GEOTHERMAL RESOURCES

Geothermal Resources Ltd

ABN 45 115 281 144

ANNUAL REPORT

GEOTHERMAL EXPLORATION LICENCE 181

FOR THE PERIOD

22 Nov. 2007 to 21 Nov. 2008

February 2009

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1. Introduction

GEL 181 was granted to Havilah Resources NL on 22nd November 2004 and subsequently transferred to Geothermal Resources Limited on 12th August 2005.

This is Geothermal Resources fourth year of tenure and the minimum work commitment was to drill one deep (1800m) pilot hole (Table 1).
This deep hole was spudded on 18th September and reached 1629.2m on 21st November; (a total vertical depth of 1761.2m was reached on 30th November 2009).

Adjacent to GEL 181 Geothermal Resources also holds GELs 208, 209 and 210. An overall or 'grouped' exploration approach to the entire GEL block has been accepted by PIRSA. From 22nd November 2008 a variation in the minimum work requirements for these GELs has been approved by Dr. Barry Goldstein, Director Petroleum, Minerals and Energy Resources, PIRSA. The original and changed work requirements are presented in Tables 1 and 2 respectively of this document. Further, this grouping of Geothermal Resources Frome GELs was also restated and formalised. Specifically, Geothermal Resources Frome GELs 181, 208, 209 and 210 will be grouped as one and have a common anniversary date (21st November). The common anniversary dates were achieved by the suspension of GELs 208, 209 and 210 from 11th August to 21st November 2008.

2. Work Completed

<u>Frome 5/5A:</u>

Frome 5 (Latitude: 31° 38' 24.7"S Longitude: 139° 48' 05.7"E [GDA 94]) was spudded on 14/02/2008 and abandoned at 130m (19/02/2008) owing to hung casing. It was mud drilled by Talager Pty. Ltd. using an Almet Masters EX 300 RC rig.

Frome 5A (Latitude: 31° 38' 25.6"S Longitude: 139° 48' 05.6"E [GDA 94]) was spudded on 24/02/2008 and also abandoned (1/03/2008); specifically at 146 metres owing to loose sand jamming the rods. The hole was mud drilled to 114 metres and then cased with 100 mm PVC. Percussion drilling followed to 146 metres. It was also drilled by Talager Pty. Ltd. using an Almet Masters EX 300 RC rig. At 113 metres green dolomitic siltstones were encountered – these continued to the bottom of hole. It is suggested that these siltstones are likely to be from the Amberoona Formation.

Frome 12:

Prior to drilling the ~1800 metre deep hole extensive temperature modelling and three dimensional stratigraphic interpretation were used to site the hole collar. All of the Frome holes were temperature logged along with other old mineral/stratigraphic holes; specifically: Frome 1A, Frome 2, Frome 3A, Frome 8, Frome 9, Frome 10, Frome 11, Telechie TM9W-1, Ben 0157, Cartspring and Emu Dam. This data was modeled using Vulcan software to produce a second order two dimensional isotherm map of temperatures in the Frome GELs. See Figure 1, the red 'bullseye' marks the predicted hottest spot.

All available drill core was inspected and relogged in terms of current stratigraphic nomenclature. This data was again interpreted using Vulcan software to produce a three dimensional model that enabled visualization of the expected geology at possible sites for the 1800 metre deep hole.

Data from the 'Curnamona Deep Seismic Survey, (2003-20040)' was reinterpreted. The Adelaidean sediments were interpreted to have many horizontal and sub-horizontal reflections resulting from the bedding in the rocks. Conversely, the buried granite was interpreted to give no/few reflections because of its presumed homogeneity.

The above temperature modelling, the new stratigraphic model and the reinterpretation of the seismic data were combined with the previously known and documented gravity and magnetic data to site Frome 12 at what was believed to be an ideal position for a deep geothermal hole.

The location of Frome 12 is shown in Figure 2. In accordance with the proposed work program, Geothermal Resources drilled one deep pilot hole. This hole has the coordinates (GDA 94):
Latitude: 31º 35' 51.6"S
Longitude: 139º 47' 22.8"E.

