detailed maps, a Geographical Information System (GIS), satellite or aerial imagery, biological databases and spatial data for a range of infrastructure and landscape features.

The proposed locations of seismic lines are assessed and modified using desktop tools to avoid sensitive infrastructure and environments. There are limited sensitivities for a survey using existing roads, however for seismic surveys in general these would typically include high quality remnant vegetation, known cultural heritage sites, significant wetland areas, groundwater wells, stock yards and other agricultural infrastructure, buildings and houses. All potential disturbances are preferentially located to minimise impacts to sensitive locations and maximise placement in pre-disturbed areas (which is generally achieved for an on-road survey by placement of seismic lines on roads).

The survey planning phase would involve consultation with Yorke Peninsula Council and the Department for Infrastructure and Transport (DIT) and any affected landowners if access to private land is required (as discussed in Section 3.2.3). Access agreements with landowners would be agreed if access to private land is required.

A preliminary layout of seismic lines using existing roads on southern Yorke Peninsula is shown in Figure 3-9. The initial survey (planned for mid-2024) will be a subset of this layout. The layout of seismic lines would continue to be refined following ground-truthing and ongoing consultation with Yorke Peninsula Council and DIT.

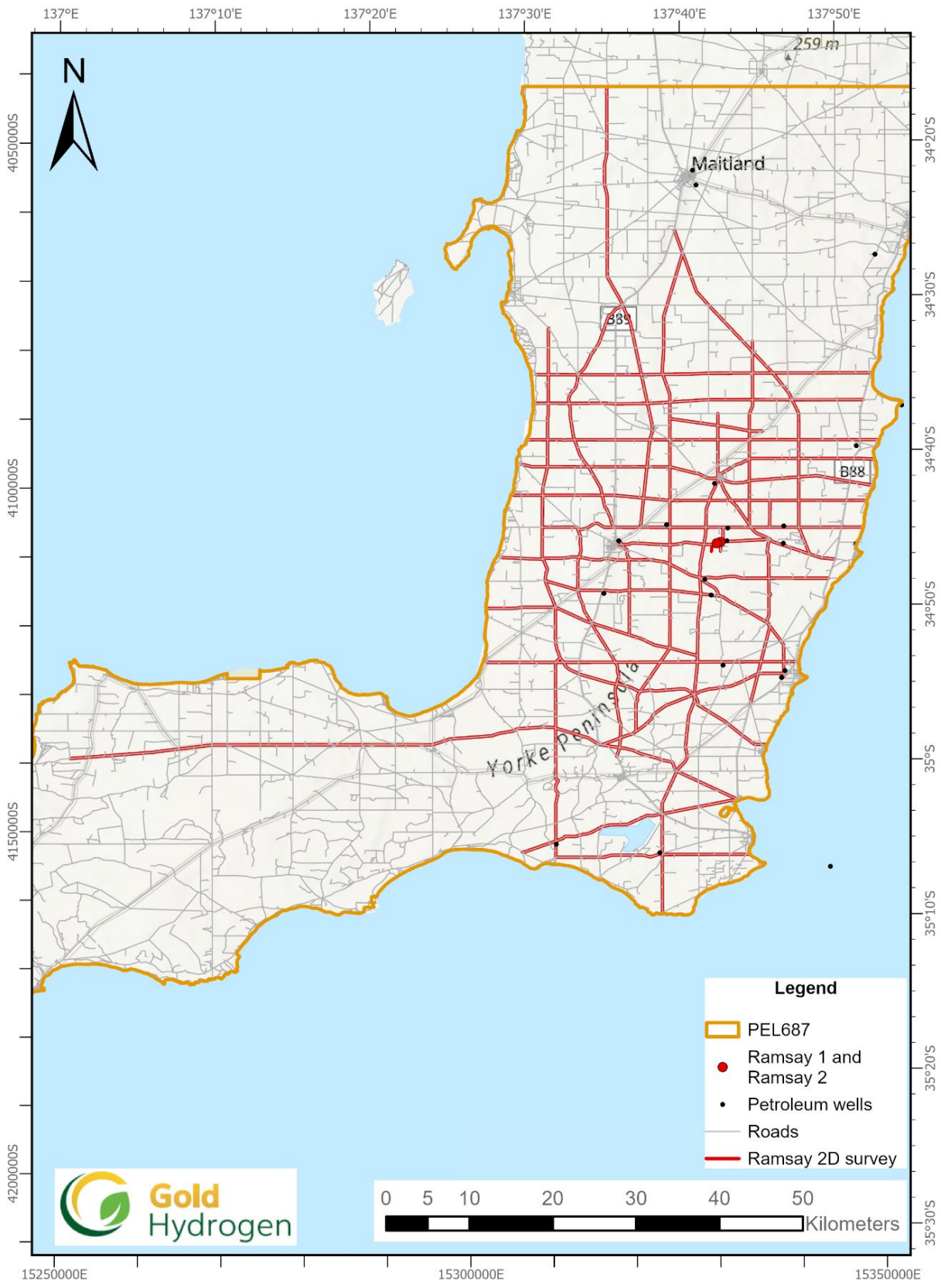


Figure 3-9: Preliminary layout of seismic lines

3.2.2. Aboriginal cultural heritage surveys

Where seismic lines traverse areas where there is potential to impact Aboriginal cultural heritage, inspections / surveys are typically carried out with the relevant Traditional Owner group in accordance with any formal agreements that are in place.

The Narungga Nation Aboriginal Corporation would be consulted if activities are located in areas where there is potential to impact cultural heritage, however as the proposed geophysical operations will use existing roads, formal cultural heritage surveys are not expected to be required.

3.2.3. Land access and seismic survey preparation activities

Light vehicles (e.g. 4WD vehicles) and vibroseis trucks / tractor require access along seismic lines in order to lay out geophones and input sound energy at source points. Vehicle access is less important for laying out receiver points (geophones) as walk-in methods can be utilised.

The proposed survey activities do not require preparation of seismic survey lines (e.g. grading, slashing of crops or vegetation) and no new access tracks would be required.

Proposed seismic lines will utilise existing roads and tracks. There may be occasions where access to private land is required, subject to landowner approval (e.g. to re-use the existing laydown used for the Ramsay 1 and 2 drilling program, or to place receivers on private land (if required)). Gold Hydrogen may also approach landowners with whom they have a relationship about the potential to record data along a short seismic line on their land. Gold Hydrogen has consulted landowners where survey activities may be undertaken on their property for the initial survey. Any access to private land would be subject to access agreement with the landowner.

3.2.4. Surveying operations

Surveying is required to ensure all source and receiver point locations are accurately recorded. It typically involves a team of field surveyors recording the location of all source and receiver points using high accuracy GPS technology. Source and receiver points are commonly referred to as ‘stations’. The location of stations may also be marked on the ground using biodegradable paint, pin flags or wooden pegs. However, mark-less systems using GPS technology are also commonly used. If pins or pegs are used, these are removed on completion of recording.

Each survey team (one to two surveyors in a 4WD light vehicle) typically makes one pass over any given section of seismic line or source / receiver station area. Field surveyors may also need to walk into sensitive areas to survey and mark stations.

3.2.5. Recording operations / data acquisition

The recording phase is the largest part of a seismic survey program in terms of personnel and vehicles required. A recording team for a 2D survey will typically consist of 20-30 personnel and 10-16 vehicles.

These numbers will vary with survey size, recording technique, terrain, season and amount of access. Vibroseis surveys require drivers and mechanics to support multiple vibroseis trucks or tractors for a weight drop system.

2D seismic operations commence with deployment of geophones. The geophones are installed into the ground by personnel on foot. In areas with harder soils, geophones may be installed using hand tools or small motorised augers to dig small holes to place geophones. As discussed above, geophone placement is typically a very low impact activity, and geophones can typically be placed in sensitive areas on foot. Seismic field crews are inducted and fully informed of all environmental requirements,

and the need to respect the rights and interests of landowners and land users. For an on-road survey, geophones would typically be installed in the road verge adjacent to the formed road surface. No access to the remnant vegetation on the roadside would be required.

Recording for 2D surveys would normally commence when sufficient geophones have been laid out. This layout is termed 'the spread' and a pre-selected 'live' section of the spread will record energy reflected from subsurface layers while source energy is being input to that area. Prior to the start of data recording, the spread and all recording systems are tested. Once the spread is live, input of the chosen source energy to the ground will commence.

Where the energy source is vibroseis, an array of one to four vibroseis trucks are typically used. The trucks are electronically synchronised to vibrate in phase with each other. The trucks line up along a source line separated by a few metres and centred on a source point. Each unit inputs one or more frequency sweeps into the ground at each source point. Each sweep lasts for only a few seconds. On completion of each source point the vibroseis trucks move to the next source point. If vibroseis trucks are operating on the sealed road surface, a rubber mat would be inserted between the vibroseis plates and the road surface to ensure there is no damage to the bitumen surface.

Where a dropped weight is used, a tractor with a large weight on the rear drives along the prepared line, stopping at set points to drop the weight. Once data collection has been confirmed by the receivers the tractor lifts the weight and moves to the next location. On sealed roads, weight drop units would operate on the road shoulder or verge.

The live spread is the only part of the survey area where data is recorded for any given source position. The live spread is moved as the vibroseis trucks or weight drop tractor move across the survey area. As sections of the spread become redundant, geophones are picked up and transported to the front end of the line. This cycle continues until the line is completed. Data recorded during this process is typically stored on internal memory modules within each geophone.

All operational vehicles stay on seismic lines. Non-operational vehicles are required to park off-line to avoid causing interference with collected data. Non-operational vehicles include light vehicles for personnel access / transport, spare vibrators, vibrator service truck (if vibroseis is used) and a recording truck (if required).

Along any single seismic line, the following vehicle passes can be expected to occur during normal operations:

- vibroseis trucks and service truck (if vibroseis is used) – one pass
- tractor and service truck (if dropped weight is used) – one pass
- recording truck – one pass (if required)
- light vehicles – 4-20 passes in total.

3.2.6. Accommodation

Gold Hydrogen successfully used local private accommodation for the recent Ramsay drilling program and this will be the preferred option for geophysical operations. It is not planned to use temporary camps on site for these operations.

3.2.7. Laydown and associated activities

A laydown area is likely to be required to support survey activities. The laydown areas used for the Ramsay 1 and 2 drilling program may be re-used (subject to landowner approval) or Gold Hydrogen may lease a suitable yard in a nearby town.

Depending on the location and size of the survey, a laydown would be used as an area to store equipment and park vehicles, allow radios and receivers to be charged overnight and act as a rendezvous point for the crew each morning prior to commencing works. A laydown area may include a transportable site office, an area for equipment maintenance and storage of fuel and lubricants, covered bins for waste storage and portable toilet facilities.

Vibroseis trucks or weight drop units would generally be refuelled in the field during recording operations, as they may not return to the laydown area at the end of each day's recording. This would typically be undertaken using a dedicated service truck with a built-in fuel pod. The service truck would be refuelled at the laydown area or at a local fuel station then driven to site at the end of each day, where the vibroseis truck would be refuelled in a safe location.

3.2.8. Rehabilitation / restoration

As the activities are low impact, requirements for active rehabilitation / restoration are expected to be minimal. Any rehabilitation / restoration activities would be undertaken in consultation with, and to the satisfaction of the road authority / landowner.

3.2.9. Monitoring and auditing

Prior to, during and subsequent to geophysical survey operations, assessments may be undertaken to ensure operations have been conducted in compliance with the SEO and applicable regulatory requirements.

4. Description of the Environment

This section provides a detailed overview of the environment within PEL 687 on Yorke Peninsula, which is taken from Gold Hydrogen's Natural Hydrogen Exploration Drilling and Well Testing EIR (Gold Hydrogen 2023).

Potential environmental impacts are discussed in Section 5.

4.1. Climate

The Bureau of Meteorology (BOM) classifies Yorke Peninsula as having a warm summer and cold winter climate, and the region is considered temperate under the Köppen classification (BOM 2023).

Climate data for Minlaton (near the centre of PEL 687) indicates that the mean daily maximum temperature ranges from approximately 15.3°C in the coolest months (June to September) to 29.6°C in the hottest months (December to February). Mean daily minimum temperatures range from between 6.8°C in the cooler months to 15.4°C in the hottest months.

Average annual rainfall at Minlaton Aero is 353.7 mm. Maximum average rainfall occurs during June and July. The highest monthly rainfall recorded is 92.0 mm, in September 2010. The highest daily rainfall event on record is 90.6 mm (in July 2021).

A summary of climate records for Minlaton Aero (Station no. 022031; BOM 2022a) is provided in Table 5-1.

Climate data for Warooka (Station no. 022018; BOM 2022a) which is in the south-west of Yorke Peninsula and has a longer period of record (162 years), show a similar pattern of temperature and rainfall, but with higher rainfall averages. The average annual rainfall for Warooka is 442.9 mm and monthly rainfall averages are also consistently higher than recorded at Minlaton Aero. The highest maximum monthly rainfall for at Warooka is 181.8 mm (recorded in February 1946).

Wind data for Warooka indicates that winds tend to come predominantly from the south and south-east during summer, and the north-west and west in winter.

Table 4-1: Temperature and rainfall records for Station # 022031 (Minlaton Aero)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Daily Max (°C)	29.6	28.5	26.6	23.4	19.4	16.3	15.3	16.3	19.1	22.6	25.9	27.8	22.6
Mean Daily Min (°C)	15.4	15.2	14.0	11.9	9.9	7.8	7.0	6.8	7.8	9.4	11.9	13.5	10.9
Mean Rainfall (mm)	15.7	18.6	14.4	25.8	40.7	49.7	46.4	45.2	33.0	26.8	20.6	17.5	353.7
Median Rainfall (mm)	9.0	10.0	9.5	23.8	44.2	46.8	42.6	47.9	29.3	23.6	15.4	12.6	354.1
Highest Rainfall (mm)	64.6	86.8	57.4	92.0	69.2	85.8	89.6	88.4	93.6	76.4	64.8	60.2	494.6

Records at Minlaton Aero (Station # 022031) commenced in 2001.

4.2. Bioregions, Landform and Soils

PEL 687 falls within the Eyre Yorke Block (EYB) bioregion as defined by the Interim Biogeographical Regionalisation for Australia (IBRA), which classifies Australia's landscapes into geographically distinct regions based on climate, geology, landform and vegetation.

Within the EYB bioregion, PEL 687 spans the Southern Yorke and St Vincent IBRA subregions and the Innes, Corny, Yorketown, Urania, Weetulta, Arthurton and Boor Plain IBRA Associations (DEW 2013). These areas are shown in Figure 4-1.

The landform of Yorke Peninsula is characterised by an undulating plain of generally low relief (Roberts 2007). It rises to approximately 244 m above sea level in the centre (near Maitland) with an average elevation of 91 m (Graham *et al.* 2001). Soils broadly consist of loam over clay, shallow calcrete or calcareous loams, with some areas of dunefields and saline land (Landscape SA Northern and Yorke 2022c). Yorke Peninsula has an extensive coastline that includes beaches, cliffs and rocky shores (Roberts 2007).

Table 4-2 summarises the landform and soil in each of the IBRA Associations.

Table 4-2: IBRA subregions and associations

IBRA Subregion	IBRA Association	IBRA Association description*
St Vincent (EYB02)	Weetulta	Landform: A gently undulating plain with low dunes, bounded along the coastline by a complex of active dunes and former lagoons. Soil: Brown calcareous loams, brown calcareous sands, white calcareous sands, crusty red duplex soils.
	Arthurton	Landform: A gently undulating plain with gentle rises on metasediments, discontinuously overlain by sand, and with low cliffs along the coast. Soil: hard pedal red duplex soils, reddish calcareous earths, grey self-mulching cracking clays.
	Boor Plain	Landform: An undulating calcreted plain with occasional outcrops of bedrock, and a complex of dunes, salt lakes and mangrove flats along the coastline. Soil: Reddish calcareous loams, whitish calcareous sands, black non-cracking plastic clays, crusty red duplex soils.
Southern Yorke (EYB01)	Urania	Landform: A calcreted plain with low rises and tracts of dunes. The coastline is backed by low cliffs or a complex high dunes and salt lakes. Soil: Friable red loams with rough-ped fabric, reddish calcareous earths, brown sands, whitish calcareous sands, grey calcareous loams.
	Yorketown	Landform: An undulating to hilly plain on tillite and calcrete with numerous salt lakes and sand dunes. Soil: Reddish calcareous loams, grey calcareous loams, brownish sands, sandy pedal mottled-yellow duplex soils, whitish calcareous sands.
	Corny	Landform: An undulating to hilly plain, with sand dunes, swamps and low cliffs along the coastline. Soil: Red friable loams with rough-ped fabric, whitish siliceous sands, grey calcareous loams, whitish calcareous sands.
	Innes	Landform: A sandy undulating plain, with dunes and salt lakes or low cliffs along the coastline. Soil: Whitish calcareous sands, brown friable loams with rough-ped fabric, whitish siliceous sands, grey calcareous loams.

*Source: DEW (2013), Laut et al. (1977)

Figure 4-1: IBRA subregions and associations in PEL 687

4.3. Surface Water

Yorke Peninsula has very little drainage definition and many surface water catchments terminate in landlocked saline lakes (N&Y NRMB 2009). The most prominent drainage outlet is the ephemeral Winulta Creek (Roberts 2007) which drains into the coastal strip north of Ardrossan. Between Ardrossan and Stansbury, a number of small ephemeral drainage lines flow from elevated near-coastal areas to Gulf St Vincent. The largest of these is Pavy Creek (located south of Ardrossan).

Small farm dams are used to collect surface water in some areas on the peninsula, mainly in the more elevated and undulating areas in the north.

Saline lakes are common near the west coast and in the south of Yorke Peninsula, and are a prominent landscape feature in the area around Minlaton and Yorketown. These lakes range in size from less than a hectare to over 900 hectares. The larger lakes are located south and west of Yorketown and include Lake Fowler, Diamond Lake and Dhalliwanggu - Lake Sunday.

There are no wetlands of international importance (listed under the Ramsar convention in PEL 687. Three identified wetlands of national significance in PEL 687 (Landscape SA Northern and Yorke 2023):

- Gum Flat, adjacent to Minlaton, which contains the only remaining seasonally flooded River Red Gum forest on Yorke Peninsula
- Native Hen Lagoon, north of Yorketown, which is a linear wetland fringed by remnant South Australian Swamp Paper-bark
- Clinton, in the north-east of PEL 687, which consists of a mangrove/samphire estuarine area with many large tidal channels fringed by mangroves.

Figure 4-2 shows the main surface water features within PEL 687.

Figure 4-2: Surface water features in PEL 687

4.4. Geology

4.4.1. Regional setting

PEL 687 on Yorke Peninsula is covered by the geological basins outlined in Table 4-3.

Table 4-3: Geological basins of PEL 687 on Yorke Peninsula

Name	Geological eon / era	Geological period	Age (millions of years)	Relevance to hydrogen prospectivity
St Vincent Basin	Cenozoic	Tertiary and Quaternary	55 to recent	Seal for reservoir(s)
Troubridge Basin	Late Palaeozoic	Permian	299 to 251	Seal for reservoir(s)
Stansbury Basin	Early Palaeozoic	Early to Middle Cambrian	540 to 510	Seal for reservoir(s) Cambrian Limestone reservoirs
Spencer Shelf, Torrens Hinge Zone	Neoproterozoic		1000 to 542	Source of hydrogen Massive Fractured Basement reservoir
Gawler Craton	Archaean to Mesoproterozoic		3150 to 1450	Source of hydrogen Massive Fractured Basement reservoir

Source: Rodrigues *et al.* (2021)

The Stansbury Basin covers the majority of Yorke Peninsula (see Figure 4-3). It is a sedimentary basin from the early to middle Cambrian period which extends across Yorke Peninsula, as well as Gulf St Vincent, Fleurieu Peninsula and Kangaroo Island.

