Department of Resources, Energy and Tourism (DRET)

PROPOSED COMMONWEALTH
RADIOACTIVE WASTE MANAGEMENT
FACILITY, NORTHERN TERRITORY

Mineral Prospectivity Report

PARSONS BRINCKERHOFF

Proposed Commonwealth Radioactive Waste Management Facility, Northern Territory

MINERAL PROSPECTIVITY REPORT

13 March 2009

Department of Resources, Energy and Tourism (DRET)

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Executive summary

Parsons Brinckerhoff Australia Pty Ltd (PB) has been commissioned by the Department of Resources, Energy and Tourism (DRET) to undertake preliminary multi-disciplinary site assessments at four locations in the Northern Territory with regard to their suitability for use as a low to medium level radioactive waste management facility. The facility is to be known as the Commonwealth Radioactive Waste Management Facility (CRWF).

Three Commonwealth owned and Defence-managed sites were selected for the studies which formed part of a larger assessment process involving the collection, collating and provision of site suitability assessments. The studies will provide a basis from which the Commonwealth Government can consider the future project requirements. The three initial sites are listed below:

- Mount Everard – Approximately 25 km north-west of Alice Springs
- Harts Range – Approximately 100 km north-east of Alice Springs
- Fishers Ridge – Approximately 40 km south-east of Katherine.

During the investigations of these three sites, an additional fourth 'volunteer' site – Muckaty Station (located approximately 110 km north of Tennant Creek) was nominated by the Traditional Owners (the Ngapa clan) and added to the scope of the investigations.

A desktop investigation was undertaken to determine the mineral prospectivity potential of each of the four sites. The study was based on current literature and laboratory analysis of selected rock and soil samples collected during the Geotechnical Investigation.

The desktop investigation did not find any economic mineral deposits within any of the proposed sites. Exploration licence EL26006 has been granted to cover Mount Everard and two exploration licences have been applied for (EL24951 and EL26553) to cover Muckaty Station.

P1. Introduction

Parsons Brinckerhoff Australia Pty Ltd (PB) has been commissioned by the Department of Resources, Energy and Tourism (DRET) to undertake preliminary multi-disciplinary site assessments at four locations in the Northern Territory with regard to their suitability for use as a low to medium level radioactive waste management facility. The facility is to be known as the Commonwealth Radioactive Waste Management Facility (CRWF).

Three Commonwealth owned and Defence-managed sites were selected for the studies which formed part of a larger assessment process involving the collection, collating and provision of site suitability assessments. The studies will provide a basis from which the Commonwealth Government can consider the future project requirements. The three initial sites are listed below:

- Mount Everard – Approximately 25 km north-west of Alice Springs
- Harts Range – Approximately 100 km north-east of Alice Springs
- Fishers Ridge – Approximately 40 km south-east of Katherine.

During the investigations of these three sites, an additional fourth 'volunteer' site – Muckaty Station (located approximately 110 km north of Tennant Creek) was nominated by the Traditional Owners (the Ngapa clan) and added to the scope of the investigations.

The four proposed sites are shown in Figure P1.1.

The outcome of the assessment process will be a selection of a preferred site by the Commonwealth that closely matches optimum site selection criteria.

The objective of this investigation was to determine the mineral potential of each site, based on a desktop review of available information and analyses of selected sediment and rock samples obtained from the sites.

P1.1 Methodology

This desktop investigation with external review by Dr Bryan Krapez of B. Krapez & Associates was conducted by qualified PB personnel with relevant experience in economic geology. It is based on a review of the following information sources:

- Alice Springs 1:250,000 Geological Series map
- Alcoota 1:250,000 Geological Series map
- Helen Springs 1:250,000 Geological Series map
- Katherine 1:250,000 Geological Series map
- Northern Territory Geological Survey website
- Pegging the Northern Territory (Jones, 1987), and
- Published information from Olympia Resources Limited.

P1.2 Northern Territory mineral occurrences

Mining and mineral exploration took place throughout the Northern Territory since the 1870s. The majority of economic mineral deposits are located north of Pine Gap in early Proterozoic bedrock. Historically, gold and tin mining have dominated with minor amounts of silver mining (Jones 1987).

The Northern Territory Department of Primary Industry, Fisheries and Mines details current and potential mining developments in the Northern Territory in its website[1].

P1.3 Northern Territory mineral leases

The Northern Territory Government under authority from the *Mining Act* (NT) 2005 has granted exploration and mining leases over much of the Territory. Three sites are located within Commonwealth land; therefore they are not subject to mineral leasing. The fourth site, Muckaty Station, is on Aboriginal Freehold land. However they are all within close proximity to exploration leases, shown in Figures P1.2 to P1.5.

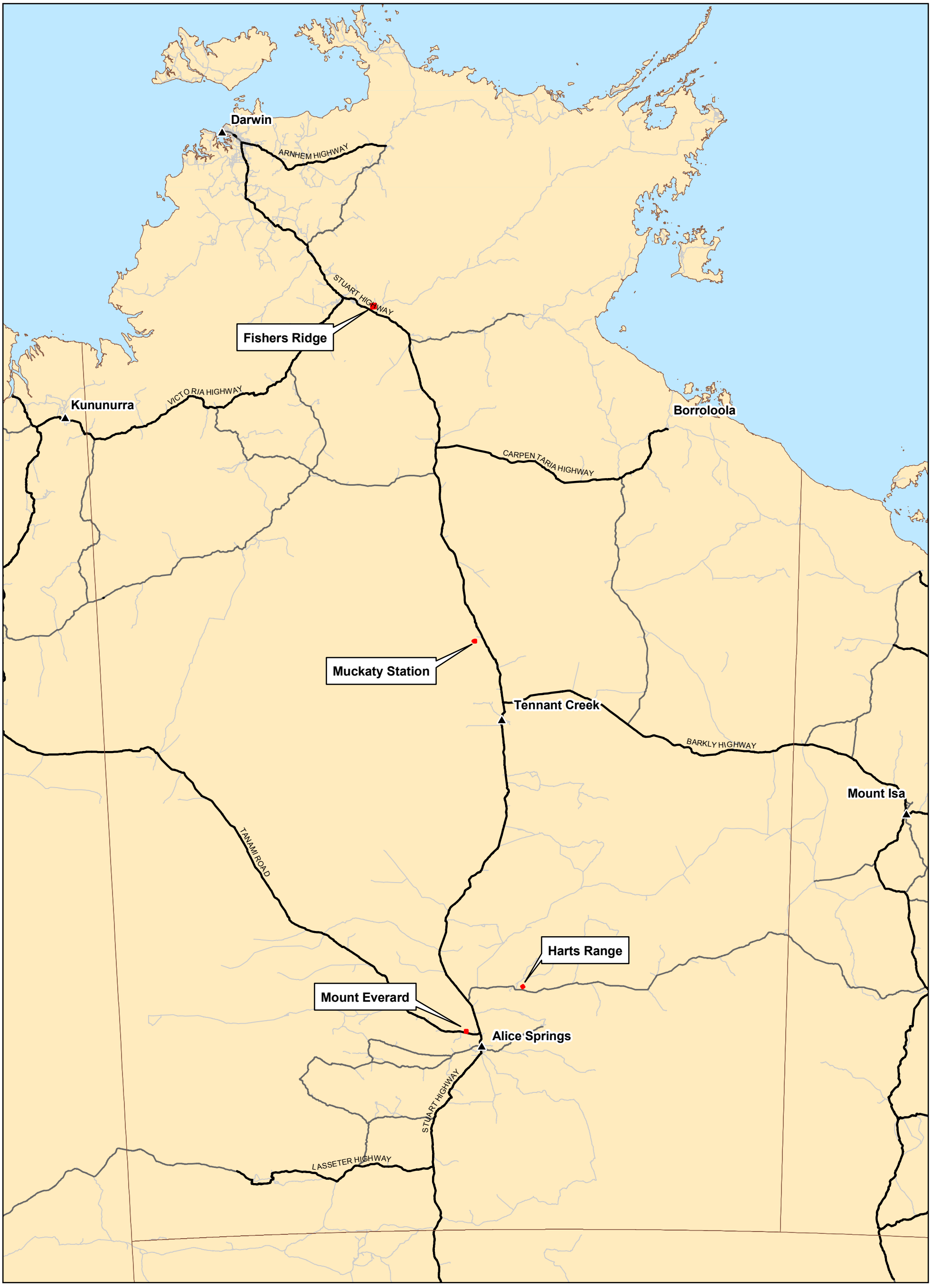
The Mount Everard site has an exploration licence (EL26006) granted over the site which is held by Arunta Uranium Pty Limited. Arunta Uranium, a wholly owned subsidiary of Callabonna Uranium Limited, currently holds three ELs in the Arunta block and project highlights[2] include:

- *Potential for accumulations of calcrete-hosted uranium mineralisation in recent drainage channels.*
- *Situated in a region of known deposits of calcrete-hosted uranium and in comparable geology to the nearby Napperby deposit.*
- *Under a farm-in Joint Venture Nupower Resources Ltd intends to fly an Airborne Electro Magnetic over the Mt. Hay area, and those results are anticipated soon after the anticipated ASX listing of Callabonna.*

The Muckaty site has two exploration licence applications (EL24951 & EL26553) over the site by Neil Henry Scriven (research unable to find any information on the applicant or mineral exploration targets).

Lists of the leases within close proximity to the four sites and their status are shown in Tables P1.1 to P1.4.