Frome 12 was drilled by Silver City Drilling, using a Hydco 1000H rig. The hole was spudded on 18th September and reached 1629.2m on 21st November; (a total vertical depth of 1761.2m was reached on 30th November 2009).

The hole was mud drilled to 3.6m and 150 mm PVC casing run and pressure cemented. PQ diamond coring was used to the commencement of hard rock at 155.8 metres depth. HQ diamond coring continued within the PQ rods (ie. HWT casing) to 1200 metres depth. NQ diamond coring continued (within the HQ rods) to 1629.2 metres on the 21st November (a total vertical depth of 1761.2m was reached on 30th November 2009).

Drilling conditions were mostly very good with all of the HQ drilling achieved using only one bit (ie. 1044.2m). A slow drilling rate was successfully employed in an effort to keep the hole vertical; the hole started at -89º and finished at -89.2º.

In view of the remote possibility of a gas encounter the following measures were taken with safety as the foremost consideration:

- The HWT casing was pressure cemented in,
- The return mud was continuosly checked for a gas encouter using a Riken four gas detector,
- All drilling ocurred through a diverter assembly,
- A stabbing valve was kept 'on the rig floor' so that the well could be closed in, in the event of a gas encounter,
- A 50 metre flare line was kept assembled ready to be connected to the diverter in the event of a low pressure gas encounter,
- A flare pit was located 50 metres down wind from the hole collar (at the far end of the flare line),
- A high pressure mud pump was positioned next to a sump reserved for 'kill mud',
- 'Kill mud' chemicals were kept next to the high pressure mud pump,
- All drilling occurred with mud weighted to approximately 1.08 SG (achieved by the addition of sodium chloride), and
- The drilling mud was regularly monitored for mud weight, viscosity and pH, and the required adjustments made.

It is pleasing to report that no gas was encountered.

TEMPERATURE LOGGING

Downhole temperature logging of Frome 12 was carried out in four phases. The first two of these phases occurred in the report period:

- As drilling progressed the hole was surveyed using a digital Camteq survey instrument. These surveys, often around every 60 metres of progress, not only provided dip, azimuth and other data; but, also temperature measurements.
- At 1000m depth drilling was suspended to allow temperature equilibration between the hot rocks and the residing drilling mud. After three days of equilibration the 1000m sequence was logged for temperature and Gamma radiation at 5cm intervals by the Department of Water, Lands, and Biodiversity Conservation.

{For completeness, the following linked phases are noted even though they marginally occurred out of the reporting period.

- At total vertical depth, and after 3 days of equilibration time, the top 1050 metres was relogged for both temperature and Gamma radiation by Geoscience Australia.
- At total vertical depth, and after 4 days of equilibration time the deeper portion of the hole, specifically from 1200m to 1760m was temperature logged using Geothermal Resources 'Sterilcyl' and 'i-button' temperature probes in an Eastman Kodak barrel positioned using the wireline of SCD's Hydco 1000H rig.}

3. Reporting Against Requirements of the Petroleum Act 2000

(a) Summary of regulated activities conducted under the licence during the Year

The drilling of Frome 12 commenced and advanced to a vertical depth of 1629.2m by the end of the reporting period. {Drilling continued into the next reporting year.}
The hole was logged continuously from surface to 1000m for both temperature and gamma radiation.

(b) Report for the Year on compliance with the Act, these regulations, the licence and any relevant statement of environmental objectives

Geothermal Resources carried out its field activities in accordance with the Cooper Basin Drilling SEO, dated November 2003 (see Appendix 1). All prevention and remediation measures, as listed in Appendix 1, were diligently followed. Geothermal Resources is not aware of any SEO non-compliance issues. A PIRSA engineer inspected the site/operation and commended the company for: a clean well planned site, safety arrangements, signage and recent rehabilitation work.