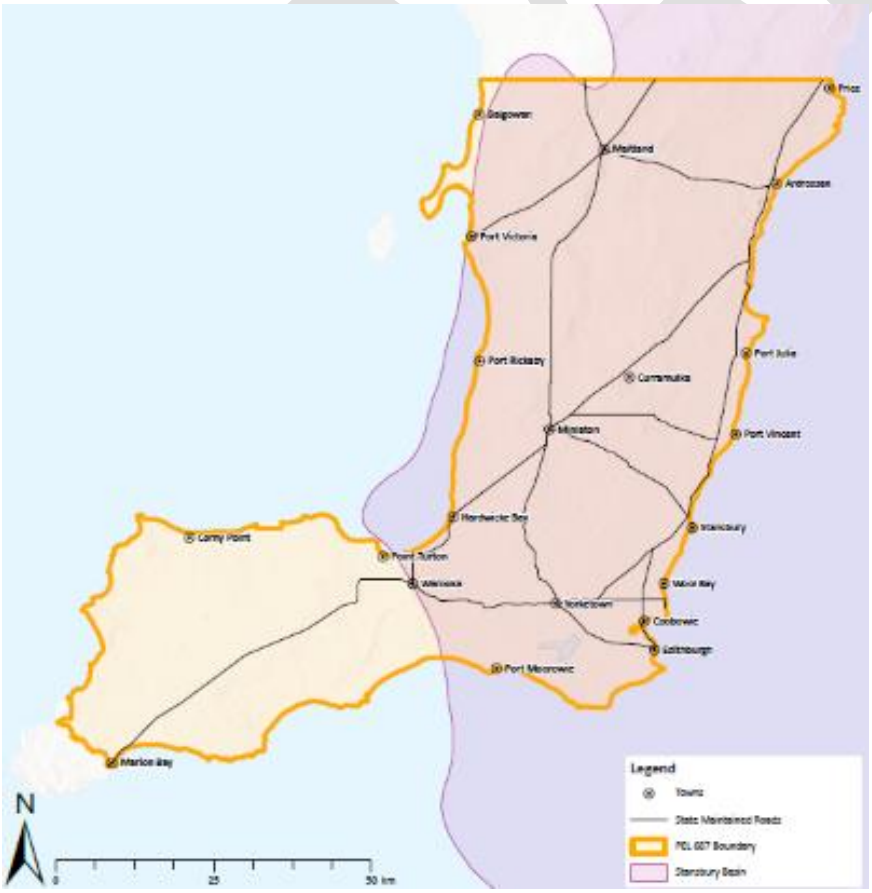


Figure 4-3: Stansbury Basin in PEL 687

Sedimentation of the Stansbury Basin was the last stage of deposition in the Adelaide Fold Belt, a belt of deep subsidence and thick sediment accumulation which began in the early Cryogenian (Neoproterozoic). The basin consists of a marginal platform in the west and the Kanmantoo Trough to the east of Gulf St Vincent. In the west, marine shelf carbonate and clastic sedimentary rocks onlap the Gawler Craton.

The Stansbury Basin overlies thick Neoproterozoic clastic and carbonate rocks of the Adelaide Fold Belt and Paleoproterozoic-Mesoproterozoic volcanic and metamorphic rocks of the southern Gawler Craton (Gravestock *et al.* 2001). It is likely that the granitic suites and metamorphosed sediments of the Neoproterozoic and older rocks could be sources for hydrogen in the region, and where fractured, they may also act as reservoirs (Rodrigues *et al*. 2021).

In the south-east of the Peninsula, the Stansbury Basin is overlain by the Troubridge Basin, which consists of the Permian sediments of the Cape Jervis Formation.

A regional structural cross-section across the Stansbury Basin is shown in Figure 4-4.

The western part of the 'foot' of Yorke Peninsula lies outside the Stansbury basin, and its geology is typified by younger (Cenozoic) sediments over Archaean / Lower Proterozoic basement.

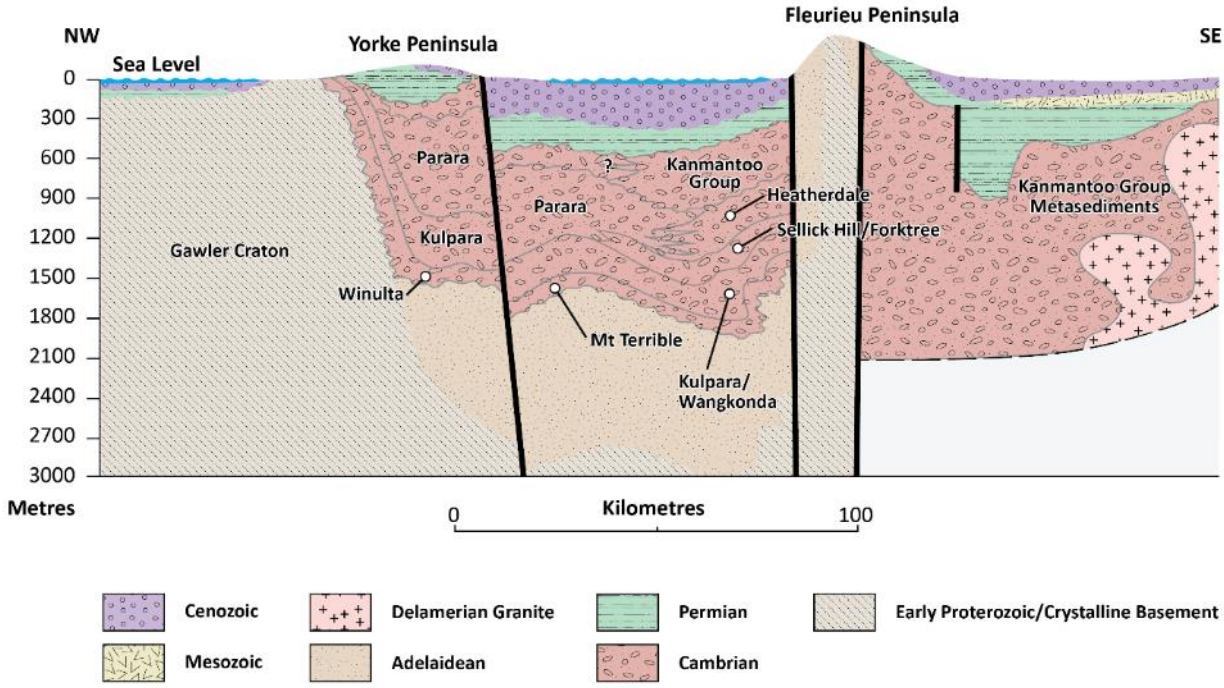


Figure 4-4: Regional structural cross-section across the Stansbury Basin (after SADME 1986)
(Note: Formation names have been shortened).

4.4.2. Yorke Peninsula

The surface geology of Yorke Peninsula is characterised by Quaternary sediments, described as aeolian sand and lacustrine sediments where lagoons / lakes are present (Alcoe and Berens 2011). Towards the centre and north of the licence area, there are several outcrops of Cambrian limestone and remnants of the Proterozoic Arthurton granite. The Permian age Cape Jervis Formation is exposed in the south-east of the Peninsula (Normington *et al*. 2018).

Figure 4-5 provides an overview of the stratigraphy of the Stansbury Basin on Yorke Peninsula. The Cambrian succession of sediments is divided into two sequences. The older sequence (C1) is a

carbonate-dominated succession, formed by the Kulpara Formation, Parara Limestone and Koolywurtie Member. The second sequence (C2) is formed by fan-delta conglomerates (Minlaton Formation) followed by transgressive-regressive shallow marine limestone alternating with sandstone and shale (Ramsay Limestone, Corrodgery Formation, Stansbury Limestone, Moonan Formation and Coobowie Limestone). Intertidal sands of the Yuruga Formation are the youngest Cambrian sediments preserved beneath the Permian unconformity.

The western Stansbury Basin on Yorke Peninsula contains complex fault-block mosaics associated with the Pine Point Fault Zone, which was tectonically active during the Early Cambrian (DEM 2023). These complex fault-block mosaics are evident in Figure 4-6. The overlying Permian age Cape Jervis Formation is also evident in the south-eastern part of Yorke Peninsula in this cross-section.

Thick micritic Lower Cambrian Parara Limestone and the upper Lower Cambrian Minlaton Formation are considered to be sealing lithologies[6] of the proven dolomite hydrocarbon reservoir of the underlying Kulpara Formation (Rodrigues *et al.* 2021, DEM 2023). A regional seal was once provided by thick red beds of the Yuruga Formation, but Permian glacial topography may have locally breached some traps (DEM 2023).

In the northern part of the PEL and in the south-west the depth to the crystalline basement[7] ranges from approximately 0-100 m, while depth to basement gradually increases towards the south and south-east, reaching depths of up to approximately 2,500 m. The south-east area of the peninsula where high depths to basement are inferred follows an approximate NE-SW direction, which is shared with the strike direction of several inferred faults, including the Pine Point Fault.

Geology of the crystalline basement in the north of the PEL mostly correspond to granites of the Hiltaba Suite (including the Arthurton Granite) and gneiss and schists of the Wallaroo Group. In the south-west of the PEL, the geology of the crystalline basement is mostly represented by gneissic granite and granodiorite of the Lincoln complex (Paleoproterozoic rock of the Gawler Craton).

[6] The Parara Limestone is also classified as an aquifer from a groundwater perspective by Alcoe and Berens (2011). It is described as blue-grey nodular limestone, minor mottled argillaceous limestone and thin calcareous shale, which suggests that this unit is in general of relatively low permeability but heterogeneous, with shale and other extremely low permeability layers potentially acting as seals. DEM (2023) describe the Parara Formation as 'lime mud', again suggesting that it would have relatively low permeability and supporting the statement that it would be an effective seal in conjunction with the Minlaton Formation for the hydrocarbon reservoir in the underlying Kulpara Formation. According to Water Connect, four observation / stock / irrigation / industrial wells located near Curramulka are listed as being screened in the Parara Limestone, suggesting that some parts of the unit may have some aquifer potential. There is, however, little data available on Yorke Peninsula to conclusively determine how extensively it acts as an aquifer versus as a seal.

[7] 'Basement' is generally used to indicate igneous and metamorphic rocks, usually older than Cambrian in age, that lie below a cover of sedimentary rocks

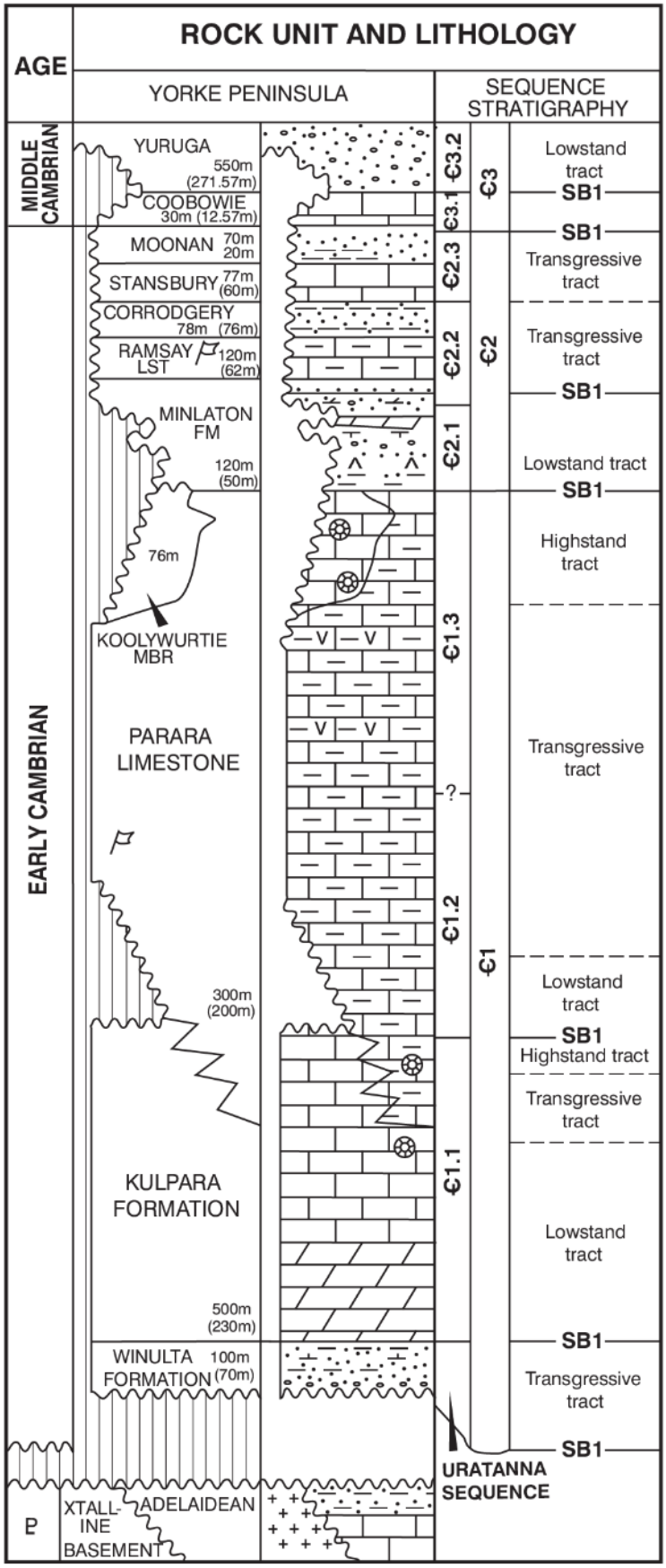


Figure 4-5: Stratigraphy of the Stansbury Basin beneath Yorke Peninsula
(Source: DEM 2023).

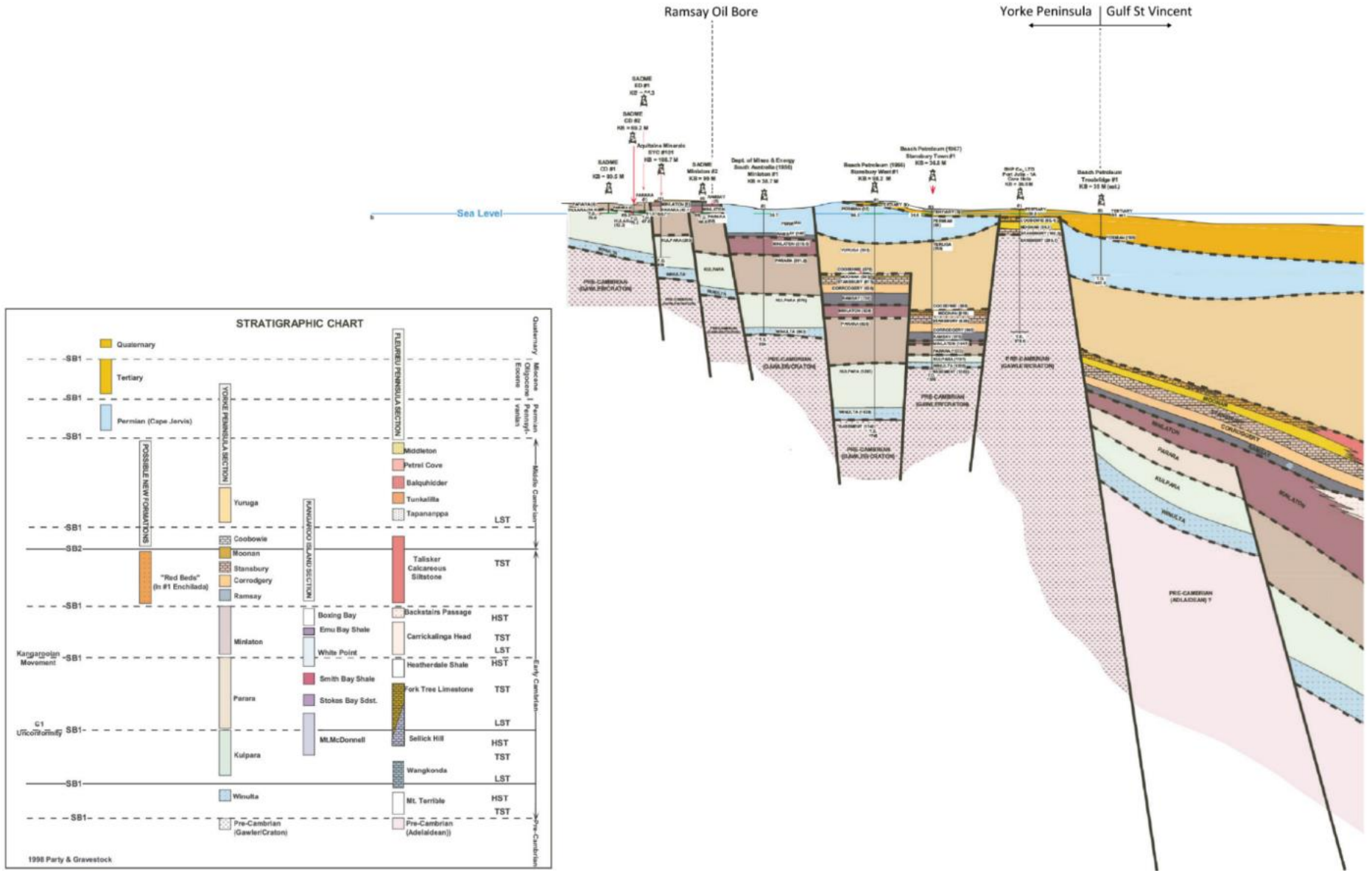


Figure 4-6: Geological cross-section - Stansbury Basin on Yorke Peninsula showing historic wells between Minlaton and Troubridge Island
(Source: DEM 2023).

4.5. Hydrogeology

4.5.1. Overview

Groundwater resources on Yorke Peninsula are mostly limited to the south of the peninsula, in undifferentiated Quaternary sediments and the Pleistocene Bridgewater Formation. Groundwater in these shallow aquifers is generally brackish, except in the south-west of the peninsula, where fresh groundwater is found. The Bridgewater Formation is used for stock and domestic supply across southern Yorke Peninsula in areas where salinity levels are lower. It was also used to supply water to Warooka and Point Turton before a pipeline connection to SA Water's River Murray water supply network was constructed in 2018 (SA Water 2018).

The northern part of PEL 687 consists of undifferentiated alluvial sediments overlying basement rock of the Stuart Shelf and Gawler Craton (Preiss 1987). There are few operational water wells in this region, as low yields and high salinities (generally over 5,000 mg/L) are a limiting factor to development (Magarey and Deane 2004).

There are no prescribed water resources or prescribed wells areas under the Landscape South Australia Act (and therefore no water allocation plans or groundwater licensing) in PEL 687. There are three water protection areas[8] established under the Environment Protection Act in the south-western part PEL 687.

The following sections provide further detail on the aquifers, groundwater resources and groundwater use in PEL 687. The information is based primarily on a review of hydrogeology of the region undertaken for Gold Hydrogen for the Ramsay Project by Innovative Groundwater Solutions.

4.5.2. Aquifers and aquitards

The main aquifers that occur in PEL 687 are summarised in Table 4-4.

The most widespread and prospective aquifers in the region are the undifferentiated Quaternary sediments and aeolian (wind-formed) sediments of the Pleistocene Bridgewater Formation. Groundwater in these shallow aquifers is mostly brackish (2,000 – 6,000 mg/L), with the exception of the south-western end of the peninsula where groundwater is generally fresh (less than 1,000 mg/L).

There are a number of underlying Palaeozoic limestone aquifers, including the semi-confined aquifers of the Permian age Cape Jervis Formation and the Cambrian age limestones comprising the Ramsay, Parara and Kulpara Formations. The spatial distribution of these aquifers is irregular, and groundwater is generally higher in salinity, reaching salinities of up to 20,000 mg/L.

The Minlaton Formation is an aquitard within the Palaeozoic layers that lies between the Ramsay Limestone and the Parara Limestone. It has been reported as having a thickness of 54 m and 128 m at historic exploration wells Minlaton 2 and Minlaton 1 respectively (Gravestock *et al.* 2001).

The basement rocks have low prospectivity as an aquifer unless fractures are present, and groundwater can exceed salinities of 35,000 mg/L. The basement can be found at large depths (e.g. 1,000 m around Minlaton), except in the north where it can be close to surface.

[8] Water protection areas are located in many areas across South Australia, generally where surface water or groundwater resources are used for drinking water supply (including the Mount Lofty Ranges, far south Eyre Peninsula and the entire South East). They provide additional administrative controls on approvals for new activities and additional enforcement options to protect water resources.

The presence and depth of the geological units containing these aquifers is variable within the PEL, due mainly to the complex fault-block mosaics present in the western Stansbury Basin (see Section 4.4.2 and Figure 4-6) and the variable geological setting that results from the position of the PEL across the edge of the basin.

Table 4-4: Summary of main aquifers and aquitards found within the PEL 687 area
(after Alcoe and Berens 2011).