1 http://www.nt.gov.au/dpifm/Minerals_Energy/Content/File/Potential_Mining_Development.pdf
2 www.planetgas.com/download.php?id=377



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Drawn By:	**RP**	**Checked by:**	**GB**
Client Ref:		**RADWASTE**	

Commonwealth Radioactive Waste Management Facility Site Characterisation

Proposed repository sites

Figure P1.1

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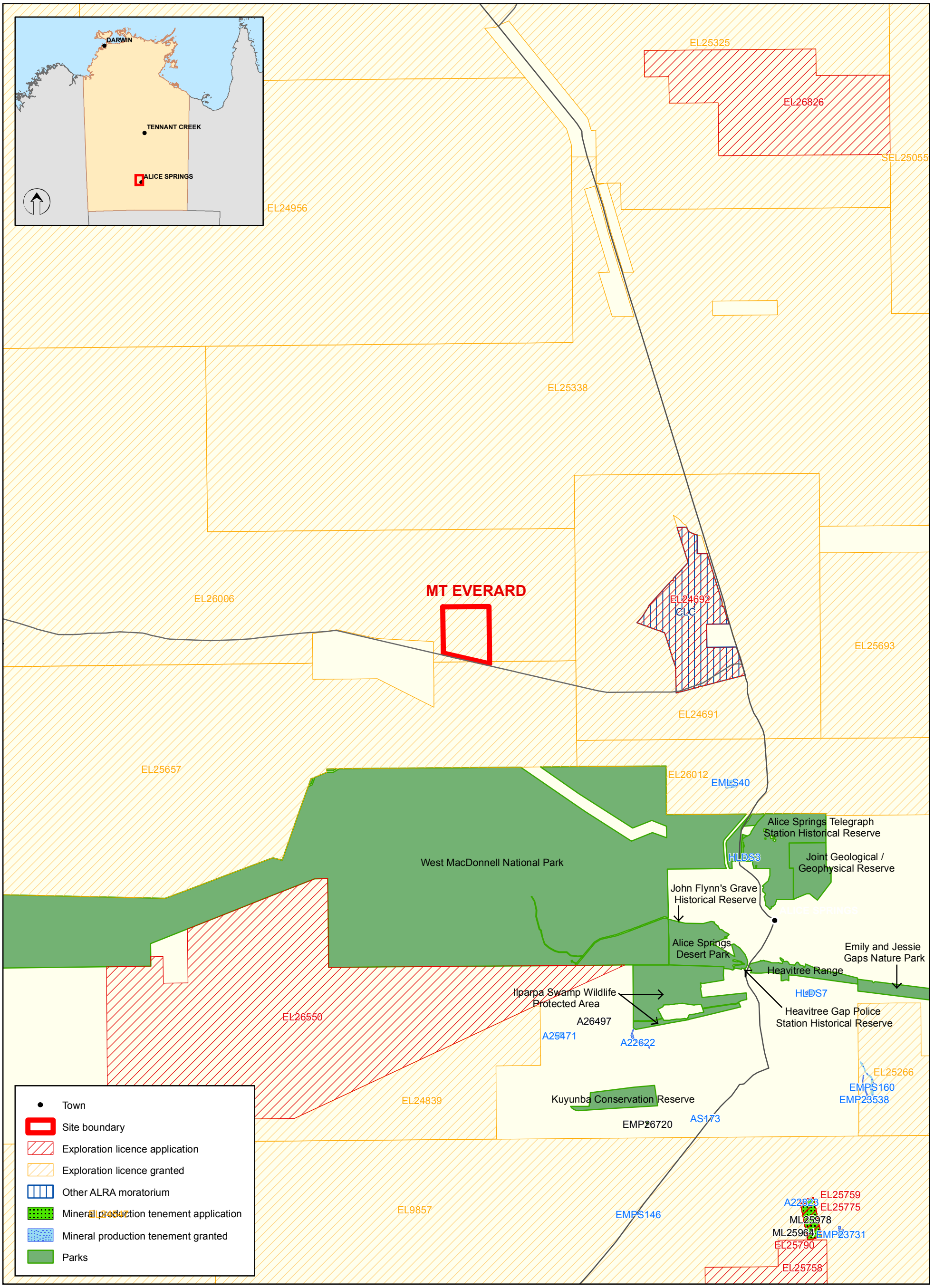

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Commonwealth Radioactive Waste Management Facility Site Characterisation

Mt Everard mineral leases

Figure P1.2

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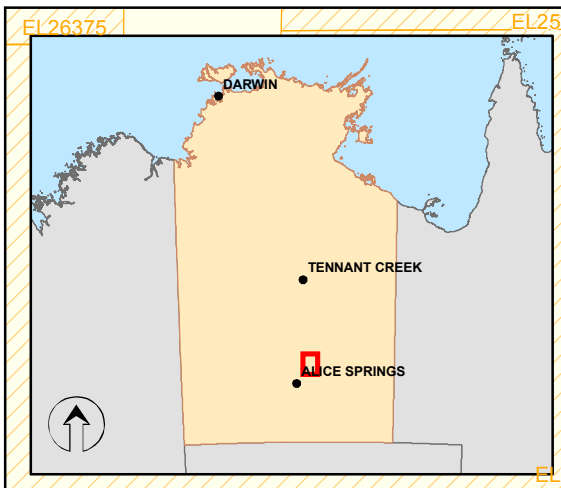

EL26375
EL25504
EL25624
EL25626
EL25658
EL26459
EL25378
EL26376
NOTE: Discrepancy between DEST supplied site boundary and NT Government exploration licence information is noted. Investigations during the project revealed that this is the likely result of cadastral inaccuracy
SEL25056
EL10331
EL24810
HARTS RANGE
A23714
MLS165
MCS251
EL10150
ML23868
EL26077
EL25099
EL24552
EL26440
EL26440
HLDS22
EL23592
EL26440
SEL25055
EL24817
EL25430
EL25169
EL25894
EL25469
EL24809
EL25620
EL9529
EL22759
MCS38
MCS120
EL25726
EL25641
EL25726
EL25644
EL23630
EL25989
EL9529
EL25685
EL25101
EL25644
EL10360
EL9410

- Town
- Exploration licence application
- Exploration licence granted
- Other ALRA moratorium
- Harts Range site boundary
- Mineral production tenement granted
- Park

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Commonwealth Radioactive Waste Management Facility Site Characterisation

Harts Range mineral leases

Figure P1.3

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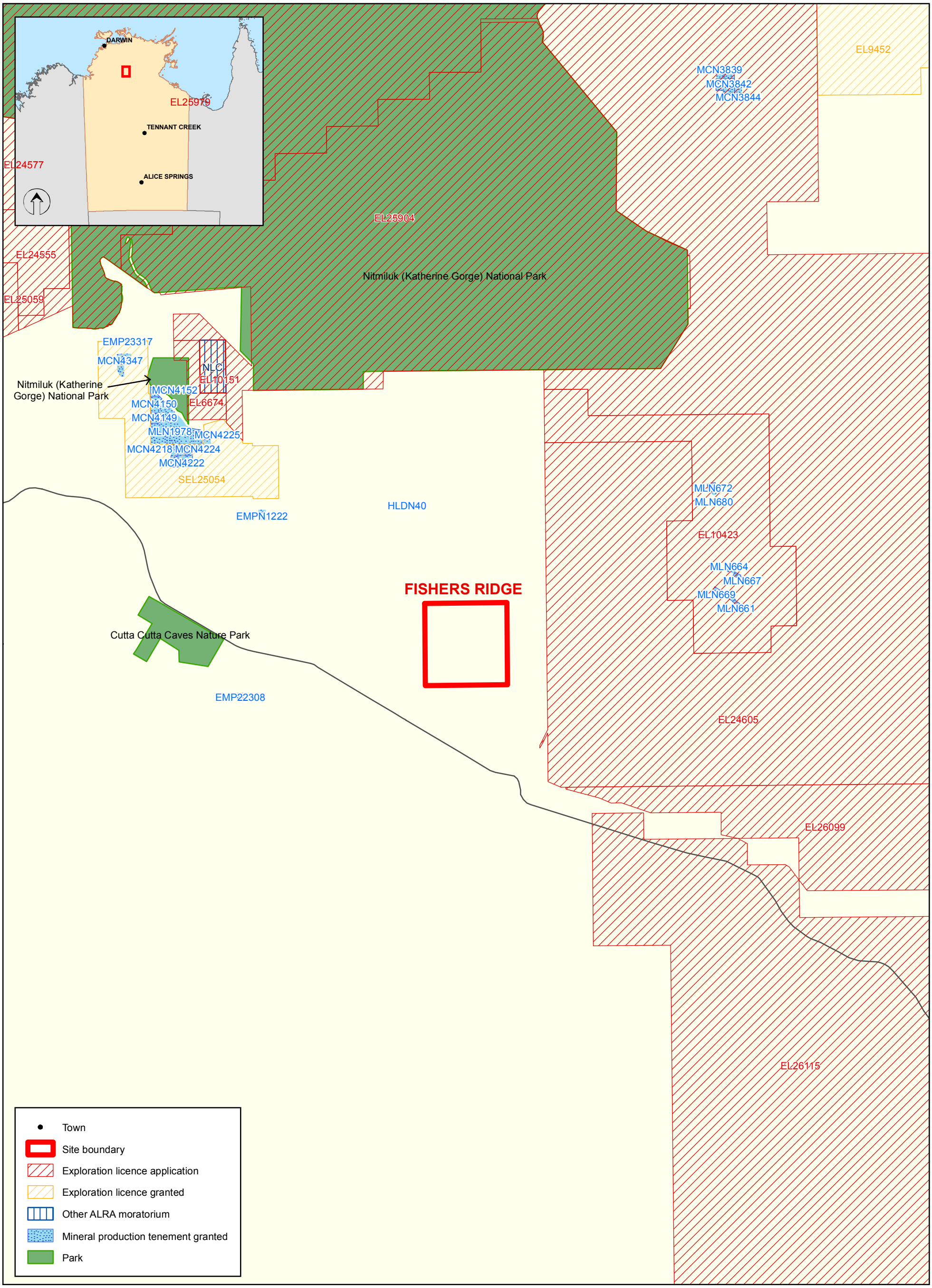

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Commonwealth Radioactive Waste Management Facility Site Characterisation

