GEOTHERMAL RESOURCES PTY LTD

Environmental Impact Report

GEL 181

Geothermal Exploration Drillhole Logging, Monitoring, Maintenance, Rehabilitation and Decommissioning

February 2023

PGER 00342 (2023)

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1. INTRODUCTION

This Environmental Impact Report (EIR) has been prepared in accordance with requirements under the *Petroleum and Geothermal Energy Act 2000* and the *Petroleum and Geothermal Energy Regulations 2013.* It has been prepared by Geothermal Resources Pty Ltd (Geothermal Resources), which is a wholly owned subsidiary of Havilah Resources Limited, in conjunction with a Statement of Environmental Objectives (SEO).

The final stage decommissioning work will be undertaken in accordance with Mineral Exploration Drillholes guideline M21 such that the groundwater integrity is maintained, which can involve back-filling and/or placing of cement plugs. New ground disturbance at the drill collar is expected to be minimal.

This EIR has utilised some information contained in publicly available environmental reports prepared for other relevant activities, namely the *South Australian Cooper Basin Operators Environmental Impact Report: Drilling, Completions and Well Operations* (Santos 2015) and *Frome Geothermal Energy Project: Proposed eight-hole geothermal gradient drilling programme* (Geothermal Resources Limited 2006).

1.1. Scope

This EIR and the SEO have been prepared to support additional downhole logging, monitoring, maintenance and ultimately final rehabilitation and decommissioning activities on previously drilled geothermal holes at the Frome Geothermal Project. They provide a risk assessment and basis for compliance for the above work, including decommissioning and environmental rehabilitation. The decommissioning will be undertaken in accordance with *Mineral Exploration Drillholes guideline M2* such that the groundwater integrity is maintained, which can involve back-filling and/or placing of cement plugs in a manner to be approved by the Department for Energy and Mining (DEM). As part of the decommissioning, all exposed PVC drill collars will be cut off below surface.

Note that complete clean up and surface contouring and scarifying of each drill site took place immediately after completion of drilling and temperature logging (refer to pictures of drillhole locations in Appendix 1). It is aimed to keep disturbance of the drill sites to a minimum in order to avoid any detrimental effects on the re-vegetation that has taken place since the original surface rehabilitation some 10 to 12 years ago.

1.2. Location

Frome Geothermal Project drill hole sites to be decommissioned and rehabilitated lie east of the main Yunta-Arkaroola road approximately 410km north-east (direct) of Adelaide and approximately 120km north (direct) of Yunta. They are situated in the North East Pastoral district on pastoral stations Kalabity, Curnamona, and Frome Downs. Well locations are shown on Figure 1. All wells are located on GEL 181 that covers approximately 641 km^2. They were designed to test the geothermal gradient over a large buried granite body that is marked by a regional gravity low. The wells were drilled to depths ranging from 200 metres to 1809 metres.

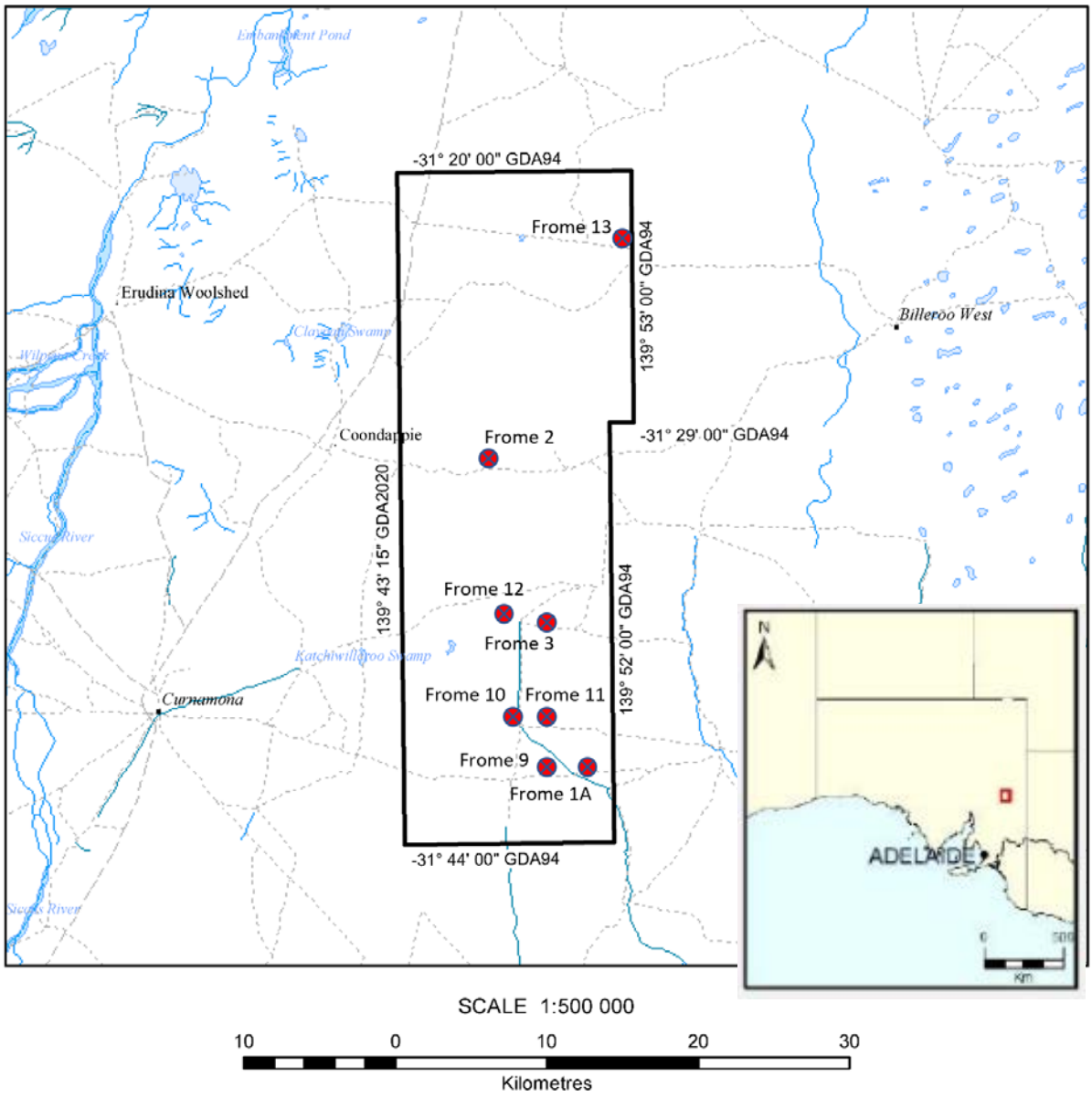


Figure 1 Locations of wells to be decommissioned

BACKGROUND

1.3. Frome Project Area

The Frome Project area was identified as a prospective geothermal resource target due to the likelihood of highly radiogenic Mesoproterozoic granites buried at depths of more than 2 km beneath the Arrowie Basin. This interpretation is based on the coincidence of a regional gravity low and non-reflective seismic responses. The Arrowie Basin covers an area in regional South Australia of approximately 43,000 km^2 aged between the early to mid Late Cambrian.

The Frome Project area lies just south of the Great Artesian Basin (Figure 2). This is confirmed by the absence of any Mesozoic age Great Artesian Basin sediments intersected in any Frome Project drillholes.

