Appendix G
Radiological survey of Matilda Minerals Ltd Andranangoo Lease Melville Island, NT

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Report Title

Radiological Survey of Matilda Minerals Ltd Andranangoo Lease Melville Island, NT

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Authorized

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Executive Summary

Matilda Minerals Limited hold a mineral lease at Andranangoo Creek West on Melville Island in the Northern Territory. The lease is being developed for the extraction and concentration of mineral sand.

Long term monitoring locations were established and fitted with gamma dosimetry badges supplied by Radiation Wise Pty Ltd. Atmospheric radon monitors were not available at the time of the site visit, these will be supplied to Matilda Minerals staff for field deployment as soon as they become available.

Monitoring at Andranangoo Creek West was undertaken on the 12th and 13th of October 2005.

Based on gamma survey results, exposure of workers and members of the public to gamma radiation from current activities and proposed mining activities is generally very low and will not be higher than natural background exposure in the region.

Based on the results of soil radon flux measurements exposure of workers and members of the public to radon and radon daughters from current activities and proposed mining activities will not be higher than natural background exposure in the region.

1 Introduction

Matilda Minerals Limited hold a mineral lease at Andranangoo Creek West on Melville Island in the Northern Territory. The lease is being developed for the extraction and concentration of mineral sand.

On Site Technology Pty Ltd was engaged by URS Australia Pty Ltd to undertake a baseline gamma survey, radon soil flux measurements and to establish a number of monitoring locations for long term determination of gamma dose and atmospheric radon values.

Long term monitoring locations were established and fitted with gamma dosimetry badges supplied by Radiation Wise Pty Ltd. Atmospheric radon monitors were not available at the time of the site visit, these will be supplied to Matilda Minerals staff for field deployment as soon as they become available Expected to be at the end of October).

It was originally intended to also undertake surveys of another lease located at Lethbridge Bay West. However this work was not undertaken because of access restrictions and time limitations during the site visit.

Monitoring at Andranangoo Creek West was undertaken on the 12th and 13th of October 2005.

2 Method

2.1 Gamma Survey

The gamma survey was undertaken with a Ludlum model 19 dose rate meter (serial number 141466). The meter has been calibrated by Applied X-Ray Instrument Services according to the requirements of regulations of the South Australian Radiation Protection Act (1982). The calibration is traceable to the national standard and is valid until 7th January 2006.

Calibration establishes that the meter reads within 5% relative at the 95% confidence limit for the Cs^{137} calibration source. The dominant energy of the calibration source is 662 kev, this is close to the dominant energy of gamma radiation in the uranium decay chain (i.e. 609 kev for the Bi^{214} daughter of Rn^{222}). The calibration is considered suitable for the determination of gamma dose rate from naturally occurring uranium and thorium minerals.

The survey was conducted by taking a reading over one minute at a height of one meter above ground level. The reading was taken as the visual average of the meter deflexion over the minute reading time. The quantification limit for the meter is 0.005 μGy per hour on the most sensitive scale. The estimated error (95% confidence limit) of readings less than 0.25 μGy per hour is 0.005 μGy per hour.

2.2 Geo-referencing

All sample locations were recorded with a Garmin model GPS 76 (serial number 80304307) running Garmin version 2.04 software (ID 2770531524). The location format used was UTM UPS and the map datum was WGS 84 (equivalent to GDA 94).

The GPS software calculated the positional accuracy was in the range 4 to 8 meters in the horizontal direction. However comparison with GPS position with exploration drilling peg lines indicated that a positional accuracy of the order of 2 meters was generally achieved.

2.3 Soil Radon Flux

Soils radon flux was determined by the charcoal cup method. This method is widely used and accepted for the determination of soil radon flux.

The method involves the use of an inverted, sealed container (in this case 22 cm in diameter) to collect radon emitted from the soil surface. The radon is absorbed onto an activated charcoal trap.

The charcoal absorber is counted on a low resolution gamma spectrometer (using a 3" NaI(Tl) detector and 512 channel multi channel analyser). Radon is quantified using the 609 kev Bi^{214} photopeak. The results are corrected for radon decay during sampling, between sampling and counting and during counting to provide an average soil radon flux during the sampling period.