Fishers Ridge mineral leases

Figure P1.4

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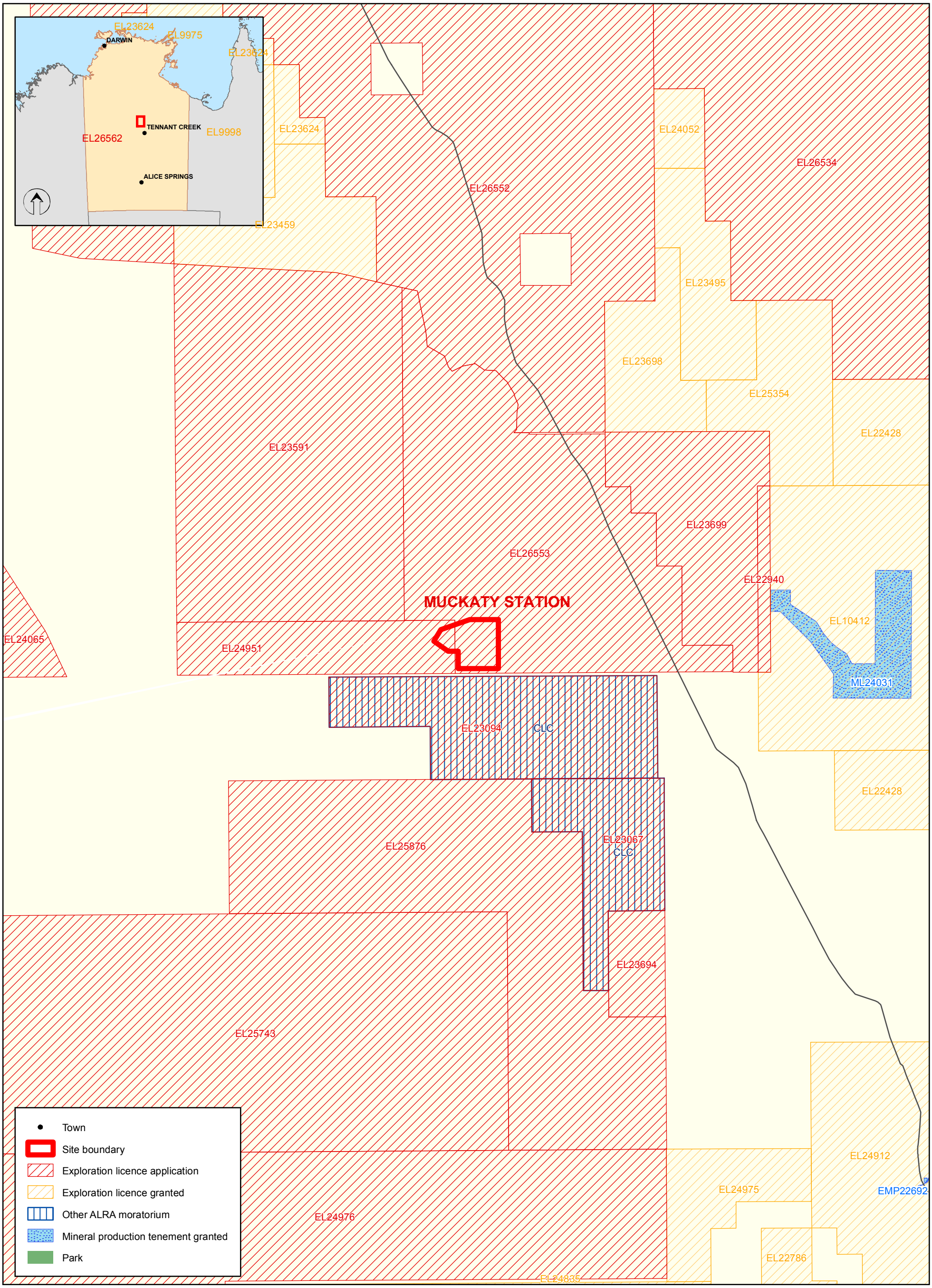

Department of Resourses, Energy and Tourism

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Source: Geoscience Australia, NTLIS

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Client Ref:	**RADWASTE**		

Commonwealth Radioactive Waste Management Facility Site Characterisation

Muckaty Station mineral leases

Figure P1.5

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Table P1.1 Mineral leases in close proximity to Mount Everard

ALRA moratorium	Exploration licence application	Exploration licence granted	Mineral production tenement application
25161	EL26550	EL26012	EMP26720
	EL26826	EL26006	ML25964
	EL24692	EL24839	ML25978
	EL25826	EL25325	A26497
	EL25828	EL24691	A22483
	EL25790	SEL25055	EMP23900
	EL25793	EL24956	HLDS3
	EL25792	EL25266	HLDS13
	EL25775	EL25693	HLDS7
	EL25765	EL25338	HLDS10
	EL25771	EL24547	HLDS14
	EL25754	EL9857	EMPS160
	EL25759	EL25657	AS193
	EL25758		EMLS40
	EL25803		EMLS41
	EL25805		EMP23538
	EL25787		EMPS146
	EL25822		AS173
	EL25823		A22622
			A22621
			A25471
			AS149
			A22823
			AS163
			EMP23731

Table P1.2 Mineral leases in close proximity to Harts Range

Exploration licence application	Mineral production tenement granted
EL10331	HLDS23
EL26077	MLS165 (Mud Tank Vermiculite Mine)
EL26375	HLDS22
EL26459	MCS251
EL22759	MCS120
EL9529	MCS121
EL10150	MCS38
EL26376	A23714
EL26440	ML23868
EL9410	
EL24810	
EL24809	

	Mineral production tenement granted
SEL25055	
SEL25056	
EL24817	
EL25101	
EL25726	
EL24552	
EL25169	
EL25099	
EL23630	
EL25378	
EL25469	
EL25430	
EL23592	
EL25624	
EL25626	
EL25504	
EL25644	
EL25641	
EL25658	
EL25620	
EL25685	
EL10360	
EL25894	
EL25989	

Table P1.3 Mineral leases in close proximity to Fishers Ridge

ALRA moratorium	Exploration licence application	Exploration licence granted	Mineral production tenement granted
10151	EL6674	SEL25054	HLDN40
	EL10151	EL9452	MLN1138
	EL10423		MLN1137
	EL24577		MLN661
	EL24555		MLN662
	EL24605		MLN663
	EL25059		MLN664
	EL25904		MLN665
	EL25979		MLN666
	EL26099		MLN667
	EL26115		MLN668
			MLN669
			MLN670
			MLN671

ALRA moratorium	licence application	licence granted	Mineral production tenement granted
			MLN680
			MLN679
			MLN672
			MLN658
			MLN1978
			MCN4145
			MCN4146
			MCN4149
			MCN4150
			MCN4152
			MCN4348
			MCN4344
			MCN4346
			MCN4347
			MCN4151
			MCN4343
			MCN4345
			MCN4218
			MCN4220
			MCN4223
			MCN4219
			MCN4221
			MCN4222
			MCN4224
			MCN4225
			EMP23317
			EMP22308
			MCN3839
			EMPN1222
			MCN3840
			MCN3842
			MCN3844
			MCN3843
			MCN3841

Table P1.4 Mineral leases in close proximity to Muckaty Station

ALRA moratorium	Exploration licence application	Exploration licence granted	Mineral production tenement granted
23094	EL26552	EL9998	EMP22692
23067	EL26553	EL9975	EMP23564
	EL26562	EL22786	ML24031
	EL22940	EL22428	
	EL23067	EL23698	
	EL23094	EL23624	
	EL23591	EL24912	
	EL23694	EL24975	
	EL23699	EL23459	
	EL24065	EL23495	
	EL25743	EL25354	
	EL24976	EL10412	
	EL24951	EL24052	
	EL25876		
	EL26534		

A more detailed explanation of the leases is available from the Northern Territory Geological Survey.

P2. Mount Everard

The Mount Everard site is located approximately 25 km north-west of Alice Springs. It lies to the north of the Tanami Road, within an area designated as a radio receiving station.

P2.1 Regional geology

On review of the Alice Springs 1:250,000 Geological Series it is shown that the Mount Everard site is covered by a Cainozoic soils composed of red clayey and sandy soils which is underlain by the following geological units:

- Tertiary rocks, approximately 150 m thick, including siltstone, limestone, sandstone, pebbly sandstone with kaolinitic quartzose sandstone, siltstone and mudstone grading to conglomerate towards the base.
- Basement rock is comprised of metamorphic sequences of Early Proterozoic age that form the MacDonnell Ranges. The rocks are highly faulted and deformed and are dominated by gneiss intruded by dykes, migmatites and pegmatitic seams.

P2.2 Regional prospectivity

A number of mineral exploration projects have taken place in the region, with limited amounts of mining. A summary of reported mineral occurrence in the Alice Springs region near Mount Everard is summarised in Table P2.1.

The Mount Everard site has an exploration licence (EL26006) granted over the site which is held by Arunta Uranium Pty Limited. Arunta Uranium, a wholly owned subsidiary of Callabonna Uranium Limited, currently holds three ELs in the Arunta block and project highlights[2] include:

- *Potential for accumulations of calcrete-hosted uranium mineralisation in recent drainage channels.*
- *Situated in a region of known deposits of calcrete-hosted uranium and in comparable geology to the nearby Napperby deposit.*

- *Under a farm-in Joint Venture Nupower Resources Ltd intends to fly an Airborne Electro Magnetic over the Mt. Hay area, and those results are anticipated soon after the anticipated ASX listing of Callabonna.*

Table P2.1 Regional mineral occurrences near Mount Everard

Mineral	Summary of regional mineral occurrences	Distance from site
Gold	Alluvial gold was worked at Arltunga. Quartz vein gold cutting the Heavitree Quartzite was mined in the White Range.	60 km north east
	Gold also occurs in basic gneiss near and within quartz bodies in gneissic rock.	70 km north east
Diamonds	A single alluvial diamond has been reported.	60 km north east
	The Mordor Igneous Complex is reported to have kimberlitic affinities but equilibrated at much lower pressure-temperature conditions than kimberlite. However it indicates that kimberlite source rocks may occur in the sheet area.	
Zinc-lead-copper	Numerous small zinc-lead-copper deposits occur throughout the basement rocks.	40 km north east
Copper	Traces of copper, associated with arsenic in places, were recorded in the Arltunga Gold Field.	60 km north east
Lead, silver and bismuth	Small lead, silver and bismuth occurrences were prospected.	70 km north-east
Lignite	Sub-economic lignite of the Hale Plain carbonaceous shale occurs immediately south of Alice Springs.	Approx. 50 km south-east
Petroleum	A petroleum exploration well, Alice No. 1, was drilled in the sheet area by Exoil (NT). No information was available regarding the results of this well. At present no petroleum deposits are known in the Alice Springs region.	25 km south-east

P2.3 Site prospectivity

The majority of mineral occurrences in the region are generally located 40 km to 70 km north-east of the site in outcropping basement rocks. The overlying Tertiary sequence is up to 200 m thick. This would likely make any underlying mineral occurrence in bedrock sub-economic, unless it was of a large magnitude and high grade. Tertiary subeconomic lignite is found in the Hale Plain deposit, just south of Alice Springs. This deposit has previously been drilled by the Northern Territory Geological Survey (Shaw & Wells, 1983).

