HASTINGS
Technology Metals Limited

APPENDIX 5-4

Baseline Radiation Report

Baseline Radiation Report

Hastings Technology Metals Limited
Yangibana Rare Earths Project

Prepared by Radiation Professionals

HAS150225_Baseline Report_2016

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Executive Summary

Hastings Technology Metals Limited (Hastings) proposes to develop the Yangibana Rare Earths Project (the Project), which is located in the upper Gascoyne region of Western Australia, approximately 220 km north-northeast of Gascoyne Junction and 450 km north east of Carnarvon by road.

Exploration activities at the project have defined a number of discrete resources, and the site will be developed to include open pit mines for each resource and common beneficiation and hydrometallurgical plants. Separate waste storage facilities will be installed for specific waste streams from each plant. Ancillary infrastructure, including accommodation village, airstrip, power generation and water supply will also be developed.

The Project is expected to mine approximately one million tonnes per annum (tpa) of ore and 8 million tpa of waste rock. The ore contains approximately 0.90 % total rare earths oxides (TREO). The processing plant is expected to produce approximately 12,880 tpa of rare earths (RE) product, which will be exported to a separation plant overseas.

The ore contains naturally elevated concentrations of uranium and thorium, and is therefore subject to radiological assessment.

The exploration activities of the Project have been operating under relevant approvals, including an approved radiation management plan. Monitoring commenced at the Project site in 2014. Monitoring initially focused on occupational exposures of personnel engaged in exploration programs and was expanded to include environmental baseline monitoring in 2015. Monitoring programs are ongoing and are expected to continue through further exploration, construction and commissioning to operation.

This report provides an assessment of the radiation baseline monitoring to date. The information is used in the radiological assessment of the proposed project.

As further data is collected from the monitoring, it will be used to complement the existing database and further characterise the naturally occurring levels in the region. It is not expected that the results will change the conclusions and management actions determined from monitoring to date provided in the radiation assessment.

A summary of the information presented in this report is as follows:

- Background radiation levels in the region are elevated, but are consistent with radiation levels at other Australian mining operations targeting materials that are associated with naturally elevated concentrations of radionuclides.
- Elevated levels are associated with outcropping mineralisation, which contains elevated concentrations of naturally occurring uranium and thorium.
- Ongoing baseline monitoring will continue as the project develops.

Scope

The aim of this report is to collate and summarise the baseline (and other) radiation monitoring data that has been conducted to date at the Yangibana site and to provide comment on the relative levels.

This report forms part of a wider radiological assessment of the proposed project.

The report also provides context on radiation protection and cover the following areas:

- A summary of the proposed project.
- Background to naturally occurring radioactive material and its regulation.
- A summary of the principles of radiation protection.

The baseline and other monitoring data is then summarised and compared to levels at other similar locations around Australia.

Characterising the naturally existing baseline radiation levels in a region is important for the following reasons:

- To demonstrate that radiation levels are naturally present.
- To understand the variability in those levels.
- To determine areas of potential radiological significance.
- To identify the potential for impact of any sources of radioactivity in the process.
- To provide background data against which to monitor and assess any changes that may happen in the radiological environment of the project area.
- To provide information for closure.

This document summarises the outcomes of baseline monitoring programs to-date using data available at the time of publishing.

Approach to Radiation Protection

System of Radiological Protection

The International Commission on Radiological Protection (ICRP) is the preeminent international authority on radiation protection. The ICRP establishes a radiation protection philosophy and has developed a "system of dose limitation", which includes guidance and recommendations that are universally adopted. The International Atomic Energy Agency (IAEA) then develops standards and codes of practice for application in practice. Many of the IAEA documents adopted verbatim in law in countries around the world. In Australia, the ICRP and IAEA documents form the basis of national guidance and state regulation.

The ICRP philosophy is based on three key features as follows:

1. Justification - Any decision that alters the radiation exposure situation should only be adopted if the benefits outweigh the risks associated with the exposure;
2. Optimisation - The likelihood of incurring exposure, the number of people exposed, and the magnitude of their individual doses should all be maintained as low as reasonably achievable (ALARA), taking into account economic and societal factors (the ALARA principle); and
3. Limitation - Radiation doses to individuals should not exceed recommended limits.