The low resolution gamma spectrometer is calibrated using a Canadian CRM uranium ore standard (BL-4) known to be in secular equilibrium. The calibration standard contains 214.9 Bq of radium mixed with charcoal in the same geometry as the charcoal absorption traps used in the field.

Triplicate preparation of the calibration standard indicates that the calibration error (at the 95% confidence limit) is 5% relative.

Multiple counting of blanks, standards and samples indicates that the error (at the 95% confidence limit) associated with counting, decay correction and sample handling is 10% relative with a detection limit of 0.01 $Bq/m^2/s$.

Preparation of an independent quality assurance standard with a nominal value of 185.8 Bq provided a result of 181 +/- 18 Bq. This result and the duplicates and replicates reported in Table 7 are consistent with the calibration and counting errors discussed above.

2.4 Long Term Monitoring

Long term monitoring for atmospheric radon and gamma dose is being undertaken using proprietary monitors supplied by Radiation Wise Pty Ltd. These monitors are processed by Landaur Incorporated who hold NVLP accreditation. Via a memorandum of understanding NVLP accreditation is accepted as being equivalent to NATA accreditation in Australia.

The long term monitors are;

Luxel monitors for gamma dose
Type DRNF for atmospheric radon

Matilda Minerals Ltd personnel have been instructed on the deployment and change over of the monitors. This change over will occur every three months for the next twelve months.

3 Results

3.1 Gamma Survey

Gamma survey results are provided in Tables 1 to 6 with a graphical representation provided in Figures 2 to 6. Long term monitoring locations and linear gamma survey locations are shown in Figure 1.

Location #	Location UTM WGS 84			Gamma µGy/hour	Location Description	Gamma Badge #
		mE	mN			
1	52 L	0699191	8743216	0.04	Top Soil Next to Costean 1	2969991
2	52 L	0699206	8743204	0.13	In Costean 1	2969993
3	52 L	0699286	8743402	0.05	Quaternary Strand Plain	2969992
6	52 L	0700234	8743138	0.20	In Costean 2 (edge of deposit)	2969987
7	52 L	0700228	8743114	0.09	Tertiary Plateau next to 6	2969988
8	52 L	0700135	8743456	0.04	Quaternary Strand Plain	2969989
9	52 L	0701918	8743892	0.11	In Costean	2969984
11	52 L	0701921	8743850	0.05	Top Soil Next to Costean	2969694
13	52 L	0700369	8743012	0.09	Camp Site (Tertiary Plateau)	2969986

Table 1 Gamma Dose Rate at Long Term Monitoring Locations

In Tables 2 to 6 the coloured bar to the right of the gamma readings is taken from Figure 1. Yellow represents non mineralised areas, red represents mineralised areas and green represents low lying wet areas.

UTM WGS 84		Gamma µGy/hour	
mE	mN		
698414	8742996	0.070	
698416	8743018	0.070	
698420	8743040	0.055	
698439	8743062	0.040	
698442	8743078	0.040	
698439	8743098	0.040	
698439	8743118	0.030	
698448	8743142	0.035	
698448	8743166	0.025	
698438	8743188	0.020	
698423	8743210	0.020	
698419	8743228	0.020	
698420	8743250	0.025	
698426	8743272	0.030	
698425	8743300	0.025	