All obligations were complied with, other than the late submissions for the annual report, well completion reports and wire-line LAS files. The annual report was not submitted within 2 months after the end of the licence year as required by Regulation 33. It was submitted within 3 months of the end of the licence year. This was largely due to the new writer assuming that there was a 3 month 'window'. The well completion reports for Frome 2, and Frome 3/3A were variably late, by up to 5 months, as the staff member to write them took up their position late (the WCR for Frome 5/5A was submitted early).

(c) Actions to rectify non-compliance with obligations imposed by the Act, these regulations or the licence, and to minimise the likelihood of the recurrence of any such non-compliance

A new staff member has been appointed.

The new staff member now knows the Annual Report regulations and intends to use the Annual Report Guidelines proforma in future.
Additionally, the new staff member knows the submission requirements for Well Completion Reports and has the time to fulfil them.
The new staff member now knows that Wire-line log LAS files must be submitted within 2 months of survey – separate from any WCR or Annual Report.

(d) A summary of any management system audits undertaken during the relevant licence Year, including information on any failure or deficiency identified by the audit and any corrective action that has, or will be, taken

Management closely monitored all activities and did not detect any reportable deficiencies or incidents.

(e) List all reports and data relevant to the operation of the Act during the relevant licence Year

Report	Due date	Date submitted	Statement of compliance
2007 Annual Report	21 Jan. 2008	Feb. 2008	Late; ie. non-compliant
WCR for Frome 2	28 Dec. 2007	May 2008	Late; ie. non-compliant
WCR for Frome 3/3A	14 Jan. 2008	May 2008	Late; ie. non-compliant
WCR for Frome 5/5A	19 Aug. 2008	June 2008	Compliant (early)
Notification of Activity	not applicable	5 Jun. 2008	Compliant (early)
Frome 5: Daily Drilling Reports	15/02/2008 to 20/02/2008	15/02/2008 to 20/02/2008	Compliant
Frome 5A: Daily Drilling Reports	25/02/2008 to 2/03/2008	25/02/2008 to 2/03/2008	Compliant
Frome 12: Daily Drilling Reports	19/09/2008 to 21/11/2008	19/09/2008 to 21/11/2008	Compliant
Frome 2 Wire-line log LAS files (Temp. & Gamma)	{19 Nov 2007}	Feb. 2008	Late; ie. non-compliant
Frome 3A Wire-line log LAS files (Temp. & Gamma)	26 Nov. 2007	Feb. 2008	Late; ie. non-compliant

Note: { } are used to indicate from previous reporting period

(f) Report of incidents reportable to the Minister under the Act and regulations

No incidents occurred and therefore none were reported.

(g) Report on any reasonably foreseeable threats that reasonably present, or may present, a hazard to facilities or activities under the licence, and a report on any corrective action that has, or will be, taken.

No threats identified.

(h) Operations proposed for the ensuing Year

During Year 5 it is proposed to:

- Complete the drilling of Frome 12 to approximately 1800m.
- Temperature log Frome 12 to total depth.
- Drill at least one other approximately 1800m deep diamond hole within the group of Frome GELs comprising: 181, 208, 209 and 210; this well will be called Frome 13 and its location can be seen in Figure 3.
- Temperature log the above hole.
- Measure the thermal conductivities of sediment samples from Frome 12.
- Relog Frome 12 for temperature (months after rig release).
- Model the temperature and thermal conductivity data three dimensionally.

4. Expenditure for Year 4

Commercial in Confidence

TABLE 1: Proposed Work Program ('original') for GEL 181

Year	Work Commitment	Work completed
One	Gravity survey	Database compilation, acquisition existing gravity and seismic data.
Two	Data review	Selection of drill sites. Aboriginal heritage survey. Submission of Activity Notification. Submission for PACE grant – (received DPY 3-77).
Three	Drill one shallow hole	Completion of two drillholes to approx. 500m: Frome 2, and Frome 3/3A. Temperature logging of these holes.
Four	Drill one deep pilot hole	Frome 5/5A drilled to 146m (prior to the drilling of Frome 12). Lodgement of Activity Notification for Frome 12. Frome 12 drilling ahead at 1629.2m. {Completion of Frome 12, at 1761.2m, less than two weeks into next year.} Temperature and gamma radiation logging of Frome 12 to 1000m ('continuous' measurements).
Five	Drill one production well and one injection well	

