

# Alcoa of Australia Limited

## **EL3350 - Howard Island, Arnhem Land Annual and Final report for the period ending 19/10/2016**

Target Commodity: Bauxite

### Maps

1:100 000	Topographic Series Howard	5973
1:250 000	Geological Series Arnhem Bay-Gove	SD/53-3-4

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## 1 ABSTRACT

EL3350 on Howard Island, East Arnhem Land was initially granted in October 2014 after traditional owners provided consent for bauxite exploration following a period of punctuated consultation dating back to 1981. Exploration programmes aimed to test whether bauxite occurrences on the eastern side of Elcho Island, reported by Plumb (1965), have analogies on Howard Island and whether the occurrences are indications of a significant deposit of marketable bauxite. Preliminary geological reconnaissance, which included the collection and analysis of samples of float, provided only limited encouragement and a vacuum drilling programme aimed to better test the laterite thickness and alumina grade across the license area. The drilling programme failed to find indications of marketable bauxite and interpretation of results suggests that any significant bauxite deposits that may have existed on the island have been eroded.

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## 3 LOCATION, TITLE HISTORY, PHYSIOGRAPHY AND ACCESS

The subject of this report, EL3350, covers an area of 71.72km<sup>2</sup> on Howard Island and was initially granted on October 20<sup>th</sup> 2014 for a period of 6 years.

Howard Island is Aboriginal Freehold Land and is located about 550km east of Darwin just off the East Arnhem Land coast. Access is only possible by light aircraft or boat but there are no scheduled services of either to the island. A gravel airstrip adjacent to the settlement of Langarra on the north coast Howard Island is suitable for single engine aircraft. Shallow draft barges are able to access the beach adjacent to Langarra during high tide. To complete the drilling programme of November 2015, a shallow draft barge operated by Barge Express was used to transport the tractor mounted vacuum drill rig, four-wheel drive support truck and personnel from Elcho Island to Howard Island. The Marthakal Homeland Resource Centre barge operated by the Marthakal Rangers was used for the return journey.

Vehicle access to the title area once on the island is limited to a single track that originally linked Langarra to Nikawu at the eastern end of Howard Island. The access track is generally not well defined, overgrown and cut in many places by fallen trees but it has been possible to follow this from Langarra to within about 1 km of the eastern edge of the title area during recent programmes. In November 2015, a bucket mounted to the front of the drill rig proved invaluable for removing newly fallen trees, the result of cyclones that passed in February 2015.

EL3350 occupies the interior of the western two thirds of Howard Island. It represents the larger of two areas, for which consent was received, from an exploration license application that covered the whole of Howard Island. The license area, initially applied for in 1981, was the subject of a number of periods of consultation and moratorium before consent areas were agreed following consultation meetings held in 2012. These were passed by the full council of the Northern Land Council (NLC) in May 2014 prior to the approval of the Federal Minister of Indigenous Affairs and the subsequent grant of exploration licenses. A work programme was approved by traditional owners following a meeting in June 2014 and commenced with a programme of geological mapping and reconnaissance, and an archaeological survey commissioned by the NLC, during August 2014. The drilling programme described by this report completed the work programme.

EL3350 was part of Alcoa's Arnhem Land project consisting of five semi-contiguous applications, being Elcho Island, Howard Island and three mainland applications immediately to their south (see Figure 1). Authorisation 0865-01 was given on September 30<sup>th</sup> 2015 and the associated Mine Management Plan was approved for exploration activities on EL22821, EL3350 and EL29848 on Elcho and Howard Islands. An application for a Certificate of Closure over that authorisation was lodged in September 2016 and the associated exploration licenses were surrendered in October 2016.

The title area is relatively flat and generally overlain by a residual sandy to silty soil cover. Surface water appears limited to two small swamps in the south and drainage lines are poorly defined and intermittent, apparently flowing only briefly after heavy rain.