Table 2 Gamma Readings for Survey 1

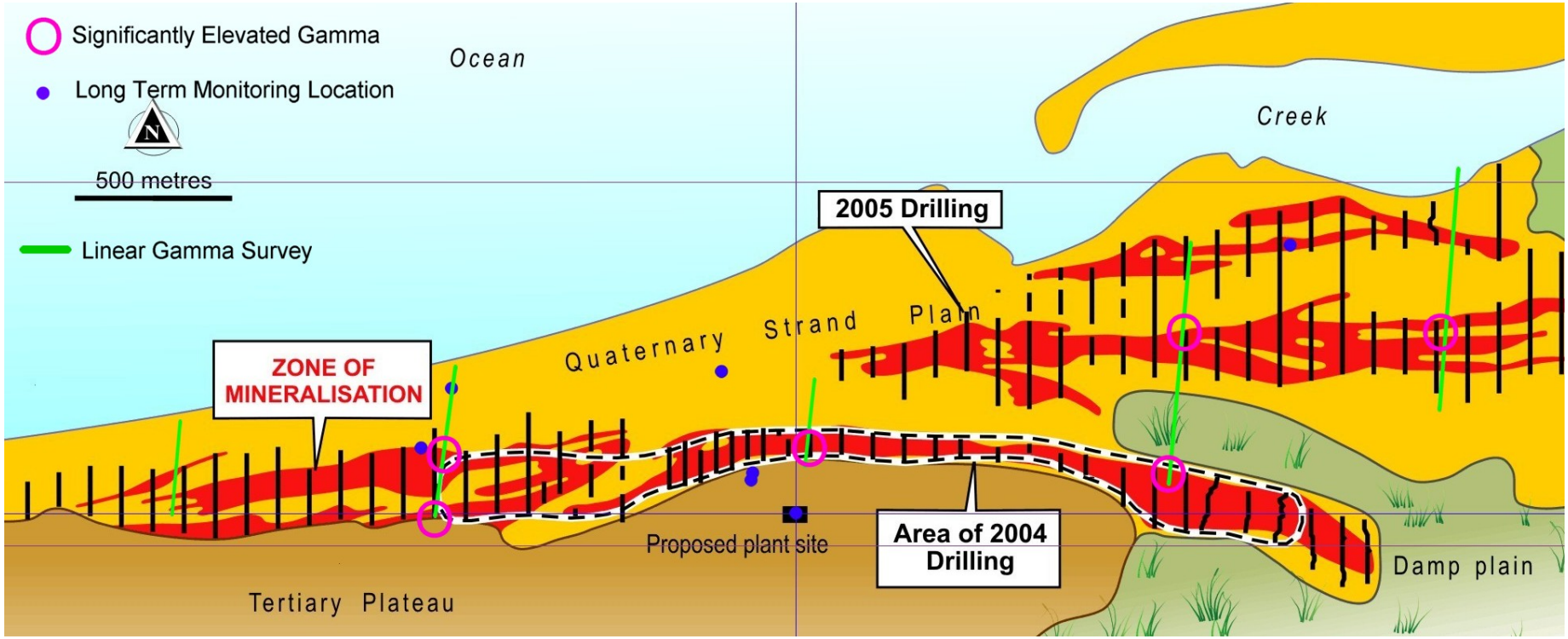

Figure 1 Monitoring Locations, Andranangoo Creek West

UTM WGS 84		Gamma μGy/hour
mE	mN	
699312	8742994	0.100
699312	8743014	0.110
699306	8743036	0.100
699306	8743058	0.080
699238	8743080	0.060
699302	8743102	0.050
699305	8743124	0.050
699305	8743150	0.065
699306	8743172	0.170
699306	8743196	0.130
699303	8743218	0.080
699300	8743244	0.080
699299	8743266	0.055
699302	8743288	0.040
699302	8743314	0.040
699305	8743336	0.040
699298	8743358	0.035
699301	8743404	0.040
699285	8743444	0.050
699278	8743470	0.130

Table 3 Gamma Readings for Survey 2

UTM WGS 84		Gamma μGy/hour
mE	mN	
700418	8743148	0.070
700415	8743166	0.100
700405	8743198	0.130
700399	8743220	0.160
700401	8743236	0.180
700402	8743256	0.085
700402	8743272	0.070
700399	8743294	0.050
700403	8743322	0.070
700412	8743336	0.060
700413	8743356	0.040
700416	8743366	0.035
700421	8743396	0.035
700436	8743430	0.035