TABLE 2: Minimum Work Requirements ('new') for GEL 181

Year of Term of Licence	Minimum Work Requirements
One	• Geological and geophysical studies.
Two	• Geological and geophysical studies.
Three	• Drill two shallow holes.
Four	• Drill one deep pilot hole to 1800m depth.
Five	• Review of pilot hole results and decision on drilling production wells. *Year 5 work program to be conducted anywhere within the boundaries GELs 181, 208, 209 and 210.*

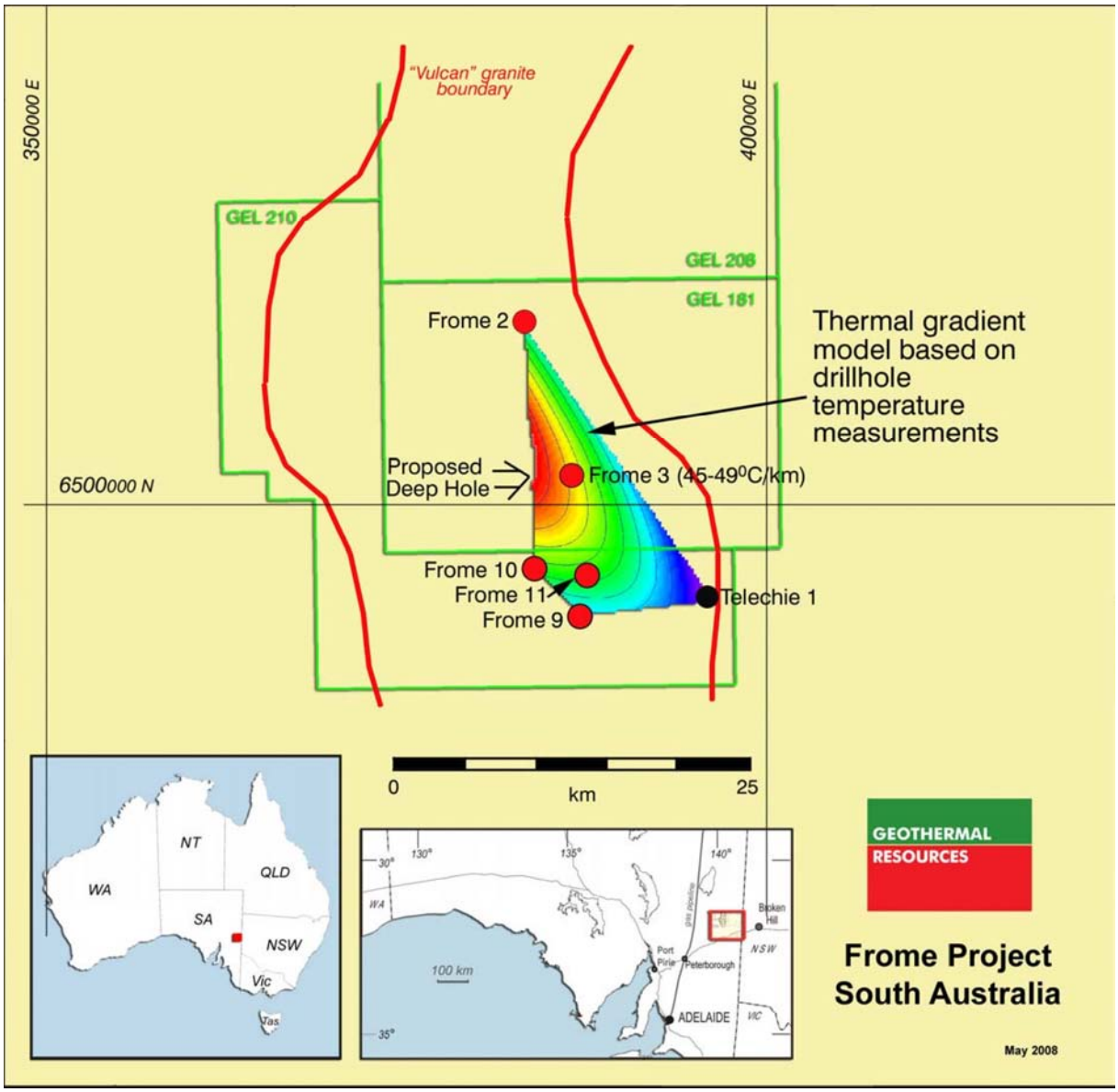

Figure 1. **2-Dimensional isotherm map of temperatures.**
The red 'bullseye' marks the predicted hottest spot and approximate location of Frome 12.