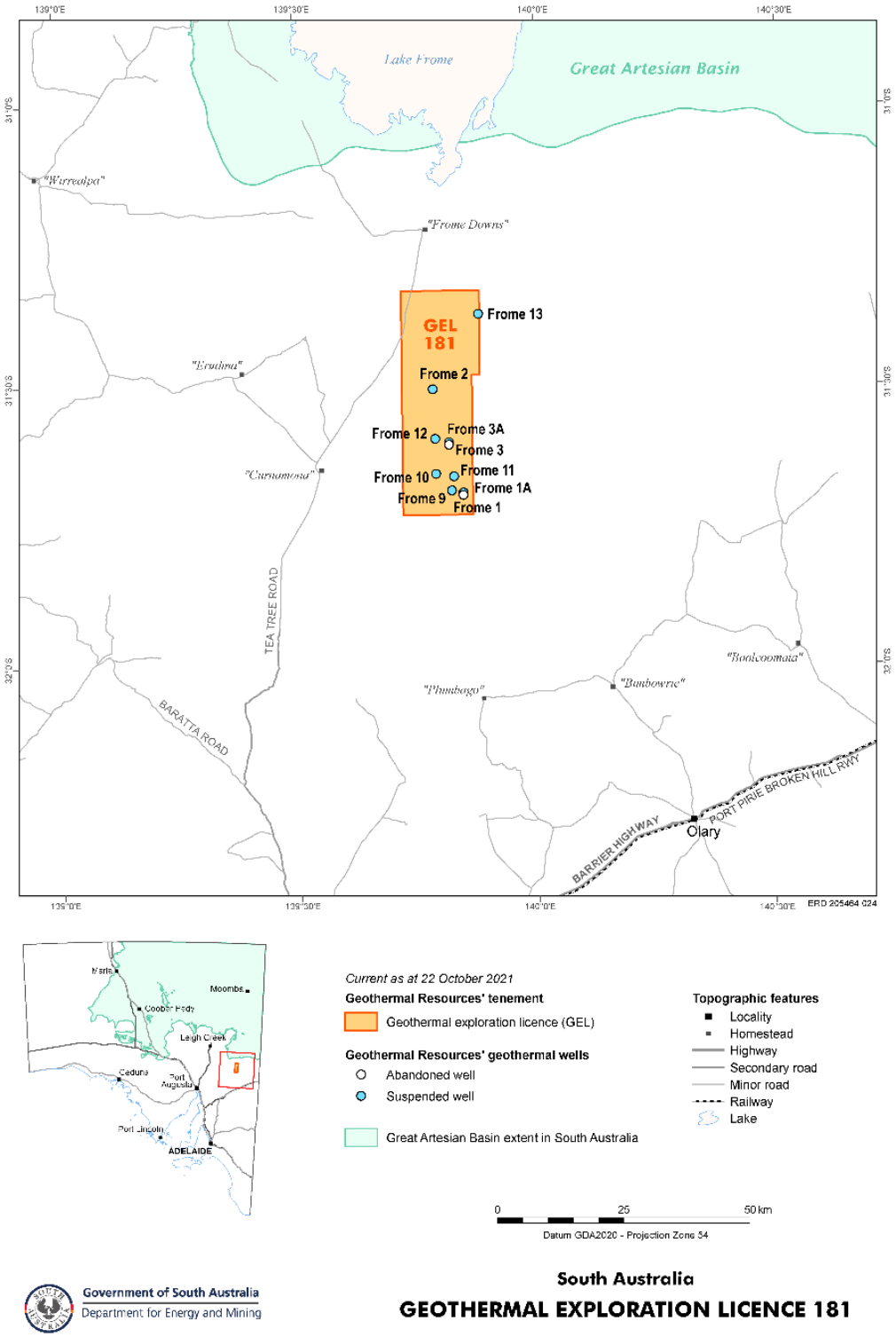


Figure 2 The southern boundary of the Great Artesian Basin lies north of the Frome wellholes, consistent with the lack of any Mesozoic sediments encountered in the Frome wellholes.

1.4. Geothermal Resources/Havilah Resources

Geothermal Resources Limited listed on the ASX in 2006 and conducted geothermal exploration drilling in the Arrowie Basin between 2007 and 2009, with the assistance of a REDI grant. The target was a large area of granite beneath the Arrowie Basin that was marked by a large gravity low feature. High geothermal gradients were discovered in all holes drilled in the area, including two deep diamond drillholes, namely Frome 12 and Frome 13 (Table 1).

Funding for geothermal exploration work dried up suddenly, preventing drilling of planned development wells. Geothermal Resources was taken over by Havilah Resources Limited ("Havilah") in 2011 and became a wholly owned subsidiary.

Havilah holds more than 16,000 km^2 of mineral exploration licences in the Curnamona Craton on which it has discovered JORC resources of more than 1.3 million tonnes of copper and 3.3 million ounces of gold. It owns Kalkaroo station where its exploration base is located. It carries out its own mineral drilling operations and has an experienced exploration and drilling team. In particular it has successfully rehabilitated thousands of drillholes in the region, some over 500 metres deep. Throughout its exploration history in the region, Havilah has maintained good working relationships with all surrounding stations, including those on which GEL 181 lies, namely, Frome Downs, Kalabity and Curnamona stations.

2. LEGISLATIVE FRAMEWORK

This chapter provides a brief overview of the legislative framework applicable to geothermal and petroleum licensing in South Australia.

2.1. Petroleum and Geothermal Energy Act 2000 and Regulations 2013

The legislation which governs petroleum and geothermal exploration in South Australia is the *Petroleum and Geothermal Energy Act 2000* (the Act) and the *Petroleum and Geothermal Energy Regulations 2013* (the Regulations).

Key objectives of this legislation include:

- creating an effective, efficient and flexible regulatory system for the industries involving exploration for, and the recovery or commercial utilisation of, petroleum and other resources (including geothermal resources and natural reservoirs suitable for storage or production purposes) to which this Act applies.
- encouraging and maintaining an appropriate level of competition in exploration for and production of petroleum and other resources to which this Act applies.
- minimising environmental damage from the activities involved in
    - exploration for, or the recovery or commercial utilisation of, petroleum and other resources to which this Act applies.
    - the construction or operation of transmission pipelines for transporting petroleum and other substances to which this Act applies
- establishing appropriate consultative processes involving people directly affected by regulated activities and public generally.
- ensuring as far as reasonably practicable, security of supply for users of natural gas.
- protecting the public from risks inherent in regulated activities.

Environmental objectives, as defined in Part 12 of the Act are:

- to ensure that regulated activities that have (actually or potentially) adverse effects on the environment are properly managed to reduce environmental damage as far as reasonably practicable.
- to eliminate as far as reasonably practicable risk of significant long-term environmental damage.
- to ensure that land adversely affected by regulated activities is properly rehabilitated.

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.

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.

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; or
- operation of a transmission pipeline for carrying petroleum or another regulated substance.

Regulated activities also include all operations and activities reasonably necessary for, or incidental to, exploration for and production of petroleum or another regulated substance, such as:

- physical and geophysical surveys of land;
- drilling of wells;
- the injection of water or some substance into a natural reservoir in order to enhance production of petroleum or another regulated substance;
- forcing water or some other substance through a source of geothermal energy in order to absorb thermal energy and enable its recovery or utilisation at the surface;
- the processing of substances recovered from a well;
- the construction of borrow pits;
- the installation of plant and equipment;
- the use of a natural reservoir to store a regulated substance;
- water disposal;

- the construction of roads, camps, airport, buildings and other infrastructure.

2.1.1. Environmental Impact Report

An Environmental Impact Report (EIR) provides an assessment of the potential impacts of regulated activities on the environment and provide the basis of information for development of the Statement for Environmental objectives (SEO) (unless activities are classified as 'high impact' and an environmental impact assessment under the *Development Act 1993* is required).

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

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

Regulation 10 outlines the content required to be included in an EIR, which are outlined in Table 2 below.

Table 1: Environmental Impact Report Requirement and Applicable Sections

	Requirement	Section
a)	a description of the regulated activities to be carried out under the licence (including their location)	Section 4
b)		
	(i) 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	Section 5
	(ii) 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 public health and safety risks inherent in those activities (insofar as these matters are relevant in the particular circumstances)	Section 5.5
	(iii) if required by the Minister – a prudential assessment of the security of natural gas supply	N/A
c)	a description of the reasonably foreseeable events associated with the activities that could pose a threat to the relevant environment, including: (i) information on A- events during the construction stage (if any), the operational stage and the abandonment stage B- events due to atypical circumstances (including human error, equipment failure or emissions, or discharges above operating levels) (ii) information on the estimated frequency of these events (iii) an explanation of the basis on which these events and frequencies have been predicted	Section 7
d)	an assessment of the potential consequences of these events on the environment, including: (i) information on i. the extent to which these consequences can be managed or addressed ii. the action proposed to be taken to manage or address these consequences iii. the anticipated duration of these consequences iv. the size and scope of these consequences	Section 7

	v. the cumulative affects (if any) of these circumstances when considered in conjunction with the consequences of other events that may occur on the relevant land (insofar as this is reasonably practicable) (ii) an explanation of the basis on which these consequences have been predicted	
e)	a list of relevant land owners	Section 6
f)	information on any consultation that has occurred with the owner of the relevant land, any Aboriginal groups or representative, any agency or instrumentality of the Crown, or any other interest person or parties, including specific detail about relevant issues that have been raised and any response to those issues, but not including confidential information.	Section 6

2.1.2. Statement of Environmental Objectives

Section 96 of the Act states that "A licence must not carry out regulated activities unless a statement of environmental objectives (SEO) is in force for the relevant activities under this Part". The accompanying SEO outlines the environmental objects that the regulated activity is to achieve and the criteria upon which the objective are to be assessed and is developed on the information provided in this EIR.

Division 4 of the Act and Part 3 of the Regulations describe the requirements for an SEO and how it is assessed and approved. The SEO must be reviewed at least once every 5 years.

2.1.3. Entry to and use of land

Under Part 10, Section 60 of the Act a licensee may enter land to carry out authorised activities on the land; or enter land for the purpose of gaining access to adjacent land on which the licensee proposes to carry out authorised activities.

Under Part 10, Section 61 of the Act a licensee must, at least 21 days before entering land, give written notice to each owner of the land, in the form required by the regulations that describes the licensee's intention to enter the land; and if the licensee proposes to carry out regulated activities on the land.