P3. Harts Range

The Harts Range site is located within the headwaters of the Plenty River, north of Harts Range. It is on the northern side of the Plenty Highway on the western banks of the Ongeva Creek. The site is situated near the southern margin of the Alcoota 1:250,000 Geological Series map, therefore reference has also been made to the Alice Springs 1:250,000 Geological Series map.

P3.1 Regional geology

With reference to the Alcoota 1:250,000 Geological Series map, the site is underlain by Quaternary red earth clayey and sandy soils, and aeolian sands. The Quaternary/Recent alluvial sediments are associated with watercourses to the east and west.

The underlying Tertiary rocks are formed from chalcedonic limestone, sandstone, mudstone and minor sandy conglomerate. There is likely to be a deeply weathered sequence underlying this of leached, mottled and ferruginised, partly kaolinitic and pisolitic laterite and silcrete.

The basement geology is expected to be either the Harts Range Group gneisses and associated metamorphic rocks or the Mount Bleecham Granulite. The gneiss of the Harts Range is highly folded and deformed, with complex structural domains. The Mount Bleechmore Granulite is composed of gneiss, plutonic migmatite, mafic granulite and calc-silicate rock.

P3.2 Regional prospectivity

On review of the explanatory notes of the Alcoota and Alice Springs 1:250,000 Geological Series maps a number of mineral exploration projects have undertaken small scale mining in the region. A summary of reported mineral deposits in the region is summarised in Table P3.1.

Table P3.1 Regional mineral occurrences near Harts Range

Mineral	Summary of regional mineral occurrences	Distance from site
Mica	A number of mica mines operated from 1945 to 1948. The resource was contained in pegmatites, intruding a gneissic host rock. It yielded approximately 18 tonnes of muscovite (mica).	30 km east
	Mica from the Harts range provided the majority of mining revenue in the sheet area. It was mined at various times between 1890 and 1960.	50 km south-west
Copper	Copper occurs within sandstone beds near Mount Skinner. A number of exploration activities targeted this resource between 1965 and 1970.	70 km north
	Disseminated copper minerals contained in a granite hosted quartz- breccia shear were explored. Assays from drilling were reported to be very low.	70 km north-east
Uranium	Prior to 1970, both airborne and down hole gamma-ray logs reported occurrences of radiometric anomalies within Tertiary sediments and granite. No economic deposits are noted.	50 km north-west
Tantalite	A number of small operations mined gneiss hosted pegmatite for tantalite. The most productive operation was the Bundey River prospect yielding 1 tonne of tantalite from 1944 to 1946.	50 km north-east
Tungsten	Two tungsten prospects occur within outcropping gneiss.	50 km north-east
Wolframite	Small quantities of wolframite have been produced from eluvium and gneiss hosted pegmatite veins.	50 km north-east
Garnet	Semi precious garnet was discovered in eluvium derived from metamorphic rock.	50 km west
	Olympia Resources Ltd is preparing to mine for garnet and hornblende to be used as abrasives. The sand sized garnet will be separated from fluvial and dune sediments of the Quaternary. At the time of this report mining had not commenced but was imminent.	30 km east
Tourmaline	Tourmaline is common in pegmatites from the northern outcropping crystalline basement.	50 km west
Building stone	Granite, gneiss, sand and gravel are available in various locations throughout the region	Various locations
Vermiculite	Mud Tank (Zircon Hill) deposit is mined by Vermiculite Industries from 1996	18 km west
Gold	White Range/ Arltunga gold field, first worked 1887	56 km south

P3.3 Site prospectivity

There are no known historic mineral occurrences in the Harts Range site. A number of mica mines are located approximately 30 km east of the site in the Harts Range pegmatites. The Mud Tank vermiculite mine is located south of the Plenty Highway approximately 18 km WSW of the site, and is similarly developed in weathered

bedrock. Fossicking for gem garnet and zircon (and some other semi-precious stones) is undertaken in the district[3].

Olympia Resources are in the process of opening an abrasive sands quarry, extracting both garnet and hornblende. This is located approximately 30 km east of the Harts Range site. At the time of this report, mining had not commenced but was imminent.

The site is located adjacent to Waite Creek which is a tributary of the Sandover River; therefore potential may exist for the accumulation of near surface alluvial minerals. If such a mineral occurrence is present however, it is likely that an anomaly would be detected within sub-surface soil analyses conducted at the site.

Soil analysis for heavy minerals were carried out on samples from the Harts Range site due to this nearby heavy mineral occurrence and results showed the presence of both garnet and hornblende but in sub-economic quantities.

To the east of the site mining has occurred in the Harts Range Group. According to the Alice Springs geological series 1:250,000 map; the site is underlain by Cainozoic age rocks up to 200 m thick. This thickness of overburden reduces the economic potential of mineral deposits should they occur within the underlying basement rock.

3 http://www.gemtree.com.au/

P4. Fishers Ridge

The Fishers Ridge site is located to the north of the Stuart Highway, approximately 40 km south-east of Katherine. The site is extends in on the west to the King River and in the east to Roper Creek.

P4.1 Regional geology

According to the Katherine 1:250,000 geological map, the Fishers Ridge site is located on Quaternary residual soil and sand, clayey and loamy soils. Quaternary alluvial sediments are associated with the creeks and rivers. Site drilling found the base of Quaternary and Cretaceous sediments at 77 m depth. The Cretaceous deposits are comprised of sandstone, siltstone and claystone.

The underlying Ordovician rocks include the Tindall Limestone and the Jinduckin Formation. The Tindall Limestone is a grey massive, bioclastic limestone with minor mudstone and siltstone with minor breccia at the top of the unit. The Jinduckin Formation is a dolomitic siliciclastic siltstone.

The basement is likely composed of the Palaeoproterozoic, Orosirian Burrell Creek Formation. Part of the Finniss River Group the Burell Creek Formation is a fine to coarse grained feldspathic greywacke.

P4.2 Regional prospectivity

According to the explanatory notes of the Katherine 1:250,000 geological map, the region hosts a number of mineral deposits. The majority of which are concentrated in a number of mineral fields. Commodities present in the region include gold, tin, tungsten, lead, molybdenum, copper and limestone, and are summarised in Table P4.1.

Proterozoic mineral deposits on the geological sheet Katherine are categorised into vein, stratabound, stratiform or placer deposits. Most mineralisation, including most of the gold and tin deposits, is hosted by metasediments of the Tollis Formation and Burrell Creek Formation.

Table P4.1 Regional mineral occurrences near Fishers Ridge

Mineral	Summary of regional mineral occurrences	Distance from site
Gold	A number of gold mines have operated in the Katherine region. The majority of the reported gold occurrences are located in the Mount Todd, Driffield and Maud Creek goldfields, occurring within sulphide-rich quartz stringers of a dolerite host rock.	25 km north-west
	Several companies explored the area through the 1960s to 1980s, mainly for banded ironstone hosted base-metal and gold mineralisation. The exploration revealed that the area contains subeconomic copper and gold mineralisation with no significant concentrations below the oxidised zone.	70 km north-west
Tin	A number of tin mines have operated in the region, exploiting both eluvial/alluvial and hard-rock tin occurrences. Hard rock tin is found in brecciated veins of ferruginous quartz, in porphyritic granite host rock.	20 km north-east 50 km north
Copper	Several companies explored the area throughout the 1960s to 1980s, mainly for banded ironstone hosted base-metal and gold mineralisation. The exploration revealed that the area contains subeconomic copper and gold mineralisation with no significant concentrations below the oxidised zone. Copper mineralisation is hosted by banded ironstones and tuffaceous, ferruginous sedimentary rocks of the Tollis Formation. Minor copper mineralisation is also associated with shears in the Maud Dolerite. In the period 1905-1919 approximately 20 t of copper ore of unspecified grade was produced from the Carpentaria mine.	25 km north-west 70 km north-west
Tungsten	Tungsten, along with minor tin and molybdenum, occurs in gneisenised portions of the Yeuralba Granite and Yenberrie Leucogranite.	40 km north 75 km north-west
Lead	The only significant lead deposit is in sheared basic volcanic rocks of the Tollis Formation Wests mine. Mineralisation is contained in quartz veins. Minor lead mineralisation is associated with the Burrell Creek Formation. Weak diagenetic lead-zinc mineralisation was encountered in the Tindall Limestone.	75 km north-west
Uranium	The Tennysons Leucogranite hosts small uranium deposits. Uranium occurrences at ABC and Edith River are within Proterozoic rocks. All workings at the ABC prospect are collapsed and outcrop is poor. The mineralisation is associated with a northeast-trending faultzone consisting of a series of small en echelon faults hosted by tuff and basalt of the McAddens Creek Volcanic.	75 km north
	Additionally, anomalous uranium was reported from pyritic dolomitic siltstone near the base of the Cambrian-Ordovician Jinduckin Formation close to Katherine.	80 km north-west
Diamonds	The Daly Basin was unsuccessfully explored for diamonds, phosphate and bauxite from the late 1960s.	25 km west

		Distance from site
Limestone	The Tindall Limestone of the Daly Basin was an exploration target for limestone, suitable for quicklime and cement manufacture, from the late 1960s. Since then 7 Mt of high-grade limestone reserve was delineated and has been mined by Northern Cement at their Mataranka operations. Therefore it is inferred that further high-grade limestone could be expected in the Dry River area and to the south in Larrimah.	75 km south-east
Wolframite	Wolframite, molybdenite and minor bismuth are found in the Yenberrie Leucogranite quartz-mica greisen. The mineralisation is finely disseminated within stringers in joints and brecciation zones. Discovered in 1911 and exploited until 1930, then later reopened and mined between 1951 and 1953.	75 km north-west

P4.3 Site prospectivity

There are no known mineral deposits in the Fishers Ridge site. A number of tin mines are located approximately 20 km north-east of the site, in a porphyritic granite host rock. A number of gold and copper deposits are reported in doleritic host rock, located approximately 25 km north-west of the site. All other known economic mineralisation is located at least 40 km from the site thus reducing the likelihood of mineral deposits at the site.

