Power down under

Partial Relinquishment Report 2010

SEL 57/2008
Partial Relinquishment
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KUTh ENERGY

Summary

KUTh Exploration Pty Ltd (KUTh) holds three Special Exploration Licences in Tasmania for Category 6 minerals (geothermal substances). The principle target of KUTh's work on these tenements is the location of high-temperature Hot Rock geothermal resources suitable for development as Enhanced Geothermal System (EGS) power generators. This relinquishment report covers work completed in the year 13/5/2009 – 13/4/2010 on part of tenement SEL 57/2008 that has now been recommended for surrender. SEL57/2008 was granted on 13/5/2009 and is located in central Tasmania and incorporates a total area of 3980km^2.

Work commenced and/or completed on the tenements in this period includes:

- *A comprehensive geological review incorporating compilation of existing surface geology, borehole and geophysical data.*

The combined results of work completed to date indicate that the potential for geothermal resource in the relinquished area is low. Whilst insulating sequences are present across the tenement, the relinquished area is interpreted to be underlain by ?Pre-Cambrian or Cambrian formations that are unlikely to act as heat sources. There are no indications of granite at depth. This being the case, a recommendation for partial surrender of this area of SEL 57/2008 has been made.

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1 Introduction

KUTh Exploration Pty Ltd (KUTh) is a geothermal explorer based in Hobart, Tasmania and is the holder of three current geothermal exploration licences in that State. The principle target of KUTh's work is the location of high-temperature Hot Rock geothermal resources suitable for development as Enhanced Geothermal Systems (EGS) power generators. Whilst the primary goal of this work is to produce electrical energy, the company also maintains an interest in both cascading and direct-use applications for geothermal energy.

This report covers work completed in the period 13/5/2009 – 13/4/2010 on that portion of KUTh's tenement SEL 57/2008 that has now been recommended for surrender.

1.1 Tenement Status

KUTh Exploration Pty Ltd (KUTh) is a subsidiary of KUTh Energy Ltd and is the sole holder and operator of SEL 26/2005, SEL 45/2007 and SEL 57/2008 (Figure 1). All three tenements were granted for periods of five years to search for geothermal substances (Category Type 6). Tenure details of SEL 57/2008, granted in May 2009, are included in Table 1.

Tenement Type	SEL
Number	57/2008
Commodity	Geothermal
Licensee	KUTh Exploration P/L
Operator	KUTh Exploration P/L
Area	3980km^2
Date Granted	13/05/2009
Renewal	07/08/2011

Table 1: Tenure details for SEL 57/2008.

1.2 Location and access

SEL 57/2008 is located across the Central Highlands and Lakes area of Tasmania incorporating the northern boundary of the Great Western Tiers from Poatina south to Bothwell and east to Miena (Figure 1). Access is primarily via the Lakes Highway which bisects the tenement diagonally from Bothwell to Miena and the Lyell Highway which passes through the south-western corner of the tenement. A number of minor roads connect various localities to the highways and, together with farm, and powerline tracks, provide reasonable access to the majority of the tenement. A small number of areas are excluded from SEL 57/2008, these consist of nature and game reserves, a gas pipeline easement and various other features.