The relevant parties who must be provided with a notice of entry prior to conducting the operations described in this EIR are:

- Representatives of Native Title Claimants
- Landholder's whose properties will be entered and/or travelled through

2.1.4. Activity Notification/Approval Process

Prior to commencing a regulated activity (e.g. drillhole decommissioning), Section 74(3) of the Act requires that:

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

The application for the Minister's approval and 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.

Consequently, the activity notification 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.

2.2. Other Legislation

A number of other Acts apply to petroleum and geothermal activities, these are listed below:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Native Title Act 1993*
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*
- *Aboriginal Heritage Act 1988*
- *Crown Land Management Act 2009*
- *Environment Protection Act 1993*
- *Fire and Emergency Services Act 2005*
- *Heritage Places Act 1993*
- *Landscapes South Australia Act 2019 (previously Natural Resources Management Act 2004)*
- *National Parks and Wildlife Act 1972*
- *Native Title (South Australia) Act 1994*
- *Native Vegetation Act 1991*
- *Pastoral Land Management and Conservation Act 1989*
- *South Australian Public Health Act 2011*
- *South Australian Radiation Protection and Control Act 1982*
- *Work Health and Safety Act 2012.*

3. DESCRIPTION OF ACTIVITIES

This chapter identifies and provides an overview of the proposed activities of the EIR and the accompanying SEO. It should be noted that this EIR does not include a description of activities for drilling but does give a brief history of operations.

3.1. Previous Drilling and Access

Geothermal Resources undertook drilling activities in the region between March 2007 and May 2009. The wells ranged from 200 to 1,809 metres in depth and currently lie in GEL 181 (Figure 1).

The wells were carefully sited along existing well maintained station tracks. This avoided the need for construction of new tracks and any cross-country travel that could have resulted in unnecessary damage to vegetation and the surface environment. These station tracks are associated with local pastoral operations and are therefore well developed and did not require any significant upgrades. These same tracks will be used by Havilah's vehicle access for the de-commissioning work.

In addition, the drill sites were chosen in locally poorly vegetated areas, that in some cases were hollows caused by wind erosion (see photos in Appendix 1).

All drill sites were cleared during a cultural heritage survey conducted by four senior representatives of the Adnyamathanha native title claimant group on 10 and 11 of August 2006 prior to commencement of any drilling work in the area.

Station owners are known to Havilah Resources personnel and the normal practice of contacting them and explaining planned activities prior to entry on their land will be adhered to in all future work

programs that will include further downhole logging, monitoring, maintenance and ultimately final rehabilitation and decommissioning.

3.2 Well Logging and Maintenance

The deep geothermal wells drilled by Geothermal Resources, particularly Frome 12 (1761 metres TD) and Frome 13 (1809 metres), are a valuable resource for future geothermal test work. This is likely to include temperature logging, gamma logging (to test the heat generating capacity of the granitic and volcanic heat generating sources) and other logging methods to determine other physical properties of the rocks, including their fracturing ability.

This logging is likely to involve only relatively light vehicles rather than heavy trucks. Any surface disturbance caused by use of logging vehicles will be rehabilitated at the time. As noted elsewhere, all drillholes are located in areas naturally deficient in native vegetation, so there will little or no disturbance to native vegetation.

3.3 Well Abandonment and Decommissioning

The wells were drilled to enable downhole temperature logging in order to calculate geothermal gradients across the region. When not in use the holes were capped at surface. It is expected, based on past experience, that the drillholes will remain in a suitable condition for future logging due to 50mm PVC piping being run for the full length of the deeper holes.

Surface rehabilitation, including removal of all drill cuttings and rubbish, and levelling and scarifying with a backhoe to promote regeneration of vegetation was completed soon after drilling ceased (see photos in Appendix 1).

Insignificant saline groundwater was cut in the bedrock and the lack of water flows indicates there is no aquifer as such in any bedrock formations. In general the rocks were very tight and unfractured as recorded in drill logs included in GEL 181 annual reports to DEM. No Cenozoic palaeochannels nor Mesozoic Great Artesian Basin sediments were encountered in any holes (Figure 2).

It is apparent that multiple aquifer layers do not occur and hence there is no possibility of mixing of groundwater from different aquifers in this case. Accordingly, conventional measures to prevent cross-flow may not be necessary for the Frome drillholes, subject to consultation with DEM.

3.4 Rehabilitation

Surface rehabilitation resulting in native vegetation regeneration to its pre-drilling (grazed) state has already taken place. This work, plus removal of drill cuttings spoil, took place using a backhoe shortly after the drilling was completed.

Final well decommissioning programs will be submitted to DEM for prior approval as part of the Activity Notification Stage. The decommissioning details will be agreed with DEM having regard to the *Mineral Exploration Drillholes guideline M21.*

It is expected that key rehabilitation tasks will include:

1. Cutting any projecting PVC drill casing below the surface and capping it with a solid PVC cap in order to:
    - To remove any surface safety hazard cause by PVC casing projecting above the ground.
    - To prevent surface material being washed into the open holes and causing a surface cratering effect.

2. Backfilling and/or placing concrete plugs in the holes as approved by DEM in accordance with *Mineral Exploration Drillholes guideline M2.*

All work will be done as far as possible with light vehicles rather than heavy drilling equipment in order to minimise further disturbance to the already re-vegetated drilling sites. Material for backfilling would need to be sourced from external locations by agreement with local station owners and may require use of heavy trucks. Such sources have not yet been determined.

It is proposed that this work will be undertaken by Havilah field staff who are well experienced in this work, having rehabilitated thousands of deep mineral exploration holes. Havilah's work has been inspected and approved by DEM Mineral Resources Division on a number of occasions.

Personnel will be accommodated at Havilah Resources exploration base camp at Kalkaroo station to the east. Public roads and private station tracks run from Kalkaroo through Kalabity, Curnamona and Frome Downs stations and will provide necessary vehicle access. Access will be avoided immediately after heavy rain to avoid unnecessary track damage.

Station owners are well known to Havilah Resources personnel and will be contacted prior to decommissioning activities taking place and once they have been completed.

As noted above, all drill sites were cleared during a cultural heritage survey conducted by four senior representatives of the Adnyamathanha native title claimant group on 10 and 11 of August 2006 prior to commencement of any drilling work in the area. The proposed decommissioning activities will be completely confined to areas cleared by this previous heritage survey.

4 SUMMARY OF EXISTING ENVIRONMENT

This section provides a summary of the existing environment in which Geothermal Resources wishes to undertake decommissioning and rehabilitation activities. It includes biophysical environments, social environments, climate, Aboriginal heritage and land use.

4.1 Climate

Meteorological data has been sourced from the Bureau of Meteorology (BOM). The closest weather station to the decommissioning sites are Yunta (BOM station number 020026) located approximately 120 km to the south. A summary of the average monthly climate data for Yunta, based on continuous records for over 100 years is presented in Table 2 below.

Table 2: Climate Summary

Month	Average Monthly Rainfall (mm)	Maximum Monthly Rainfall (mm)	Average Daily Maximum Temperature (°C)	Average 9am Wind Speed (km/h)
January	21.1	176.5	32.6	11.4
February	20.8	146.9	32.1	10.8
March	15.6	146.0	29.3	11.3
April	15.9	116.0	24.2	10.0
May	22.5	123.0	19.1	9.0
June	21.7	70.9	15.9	9.5
July	16.8	71.9	15.4	10.9
August	19.0	58.3	17.3	12.4
September	18.3	97.4	20.8	14.7

October	22.5	99.0	24.3	15.9
November	19.7	113.5	28.3	12.9
December	21.7	154.2	31.1	12.4

The Frome Downs project area is generally arid with an annual average rainfall of approximately 200mm and a temperature variation of between 0°C and 45°C. Rainfall is extremely variable, with drought seasons common. Surface runoff may occur after heavy rainstorms and is relied upon to fill local station dams for stock watering.

4.2 Biophysical Environment

4.2.1 Landforms, soils, geology, vegetation and habitat

The Frome Downs project area is mostly flat open country vegetated with species of saltbush, bluebush and small shrubby trees (predominately Acacia species) and occasional groves of larger trees such as black oak and mulga. There are wide flood plains occupying the low areas that may become temporarily inundated after extreme rain storms. Well defined water courses are generally lacking. Interspersed sand sheets that form slightly higher ridges are mostly covered with thicker low scrubby vegetation.

The area is marked by a thin veneer of wind blown sand and hardpan comprised of ferruginous and gypsum cemented sandy to gravelly material. Variable thicknesses of Cenozoic sands and clays (eg Namba Formation) up to 90 metres thick rest unconformably on either Cambrian or Neoproterozoic gently dipping shelf sediments of the Arrowie Basin. This sequence rests unconformably on either Mesoproterozoic granitic rocks or Palaeoproterozoic metasediments and granitic gneisses.