The site is located adjacent to the King River; therefore there may be potential for the accumulation of near surface alluvial minerals. If such a mineral occurrence is present, it is likely that an anomaly would be detected within sub-surface soil analyses conducted at the site.

The Burrell Creek Formation greywacke is believed to form basement below the site. To the north-west it hosts numerous gold and tin deposits, which were exploited, including the Driftfield deposit. The area to the north-west is associated with a high degree of faulting and numerous intrusions. It is therefore possible that mineral deposits associated with the Burrell Creek Formation exist beneath the site; however the relatively thick overburden would likely make such deposits uneconomic unless of large size and high grade.

P5. Muckaty Station

Muckaty Station is located approximately 110 km north of Tennant Creek. The Muckaty site is situated on the northern side of the Bootu Creek haul road that extends westwards from the Stuart Highway to the Alice Springs to Darwin railway line.

P5.1 Regional geology

The regional geology of the Muckaty Station site comprises mainly of fine to very coarse grained Lower Proterozoic Quartz Sandstone and Pebbly Sandstone with interbedded Claystone and Siltstone of the Tomkinson Group. Around the Muckaty Station homestead is the Cambrian Helen Springs Volcanics.

Much of the west part of the Helen Springs 1:250,000 geological map consists of a surface covering of Quaternary aeolian sand and silty sand with some minor outcrops of Laterite.

The Tomkinson Group consists of thick siliciclastic units that alternate with six mixed siliciclastic-carbonate intervals. This Group is a succession of shallow marine and continental sedimentary rocks, which the Hayward Creek Formation is the lower part of the sequence.

The Hayward Creek Formation is described as a thinly to very thickly bedded medium to very coarse sandstone and pebbly sandstone with minor pebble to cobble conglomerate (clasts of white vein quartz and white to pinkish cream quartz arenite), minor thinly bedded fine to medium sandstone, siltstone, mudstone and intraformational conglomerates, and basaltic lava. The depositional environment is fluvial to shallow marine, intertidal with periodic subaerial exposures.

Surface exposures of the Helen Springs Volcanics basaltic lava or flood basalt is limited but airborne magnetic imagery (TMI – Total Magnetic Intensity and Magnetic Depth) suggest the basalt may extend under the north-eastern corner of the Muckaty site and below the alluvial and aeolian sand plains which were targeted by several boreholes.

P5.2 Regional prospectivity

The Helen Springs 1:250,000 geological map which includes Muckaty Station indicates that the area contains significant manganese deposits and is prospective for base metals, diamonds, copper and hydrocarbons. Known commodities include manganese, diamonds, and copper. A summary of these deposits is listed in Table P5.1.

Two exploration licence applications (EL24951 & EL26553) cover the Muckaty site which have been applied for by Neil Henry Scriven (research has been unable to find any information on the applicant or mineral exploration targets).

Table P5.1 Regional mineral occurrences near Muckaty Station

Mineral	Summary of regional mineral occurrences	Distance from site
Manganese	*Bootu Creek area:* contains six named manganese occurrences including the Mucketty deposit which was first pegged in 1954. Several companies have explored the region since this time and geochemical sampling and drilling results for the eastern limb of the Bootu Sycline indicates significant economic potential.	
	Renner Springs area: contains six named manganese occurrences. Mining from several small pits showed maganise oxides replacing a brecciated siltstone bed at the surface. Massive manganese ore containing fragments of unreplaced siltstone has been described and estimated a pre-mining resource of 4000 t if ore averaging 31% Mn per vertical foot to a depth of 3 m.	
Base metals	Geological drilling in the area in the 1980s discovered only uneconomic sulphide stringers and trace galena, sphalerite, chalcophyrite anf pyrite mineralisation. The search for base metal deposits resumed in the 1990s but had little success in their exploration for sediment-hosted base metals	
Diamonds	A number of microdiamonds were found in gravel throughout the eastern and central parts of the sheet area. Aeromagnetic surveys and modelling of the data showed that none of the prospective anomalies had the dipolar characteristics of target kimberlitic diatremes.	
Other commodities	Several small copper occurrences have been identified southwest of Banka Banka which are principally malachite and are hosted by basalt of the Whittington Range Member and siltstone of the Morphett Creek Formation. Analysis of two surface samples failed to indicate any other anomalous base metals or gold. Northernmost parts of Helen Springs and Beetaloo are prospective for hydrocarbons as well as base metals due to the presence of Velkerri Formation equivalents.	

P5.3 Site prospectivity

There are no known economic mineral deposits within the Muckaty Station site. Bootu Creek Manganese Mine is located 25 km to the east of the site, which is mining

amorphous and massive cryptomelane manganese oxides. There are no other known economic mineral deposits within close proximity to the Muckaty Station site.

The lowermost lithofacies of the Bootu Creek Formation host the manganese occurrences, as mined at Bootu Creek. The Bootu Creek Formation has outcrops on Muckaty Station, hence it is possible that manganese deposits may be present at depth on Muckaty Station. However, since the formation is estimated to be between 1350 and 2000 m thick, it is unlikely that mining would be economical.

P6. Concentrations of potentially economic elements

Selected samples chosen to represent rock and sediment types at each site were analysed for potentially economic and tracer elements, results are contained in Appendix A, namely:

- Ag, Al, As, Au, Cd, Cr, Co, Cu, Fe, Pb, Ni, S, Sr, Sn, U, Zn

Element concentrations are compared to crustal averages (Berkman 2001; www.daviddarling.com) in Appendix B with relative enrichment values. The element concentrations in the samples taken are not significantly concentrated with respect to average crustal abundances.

In addition, organic carbonate (limestone) content was assessed for the Mount Everard, Harts Range and Fishers Ridge sites and heavy minerals for shallow samples from Harts Range and Muckaty Station (Appendix C). All limestone (calcium carbonate) and organic carbon were too low to be of economic interest.

Olympia Resources Ltd is planning to open an abrasive sands quarry 30 km to the east of the Harts Range site. The garnet and hornblende will be extracted from Quaternary fluvial and dune sands on the floodplain of the Aturga Creek. Heavy mineral analysis was carried out on soil samples from three boreholes within the Harts Range site. The results contained in Appendix C returned were 5.3% garnet for HR BH03, 2.4% garnet for HR BH 04 and 4.3% garnet for HR BH05. In the report produced by Olympia Resources Limited – Harts Range Project Resource Report March 2003, the measured garnet grade ranges from 6.1% garnet to 10.8% garnet. The percent garnet is lower at the Harts Range site, however, it can not be ruled out as a potential garnet source. Hornblende will also be mined by Olympia Resources Limited. The portions of hornblende on the Harts Range site are 5.3% hornblende for HR BH03, 2.4% hornblende for HR BH 04 and 5.1% hornblende for HR BH05. Olympia's hornblende reserves are two to four times greater than garnet reserves suggesting hornblende grades are similarly higher than garnet.

P7. Conclusions

Based on the information reviewed as part of this investigation Parsons Brinckerhoff concludes the following:

- No known economic mineral deposits are located in any of the four prospective sites.
- Numerous mineral occurrences are present in the regions surrounding each site including gem and industrial garnet, gold, tin, tungsten, lead, molybdenum, manganese, uranium, copper, vermiculite, gem zircon and limestone.
- It is possible that the basement rocks contain mineralisation. All four sites are covered by thick sequences of Quaternary sediments, and therefore any basement mineral deposits would likely be uneconomic.
- The Harts Range and Fishers Ridge sites are located adjacent to river systems, therefore there may potential for the accumulation of near surface alluvial minerals of potential interest. Soil analyses were carried out on all four sites, with the samples analysed by Amdel Laboratories and MGT Environmental. No economic concentrations of any elements tested were detected in the samples.
- 30 km to the south east of the Harts Range site, Olympic Resources Ltd is planning to open an abrasive sands garnet and hornblende quarry. Soil samples taken at the site give a range of 2.4% to 5.2% garnet with similar amounts of hornblende. The Harts Range site has some potential to host an economic abrasive sands (garnet/hornblende) deposit.

P8. References

Reports

Baxter John & Doepel John, 2003, *Harts Range Garnet Project Resource Report, March 2003 – Report number WA03/005*. Olympia Resources Limited.

Berkman, D.A. (compiler) 2001. Field Geologists Manual, Australian Institute of Mining and Metallurgy Monograph No. 9, AusIMM, Carton, Victoria.

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Jones T.G., *Pegging the Northern Territory. A history of mining in the Northern Territory, 1870-1946*. Darwin, Northern territory Government Printer, 1987.

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Shaw, R.D. & Warren, R.G., 1975, Alcoota, Northern Territory – 1:250 000 Geological Series. Bureau of Mineral Resources, Geology and Geophysics. Explanatory Notes SF/53-10.

Shaw, R.D. & Wells, A.T., 1983, Alice Springs, Northern Territory – 1:250 000 Geological Series. Bureau of Mineral Resources, Geology and Geophysics, Explanatory Notes SF/53-14.

Web sites

http://www.daviddarling.com

http://www.gemtree.com.au/

http://www.nt.gov.au/dpifm/Minerals_Energy/Content/File/Potential_Mining_Development.pdf

http://www.olympiaresources.com/Home.aspx

http://www.vermiculite.com.au/mtm_about.htm

P9. Statement of limitations

Scope of services

This environmental site assessment report ("the report") has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Parsons Brinckerhoff (PB) ("scope of services"). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

Reliance on data

In preparing the report, PB has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise stated in the report, PB has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. PB will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to PB.