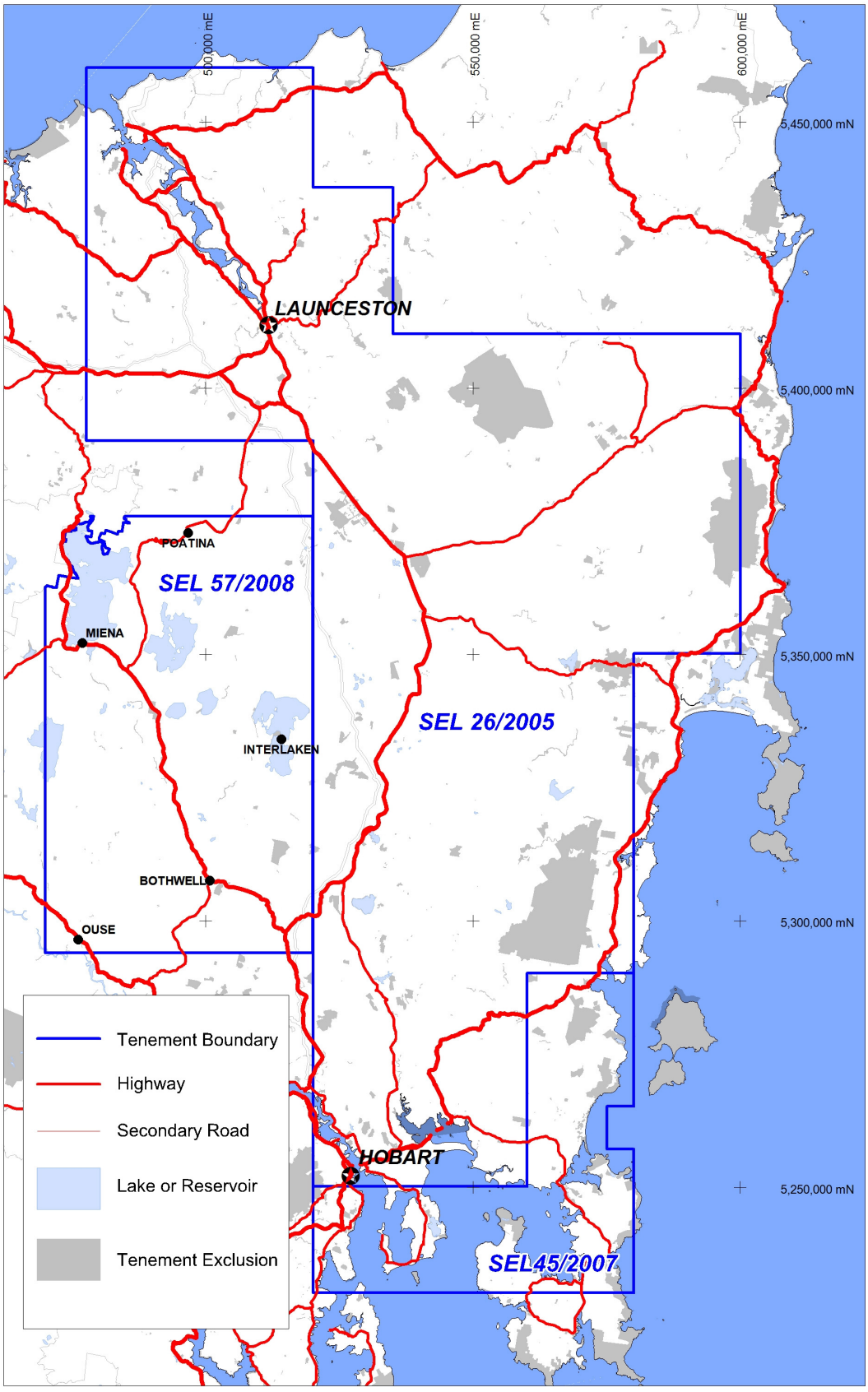

Figure 1: KUTh Energy tenement boundaries including restricted areas (exclusions within tenement boundaries). SEL 57/2008 was granted on the 13th May 2009. Total combined tenement area is 18,151km^2.

1.3 Geological setting

Tasmania is divided into two basement terrains located in the west and east of the State (Figure 2). Distinguished by age, lithology and deformation these two regions are 'believed to have been juxtaposed at a NNW trending dislocation' inferred to coincide with the Tamar Valley region in central Tasmania (Burrett & Martin, 1989). The Western Terrain comprises variably deformed and metamorphosed Pre-Cambrian basement, the now-deformed Cambrian volcanics and sediments of the Dundas Trough and Mt Read Volcanic Belt and the Ordovician-Silurian shelf sediments of the Wurrawina Supergroup. In the East, deformed low-grade meta-sediments of the Ordovician – Devonian Mathinna Supergroup comprise deep water turbidite deposits that are analogous to the ubiquitous Tasminide flysch of mainland eastern Australia. Similarities in the deformation and depositional style of the Mathinna Supergroup and mainland Tasminide units have led to numerous attempts to correlate the two, the Mathinna being compared variably to the Melbourne Trough and the Tabberabbera Zone of central and eastern Victoria (Powell & Baillie, 1992; Reed, 2001).

