Titleholder: Rum Jungle Resources Ltd
Operator: Rum Jungle Resources Ltd
Titles Agent: Complete Tenement Management
Tenements: EL 30381, EL 30382
Project Name: Karinga Lakes Sulphate of Potash Brine
Group Report: GR360
Report Title: Partial relinquishment report EL 30381 and EL 30382 Karinga Lakes Potash Project, GR360, 16/03/2015 to 21/11/2016
Author: John Dunster
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Target Commodity: Potash / schoenite
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Note: Rum Jungle Resources Ltd will become Verdant Minerals Ltd on 05/12/2016.
SUMMARY

The Karinga Lakes Potash Project is one of many in which Rum Jungle Resources is involved across three Australian jurisdictions. All the projects are targeting salt lakes and sub-surface aquifers that contain potassium- and magnesium-rich sulphate brines. Potash and/or schoenite fertiliser can be produced by simple staged solar evaporation and flotation and/or other onsite treatments. Karinga Lakes is one of several Rum Jungle Resources' projects that have JORC brine resources drilled-up by the company since 2010. Karinga remains the most advanced of these projects. Major desktop evaluations were undertaken of the largest ELs in the Karinga project, namely EL 30381 and EL 30882. It was decided to partially relinquish almost all of the ground in these ELs, retaining only 4 (four) and 8 (eight) blocks respectively contiguous with other ELs in the project.
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PHYSIOGRAPHY, ACCESS AND LOGISTICS

Location
The Karinga Lakes Sulphate of Potash Brine Project is located in central Australia, west of the north-south Stuart Highway and the Central Australian Railway.

Figure 1. Location of the Karinga Lakes Project (shown in bright green) in central Australia. Main roads in red, and railways shown.
Habitation and Land Use

The Karinga Lakes Project is entirely on pastoral leases, covering portions of Angus Downs which is Aboriginal-owned, a tiny corner of Mount Ebenezer, Curtin Springs, Lyndavale and Erldunda perpetual pastoral leases. Few cattle are run in the area generally, but this does vary from season to season. Historically, this is the only land use of the ELs. However, the cattle stations are diversifying into tourism. Apart from the pastoral stations, the nearest points of habitation are Aboriginal communities, the largest of which is Imanpa (population between 180 and 250), 7 km north of the Lasseters Highway and about 17 km from Mt Ebenezer Roadhouse which is owned and run by the community. The community is predominantly Pitjantatjara and Yankunyatjara although Walpiri, Luritja and Arrernte people also live there. Imanpa has a clinic which was built in 1986 and a visiting nurse with an ambulance.
Access and Logistics
Access is from the Lasseter Highway which runs east-west through the project area. Access to the lakes themselves is restricted to unmapped and poorly maintained station tracks or lesser tracks constructed by Rum Jungle Resources. In the past, Curtin Springs Station and roadhouse and Mount Ebenezer roadhouse were used as logistic bases. From June 2013 until mid 2014, work was conducted from a transportable camp located in the south of the project area. This camp has now been removed from site and Curtin Springs was again used as base for 2015 and 2016 work.

![Map of access within the project area](image)

Figure 4. Access within the project area prior to reduction highlighting the existing pastoral tracks and fencelines which give access to the lakes.

Land Use Agreements
ELs 30381 and 30382 are on Curtin Springs Station and, if required by the pastoral leaseholder, Rum Jungle Resources will enter into a formal Land Use Agreement for all ground-disturbing activities.

Climate
The climate is typical of the central Australian deserts and classified as arid/semi-arid with long hot summers and relatively mild winters. A feature of the winter months is the marked diurnal fluctuations in temperature, which can range from sub-zero overnight to mid twenties (°C) or higher during the day. Daytime summer temperatures rarely fall below 30°C and there are often long periods with days in excess of 40°C. On the salt lakes themselves, temperatures can be even higher because of reflected heat.