By applying this system, exposure scenarios may be managed effectively with minimal potential for harm to any individuals and to the environment.

Dose Limits

Radiation dose limits apply to project originated exposures and do not include exposure from natural background or medical exposures.

Dose limits are recommended by the ICRP and are adopted by Australian and Western Australian legislation, which takes into account the exposure to different forms of radiation and different exposure pathways. The unit of effective dose is the Sieverts (Sv).

Dose limits applicable to the Project are:

- Annual limit to a radiation worker of 20 mSv per year; and
- Annual limit to a member of public of 1mSv per year.

A dose of up to 50 mSv may be received by a worker in a single year, as long as their annual dose does not exceed 20mSv per year when averaged over any five-year period.

Legislative Framework

Materials that are defined as radioactive are subject to regulation for the purposes of radiation protection.

In Western Australia, a material is defined as radioactive under the Radiation Safety (General) Regulations (1983), when the prescribed activity concentration exceeds 0.03 $MBq.kg^{-1}$ (30 $Bq.g^{-1}$). This value applies to the total activity of all radionuclides present in a material. For mined materials containing both naturally occurring uranium and thorium, it can reasonably be assumed that the uranium and thorium decay chains are in secular equilibrium. This means that the activity concentrations of the decay products in the uranium and thorium decay chains are equal.

The average thorium and uranium content of the ore is approximately 450ppm and 24ppm respectively, which is equivalent to activity concentrations of approximately 1.8 and 0.3 $Bq.g^{-1}$ per radionuclide, respectively. However, radionuclides are predicted to concentrate in certain parts of the processing and exceed the prescribed activity concentration.

It should be noted that the national guidance provided by ARPANSA defines radioactive materials as materials with activity concentrations that exceed 1 $Bq.g^{-1}$ for each radionuclide.

The project is therefore required to comply with the appropriate radiation protection legislation.

Relevant state and federal legislative requirements include:

Radiation Safety Act 1975 (WA)

Radiation Safety (General) Regulations 1983 (WA)

Radiation Safety (Qualifications) Regulations 1980 (WA)

Radiation Safety (Transport of Radioactive Substances) Regulations 2002 (WA)

Mines Safety and Inspection Act 1994 (WA)

Mines Safety and Inspection Regulations 1995 (WA)

Australian Radiation Protection and Nuclear Safety Act 1998 (C'th)

Applicable codes and guidelines (both state and national) include:

Code for the Safe Transport of Radioactive Material (ARPANSA, 2014)

Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA, 2005)

Fundamentals for Protection Against Ionising Radiation (ARPANSA, 2014)

National Directory for Radiation Protection(ARPANSA, 2014)

Managing naturally occurring radioactive material (NORM) in mining and mineral processing — guideline (2nd edition)(DMP, 2010)

Australian Drinking Water Guidelines Paper 6 (NHMRC and NRMMC, 2011).

Workplace exposure standards for airborne contaminants (Safe Work Australia, 2013)

Project Description

Location

The Project is located in the Upper Gascoyne Shire in Western Australia, approximately 900 km north of Perth and 450 km east-northeast of Carnarvon ('as the crow flies'; Figure 1). The Project mining tenure area covers approximately 650 square kilometres. The tenements are located on Wanna Station, which is managed in conjunction with the neighbouring Gifford Creek Station.