4.2.2 Threatened Species

Reviews of DEW and EPBC databases, including Nature Maps and BDBSA searches found no records of threatened plants or animals near the decommissioning sites or within GEL 181. Although this area has not been intensely surveyed, there have been no long-term observations of rare or endangered species indicating there is little likelihood of encountering such.

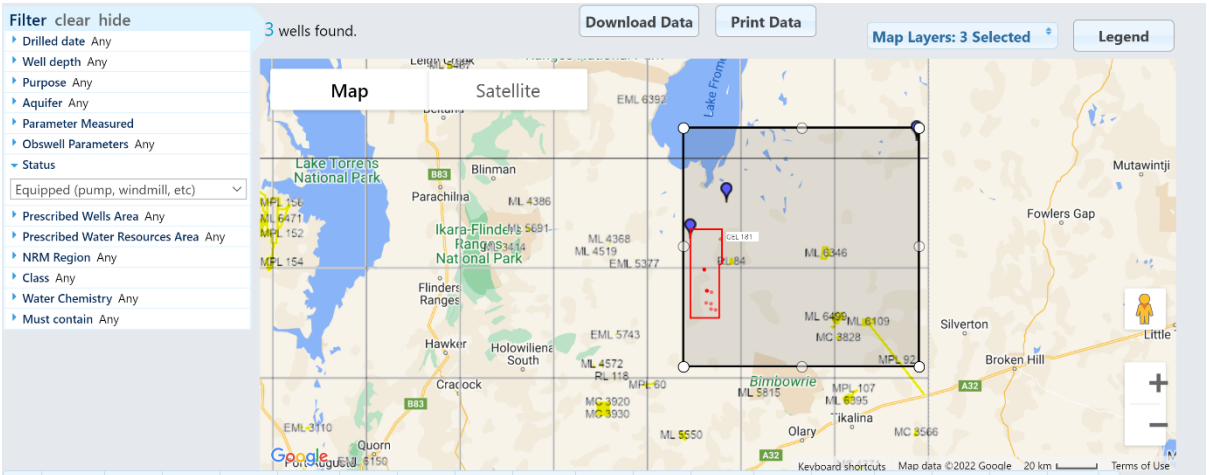
Confinement of all vehicles to existing station tracks and selection of open sparsely vegetated areas for the drilling sites means that the likelihood of the drilling work having impacted any unrecognised threatened species was exceptionally low. Likewise, the likelihood of impacting any of these species as a result of the well logging, monitoring or decommissioning work will be extremely low.

4.3 Groundwater

Groundwater in the region is almost exclusively sub-artesian and occurs in Cenozoic Eyre Formation palaeochannel sands and gravels (eg Goulds Dam palaeochannel). It is of high-salinity and is not suitable for stock (mostly >10,000 TDS). Hence almost all stock water in the region is derived from natural surface catchments in dams rather than bores.

These observations are supported by data from the Waterconnect SA database, which for a very large area of almost 20,000 km^2 surrounding GEL 181, records only two water bores in the region that are equipped with pumps or windmills (Figure 3). This area was selected because of the similarity of the surface topography and underlying geology to GEL 181 (unlike areas to the west nearer the Flinders Ranges, where the geology is different and the topography more undulating).

The more southerly of these bores (6835-69) is highly saline (19,659) and an earlier field search by Geothermal Resources showed that it was abandoned many years ago. The only other recorded equipped bore (6835-5) has water quality that is suitable for stock (3,032 TDS) but is only 8 metres deep with very low water yields. Discussions with the former station manager revealed that this bore is mostly dry and only has standing water after prolonged wet spells and even then was quickly pumped dry. It is almost certainly recharged locally after heavy rains and is quickly depleted by evaporation.



Detail	Unit No	Obs No	Obs Network	Permit No	Date Drilled	Max Depth (m)	Latest Depth (m)	SWL (m)	SWL Date	SWL Status	Yield (L/sec)	Yield Date	TDS (mg/L)	TDS Date	Salinity Status	Purpose	Aquifer	Status
Details	6835-5				01/01/1961	8.84	7.90	5.90	17/11/1977				3032	17/11/1977		STK		EQP
Details	6835-69			30373	22/11/1993	47.50	47.50	14.80	12/03/1994		1.000	22/11/1993	19659	12/03/1994		IND	TpQaw	EQP

Figure 3 GEL 181 (red boundary) within a surrounding 20,000 km^2 area (grey rectangle) in which there are only two records of "equipped" bores in the Waterconnect database. Neither of these bores are presently in use.

Due to the exclusive reliance on surface catchment dams for stockwater in the region, which frequently go dry in times of prolonged drought, if there were any water bores that contain suitable stockwater they would almost certainly be equipped and in service. This point is supported by the almost total absence windmills and solar pumps on pastoral properties in the region (including Kalkaroo Station owned by Havilah), in contrast to other parts of the State. Further confirmation comes from the tens of thousands of mineral drillholes completed by Havilah mostly to the east of GEL 181, in which not one low salinity groundwater discovery of suitable quality for long term stock usage has ever been made, in spite of frequent site testing of groundwater samples.

No Cenozoic palaeochannels, which are typically marked by freely flowing pressurised sands, were intersected during the drilling. Eyre Formation brown sands were logged in Frome 2 and 3, but no water flows were recorded. No Eyre Formation was logged in the other wells.

No Mesozoic sedimentary formations were encountered in any of the wells, hence there is no groundwater connection to the better quality water of the Great Artesian Basin that lies to the north of GEL 181 (Figure 2).

None of the wells recorded water flows of any significance from the Cambrian, Neoproterozoic and Mesoproterozoic age bedrock formations. Drillcore shows that these rocks were uniformly tight and unfractured, with no evidence for more permeable faulted or fractured zones (refer to drill logs in GEL 181 annual reports previously submitted to DEM).

The lack of well defined aquifers and the general absence of groundwater in any of the wells drilled indicates that the possibility of undesirable cross-contamination between aquifers is minimal. The only known groundwater in the region is from Eyre Formation palaeochannels, and it is too saline for stock use. Contamination of (non-existent) bedrock aquifers from the Eyre Formation is not feasible because of the extremely low permeability of the bedrock and the lack of any significant permeability enhancing fracturing or faulting observed in any drillcore.

4.4 Surface Water

Local ephemeral water holes and clay pans are rare within the GEL area. Lake Frome lies to the north of the Frome project area and is the largest drainage feature in the region. The lake is fed by a large catchment, including the Flinders Ranges to the west, the Olary Ranges to the south, and the Barrier Ranges to the east.

In places extensive man-made drains channel surface water into dams, but none of the geothermal holes lie near such channels so there is no possibility of contamination from saline groundwater nor surface water draining into the holes.

4.5 Aboriginal Cultural Heritage

The Frome Downs project area lies within two Native Title determined areas, those being; the Adnyamathanha People No. 1 (Stage 1) determination to the north, and Adnyamathanha No.1 (Stage 2) determination in the south.

On 10 and 11 August 2006, prior to drilling, a heritage survey was conducted by four senior Adnyamathanha people who were familiar with the area. They were taken to each of the proposed drilling sites and in each case did not identify any culturally significant features as recorded in a signed statement clearing the sites for drilling activities. The proposed well logging, monitoring and decommissioning activities will be completely confined to the areas subject to this previous heritage survey thereby mitigating the risk of disturbance to any Aboriginal sites, objects or remains.

All drill sites were chosen adjacent to station tracks and in areas of naturally sparser vegetation, usually shallow wind blow-outs, to minimise any environmental impacts (refer to photos of drill collar areas in Appendix 1). No new tracks were created to access any of the drill sites.

4.6 Non-Aboriginal Heritage

Non-indigenous heritage in the region dates back to the 1840s when European exploration of the area was occurring. Rapid pastoral development followed with all pastoral leases being taken up by the mid 1880s. Sheep and cattle grazing continues to this day in the region with some conservation work being undertaken on stations such as Bimbowrie and Boolcoomatta.

There are three Heritage Places listed on the SA Heritage Register that occur in the general vicinity of the Frome project area (Table 4). None are affected by the current well sites nor any proposed future activities.

Table 3: State Heritage Places in proximity to GEL181

State Heritage Code	Description
10310	Original Curnamona Station Homestead
12601	Mount Victoria Well Historic Site, including boiler, tank, trough and wind pump
10311	Antro Woolshed and shearers quarters

4.7 Land Use

The project area lies within the pastoral leases of Curnamona, Kalabity and Frome Downs that have been used for sheep grazing for over 100 years. There are no other land uses. The country is flat and mostly featureless with rainfall unpredictable and drought periods common.

The nearest settlement is Yunta, approximately 120 km to the south, which lies on the main Barrier Highway.