Name	Era	Age	Aquifer / aquitard	Description and location
Undifferentiated Quaternary sediments	Cenozoic	Quaternary	Aquifer	White-beige alluvial-fluvial fine-grained sand. Widespread across Yorke Peninsula. Unconfined.
Bridgewater Formation		Pleistocene	Aquifer	Unconsolidated aeolian calcareous sands, rounded shell fragments and limestone. Notably present in the western and southern parts of the peninsula. Unconfined.
Permian Clays	Palaeozoic	Permian	Aquitard	Confining unit generally found beneath salt lagoons/lakes in the south-eastern corner of the peninsula and beneath Cenozoic sediments in general. Mostly found around Yorketown.
Cape Jervis Formation		Permian	Aquifer	Poorly sorted and unconsolidated siltstone-sandstone-limestone, notably abundant between Minlaton and Edithburgh. Confined.
Ramsay Formation		Mid-Cambrian	Aquifer	Blue-grey limestone, mostly found in the northern part of PEL 687. Unconfined.
Minlaton Formation		Mid-Cambrian	Aquitard	Dark red-brown fine-medium sandstone, yellowish calcareous siltstone and sandy limestone, clastic conglomerates, evaporites.
Parara Limestone		Early-Cambrian	Aquifer	Blue-grey limestone, mostly present in the central part of PEL 687 between Minlaton and Port Vincent. Unconfined.
Kulpara Formation		Early-Cambrian	Aquifer	Dolomite massive to thick-bedded, locally stromatolitic. Blue-grey limestone. Mostly present in the central part of PEL 687 between Minlaton and Port Vincent. Unconfined.
Hiltaba Suite	Pre Cambrian	Neoproterozoic	Aquifer	Part of the Adelaidean basement. Rarely water-bearing unless fractures are present.

Well data on the WaterConnect website (WaterConnect 2023) indicates that well yields (i.e. maximum flow rates) are generally low in all aquifer formations on Yorke Peninsula. Yields are typically between 0.5 and 1 L/s, although yields of up to 13 L/s in the Quaternary sediments, 6 L/s in the Cape Jervis Formation and 4.5 L/s in the Cambrian limestone have been recorded.

The Bridgewater Formation in the south-west of the Peninsula is the most prospective aquifer, with yields exceeding 5 L/s.

In the central and northern parts of the licence area, all wells with yields equal to or higher than 5 L/s are strictly located along the eastern coast, although no aquifer information is recorded for these wells.

Overall, in the PEL 687 area, yields are generally low and no aquifer formation can be specifically associated to having high yields (greater than 5-10 L/s), although Quaternary and Bridgewater Formation aquifers appear to be to be more prospective.

4.5.3. Groundwater depth, flow, recharge and discharge

The depth to groundwater varies across Yorke Peninsula. Mapping of standing water level in the shallowest aquifer (DEW 2016a) indicates that depth to groundwater is typically over 20 m in the central and eastern part of PEL 687, but is much closer to the surface along the west coast and in the area south and west of Minlaton and Yorketown (Figure 4-8). The saline lakes that occur in this area are likely to be locations of groundwater discharge.

Preliminary analysis of reduced standing water level data on the WaterConnect website has indicated that groundwater flows from recharge areas in the centre of the Peninsula associated with topographic and basement highs, towards the coast and/or lowland areas. Groundwater discharge occurs in lakes and lagoons and likely along the coast.

Figure 4-7: Shallow groundwater salinity and active water wells

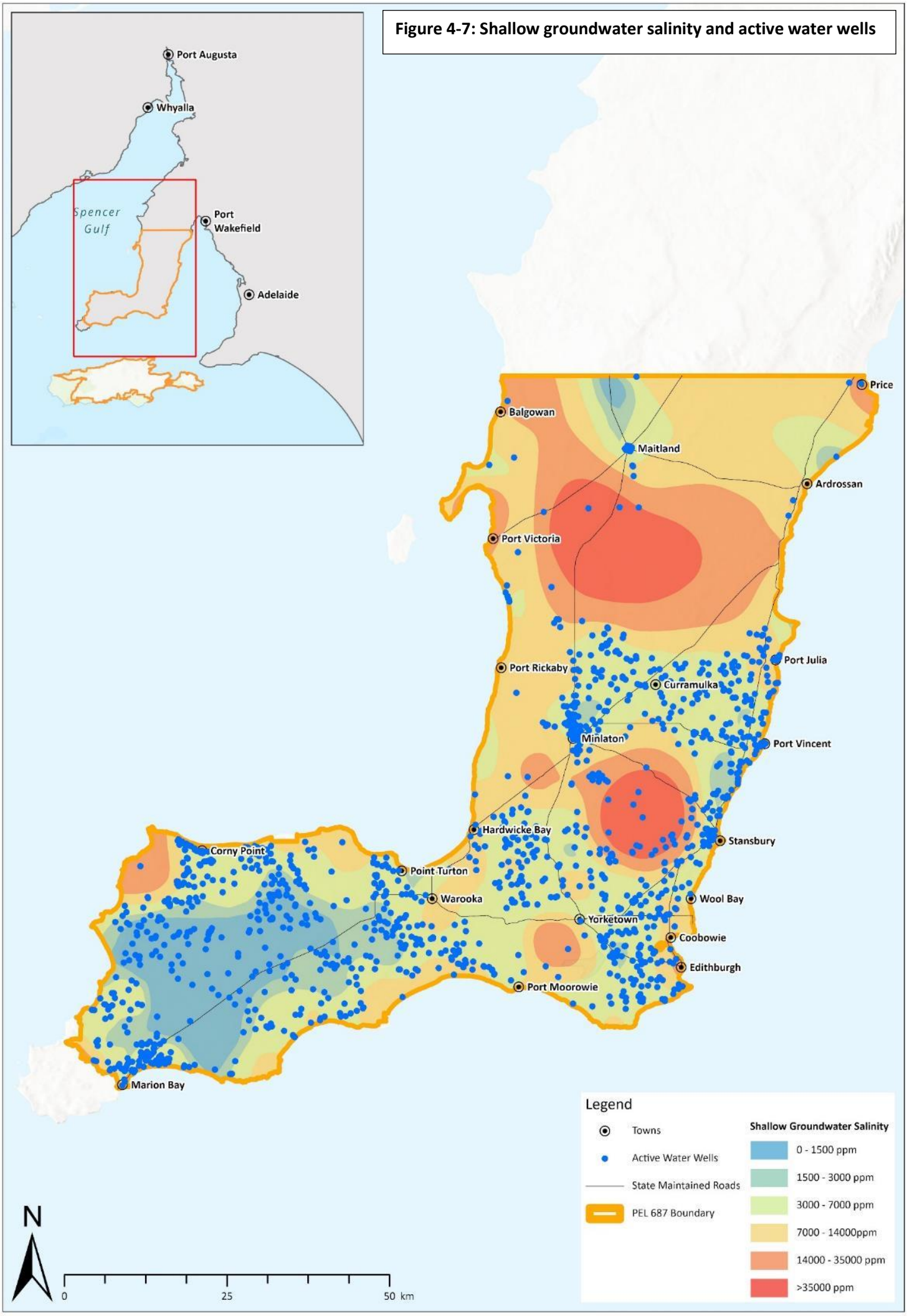
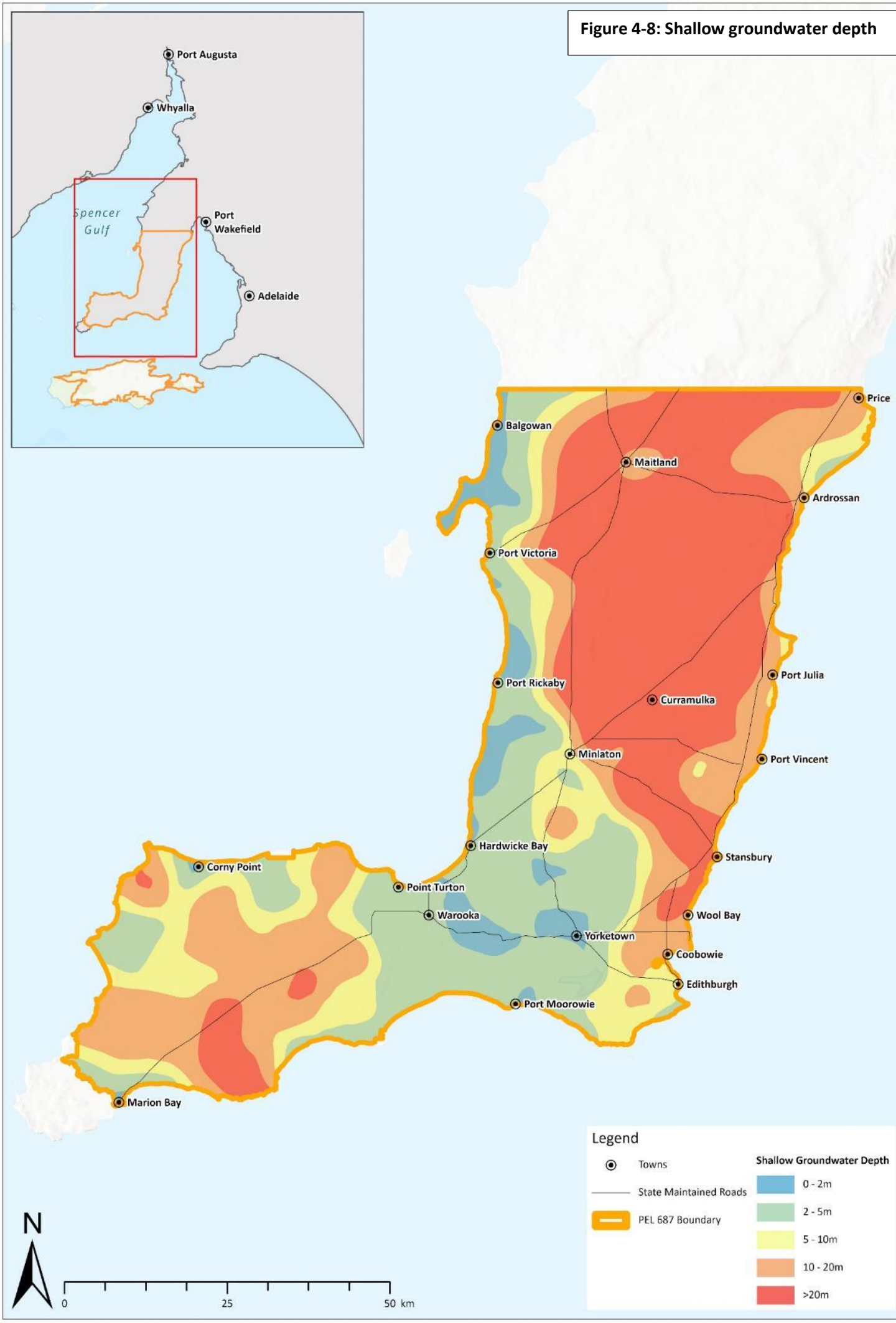


Figure 4-8: Shallow groundwater depth



4.5.4. Groundwater resources and use

As noted above, groundwater resources on Yorke Peninsula are mostly limited to the undifferentiated Quaternary sediments and the Bridgewater Formation.

Groundwater is used for stock and domestic purposes in areas of Yorke Peninsula where salinity levels are suitable[9] (see Figure 4-7). Although there are no licensed groundwater allocations or previous government estimates of unlicensed use for stock and domestic purposes in the area, it is likely that water supply for stock represents the greatest groundwater demand in the area. Approximately a third of the over 5100 wells recorded in PEL 687 have information about their purpose recorded in WaterConnect and 73% of these are recorded as stock wells (with some having a combined purpose such as domestic and stock) (WaterConnect 2023).

The Carribie and Para-Wurlie Basins in the far west of the 'foot' of Yorke Peninsula are noted as significant groundwater resources, with good water quality and salinity levels often less than 1,000 mg/L (Roberts 2007). The geology of both basins consists of unconfined Bridgewater Formation over Archaean/Lower Proterozoic basement (Magarey and Deane 2004). Water from the Carribie Basin is used for stock and domestic purposes (Magarey and Deane 2004) and the Para-Wurlie Basin was used for town water supply until it was replaced in 2018 by piped River Murray water, as noted in Section 4.5.1.

Both these basins are covered by water protection areas under the Environment Protection Act (see Section 4.5.1), along with an area near Marion Bay, where groundwater from the unconfined aquifer was historically used for water supply to entities including the landowner, the caravan park, the CFS and Dhilba Guuranda – Innes National Park (Magarey and Deane 2004). The use of groundwater at Marion Bay has largely been replaced by construction of a saltwater desalination plant at Marion Bay (Yorke Peninsula Council 2023). Water protection areas on Yorke Peninsula are shown in Figure 4-9.

The coastal strip between Pine Point and Edithburgh on the east of Yorke Peninsula, which is located on the western margin of the St Vincent Basin, has been identified as having a small groundwater resource. However, its potential uses are restricted by low yields (Magarey and Deane 2004).

[9] The *Environment Protection (Water Quality) Policy 2015* identifies groundwater of less than 1,200 mg/L salinity as having environmental values for drinking water for human consumption, and groundwater up to 13,000 mg/L as having environmental values for livestock drinking water. However, ANZECC/ARMCANZ (2000) notes that above 10,000 mg/L for sheep (and less for other animals), a loss of production and decline in animal condition would be expected with long term consumption.

Figure 4-9: Groundwater protection areas on south-western Yorke Peninsula

4.6. Flora and Fauna

4.6.1. Vegetation communities

There has been widespread native vegetation clearance across Yorke Peninsula and the majority of the PEL is cleared agricultural land. The proportion of native vegetation remaining is 2-3 % in the Arthurton and Boor Plain IBRA associations in the north-east of PEL 687, 6-10 % in the Corny, Yorketown and Urania IBRA associations, and 52% in the Innes IBRA association in the south-west of the PEL. Large tracts of remnant native vegetation occur only in the south-west of the PEL, with native vegetation elsewhere typically present as isolated patches in paddocks and on roadsides.

Vegetation communities present in areas of remnant vegetation include *Eucalyptus* mallee woodland, *Melaleuca* woodland, *Allocasuarina* woodland, *Melaleuca* shrubland, samphire shrubland, tussock grassland, rushland / sedgeland and coastal shrubland (DEW 2018).

A list of vegetation communities mapped within PEL 687 in areas of remnant native vegetation is provided in Appendix A.

4.6.2. Threatened ecological communities

Two threatened ecological communities listed under the EPBC Act are predicted to occur in PEL 687 by the Protected Matters Search Tool (DCCEEW 2022b). These communities are listed in Table 4-5.

Table 4-5: EPBC Act Listed threatened ecological communities potentially occurring within PEL 687

Name	Status
Drooping sheoak grassy woodland on calcrete of the Eyre Yorke Block Bioregion	Critically endangered
Subtropical and Temperate Coastal Saltmarsh	Vulnerable*

*Note: Vulnerable threatened ecological communities are not matters of national environmental significance for the purposes of Part 3 of the EPBC Act (requirements for environmental approvals).

Vegetation mapping (DEW 2018) shows very scattered occurrences of generally small patches of Drooping Sheoak woodland across the southern part of Yorke Peninsula. Saltmarsh (i.e. samphire shrubland) is mapped at several locations around the coast, with large tracts mapped in the area around Yorketown and Warooka (however it is noted that most of these inland areas are unlikely to qualify as the listed threatened ecological community as they are not subject to tidal influence).

4.6.3. Threatened species

Flora

Searches of the Biological Databases of South Australia (DEW 2022a) and the EPBC Act Protected Matters Search Tool (DCCEEW 2022b) identified 15 plant species listed as threatened at a national level that have been recorded within or adjacent to the PEL. A further 5 nationally threatened species were predicted to occur by the Protected Matters Search Tool. Twenty-five plant species listed as threatened at a State level and a further 49 species listed as Rare have been recorded within the or adjacent to the PEL.

The vast majority of threatened plant records are associated with patches of remnant vegetation, however there are records of some species (e.g. shrubs such as Resin Wattle *Acacia rhetinocarpa,* Jumping-jack Wattle *Acacia enterocarpa* and Silver Daisy-bush *Olearia pannosa*) on roadsides.

Threatened plant species recorded or predicted within the PEL are listed in Appendix A.

Fauna

Database searches (DEW 2022a and DCCEEW 2022b) identified 23 fauna species listed as threatened at a national level that have been recorded within or adjacent to the PEL. A further 23 nationally threatened species were predicted to occur by the Protected Matters Search Tool. Thirty-three fauna species listed as threatened at a State level and a further 22 species listed as Rare have been recorded within or adjacent to the PEL.

The majority of threatened species recorded were birds (27 species, of which 18 were marine or coastal species) (DEW 2022a). Five threatened mammal species (all marine species) and five threatened reptile species (including three marine turtle species) have been recorded (DEW 2022a).

The vast majority of threatened fauna records are associated with the coastline and, to a lesser extent, patches of remnant vegetation.

Threatened fauna species recorded or predicted within the PEL are listed in Appendix A.

4.6.4. Listed migratory species

The EPBC Act Protected Matters Report (DCCEEW 2022b) identified 65 migratory species listed under the EPBC Act as potentially occurring within the PEL 687 search area. This includes 16 migratory marine birds, 12 migratory marine species, 3 migratory terrestrial species and 34 migratory wetland species.

4.6.5. Groundwater dependent ecosystems

Groundwater dependent ecosystems require access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis.

Review of the Groundwater Dependent Ecosystems Atlas mapping (BOM 2022b) shows aquatic groundwater dependent ecosystems occurring within PEL 687, with concentrations along the west coast of Yorke Peninsula, south and west of Minlaton and in the region around Yorketown and Warooka. These generally correlate with the numerous salt lakes present in these areas.

Terrestrial groundwater dependent ecosystems are also mapped as occurring throughout PEL 687 with larger concentrations to the south (BOM 2019, BOM 2022b).

4.6.6. Weeds, pests and pathogens

Pest plants

Eleven weeds have been identified as priority plants for the Yorke district, including four Weeds of National Significance (WoNS) and seven declared weeds. An additional ten declared plants are identified as ‘other declared local action pest plants’ (Natural Resources Northern and Yorke 2022). A list of these plants is provided in Appendix A.

Pest animals

Key pest animals in the Northern and Yorke Landscape region include Rabbit, Fox, Feral Deer and Feral Goat (Landscape SA Northern and Yorke 2022b).

Pathogens

Yorke Peninsula is identified as a moderate potential threat area for phytophthora (DIT 2022a). There are no records of phytophthora on Yorke Peninsula in NatureMaps (DEW 2023).

4.7. Land Use

4.7.1. Agriculture

In the early years of the colony of South Australia and the Yorke Peninsula, the main agricultural industry was grazing of sheep with good rainfall and soil conditions conducive to wool and meat production. Cropping was progressively introduced in the second half of the 1800s and when annual legumes were introduced into rotations of sheep in the early 1900s, production increased[10].

Agriculture continues to be the dominant land use on Yorke Peninsula, mainly comprising broadacre cropping of wheat, barley, lentils and canola and sheep farming. Other crops grown include beans, peas, chickpeas and oats. Yorke Peninsula is one of Australia's prime agricultural regions, renowned for the quality of its barley, having been referred to as the 'Barley Capital of the World' (Yorke Peninsula Tourism 2023).

The 2022-2023 crop production for Yorke Peninsula was 2.3 million tonnes, which was approximately 18% of South Australia's total production (PIRSA 2023). The main crops grown in 2022-2023 were wheat, barley and lentils.

Farms on Yorke Peninsula are typically in the order of 600 ha in size (YPVC 2022). Key periods of farming activity generally include late summer and autumn for lambing, sowing of crops in early autumn, cutting, raking and baling of hay in spring and harvesting, which usually commences in early to mid-November, with the coastal regions the first to ripen (YPVC 2022).

4.7.2. Tourism

Yorke Peninsula is a popular holiday destination, and the population of coastal towns increases significantly in summer (particularly Christmas holidays and weekends) and Easter. Tourist attractions include beaches, coastal towns and national parks (Yorke Peninsula Tourism 2022). Other attractions include surf breaks, shipwrecks, pink salt lakes south of Yorketown, small wineries and craft breweries / distilleries.

For the year ending December 2021, Yorke Peninsula had 620,000 domestic overnight visitors, consisting of 90% visitors from within South Australia, who stayed an average length of 3 nights, and 10% from interstate, who stayed an average of 6 nights. Of the visitors to Yorke Peninsula. 91% were leisure visitors, either on holiday or visiting family. The most popular activity undertaken by domestic overnight visitors to Yorke Peninsula is going to the beach, followed by eating out, fishing and visiting friends and family (SATC 2022)[11].

4.7.3. Mining

Significant mining operations within PEL 687 include the Ardrossan Dolomite Mine/Ardrossan Dolomite Quarry and the Klein Point Quarry. Mining operations licensed under the *Mining Act 1971* within PEL 687 are summarised in Table 4-6.

The Rex Minerals' Hillside Project, located within PEL 687, has an approved mining lease but is currently undeveloped (DEM 2022).

[10] https://www.pir.sa.gov.au/aghistory/dept_of_agriculture_as_an_organisation/locations/kadina2

[11] Note that the 2021 statistics may have been affected by COVID restrictions and interstate border closures.

Historic gypsum mining occurred in Dhilba Guuranda - Innes National Park at sites including Marion Lake Gypsum Mine, Snow Lake and Spider Lake (DEM 2022).