<table>
<thead>
<tr>
<th>Month</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean rainfall (mm)</td>
<td>28.3</td>
<td>26.6</td>
<td>29.2</td>
<td>15.4</td>
<td>17.7</td>
<td>14.1</td>
<td>12.8</td>
<td>8.2</td>
<td>9.9</td>
<td>18.8</td>
<td>24.0</td>
<td>29.1</td>
<td>234.1</td>
</tr>
<tr>
<td>Evaporation rate (mm)</td>
<td>344</td>
<td>284</td>
<td>264</td>
<td>188</td>
<td>129</td>
<td>94</td>
<td>111</td>
<td>153</td>
<td>216</td>
<td>270</td>
<td>285</td>
<td>310</td>
<td>2647</td>
</tr>
<tr>
<td>Mean maximum temperature (°C)</td>
<td>37.8</td>
<td>36.4</td>
<td>33.7</td>
<td>29.1</td>
<td>23.7</td>
<td>20.2</td>
<td>20.2</td>
<td>23.0</td>
<td>27.7</td>
<td>31.6</td>
<td>34.4</td>
<td>36.3</td>
<td>29.5</td>
</tr>
<tr>
<td>Mean minimum temperature (°C)</td>
<td>22.2</td>
<td>21.6</td>
<td>18.4</td>
<td>13.5</td>
<td>8.6</td>
<td>4.9</td>
<td>3.7</td>
<td>5.7</td>
<td>10.0</td>
<td>14.3</td>
<td>17.9</td>
<td>20.5</td>
<td>13.4</td>
</tr>
</tbody>
</table>

Table 1. Average monthly climate statistics from Curtin Springs with evaporation averages between 2006 and 2013.

Rain is infrequent and largely unpredictable and evaporation rates greatly exceed rainfall, often by a factor of ten. The average rainfall is about 250-300 mm, most of which falls in the mid to late summer, and the average annual
evaporation is 3,000-4,000 mm. 1974 was an exceptionally wet year, during which all of the lakes were full for several months. Average annual rainfall has been falling consistently since 2010.

Site-specific rainfall monitoring equipment has been installed on selected lakes.

**Land Systems, Flora and Fauna**
Several flora and fauna studies have been undertaken and were reported under the Mining Management Act.

**Heritage Sites**
A search of the NT Heritage Register held by NRETAS shows no Declared Heritage Sites in the project area. Individual archaeological surveys have also been conducted by specialist contractors on behalf of Rum Jungle Resources and have been reported elsewhere.

**EXPLORATION AND PROJECT RATIONALE**
The Karinga Lakes Potash Project is one of many in which Rum Jungle Resources is involved across three jurisdictions (Figure 6). All the projects are targeting salt lakes and sub-surface aquifers that contain potassium- and magnesium-rich sulphate brines. Potash and/or schoenite fertiliser can be produced by simple staged solar evaporation and flotation and/or other onsite treatments. Australia has no producing potash mines. Around 350,000 tonnes of potash is imported into Australia annually from Canada and is worth around $200 million. Potash of sulphate and schoenite are utilised as high-end fertiliser products globally, as they have a lower salt index than muriate of potash and are often preferred in crops sensitive to chloride or susceptible to fertiliser burn. Sulphate of potash and schoenite attract premium pricing in comparison to the more common muriate of potash. Karinga Lakes is one of several Rum Jungle Resources’ projects that have JORC resources drilled-up by the company since 2010. Karinga remains the most advanced of the projects.
The Karinga Salt Lake Project is strategically well located adjacent to the Lasseter Highway and within close proximity of the Central Australian Railway line, providing access north to the port of Darwin and proximity to Asian markets and south to domestic markets.
**HISTORY OF TENURE**

Rum Jungle Resources has multiple granted tenements along the string of salt lakes which form Karinga Creek, from just east of Lake Amadeus to Mount Richards Dam. Several of the flagship titles were purchased from other entities and some were part of a former JV with Reward Minerals. Rum Jungle Resources has always been the operating company responsible for on-ground work. All the titles in the Karinga Lakes project have been transferred into a single company name so group technical reporting could be applied for.