Table 4 Gamma Readings for Survey 3

UTM WGS 84		Gamma μGy/hour
mE	mN	
701575	8743092	0.080
701587	8743114	0.100
701594	8743134	0.110
701605	8743164	0.120
701613	8743188	0.065
701619	8743212	0.090
701617	8743232	0.060
701610	8743262	0.050
701610	8743292	0.040
701604	8743312	0.040
701600	8743326	0.055
701599	8743338	0.070
701597	8743362	0.065
701599	8743386	0.055
701602	8743420	0.055
701610	8743440	0.030
701617	8743466	0.040
701623	8743488	0.050
701622	8743510	0.050
701615	8743534	0.065
701605	8743558	0.055
701599	8743586	0.360
701599	8743610	0.130
701599	8743624	0.050
701598	8743652	0.055
701593	8743670	0.030
701588	8743692	0.035
701580	8743716	0.030
701573	8743738	0.035
701569	8743758	0.040
701567	8743784	0.040
701564	8743802	0.040
701560	8743814	0.060
701551	8743834	0.055
701545	8743854	0.040

Table 5 Gamma Readings for Survey 4

UTM WGS 84		Gamma μGy/hour
mE	mN	
702401	8743322	0.025
702405	8743338	0.030
702407	8743364	0.030
702412	8743386	0.030
702418	8743402	0.040
702412	8743422	0.065
702412	8743448	0.040
702412	8743470	0.045
702412	8743486	0.060
702412	8743508	0.080
702412	8743528	0.075
702412	8743550	0.150
702412	8743570	0.220
702412	8743594	0.100
702412	8743612	0.210
702412	8743636	0.055
702412	8743658	0.040
702412	8743682	0.025
702412	8743704	0.030
702412	8743724	0.045
702412	8743742	0.065
702419	8743764	0.030
702416	8743784	0.025
702419	8743806	0.025
702413	8743828	0.020
702412	8743850	0.025
702412	8743872	0.040
702416	8743894	0.040
702421	8743916	0.085
702429	8743934	0.040
702439	8743956	0.030
702445	8743976	0.030
702450	8743998	0.050
702453	8744020	0.055
702458	8744042	0.055
702461	8744066	0.045
702462	8744088	0.040