Table 4-6: Licensed mining operations within PEL687

Name	Tenement Holders	Type[1]	Commodities	Status
Ardrossan Quarry	OneSteel Manufacturing Pty Limited	ML, PM	Dolomite	Operating
Carribie Whiting Mine	Agricola Mining Pty Ltd	ML	Dolomite	Care/Maintenance
Coobowie Limestone Quarry	Vigar, Peter Gerald	EML	Limestone	Operating
Crowell Sand Pit	Southern Quarries Pty. Ltd	EML	Sand	Operating
Crowell Sand Pit	Crowell, Bevan Wayne; Crowell, Lynette Jean (operators: Direct-Screens Holdings Pty. Ltd.)	PM	Sand	Operating
Crowell Sand Pit	Direct-Screens Holdings Pty. Ltd (operators: Southern Quarries Pty. Ltd.)	PMA	Sand	Operating
Curramulka Quarry	Hanson Construction Materials Pty Ltd	EML	Dolomite; Limestone	Operating
Hillside Project	Rex Minerals (SA) Pty Ltd	EML	Sand, gravel, clay, limestone	Operating
Hillside Project	Rex Minerals (SA) Pty Ltd	ML	Iron ore - hematite DSO, gold, copper, iron ore - magnetite DSO	Approved
Hollams Sand Pit	Clay & Mineral Sales Pty Ltd	EML	Sand	Operating
Klein Point Quarry	Adelaide Brighton Cement Ltd	ML	Limestone	Operating
Lake Fowler Gypsum Mine	Adelaide Brighton Cement Ltd	ML	Gypsum	Operating
Olsson Saltfield	Olsson Industries Pty Ltd	ML	Salt	Care/Maintenance
Price	Ocsalt Proprietary Limited	ML	Salt	Operating
Price Sand Quarry	Direct-Screens Holdings Pty. Ltd.	EML	Sand	Operating
Ramsey Blue Stone Quarry	Parsons as Executor, Nerida Jean	EML	Limestone	Operating

Source: DEM (2022)

[1] Tenement types: EML – Extractive Minerals Lease, ML – Mining Lease, PM – Private Mine

4.7.4. Renewable energy

The main renewable energy infrastructure within PEL 687 on Yorke Peninsula is the 90 MW Wattle Point Wind Farm. Wattle Point Wind Farm, located near Edithburgh was opened in 2005 and has 55 turbines (AGL 2022).

ElectraNet has installed a 30 MW large scale battery energy storage system at the Dalrymple substation, which works with the Wattle Point Wind Farm and rooftop solar PV to provide back-up power in the event of any interruption to supply from the grid. In addition, 33 kW of solar panels and

54 kWh of batteries have been installed across hubs in Edithburgh and Stansbury and at two locations in Yorketown (AGL 2021).

The proposed Ceres Wind Farm (located west of Black Point) was approved in 2014 but never constructed. Spark Renewables is working on a revitalisation of the project known as the Yorke Peninsula Energy Hub (Spark Renewables 2023).

4.7.5. Roads and infrastructure

The road network on Yorke Peninsula includes sealed roads controlled by the Department for Infrastructure and Transport (DIT) and sealed and unsealed roads controlled by Yorke Peninsula Council (Figure 4-10). The main highways within PEL 687 are summarised in Table 4-7.

Table 4-7: Highways within PEL 687

Name and Road Type	Class	Surface	Route number	Traffic estimates*
Yorke Highway	Arterial	Sealed	B86	220-2000
St Vincent Highway	Arterial	Sealed	B88	420-1100
Spencer Highway	Sub-arterial	Sealed	B89	600-1500

*Source: *DIT (2023). Estimated average number of vehicles per day (lowest and highest volumes across all sections)*

There are commercial airstrips at Maitland, Minlaton and Yorketown and aeroplane landing areas at Ardrossan, Port Victoria and Warooka.

There is a network of South Australia Power Network transmission lines and substations across Yorke Peninsula (SAPN 2022) and an ElectraNet overhead transmission line runs north-south along the eastern side of Yorke Peninsula (ElectraNet 2022).

There are no operational rail lines in PEL 687. The nearest open railway is the Adelaide to Crystal Brook line owned by the Australian Rail Track Corporation (DIT 2022b).

Other infrastructure of note includes lighthouses at Corny Point, Troubridge Point, West Cape and Cape Spencer and large silos at the main ports (Ardrossan and Port Giles). Many regional centres also have smaller silos.

Figure 4-10: DIT and Yorke Peninsula Council sealed and unsealed roads on Yorke Peninsula

Price
Balgowan
Maitland
Ardrossan
Port Victoria
Port Julia
Port Rickaby
Curramulka
Minlaton
Port Vincent
Hardwicke Bay
Stansbury
Corny Point
Point Turton
Warooka
Wool Bay
Yorketown
Coobowie
Edithburgh
Port Moorowie
Marion Bay

Legend
Towns
PEL 687
Sealed Road (DIT)
Sealed Road (Council)
Unsealed Road (Council)

N

0 25 50 km

4.7.6. Conservation areas

There are a number of areas reserved for conservation under the *National Parks and Wildlife Act 1972* (NPW Act) in or immediately adjacent to PEL 687. On-ground activities regulated under the PGE Act are not permitted in most of these reserves (refer Table 4-8). The PEL also contains numerous Heritage Agreements established under the *Native Vegetation Act 1991* and there are several marine parks established adjacent to PEL 687. Figure 4-11 shows areas reserved for conservation in and adjacent to PEL 687.

As noted in Section 1.3.1, the scope of this EIR and the accompanying SEO excludes activities in reserves established under the National Parks and Wildlife Act or exploration activities immediately adjacent to a Marine Park established under the *Marine Parks Act 2007*.

South-western Yorke Peninsula is also home to Marna Banggara, a landscape-scale project involving predator control and large-scale predator fencing across the 'foot' of the peninsula. The project is investigating whether the reintroduction of targeted native species can restore ecosystem function and provide flow-on benefits to agriculture, local business and the community (Marna Banggara 2023).

Table 4-8: Conservation reserves within or adjacent to PEL 687 on Yorke Peninsula

Name	Type	Location	PGE Act entry
Carribie	Conservation Park	Within PEL	×
Dhilba Guuranda-Innes	National Park	Adjacent PEL	×
Goose Island	Conservation Park	Adjacent PEL	×
Leven Beach	Conservation Park	Adjacent PEL	×
Minlacowie	Conservation Park	Within PEL	✓
Point Davenport	Conservation Park	Within and adjacent PEL	×
Ramsay	Conservation Park	Within PEL	✓
Thidna	Conservation Park	Within PEL	✓
Warrenben	Conservation Park	Within PEL	×
Wills Creek	Conservation Park	Adjacent PEL	×

4.7.7. Wardang Island Indigenous Protected Area

The north-western extent of PEL 687 also intersects the Wardang Island Indigenous Protected Area (see Figure 4-11). This area encompasses Wardang Island (which is offshore from PEL 687) and 28 km of coastal fringe adjacent to the island on Yorke Peninsula.

The Narungga people are working to protect their connections to country, storylines and songlines for future generations in this area and rangers are working to eradicate feral animals from Wardang Island with a vision to create a sanctuary for endangered native species (NIAA 2023). As noted in Section 1.3.1, activities undertaken under this EIR and SEO would avoid the Wardang Island Indigenous Protected Area.

4.8. Native Title

PEL 687 is within the area of the Narungga Nation (SC2013/002) native title claim which acknowledges native title rights and interests in land and waters on the Yorke Peninsula from Mundoora in the north to Dhilba Guuranda-Innes National Park in the south.

This claim was determined in March 2023 by agreement with the State. The determination recognises the claimants as Native Title Holders for Native Title Land in the claim area as set out in the Narungga Nation Determination Indigenous Land Use Agreement (ILUA)[12]. The determination includes parcels of land within PEL 687.

[12] The determination will take effect upon the final registration of the ILUA on the Register of Indigenous Land Use Agreements

Figure 4-10: Conservation reserves and other protected areas in and adjacent to PEL 687

4.9. Amenity

4.9.1. Air quality

The air quality in PEL 687 is generally expected to be good and typical of that found in a rural setting in South Australia, due to low population numbers and limited industrial activities. Existing sources of air pollution within the broader area are expected to include vehicle emissions and dust generated by traffic on unsealed roads, agricultural activities and isolated mining and quarrying activities.

4.9.2. Noise

The noise environment on Yorke Peninsula is typical of a predominantly rural setting. Background noise levels are generally dominated by natural sources such as wind and waves (in coastal areas) with some contribution from incidental traffic and intermittent or periodic agricultural activities (e.g. farm equipment movements or aerial spraying). Traffic noise levels increase near major roads and within townships there is an increase in traffic and residential noise. There are isolated areas which experience industrial noise originating from mining activities or agricultural facilities (e.g. silos) and port operations.

4.10. Socio-economic Environment

PEL 687 is located within the Yorke Peninsula Council local government area (LGA).

Maitland is the largest centre within PEL 687, with a population of 2021 (ABS 2022). Other population centres include Price, Ardrossan, Port Victoria, Port Vincent, Stansbury, Minlaton, Yorketown, Coobowie, Edithburgh, Warooka, Point Turton and Marion Bay. There are also numerous localities with smaller permanent populations such as Pine Point, Port Julia, Curramulka, Wool Bay, Port Moorowie, Hardwicke Bay, Corny Point, Port Rickaby and Balgowan.

The population of the Yorke Peninsula Council LGA in 2021 was 11,598 comprising 5,695 males and 5,629 females. The population was distributed relatively evenly across the age brackets between 0 and 54 years and 80 years and older, with a higher number of people in the age brackets between 55 and 79 years. The median age was 57 (ABS 2022).

The median weekly household income across the LGA was $960; this compares to a median weekly household income of $1,455 across South Australia (ABS 2022).

The main industry of employment in the region is ‘Other Grain Growing’, with ‘Grain-Sheep or Grain-Beef Cattle Farming’ employing the second highest number of workers (ABS 2022). The high proportion of employment within the agriculture industry reflects the economic importance of agricultural production within the region.

4.11. Aboriginal Cultural Heritage

The Yorke Peninsula component of PEL 687 is located on the traditional lands of the Narungga people. Archaeological evidence of their ties to the land and water is recorded in the central archives (including the Register of Sites and Objects administered by Aboriginal Affairs and Reconciliation (AAR). A search of the central archives has indicated that there are entries for Aboriginal heritage within PEL 687 on Yorke Peninsula which include archaeological and cultural sites, stone quarries, arrangements, historic sites and culturally modified trees and burial sites.

Gold Hydrogen's approach to its responsibilities under the *Aboriginal Heritage Act 1988*[13] to avoid damaging, disturbing or interfering with Aboriginal sites, objects and remains are set out in Section 5.7.

4.12. Non-Aboriginal Heritage

European settlers moved onto the Yorke Peninsula from around 1840. The region has a rich heritage related to its maritime, agriculture and mining history which is reflected in the nature of the heritage places that are protected under State heritage legislation.

A search of heritage places using the South Australian Heritage Places Database[14] (DEW 2022b) identified 14 State Heritage Places and no local heritage places listed in the database within PEL 687. These are listed in Table 4-9.

Table 4-9: SA Heritage Places Database sites within PEL 687

Name	Location	State Heritage Place Number
Corny Point Lighthouse	Corny Point	10110
Corra Lynn Cave (designated place of palaeontological and speleological significance)	Curramulka	22798
Dowlingville Post Office	Dowlingville	17071
Clan Ranald Graves, Edithburgh Cemetery	Edithburgh	16675
Dry Stone Walling	Honiton-Edithburgh Road	16676
Lake Fowler Salt Works Site	Lake Fowler Road	16677
Minlaton Showground Pavilion/Grandstand	Minlaton	10186
Former Grain Shed and associated Enclosed Yard with Stone Wall	Pine Point	16682
Former Point Pearce Aboriginal Mission	Point Pearce	12723
Port Julia Jetty and Cargo Shed	Port Julia	16681
The Grainstore Galleries	Port Vincent	12536
Lime Kiln (designated place of archaeological significance)	Stansbury-Yorketown Road	16680
Orrie Cowie Homestead (main house and overseer's cottage)	Warooka	14515
Wool Bay Lime Kiln & Jetty	Wool Bay	10112

There are no World, Commonwealth or National heritage listed places within PEL 687 (DCCEEW 2022a). The closest listed place on the National Heritage List is the Australian Cornish Mining Sites: Moonta, located approximately 21 km north of PEL 687 (NatureMaps 2022). Two South Australian Geoheritage Sites[15] are located within PEL 687 (NatureMaps 2022): Horse Gully and Port Victoria.

[13] The fact sheet *Managing Aboriginal heritage in South Australia* (AAR 2023) also provides guidance on legislative requirements and strategies for managing Aboriginal heritage.

[14] The South Australian Heritage Places Database provides a listing of State Heritage Places from the South Australian Heritage Register, and Local heritage places and contributory items from South Australian Development Plans

[15] South Australian Geoheritage sites were formally described as 'geological monuments' and are declared by the Geological Society of Australia. They represent rare, unique or representative occurrences of geological interest that are considered by the earth science community to be worthy of conservation for reference, research and training.

5. Environmental Impact Assessment

5.1. Overview

This section discusses potential environmental impacts related to geophysical operations using existing roads within PEL 687 on Yorke Peninsula.

The discussion is supported by an environmental risk assessment. The risk assessment is presented in Table 5-4 (in Section 5.9), which outlines the key hazards, management measures and resulting level of risk.

The discussion in Sections 5.2 to 5.8 summarises the key risks and management measures that would be implemented, with the detail provided in Table 5-4.

Reference is made to the results of the risk assessment where relevant throughout the discussion.

5.1.1. Risk assessment process

Environmental risk is a measure of the likelihood and consequences of environmental harm occurring from an activity. The risk assessment process involves:

- identifying the potential hazards or threats posed by the activity
- categorising the potential consequences and their likelihood of occurring; and
- using a risk matrix to characterise the level of risk.

The objective of the risk assessment process is to separate the minor acceptable risks from the major risks and to provide data to assist in the evaluation and management of risks.

The risk assessment was carried out by JBS&G and Gold Hydrogen personnel, based on knowledge of the existing environment, and experience with similar operations in other areas of South Australia, Australia and overseas.

The risk assessment process was based on procedures outlined in Australian and New Zealand Standard AS/NZS ISO 31000:2018 (Risk Management) and HB 203:2012 (Managing environment-related risk).

The risk assessment captures proposed risk controls and assign a consequence and likelihood rating to the residual risk. Consequence and likelihood categories and the risk matrix adopted for use in this document are consistent with those used previously for assessment of similar projects in South Australia, and are described below.

The risk assessment process is also iterative. ‘Low’ risks were generally accepted, and ‘medium’ and ‘high’ risks were reviewed to determine if each risk was as low as reasonably practicable. Where necessary, management practices were reviewed to identify additional management options to lower risk and/or improve environmental outcomes (e.g. elimination, substitution, reduction, engineering controls and management controls). The risk was then re-assessed based on these additional management options. This EIR details the final or residual risk after management options have been applied.

Definition of consequences

To describe the severity, scale and duration of potential impacts, the five categories of consequence listed in Table 5-1 are used.

Table 5-1: Consequence definition

Category	Natural environment	Socio-economic environment
Negligible	Possible incidental impacts to flora and fauna in a locally affected land system but no ecological consequence. Possible incidental impacts to aquifers associated with the target formation(s) without ecological consequence.	Community is aware of operations and concerns have been addressed.
Minor	Changes to the abundance or biomass of flora & fauna, and existing soil and/or water quality in the affected land system, but no changes to biodiversity or ecological function. Aquifers have a small amount of exposure from other sources of fluids, negligible volume movement in or out of formations or aquifers. No measurable change to aquifer water quality or pressure in local area.	Temporary disturbance to the community.
Moderate	Changes to the abundance or biomass of flora & fauna, and existing soil and/or water quality in the affected land system, with local changes to biodiversity but no loss of ecological function. Detectable change to aquifer water quality and pressure in the local area.	Longer term disturbance able to be managed with communication to affected community.
Major	Substantial changes to the abundance or biomass of flora & fauna, existing soil and/or water quality in the affected land system with significant change to biodiversity and change of ecological function. Eventual recovery of ecosystem possible, but not necessarily to the same pre-incident conditions. Substantial changes to aquifer water quality and pressure in the local area.	Significant effect which can be mitigated by extensive rehabilitation and negotiation with community.
Critical	Irreversible and irrecoverable changes to abundance/biomass or aquifers in the affected area. Loss of biodiversity on a regional scale. Loss of ecological functioning with little prospect of recovery to pre-incident conditions. Widespread effect of reduction in aquifer pressure (i.e. reduced flow from bores in locations remote from operations). Contamination of aquifers remote from operations.	Significant and long lasting negative economic and social effects.

Definition of likelihood

The likelihood of potential environmental consequences occurring is defined using the five categories shown in Table 5-2. The likelihood refers to the probability of the particular consequences eventuating, rather than the probability of the hazard or event itself occurring.

Table 5-2: Likelihood definition

Likelihood	Description
Almost Certain	Is expected to occur in most circumstances
Likely	Would probably occur in most circumstances
Possible	Possible that it might occur at some time
Unlikely	Unlikely, but could occur at some time
Remote	May only occur in very exceptional circumstances

Characterisation of risk

The risk associated with each hazard was characterised as low, medium or high, using the matrix in Table 5-3 below.

Table 5-3: Environmental risk matrix

Risk matrix		Consequence				
		Negligible	Minor	Moderate	Major	Critical
Likelihood	Almost certain	M	M	H	H	H
	Likely	M	M	H	H	H
	Possible	L	M	M	H	H
	Unlikely	L	L	M	M	H
	Remote	L	L	L	M	M

5.2. Soil and Shallow Groundwater

Potential impacts to soil and shallow groundwater arise mainly from the following risk events / hazards:

- Minor disturbance to soil due to seismic survey activities
- Spills or leaks associated with storage and handling of fuel, oil and chemicals, seismic survey machinery and drilling equipment
- Storage, handling and disposal of waste.

5.2.1. Minor disturbance to soil due to seismic survey activities

Some localised disturbance to soil may occur following completion of seismic survey operations (e.g. wheel rutting, compaction). These impacts are expected to be minimal for the proposed operations, as they will utilise existing roads and tracks and will have minimal requirement to access private land.

These disturbances generally rehabilitate naturally within a short period of time following natural processes e.g. rainfall or regrowth of vegetation. If any active rehabilitation / restoration is required, it would be undertaken in consultation with, and to the satisfaction of the road authority / landowner.

5.2.2. Spills or leaks

Improper storage and handling of fuel, oil and chemicals has the potential to result in localised contamination of soil and shallow groundwater. In order to minimise this risk, fuel, oil and chemicals on site are stored and handled in accordance with relevant standards and guidelines (e.g. AS 1940, EPA guideline 080/16 Bunding and Spill Management and the Australian Dangerous Goods Code). Fuel, oil and chemicals would be stored in their product containers with appropriate secondary containment (e.g. lined, bunded areas or on self-bunded pallets). Bulk storage and handling of fuel and chemicals is restricted to designated areas (typically a paved laydown area). Field refuelling of vibroseis trucks (if required) would be undertaken in a safe location, away from native vegetation or surface water features, with appropriate measures in place (e.g. fire extinguishers, emergency isolation lever / stop button, spill response equipment).

Vehicles and associated seismic survey equipment have the potential to cause minor leaks of fuel and chemicals during the course of geophysical survey operations. All vehicles and associated equipment

will be operated and maintained in accordance with specifications to minimise the potential for a spill or leak (e.g. oil leak or hydraulic hose failure).

Appropriate emergency / spill response procedures will be in place for any loss of containment, and any spills would be immediately cleaned up and any contaminated material removed off-site for appropriate treatment or disposal to a licensed facility. If larger scale spills occur that cannot be immediately contained and cleaned up they would be assessed consistent with the requirements of the National Environmental Protection Measure (NEPM) and, where required, remediated in accordance with relevant guidelines (e.g. EPA guidelines).

5.2.3. Storage, handling and disposal of waste

Inappropriately managed waste has the potential to result in localised disturbance or contamination of soil and shallow groundwater. Waste generation would be relatively limited for the proposed activities. Storage of waste (e.g. at the laydown) and subsequent transport to licensed disposal or recycling facilities would be undertaken in accordance with relevant legislation and guidelines. Waste generation would be minimised where practicable, waste would be stored securely, and licensed waste contractors would be used for waste transport where it is required.

If a wastewater disposal system is used (e.g. at the laydown), all wastewater will be stored and disposed of in accordance with the *South Australian Public Health (Wastewater) Regulations 2013* or to the satisfaction of the Department of Health) and consistent with the *Environment Protection (Water Quality) Policy 2015*.

Risk Assessment

The level of risk to soil and shallow groundwater has been assessed as low (refer Table 5-4).