The titles have changed considerably since the project began. Areas, particularly in the east out to the Stuart Highway, have been tested and dropped. Areas and whole lakes which contain culturally sensitive areas have been relinquished or surrendered. ELs 30381 and 30382 being reported here were added to the west to link the Karinga Lakes Project to Rum Jungle Resources’ applications over Lake Amadeus.

![Figure 7. Karinga titles as of January 2012, showing the 2011 vibrocore and sonic core drillholes. The tenement package originally extended east past the Stuart Highway.](image)

The reduction of EL 30381 from 154 to four (4) blocks and EL 30382 from 114 blocks to eight (8) blocks is the first partial relinquishment to these ELs and is the subject of this report.

![Figure 8. Karinga titles as of 13 October 2015, prior to reduction. JORC resource outlined in blue.](image)
MINERAL TITLES ACT REPORTING
Group technical reporting was approved as GR360 on 04/02/2015. The reporting period is 10 October to 09 October. There is no Expenditure Project Area.

MINING MANAGEMENT ACT
The Karinga Lakes Project is being worked under DME / DPIR Authorisation 0565-02 and the associated MMP.

NT WORKSAFE
As part of an NT-wide move by Worksafe to improve its monitoring and inspections of exploration and mining projects, Worksafe required Rum Jungle Resources to redo its Safety Management System and update its Risk Management Plans for each project including Karinga. Consultants Switched on to Safety were engaged to completely update Rum Jungle Resources WHS&E. The most recent NT Worksafe inspection of the Karinga Lakes Project was conducted by Nigel Butler on 12-13/12/2013.

ABORIGINAL ISSUES
Rum Jungle Resources has obtained an AAPA Clearance Certificate for all areas of work. Despite being on pastoral leases, the CLC has become involved in the Karinga Lakes project. They undertook an inspection of their own volition during 2014. On 13 November 2014, an on-country courtesy meeting was held with Traditional Owners and the Central Land Council at Imanpa.

GEOLOGICAL AND HYDROLOGICAL SETTING
The Karinga Lakes Potash Project overlies the southwestern sector of the Amadeus Basin in the Northern Territory. The Amadeus Basin covers approximately 150,000 km² and extends into Western Australia. It is comprised of a Neoproterozoic to mid-Palaeozoic succession of predominantly shallow marine sedimentary rocks and attains a thickness of up to 14,000 m. The siltstones of the central Amadeus Basin have weathered into a modern topographic low. This depression contains a chain of Cenozoic playa salt lakes. Quaternary sand dunes, up to 30 m high, encroach onto the depression. The dunes are mostly vegetated and stable. The playas presently occupy only the lowermost topographic depressions in swales between dunes. Quaternary calcrete and silcrete duricrusts (of vadose origin) are characteristically superimposed on Amadeus Basin outcrops, forming escarpments, several metres high along the margins of some of the playa lakes. Low-relief gypsum-sand “islands” are also present in some of the playas.
The sediments in the modern playa lakes and their palaeo-drainages contain brines formed by the evaporation of surface and near-surface water from infrequent and largely unpredictable rain and flooding events.
Most importantly, the lakes are also fed from groundwater discharge in the Central Australian Groundwater Discharge Zone as described below.
Figure 9. Regional view of the Central Australian Groundwater Discharge Zone (outlined in light blue) running from Lake Hopkins in WA through to Karinga Lakes, nearest the railway. The blue arrows indicate sub-surface flow. Rum Jungle Resources Ltd titles are shown in green.