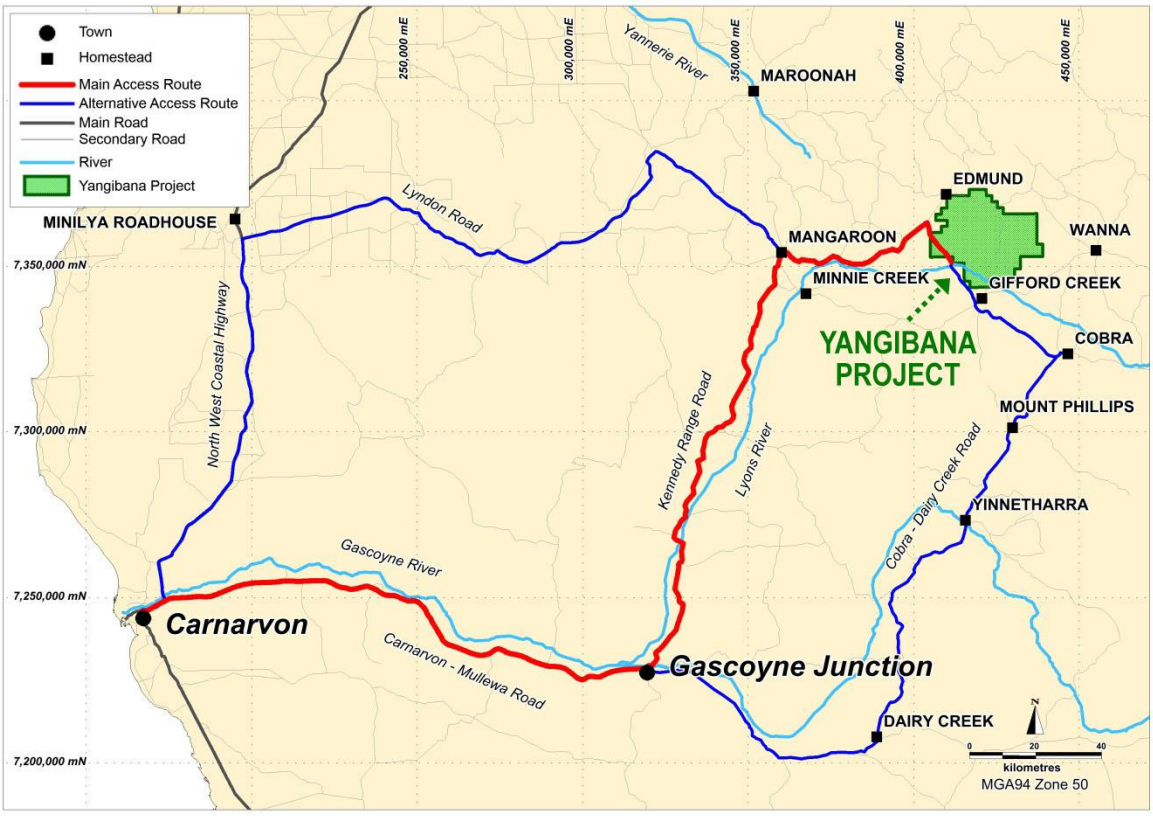

Figure 1: Yangibana Rare Earths Project Location

Geology

The site is mostly arid and the surface is sand interspersed with rock outcrops. The outcrops are predominantly granites although the mineralisation presents as outcropping ironstone. Intermittent and ephemeral stream beds cross large areas of the site, linking larger waterways.

The area was initially explored in the 1970s for base metals before rare earths targets were identified and targeted in the 1980s. Hastings acquired an interest in the project and commenced its own exploration on site in 2014.

Subsequent exploration and drilling programs have established JORC resources at a number of deposits, and the current total JORC resource estimate exceeds 12 million tonnes at 1.10% total rare earths oxides (TREO).

The Project covers a cluster of deposits found in the local Pimbyana and Yangibana Granites, which are being assessed for economic recovery of rare earths elements. The initial targets are a series of ferrocarbonatite/ironstone veins in which the rare earths are found predominantly in the rare earths phosphate mineral monazite.

Monazite contains low-levels of naturally occurring thorium and some uranium. Like other similar deposits, it is likely that the thorium is associated with and probably contained within the mineralisation which hosts the rare earths elements. A less significant uranium content is broadly associated with the local granites (Radiation Professionals, 2016).

Based on resource estimations the overall average values for the mineralisation within the Yangibana Project is 25ppm U_3O_8 and 450ppm ThO_2 (Radiation Professionals, 2016).

A detailed description of local lithology along with estimated average composition of mineralised and non-mineralised material is given in the Radiation Waste Characterisation Report (Radiation Professionals, 2016).