5 CONSULTATION

Relevant stakeholders are:

- The Adnyamathanha Traditional Lands Association Aboriginal Corporation RNTBC (ATLA)
- Pastoral leaseholders/managers affect by activities including:
    - Curnamona Station
    - Frome Downs Station
    - Kalabity Station
- Relevant government agencies
    - Department for Environment and Water
    - Environmental Protection Agency
    - AAR

In each case the relevant stakeholders were provided with draft copies of the Environmental Impact Report and Statement of Environmental Objectives that outline the nature of the decommissioning activities to be undertaken, a description of possible disturbance and mitigation measures and invite any feedback. Contact was via email to ATLA and the government agencies and via telephone call followed up by email to the three pastoral property managers or owners.

Responses to stakeholder comments are summarised in Appendix 2. Comments provided by DEW relating mainly to groundwater issues have now been addressed in this report.

Responses to government comments received through DEM consultation on the EIR and SEO documents in August 2022 are provided in Appendix 3.

6. RISK ASSESSMENT

This chapter identifies and assesses the potential hazards and risks to the environment as outlined in Section 5. It also provides a matrix by which these risks can be measured and a risk assessment table outlining the activity, event, type of impact, consequences, control measures and residual risk.

6.1 Potential Hazards and Consequences

A hazard is considered to be a source of potential environmental harm or impact. Hazards are likely to be minimal in view of the non-ground disturbing rehabilitation work proposed, but could include:

- Fire
- Vehicle movement on access tracks and roads (chiefly dust)
- Litter and rubbish

- Hydrocarbon and contaminated water spills

Potential consequences associated with the above hazards could include but are not limited to:

- Impact to visual amenity
- Loss/damage to native vegetation
- Soil erosion and compaction
- Disturbance/injury to native fauna
- Damage to sites of cultural heritage
- Injury to company personnel or members of the public
- Injury/loss of stock
- Disturbance to land uses
- Dust and noise
- Introduction/spread of pest plant species
- Contamination of soil

6.2 Risk Assessment

An environmental risk assessment has been carried out by Geothermal Resources to ascertain minor acceptable risks, and major risks in relation to proposed activities in this EIR. This has been achieved by comparing the likelihood and consequence of environmental harm that may occur due to each activity. Table 4 outlines the measurement of likelihood of a threat occurring while Table 5 outlines the criteria for judging the severity of the potential consequence. Table 6 shows the overall risk rating when likelihood and consequence are combined.

Table 4: Risk Likelihood Table

Rating	Descriptor	Description	Frequency
A	Almost certain	The threat is expected to occur in most circumstances	Recurring threat during the lifetime of the project or operation (e.g. more than once a month)
B	Likely	The threat will probably occur in most circumstances	Threat that may occur frequently during the lifetime of the project or operation (e.g. at least once per year)
C	Possible	The threat could occur	Threat that may occur during the lifetime of the project or operation (e.g. once in 3 years)
D	Unlikely	The threat could occur but not expected	Threat that is unlikely to occur during the lifetime of the project or operation (e.g. once in 10 years)
E	Rare	The threat may occur in exceptional circumstances	Threat that is very unlikely to occur during the lifetime of the project or operation (e.g. once in 15 years)

Table 5: Risk Consequence Table

Rating	Safety	Health	Environment	Equipment and Assets	Business Continuity	Community and Reputation	Liability
1 Minor	Single minor injury to one person. First aid or no treatment required. No lost time.	Reversible health effects of minor concern requiring first aid treatment at most.	Issues of non-continuous nature with promptly reversible impact or consequence (e.g. within shift). Low-level incident, site contained.	Below $5,000 (or 0.1% of operational budget based at $50,000,000).	Loss of operations for > ½ day. Reduction in capacity, < 10% for up to one month.	Unsubstantiated, low profile or no media attention. One-off complaint which is resolved via existing procedures.	Below $50,000 (or 0.1% of operational budget based at 50,000,000). Financial or accounting issue with ability to resolve with existing resources.
2 Moderate	Medically treated injury. Reversible injury. Requires treatment but does not lead to restricted duties.	Reversible health effects of concern that result in medical treatment but not restricted duties.	Issues of a non-continuous nature and minor impact and consequence. Low-level incident, site contained. Short term reversible (e.g. within days).	Between $5,000-$50,000 (or 0.1%- 0.5% of operational budget)	Loss of operations for > ½ day. Reduction in capacity, < per 20% for up to one month. Minor disruption to supply of services or technical support.	Substantiated, low impact, low media profile. Unresolved, low level community dissatisfaction, Repeated community complaints.	Between $50,000 - $100,000 (or 0.1% - 0.5% of operational budget). Financial or accounting issue requiring CFO resolution.
3 Serious	Reversible injury or moderate irreversible impairment. Less than 10 days lost time.	Severe but reversible health effects. Results in a lost time illness of less than 10 days.	Issues of a continuous nature - limited impact and consequence. Incident resulting in some site contamination. Medium term recovery impact.	Between $50,000 - $200,000 (or 0.5% - 3.5% of operational budget). Threat to property by known extreme organisations.	Loss of operations for one day to one-week Reduction in capacity, < 30% for up to one month. Increased government interest.	Substantiated, public embarrassment, moderate media profile (front page, one day). Repeated community complaint. Community demonstration. Impact on share price.	Between $100,000 - $250,000 (or 0.5% - 3.5% of operational budget).
4 Major	Severe irreversible damage to one or more persons. Lost Time Injury greater than 10 days.	Severe and irreversible health effects or disabling illness.	Compliance issue with large fine, media attention. Serious harm not immediately recovered. Significant site contamination or off-site impact. Long term recovery.	Between $200,000 - $500,000 (or 3.5 -10% of operational budget). Confirmed threats, without actions.	Loss of operations for one week to one month. Reduction in capacity, < 50% for up to one month. Regulatory enquiry.	Substantiated, public embarrassment, high impact, major media attention. Local or state media interest. Severe community dissent. Criticism from NGO and / or government.	Between $250,000 - $1,000,000 (or 3.5 - 10% of operational budget). Financial or accounting issue requiring General Manager finance resolution.
5 Catastrophic	Single fatality. Permanent disabling injuries.	Life threatening or permanently disabling illness.	Issues of a continuous nature with major long-term impact and potentially serious consequences.	Above $1,000,000 (or more than 10% of operational budget). Escalating threats or actions.	Loss of operations for > 1-3 months. Loss of permit to operate. Total loss of production for more than one month.	Substantiated, public embarrassment, multiple impacts, long lasting widespread media coverage. Severe, prolonged community dissent.	Above $1,000,000 (or more than 10% of operational budget).

Table 6: Risk Matrix (red= very high risk, orange= high risk, yellow=medium risk, green=low risk)

		Consequence				
		1 Minor	2 Moderate	3 Serious	4 Major	5 Catastrophic
Likelihood	A Almost Certain	10	16	20	23	29
	B Likely	7	12	17	21	24
	C Possible	4	8	13	19	22
	D Unlikely	2	5	9	14	18
	E Rare	1	3	6	11	15

Table 7 below details the hazards and threats, potential consequences, management strategies and residual risks associated with decommissioning and rehabilitation activities outlined in this EIR.

The following activities and/or events associated with well decommissioning have been identified that have the potential to impact on the environment as defined under the Petroleum and Geothermal Energy Act 2000:

Movement of vehicles to, from and within well site locations

Potential threats are mainly to the native vegetation and fauna, soil and the introduction/spread of pest plant species. These can be mitigated to a large degree by ensuring vehicles use only existing tracks during dry weather. Introduction of pest plant species can be avoided be regular inspection and washing down of vehicles.

Fire (resulting from rehabilitation and decommissioning activities)

While wild fires are almost unknown in this area due to the sparse vegetation, risk will be mitigated by ensuring firefighting equipment is carried on all vehicles, avoiding working on high fire danger days and not driving off-road over dry vegetation that could come in contact with hot exhausts.

Storage and Handling of Fuel and Oil

Spillage of fuel and oil can contaminate soil and potentially kill native vegetation and fauna. This will be mitigated by not handing any hydrocarbons on site and carrying spill kits.

Storage and transport of waste

All waste material resulting from the de-commissioning work will removed from site and disposed of in accordance with accepted methods.

Subsurface decommissioning

Groundwater cross-contamination and collapse of the hole collar are outcomes that can be avoided by adherence to the well decommissioning guidelines as described in *Mineral Exploration Drillholes guideline M2.*

All risk consequences that were identified returned a residual risk rating of “Low” or “Medium” when control measures were put into place. This is consistent with the proposed activities in this EIR being decommissioning and rehabilitation only with no drilling or site preparation required.

The highest consequence activities involved with decommissioning and rehabilitation include the movement of vehicles to and from site potentially introducing pest plant species, along with the risk of fire caused by operations. Geothermal Resources will ensure that all appropriate management strategies are in place prior to operations to further minimise the likelihood of these occurring, including relevant personnel induction.