5.3. Surface Water

Potential impacts to surface water arise mainly from the following risk events/ hazards:

- Minor disturbance to surface water due to seismic survey activities (e.g. very minor disturbance to natural drainage patterns, increased erosion / sedimentation risk)
- Spills or leaks associated with storage and handling of fuel, oil and chemicals, seismic survey machinery
- Storage, handling and disposal of waste.

5.3.1. Minor disturbance to surface water due to seismic survey activities

Following completion of seismic survey operations, some localised disturbance to soil and areas of natural surface water movement (e.g. wheel rutting) could occur and may cause very minor impacts to surface water e.g. minor disturbance to natural drainage patterns / surface water flow, increased erosion / sedimentation risk. These impacts are expected to be minimal for the proposed operations, as they will utilise existing roads and tracks and will have minimal requirement to access to private land.

These disturbances generally rehabilitate naturally within a short period of time following natural processes e.g. regrowth of vegetation. If any active rehabilitation / restoration is required, it would be undertaken in consultation with, and to the satisfaction of the road authority / landowner.

5.3.2. Spills or leaks

The principal risk to surface water results from the transport and handling of fuels, oils, chemicals associated with vehicles and the potential movement off-site of contaminated material from spills or leaks from these vehicles. Measures discussed in Section 5.2 will be implemented to ensure safe storage and handling of fuel and chemicals. Spill containment and clean-up equipment would be present on-site during operations. Refer to Section 5.2 for further detail on spill and leak management.

5.3.3. Storage, handling and disposal of waste

Measures to ensure secure storage and handling of waste will be implemented as outlined in Section 5.2.

Risk assessment

The level of risk to surface water has been assessed as low (see Table 5-4).

5.4. Native Vegetation and Fauna

Potential impacts to native vegetation and fauna arise mainly from the following risk events/ hazards:

- Disturbance from site activities (e.g. light, noise, vibration, presence of machinery and personnel)
- Use of roads and movement of heavy vehicles and machinery
- Access to contaminants (e.g. spills and leaks) and waste by wildlife (and stock)
- Risk of weed introduction; and
- Fire.

5.4.1. Disturbance from survey activities

The proposed activities will not impact native vegetation.

Potential disturbance to wildlife from proposed activities (e.g. noise, vibration, presence of machinery, and personnel) is short-term, localised and generally of limited significance in the region given the existing land uses, extent of vegetation clearance and habitat modification and intermittent presence of traffic and farm machinery on existing roads.

5.4.2. Use of roads and movement of heavy vehicles and machinery

The movement of vehicles and machinery along roads tracks has the potential to impact native fauna, principally through collisions. This is likely to be relatively insignificant due to the level of existing traffic, the short-term nature of the activities and the limited extent of significant fauna habitats. Transport procedures (e.g. speed restrictions, limitation of movements at night) would also reduce the potential level of impact.

5.4.3. Access to contaminants and waste by wildlife and stock

The potential for wildlife (and stock) to access contaminants and waste is very limited. Measures discussed in Section 5.2 will be implemented to ensure safe storage and handling of fuel and chemicals and waste.

5.4.4. Risk of weed introduction

The introduction of weeds or pathogens by vehicles and equipment can potentially impact land and biodiversity, however the risk is relatively low given the nature and location of the proposed operations. A range of measures will be undertaken to manage the potential for the introduction or spread of weeds or pathogens (refer to Section 5.5 for further information).

5.4.5. Fire

Fire initiated by site activities (e.g. sparks from vehicles or equipment, cigarette butts) has the potential to impact large areas of vegetation. Measures would be in place to prevent fires including firebreaks, restriction of vehicles to tracks and cleared areas, maintenance of suitable fire-fighting equipment on site and liaison with the CFS.

Risk assessment

The level of risk has been assessed as low for these potential hazards (see Table 5-4).

5.5. Land Use

Potential impacts to land use arise mainly from the following risk events/ hazards:

- Minor ground surface disturbance associated with seismic survey activities
- Disturbance from site activities (e.g. light, noise, vibration, presence of machinery and personnel)
- Risk of weed introduction; and
- Fire.

Further detail on noise and vibration, use of roads and other potential impacts to landowners are discussed under Community Amenity in Section 5.6 below.

5.5.1. Minor ground surface disturbance associated with seismic survey

As noted in Section 5.2.1, ground surface impacts are expected to be minimal for the proposed operations, as they will utilise existing roads and tracks and will have minimal requirement to access to private land.

Some localised disturbance to soil may occur following completion of seismic survey operations (e.g. wheel rutting, compaction). These disturbances generally rehabilitate naturally within a short period of time. If any active rehabilitation / restoration is required, it would be undertaken in consultation with, and to the satisfaction of the road authority / landowner.

5.5.2. Disturbance from survey activities

Geophysical survey activities and transport moves have the potential to disturb and possibly injure stock or interfere with other land use activities. These impacts are expected to be minimal for the proposed operations, as they will utilise existing roads and tracks and will have minimal requirement to access to private land. If access to private land is required, consultation with landowners would be undertaken to ensure that the location, management and timing of activities minimise the potential for impact, including disruption of farm operations. Land access agreements would be agreed and put into place before any activities are undertaken on private land.

Measures would be in place to minimise impacts include speed limits, use of existing roads and avoidance of night operations.

5.5.3. Access to contaminants by stock (e.g. spills or leaks, waste)

The potential for stock to access contaminants and waste is very limited. Measures for storage and handling of fuel, oil and chemicals discussed in Section 5.2 will be implemented. Spills or leaks are not likely to occur where stock are present and would be immediately cleaned up. Waste would be stored in covered bins before being transported off-site for disposal.

The level of risk has been assessed as low (refer Table 5-4).

5.5.4. Risk of weed introduction

The introduction of weeds or pathogens by vehicles and equipment can potentially have a significant impact on land use (and biodiversity). This hazard is somewhat limited for the proposed operations, as they will utilise existing roads and tracks and will have minimal requirement to access to private land.

A range of measures will be undertaken to manage the potential for the introduction or spread of weeds or pathogens, including:

- consultation with the road authority / landowner and (Landscape Board officers where appropriate) to identify any potential issues or specific management requirements
- implementing biosecurity procedures implemented as agreed with the road authority / landowner
- ensuring that vehicles and equipment arriving at the site are clean and free of soil and plant material
- assessment of vehicles and equipment entering the region or moving between sites (especially from weed or pathogen infested areas into non-infested areas) for the risk of transporting weeds and pathogens and cleaning them down where appropriate.

Under the PGE Act, landowners have rights to compensation. Compensation is payable where there is:

- deprivation or impairment of the use and enjoyment of the land
- damage to the land (not including damage that has or will be made good by the licensee)
- damage to, or disturbance of, any business or other activity lawfully conducted on the land
- consequential loss.

Compensation agreements are agreed and put into place before any activities are undertaken on private land.

5.5.5. Fire

Fire initiated by site activities (e.g. sparks from vehicles or equipment, cigarette butts) has the potential to significantly impact land use (e.g. via damage to pasture, crops, buildings and other infrastructure). Measures discussed in Section 5.4.5 above would be in place to manage the risk of fire.

Risk Assessment

The level of risk has been assessed as low for these potential hazards (refer Table 5-4).

5.6. Community Amenity

Potential impacts to amenity arise mainly from the following risk events/ hazards:

- Disturbance from site activities (e.g. presence of seismic survey activities, equipment and machinery, and personnel) and generation of noise, light, dust and vibration
- Increased traffic, use of roads and movement of vehicles and heavy machinery
- Potential for unauthorised site access; and
- Fire.

5.6.1. Disturbance from survey activities (e.g. light, noise, dust and vibration)

Disturbance from site activities (e.g. seismic lines and the presence of machinery and equipment) can result in short-term impact to landowners and nearby residents. A range of measures would be implemented to manage these potential impacts.

Road authorities, landowners (if access to private land is required) and other stakeholders (e.g. the local council) would be consulted regarding the proposed activities, with the aim of identifying potential issues and minimising disturbance through site selection and planning of activities. All survey activities would be restricted to daylight hours.

The timing and location of geophysical survey activities is typically undertaken in consultation with the local council and landowners to ensure there is minimal economic impact or disruption to the local community.

Noise limitation would be included as part of induction procedures with a focus on noise minimisation during early morning and evening activities (e.g. unnecessary use of horns, reversing of machinery). Noise generated during survey activities is transient and relatively low-level (similar to a truck passing at low speed) and is not expected to result in significant noise disturbance to the local community. Systems would be in place for logging stakeholder complaints to ensure that issues are addressed as appropriate.

Generation of dust during geophysical survey activities, and general use of unsealed roads and tracks, can result in temporary and localised impacts to air quality. Dust generation will be minimised by restriction of speeds on unsealed roads and spraying of unsealed roads with water if necessary to moderate the potential for dust generation, subject to council approval.

Generation of vibration associated with geophysical survey activities is largely restricted to heavy vehicle movements on roads and localised disturbance associated with vibroseis trucks or tractors for drop weight systems. As discussed in Section 3.3.1, vibroseis produces a low energy density, which allows it to be used in cities and other built-up areas. Vibroseis has been used in sensitive locations without damaging buildings or the environment (APPEA, 2019). Any vibration generated by the proposed survey activities would be very localised and short-term and would not be significant.

5.6.2. Use of roads and movement of vehicles and heavy machinery

The movement of vehicles and machinery along roads (including mobilisation and use of roads for survey operations) has the potential to increase noise disturbance to the community and can result in an increased road hazard to road users. Use of roads and tracks for geophysical survey operations could cause minor damage or degradation.

Impacts from survey-related transport movements would generally be short-term, with peak traffic movements occurring during initial and final mobilisation to and from a project location. Landowners, local councils, potentially affected residents and police will be informed of significant activities such as initial project mobilisation and final demobilisation. Transport procedures (e.g. speed restrictions, limitation of movements at night) will also reduce the potential level of impact. Project mobilisations will be restricted to daylight hours as far as possible.

A traffic management plan would be developed in consultation with the relevant road authority to ensure that road hazards from operation of slow-moving survey vehicles on public roads is appropriately managed. All necessary transport / road use permits will be obtained. Warning signage and traffic management measures (e.g. speed restrictions) will be implemented where required near the survey location, in accordance with local council and State government requirements.

The operation of vibroseis units on sealed and unsealed roads would not impact the surface of the road. On sealed roads with a bitumen surface, the operator would insert a rubber mat between the vibroseis plates and the road surface, while for unsealed roads the vibroseis plates are placed directly onto the road surface. Video recording to document the status of the road surface would be undertaken before and after operation of the vibroseis units to allow the impact of the operation to be assessed in real time. Several seismic surveys have been acquired in South Australia and Western Australia on public roads using this methodology and no damage has been reported to any of the roads used for the data acquisition.

Yorke Peninsula Council and DIT would be consulted regarding the proposed survey activities, including aspects such as traffic management and protection of the road surface condition.

5.6.3. Unauthorised site access

Unauthorised or uncontrolled access to a geophysical survey site (e.g. laydown area) could expose members of the public to potential harm. Access to the geophysical survey sites will be restricted (as far as is reasonably practicable) during operations (e.g. appropriate signage displayed at key locations). If access to private land is required, access points will be agreed and additional controls, such as the installation of gates, will be implemented.

5.6.4. Fire

Fire initiated by site activities (e.g. sparks from vehicles or equipment, cigarette butts) has the potential to significantly impact landowners and the community through damage to property or possibly loss of life. Measures discussed in Section 5.4.5 and 5.5.5 above would be implemented to manage fire risk.

Risk Assessment

The level of risk has been assessed as low for most of these potential hazards (see Table 5-4). A moderate risk is assigned for the use of roads and movement of heavy machinery; although it is not likely to occur, the consequence is major.

5.7. Cultural Heritage

The potential for impact to cultural heritage is expected to be very low for the proposed operations, as they will utilise existing roads and tracks and will have minimal requirement to access to private land.

A search of the Central Archive including the Register of Aboriginal Sites and Objects administered by Aboriginal Affairs and Reconciliation (AAR) would be undertaken to identify whether there are entries

for Aboriginal sites on or near proposed survey lines. Any identified sites or areas of cultural heritage significance would be avoided and flagged off where necessary.

Consultation would be carried out with the Narungga Nation Aboriginal Corporation if activities are located in areas where there is potential to impact cultural heritage, and a cultural heritage survey would be carried out if required. Cultural heritage surveys would not be required on existing roads.

Aboriginal and non-Aboriginal heritage awareness and issues would be covered in inductions and procedures would be in place to respond in the event that any sites, objects and remains are discovered during activities.

If Aboriginal sites, objects and remains are discovered during activities, works would halt in the vicinity of the discovery and advice would be sought from the Narungga Nation Aboriginal Corporation, a qualified heritage consultant or AAR. Mitigation measures would be implemented to ensure the discovery is avoided[16]. Any discovery would be reported as required under the Aboriginal Heritage Act[17].

Heritage registers (and the Heritage Branch, DEW, where appropriate) would be consulted regarding the location of non-Aboriginal heritage sites and any identified sites would be avoided.

Risk Assessment

The level of risk has been assessed as low (refer Table 5-4).

5.8. Local and Regional Economy

Many of the environmental risks discussed above have potential for negative economic impact on landowners and other stakeholders. However, the implementation of the measures discussed above would minimise both the environmental risk and the economic risk.

The proposed geophysical operations are relatively short-term and small scale and with the measures outlined in this EIR in place, they are not expected to have any adverse impact on the local or regional economy, rather a positive impact.

The proposed activities have the potential to result in some economic benefit, including

- potential for utilisation of local food, fuel and accommodation services which has direct benefit to business owners and benefits the regional economy.
- potential for engagement of local contractors for activities such as traffic management

The proposed activities also provide a benefit to the State in the increased understanding of the geological zones in the region.

If exploration for natural hydrogen is successful, there are a number of potential economic benefits for the community and the State:

- Natural hydrogen could provide a low-cost, clean energy source and play a key role in the transition to a decarbonised economy.
- There would be potential for natural hydrogen to be used locally, benefiting the local community.

[16] If the works cannot be relocated to avoid the Aboriginal site, object or remains, authorisation would be required pursuant to s23 of the Aboriginal Heritage Act.

[17] SA Police must be notified under the *Coroners Act 2003* if skeletal remains are discovered.

- Production of natural hydrogen on a commercial basis would result in royalties to be paid, which benefits the State.
- Economic activity associated with successful natural hydrogen production also has the potential to directly benefit business owners and the regional economy.

5.9. Environmental Risk Assessment Summary

As discussed in Section 5.1, Gold Hydrogen has undertaken an environmental risk assessment of the proposed activities. This section summarises the process and results of the assessment.

Table 5-4: Environmental risk assessment for low impact on-road geophysical activities in PEL 687 Yorke Peninsula

Risk Event / Hazard	Potential Environmental Impacts	Key Management Measures / Comments	Consequence	Likelihood	Residual Risk
Seismic line preparation **Survey infrastructure construction and rehabilitation / restoration activities**	Impacts to soil (e.g. increased erosion, inversion, compaction) Disturbance to natural drainage patterns Sedimentation of surface waters Visual impact	• Planning has been undertaken to minimise impacts of activities, and records are available for audit. • Existing roads and tracks are utilised. • Balloon tyres or tracked vibroseis trucks are used to reduce ground pressures and minimise impact on soil where necessary. • Survey line establishment is monitored and documented to ensure soil disturbance is minimised. • Original drainage patterns will be maintained. • Road authority / landowner consulted about proposed activities to minimise potential for surface disturbance / damage and facilitate rehabilitation / restoration (if required). • Any activities on private land conducted in accordance with land access agreement. • Imported paving materials (e.g. gravel at the laydown) are removed from site and soil profiles and contours restored, unless otherwise agreed with the landowner. • Any rehabilitation / restoration activities are undertaken in consultation with, and to the satisfaction of the road authority / landowner. • Remediation work (if required) carried out as soon as possible after completion of all activities.	Minor	Unlikely	**Low**
	Introduction and spread of weeds or pathogens	• All reasonable and practical endeavours taken to minimise the risks of introducing weeds, exotic pest fauna and pathogens into the areas of operation. • Appropriate consultation regarding weeds or pathogens carried out with road authority / landowner (and Landscape Board officers where appropriate). • Vehicles and equipment arriving at the site must be clean and free of soil and plant material. • Vehicles and equipment entering the region or moving between sites (especially from weed or pathogen infested areas into non-infested areas) will be assessed for the risk of transporting weeds and pathogens and cleaned down where appropriate. • Biosecurity procedures implemented as agreed with road authority / landowner. • Remain on sealed / gravelled roads and tracks where possible. • All records of vehicle or equipment inspections and cleaning will be kept for auditing. • Any records of detection, monitoring or eradication of weeds or pathogens introduced by activities are kept and available for review.	Minor	Unlikely	**Low**
	Damage to native vegetation and wildlife habitats Disturbance to native fauna	• Native vegetation clearance avoided by location of geophysical survey and associated infrastructure. • Vegetation trimmed, not removed, if required. • Vehicles avoid driving or parking in areas where native vegetation is present. (Note that 'native vegetation' includes small shrubs, herbs and native grasses as well as large shrubs and trees). • Activities are not carried out in parks or reserves established under the National Parks and Wildlife Act. • If proposed activities are in close proximity to a park or reserve established under the National Parks and Wildlife Act and indirect impacts are likely, consultation is undertaken with DEW to determine appropriate mitigation measures. • Fauna mortality (if it occurs) to be captured by incident reporting system and advice from an ecologist if required. • Feeding of wildlife is not permitted. • No domestic pets allowed at operational sites. • No unauthorised off-road or off-line driving or creation of shortcuts.	Minor	Unlikely	**Low**
	Damage to infrastructure Disturbance to stock Disturbance to land use Disturbance to local community Dust generation Noise generation Light generation Vibration generation	• Road authority / landowner consulted regarding the location, management and timing of proposed activities. • Road authority / landowner consulted about proposed activities to minimise potential for surface disturbance / damage and facilitate rehabilitation / restoration (if required). • Land access agreements are agreed and put into place before any activities are undertaken on private land. • Any activities on private land conducted in accordance with land access agreement. • Activities are restricted to agreed / defined areas / times. • Systems in place for logging stakeholder complaints to ensure that issues are addressed as appropriate. • Compliance with Part 10 of the PGE Act (Notice of Entry requirements). • If necessary, unsealed roads and tracks are sprayed with water as required to minimise dust generation (subject to council approval). • Noise limitation (particularly during early morning/evening) to be included as part of induction procedures (e.g. unnecessary use of horns, reversing of machinery).	Minor	Unlikely	**Low**

Risk Event / Hazard	Potential Environmental Impacts	Key Management Measures / Comments	Consequence	Likelihood	Residual Risk
		• Equipment operated and maintained in accordance with manufacturer specifications. • Transport trucks to be restricted to daylight hours as far as possible. • Drivers of heavy vehicles to be instructed not to use engine brake near dwellings. • Adequate buffer maintained between proposed activities and residences. • Assessments of potential noise impacts undertaken as appropriate during design and planning stages. • Lighting will be positioned to minimise light emanating from sites (e.g. laydown) during operations.			