Environment

The region is at the southern edge of the tropical zone and temperatures are warm for most of the year. Annual rainfall in the area is generally low, but tropical events to the north cause water to flow through the site, raising the height of rivers and creeks and limiting access at some crossings. During wetter months (approximately December until May) the larger rivers and creeks in the area swell and ephemeral waterways make access roads to the project site impassable for brief periods.

Local vegetation is mainly scrub with tussock grasses, spinifex and mulga dominating the open areas and larger eucalypts lining larger waterways. The current land use is pastoral and the tenements lie within the cattle grazing rangelands of Gifford Creek Station.

The following relevant environmental studies should be read in conjunction with this report to gain a further understanding of the environment:

- Vegetation and Flora Assessment (Ecoscape, 2016a);
- Terrestrial Fauna Assessment (Ecoscape, 2016b);
- Subterranean Fauna Assessment (Ecoscape, 2016c);
- Soils Assessment (Landloch, 2016a);
- Waste Characterisation (Landloch, 2016b; Trajectory and Graham Campbell and Associates 2016);
- Air Quality Assessment (Pacific Environment 2016);
- Conceptual Hydrogeological Assessment (Global Groundwater 2016); and
- Surface Water Assessment (JDA 2016).

Description of Operations

Current Exploration Activities

Hastings acquired its initial interest in the Project in 2014 and embarked on a series of drilling programs to define and extend the resources. Typically, these programs have run for a period of several weeks to several months with a single reverse circulation (RC) drill rig operating for each program and a limited amount of supplementary diamond core drilling.

Site access is mainly via station tracks with access to drill sites being cleared by earthmoving equipment on an as needs basis under DMP Program of Works approvals and an Exploration Radiation Management Plan (RMP; approved by DMP Resources Safety). Radiation management has occurred in accordance with the approved RMP.

Monitoring during exploration has shown that 1) doses to personnel are low, and 2) that exploration activities have not caused release of radioactive material to the surrounding environment. Radiation levels associated with the target mineralisation are higher in comparison to nearby locations off the mineralisation, which is anticipated. This has a small effect on the annual dose to personnel conducting

targeted exploration drilling in the near vicinity of the mineralisation, but not to the degree where further controls from those described in the RMP are warranted.

Proposed Future Operations (Construction, Mining and Processing)

The Project consists of a series of discrete but linked prospects. The planned operation will include conventional open cut mining of these prospects, initially at the areas named as Bald Hill and Fraser's. Each open pit will have an adjacent waste rock landform, mainly consisting of overlying granites removed for access to the target mineralisation. Mined ore will be hauled by road to a run of mine (ROM) pad adjacent to the processing plant.

The on-site processing plant will treat up to one million tonnes per annum (tpa) of mineralised material and include two separate processing circuits. The first circuit will be the beneficiation circuit in which ore will pass through crushing, grinding and flotation to produce mineral concentrate. For an input of one million tpa, this circuit will produce approximately 30 000 tpa of concentrate. This circuit will produce the majority of the waste (approximately 930 000 tpa from rougher flotation) which will be sent to a Tailing Storage Facility (TSF 1), and an additional 37 000 tpa from secondary flotation, which will be sent to another TSF (TSF 2). The liquid fraction of the waste from this circuit will be recycled for use in the process.

Following thickening and filtration, mineral concentrate generated by the beneficiation plant (approximately 30 000 tpa) will be sent to the hydrometallurgical plant. The concentrate will undergo sulfation bake in a kiln followed by water leach, which will bring the target rare earths into solution. Magnesium oxide will be used to neutralise the solution, and the residue separated from the solution by filtration. The residue will undergo further chemical treatment before being sent to a separate TSF (TSF 3) (approximately 56 000 tpa). The leach liquor containing the rare earths in solution will be purified before the rare earths are precipitated as rare earths product (approximately 12 800 tpa) and the remaining effluent (approximately 480 000 m^3 per annum) is sent to an evaporation pond.

Concentrations of radionuclides will increase with each stage of the process, and wastes will contain sufficient radioactive material to fulfil regulatory criteria for material requiring control and compliance (described further in the Radiation Waste Characterisation Report by Radiation Professionals, 2016).

A conceptual layout for the proposed operation (Figure 2) indicates operational areas, infrastructure and transport routes.