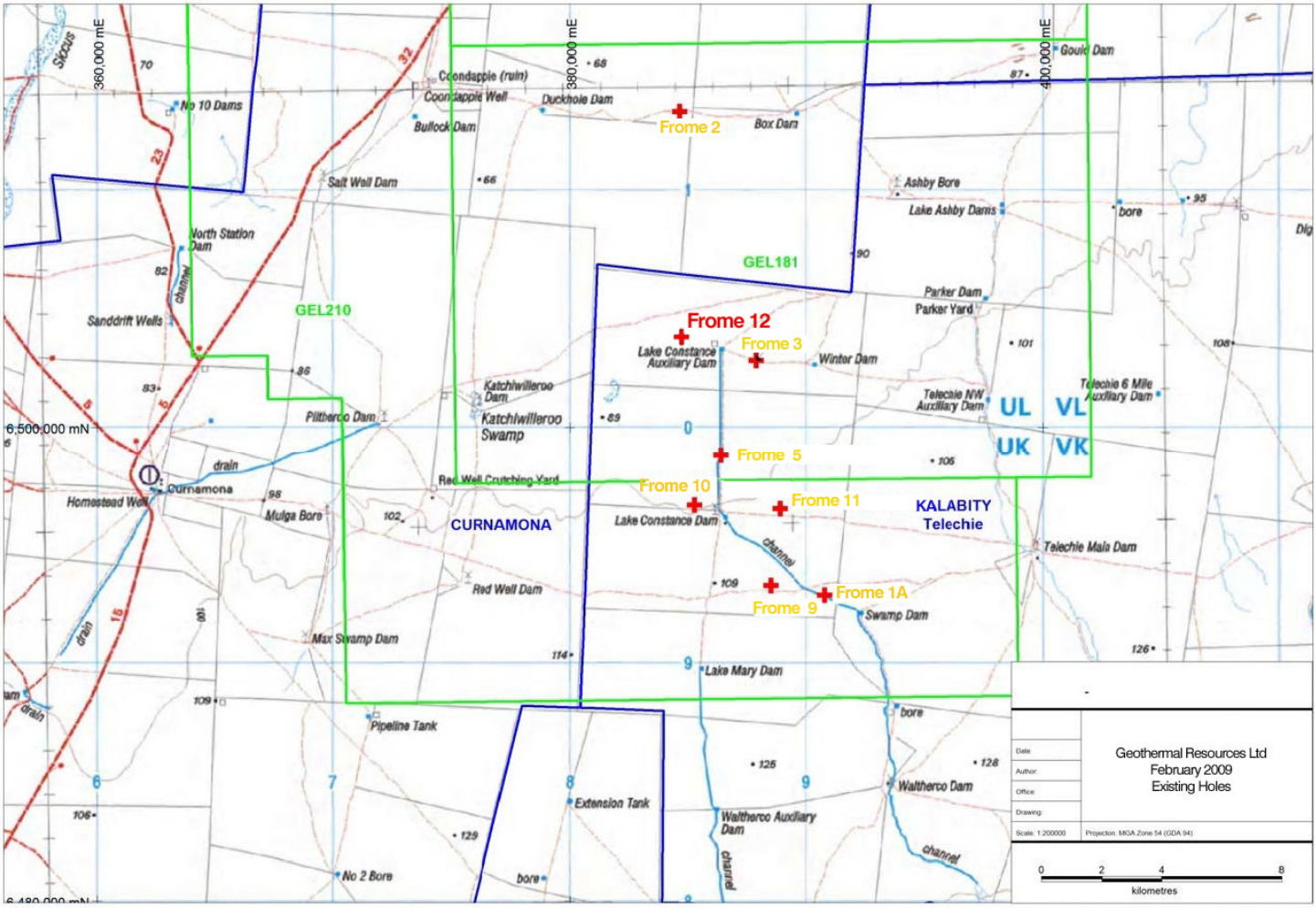

Figure 2. **GEL boundaries, pastoral leases and location of Frome 12 (red label). [Previously drilled Frome holes have yellow-orange labels.]**