Figure 10. Schematic diagram of how the Central Australian Groundwater Discharge Zone works.
The Devonian Horseshoe Bend Shale forms low mesas around many of the lakes and constitutes the lake “floor”. Where it is fractured and/or deeply weathered, the Horseshoe Bend Shale is a brine aquifer in its own right; being the local discharge point for the Central Australian Groundwater Discharge Zone. It is hydraulically connected to the brine in the modern lake sediments, to collectively form a single brine aquifer. The Horseshoe Bend Shale was/is evaporitic, containing sulphate and chloride evaporites. It also contains locally abundant detrital biotite. The evaporites have been leached out over geological time and have almost certainly contributed to the brine, both within the shale and within the lake sediments. These migrating brines have also liberated additional potassium from the weathering biotite.

**JORC 2012 RESOURCE**

The most recent Karinga Lakes brine potash resource estimate is 8.4 million tonnes $\text{K}_2\text{SO}_4$ including over 70% in the Measured and Indicated category. This is equivalent to 19 million tonnes of schoenite.

<table>
<thead>
<tr>
<th>Resource</th>
<th>Potassium</th>
<th>$\text{K}_2\text{SO}_4$</th>
<th>Schoenite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured</td>
<td>2,600,000</td>
<td>5,800,000</td>
<td>13,000,000</td>
</tr>
<tr>
<td>Indicated</td>
<td>210,000</td>
<td>460,000</td>
<td>1,100,000</td>
</tr>
<tr>
<td>Inferred</td>
<td>950,000</td>
<td>2,100,000</td>
<td>4,900,000</td>
</tr>
<tr>
<td>Total</td>
<td>3,800,000</td>
<td>8,400,000</td>
<td>19,000,000</td>
</tr>
</tbody>
</table>

Table 2. Karinga Lakes Brine Resource (entries have been rounded).

The Karinga Lakes Potash Resource is a brine hosted resource. The potassium is dissolved in brines that are contained in aquifers below the dry salt lake surface. The JORC code was not designed for use in connection with minerals that are dissolved in brines. It is generally accepted that geological uncertainties are greater when dealing with the estimation of brine resources.

The sulphate of potash tonnage represents the in-situ brine with no recovery factor applied. It will not be possible to extract all of the contained brine by pumping of trenches; the amount which can be extracted depends on many factors including the permeability of the sediments, the drainable porosity, and the recharge dynamics of the aquifers.

Brine is hosted within two stratigraphic units:
- modern lake bed sediments, and
- weathered siltstone of the Devonian Horseshoe Bend Shale

Potassium tonnage was calculated individually for each stratigraphic unit at each lake. Potassium tonnage was calculated as:
- Bulk volume x porosity x brine concentration.

Ordinary kriging interpolation was used for resource estimation at a cut-off of 3,000 mg/L potassium. The average potassium grade of the lakes using this cut-off is 4,760 mg/L.

Porosity values were assigned to each stratigraphic unit on the basis of measured porosity in 142 samples obtained from the 2013 sonic drill core samples. 71 porosity samples were sent to E-Precision laboratory in Perth and 71 porosity samples were sent to the British Geological Survey Hydrogeological Properties and Processes Laboratory in Wales. Median porosity values for each stratigraphic unit were determined as follows:
- Modern lake bed sediments – 33%
- Devonian Horseshoe Bend Shale – 36%

The total resource is contained beneath 25 lakes with a total area of 132 km$^2$. The average thickness of the identified resource is 17 m.

The potash brine resource is based on data acquired over four years, including:
- 93 brine samples from hand dug pits
- 4 small backhoe trenches which were pump tested
- 8 vibrocore drill holes
- 73 sonic drill holes
- 200 aircore drill holes
- 42 installed 50 mm piezometers around drill holes and 48 piezometers around trenches
- 47 installed 100 mm wells
- 10 pumping tests from 100 mm wells
- 4 long term pump tests from 3 trenches and a well
- 142 porosity samples
The full JORC 2012 Resource Statement, the ASX announcement and all the relevant JORC reporting tables have been supplied to DME / DPIR previously.