#### **4 GEOLOGICAL SETTING, EXPLORATION HISTORY AND EXPLORATION RATIONALE**

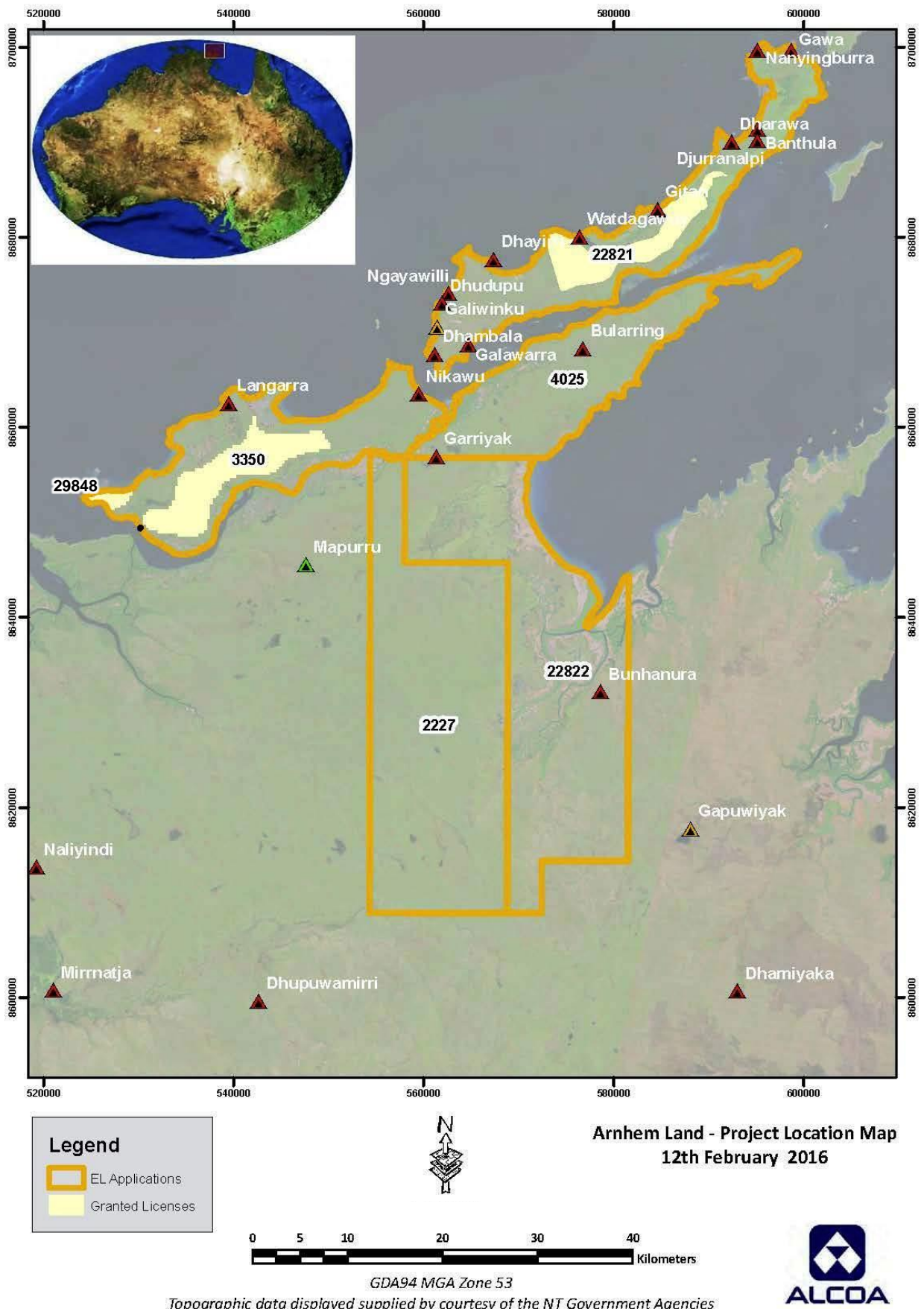
Geologically, Elcho Island and Howard Island sit in the onshore portion of the Arafura Basin. A detailed description of the geology of the Arafura Basin can be found in Rawlings (1997). Beneath cover, the geology of Howard Island is dominated by the Elcho Island Formation with limited exposure of the younger Jigaimara Formation on the north coast of the island. The surface geology of EL3350 is dominated by alluvium and residual soil that ranges from sand to silty sand. This cover masks an underlying laterite which is exposed only on coastal cliffs and sits unconformably on the sandstones and siltstones of the Elcho Island Formation. Sub-cropping siltstones and sandstones in some locations suggest that the laterite is absent in these areas.

No record of previous mineral exploration within EL3350 has been found, although the presence of laterite is noted on the drill logs of water bore drilling carried out in the 1980s. Two bauxite occurrences on the eastern side of Elcho Island, recorded by Plumb (1965), provided the impetus for exploration of Elcho and Howard Islands. The occurrences were essentially untested and Ferenczi (2001) suggested that the area "may host bauxite deposits comparable to those on Marchinbar Island".