Across much of the state, basement is concealed by up to 1km of flat-lying Permian-Triassic sediments of the Tasmania Basin and the extensive thick (>300m) Jurassic dolerite sills which intruded these during Gondwana break-up. Mesozoic and Tertiary cover, including extensive dolerite, shale, silt and some coal formations, totally obscure the contact between the Pre-Cambrian Western and Palaeozoic Eastern terrains, which is inferred lie to the east of the tenement area. Both Western and Eastern Terrains host Devonian granite, the most extensive intrusions being the slightly older batholiths in the East (Burrett & Martin, 1989).

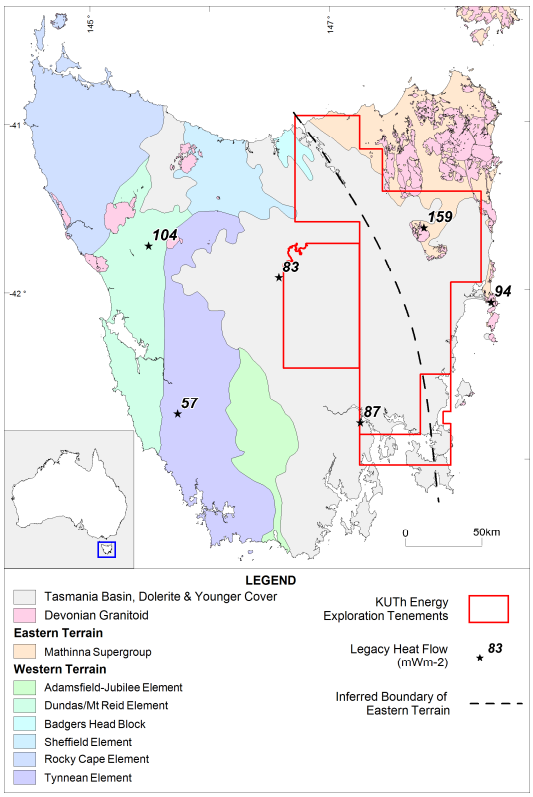

Figure 2: Regional geology of Tasmania showing the major crustal elements. Legacy heat flow data are as summarised by Cull (1991).

2 Geological Review

Information regarding the *in situ* geological relationships at surface and depth are relevant to geothermal explorers and, even in the absence of specific thermal data, may be sufficient to determine the geothermal prospectivity of an area. To this end, a summary of available relevant geological data on SEL 57/2008 was collated to assess the prospectivity of the tenement area.

2.1 Surface Geology & Stratigraphic Drilling

SEL 57/2008 is overlain by six 1:50,000 geological map sheets (clockwise from NW corner): Great Lake, Lake River, Interlaken, Oatlands, Ouse and Lake Echo.

The basement geology within SEL 57/2008 is almost entirely obscured by younger sequences with the exception of a number of small inliers located along the north-west trending margin of the Great Western Tiers (Figure 3). Where exposed, basement comprises metabasalt, volcanogenic metasediment, pelitic metasediment and minor dolomite and is interpreted to be of ?Proterozoic – ?Cambrian age (Matthews *et al*., 1996). Basement units are also encountered in deep stratigraphic drilling (RG145) located near Tunbridge to the east of SEL 57/2008 (Figure 4). Petrological analyses of these rocks have concluded that they are analogous to Pre-Cambrian units of the northern Badger Head Group (Western Tasmanian Terrane).