	Damage to cultural heritage sites	• Existing roads and tracks are utilised.
		• Activities avoid areas of identified cultural heritage significance (e.g. any sites identified in searches of the Central Archive and the Register of Aboriginal Sites and Objects).
		• Consultation carried out with the Narungga Nation Aboriginal Corporation if activities are located in areas where there is potential to impact cultural heritage, and a cultural heritage survey carried out where required. Any identified sites are avoided.
		• Cultural heritage awareness and issues covered in inductions. Key personnel (e.g. supervisors, machinery operators) receive appropriate cultural heritage training.
		• Procedures consistent with the relevant obligations under the Aboriginal Heritage Act are in place to appropriately report and respond to any sites discovered during activities.
		• If Aboriginal sites, objects and remains are discovered during activities:
		  ○ works would halt in the vicinity of the discovery
		  ○ advice would be sought from the Narungga Nation Aboriginal Corporation, a qualified heritage consultant or AAR
		  ○ mitigation measures would be implemented to ensure the discovery is avoided. (If the works cannot be relocated to avoid the Aboriginal site, object or remains, authorisation would be obtained under the Aboriginal Heritage Act).
		• Aboriginal heritage discoveries reported to AAR on behalf of the Minister in accordance with section 20 of the Aboriginal Heritage Act.
		• Records relating to management/avoidance of any identified sites of cultural heritage significance kept and available for audit.
		• Heritage site registers (and Heritage Branch, DEW, where appropriate) consulted regarding the location of non-Aboriginal heritage sites and any identified sites are avoided.
			Moderate	Remote	**Low**

Physical presence of machinery, equipment, and personnel. **Light emissions** **Vibration emissions**	Visual impact Disturbance to native fauna Disturbance to stock Disturbance to land use Disturbance to local community	• Road authority / landowners and relevant stakeholders consulted regarding location of proposed activities. • Activities are restricted to agreed / defined areas / times. • Machinery and equipment removed from site promptly following completion of activities, particularly in visible locations. • Systems in place for logging stakeholder complaints to ensure that issues are addressed as appropriate. • Adequate buffers maintained between proposed activities and residences. • See measures listed under light and vibration generation, disturbance to stock, land use and local community listed above.	Minor	Unlikely	**Low**
Use of roads; movement of vehicles and heavy machinery	Injury or death of stock or fauna Dust generation Noise generation Damage to third party infrastructure Damage to road pavement Disturbance to local community	• Traffic management plan developed in consultation with road authority. • Road authority / landowner consulted about proposed activities to minimise potential for surface disturbance / damage and facilitate rehabilitation / restoration (if required). • If operating on sealed roads, vibroseis trucks or weight drop units implement measures to avoid damage to the road pavement (e.g. use of rubber mats between vibroseis plates and bitumen surface, operation of weight drop units on the road shoulder or verge). • Documentation of road surface condition before and after vibroseis operation (e.g. video recording). • Compliance with relevant speed restrictions on roads and tracks. • If necessary, unsealed roads and tracks are sprayed with water as required to minimise dust generation (subject to council approval). • Warning signage and traffic management measures (e.g. speed restrictions) installed where appropriate. • Driver behaviour and vehicle speed limits to be included in compulsory induction. • Vehicle speed limits to be observed. • Landowners, local councils, potentially affected residents and emergency services will be informed of significant activities such as initial mobilisation and final demobilisation from project sites. • Any required authorisations (e.g. local council, DIT, police) obtained where required for movement of heavy vehicles along public roads (and transport of dangerous goods), including joint inspections of roads before and after transport moves if necessary.	Minor	Unlikely	**Low**
	Road hazard / disturbance to local road users		Moderate	Remote	**Medium**

Risk Event / Hazard	Potential Environmental Impacts	Key Management Measures / Comments	Consequence	Likelihood	Residual Risk
		• Project site mobilisation and demobilisations to detour around town centres where possible. • Refer to measures listed under noise generation, disturbance to stock, land use and local community above.			
Air emissions	Reduction in local air quality Generation of greenhouse gas emissions	• Equipment operated and maintained in accordance with manufacturer specifications. • If necessary, unsealed roads and tracks are sprayed with water as required to minimise dust generation (subject to council approval).	Minor	Unlikely	**Low**
Noise emissions	Disturbance to native fauna Disturbance to stock Disturbance to local community	• Assessments of potential noise impacts undertaken as appropriate during design and planning stages. • Equipment operated and maintained in accordance with manufacturer specifications. • Transport trucks to be restricted to daylight hours as far as possible. • Drivers of heavy vehicles to be instructed not to use engine brake near dwellings. • Noise limitation (particularly during early morning and evening) to be included as part of induction procedures (e.g. unnecessary use of horns, reversing of machinery). • Systems in place for logging stakeholder complaints to ensure that issues are addressed as appropriate. • Refer to measures listed under noise generation, disturbance to stock, land use and local community above.	Minor	Unlikely	**Low**
Spills or leaks associated with: • **storage of fuel, oil and chemicals** • **refuelling operations and high-pressure hydraulic systems**	Localised contamination of soil, surface water and groundwater.	• All fuel and chemical storage areas will be in accordance with relevant standards and guidelines (e.g. AS 1940, EPA guideline 080/16 Bunding and Spill Management and the Australian Dangerous Goods Code). • Hazardous materials stored, used and disposed of in accordance with relevant legislation on dangerous substances. • Generators (if required e.g. at laydown) to be appropriately located to contain any spills (e.g. in polyethylene lined bunded areas or with suitable alternative spill containment). • Refuelling undertaken in designated refuelling or servicing areas. • Appropriate drip capture / spill capture methods implemented in refuelling areas (e.g. use of drip trays or liners). • Field refuelling of vibroseis trucks (if required) undertaken in a safe location, away from native vegetation or surface water features, with appropriate measures in place (e.g. fire extinguishers, emergency isolation lever / stop button, spill response equipment). • Appropriate spill response equipment is available on site. • Personnel have received training in the use of spill response equipment. • Spills or leaks are immediately reported and clean up actions initiated. • All contaminated soil will either be treated in-situ or removed for treatment / disposal at an EPA approved facility. • Assessment and remediation of uncontained spills with larger scale impact is consistent with the National Environment Protection (Assessment of Site Contamination) Measure and relevant guidelines (e.g. SA EPA guidelines). • Records of any spill events and corrective actions are maintained. • Relevant Safety Data Sheet information readily available on site.	Minor	Unlikely	**Low**
	Damage to native vegetation and wildlife habitats Access to contaminants by stock and wildlife Danger to health and safety of employees, contractors and possibly the public		Minor	Unlikely	**Low**
Unauthorised access by third parties	Injury / danger to health and safety of employees, contractors and third parties	• Signage warning of access restrictions / hazards placed at the entry to geophysical operations specific work sites (e.g. laydown) as appropriate. • If access to private land is required, access points will be agreed and additional controls, such as the installation of gates, will be implemented.	Minor	Unlikely	**Low**
Fire (resulting from activities)	Danger to health and safety of employees, contractors and possibly the public	• Existing roads and tracks are utilised. • Liaise with CFS regarding operations to ensure fire concerns are addressed and any Fire and Emergency Services Act requirements are met. • Response to fire included in Emergency Response Plan. • Where necessary (e.g. in fire danger season), fire break constructed around operational sites (e.g. laydown). • Emergency response procedures included in staff training. • Ensure fire risk is included in the induction and all personnel are fully informed on the fire danger season and associated restrictions.	Moderate	Remote	**Low**
	Loss of vegetation and habitat Disturbance, injury or death of fauna Atmospheric pollution Damage to infrastructure Disruption to land use		Moderate	Remote	**Low**

Risk Event / Hazard	Potential Environmental Impacts	Key Management Measures / Comments	Consequence	Likelihood	Residual Risk
Storage, handling and disposal of waste	Localised contamination of soil, surface water and groundwater Damage to vegetation and habitat Attraction of scavenging animals (native / pest species) and access to contaminants by stock and wildlife Litter / loss of visual amenity	• EPA's Waste Hierarchy model (avoid, reduce, reuse, recycle, recover, treat, dispose) should be complied with and waste management undertaken with regard to the *Environment Protection (Waste to Resources) Policy 2010*. • Covered bins are provided for the collection and storage of wastes. All loads of rubbish are covered during transport to an approved waste facility. • Waste streams are segregated on site and transported to appropriate facilities to maximise waste recovery, reuse and recycling. • Production of waste is minimised by purchasing reusable, biodegradable or recyclable materials where practical. • Waste disposal is at an EPA licensed facility. • Any hazardous wastes handled in accordance with relevant legislation and standards. • Licensed contractors used for waste transport. • If wastewater disposal system is used (e.g. at laydown), wastewater disposal is in accordance with the *South Australian Public Health (Wastewater) Regulations 2013* and in compliance with the South Australian Health On-site Wastewater Systems Code. Any necessary approvals (e.g. local council) are obtained for use of wastewater disposal system. • Survey areas are kept free of litter and rubbish.	Minor	Unlikely	**Low**

6. Environmental Management Framework

Geophysical operations will be undertaken in accordance with Gold Hydrogen's Health, Safety and Environment (HSE) Management Plan. It provides a framework for the coordinated and consistent management of environmental issues and addresses the:

- establishment of an environmental policy (https://www.goldhydrogen.com.au)
- identification of environmental risks and legal and other requirements relevant to the operations
- setting of appropriate environmental objectives and targets
- delineation of responsibilities
- establishment of a structure and program to implement environmental policy and achieve objectives and targets, including the development of procedures or guidelines for specific activities and education and induction programs
- facilitation of planning, control monitoring, corrective action, auditing and review of activities to ensure that the requirements and aspirations of the environmental policy are achieved.

Key aspects are discussed in the following sections.

Environmental objectives

Environmental objectives for geophysical operations have been developed based on the information and issues identified in this EIR and are detailed in the accompanying Statement of Environmental Objectives.

Responsibilities

Environmental management and compliance is the responsibility of all personnel.

The overall responsibility for environmental compliance lies with Gold Hydrogen, who will maintain a high level of on-site supervision. The geophysical survey contractors and individuals will also be responsible and accountable through their conditions of contract. The training of all personnel will ensure that each individual is aware of their environmental responsibility.

Indicative organisation and responsibilities for environmental management are outlined in Table 6-1. It is noted that the exact nature and title of these roles may vary and positions may be amalgamated or the responsibilities shared.

Table 6-1: Indicative roles and responsibilities

Role	Responsibility
Gold Hydrogen management	Licence holders Hold overall responsibility for activities and environmental management Responsible for coordinating the management of the activities, including all environmental aspects Responsible for overall implementation of EHS Responsible for the overseeing and fulfilling of commitments contained in EIR and SEO Overall responsibility for reporting on environmental performance and due diligence Coordinates environmental incident internal reporting and investigation

Role	Responsibility
	Incident notification to authorities
Gold Hydrogen on-site supervisor	Directly responsible for on-site management, including all environmental aspects Responsible for the overseeing and fulfilling of commitments contained in EIR and SEO Reports to Gold Hydrogen management on environmental performance and due diligence Coordinates the monitoring and audit program Environmental internal reporting and incident investigation
Contractor on-site Manager	Responsible for ensuring that works meet regulatory requirements and all environmental objectives contained in the SEO Directly responsible for the overseeing and fulfilling of commitments contained in relevant approvals, EIR and SEO Responsible for ensuring adequate resources are provided for constructing and maintaining environmental controls Inspection of work area to ensure appropriate environmental management Environmental internal reporting and incident investigation Reports to the GHY on-site supervisor

Environmental management procedures

All employees and contractors are responsible for ensuring compliance with environmental procedures which are contained in the HSE Management Plan and associated documents. The HSE Management Plan and associated procedures are developed to identify environmental risks and set minimum operating standards to ensure that Gold Hydrogen and its contractors comply with the relevant environmental legislation.

Induction and training

Prior to the start of field operations all field personnel will be required to undertake an environmental induction to ensure they understand their role in protecting the environment. This induction will be part of a general induction process which also includes safety procedures. Site specific environmental requirements will be documented in the work program or work instruction.

A record of induction and attendees will be maintained.

Emergency response and contingency planning

In the course of normal operations, there is always the potential for environmental incidents and accidents to occur. To manage these incidents, emergency response plans are developed to guide actions to be taken to minimise the impacts of accidents and incidents. Emergency response plans will be reviewed and updated on a regular basis to incorporate new information arising from any incidents, near misses and hazards and emergency response simulation training sessions. These plans will also include the facilitation of fire danger season restrictions and requirements.

Emergency response drills will also be undertaken at regular intervals to ensure that personnel are familiar with the plans and the types of emergencies to which they apply, and that there will be a rapid and effective response in the event of a real emergency occurring.

Environmental monitoring and audits

Monitoring and auditing of geophysical operations will be undertaken to determine whether significant environmental risks are being managed, minimised and where reasonably possible, eliminated.

Monitoring and auditing undertaken will assess aspects such as:

- compliance with regulatory requirements (particularly the Statement of Environmental Objectives)
- impact upon land use and infrastructure
- impact on flora and fauna
- visual impact of the operations
- contractor performance.

Incident management, recording and corrective actions

Gold Hydrogen and its contractors have a system in place to record environmental incidents, near misses and hazards, track the implementation and close out of corrective actions, and allow analysis of such incidents to identify areas requiring improvement. The system also provides a mechanism for recording 'reportable' incidents, as defined under the PGE Act and associated regulations.

Reporting

Internal and external reporting procedures will be implemented to ensure that environmental issues and / or incidents are appropriately responded to. A key component of the internal reporting will be contractors' progress and incident reports to Gold Hydrogen.

External reporting (e.g. incidents, annual reports) will be carried out in accordance with PGE Act requirements (and Environment Protection Act requirements where applicable) and the SEO. Incident reporting requirements are detailed in the SEO.

7. Stakeholder Consultation

7.1. Context for Community Engagement

Yorke Peninsula is an economically important primary production area, with the region's rich limestone soil making it some of the most highly productive land in Australia and one of the best wheat and barley growing regions in the world. A significant proportion of the community is involved in primary production and the rural lifestyle and heritage and natural environment of Yorke Peninsula are highly valued by the local community and visitors alike.

Exploration for natural hydrogen is a new development for energy production as the world moves to a decarbonised economy. Yorke Peninsula previously experienced a brief period more than ninety years ago of exploration drilling for petroleum (which was short-lived and unsuccessful) and seismic surveys were undertaken in the 1960s and 1980s. Gold Hydrogen acknowledges that understanding in the Yorke Peninsula community of the concept of natural hydrogen is likely to be limited, and that the activities which are the subject of the draft EIR and the accompanying SEO may be unfamiliar. Accordingly, Gold Hydrogen takes seriously its responsibility to provide the Yorke Peninsula community with timely, accurate, accessible information, and opportunities to learn more about natural hydrogen and the proposed exploration activities in PEL 687.

As a leader in this emerging sector, Gold Hydrogen understands the importance of establishing credibility and trust in the manner in which it undertakes exploration activities and builds relationships with the community within which it wishes to operate.

7.2. Stakeholder and Community Engagement

Gold Hydrogen is committed to early, genuine and transparent engagement with the Yorke Peninsula community. Prior to commencing stakeholder engagement for the Ramsay Project, Gold Hydrogen developed a project-specific stakeholder and community engagement strategy to guide its approach to identifying and engaging with community stakeholders.

The strategy sets out key desired outcomes, a process for identifying important stakeholders and appropriate engagement strategies. The overall objectives of the strategy are to:

- Establish community and stakeholder confidence in the Natural Hydrogen project and Gold Hydrogen's ability to deliver it
- Build relationships and foster trust through transparent, genuine two-way engagement
- Build shared value and support for the project through strong community partnerships.

The strategy identifies the stakeholders and engagement that is planned to be undertaken to underpin natural hydrogen exploration activities in PEL 687. Early engagement priorities included detailed discussions with key landowners (e.g. whose properties are either potential sites for drilling or adjacent), and meetings with the Yorke Peninsula Council, local State and Federal MPs, and the Narungga Nation Aboriginal Corporation.

Table 7-1 outlines the stakeholders that have been identified and consultation that has been undertaken by Gold Hydrogen regarding its activities. Further discussion on consultation undertaken during the development of this EIR and SEO is provided in Section 7.3.

Table 7-1: Stakeholders and engagement undertaken for Gold Hydrogen activities

Category	Stakeholder / stakeholder group	Engagement (*activities specific to the geophysical EIR and SEO in bold)
Community	Yorke Peninsula community	Details of preliminary activities (airborne geophysical and soil gas surveys) and information sheets provided on the Gold Hydrogen website, council offices and advertised in local paper. Newspaper advertisements inviting comments on the draft drilling EIR / SEO and advertising drop-in sessions. Community drop-in sessions in Minlaton in May/June 2023. Draft drilling EIR / SEO placed on Gold Hydrogen website inviting community comments. General community discussions during the recent Ramsay 1 and 2 drilling programs, with all GHY staff and contractors staying locally. Attendance at local community events, shows etc. Note: GHY had very positive interactions with the local community during 2023 with no issues raised about recent drilling program. **Draft Geophysical EIR / SEO (this document) will be placed on Gold Hydrogen website inviting community comments.**
Traditional Owners	Narungga Nation Aboriginal Corporation	Telephone calls, emails, provision of information sheets and in-person meetings regarding Gold Hydrogen and project activities. Email correspondence regarding availability of draft drilling EIR / SEO for comment. Completion of site clearance work for Ramsay 1 and 2. Invitations to site induction meeting and an open invite for a tour of the Ramsay 1 and 2 sites. **Email advice that the draft Geophysical EIR / SEO (this document) will be available on the website inviting community comments (in progress**).
	Other Aboriginal groups or people who may have an interest in the Project	Details of preliminary activities (airborne geophysical and soil gas surveys) and information sheets provided on the Gold Hydrogen website, council offices and advertised in local paper. Newspaper advertisements inviting comments on the draft drilling EIR / SEO and community drop-in sessions in May/June 2023. Draft drilling EIR / SEO placed on Gold Hydrogen website inviting community comments. **Draft Geophysical EIR / SEO (this document) will be placed on Gold Hydrogen website inviting community comments (in progress).**
Council	Yorke Peninsula Council	Meetings with council CEO and Director Development Services regarding Gold Hydrogen and project activities. Regular correspondence over two years providing updates on the project to Mayor and the CEO. Email regarding availability of draft drilling EIR / SEO for comment. **Meeting in January 2024 to discuss proposed geophysical activities.** **Email advice that the draft Geophysical EIR / SEO (this document) will be available on the website inviting community comments (in progress).**
Government Departments and Agencies	Department for Energy and Mining	**Meetings and ongoing engagement during preparation of** the draft drilling **and geophysical EIRs and SEOs**, activity approvals and regulatory reporting. Site visits at Ramsay 1 and 2.
	Department for Environment and Water	Engagement as part of airborne survey activities. Email correspondence regarding comments on draft drilling EIR / SEO. Consulted on draft drilling EIR / SEO as part of DEM formal consultation phase.

Category	Stakeholder / stakeholder group	Engagement (*activities specific to the geophysical EIR and SEO in bold)
		Email advice that the draft Geophysical EIR / SEO (this document) will be available on the website inviting community comments (in progress).
	PIRSA	Email regarding availability of draft drilling EIR / SEO for comment. Consulted on draft drilling EIR / SEO as part of DEM formal consultation phase. **Email advice that the draft Geophysical EIR / SEO (this document) will be available on the website inviting community comments (in progress).**
	Department of Infrastructure and Transport	Advice of proposed soil gas sampling on road reserves. Email regarding availability of draft drilling EIR / SEO for comment. Consulted on draft drilling EIR / SEO as part of DEM formal consultation phase. **Emailed in January 2024 regarding proposed geophysical activities.** **Email advice that the draft Geophysical EIR / SEO (this document) will be available on the website inviting community comments (in progress).**
	Planning and Land Use Services (PLUS)	Email regarding availability of draft drilling EIR / SEO for comment. Consulted on draft drilling EIR / SEO as part of DEM formal consultation phase. **Email advice that the draft Geophysical EIR / SEO (this document) will be available on the website inviting community comments (in progress).**
	Environment Protection Authority	Email correspondence regarding comments on draft drilling EIR / SEO. Consulted on draft drilling EIR / SEO as part of DEM formal consultation phase. **Email advice that the draft Geophysical EIR / SEO (this document) will be available on the website inviting community comments (in progress).**
	Aboriginal Affairs and Reconciliation	Engagement in relation to consultation with Traditional Owner groups and location of Aboriginal cultural heritage. Email correspondence regarding comments on draft drilling EIR / SEO. Consulted on draft drilling EIR / SEO as part of DEM formal consultation phase. **Email advice that the draft Geophysical EIR / SEO (this document) will be available on the website inviting community comments (in progress).**
	SafeWork	Email regarding availability of draft drilling EIR / SEO for comment. Consulted on draft drilling EIR / SEO as part of DEM formal consultation phase. **Email advice that the draft Geophysical EIR / SEO (this document) will be available on the website inviting community comments (in progress).**
	SA Health	Consulted on draft drilling EIR / SEO as part of DEM formal consultation phase.
	Country Fire Service (CFS)	Will be consulted as part of planning of exploration operations where required.
	South Australia Police (SAPOL)	Will be consulted as part of planning of exploration operations where required (e.g. in relation to rig moves).
	Northern and Yorke Landscape Board	Email regarding availability of draft drilling EIR / SEO for comment. Consulted on draft drilling EIR / SEO as part of DEM formal consultation phase. **Email advice that the draft Geophysical EIR / SEO (this document) will be available on the website inviting community comments (in progress).**
	Regional Development Australia Yorke and Mid North	Email regarding availability of draft drilling EIR / SEO for comment. **Email advice that the draft Geophysical EIR / SEO (this document) will be available on the website inviting community comments (in progress).**

Category	Stakeholder / stakeholder group	Engagement (*activities specific to the geophysical EIR and SEO in bold)
Non-government Organisations	South Australian Chamber of Mines & Energy (SACOME)	Email regarding availability of draft drilling EIR / SEO for comment. **Email advice that the draft Geophysical EIR / SEO (this document) will be available on the website inviting community comments (in progress).**
	Landowner Information Service	Email regarding availability of draft drilling EIR / SEO for comment. **Email advice that the draft Geophysical EIR / SEO (this document) will be available on the website inviting community comments (in progress).**
	Conservation Council SA	Email regarding availability of draft drilling EIR / SEO for comment. **Email advice that the draft Geophysical EIR / SEO (this document) will be available on the website inviting community comments (in progress).**
	Wilderness Society	Email regarding availability of draft drilling EIR / SEO for comment. **Email advice that the draft Geophysical EIR / SEO (this document) will be available on the website inviting community comments (in progress).**
Elected representatives	Rowan Ramsey MP (Federal MP for Grey)	Multiple meetings regarding Gold Hydrogen and initial project activities and providing updates on the project
	Tom Koutsantonis MP – Minister for Energy and Mining	Meetings with policy advisors and regular briefings provided.
	Susan Close MP - Minister for Climate, Environment and Water	Minister's office contacted to provide briefing on the project.
	Fraser Ellis, State Member for Narungga, Independent (Yorke Peninsula)	Meeting in February regarding Gold Hydrogen and initial project activity. Regular correspondence over two years providing updates on the project.