The target of the current exploration is lateritic bauxite of marketable grade that could be added to the sea-borne market, most of which is bound for China. In this setting, the target bauxite would lie immediately below cover within the laterite profile and if present, could be up to several metres thick. The drilling programme described in this report aimed to test the thickness and grade of the bauxite without missing individual targets of approximately five million tonnes. Analysis of rock chip samples collected during a programme of reconnaissance in August 2014 indicated that the exposed laterite was ferruginous with limited potential from a bauxite perspective. Sample H002 with Av. Al<sub>2</sub>O<sub>3</sub> of 11.7% and Re.SiO<sub>2</sub> of 16.9% was the best sample recorded, but sample H001, a piece of iron rich sandstone, which returned a value of 94.1% Fe<sub>2</sub>O<sub>3</sub> was also of interest. Despite the lack of encouraging rock chip results, the drilling programme described here was believed necessary to provide a conclusive indication of the bauxite prospectivity of the drilled part of the license, and by inference, the potential for other parts of the island to host bauxite deposits (Hatch, 2016).

#### **5 EXPLORATION INDEX MAP**

The exploration index map has been plotted at 1:100,000 and is included as an attachment with the filename EL3350\_2016\_AF\_02\_IndexMap.pdf.



**Figure 1.** Location map showing license boundaries relative to Exploration License Applications

## 6 DRILLING

The initial drilling programme originally planned for the island proposed holes at 1km centres across the whole of the license area, with the aim that it should test thickness and grade of any bauxitic laterite without missing individual targets of approximately five million tonnes. In practice, the programme was limited to the northern half of the license area, where access ways and drill pads received archaeological clearance during a survey in August 2014. Drilling was completed using a tractor mounted vacuum drilling rig (see Figure 2) which was able to move relatively easily between holes without clearing. Access for support vehicles was limited to the main access track.



**Figure 2.** A tractor mounted vacuum drilling rig, of the type used, in uncleared forest

During the year, 29 vacuum holes for a total of 159.9m, were drilled in the license area. Table 1 is a summary of the drilling completed during the reporting period and the spatial relationship of all holes can be seen on the Exploration Index Map. All holes were vertical, about 45 mm in diameter and between 4.4m and 8.3m deep. The pervasive silty to sandy soil cover was not sampled, but the thickness of this overburden layer was recorded and samples were collected in 0.5m intervals from the base of overburden until the end of hole. The volume of each sample was reduced to a standardised half cup measure after two passes through a rig mounted single stage riffle splitter, before collection in a barcoded paper packet. Drill hole and sample information was recorded by the drill crew on sequentially numbered tickets that matched the identification on the sample packets.

**Table 1.** Summary of drilling completed during the reporting period.

Hole Type	Hole Number Range	No of Holes	Min. Depth	Max. Depth	Total Metres
Vacuum	HO35-62, HO64	29	4.4	8.3	159.9
<b>Grand Total</b>	-	<b>29</b>			<b>159.9</b>

Generally, holes were drilled through the laterite and two samples into the underlying sediment. A number of holes, penetrated the sediment far enough to test the thickness and grade of a haematite rich layer within it.

254 samples were collected and transported to Alcoa's Mining Laboratory at their Kwinana Refinery. The samples were oven dried and pulverised at Bella Analytical's on-site contract facility and FTIR spectra were collected. Quantitative prediction of a standard suite of 12 components was completed from the collected spectra by Alcoa's Mining Laboratory. The prediction is a computational method involving comparison of the collected spectra to reference models based on wet chemistry analysis of a significant sample set. The sample set used for calibration and validation of the FTIR prediction method originated entirely from the Darling Range, but this was considered adequate for the required indicative results. The processing of samples for FTIR analysis includes routine collection of spectra from standard reference material to confirm the stability of the process, and the preparation of duplicates for a random selection of 1% of samples. These duplicates are analysed by the reference methods. In this case, three duplicate samples were analysed for 10 of the components using the respective reference methods. Post analysis, pulverised material from all samples has been stored at the mining laboratory.

Table 2 contains a summary of analyses and the respective reference analysis methods. More detailed descriptions of the sample preparation and analysis methods are provided in Appendix 1.