Cover rocks within the tenement area are dominated by the sediment of the Permo-Triassic Tasmania Basin (Parmeener Group) and the younger Jurassic Dolerite which intrudes them. Parmeener Group sediments are generally divided into two sub-groups, the older (Permian), dominantly marine, Lower Parmeener and the younger (Triassic), fluvial/lacustrine, Upper Parmeener. Parmeener sediments are generally observed to be flat-lying with bedding dips of <10° (Forsyth, 1984). Block faulting has led to offsets and tilting but there is little to no evidence of folding in the region of SEL 57/2008 (Matthews *et al*., 1996; Forsyth, 1989; Forsyth, 1984). Sediment thicknesses of up to 1700m are predicted within or adjacent to the tenement although considerable lateral variation is apparent due both to basin geometry and later faulting (Forsyth, 1989). Stratigraphic drilling at Tunbridge (RG145) intersected a near-complete Lower Parmeener sequence ~900m thick. A borehole at Mount Vernon (MTV-1) in the south-east of the tenement (Figure 4) intersected a significant Upper Parmeener sequence, including a 2.3m thick Triassic coal seam at 205m (Bacon, 1983). Intrusion of tholeiitic Jurassic Dolerite into the Parmeener sequences is extensive and typically manifests as flat-lying sills 300-400m thick along sedimentary bedding layers.

Within the boundaries of SEL 57/2008 dolerite is overlain only by relatively minor occurrences of Tertiary basalt and sedimentary sequences and younger Quaternary alluvium and colluvial deposits. Tertiary basalts are alkali - tholeiite in composition and are typically preserved in palaeo-drainage channels (Matthews *et al*., 1996; Forsyth, 1989; Forsyth, 1984). Tertiary sediments are most significant to the north-east of the tenement where they form basin fill within the interpreted Tamar rift valley.