Table 7: Risk Assessment for Decommissioning and Rehabilitation Activities

Activity/Event	Type of Impact	Potential Hazard/Threat	Control/Management Strategy	Consequence	Likelihood	Residual Risk
Movement of vehicles to, from and within well site locations	Soil	Soil erosion and compaction	- Vehicles to travel at reduced speeds to minimise rutting - Travel to be prohibited during wet weather events - Personnel to use only existing pastoral tracks - Ripping and rehabilitation to be undertaken if compaction occurs	1	E	**Low**
	Vegetation	Damage to native vegetation and fauna habitat	- Personnel to use only existing pastoral tracks - No off-road driving will be undertaken	2	E	**Low**
	Native fauna	Disturbance to rare, endangered species and loss due to collision	- Personnel to use only existing pastoral tracks - No off-road driving or excessive speed - Operations to take place in areas known to be absent of species	2	E	**Low**
	Existing landuse / stakeholder activities	Damage to stakeholder infrastructure or stock	- Vehicles to travel at reduced speeds to minimise chances of collision -Personnel to use only existing tracks - Station managers to be contacted prior to any work being undertaken	2	E	**Low**
	Surface water impacts	Alteration of surface water drainage	- Drainage lines to be avoided when driving to and from sites - Travel to be prohibited during wet weather events -Unavoidable damage to be repaired as soon as practicable	2	E	**Low**
	Existing landuse / stakeholder activities	Generation of dust resulting in reduction in local air quality	- Vehicles to travel at reduced speeds to avoid generating excess dust - Vehicles to further reduce speed when in close proximity to infrastructure	1	A	**Medium**
	Existing landuse / stakeholder activities and native vegetation	Introduction/spread of pest plant species	- Vehicles to be washed down prior to entering work area - Inspections of vehicles to be undertaken prior to entering work area	3	E	**Medium**

	Cultural heritage	Disturbance or damage to sites of cultural heritage significance	- Drill sites have already been cleared by heritage survey. - Personnel to use only existing tracks - Personnel to be trained to identify areas or objects of significance	3	E	**Medium**
	Public safety	Vehicle collision	- Vehicles to travel at reduced speeds to minimise chances of collision -Personnel to use only existing tracks	2	E	**Low**
Fire (resulting from any siteactivities)	Native flora and fauna	Damage to vegetation and habitat, loss of native fauna	- Firefighting equipment will be available in all vehicles - Fire safety induction for all personnel - Fire danger season restrictions applied when operating - Driving over dry vegetation litter and foliage prohibited	2	E	**Low**
	Existing landuse / stakeholder activities	Damage to stakeholder infrastructure or stock	- Firefighting equipment will be available in all vehicles - Fire safety induction for all personnel - Fire danger season restrictions applied when operating - Driving over dry vegetation litter and foliage prohibited - Activities not to take place in close proximity to infrastructure	3	E	**Medium**
	Public safety	Impacts to public safety and reduction in air quality	- Firefighting equipment will be available in all vehicles - Fire safety induction for all personnel - Fire danger season restrictions applied when operating - Emergency response plan in place - Activities not to take place in any communities or near dwellings	3	E	**Medium**
Storage and handling of fuel and oil	Soil	Spill/leak resulting in contamination of soil	- All vehicle refuelling to be undertaken offsite - Spill kits to be available at each site - Emergency response plan in place	2	E	**Low**
	Surface and groundwater	Spill/leak resulting in contamination of surface or groundwater	- All vehicle refuelling to be undertaken offsite - Spill kits to be available at each site - Emergency response plan in place	2	E	**Low**
	Public safety	Spill/leak resulting in impacts to public safety	- All vehicle refuelling to be undertaken offsite - Spill kits to be available at each site - Emergency response plan in place	2	E	**Low**
	Existing landuse / stakeholder activities	Spill/leak resulting in impacts on stock	- All vehicle refuelling to be undertaken offsite - Spill kits to be available at each site - Impacted soil to be immediately contained and removed - Any affected areas will be fenced off to exclude stock	2	E	**Low**

	Native flora and fauna	Spill/leak resulting in damage to vegetation and habitat, loss of native fauna	- All vehicle refuelling to be undertaken offsite - Spill kits to be available at each site - Impacted soil to be immediately contained and removed - Any affected areas will be fenced off to exclude native fauna	2	E	**Low**
Storage and transport of waste	Fauna and flora	Scavenging of native species	- All litter and waste will be removed from site post operations - Litter and waste will be contained during operations	1	E	**Low**
	Local stakeholder safety	Litter and reduced visual amenity	- All litter and waste will be removed from site post operations	1	E	**Low**
Subsurface well decommissioning	Groundwater	Cross flow of groundwater	-Decommissioning of wells undertaken in accordance with Mineral Exploration Drillholes guideline M21 -Decommissioning program developed and approved by DEM through Activity Notification process	3	E	**Medium**
	Soil	Collapse and subsidence of hole collar	-Decommissioning of wells undertaken in accordance with Mineral Exploration Drillholes guideline M21 -Decommissioning program developed and approved by DEM through Activity Notification process	3	E	**Medium**

7. RISK MANAGEMENT

To manage the risks outlined in Section 7, Havilah adopts a number of strategies in risk management. This chapter outlines the standards by which Geothermal Resources personnel abide, training and inductions which on site personnel will be required to complete, the emergency response plan, and reporting criteria in the event of an incident.

7.1 Standards

Geothermal Resources operate in full compliance with applicable Australian and international standards, including but not limited to:

- AS/NZS ISO 31000:2009 Risk Management
- AS/NZS ISO 45001:2018 Occupational Health and Safety Management Systems – Specification with Guidance for Use
- AS/NZS ISO 14001:2016 Environmental Management Systems – Requirements with Guidance for Use
- AS 1940:2017 The Storage and Handling of Flammable and Combustible Liquids

Havilah's policies and procedures manuals, which its personnel are familiar with, cover these aspects.

7.2 Training, Inductions and Responsibilities

As noted above Geothermal Resources will use internal staff and its own equipment to undertake decommissioning and rehabilitation of wells. All employees will undertake relevant inductions and training for all aspects of operations, including but not limited to:

- Havilah Resources Operating Light Vehicles SOP
- Havilah Resources Fire Awareness SOP
- Havilah Resources Waste Management SOP

For general environmental aspects, a Geothermal Resources nominated representative will be responsible for cleanliness of the site and access tracks, supervision of decommissioning works, and general documentation of operations. An on-site induction will be carried out which refers to these environmental outcomes.

7.3 Emergency Response

An Emergency Response Plan has been developed for all of Havilah's projects and will be applied to Geothermal Resources decommissioning activities. The conditions at the various well sites are no different to those that Havilah encounters on a daily basis at its current drilling sites.

7.4 Reporting

External reporting (e.g. Serious or Reportable incidents, annual reports) is carried out in accordance with the requirements of the *Petroleum and Geothermal Energy Act 2000* and the applicable SEO.

All serious incident and reportable incidents will be reported on to the relevant official governing body by Geothermal Resources personnel.

8 REFERENCES

Department for Energy and Mining (website)*, Arrowie Basin information page,* http://energymining.sa.gov.au/petroleum/prospectivity/arrowie_basin, viewed 1 April 2020

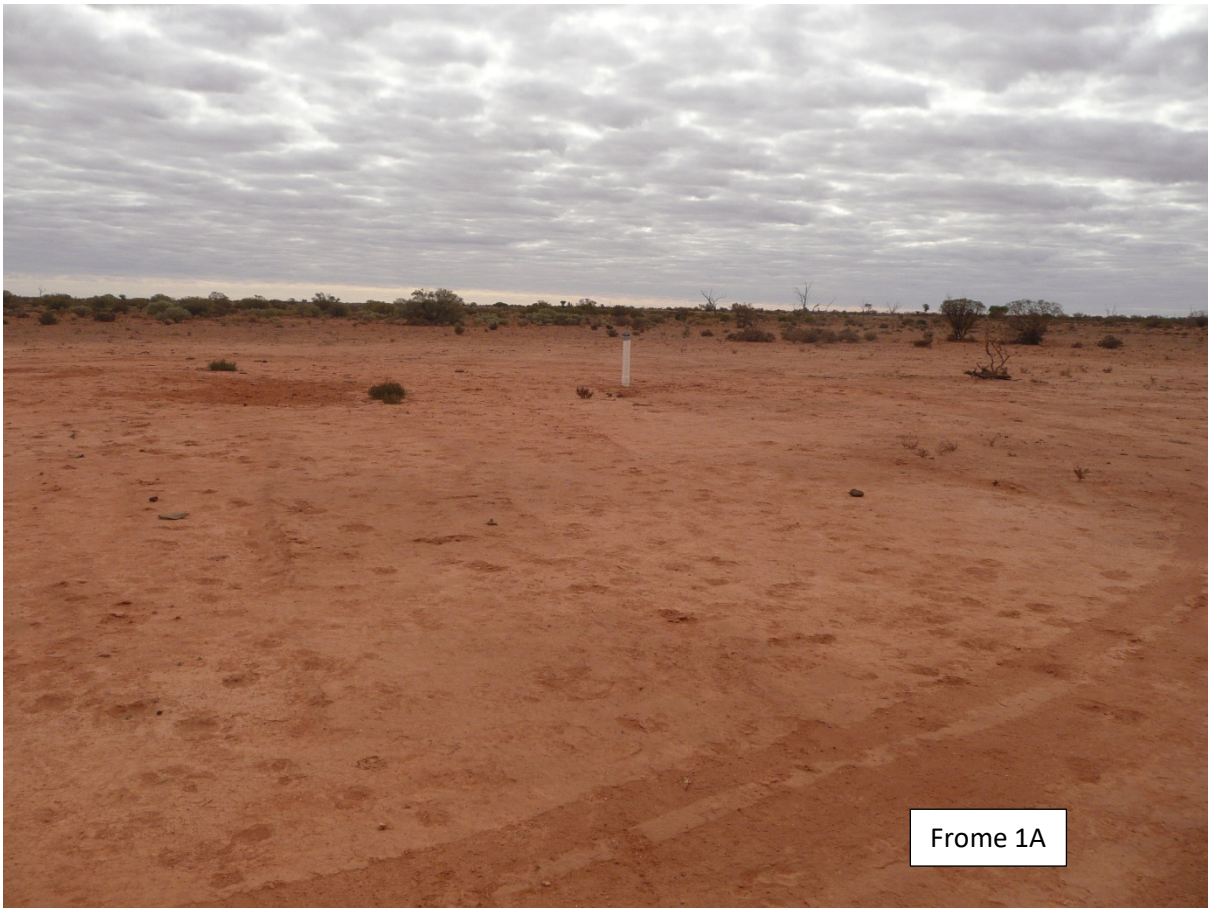
Geothermal Resources Limited, *Proposed eight-hole geothermal gradient drilling programme,* 2006