Environmental conclusions

In accordance with the scope of services, PB has relied upon the data and has not conducted any environmental field monitoring or testing in the preparation of the report. The conclusions are based upon the data and visual observations and are therefore merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of contaminants or emissions.

Within the limitations imposed by the scope of services, the assessment of the site and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

Report for benefit of client

The report has been prepared for the benefit of the Client and no other party. PB assumes no responsibility and will not be liable to any other person or organisation for

or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of PB or for any loss or damage suffered by any other party in relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

Other limitations

PB will not be liable to update or revise the report to take into account any events, emergent circumstances or facts occurring or becoming apparent after the date of the report.

The scope of services did not include any assessment of the title to nor ownership of the properties, buildings and structures referred to in the report, nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

Appendix A

Soil sample analyses

amdel
www.amdel.com

Analytical Report

Coffey Environments Pty Ltd (SA)
Level 1,
2-3 GREENHILL ROAD
WAYVILLE
SA 5034

Contact	: **WESTLEY FIELDHOUS**
Batch Number	: **0612465**
Job Ref	: **06057/AA**
Sample(s) Received	: **08/12/2006**
Report No	: **178274**

Methods:

100 Moisture Content
252 Calcium Carbonate Content #
402-AES Elements by ICP-AES, Dry Weight
404FIMS Mercury by Vapour AAS, Dry Weight
406-MS Elements by ICP-MS, Dry Weight
E3795 Walkley & Black - Total Organic Carbon

Attached Results Approved by:

Mark Herbstreit
B.App.Sci.
Senior Analyst - Metals

Helen Lei
B.App.Sci. (Biochemistry)
Senior Analyst - Waters

Leanne Murray
PhD (Organic Chemistry)
Production Manager

NATA

This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025.

NATA ENDORSED DOCUMENT

NATA Accreditation No. 1645 (Chemical Testing) NATA Accreditation No. 14278 (Biological Testing)

*** This is the Final Report which supersedes any reports previously issued relating to the sample(s) included.***

All samples tested as submitted by client.

 # Denotes methods not covered by NATA scope of accreditation

Results

Report No: 178274

	0612465/001 9044 21/07/06 8/12/06	0612465/002 9046 22/07/06 8/12/06	0612465/003 9047 22/07/06 8/12/06	0612465/004 9049 25/07/06 8/12/06	0612465/005 9050 25/08/06 8/12/06
CALCIUM CARBONATE CONTENT, % HCl SOLUBLE					
Method: 252 Units : %					
Calcium Carbonate #	7.1	5.1	42.6	4.0	8.1
ELEMENTS by ICP-AES, DRY WEIGHT					
Method:402-AES Units: mg/kg unless stated					
Aluminium	15000	12000	28000	11000	12000
Iron	22000	18000	18000	26000	25000
Sulphur #	31	53	47	100	81
MERCURY by VAPOUR-AAS, DRY WEIGHT					
Method: 404FIMS Units: mg/kg					
Mercury	<0.01	<0.01	<0.01	<0.01	<0.01
METALS by ICP-MS, DRY WEIGHT					
Method: 406-MS Units: mg/kg					
Arsenic	<2.0	<2.0	<2.0	<2.0	2.6
Cadmium	<2.0	<2.0	<2.0	<2.0	<2.0
Chromium	30	32	24	47	32
Cobalt	8.4	5.2	8.7	12	6.5
Copper	16	9.9	I4	16	10
Lead	9.0	6.5	15	13	8.9
Nickel	I6	12	29	13	11
Silver	<2.0	<2.0	<2.0	<2.0	<2.0
Strontium	74	33	150	43	54
Tin	<2.0	<2.0	<2.0	<2.0	<2.0
Uranium #	<2.0	<2.0	2.6	<2.0	<2.0
Zinc	25	24	7.7	17	13
OVEN MOISTURE CONTENT					
Method: 100 Units: % w/w					
Moisture	3.4	1.8	5.5	1.9	2.4
TOTAL ORGANIC CARBON in soil					
Method: E3795 Walkley & Black (W&B) Units: %					
Total Organic Carbon	<0.5	<0.5	<0.5	<0.5	<0.5

Results

Report No: 178274

	0612465/006 9052	0612465/007 9054	0612465/008 9056	0612465/009 9043	0612465/010 9057
	21/07/06 8/12/06	14/08/06 8/12/06	14/08/06 8/12/06	20/07/06 8/12/06	15/08/06 8/12/06
CALCIUM CARBONATE CONTENT, % HCl SOLUBLE					
Method: 252 Units : %					
Calcium Carbonate #	3.5	3.6	4.6	7.3	3.9
ELEMENTS by ICP-AES, DRY WEIGHT					
Method:402-AES Units: mg/kg unless stated					
Aluminium	8400	6300	12000	-	19000
Iron	18000	14000	27000	-	62000
Sulphur #	25	24	54	18	30
MERCURY by VAPOUR-AAS, DRY WEIGHT					
Method: 404FIMS Units: mg/kg					
Mercury	<0.01	<0.01	0.03	-	<0.01
METALS by ICP-MS, DRY WEIGHT					
Method: 406-MS Units: mg/kg					
Arsenic	<2.0	<2.0	<2.0	-	<2.0
Cadmium	<2.0	<2.0	<2.0	-	<2.0
Chromium	31	21	30	-	100
Cobalt	5.3	6.9	16	-	51
Copper	6.9	14	20	-	59
Lead	3.6	5.0	14	-	18
Nickel	7.6	9.5	11	-	59
Silver	<2.0	3.4	<2.0	-	<2.0
Strontium	17	20	47	-	29
Tin	<2.0	<2.0	<2.0	-	<2.0
Uranium #	<2.0	<2.0	<2.0	-	<2.0
Zinc	8.9	14	22	-	76
OVEN MOISTURE CONTENT					
Method: 100 Units: % w/w					
Moisture	0.7	0.7	3.0	1.9	2.8
TOTAL ORGANIC CARBON in soil					
Method: E3795 Walkley & Black (W&B) Units: %					
Total Organic Carbon	<0.5	<0.5	<0.5	-	<0.5

Results

Report No: **178274**

	0612465/011 9059	0612465/012 9060	0612465/013 9062	0612465/014 9064	0612465/015 9065
	19/08/06 8/12/06	21/08/06 8/12/06	28/07/06 8/12/06	29/07/06 8/12/06	30/07/06 8/12/06
CALCIUM CARBONATE CONTENT, % HCl SOLUBLE					
Method: 252 Units : %					
Calcium Carbonate #	2.8	3.5	2.9	1.3	1.2
ELEMENTS by ICP-AES, DRY WEIGHT					
Method:402-AES Units: mg/kg unless stated					
Aluminium	8800	8300	15000	9300	8700
Iron	16000	17000	120000	13000	120000
Sulphur #	18	24	13	16	23
MERCURY by VAPOUR-AAS, DRY WEIGHT					
Method: 404FIMS Units: mg/kg					
Mercury	<0.01	<0.01	0.03	<0.01	<0.01
METALS by ICP-MS, DRY WEIGHT					
Method: 406-MS Units: mg/kg					
Arsenic	<2.0	<2.0	9.6	<2.0	12
Cadmium	<2.0	<2.0	<2.0	<2.0	<2.0
Chromium	27	24	210	25	74
Cobalt	6.3	7.6	<2.0	<2.0	<2.0
Copper	9.0	13	10	6.0	31
Lead	4.6	4.0	24	5.5	9.2
Nickel	8.8	10	4.6	<2.0	2.6
Silver	<2.0	<2.0	<2.0	<2.0	<2.0
Strontium	17	26	13	5.5	4.1
Tin	<2.0	<2.0	<2.0	<2.0	<2.0
Uranium #	<2.0	<2.0	2.4	<2.0	3.5
Zinc	13	14	3.3	2.5	5.1
OVEN MOISTURE CONTENT					
Method: 100 Units: % w/w					
Moisture	1.0	1.2	1.0	1.0	0.8
TOTAL ORGANIC CARBON in soil					
Method: E3795 Walkley & Black (W&B) Units: %					
Total Organic Carbon	<0.5	<0.5	<0.5	<0.5	<0.5

	0612465/016 *9066*	*0612465/017* *9070*
	7/08/06 *8/12/06*	*8/08/06* *8/12/06*
CALCIUM CARBONATE CONTENT, % HCl SOLUBLE		
Method: 252 Units : %		
Calcium Carbonate #	3.5	4.3
ELEMENTS by ICP-AES, DRY WEIGHT		
Method:402-AES Units: mg/kg unless stated		
Aluminium	11000	3800
Iron	97000	2200
Sulphur #	11	17
MERCURY by VAPOUR-AAS, DRY WEIGHT		
Method: 404FIMS Units: mg/kg		
Mercury	0.02	<0.01
METALS by ICP-MS, DRY WEIGHT		
Method: 406-MS Units: mg/kg		
Arsenic	7.7	<2.0
Cadmium	<2.0	<2.0
Chromium	120	14
Cobalt	<2.0	<2.0
Copper	15	7.7
Lead	20	4.0
Nickel	2.1	<2.0
Silver	<2.0	<2.0
Strontium	2.5	24
Tin	<2.0	<2.0
Uranium #	<2.0	<2.0
Zinc	3.1	3.8
OVEN MOISTURE CONTENT		
Method: 100 Units: % w/w		
Moisture	1.1	0.6
TOTAL ORGANIC CARBON in soil		
Method: E3795 Walkley & Black (W&B) Units: %		
Total Organic Carbon	<0.5	<0.5