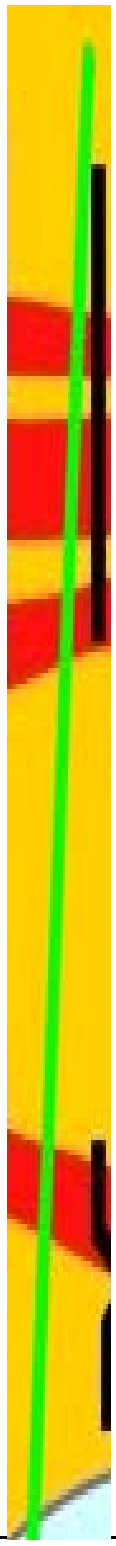

Table 6 Gamma Readings for Survey 5

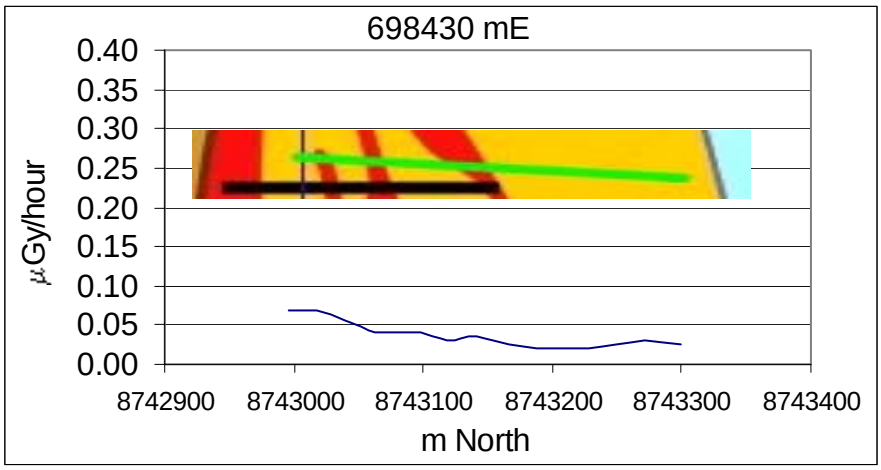

Figure 2 Gamma Survey 1

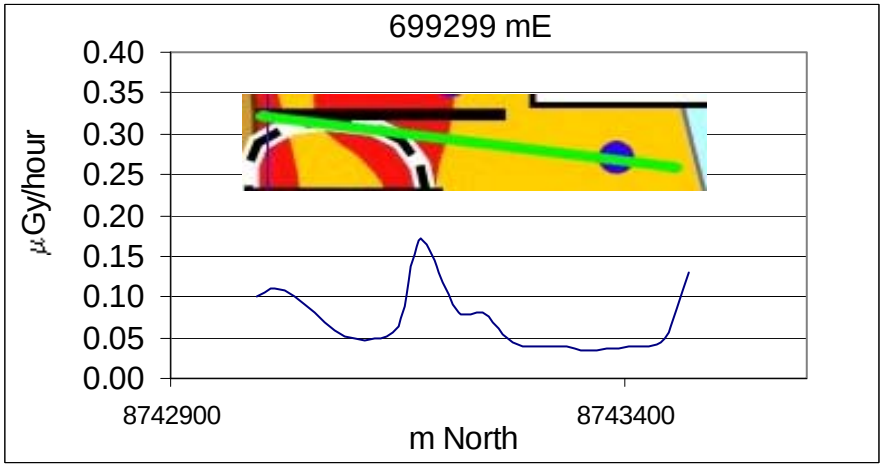

Figure 3 Gamma Survey 2

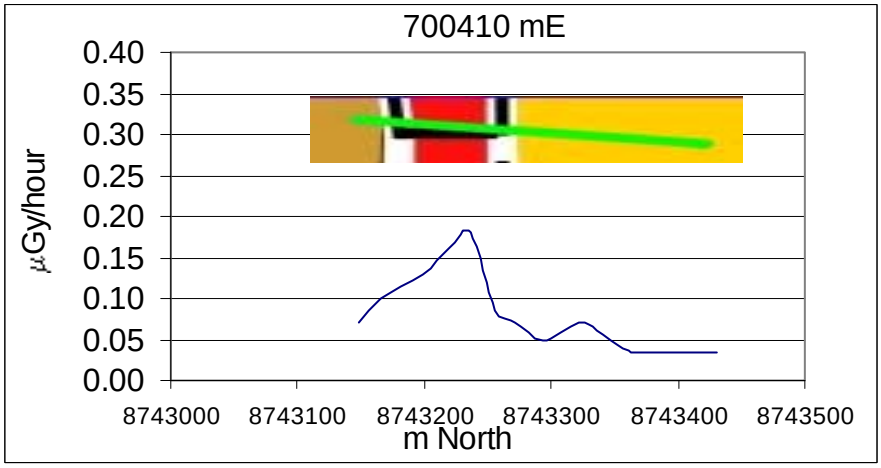

Figure 4 Gamma Survey 3

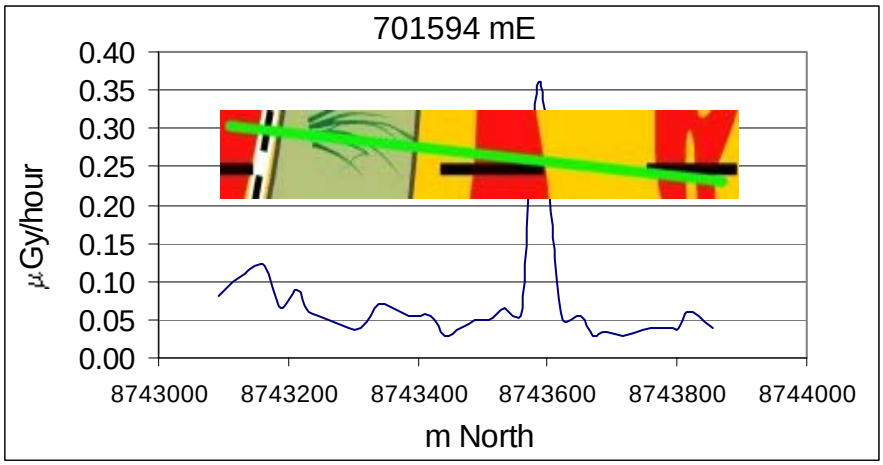

Figure 5 Gamma Survey 4

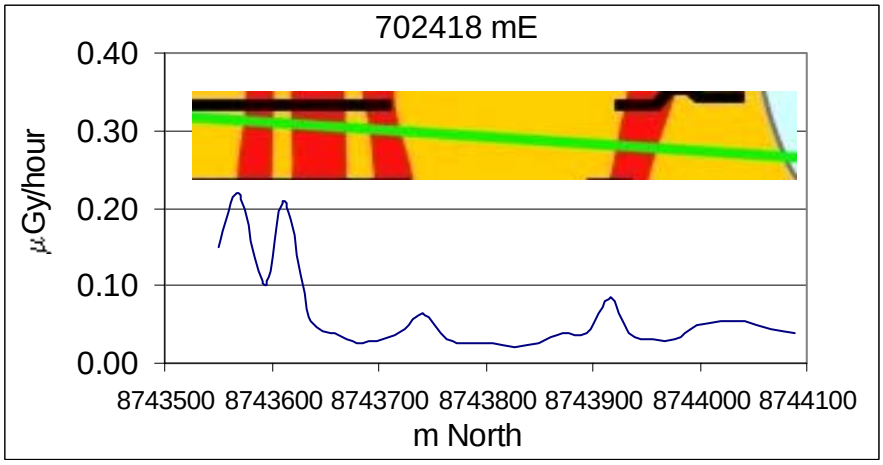

Figure 6 Gamma Survey 5

A statistical summary of the gamma survey results is provided in Table 7. The Table provides the average, standard deviation and 95% lower and upper confidence limits as numerical data and the 95% confidence interval as a bar chart at the right side.

Area Description	Dose Rate µSv/hour				95% CI
	Average	Std Dev	95% LCL	95% UCL	Graph
All undisturbed areas	0.06	0.05	0.00	0.16	
Non Mineralised areas	0.04	0.01	0.01	0.07	
Mineralised areas	0.09	0.06	0.00	0.20	
Low Mineralised areas	0.06	0.02	0.02	0.09	
High Mineralised areas	0.15	0.06	0.02	0.20	
In Costeans	0.15	0.05	0.05	0.24	

Table 7 Summary of Statistical Results for Gamma Dose Rate

A number of conclusions can be drawn from the gamma survey data, particularly the statistical data presented in Tables 1 and 7.

At the 95% confidence limit there is no significant difference between areas that have been identified as mineralised and those identified as non mineralised. There are some mineralised areas with higher gamma activity (depicted as O in Figure 1), however there is little statistical reason to treat these as a separate data sub set.

There is an elevated gamma dose rate (compared to background) in the costeans, where the mineral bearing sand has been exposed. This elevation is also evident at the coast in locations where black sand has been concentrated and exposed by wind and wave action.