Santos, *Australian Cooper Basin Operators Environmental Impact Report, Drilling, Completions and Well Operations,* 2015

South Australian Resources Information Gateway (SARIG), *SA Heritage Places (map),* viewed 3 April 2020

Appendix 1

Photographs of Frome well sites


Frome 1A


Frome 2


Frome 3


Frome 5


Frome 9


Frome 10


Frome 11


Frome 12

Appendix 2

Summary of communication with relevant stakeholders and response to issues raised

Stakeholder	Contact Method	Contact Person	Comments Received	Havilah Response
Department for Environment and Water	Email on 2 Dec 2021; detailed written reply 14 Jan 2022.	Relevant office staff	Provided detailed comment and suggestions for providing additional information to support statements made in the document about the lack of active water bores and high groundwater salinity. Also some suggested clarifications to be made on maps and climate data.	Havilah provided an excerpt from the Waterconnect database that showed only two equipped bores in a more than 20,000km^2 area surrounding GEL181. Both had now been abandoned, one due to excessive salinity and the other had dried up. Other comments relating to improved clarification were addressed
Environmental Protection Authority (EPA)	Email on 2 Dec 2021; reply 24 Dec 2021	Relevant office staff	No concerns or issues were raised in EPA's email response.	Noted
DPC-AAR	Email on 2 Dec 2021; no reply.	Relevant office staff and general contact	No response was received	Noted
ATLA (Adnyamathannha Traditional Land Association)	Email on 2 Dec 2021; replies 6 Dec 2021 and 24 Jan 2022.	Principal advisor	Asked to be advised of the dates for the planned decommissioning work once settled,	Noted and agreed
Frome Downs Station (Frome 13 well)	Telephone call and follow up email 2 Dec 2021; reply 3 Dec 2021.	Willoway Farming representative	No objection to planned activities. Requested Havilah make contact with their station manager prior to going onto their land for the decommissioning work.	Noted and agreed
Kalabity Station (Frome 1A, 3, 9, 10, 11&12 wells)	Telephone call and follow up email 12 Dec 2021; reply 12 Dec 2021.	Willoway Farming representative	No objection to planned activities. Agreed to meet as nearby neighbours (with Kalkaroo) when the opportunity arose. Requested Havilah make contact prior to going onto their land for the decommissioning work.	Noted and agreed
Curnamona Station (Frome 2 well)	Telephone call and follow up email 12 Dec 2021.	Owner and Station Manager	No objection to planned activities. Requested Havilah make contact with station manager prior to going onto their land for the decommissioning work.	Noted and agreed

Appendix 3

Responses to comments received from Government Agencies through DEM consultation – August 2022

1. Department for Environment and Water

The following comments are provided on the for Geothermal Resources' Well Monitoring and Decommissioning EIR and SEO.

EIR
p11. delete Crown Lands Act 1929, insert Crown Land Management Act 2009
Havilah comment: done

p11. And *Section 4.3*
Minor saline groundwater was cut in the bedrock and there is no aquifer as such in any bedrock formations, due to the very weak water flows. In general the rocks were very tight and unfractured as recorded in drill logs. No Cenozoic palaeochannels nor Mesozoic Great Artesian Basin sediments were encountered in any holes (Figure 2).

For future iteration, is there a drilling or exploration report that can be cited in these sections when reference to stratigraphy, water cuts or water quality encountered is made? A reference to the logging data would help support this argument.
Havilah comment: all drill logs have been provided in reporting to DEM that supports this statement. Given the purposes of the SEO and EIR reports it is not appropriate to incorporate full previous drill logs.

Pg. 11. Accordingly, it considered that measures such as concreting to isolate and confine aquifers and prevent cross-flow should not be required for the Frome drillholes.

Whilst no paleochannel sediments were noted, the considered measures appear to be pre-empting consultation with DEM as proposed later on in the document. It is recommended this sentence be removed in light of statements highlighted by comments made later in the document (see next comment).
Havilah comment: DEM will be consulted to arrive at a sensible and practical outcome for decommissioning that causes minimal disturbance to the environment. Havilah has revised the wording of this statement accordingly.

Pg 12/ Pg 23. Backfilling and/or placing concrete plugs in the holes as approved by DEM in accordance with Mineral Exploration Drillholes guideline M2.

DEW approve of this measure and appreciate being consulted by DEM on decommissioning proposals.
Havilah comment: the guidelines are designed to cover the general situation. Particular geological/hydrological conditions need to be taken into account and the advisability of maintaining the opportunity to record further subsurface scientific data.

Pg 13: Groundwater in the region is almost exclusively sub-artesian and occurs in Cenozoic Eyre Formation palaeochannel sands and gravels (eg Goulds Dam palaeochannel). It is of high-salinity and is not suitable for stock (mostly >10,000 TDS). Hence almost all stock water in the region is derived from natural surface catchments in dams rather than bores.

DEW acknowledge the additional information provided.

DEW note descriptions of minor groundwater occurrence found in bedrock found in this EIR and also in Waterconnect. Please confirm if this sentence is referring to any water cuts or groundwater occurrence or just groundwater occurrence of sufficient quantity and yield to be potentially exploitable for economic purpose (”flowing”). If the latter, please modify the sentence for clarity.
Havilah comment: no water flows of significance were logged in the geothermal wells as stated in the report. Havilah cannot comment about bedrock waterflows in areas where it has not drilled, especially given the lack of Waterconnect data for the bedrock. Wording here has been clarified.

DEW notes that there are more historical water quality results in the area than active bores (See attached). For future works, a brief description of water quality data (minimum –maximum range from defined wells/ tabulated results) available from the study area as described in figure 2, similar to what was done for well status, would help bolster the argument. Further, DEW are conscious that future use of groundwater resources in this area might constitute other uses beyond stock and domestic, such as mining supply or industrial, for which water quality requirements are more lenient.
Havilah comment: Havilah agrees with the last sentence, However it is not directly relevant to the geothermal wells in question as water flows were insignificant and could not ever be contemplated as sources for say a mining operation. The lack of water flow in the wells indicates there is no hydraulic connection with other potential larger volume water sources such as Cenozoic palaeochannels. The lack of Mesozoic strata in the geothermal wells precludes any hydraulic connection to the Great Artesian Basin.

Pg 14: Further confirmation comes from the tens of thousands of mineral drillholes completed by Havilah mostly to the east of GEL 181, in which not one low salinity groundwater discovery of suitable quality for long term stock usage has ever been made, in spite of frequent site testing of groundwater samples.

Is there a citation available for the results for these aforementioned groundwater samples? If not subject to confidentiality, are these results available for upload to SAGeodata?
Havilah comment: although Havilah does field water quality tests from time to time (and more often “taste test”) there is no formal reporting of such and hence no references can be cited. Water flows are always reported in Havilah’s mineral drilling geological logs because it typically affects the sample quality and RC drilling progress. Mostly areas with high waterflows (eg Eyre Formation palaeochannels) are avoided in Havilah’s mineral drilling.