Quality Results

Report No: 178274

	0612465Q018 DIGEST BLANK	0612465Q019 Duplicate 0612465/001	0612465Q020 Spike Recovery 0612465/001	0612465Q021 Duplicate 0612465/011	0612465Q022 Spike Recovery 0612465/011
		13/12/06		13/12/06	
	12/12/06	13/12/06	13/12/06	13/12/06	13/12/06
	12/12/06		13/12/06		13/12/06
ELEMENTS by ICP-AES, AS RECEIVED					
Method: 402-AES Units: mg/kg					
Iron	<5.0	-	-	-	-
Sulphur	<5.0	-	-	-	-
MERCURY by VAPOUR-AAS, AS RECEIVED					
Method: 404FIMS Units: mg/kg					
Mercury	<0.01	-	-	-	-
METALS by ICP-MS, AS RECEIVED					
Method: 406-MS Units: mg/kg					
Aluminium #	<5.0	-	-	-	-
Arsenic	<1.0	-	-	-	-
Cadmium	<1.0	-	-	-	-
Chromium	<1.0	-	-	-	-
Cobalt	<1.0	-	-	-	-
Copper	<1.0	-	-	-	-
Lead	<1.0	-	-	-	-
Nickel	<1.0	-	-	-	-
Silver #	<1.0	-	-	-	-
Strontium #	<1.0	-	-	-	-
Tin	<1.0	-	-	-	-
Uranium #	<1.0	-	-	-	-
Zinc	<1.0	-	-	-	-
QC RESULTS - DUPLICATES					
Relative Percent Difference, %					
Mercury	-	<1.0	-	3.8	-
QC RESULTS - SPIKED SAMPLES					
Percent Recovery, %					
Mercury	-	-	99.0	-	95.8

Quality Results

Report No: 178274

	0612465Q023 Spike Recovery Lab Control 13/12/06 13/12/06	0612465Q024 Spike Recovery Lab Control 14/12/06 14/12/06	0612465Q025 Duplicate 0612465/001 14/12/06 14/12/06	0612465Q026 Duplicate 0612465/011 14/12/06 14/12/06	0612465Q027 Spike Recovery Lab Control 14/12/06 14/12/06
QC RESULTS - DUPLICATES					
Relative Percent Difference, %					
Aluminium	-	-	<1.0	4.6	-
Iron	-	-	<1.0	3.7	-
Sulphur	-	-	4.7	5.6	-
QC RESULTS - SPIKED SAMPLES					
Percent Recovery, %					
Aluminium	-	98.0	-	-	-
Arsenic	-	-	-	-	86.6
Cadmium	-	-	-	-	88.7
Chromium	-	-	-	-	104
Cobalt	-	-	-	-	99.3
Copper	-	-	-	-	101
Iron	-	103	-	-	-
Lead	-	-	-	-	94.8
Nickel	-	-	-	-	102
Sulphur	-	107	-	-	-
Tin	-	-	-	-	106
Zinc	-	-	-	-	81.1
Mercury	103	-	-	-	-

Quality Results

Report No: 178274

	0612465Q028 Duplicate 0612465/001 14/12/06 14/12/06	0612465Q029 Spike Recovery 0612465/001 13/12/06 14/12/06	0612465Q030 Duplicate 0612465/011 14/12/06 14/12/06	0612465Q031 Spike Recovery 0612465/011 13/12/06 14/12/06	0612465Q032 Spike Recovery Lab Control 14/12/06 14/12/06
QC RESULTS - DUPLICATES					
Relative Percent Difference, %					
Arsenic	7.7	-	9.7	-	-
Cadmium	<1.0	-	<1.0	-	-
Chromium	2.1	-	<1.0	-	-
Cobalt	<1.0	-	6.3	-	-
Copper	1.4	-	2.8	-	-
Lead	1.6	-	<1.0	-	-
Nickel	3.5	-	4.3	-	-
Silver	13.2	-	<1.0	-	-
Strontium	3.3	-	1.8	-	-
Tin	<1.0	-	<1.0	-	-
Uranium	2.6	-	2.4	-	-
Zinc	1.6	-	<1.0	-	-
QC RESULTS - SPIKED SAMPLES					
Percent Recovery, %					
Arsenic	-	89.7	-	90.1	88.6
Cadmium	-	90.4	-	92.7	89.1
Chromium	-	113	-	111	107
Cobalt	-	104	-	109	105
Copper	-	99.5	-	105	106
Lead	-	101	-	102	96.0
Nickel	-	103	-	108	106
Tin	-	111	-	114	107
Zinc	-	87.4	-	91.5	83.5

Quality Results provided in this report are for laboratory Quality Control purposes.

Sample Comments:

0612465/001 Au not tested at Amdel Melbourne

mgt Environmental Consulting Pty. Ltd.

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CERTIFICATE OF ANALYSIS

Coffey Geotechnics Pty Ltd SA
14B Henley Beach Rd
Mile End
SA 5000
Site: 508AA

Report Number: 229952 Page 1 of 4
Order Number:
Date Received: Jul 4, 2008
Date Sampled: Jul 3, 2008
Date Reported: Jul 22, 2008
Contact: Westley Fieldhouse

Methods

- USEPA 6010B Heavy Metals & USEPA 7470/71 Mercury
- APHA 3125 Gold (3500-Au) by ICPAES
- Method 102 - ANZECC - % Moisture

Comments

Notes

1. The results in this report supersede any previously corresponded results.
2. All Soil Results are reported on a dry basis.
3. Samples are analysed on an as received basis.
4. LOR's are matrix dependent. Stated LOR's may be raised where sample extracts are diluted due to interferences.

ABBREVIATIONS
mg/kg : milligrams per kilograms, mg/L : milligrams per litre, ppm : parts per million,
LOR : Limit of Reporting
RPD : Relative Percent Difference
CRM : Certified Reference Material
LCS : Laboratory Control Sample

Authorised

Report Number: 229952

Michael Wright
Laboratory Manager
NATA Signatory

Tammy Lakeland
Chief Inorganic Chemist

mgt Environmental Consulting Pty. Ltd.

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Coffey Geotechnics Pty Ltd SA **14B Henley Beach Rd** **Mile End** **SA 5000**	**Client Sample ID**		**165907**	**165763**	**165767**
	Lab Number		**08-JL02561**	**08-JL02562**	**08-JL02563**
	Matrix		**Soil**	**Soil**	**Soil**
	Sample Date		**Jul 3, 2008**	**Jul 3, 2008**	**Jul 3, 2008**
Analysis Type	**LOR**	**Units**			
% Moisture	0.1	%	8.9	2.6	3.1
Gold	10	mg/kg	< 10	< 10	< 10
Heavy Metals					
Aluminium	10	mg/kg	8500	9100	10000
Arsenic	2	mg/kg	< 2	< 2	12
Cadmium	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Chromium	5	mg/kg	5.5	16	70
Cobalt	5	mg/kg	< 5	< 5	7.2
Copper	5	mg/kg	10	< 5	30
Iron	5	mg/kg	8000	11000	100000
Lead	5	mg/kg	< 5	< 5	20
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	5.6	< 5	9.5
Silver	5	mg/kg	< 5	< 5	< 5
Strontium	10	mg/kg	16	< 10	< 10
Tin	10	mg/kg	< 10	< 10	< 10
Vanadium	10	mg/kg	< 10	24	190
Zinc	5	mg/kg	7.9	< 5	< 5

COMMENTS:

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Coffey Geotechnics Pty Ltd SA 14B Henley Beach Rd Mile End SA 5000	Client Sample ID	RPD	SPIKE	LCS	Method blank
	Lab Number	Batch	Batch	Batch	Batch
	QA Description		Spike % Recovery	% Recovery	
	Matrix	Soil	Soil	Soil	Soil
	Sample Date	Jul 3, 2008	Jul 3, 2008	Jul 3, 2008	Jul 3, 2008
Analysis Type	Units		% Recovery	% Recovery	mg/L
Heavy Metals					
Aluminium		-	-	-	< 0.5
Arsenic		8.4	83	102	< 0.05
Cadmium		< 1	89	107	< 0.02
Chromium		8.1	85	104	< 0.2
Cobalt		< 1	87	107	< 0.2
Copper		< 1	88	106	< 0.2
Iron		8.5	-	-	< 0.5
Lead		19	79	101	< 0.05
Nickel		< 1	85	106	< 0.2
Silver		< 1	-	-	< 0.2
Strontium		-	-	-	< 0.5
Tin		< 1	88	111	< 0.25
Vanadium		3.7	92	104	< 0.25
Zinc		16	83	96	< 0.2

COMMENTS:

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Coffey Geotechnics Pty Ltd SA 14B Henley Beach Rd Mile End SA 5000	Client Sample ID	165767	165767	RPD	SPIKE	LCS	Method blank
	Lab Number	08-JL02563	08-JL02563	08-JL02563	08-JL02563	Batch	Batch
	QA Description		Duplicate	Duplicate % RPD	Spike % Recovery	% Recovery	
	Matrix	Soil	Soil	Soil	Soil	Soil	Soil
	Sample Date	Jul 3, 2008	Jul 3, 2008	Jul 3, 2008	Jul 3, 2008	Jul 3, 2008	Jul 3, 2008
Analysis Type	Units			% RPD	% Recovery	% Recovery	mg/L
Heavy Metals							
Mercury		< 0.1	< 0.1	< 1	96	96	< 0.005

COMMENTS:

Laboratory test results

Laboratory Sample reference numbers and locations in laboratory test certificates.