When considering the average annual dose that may be received by various groups the following factors have been used;

For the local population, the background dose rates in the lease area are probably typical of all areas on the island. Based on the data for all undisturbed areas in Table 7 the average background dose is estimated to be 0.53 mSv per year (95% upper confidence limit 1.4 mSv per year).

For workers currently engaged in exploration and other pre mining activities the occupational dose is estimated to be 0.44 mSv per year (95% upper confidence limit 0.73 mSv per year). This estimate is based on a 2 week on 1 week off roster with a 12 hour working day and includes a dose rate of 0.06 μSv per hour while working and a 0.09 μSv per hour while at the camp. While these estimated doses are considered occupational because they would not be received except for the working environment they are comparable to the normal background dose that would be received anywhere in Australia.

For mining operations, where the mineralised sand will be exposed, occupational exposure is estimated to be slightly higher with an average of 0.70 mSv per year (95% upper confidence limit 0.96 mSv per year). These estimates are based on the same working regime discussed above and assume the worker spends all working hours in close proximity to the exposed mineral bearing sand.

The occupational exposure estimates discussed above are considered over estimates because they include exposure while at the mining camp. Even considering this over estimation the dose rate received by current employees and expected to be received by those future employees engage in mining activities are low compared to the 1 mSv maximum permitted for members of the public and are considered typical of the normal background dose received in Australia.