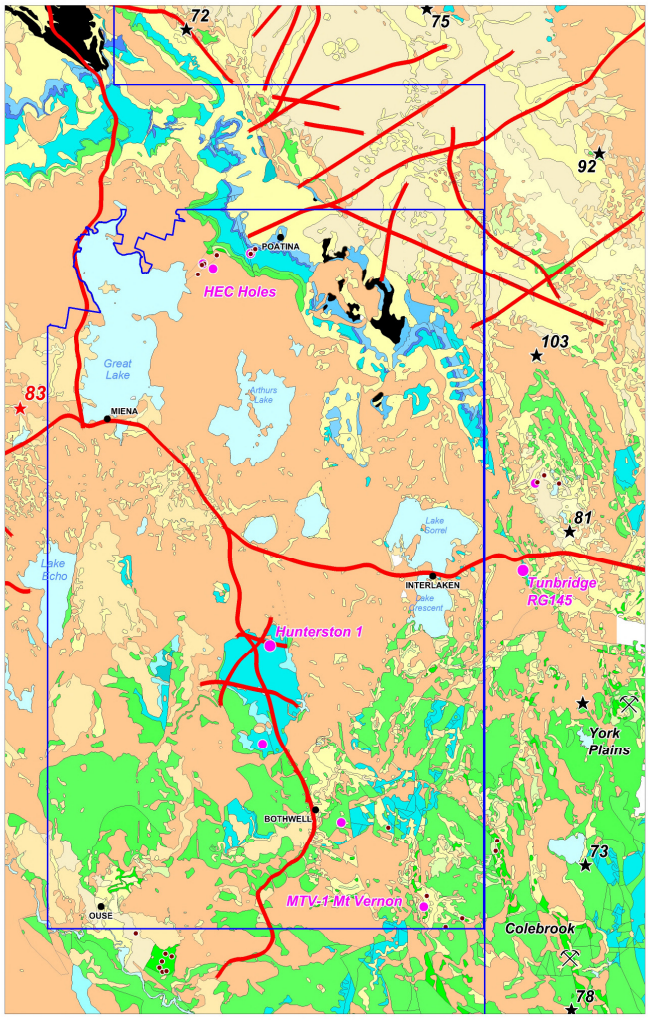

Figure 3: Surface geology and legacy data beneath SEL 57/2008. Geology legend is as per 1:500,000 Geological Map of Tasmania except for Cambrian-PreCambrian units which have been highlighted in black. Small purple dots are legacy drill holes <300m deep; larger pink dots, holes >300m deep. Significant hole names referred to in the text are labelled. Black stars indicate KUTh Energy surface heat flow data; red, legacy heat flow data. All heat flows are reported in mWm^{-2}. Red lines indicate the location of GSLM seismic lines from survey TB01. At the time of reporting GIS were not available to indicate the location of TB02 lines, which are predominantly located in the SW quadrant of this image. The location of legacy coal mines at York Plains and Colebrook are as shown.

General structural trends vary across the tenement from NW in the Lake River sheet to ESE in the south Interlaken sheet to NS in the Oatlands Sheet. The majority of observed and inferred faults within the tenement area are considered to post-date dolerite intrusion with no clear evidence for the presence of significant older structures. The tectonic environment in which these features developed was most likely a Tertiary-aged rifting event which led to the formation of a series of half-grabens along the axis of what is now the modern-day Tamar Valley (Forsyth, 1984).

2.2 Hydro-Electric Commission Drilling

Development of extensive hydro-electric resources across the Central Highlands area in the 1950-60's necessitated the drilling of a number of deep (>300m) diamond boreholes for engineering purposes. Immediately to the west of SEL 57/2008 a heat flow value of $83mWm^{-2}$ was recorded in dolerite intersected by a 320m deep vertical Hydro borehole, HEC-5001 Great Lake (Newstead & Beck, 1953; Figure 4). This value implies a comparatively

moderate heat flow and, until recent work by KUTh to the east in SEL 26/2005, remained the only direct indicator of crustal thermal conditions in this area.

2.3 Coal Exploration

The existence of Triassic coal measures in the Midlands region to the south and east of SEL 57/2008 has been known since the early nineteenth century. Named fields include areas between Bagdad and Kempton to the south of SEL 57/2008, around Colebrook, York Plains and Woodbury to the east of the tenement and at Mike Howes Marsh near Melton Mowbray within the south-east corner of SEL 57/2008 (Bacon, 1991). Where observed today, remaining coal seams are generally thin (typically <1m) and are often discontinuous amounting to relatively small *in situ* reserve estimates (<100Mt; Bacon, 1991).

Exploration within the vicinity of SEL 57/2008 was undertaken by Capricorn Mining and CRA Exploration in the late 1970's to early 1980's and is summarised in Bacon (1991). Whilst this work failed to identify significant economic coal seams within or adjacent to the tenement area, interest in the region continued due to the 2.3m coal intersection observed in stratigraphic hole MTV-1 at Mt Vernon. In the early 1990's the Cornwall Coal Company undertook a shallow drilling program (<200m) to further explore the Mount Vernon area. The results of this program revealed a locally complex geology with coal seams disrupted by faulting, sections missing due to uplift and erosion, dipping too steeply to mine or over-heated by local dolerite intrusion (Bryan 1992, 1993).

2.4 Petroleum Exploration

The Central Highlands area, including SEL 57/2008, has been subject to petroleum exploration by Great South Land Minerals Limited (GSLM) since the late 1990's. Notable work completed by GSLM during this time includes the drilling of a single well (Hunterston 1) to 1324m, the acquisition of deep seismic reflection data and the commissioning of integrated geophysical interpretation using available seismic, magnetic and gravity data.

Information regarding the stratigraphy encountered by well Hunterston 1 (located in central SEL 57/2008; Figure 3), is available from Stacey & Roach (2003). Spudded in Lower Parmeener mudstone, dolerite was intersected at 134m and continued to 784m where it was again bounded by Lower Parmeener sediments. These continue until 980m where they terminate at an unconformable contact atop basement dolomite. Basement dolomite is interpreted to be Pre-Cambrian in age and is currently the only drilled intersection of these strata observed within the Central Highlands area. No log or lithological data describing the dolomite are available from GSLM, although descriptions contained in Leaman (2007) are of 'massive dolerite' suggesting little to no *in situ* porosity.