Coffey Lab sample number	Site	Sample location
9043	MOUNT EVERARD	ME TP 07 0.4 - 0.8
9044		ME BH 01 6.7 - 7.0
9046		ME BH 01 22.85 - 23.1
9047		ME BH 01 59.55 - 59.9
9049		ME BH 02 13.4 - 13.6
9050		ME BH O4 2.0 & 3.0
9052	HARTS RANGE	HR TP 01 1.0 - 1.4
9054		HR BH 01 9.0 - 10.0
9056		HR BH 01 26.5 - 26.6
9057		HR BH 01 48.0 - 48.35
9059		HR BH 04 2m & 3m
9060		HR BH 05 9m & 10m
9062	FISHERS RIDGE	FR TP 04 0.4 - 0.8
9064		FR BH 01 12.1 - 12.6
9065		FR BH 01 22.65 - 22.85
9066		FR BH 02 1.0 - 1.3
9070		FR BH 02 23.7 - 24.0
165763	MUCKATY STATION	MSTP 02 3.0 – 3.1
165767		MSTP 08 1.7 – 1.8
165907		GBH 02 39.85 – 40.0

Appendix B

Comparison to crustal elemental averages

Appendix B: Comparision of element concentrations to crustal average

Element	Crustral																				
	Averages	**Mount Everard**						**Harts Range**						**Fishers Ridge**					**Muckaty Station**		
	(mg/kg)	9043	9044	9046	9047	9049	9050	9052	9054	9056	9057	9059	9060	9062	9064	9065	9066	9070	165907	165763	165767
CaCO3		7.3	7.1	5.1	42.6	4	8.1	3.5	3.6	4.6	3.9	2.8	3.5	2.9	1.3	1.2	3.5	4.3	-	-	-
Al	81300*		15000	12000	28000	11000	12000	8400	6300	12000	19000	8800	8300	15000	9300	8700	11000	3800	8500	9100	10000
Fe	50000*		22000	18000	18000	26000	25000	18000	14000	27000	62000	16000	17000	120000	13000	1E+05	97000	2200	8000	11000	100000
S	500*	18	31	53	47	100	81	25	24	54	30	18	24	13	16	23	11	17	-	-	-
As	1.8		<2.0	<2.0	<2.0	<2.0	2.6	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	9.6	<2.0	12	7.7	<2.0	<2	<2	<2
Cd	0.2		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<0.5	<0.5	<0.5
Cr	100		30	32	24	47	32	31	21	30	100	27	24	210	25	74	120	14	5.5	16	70
Co	25		8.4	5.2	8.7	12	6.5	5.3	6.9	16	51	6.3	7.6	<2.0	<2.0	<2.0	<2.0	<2.0	<5	<5	7.2
Cu	55		16	9.9	14	16	10	6.9	14	20	59	9	13	10	6	31	15	7.7	10	<5	30
Pb	12.5		9	6.5	15	13	8.9	3.6	5	14	18	4.6	4	24	5.5	9.2	20	4	<5	<5	20
Ni	75		16	12	29	13	11	7.6	9.5	11	59	8.8	10	4.6	<2.0	2.6	2.1	<2.0	5.6	<5	9.5
Ag	0.07		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	3.4	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<5	<5	<5
Au	0.004		0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.03	<0.04	<0.06	<0.07	<0.09	<0.11	<0.01	<0.01	<0.01	<10	<10	<10
Sr	375		74	33	150	43	54	17	20	47	29	17	26	13	5.5	4.1	2.5	24	16	<10	<10
Sn	2		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<10	<10	<10
U	2.7		<2.0	<2.0	2.6	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.4	<2.0	3.5	<2.0	<2.0	-	-	-
Zn	70		25	24	7.7	17	13	8.9	14	22	76	13	14	3.3	2.5	5.1	3.1	3.8	7.9	<5	<5

Note: Crustal averages taken from AusIMM Field Geologists' Manual (Berkman, D.A. (compiler) 2001)

*Crustal averages taken from www.daviddarling.com Averages are for the lithosphere (crust & upper mantle).

Appendix C

Harts Range and Muckaty Station
heavy mineral analyses

www.amdel.com

A.B.N. 30 008 127 802

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22 December 2006

Coffey and Partners Pty Ltd
14B Henley Beach Road
MILE END
SA 5031

Attention: Westley Fieldhouse

REPORT N2200HL06

HEAVY MINERAL CONTENT OF THREE SOIL SAMPLES

YOUR REFERENCE:	Job No 06051/AA – Order 061074
SAMPLE IDENTIFICATION:	HR BH03 1.0m HR BH04 2.0-3.0m HR BH05 9.0-10.0m
MATERIAL:	Soil samples
DATE RECEIVED:	24 November 2006
PROJECT MANAGER:	Frank Radke

Frank Radke

Frank Radke
Senior Mineralogist

FR : mb

1. INTRODUCTION

Three soil samples were submitted by Coffey and Partners Pty Ltd for determination of heavy mineral content.

2. PROCEDURE

A riffled portion of each sample was wet screened at 1000 and 45µm. The +1000µm and -1000 +45µm fractions were collected, dried and weighed. The -45µm fraction was discarded. Riffled portions of the –1000 +45µm size fractions were separated in heavy liquid (tetrabromoethane) at a specific gravity (sp. gr.) of 2.96. Both sp. gr. products were collected, washed of separation medium, dried and weighed.

Polished thin sections were made of the >3.3 sp. gr. products and examined by transmitted and reflected light microscopy. Mineral proportions were visually estimated.

3. RESULTS

The sizing and heavy liquid separation results are given in Table 1.

Visually estimated mineral proportions in the >2.96 sp. gr. products are given in Table 2 which show that all three samples consist mainly of hornblende and garnet with moderate amounts of pyroxene, ilmenite, epidote and various iron oxides (magnetite, hematite and goethite). Most of the minerals in the heavy products occur as liberated particles. The goethite occurs as an alteration product of hornblende, garnet and pyroxene along fractures and grain margins. The pyroxene consists of both clinopyroxene and orthopyroxene including some hypersthene.

TABLES

Table 1. Sizing and Separation Results

Size Fraction (um)	Sp. Gr. Product	Distribution (wt. %) In Sample	Distribution (wt. %) In Sp. Gr. Product
Sample HR BH03 1.0m			
+1000		4.55	
-1000+45	<2.96	65.32	81.14
	>2.96	15.18	18.86
	Total	80.50	100.00
-45		14.95	
Total		100.00	
Sample HR BH04 2.0-3.0m			
+1000		0.78	
-1000+45	<2.96	73.71	91.57
	>2.96	6.79	8.43
	Total	74.60	100.00
-45		24.62	
Total		100.00	
Sample HR BH05 9.0-10.0m			
+1000		13.85	
-1000+45	<2.96	66.04	82.04
	>2.96	14.46	17.96
	Total	65.14	100.00
-45		21.01	
Total		100.00	

Table 2. Visually Estimated Mineralogy of the >2.96 Sp Gr Products

Mineral	Sample		
	HR BH03 1.0m	HR BH04 2.0-3.0m	HR BH05 9.0-10.0m
Hornblende	35	35	35
Garnet	35	35	30
Pyroxene	10	10	5
Epidote	3	5	15
Ilmenite	10	10	10
Hematite	3	2	1
Goethite	2	2	1
Magnetite	2	1	1
Biotite	trace	-	1
Staurolite	-	-	1
Zircon	trace	trace	trace
Tourmaline	trace	trace	-
Sphene	-	trace	trace
Rutile	-	trace	-

REPORT N3048PE08

HEAVY MINERAL ANALYSIS OF THREE SAMPLES

A.B.N. 30 008 127 802

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	(Int):	61 8 8352 8243	AUSTRALIA	AUSTRALIA

18 July 2008

Coffey Information Pty Ltd
14B Henley Beach Road
Mile End SA 5031

Attention: Ross Dingle/Westley Fieldhouse

REPORT N3048PE08

HEAVY MINERAL ANALYSIS OF THREE SAMPLES

YOUR REFERENCE:	Order No I 08005, Chain of Custody No. 1030
SAMPLE IDENTIFICATION:	165763, 165767 and 165907
MATERIAL:	One rock and two soil samples
LOCATION:	Job No. 503 AA
DATE RECEIVED:	14 July 2008
PROJECT MANAGER:	Frank Radke

Frank Radke
Senior Mineralogist

Phone: 08 8416 5268
Fax : 08 8352 8243
fradke@amdel.com

FR : mb

1. INTRODUCTION

Coffey Information Pty Ltd submitted three samples for heavy mineral analysis to determine the possible presence of garnet, zircon and hornblende. The samples are as follows.

Sample No.	Sample type
165763	Soil sample with sand sized particles
165767	Soil sample with gravel sized particles
165907	Rock sample

2. PROCEDURE

Sample 165907 and a riffled half portion of sample 165767 were stage crushed and ground to 100% passing 212 um, weighed and wet screened at 20 um. The +20um fraction was collected, dried and weighed and the –20um fraction discarded. A riffled half portion of sample 165763 was wet screened at 75 um. The +75um fraction was collected, dried and weighed and the –75um fraction discarded. Riffled portions of the +20um and +75um fractions were separated in heavy liquid (tetrabromoethane) at a specific gravity (sp. gr.) of 2.96. The >2.96 sp. gr. products were collected, washed of separating medium, dried and weighed. The <2.96 sp. gr. products were discarded.

Temporary oil mounts of the >2.96 sp. gr. products were microscopically examined with a petrographic microscope to visually estimate mineral proportions.

3. RESULTS

The sizing and separation results are given in Table 1.

The visually estimated mineral percentages of the >2.96 sp. gr. products are given in Table 2. The opaques these samples are thought to consist mainly of iron oxides but other opaque minerals could be present. Many of the opaques in sample 165767 have a translucent red colour indicating they are an iron oxide.

TABLES

Table 1. Sizing and Heavy Liquid Separation Results

	Sample 105763			Sample 105767		Sample 105907	
Sizing							
Size Fraction (um)	Weight (g)	Weight %	Size Fraction (um)	Weight (g)	Weight %	Weight (g)	Weight %
Initial Wt.	518.08		Initial Wt.	642.03		182.99	
+75	411.21	79.37	+20	502.72	78.30	72.21	39.46
-75*	106.87	20.63	-20*	139.31	21.70	110.78	60.54
Total	518.08	100.00	Total	642.03	100.00	182.99	100.00
Heavy Liquid Separations							
Sp. Gr. Product	Weight (g)	Weight %	Sp. Gr. Product	Weight (g)	Weight %	Weight (g)	Weight %
Initial Wt.	91.59		Initial Wt.	86.07		72.28	
<2.96*	91.467	99.87	<2.96*	60.15	69.88	69.795	96.56
>2.96	0.123	0.13	>2.96	25.92	30.12	2.485	3.44
Total	91.59	100.00	Total	86.07	100.00	72.28	100.00

Table 2. Visually Estimated Mineralogy

Sample 105763		Sample 105767		Sample 105907	
Mineral	%	Mineral	%	Mineral	%
Zircon	25	Zircon	Tr	Zircon	5
Tourmaline	25	Rutile	Tr	Amphibole	Tr-1
Rutile	5	Amphibole	Tr	Quartz	5
Andalusite	1	Opaques	>99	Tourmaline	1
Staurolite	Tr			Opaques	89
Kyanite	Tr				
Opaques	4				