The estimated annual dose rates are comparable with normal background radiation exposure in the Australian environment. For example typical backgrounds in Adelaide vary from 0.80 to 1.3 mSv per year. Typical backgrounds in Darwin based on measurements taken on 14th October range from 0.50 to 1.0 mSv per year.

Evaluation of estimated exposure for those future employees engaged in operation of the heavy mineral concentrator, waste disposal, product handling and product shipping have not been included in this report. However, the zircon concentrate to be produced at the proposed operation will contain of the order of 150 ppm uranium and 200 ppm thorium. Based on

typical mineral sand industry operations with concentrates having higher uranium and thorium content it is considered unlikely that occupational exposure at the proposed operation will exceed 5 mSv per year for any worker.

3.2 Soil Radon Flux

Soil Radon Flux results are provided in Table 8. Sampling locations are shown as Long Term Monitoring Locations in Figure 1.

Sample	Location UTM WGS 84			Flux	Location Description
		mE	mN	$Bq/m^2/s$	
0		not applicable	not applicable	<0.01	Trip Blank
1	52 L	0699191	8743216	0.01	Top Soil Next to Costean 1
2	52 L	0699206	8743204	<0.01	In Costean 1
2R				<0.01	Recount of Sample 2
3	52 L	0699286	8743402	0.01	Quaternary Strand Plain
6	52 L	0700234	8743138	0.01	In Costean 2 (edge of deposit)
7	52 L	0700228	8743114	0.04	Tertiary Plateau next to 6
7R				0.02	Recount of Sample 7
8	52 L	0700135	8743456	0.01	Quaternary Strand Plain
9	52 L	0701918	8743892	<0.01	In Costean
10	52 L	0701918	8743892	<0.01	Duplicate of 9
11	52 L	0701921	8743850	0.01	Top Soil Next to Costean
12	52 L	0701921	8743850	<0.01	Duplicate of 11
13	52 L	0700369	8743012	0.02	Camp Site (Tertiary Plateau)
blank		not applicable	not applicable	<0.01	Equipment Blank

Table 8 Soil Radon Flux Results

The data set for soil radon flux is relatively small but there is some clear conclusions that can be drawn form it.

There is no statistically significant difference between the radon flux in the costeans (3 locations with exposed mineral sands), the surface soil adjacent to the costeans (2 locations above the mineralisation) or the quaternary strand plain (2 locations not over mineralisation). For statistical analysis purposes these seven locations can be treated as the same data sub set.

There is a statistically significant difference between the locations on the tertiary plateau and all other locations. It can be stated with greater than 95% confidence that the tertiary plateau locations (95% confidence interval 0.01 to 0.04 $Bq/m^2/s$) have a higher soil radon flux than at other locations (95% confidence interval 0.00 to 0.01 $Bq/m^2/s$).

The significance of this is that the dominant regional source of radon is the tertiary plateau irrespective of the mineralisation being exposed or not. It can be concluded that the proposed mining operation at Andranangoo Creek West will not significantly impact on regional or local atmospheric radon levels.

Under these conditions exposure of workers and members of the public to radon and radon daughters from current activities and proposed mining activities will not be higher than natural background exposure in the region.

It is possible that mineral processing activities may impact on local atmospheric radon levels because the uranium containing minerals will be separated and subjected to mechanical processing. This possibility is not considered likely because the proposed HMC Separator will be operated in a well ventilated open environment and because radon is generally not an environmental or occupational concern in other Australian mineral sand operations. In any case the radon flux from stockpiled heavy mineral concentrate and tailings and the atmospheric radon and radon daughter activity will be measured as part of the operational monitoring program. The operational monitoring program will be undertaken for the first year of operation, the program will then be reviewed and evaluated to decide if ongoing monitoring is required and what form such monitoring should take.

3.3 Long Term Monitoring

At the time of preparing this report no long term monitoring results were available.

Long term passive gamma monitors were deployed on 12th October 2005 and will be collected for analysis at the end of February 2006.

Long term passive radon monitors will be deployed at the end of October 2005 and will be collected for analysis at the end of February 2006.

Both sets of monitors will be replaced in February 2006 with a set due for collection at the end of May 2006.