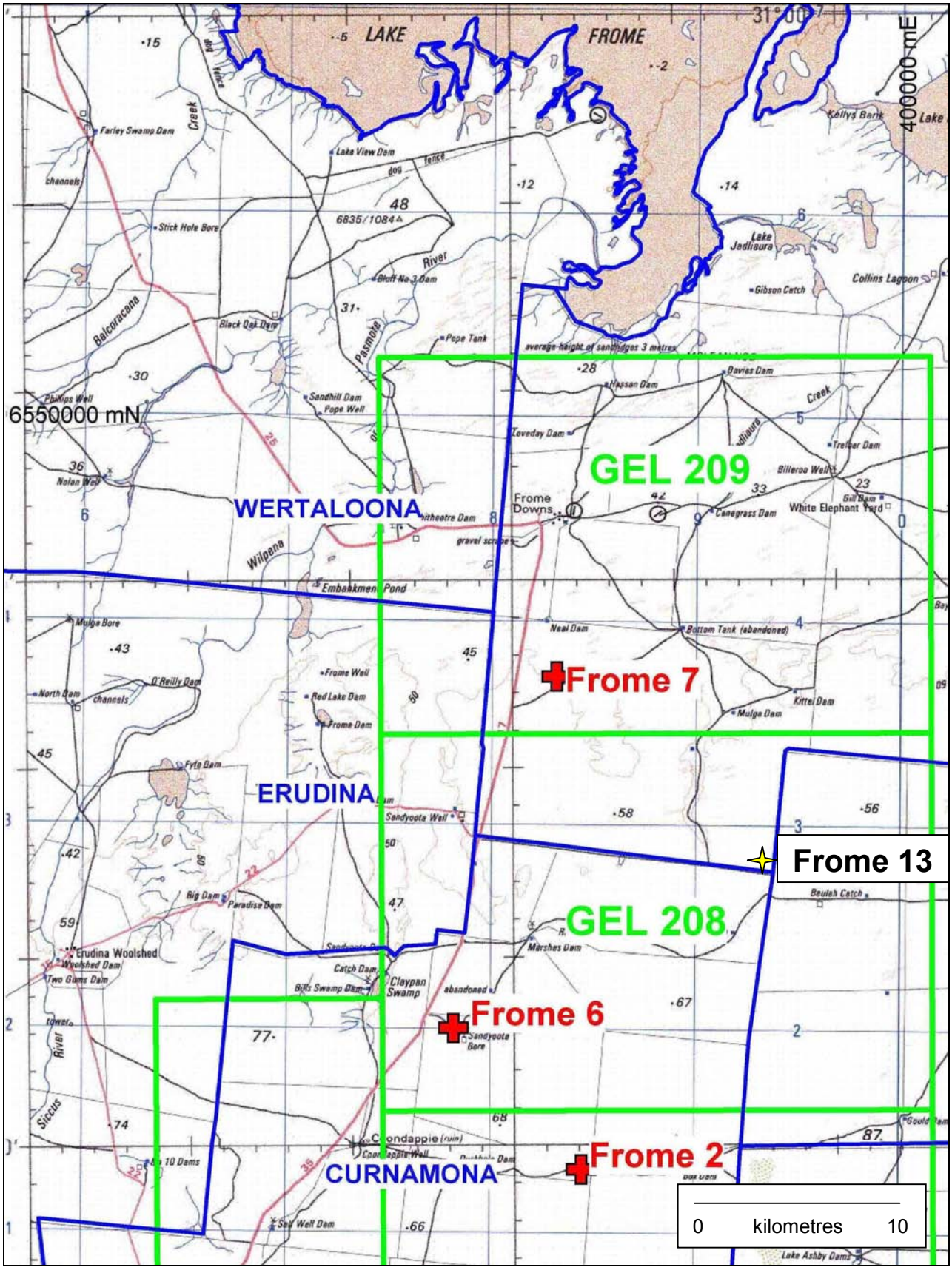

Figure 3. Location of proposed (for Year 5) 1800m deep hole, Frome 13 (yellow star).

APPENDIX 1

ASSESSMENT of GEOTHERMAL RESOURCES

PERFORMANCE IN ACHIEVING

ENVIRONMENTAL OBJECTIVES

(as defined in the **COOPER BASIN DRILLING SEO, 2003)**

for all Drilling and Well Operations

in GEL 181 (AR 2008)

ASSESSMENT of GEOTHERMAL RESOURCES PERFORMANCE IN ACHIEVING ENVIRONMENTAL OBJECTIVES (as defined in the **COOPER BASIN DRILLING SEO, 2003)**

2008 AR: GEL 181 (all Drilling and Well Operations)

Environmental Objectives	**Assessment Criteria**	**Compliant/ Non-Compliant**	**Comment**
Objective 1: Minimise the risk to public and other third parties.	• Reasonable measures implemented to ensure no injuries to the public or third parties.	Compliant	
Objective 2: Minimise disturbance and avoid contamination to soil.	<u>Well Site and Access Track Construction</u> ▪ 0, + 1 or + 2 GAS criteria are attained for 'Minimise visual impacts of abandoned well sites and access tracks' objective as listed in Appendix 4 for well lease and access track construction. ▪ No unauthorised off-road driving or creation of shortcuts. ▪ No construction activities are carried out on salt lakes, steep tableland land systems or wetlands land systems (as defined in EIR).	<u>Well Site and Access Track Construction</u>: Compliant GAS +1	GAS of +1, rather than +2, because the earthwork disturbance is only beginning to blend with the surroundings.
	<u>Fuel and Chemical Storage and Handling</u> ▪ No spills/leaks outside of areas designed to contain them. ▪ Level of hydrocarbon continually decreasing for in situ remediation of spills. ▪ Soils remediated to a level as determined by the SHI process.	<u>Fuel and Chemical Storage and Handling</u>: Compliant	
	<u>Waste Disposal (domestic, sewage and sludges)</u> ▪ All domestic wastes are disposed of in accordance with WPA licensing requirements. ▪ 0, + or + 2 GAS criteria for 'Waste material' objective is attained.	<u>Waste Disposal</u>: Compliant GAS +2	