7.3. Stakeholder Consultation on the draft EIR and SEO

Given the location and low impact nature of the proposed activities, Gold Hydrogen is undertaking a focused stakeholder consultation program.

In addition to directly consulting authorities for the roads that will be used in the survey (DIT and Yorke Peninsula Council), Gold Hydrogen will make the drafts of the geophysical EIR and accompanying SEO publicly available for comment on its website. This will provide the community with the opportunity to learn more about the purpose and aims of the proposed activities, and provide feedback about specific or general concerns or issues before the EIR and draft SEO are formally submitted to DEM.

To notify the community of the availability of the draft EIR and SEO, newspaper advertisements will be placed in the Yorke Peninsula Country Times.

Other stakeholders identified in Table 7-1 will be emailed advising that the draft documents are available for viewing and indicating that Gold Hydrogen would welcome any comments on the draft documents and would be happy to discuss the documents or the planned exploration program.

Issues raised in stakeholder comments and Gold Hydrogen's responses will be summarised in Table B-1 in Appendix B. The EIR and draft SEO will be updated accordingly for formal submission to DEM, for further review and consultation under the formal PGE Act consultation process (summarised below).

7.4. Formal PGE Act Consultation Process

This EIR and draft SEO will be formally submitted to DEM in after being updated to address the issues raised during Gold Hydrogen's stakeholder consultation.

DEM, through concurrence with EPA and DEW, will classify the level of impact of the activity (refer Section 2.1.3). Government agencies will subsequently be formally consulted by DEM under the PGE Act process. A period of further public consultation may also be conducted by DEM depending on the classification of level of impact.

All feedback received from government agencies, the community and other stakeholders through the PGE Act consultation process will be detailed and addressed in Table C-1 in Appendix C in the final EIR and SEO to be submitted to DEM for approval.

7.5. Ongoing Consultation

Gold Hydrogen undertakes to continue to engage with and update affected landowners, the community and other stakeholders should geophysical survey activities be approved. This could include (but not be limited to) consulting and advising affected stakeholders of proposed activities in a timely manner, responding to any issues raised, maintaining a database of interested stakeholders in order to provide regular updates, including information on the website on progress of the Ramsay Project and provision of factsheets and other information.

8. References

AAR (2023). *Managing Aboriginal heritage in South Australia.* Fact sheet. Accessed June 2023 at https://www.agd.sa.gov.au/__data/assets/pdf_file/0011/908417/Managing-Aboriginal-heritage-in-South-Australia.pdf. Aboriginal Affairs and Reconciliation, Attorney General's Department.

ABS (2021). Yorke Peninsula – 2021 Census All persons QuickStats. Accessed 17/11/2022 at https://www.abs.gov.au/census/find-census-data/quickstats/2021/LGA48830.

AGL (2021). *Yorke Peninsula community hubs powered by AGL*. Accessed November 2022 at https://www.agl.com.au/about-agl/media-centre/asx-and-media-releases/2021/september/yorke-peninsula-community-hubs-powered-by-agl?7zs43y=jpts1o

Alcoe, D. and Berens, V. (2011). *Non-prescribed groundwater resources assessment – Northern and Yorke Natural Resources Management Region. Phase 1 – Literature and Data Review.* Science, Monitoring and Information Division. Department for Water. Technical Report DFW 2011/17. June 2011.

ANZECC/ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).

ANZG (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Canberra: Australian and New Zealand Governments and Australian state and territory governments.

APPEA (2019). Seismic Surveys. Accessed: 28 December 2019 at https://www.appea.com.au/oil-gas-explained/operation/seismic-surveys/. Australian Petroleum Production & Exploration Association. Canberra, Australian Capital Territory.

ASRIS (2022). Australian Soil Resource Information System. Accessed on 17/11/2022. http://www.asris.csiro.au/mapping/viewer.htm.

BOM (2019). Terrestrial GDE. Accessed at https://map.sarig.sa.gov.au/.

BOM (2022a). Climate data online. Accessed on 16/11/2022 at http://www.bom.gov.au/climate/data/index.shtml.

BOM (2022b). Groundwater Dependent Ecosystems Atlas. Accessed 17/11/2022 at http://www.bom.gov.au/water/groundwater/gde/map.shtml.

BoM (2023). Climate classification maps. Accessed April 2023 at http://www.bom.gov.au/climate/maps/averages/climate-classification/.

Cohen, K.M., Finney, S.C., Gibbard, P.L. & Fan, J.-X. (2013; updated). The ICS International Chronostratigraphic Chart. Episodes 36: 199-204. URL: http://www.stratigraphy.org/ICSchart/ChronostratChart2022-02.pdf

DCCEEW (2022a). Australian Heritage Database. Accessed 17/11/2022 at http://www.environment.gov.au/cgi-bin/ahdb/search.pl. Department of Climate Change, Energy, the Environment and Water.

DCCEEW (2022b). EPBC Act Protected Matters Search Tool. Accessed at https://pmst.awe.gov.au, October 2022. Department of Climate Change, Energy, the Environment and Water, Canberra.

DEM (2022). Mineral Production Tenements. Accessed at https://map.sarig.sa.gov.au/.

DEM (2023). Stansbury Basin. Accessed February 2023 at https://www.energymining.sa.gov.au/industry/energy-resources/geology-and-prospectivity/neoproterozoic-middle-paleozoic-basins/stansbury-basin#accordion-697991-2. Department for Energy And Mining, South Australia.

DEW (2013). Interim Biogeographic Regionalisation for Australia (IBRA Version 7.0) Associations (Part SA only). GIS dataset 1107. Accessed at https://data.environment.sa.gov.au/NatureMaps.

DEW (2014). Land Use (ACLUMP). GIS dataset 2072. Accessed at http://spatialwebapps.environment.sa.gov.au/naturemaps/?locale=en-us&viewer=naturemaps

DEW (2018). Native Vegetation Floristic Areas - NVIS - Statewide (Incomplete Version). GIS dataset 898. Accessed at http://spatialwebapps.environment.sa.gov.au/naturemaps/?locale=en-us&viewer=naturemaps.

DEW (2016a). Shallow Standing Water Level. GIS dataset 1021. Accessed at https://map.sarig.sa.gov.au/.

DEW (2016b). Shallow Total Dissolved Salts. GIS dataset 1026. Accessed at https://map.sarig.sa.gov.au/.

DEW (2022a). Biological Database of South Australian search. Recordset DEWNRBDBSA220517-1. Department for Environment and Water, Adelaide

DEW (2022b). SA Heritage Places Database Search. Accessed 17/11/2022 at https://maps.sa.gov.au/heritagesearch/HeritageSearchLocation.aspx

DEW (2023). Locations of Phytophthora Infestations. GIS dataset 1080. Accessed at http://spatialwebapps.environment.sa.gov.au/naturemaps/?locale=en-us&viewer=naturemaps

DEWNR (undated). Winulta Creek Land System. DEWNR Soil and Land Program. Department of Environment, Water and Natural Resources. Accessed April 2023 at https://data.environment.sa.gov.au/Content/Land-System-reports/WIC.pdf.

DIT (2022a). Phytophthora (Dieback) Control Environmental Instruction. Department for Infrastructure and Transport, South Australia. Accessed at https://www.dit.sa.gov.au/standards?a=921168.

DIT (2022b). Railway. Department for Infrastructure and Transport, South Australia. Accessed at https://map.sarig.sa.gov.au/

DIT (2023). Traffic volumes. Department for Infrastructure and Transport, South Australia. Accessed March 2023 at https://www.dit.sa.gov.au/traffic_volumes.

ElectraNet (2022). Dalrymple ESCRI-SA Battery Project. https://www.electranet.com.au/electranets-battery-storage-project/ Accessed 25/11/2022

ElectraNet (2022). Power Transmission Network (ElectraNet). GIS dataset 1912. Accessed at https://map.sarig.sa.gov.au/

Gold Hydrogen (2023). *Natural Hydrogen Exploration Drilling and Well Testing Environmental Impact Report PEL 687 Yorke Peninsula. August 2023.*

Graham, A. Oppermann, A. and Inns, R.W. (2001). *Biodiversity Plan for the Northern Agricultural Districts*. Department for Environment and Heritage, South Australia.

Gravestock, D.I., Alexander, E.M., Demidenko, Yu.E., Esakova, N.V., Holmer, L.E., Jago, J.B., Lin, T., Melnikova, L.M., Parkhaev, P.Yu., Rozanov, A.Yu., Ushatinskaya, G.T., Zang, W., Zhegallo, E.A., and

A.Yu. Zhuravlev (2001). The Cambrian biostratigraphy of the Stansbury Basin, South Australia. Palaeontological Institute RAS, Transactions 282: 1-344.

GSA (2022). Attraction – Wattle Point Wind Farm. Accessed 17/11/2022 at https://southaustralia.com/products/yorke-peninsula/attraction/wattle-point-wind-farm

Landscape SA Northern and Yorke (2022a). Native Plants. Accessed 25/11/2022 at https://www.landscape.sa.gov.au/ny/plants-and-animals/native-plants-and-animals/native-plants.

Landscape SA Northern and Yorke (2022b). Pest Animals. Accessed 18/11/2022 at https://www.landscape.sa.gov.au/ny/plants-and-animals/pest-plants-and-animals/pest-animals.

Landscape SA Northern and Yorke (2022c). Soil management. Accessed 25/11/2022 at https://www.landscape.sa.gov.au/ny/land-and-coast/land-management/soil-management.

Landscape SA Northern and Yorke (20223). Wetlands. Accessed 30/3/2023 at https://www.landscape.sa.gov.au/ny/water/managing-water-resources/wetlands

Laut, P., Heyligers, P.C., Keig, G., Loffler, E., Margules, C., Scott, R.M. and Sullivan, M.E. (1977). *Environments of South Australia*. Division of Land Use Research, CSIRO, Canberra.

Magarey, P.D. and Deane, D. (2004). *Small Groundwater Basins Risk Assessment: Northern and Yorke Agricultural District.* Department of Water, Land and Biodiversity Conservation. Report, DWLBC 2004/54.

Marna Banggara (2023). Project Overview. Accessed April 2023 at https://marnabanggara.com.au/.

N&Y NRMB (2009). *Northern and Yorke regional NRM plan, Volume A: State of the region report 2008.* Northern and Yorke Natural Resources Management Board, Crystal Brook.

N&Y LB (2020). Water-Affecting Activities Control Policy. Northern and Yorke Landscape Board, December 2020.

National Native Title Tribunal (NNTT) (2022). Application Details – Narungga Nation (SC2013/002). Accessed at http://www.nntt.gov.au/searchRegApps/NativeTitleClaims/Pages/details.aspx?NTDA_Fileno=SC2013/002. Accessed on 17/11/2022

Natural Resources Northern and Yorke. Managing pest plants. Accessed at https://cdn.environment.sa.gov.au/landscape/docs/ny/2019_managing_pest_plants_yorke_district_fact_sheet.pdf. Accessed on 18/11/2022

NatureMaps (2022). http://spatialwebapps.environment.sa.gov.au/naturemaps/?locale=en-us&viewer=naturemaps. Accessed 17/11/2022

NIAA (2023). Wardang Island IPA. National Indigenous Australians Agency. Accessed April 2023 at https://www.niaa.gov.au/indigenous-affairs/environment/wardang-island-ipa.

Normington V.J., Hill S.M., Tiddy C.J., and Giles D. (2018). *Sedimentology of the late Palaeozoic Cape Jervis Formation, Troubridge Basin, South Australia*, Report Book 2018/00026. Department for Energy and Mining, South Australia, Adelaide.

PIRSA (2023). *South Australian Crop and Pasture Report, 2022-23 Final Summary, March 2023*. Department of Primary Industries and Regions.

Preiss, W. V., (Compiler, 1987). *The Adelaide Geosyncline – Late Proterozoic Stratigraphy, Sedimentation, Palaeontology and Tectonics.* Bulletin 53, Geological Survey of South Australia.

Roberts, S. (2007). *Northern and Yorke Natural Resources Management Region water monitoring review*. DWLBC Report 2006/15. Department of Water, Land and Biodiversity Conservation, Adelaide.

Rodrigues, T. Strong, P. and Horton, G. (2021). Gold Hydrogen Prospective Resources Report, PEL 687, SA. Teof Rodrigues & Associates Pty Ltd.

SADME (1986). Exploration opportunity: Stansbury Basin Data package. Department of Mines and Energy SA, April 1986.

SAPN (2022). Power Distribution Network (SA Power Networks). GIS dataset 1913. Accessed at https://map.sarig.sa.gov.au/

SATC (2022). Yorke Peninsula Regional Profile. Results for year ending December 2021. South Australian Tourism Commission. Accessed April 2023 at https://tourism.sa.gov.au/media/3e3n1zty/yorke-peninsula-december-2021.pdf.

SA Water (2018). Yorke Peninsula towns tap in to better water. Accessed January 2023 at https://www.sawater.com.au/news/yorke-peninsula-towns-tap-in-to-better-water.

Sercel (2020). Sercel Vibroseis Truck. Accessed: 8 January 2020 at: http://www.sercel.com/about/Pages/default.aspx

Spark Renewables (2023). Yorke Peninsula Energy Hub. Accessed April 2023 at https://sparkrenewables.com/yorke-peninsula-energy-hub.

WaterConnect (2023). https://www.waterconnect.sa.gov.au/Systems/SitePages/Home.aspx.

Yorke Peninsula Council (2023). Water. Accessed 31 March 2023 at https://yorke.sa.gov.au/community-services/facilities/water/.

Yorke Peninsula Tourism (2022). Yorke Peninsula, South Australia. Accessed 25/11/2022 at https://yorkepeninsula.com.au/

YPVC (2022). A year on the Farm. Yorke Peninsula Visitors Centre. Accessed November 2022 at https://images.impartmedia.com/visityorkepeninsula.com.au/A_Year_on_the_Farm.pdf

9. Abbreviations and Glossary

Abbreviation / Glossary	Definition
AAR	Aboriginal Affairs and Reconciliation, Attorney-General's Department (South Australia)
ABS	Australian Bureau of Statistics
aeolian	Process involving erosion, transportation and deposition of sediment by the wind
ANZECC	Australian and New Zealand Environment and Conservation Council
aquitard	A bed of low permeability adjacent to an aquifer
Archaean	Geological eon: 4 – 2.5 billion years ago
AS 1940	Australian Standard AS 1940 Storage and Handling of Flammable and Combustible Liquids
basement	Crystalline rocks lying above the mantle and beneath all other rocks and sediments. Generally used to indicate igneous and metamorphic rocks, usually older than Cambrian in age, that lie below a cover of sedimentary rocks
BoM	Bureau of Meteorology
bunded	Enclosed within an earth, rock or concrete wall constructed to prevent the inflow or outflow of liquids
Cambrian	Geological period: 539 – 485 million years ago
Cenozoic	Geological Era: 66 million years ago to present
CFS	Country Fire Service
Cryogenian	Geological period: ~720 to ~635 million years ago
DCCEEW	Department of Climate Change, Energy, Environment and Water (Commonwealth)
DEM	Department for Energy and Mining
DEW	Department for Environment and Water (SA)
DEWNR	Department for Environment, Water and Natural Resources (now DEW) (SA)
DIT	Department for Infrastructure and Transport
EHS	Environment, Health and Safety
EIR	Environmental Impact Report prepared in accordance with Section 97 of the South Australian *Petroleum and Geothermal Energy Act 2000* and Regulation 10
EML	Extractive Minerals Lease
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
ephemeral	Existing for only a short time, often dependent upon climatic influences
formation	The term for the primary unit in stratigraphy consisting of a succession of strata useful for mapping or description, which possesses certain distinctive lithologic and other features
ha	hectares
IBRA	Interim Biogeographical Regionalisation for Australia
infrastructure	Infrastructure includes buildings (including residences), fences, bores, tanks, piping, roads and tracks and other structures, utilities or equipment.
ISO	International Standards Organisation
km	kilometre

Abbreviation / Glossary	Definition
km/hr	kilometres per hour
LGA	Local government area
lithology	Description of the physical characteristics of a rock such as colour, texture, grain size or composition
m	metre
Mesoproterozoic	Geological Era: 1.6 to 1 billion years ago
mg/L	milligrams per litre
ML	Mining Lease
mm	millimetre
MW	megawatt
Native Vegetation Council	A council established under the South Australian *Native Vegetation Act 1991* to assess vegetation clearance applications
Neoproterozoic	Geological Era: 1 billion to 539 million years ago
NEPM	National Environmental Protection Measure
NGER	National Greenhouse and Energy Reporting
NPW Act	*National Parks and Wildlife Act 1972* (SA)
Palaeozoic	Geological Era: 539 - 252 million years ago
Paleoproterozoic	Geological Era: 2.5 to 1.6 billion years ago
perforating	The process of punching holes in the casing or liner of a well to connect it to the reservoir
Permian	Geological period: 299 – 252 million years ago
PEL	Petroleum Exploration Licence
PGE Act	*Petroleum and Geothermal Energy Act 2000* (SA)
PIRSA	Department of Primary Industries and Regions, South Australia
Pleistocene	Geological epoch: 2.58 million to 11,700 years ago
PM	Private mine
prescribed well	Water well prescribed under the *Landscape South Australia Act 2019*
Proterozoic	Geological eon: 2.5 billion – 539 million years ago
Ramsar wetland	A Wetland of International Importance listed under the Ramsar Convention (held in Ramsar, Iran 1971)
Quaternary	Geological period: 2.58 million years ago to present
SEO	Statement of Environmental Objectives
stratigraphy	The study of rock layers and layering (stratification)
Tertiary	Geological period: 66 – 2.6 million years ago
venting	The release of gases to the atmosphere, typically through a vertical pipe (called a vent or vent stack)
vibroseis	A seismic vibrator or 'vibroseis' system is an adjustable mechanical source that delivers low frequency vibrations to the earth, using steel plates mounted on trucks or buggies which are vibrated when in contact with the ground.