Seismic data were collected by GSLM from two major surveys, TB01 (2001) and TB02 (2006-2007). Of these, the most relevant to SEL 57/2008 is TB01 which comprises 662km of data acquired along 23 regional lines, several of which effectively bisect the tenement area (Figure 3). The quality of data derived from TB01 is variable with the effects of curved survey lines, seismic attenuation through high velocity dolerite and poorly constrained stratigraphic control (particularly of basement sequences) combining to reduce the resolution and decipherability of the resulting images (Leaman 2007). Regional interpretation of TB01 is provided in Stacey (2007).

Seismic data confirm the presence of Parmeener sediments across the Central Highlands area as broadly flat-lying layers. Disruptions are due mainly to faulting and dolerite intrusion although occasional very gentle upright folds are interpreted. Dolerite intrusions are confirmed to be generally flat-lying sills, conformable with the bedding horizons of their host sediments and generally located in the interval between Base Lower Parmeener and mid-Upper Parmeener sections. Sill thicknesses are typically between 300-500m but may increase to 800m in areas where intrusions remain undercover. Significant lateral variations are observed in sill thickness; these may be abrupt and step-like structures from one stratigraphic level to another are common.

The total thickness of cover sequences (dolerite plus Parmeener) is typically found to be <1000m. The majority of structures observed at surface are considered to be related to Tertiary-aged rifting along the Tamar Valley. Throughout the region, younger surface structures are often observed to be reactivations of older basement features. The structural style observed in basement units appears to vary from east to west with inferred Devonian-aged NE-dipping thrust stacks beneath the Tamar Valley and Midlands areas in the east becoming mixed fold/thrust sequences beneath the Central Highlands area and finally fold-dominated in the west (Stacey, 2007).

Despite the success of seismic interpretation in indicating basement structures, determining the nature of the basement geology beneath the Central Highlands area remains problematic. Leaman (2007) undertook to integrate local gravity and magnetic data with seismic data from both TB01 and TB02 surveys to better predict the nature of the basement at depth. The results of this work, whilst untested, are consistent with a complex overthrust terrane in which thrusts are both east and west facing and basement is comprised of juxtaposed slices of Pre-Cambrian and Palaeozoic material. Significantly, Leaman did not predict any granite or granite-like bodies in the area beneath SEL 57/2008.

2.5 KUTh Energy Geothermal Exploration SEL 26/2005

In 2007 KUTh Exploration commenced work on its tenement SEL 26/2005 which now lies adjacent to the east of SEL 57/2008. Work completed to date includes determination of shallow heat flow values in areas adjacent to SEL 57/2008 (Figure 3). The heat flux recorded in areas adjacent to the relinquishment are moderate, typically <80mWm^{-2}, and are consistent with an absence of heat producing granite at depth.

3 Conclusion and Recommendations

The combined results of work completed to date indicate that the potential for geothermal resource in the relinquishment area (2930km^2) is limited. Whilst insulating sequences are present across the tenement, the relinquishment area is interpreted to be underlain by Pre-Cambrian or Cambrian formations that are unlikely to act as heat sources. There are no indications of granite at depth within this area and no suggestion of significant heat flow values in surrounding regions. For this reason a 2930km^2 area is considered to have a low prospectivity for geothermal exploitation and is thus recommended for surrender. A map detailing the proposed partial surrender of SEL 57/2008 is presented in Figure 4.