**PREVIOUS WORK BY OTHERS**

Local pastoralists have exploited surface salt on a few of the Karinga Lakes (e.g., Swansons Lake) as a source of NaCl for cattle licks since the 1940s and there was some local exploitation of gypsum for domestic and commercial use. Small-scale commercial salt-crust scraping operations have operated sporadically over the decades, notably at Lake Suzi. There has been no exploitation of the subsurface lake brines except for road crews who dug pits and pumped brine for use in road works. The possibility of commercial exploitation was examined in 1960s and again by NT Evaporites during the late 1980’s and early 1990’s. In 1988, NT Evaporites and the Northern Territory Department of Industry and Development created a geological data base to assess the industrial mineral resources in the licence areas. The investigation involved field mapping, sediment sampling and water sample collection. This work identified a variety of industrial minerals and brine resources including industrial clays, zeolites and evaporites. In 1992, Geo-Processors Pty Ltd conducted an assessment of resources and feasibility study of the Karinga Lakes area and concluded that the site was suitable for a commercial operation and technically feasible. These studies, and the reasons for their lack of success, have been summarised elsewhere and are not reproduced here.

Petroleum explorers acquired seismic data and drilled one unsuccessful well, Murphy 1, within the Karinga Lakes project area. The seismic data has been examined but is too widely spaced and too poorer quality shallow to be of much use. The only significant water intersected in Murphy 1 was significantly deeper than currently being targeted by Rum Jungle Resources.

![Figure 11. Petroleum exploration in the project area.](image)

There has also been limited uranium and diamond exploration in the general area. Quasar Resources held part of the ground from 2008 to 2013. They undertook a NTGS co-funded gravity survey to look for IOCG targets and palaeochannels that might contain uranium. No IOCG targets were identified and gravity did not show palaeo-channels. Their work was of limited relevance to the potash project.
PREVIOUS WORK BY RUM JUNGLE RESOURCES
The extensive previous work by Rum Jungle Resources has been reported in previous annual and bridging reports. Ground has been progressively surrendered as it has been tested and this work is documented in open-file partial relinquishment and surrender reports.

WORK BY RUM JUNGLE RESOURCES

Scoping Study
The Karinga Lakes Scoping Study was the major focus of work on the Karinga Project during 2014-2015. A review of the extractable brine resource, chemical composition and processing analytics, process flow sheet design, mass balance work and general brine extraction and processing facility layout was completed by China International Chemical Consulting Corporation (CICCC). GHD Australia completed estimates of Australian capital and operating costs, based on the CICCC design. Baseline regional market studies for both sulphate of potash and potassium magnesium sulphate were also conducted.

Two development scenarios were studied to a scoping study level of accuracy (+/- 40% capital and operating costs):

**Scenario 1**
- 125,000 tonnes per annum of sulphate of potash (SOP) for a minimum of 10 years of production. 75% of the in-situ potash brine resource is in the Measured and Indicated JORC (2012) categories.

**Scenario 2**
- 100,000 tonnes per annum of potassium magnesium sulphate (schoenite) for a minimum of 15 years of production. For scenario 2, it is considered that there are sufficient recoverable brines in the known in-situ resource and without recharge to support the 15 year operation envisaged.

Schoenite is an intermediate product of the sulphate of potash process. Scenario 2 is approximately one fifth the size of Scenario 1 and represents the potential to develop a small scale start up, using a smaller number of lakes thus decreasing the environmental footprint and significantly lower energy usage due to lower volumes of brines being pumped smaller distances and avoiding the need to create steam that is used to convert schoenite to SOP.