Some minor editorials found in the SEO that do not impact salience but may improve clarity:

Table 1, point 7: “No mixing of aquifers” replace with “No interconnection of aquifers” or “no mixing of groundwater from different aquifers”
Havilah comment: done

Table 3: “in manner” replace with “in a manner”
Havilah comment: done

2. EPA

RE: Geothermal Exploration Drillhole Logging, Monitoring, Maintenance, Rehabilitation and Decommissioning

Thank you for the opportunity to provide comment on the following documents:

- ENVIRONMENTAL IMPACT REPORT - Geothermal Exploration Drillhole Logging, Monitoring, Maintenance, Rehabilitation and Decommissioning, June 2022
- STATEMENT OF ENVIRONMENTAL OBJECTIVES - Geothermal Exploration Drillhole Logging, Monitoring, Maintenance, Rehabilitation and Decommissioning Program, June 2022

The Environment Protection Act 1993 does not apply in relation to petroleum exploration activity undertaken under the Petroleum Act 2000 or the Petroleum (Submerged Lands) Act 1982. The EPA has assessed the documents in the context of what it considers the key environmental risks and has no further comments.

The EPA is satisfied the impacts from downhole logging, monitoring, maintenance and ultimately final rehabilitation and decommissioning activities on previously drilled geothermal holes have been identified and appropriate measures will be implemented to reduce the risk of environmental harm.

Havilah: no further comment

3. South Australian Arid Lands Landscape Board

The documents have been reviewed with consideration of the boards areas or responsibility and interest and the following feedback is now provided in relation to the SEO and EIR.

- The SEO page 5 identified the environmental objective of preventing the introduction of pest plant species and pathogens, supporting this should be appropriate hygiene associated with equipment used in decommissioning activities as only vehicles are identified and no or minimal disturbance to any pest species identified within the decommissioning area to avoid spread. Appropriate monitoring to be included.
- Note Water Affecting Activity permits are not identified in the SEO, whilst reviewing the documents it is unlikely that any permits are required for the activities, it would be useful to acknowledge.

Havilah comment: both points have been addressed in the updated documents

4. Aboriginal Affairs and Reconciliation

RE: Request for Comment – Geothermal Resources Pty Ltd – SEO and EIR

Thank you for seeking comment from Aboriginal Affairs and Reconciliation (**AAR**) about Geothermal Resources Pty Ltd (**Proponent**) Geothermal Exploration Licence 181 (**Project**) and its related Environmental Impact Report (**EIR**) and Statement of Environmental Objectives (**SEO**).

AAR's comments about the Proponent's EIR and SEO are in Attachment 1. Below are general comments about managing Aboriginal heritage and Aboriginal engagement.

Aboriginal Heritage Act

The *Aboriginal Heritage Act 1988* (SA) (**Heritage Act**) applies to the whole of the Project area, and protects all Aboriginal sites, objects and remains (together, **heritage**) in it, whether recorded, reported or undiscovered. This protection extends to Aboriginal heritage that may exist in disturbed areas, or areas that have been subject to cultural heritage assessments or 'clearances'.

Under section 20 of the Heritage Act, heritage discoveries must be reported to the Minister for Aboriginal Affairs via AAR on 08 8226 8900 or at DPC-AAR.HeritageSites1@sa.gov.au.

If heritage is discovered during the Project, the Proponent must cease all ground-disturbing work in the discovery location and avoid the site. Authorisation from the minister under section 23 of the Heritage Act may be required to recommence work in that area.

If skeletal remains are discovered during the Project, the *Coroner's Act 2003* (SA) requires the Proponent to contact SAPOL immediately on 131 444.

Central Archives

AAR administers central archives of heritage on behalf of the Minister that contain over eight thousand records from across the state. New entries are added regularly. AAR recommends that proponents search the central archives early in project planning and again throughout long-term projects.

The central archives are not an exhaustive record. Aboriginal heritage may exist within an area even though it is not recorded. Aboriginal tradition dictates that the nature and location of some heritage must not be widely shared. Traditional Owners and Aboriginal organisations maintain local archives with information not held on the central archives.

Early and meaningful consultation with Traditional Owners and Aboriginal organisations is strongly recommended as part of all heritage management strategies.

Heritage searches can be made via AAR's online information portal *Taa Wika:*

http://taawika.sa.gov.au/public/request-for-access/enter

Alternatively, please call the Heritage Information Team on 08 8303 0738 for assistance. Search fees apply.

Aboriginal Consultation

AAR always recommends that proponents engage early and meaningfully with Traditional Owners and their representatives about possible projects. This helps proponents to negotiate acceptable heritage risk management strategies before projects start. This can minimise time and cost impacts for proponents later.

AAR notes that the Proponent engaged the Adnyamathanha Traditional Lands Association RNTBC (ATLA) to join a heritage assessment for the Project in 2006. Please note that neither native title holders nor Traditional Owner can authorise impacts to heritage under the Act. Only the Minister can do so after broad public consultation with all interested Aboriginal people and organisations.

ATLA is currently in administration and has a limited ability to engage with external stakeholders. Because of this, and in any case, AAR recommends that the Proponent is open to consulting and engages with any Aboriginal person or party who may be interested in the Project, not just ATLA.

Management and reporting of Aboriginal heritage

AAR commends the Proponent for engaging Traditional Owners to participate in a heritage assessment of the Project area. The EIR advises that no heritage was identified in the survey undertaken by four senior Adnyamathanha people in 2006.

Should heritage be discovered during well monitoring and decommissioning, it must be reported to AAR.

Legislative Awareness Training

AAR is available to deliver legislative awareness training sessions to the Proponents' staff and contractors. These sessions aim to increase attendees' awareness of the Heritage Act, heritage risk management strategies, and Aboriginal heritage more generally.

Attachment:

1. AAR comments on Project EIR and SEO (see below)

9 August 2022

AAR Agency Comment

Summary of Project Area

- Geothermal Resources Pty Ltd (Geothermal Resources) holds Geothermal Exploration Licence 181 (GEL 181) which lies in the North East Pastoral District south of Lake Frome and approximately 120km north of Yunta.
- A number of geothermal exploration wells were drilled in the Arrowie Basin within GEL 181 between 2007 and 2009.
- In 2006, four senior Adnyamathanha people undertook an Aboriginal heritage survey of geothermal well locations within Geothermal Exploration Licence area 181 (GEL181)
- No Aboriginal heritage was recorded at these locations
- A program of well monitoring and decommissioning is being undertaken in accordance with Geothermal Resources' Environmental Impact Report (EIR) and Statement of Environmental Objectives (SEO).

Geothermal Resources Well Monitoring and Decommissioning - GEL181 (SEO)

Document Reference	Section Detail	AAR – Replace with or Comment
Table 1, Section 8 , Page 6	*Avoid disturbance to sites of Aboriginal and European cultural significance.*	Replace with: Avoid disturbance to sites of Aboriginal and non-Aboriginal cultural significance. AAR Comment: Afghan or non-European heritage is present in South Australia.

Document Reference	Section Detail	AAR – Replace with or Comment
Table 1, Section 8 , Page 6	• *Surveys conducted for any proposed new areas of ground disturbance and any sites of Aboriginal and non-Aboriginal heritage identified and avoided.* • *Avoid damage, disturbance or interference to Aboriginal sites, objects or remains ("Aboriginal heritage") as required by the Aboriginal Heritage Act 1988 (SA)("AHA").* • *No incident of unauthorised off-road driving or creation of shortcuts*	Replace with: *No incident of unauthorised off-road driving, creation of shortcuts* to *Project sites or track braiding.*
Table 1, Section 8 , Page 6	• *A cultural heritage survey by senior Adnymathanha people has been conducted previously and clearances have been obtained for all of the drill sites that are to be decommissioned.* • *Personnel to only use existing tracks and not to disturb any areas away from those that have been previously cleared by cultural heritage surveys.* • *Personnel to be trained to identify areas or objects of significance.*	Replace with: *A cultural heritage survey by senior Adnyamathanha people has been conducted previously and clearances have been obtained for all of the drill sites that are to be decommissioned.* Replace with: *Personnel to be trained to identify areas or objects of Aboriginal heritage significance.*

Geothermal Resources Well Monitoring and Decommissioning - GEL181 (EIR)

Document Reference	Section Detail	AAR – Replace with or Comment
Section 4; Page 12	*Aboriginal Heritage*	Replace with: Aboriginal heritage

Document Reference	Section Detail	AAR – Replace with or Comment
Section 4.5; Page 15	*cultural sites, objects or remains.*	Replace with: Aboriginal sites, objects or remains
Section 4.6 Page 15	*Non-Indigenous Heritage*	Replace with: Non-Aboriginal Heritage. AAR Comment: consistent with SEO use of non-Aboriginal
Section 5; Page 16	*DPC-AAR*	Replace with: AAR AAR Comment: AAR is now within the Attorney-General's Department
Section 5; Page 16	*The Adnyamathanha Native Title Claimant group (ATLA)*	Replace with: Adnyamathanha Traditional Lands Association Aboriginal Corporation RNTBC (ATLA).

Havilah comment: Aboriginal cultural heritage requirements are noted. All replacements have been made in the SEO and EIR documents.