Appendix A: Flora and Fauna Information

Table A-1: Vegetation communities mapped in areas of remnant vegetation in PEL 687

SA Veg ID	Description
EP2606	*Eucalyptus porosa* mid mallee woodland over *Melaleuca lanceolata* tall shrubs and *Acrotriche patula* (mixed) low shrubs and *Gahnia lanigera* low sedges
EP3906	*Alyxia buxifolia* (mixed) low shrubland over *Acrotriche patula* (mixed) low shrubs
EP4701	*Triodia compacta* low hummock grassland
EP4901	*Gahnia filum* tall sedgeland over *Juncus kraussii* mid sedges
MM0901	*Eucalyptus porosa* mid open mallee woodland over *Austrostipa* sp. (mixed) tussock grasses
MM2901	*Melaleuca halmaturorum* low open forest over *Sarcocornia quinqueflora* (mixed) shrubs
MN2102	*Eucalyptus camaldulensis* ssp. mid open forest over *Lycium ferocissimum* (mixed) shrubs and *Foeniculum vulgare* (mixed) forbs
MN2301	Emergent *Acacia pycnantha* shrubs over *Austrostipa eremophila* (mixed) mid tussock grassland
MN2401	*Eucalyptus socialis* ssp., *Callitris gracilis* mid mallee woodland over *Vulpia m*yuros f. *myuros* (mixed) tussock grasses
MN3703	*Eucalyptus oleosa* ssp. *ampliata* mid open mallee forest over *Sclerolaena diacantha* (mixed) shrubs
MN3705	*Eucalyptus oleosa* ssp. *ampliata* mid open mallee forest over *Sclerolaena diacantha* (mixed) shrubs
MN4001	*Avicennia marina* ssp. *marina* low open forest over *Tecticornia* sp., *Sarcocornia quinqueflora* shrubs
SE0095	*Melaleuca uncinata* mid shrubland
SM4001	*Sarcocornia quinqueflora* (mixed) low shrubland over *Atriplex paludosa* ssp. (mixed) low shrubs
SM4005	*Tecticornia* sp. low open shrubland over *Parapholis incurva* (mixed) low tussock grasses
YP0601	*Eucalyptus porosa* mid open mallee woodland over *Melaleuca lanceolata* tall shrubs and *Bursaria spinosa* ssp. mid shrubs and *Gahnia lanigera*, *Lepidosperma congestum* (NC) low sedges
YP0603	*Eucalyptus porosa* low open woodland over *Gahnia lanigera* (mixed) low sedges
YP0604	*Eucalyptus porosa* low open woodland over *Senna artemisioides* ssp. *petiolaris* (mixed) tall shrubs and *Enchylaena tomentosa* var. *tomentosa* low shrubs
YP0605	*Eucalyptus porosa* mid open mallee woodland over *Melaleuca lanceolata* mid shrubs and *Acrotriche patula* low shrubs and *Gahnia lanigera* low shrubs
YP0606	*Eucalyptus porosa* mid mallee woodland over *Melaleuca uncinata* tall shrubs and *Gahnia lanigera* low sedges
YP0608	*Eucalyptus porosa* mid open mallee woodland over *Melaleuca lanceolata* tall shrubs and *Bursaria spinosa* ssp. low shrubs and *Helichrysum leucopsideum*, *Gahnia lanigera* low tussock grasses
YP0701	*Allocasuarina verticillata* low woodland over *Olearia axillaris* mid shrubs and *Rhagodia candolleana* ssp. *candolleana* low shrubs and *Lagurus ovatus* low tussock grasses
YP0703	*Allocasuarina verticillata* low woodland over *Exocarpos aphyllus*, *Bursaria spinosa* ssp. tall shrubs and *Beyeria lechenaultii*, *Acrotriche patula* low shrubs and *Lepidosperma congestum* (NC) low tussock grasses
YP0704	*Allocasuarina verticillata* low woodland over *Bursaria spinosa* ssp. tall shrubs and *Lepidosperma congestum* (NC) (mixed) low sedges
YP0705	*Allocasuarina verticillata* low open woodland over *Acacia paradoxa* tall shrubs
YP0801	*Melaleuca lanceolata* low woodland

SA Veg ID	Description
YP0802	*Melaleuca lanceolata* low woodland over *Exocarpos aphyllus* mid shrubs and *Acrotriche patula* low shrubs
YP0803	*Allocasuarina verticillata* low woodland over *Melaleuca lanceolata* tall shrubs and *Lasiopetalum discolor* mid shrubs and *Rhagodia candolleana* ssp. *candolleana* low shrubs
YP0804	Emergent *Eucalyptus socialis* ssp. mid mallee trees over *Melaleuca lanceolata* tall shrubland and *Rhagodia candolleana* ssp. *candolleana* (mixed) low shrubs and *Threlkeldia diffusa* (mixed) low shrubs
YP0805	*Melaleuca lanceolata* low woodland over *Lycium ferocissimum* tall shrubs and *Austrostipa* sp.,*Moraea setifolia* low forbs
YP0807	*Melaleuca lanceolata, Eucalyptus porosa* mid open woodland over *Acacia ligulata* tall shrubs and *Austrodanthonia caespitosa* (mixed) low tussock grasses
YP0808	*Melaleuca lanceolata* mid mallee woodland over *Exocarpos aphyllus* mid shrubs and *Acrotriche patula* low shrubs
YP0809	emergent *Melaleuca lanceolata* low trees over *Templetonia retusa, Acacia nematophylla* mid open shrubland and *Carpobrotus rossii* (NC) low shrubs
YP1001	*Eucalyptus diversifolia* ssp. *diversifolia* mid open mallee forest over *Templetonia retusa*, *Melaleuca lanceolata* mid shrubs and *Acrotriche patula*, *Correa pulchella* low shrubs
YP1002	*Eucalyptus diversifolia* ssp. *diversifolia* low open mallee forest over *Melaleuca lanceolata* mid shrubs and *Acrotriche cordata*, *Lasiopetalum discolor* low shrubs
YP1003	*Eucalyptus diversifolia* ssp. *diversifolia* low open mallee shrubland over *Gahnia lanigera* low shrubs
YP1004	*Eucalyptus diversifolia* ssp. *diversifolia* mid mallee woodland over *Melaleuca lanceolata* tall shrubs and *Templetonia retusa* mid shrubs and *Beyeria lechenaultii*, *Lasiopetalum discolor* low shrubs and *Acrotriche patula* low shrubs
YP1102	*Eucalyptus dumosa* mid mallee woodland over *Melaleuca acuminata* ssp. *acuminata* tall shrubs and *Gahnia lanigera* low shrubs
YP1201	*Eucalyptus gracilis* mid mallee woodland over *Melaleuca lanceolata* tall shrubs and *Acacia notabilis* mid shrubs and *Rhagodia parabolica* low shrubs and *Enchylaena tomentosa* var. *tomentosa* low shrubs
YP1301	*Eucalyptus incrassata* mid open mallee woodland over *Melaleuca uncinata* tall shrubs and *Baeckea crassifolia* (mixed) low shrubs
YP1401	*Eucalyptus leptophylla*, *Eucalyptus phenax* ssp. mid mallee woodland over *Melaleuca uncinata* tall shrubs and *Melaleuca acuminata* ssp. *acuminata* mid shrubs and *Acrotriche patula* low shrubs and *Austrodanthonia setacea*
YP1502	*Melaleuca pauperiflora* ssp. *mutica* low woodland over *Melaleuca lanceolata* tall shrubs and *Rhagodia candolleana* ssp. *candolleana* low shrubs and *Threlkeldia diffusa* low shrubs
YP1603	*Eucalyptus phenax* ssp. mid open mallee woodland over *Melaleuca acuminata* ssp. *acuminata* tall shrubs and *Alyxia buxifolia* mid shrubs and *Acrotriche patula* low shrubs and *Gahnia lanigera* low sedges
YP1701	*Eucalyptus diversifolia* ssp. *diversifolia*, *Eucalyptus rugosa* mid mallee woodland over *Melaleuca lanceolata* tall shrubs and *Templetonia retusa* mid shrubs and *Acrotriche patula*, *Beyeria lechenaultii* low shrubs and *Pimelea serpyllifolia* ssp. *serpyllifolia*
YP1801	*Eucalyptus socialis* ssp. (mixed) mid open mallee forest over *Melaleuca acuminata* ssp. *acuminata* tall shrubs and *Melaleuca lanceolata* mid shrubs and *Gahnia deusta* mid sedges and *Correa backhouseana* var. *coriacea*, *Gahnia lanigera* low shrubs
YP1804	*Eucalyptus socialis* ssp. mid mallee woodland over *Melaleuca lanceolata* tall shrubs and *Gahnia deusta* mid sedges and *Acrotriche patula* low shrubs
YP1805	*Eucalyptus socialis* ssp. mid mallee woodland over *Melaleuca uncinata* tall shrubs and *Gahnia lanigera* low sedges

SA Veg ID	Description
YP2201	*Olearia axillaris* mid sparse shrubland over *Rhagodia candolleana* ssp. *candolleana* low shrubs and *Carpobrotus rossii* (NC) (mixed) low forbs
YP2302	*Olearia axillaris* mid open shrubland over *Poa poiformis* var. *poiformis*, *Lagurus ovatus* low shrubs
YP2402	emergent *Eucalyptus porosa* mid trees over *Alyxia buxifolia* mid open shrubland and *Rhagodia candolleana* ssp. *candolleana* low shrubs and *Helichrysum leucopsideum* low tussock grasses
YP2601	*Bursaria spinosa* ssp. mid sparse shrubland over *Acrotriche patula* low shrubs and *Bromus diandrus*, *Lepidosperma congestum* (NC) low tussock grasses
YP2701	*Callitris canescens* mid sparse shrubland over *Gahnia lanigera* low sedges
YP2901	*Geijera linearifolia* tall open shrubland over *Austrostipa platychaeta* low shrubs and *Enchylaena tomentosa* var. *tomentosa*, *Gahnia lanigera* low shrubs
YP3001	*Lasiopetalum discolor*, *Melaleuca lanceolata* ssp. *lanceolata* (NC) low shrubland over *Pultenaea tenuifolia* (mixed) low shrubs
YP3201	*Olearia axillaris* mid open shrubland over *Ficinia nodosa* low shrubs and *Senecio pinnatifolius* (NC) low shrubs
YP3402	*Myoporum insulare* (mixed) low open shrubland over *Leiocarpa supina* (mixed) low forbs
YP3501	*Nitraria billardierei* (mixed) low shrubland over *Mesembryanthemum crystallinum* low forbs
YP3601	*Olearia axillaris* mid open shrubland over *Senecio pinnatifolius* (NC) (mixed) low shrubs
YP3602	emergent *Allocasuarina verticillata* mid trees over *Dodonaea viscosa* ssp. *spatulata* tall shrubland and *Alyxia buxifolia* mid shrubs and *Tetragonia implexicoma* low shrubs
YP3604	*Melaleuca lanceolata* tall open shrubland over *Olearia axillaris* mid shrubs and *Adriana quadripartita*, *Lepidosperma gladiatum* low shrubs
YP3701	*Beyeria lechenaultii* low shrubland over *Senecio pinnatifolius* (NC) low shrubs
YP3801	emergent *Callitris gracilis* mid trees over *Senna artemisioides* ssp. *petiolaris* (mixed) mid open shrubland
YP4101	*Austrodanthonia caespitosa* (mixed) low open tussock grassland over *Gahnia deusta* (mixed) low forbs
YP4401	*Gahnia lanigera* (mixed) low sedgeland over *Linum strictum* ssp. *strictum* low tussock grasses
YP4501	*Lepidosperma congestum* (NC) low sedgeland over *Medicago minima* var. *minima*, *Bromus diandrus* low tussock grasses

Table A-2: Threatened flora species recorded or predicted in PEL 687 on Yorke Peninsula[1]

Scientific name	Common name	Status[2]		Source[3]
		Cth	SA	
Acacia enterocarpa	Jumping-jack Wattle	EN	E	1,2
Acacia rhetinocarpa	Resin Wattle	VU	V	1
Acacia rhetinocarpa	Neat Wattle, Resin Wattle (SA)	VU	V	2
Angianthus phyllocalymmeus	Silver Candles	VU		2
Austrostipa nullanulla	Club Spear-grass		V	1
Billardiera sp. Yorke Peninsula (P.C.Heyligers 80164)	Lehmann's Apple-berry		E	1
Caladenia brumalis	Coast Spider-orchid	EN	E	1,2
Caladenia intuta	Ghost Spider Orchid	CR	E	1,2

Scientific name	Common name	Status[2]		Source[3]
		Cth	SA	
Caladenia macroclavia	Large-club Spider-orchid	EN	E	1,2
Caladenia tensa	Inland Green-comb Spider-orchid, Rigid Spider-orchid	EN		1,2
Corybas expansus	Dune Helmet-orchid		V	1
Daviesia sejugata	Disjunct Bitter-pea		E	1
Diuris behrii	Behr's Cowslip Orchid		V	1
Dodonaea subglandulifera	Peep Hill Hop-bush	EN	E	1
Euphrasia collina ssp. *osbornii*	Osborn's Eyebright	EN	E	1,2
Leptorhynchos elongatus	Lanky Buttons		E	1
Olearia microdisca	Small-flower Daisy-bush	EN	E	1
Olearia pannosa ssp. *pannosa*	Silver Daisy-bush, Silver-leaved Daisy, Velvet Daisy-bush	VU	V	1,2
Phebalium glandulosum ssp. *macrocalyx*	Glandular Phebalium		E	1
Pleuropappus phyllocalymmeus	Silver Candles	VU	V	1
Poa meionectes	Fine-leaf Tussock-grass		V	1
Prasophyllum calcicola	Limestone Leek-orchid		V	1
Prasophyllum goldsackii	Goldsack's Leek-orchid	EN	E	1, 2
Prasophyllum validum	Sturdy Leek-orchid, Mount Remarkable Leek-orchid	VU	V	2
Pteris tremula	Tender Brake			1
Pterostylis xerophila	Desert Greenhood	VU	V	2
Ranunculus sessiliflorus var. *pilulifer*	Annual Buttercup		V	1
Sarcozona bicarinata	Ridged Noon-flower		V	1
Senecio macrocarpus	Large-fruit Groundsel, Large-fruit Fireweed,	VU	V	1,2
Stackhousia annua	Annual Candles, Annual Stackhousia	VU	V	1,2
Swainsona pyrophila	Yellow Swainson-pea	VU		2
Tecticornia flabelliformis	Bead Samphire	VU	V	1

[1] Search area encompassed the PEL and a buffer of 5 km. Database records and species conservation status were current at the time of searching (October 2022).

[2] Conservation status under the SA *National Parks and Wildlife Act* 1972 and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*: V / VU = Vulnerable, E / EN= Endangered, CR = Critically endangered, EX = Extinct.

[3] Source: 1 = Biological Databases of South Australia (Recordset number DEWNRBDBSA220517-1); 2 = Protected Matters Search Tool (https://pmst.awe.gov.au)

Note: In addition to these threatened species, a number of species listed as Rare under the NPW Act have also been recorded in the PEL.

Table A-3: Threatened fauna species recorded or predicted in PEL 687 on Yorke Peninsula[1]

Scientific name	Common name	Status[2]		Source[3]
		Cth	SA	
Birds				
Acanthiza iredalei rosinae	Samphire Thornbill or Slender-billed Thornbill Gulf St Vincent)	VU	V	1,2
Ardeotis australis	Australian Bustard		V	1
Botaurus poiciloptilus	Australasian Bittern	EN	E	2
Calidris canutus rogersi	Red Knot (ssp. rogersi)	EN	E	1,2
Calidris ferruginea	Curlew Sandpiper	CR	E	1,2
Calidris tenuirostris	Great Knot	CR	E	1,2
Charadrius leschenaultii leschenaultii	Greater Sand Plover	VU	R	1,2
Charadrius mongolus mongolus	Lesser Sand Plover	EN	E	1,2
Cladorhynchus leucocephalus	Banded Stilt		V	1
Coturnix ypsilophora australis	Brown Quail		V	1
Diomedea antipodensis	Antipodean Albatross	VU		2
Diomedea epomophora	Southern Royal Albatross	VU	V	2
Diomedea exulans	Wandering Albatross	VU	V	2
Diomedea sanfordi	Northern Royal Albatross	EN	E	2
Elanus scriptus	Letter-winged Kite		V	1
Falco hypoleucos	Grey Falcon	VU	R	2
Grantiella picta	Painted Honeyeater	VU	R	2
Haliaeetus leucogaster	White-bellied Sea Eagle		E	1
Halobaena caerulea	Blue Petrel	VU	R	2
Ixobrychus dubius	Black-backed Bittern (Australian Little Bittern)		E	1
Leipoa ocellata	Malleefowl	VU	V	1,2
Limosa lapponica baueri	Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit	VU	R	1,2
Macronectes giganteus	Southern Giant-Petrel	EN	V	2
Macronectes halli	Northern Giant Petrel	VU		2
Neophema chrysogaster	Orange-bellied Parrot	CR	E	2
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	CR	E	1, 2
Pachyptila turtur subantarctica	Fairy Prion (southern)	VU		2
Pandion cristatus	Eastern Osprey		E	1
Pedionomus torquatus	Plains-wanderer	CR	E	1, 2
Pezoporus occidentalis	Night Parrot	EN	E	2
Phoebetria fusca	Sooty Albatross	VU	E	2
Psophodes leucogaster leucogaster	Mallee Whipbird	VU	E	1, 2
Pterodroma mollis	Soft-plumaged Petrel	VU		2

Scientific name	Common name	Status[2]		Source[3]
		Cth	SA	
Rostratula australis	Australian Painted Snipe	EN	E	2
Stagonopleura guttata	Diamond Firetail		V	1
Stercorarius antarcticus lonnbergi	Brown Skua		V	1
Sternula albifrons sinensis	Little Tern		E	1
Sternula nereis nereis	Australian Fairy Tern	VU	E	1, 2
Thalassarche carteri	Indian Yellow-nosed Albatross	VU	E	1, 2
Thalassarche cauta cauta	Shy Albatross	EN	V	1, 2
Thalassarche impavida	Campbell Albatross, Campbell Black-browed Albatross	VU	V	2
Thalassarche melanophris	Black-browed Albatross	VU		1, 2
Thalassarche steadi	White-capped Albatross	VU		2
Thinornis cucullatus cucullatus	Eastern Hooded Plover	VU	V	1, 2
Zanda funerea whiteae	Yellow-tailed Black Cockatoo		V	1
Mammals				
Arctocephalus tropicalis	Subantarctic Fur Seal	EN	E	1
Balaenoptera musculus	Blue Whale	EN	E	2
Eubalaena australis	Southern Right Whale	EN	V	1, 2
Megaptera novaeangliae	Humpback Whale		V	1
Miniopterus orianae bassanii	Large Bent-winged Bat	CR	E	1
Neophoca cinerea	Australian Sea-lion	EN	V	1
Reptiles				
Aprasia pseudopulchella	Flinders Ranges Worm-lizard	VU		2
Caretta caretta	Loggerhead Turtle	EN	E	2
Chelonia mydas	Green Turtle	VU	V	1, 2
Dermochelys coriacea	Leatherback Turtle	EN	V	1,2
Notechis scutatus	Tiger Snake	ssp		1
Tiliqua adelaidensis	Pygmy Blue-tongue Lizard, Adelaide Blue-tongue Lizard	EN	E	2
Varanus rosenbergi	Heath Goanna		V	1
Sharks				
Carcharodon carcharias	White Shark, Great White Shark	VU		2

[1] Search area encompassed the PEL and a buffer of 5 km. Database records and species conservation status were current at the time of searching (October 2022).

[2] Conservation status under the SA *National Parks and Wildlife Act* 1972 and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*: R = Rare, V / VU = Vulnerable, E / EN= Endangered, CR = Critically endangered, EX = Extinct.

[3] Source: 1 = Biological Databases of South Australia (Recordset number DEWNRBDBSA220517-1); 2 = Protected Matters Search Tool (https://pmst.awe.gov.au)

Note: In addition to these threatened species, a number of species listed as Rare under the NPW Act have also been recorded in the PEL.

Table A-4: Priority pest plants in the Yorke District[1]

Scientific name	Common name	Management Strategy	Status
Priority plants for Yorke District			
Lycium ferocissimum	African boxthorn	manage weed	WoNS[2]
Chrysanthemoides monilifera ssp. *monilifera*	Boneseed	destroy infestations	WoNS
Asparagus declinatus	Bridal veil	destroy infestations	WoNS
Cenchrus ciliaris	Buffel grass	destroy infestations	Declared plant
Oncosiphon suffruticosum	Calomba Daisy	contain spread	Declared plant
Tribulus terrestris	Caltrop	manage weed	Declared plant
Rhaponticum repens	Creeping knapweed	destroy infestations	Declared plant
Marrubium vulgare	Horehound	manage weed	Declared plant
Alternanthera pungens	Khaki weed	alert weed - eradicate	Declared plant
Diplotaxis tenuifolia	Lincoln Weed	manage weed	Declared plant
Solanum elaeagnifolium	Silverleaf nightshade	contain spread	WoNS
Other declared local action pest plants			
Pinus halepensis	Aleppo pine		Declared plant
Arctotheca populifolia	Beach daisy		Local action
Acacia cyclops	Western Coastal Wattle		Local action
Reseda lutea	Cutleaf mignonette		Declared plant
Cenchrus setaceus	Fountain grass		Declared plant
Gazania sp.	Gazania		Declared plant
Cenchrus longispinus and *C. incertus*	Innocent weed		Declared plant
Olea europaea	Olive		Declared plant
Polygala myrtifolia var. myrtifolia	Polygala		Declared plant
Ratama raetam	White weeping broom		Declared plant

[1] Source: Natural Resources Northern and Yorke. *Managing pest plants – Pest plant control in the Yorke District*. https://cdn.environment.sa.gov.au/landscape/docs/ny/2019_managing_pest_plants_yorke_district_fact_sheet.pdf

[2] Weed of National Significance.

Appendix B: Summary of issues raised - stakeholder consultation undertaken by Gold Hydrogen

Note: This table will be compiled (and the EIR and SEO updated where required in response to the comments) following Gold Hydrogen's initial stakeholder consultation on the draft EIR and SEO.

Table B-1: Summary of stakeholder comments and Gold Hydrogen responses

Submitter	EIR / SEO Reference	Comment / issue raised	Response
General			
EIR			
SEO			

Appendix C: Summary of issues raised – formal PGE Act consultation undertaken by DEM

Note: This table will be compiled (and the EIR and SEO updated where required in response to the comments) following consultation undertaken by DEM under the PGE Act following formal submission of the EIR and SEO.

Table C-1: Summary of comments and Gold Hydrogen Responses

Submitter	EIR / SEO Reference	Comment / issue raised	Response
General			
EIR			
SEO			