The following table summarises the scoping study level economic assumptions for the project:

<table>
<thead>
<tr>
<th>Units</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOP Sold</td>
<td>tpa 125,000</td>
<td></td>
</tr>
<tr>
<td>Schoenite Sold</td>
<td>tpa 100,000</td>
<td></td>
</tr>
<tr>
<td>Minimum Life</td>
<td>years 10</td>
<td>15</td>
</tr>
<tr>
<td>Estimated wholesale market price</td>
<td>$A/t $700-$800</td>
<td>$400-$450</td>
</tr>
<tr>
<td>Estimated operating costs including transport</td>
<td>$A/t $300-$370</td>
<td>$140-$160</td>
</tr>
<tr>
<td>Estimated Total Capex</td>
<td>$AM 340</td>
<td>93</td>
</tr>
<tr>
<td>Contingency included in Total Capex</td>
<td>$AM 50</td>
<td>14</td>
</tr>
</tbody>
</table>

Table 3. Summary of results of Scoping Study.

The Opex range provided in the table above is determined by the gas supply scenario. The upper bound is when gas is delivered by CNG from Alice Springs and the lower bound assumes gas supplied via pipeline from emerging regional production.

In order to take one of the development scenarios forward to a bankable feasibility study, it will be necessary to secure funding through the establishment of a joint venture. As previously announced to the ASX, Flagstaff Partners have been engaged to facilitate a formal investment process.

Prefeasibility Study
A consortium of GHD Australia and Norwest based in the USA was appointed as study manager to conduct a preliminary feasibility study (PFS) for the Karinga Lakes Sulphate of Potash project. This was announced to the ASX on 20 November 2015, during the reporting period. Unfortunately, the PFS has now been put on hold because of:
• a change in company philosophy when Washington H. Soul Pattinson acquired a further stake in Rum Jungle Resources. WHSP now controls 38% of RUM and WHSP directed funding to Ammaroo phosphate
• uncertainty about the grant of access by the pastoral leaseholder of Lyndavale PPL
• extra conditions imposed by DPIR and NT EPA because the project is in a Zone of Conservation Significance
• the adjacent titles over Lake Amadeus which would have greatly increased the projects viability went into ALRA moratorium.

Assessment of EL 30381 and EL 30382
EL 30381 and EL 30382 are the large western-most titles adjacent to the Lake Amadeus applications. These ELs were originally pegged to test a potential palaeo-lake and for palaeochannels. Satellite imagery (Is7, various Landsat, GoogleEarth, Bing, in-house SPOT5 and numerous ASTER ratios) were used to interpret and map modern drainages and lakes and their possible palaeo equivalents.
Figure 12. Modern and palaeo-drainages (yellow) and lakes (blue) interpreted from satellite imagery. Waterbores (mentioned later) are plotted for reference points.

Night-time thermal imagery acquired for Rum Jungle Resources in 2012 was also studied. Such studies are based on the premise that any large volumes of near-surface extremely salty brine (in lakes or palaeochannels) should absorb more heat from their surroundings during the day and radiate this as anomalous thermal energy at night. Interpretation of the images over ELs 30381 and 30382 shows that, other than outcrop, only a single small area of less than 0.5 km$^2$ (shown in the figure below) is thermally anomalous.
A waterbore study found that the largest palaeolake has about 6 m of gypsum. There are no obvious palaeochannels intersected in waterbores. None of the water assays look promising for potash or other minerals. Some are high in F and nitrates but not high enough to be economically interesting and the best of the nitrate-bores are actually outside the ELs. K is barely above 50 ppm.
Figure 14. Waterbores (labelled) used in the study. RN014934 tested the interpreted palaeo-lake and intersected gypsum.

MAPS OF BLOCKS RELINQUISHED AND RETAINED

Figure 15. Map of the Karinga Lakes Project ELs showing EL 30381 and EL 30382 in the west prior to relinquishment. The locations of all sample data acquired in the project to date are plotted.
CONCLUSIONS AND RECOMMENDATIONS

Desk-top studies have shown that large portions of northern EL 30381 and EL 30382 are not worth retaining and have been voluntarily partially relinquished.