**Table 2.** Summary of the standard suite and their respective reference methods

Code	Description	Formula	Unit	Method
AL	Available alumina	Av. Al <sub>2</sub> O <sub>3</sub>	%W/W	MD/ICP-MS
SI	Reactive Silica	Re. SiO <sub>2</sub>	%W/W	MD/ICP-MS
FE	Iron	Fe <sub>2</sub> O <sub>3</sub>	%W/W	XRF
CO	Carbonate	NaCO <sub>3</sub>	kg/t	BD/NDIR
EO	Organic Carbon	EOC	kg/t	BD/NDIR
OX	Oxalate	NaC <sub>2</sub> O <sub>4</sub>	kg/t	BD/GC
SU	Sulphate	Na <sub>2</sub> SO <sub>4</sub>	kg/t	
PT	Phosphate	P <sub>2</sub> O <sub>5</sub>	%W/W	XRF
ST	Silica	SiO <sub>2</sub>	%W/W	XRF
AT	Total Alumina	Al <sub>2</sub> O <sub>3</sub>	%W/W	XRF
MS	Magnetic Susceptibility		CGS	
BO	Boehmite	γ-AlO(OH)	%W/W	XRD

The sandy to silty soil cover was pervasive in the area drilled, with a thickness that ranged between 0.4m and 2m and averaged 1.1m. Below this, lateritic material encountered was generally silica rich, often clayey and a competent hardpan layer was encountered in only one drill hole. The weathered Elcho Island formation at the base of most holes presented as a mixture of iron stained quartz and clay.

A thin hematite rich layer that is likely the source of the iron rich grab sample from the August 2014 programme returned a maximum half metre value of 74% Fe<sub>2</sub>O<sub>3</sub>.

No significant bauxite mineralisation was intersected during the drilling programme with a maximum Available Alumina value of 19.0% recorded.

## 7 CONCLUSION AND RECOMMENDATIONS

Exploration drilling completed on EL3350 in November 2015 was believed necessary to properly assess the prospectivity of the northern part of the license and in doing so, better inform a decision on how to proceed in the southern half of the license. The drilling programme failed to find indications of marketable bauxite. Interpretation of these results suggests that any significant bauxite deposits that may have existed on the island have been eroded. Even in areas of the island not drilled, the elevation is believed to be too low for significant deposits of bauxite to have persisted.

On this basis, no further exploration on Howard Island is believed to be warranted and the relinquishment of the granted licence EL3350 and withdrawal of the associated application ELA29847 was recommended.

## 8 REFERENCES

Ferenczi P, 2001. Iron ore, manganese and bauxite deposits of the Northern Territory. *Northern Territory Geological Survey, Report 13*.

Hatch A, 2016. *EL3350 - Howard Island, Arnhem Land Annual report for the period ending 19/10/2015*. Alcoa of Australia Limited, Australia.

Plumb KA, 1965. *Wessel Islands-Truant Island, Northern Territory. 1:250 000 geological map series and explanatory notes, SC 53-15, 16*. Bureau of Mineral Resources, Geology and Geophysics, Australia, Canberra.

Rawlings DJ, 1997. *Arnhem Bay-Gove, SD 53-3, 4. 1:250 000 geological map series explanatory notes*. Northern Territory Geological Survey, Australia.



## **9 APPENDIX 1: ANALYSIS METHODS**

### **9.1 Sample Preparation – milling**

The samples are processed by an automated robotic system whereby they are milled to 85 % passing 180 micron in a bank of ring mills. The milled samples are then split and the retained portions deposited into plastic sample containers. These containers are 80mm in diameter and 20mm high, and hold approximately 80g to 100g. A matching bar-coded lid is printed and automatically placed on the container after scanning confirms that there is sufficient sample in the container. If there is insufficient sample, the system halts until the issue can be diagnosed and rectified by a laboratory operator. The discarded portions of the post milling splits are discarded to waste.

### **9.2 FTIR Analysis and Prediction**

The bar coded plastic sample containers are automatically fed via conveyor into the FTIR analysis area where spectra collection is also fully automated. The sample for analysis is collected by a rotating scoop then upended into a platinum crucible. It is pressed and scraped to ensure a flat and level surface, then presented to the spectrometer. A spectral profile for each sample is generated from 20 scans across the surface of the sample as it is rotated.

The FTIR spectra is compared against a set of reference grade data based upon wet chemistry analyses and from this comparison, the sample grades are predicted rather than measured using what is termed the prediction method. There is a set of approximately 700 calibration and validation (Cal Val) samples that have been used to develop the methods used for the 12 reported components.