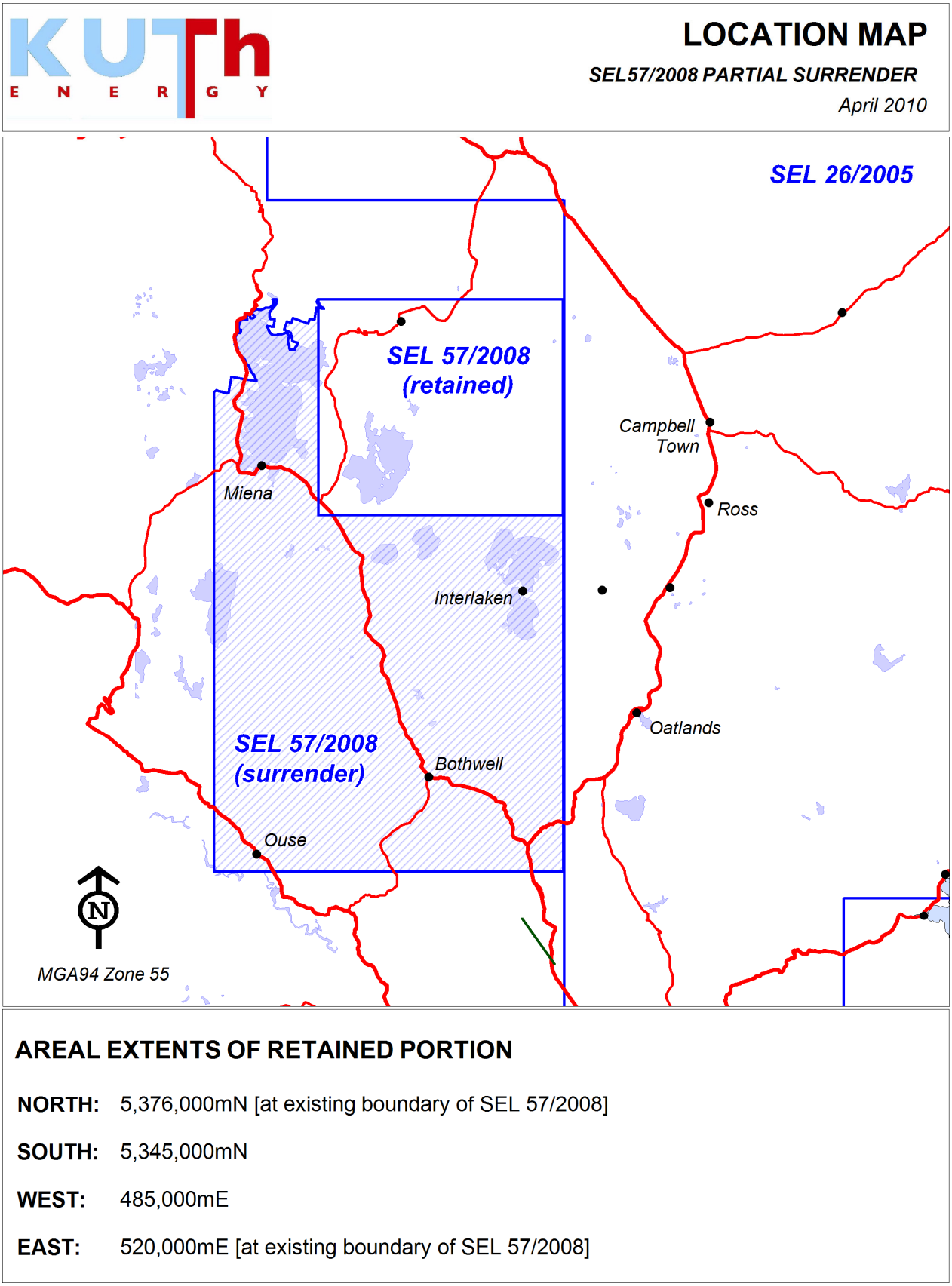

Figure 4: Map illustrating partial surrender area for SEL 57/2008.

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5 Keywords

Geothermal exploration

HDR (Hot Dry Rock)

HFR (Hot Fractured Rock)

EGS (Enhanced Geothermal System)

High Heat Producing (HHP) granite