Environmental Objectives	Assessment Criteria	Compliant/ Non-Compliant	Comment
Objective 3: Avoid the introduction or spread of pest plants and animals and implement control measures as necessary.	▪ No weeds or feral animals are introduced to operational areas.	Compliant	
Objective 4: Minimise disturbance to drainage patterns and avoid contamination of surface water and shallow ground water resources.	<u>Well Lease and Access Track Construction.</u> ▪ Well leases and access tracks are located and constructed to maintain pre-existing water flows (ie. channel contours are maintained on floodplains and at creek crossings). <u>Drilling Mud Sumps and Flare Pits</u> ▪ No overflow of drill cuttings, mud and other drilling fluids from mud sumps. ▪ No waste material disposal to sumps and flare pits. <u>Fuel/Chemical Storage and Handling</u> ▪ No leaks spills outside of areas designed to contain them.	Compliant	
Objective 5: Avoid disturbance to sites of cultural and heritage significance.	▪ Proposed well sites and access tracks have been surveyed and any sites of Aboriginal and non-Aboriginal heritage identified. ▪ Any identified cultural and heritage sites have been avoided.	Compliant	
Objective 6: Minimise loss of aquifer pressure and avoid aquifer contamination.	<u>Drilling & Completion Activities</u> ▪ There is no uncontrolled flow to surface (Blow out). ▪ Sufficient barriers exist in casing annulus to prevent cross flow between separate aquifers of hydrocarbon reservoirs. ▪ Relevant government approval obtained for abandonment of any radioactive tool left down-hole.	Compliant	

Environmental Objectives	Assessment Criteria	Compliant/ Non-Compliant	Comment
Objective 6 cont. **:** Minimise loss of aquifer pressure and avoid aquifer contamination.	<u>Producing, Injection, Inactive and Abandoned Wells</u> ▪ No cross-flow behind casing between aquifers, and between aquifers and hydrocarbon reservoirs unless approved by DWLBC.		
Objective 7: Minimise disturbance to native vegetation and native fauna.	<u>Well Lease and Access Track Construction and Restoration</u> ▪ Any sites with rare, vulnerable and endangered flora and fauna have been identified and avoided. ▪ 0, + 1 or + 2 GAS criteria are attained for 'Minimise impacts on vegetation' objectives as listed in Appendix 2, during well lease and access track site selection and construction and for 'Re-establish natural vegetation on abandoned well sites and access track' objective in Appendix 4. <u>Waste Management</u> ▪ Refer to assessment criteria for Objective 11. <u>Fuel and Chemical Storage and Management</u> ▪ Refer to assessment criteria for Objectives 2 and 4.	Compliant Appendix 2 GAS: +2 Appendix 4 GAS: +1	GAS of +1, rather than +2, because there are no perennials.
Objective 8: Minimise air pollution and greenhouse gas emissions.	▪ Compliance with EPA requirements.	Compliant	
Objective 9: Maintain and enhance partnerships with the Cooper Basin community.	• No unresolved reasonable complaints from the community.	Compliant	
Objective 10: Avoid or minimise disturbance to stakeholders and/or associated infrastructure.	• No reasonable stakeholder complaints left unresolved.	Compliant	

Environment Objectives	Assessment Criteria	Compliant/ Non- Compliant	Comment
Objective 11: Optimise waste reduction and recovery.	▪ With the exception of drilling fluids, drill cuttings and other fluids disposed during well clean-up, and sewage wastes, all wastes to be disposed of at an EPA licensed facility in accordance with IPA Licence conditions. ▪ Attainment of GAS criteria for 'Site left in clean, tidy and safe conditions after final clean-up' objective during well site restoration (refer Appendix 4). ▪ Attainment of Gas criteria for 'site left in clean, tidy and safe condition' objective during borrow pit restoration (refer Appendix 5).	Compliant Site cleanliness GAS: 0	A GAS score of 0 is the maximum attainable in this category.
Objective 12: Remediate and rehabilitate operational areas to agreed standards.	▪ No unresolved reasonable stakeholder complaints. <u>Contaminated Site Remediation</u> ▪ Contaminated sites are remediated in accordance with criteria developed with the principals of the National Environment Protection Measure of Contaminated sites and in consultation with the EPA. <u>Well Site and Access Track Restoration</u> ▪ The attainment of 0, + 1 or + 2 GAS criteria for (refer Appendix 4): – 'minimise visual impact of abandoned well sites' – 'minimise visual impact of abandoned access tracks' – 're-establish natural vegetation on abandoned well sites and access tracks' • *<u>Note:</u>* Well abandoned issues addressed under objective 6.	Compliant na GAS: +1	GAS of +1, rather than +2, because the earthwork disturbance is only beginning to blend with the surroundings.