The Cal Val samples, collected from across the Darling Range, have been run for full reference analysis and also run by FTIR and all of the spectra and reference data are used in the development of the FTIR methods.

### **9.3 EOC, CO & OX Reference Analyses**

For the reference determinations of Extractable Organic Carbon (EOC), carbonate (CO) and oxalate (OX), samples are digested in a bomb oven at 145°C in a 10ml pressure vessel bomb using 52% carbonate free caustic. The final liquor is centrifuged and diluted ready for TIC, TOC & GC analysis.

Sample determinations of TIC (carbonate) and TOC (EOC) are performed by wet oxidation. TIC is determined by measuring CO<sub>2</sub> released when a sample is acidified with Phosphoric acid. The CO<sub>2</sub> is purged from the solution and detected by a NDIR detector that has been calibrated to directly display the mass of CO<sub>2</sub> detected. After the sample is acidified and purged of TIC, sodium persulphate is added. The oxidant quickly reacts with organic carbon in the sample at 100°C to form CO<sub>2</sub>. The carbon dioxide is purged from the solution and also detected by the NDIR. The resulting mass of carbon dioxide is proportional to the mass of the TOC in the sample.

Gas Chromatography (GC) is used in the measurement of sodium oxalate (Ox) in process liquor samples, which involves a sample being vapourised and injected onto the head of the chromatographic column. The sample is transported through the column by the flow of an inert, gaseous mobile phase. The column itself contains a liquid stationary phase which is adsorbed onto the surface of an inert solid.

### **9.4 Al & Si Reference Analyses**

Available alumina and reactive silica reference determinations are conducted using ICP analysis. The samples are digested in a microwave oven using a 13% caustic solution. Internal Standard and 13% Sulfuric acid is later added to the digested solution and diluted in preparation for ICP analysis.

The ICP is used to analyse for Al and Si simultaneously using pre-prepared Av.Alumina and Reactive Silica standards. The ICP instrument works by pumping the sample from an auto sampler rack through a capillary tube into a nebuliser unit where the liquid sample is converted into a fine aerosol mist which is carried into the spray chamber. A small portion of the mist is carried into the plasma which looks visually like a flame. The sample is introduced as a mist into the plasma which excites each element to emit light at defined wavelengths. The intensity of the light emitted from each element is then compared with calibration standards to determine the concentration.

### **9.5 MS Analyses**

The sample is placed inside a magnetic coil and the frequency through the sample is measured. The difference between this and the frequency with no sample in the coil is used to calculate the magnetic susceptibility (MS).

## **9.6 BO Reference Analyses**

For the analysis of Boehmite (BO), reference samples are micronized to a fine size suitable for XRD analysis, pressed and presented to an XRD instrument.

XRD has the potential to qualitatively and semi-quantitatively estimate the main mineralogical components within a bauxite sample.

## **9.7 FE, ST, PT, SU & AT Reference Analyses**

For the reference determinations of total iron (FE), total silica (ST), total phosphorous (PT), sulphur (SU\_READING) and total alumina (AT), the sample (a mixture of flux and the unknown sample) is weighed accurately, fused in a platinum crucible and cast into a platinum mould to produce a glass disc. This disc is presented to the XRF instrument for analysis of the routine elements present. The accuracy of the XRF analysis is increased by using the fusion technique of sample preparation, in which particle size and mineralogical effects are eliminated.

## 10 APPENDIX 2: GLOSSARY OF ABBREVIATIONS AND TERMS

<b>Abbreviation</b>	<b>Description</b>	<b>Used as</b>
AHD	Australian Height Datum	Geodetic datum for altitude measurement in Australia
EL	Exploration License	Mineral title for non-extractive exploration
FTIR	Fourier-Transformed Infra-Red	Prediction method used by Alcoa
GDA94	Geocentric Datum of Australia 94	projected coordinate system for Australia
GPS	Global Positioning System	Allows reliable location information
ICP-MS	Inductively Coupled Plasma Mass Spectrometry	Analysis method
MGA	Map Grid of Australia	Coordinate system based on the UTM projection and GDA94
NDIR	Non-Dispersive Infra-Red	Analysis method for gases (CO <sub>2</sub> )
PDF	Portable Document Format	File type
XRD	X-Ray Diffraction	Semi-quantitative analysis method
XRF	X-Ray Florescence	Analysis method for major oxides