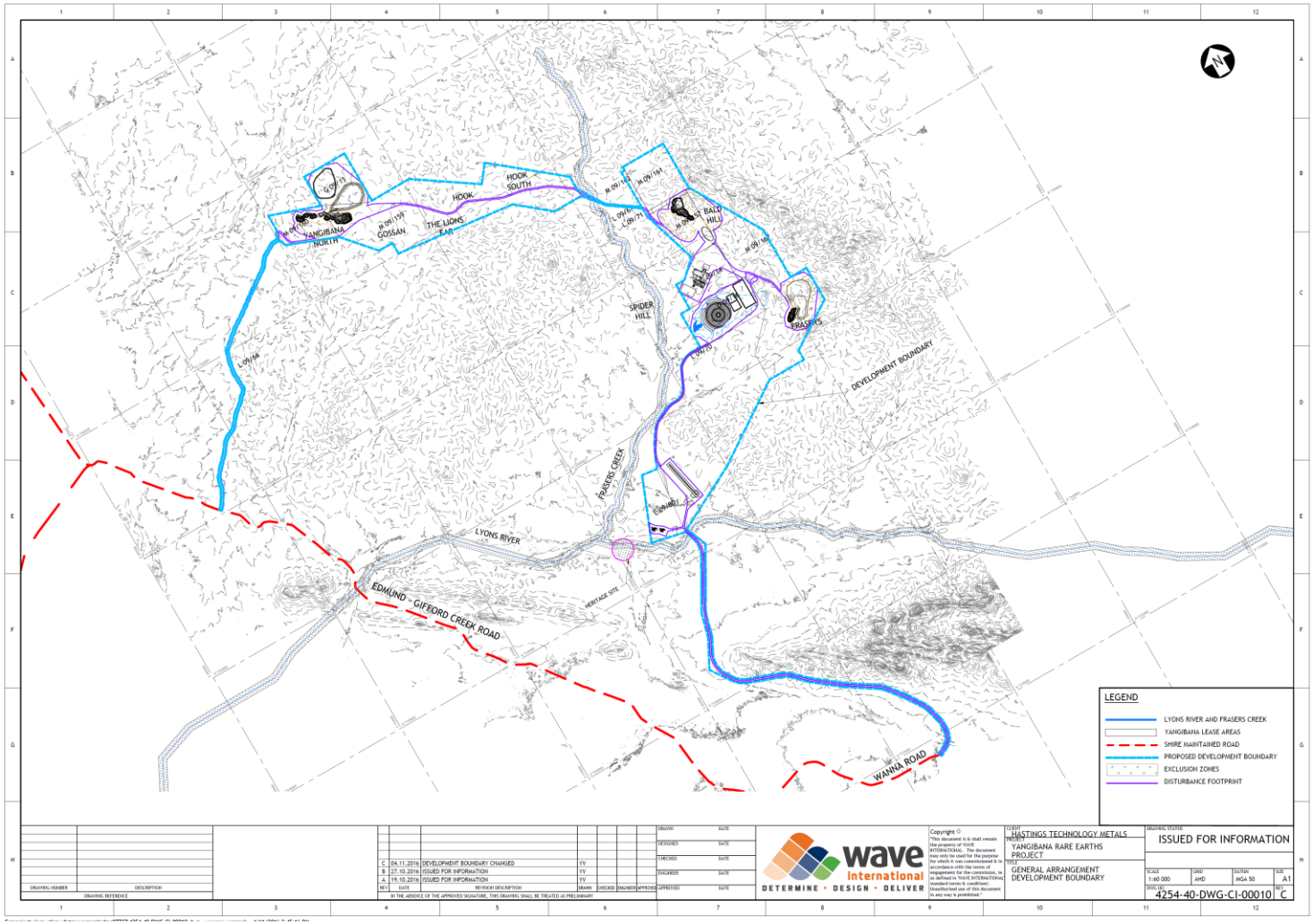

Figure 2 Conceptual Site Layout

Background Radiation

Radiation is ubiquitous – it comes from the food and water that we ingest, the air we breathe, the Earth itself and from cosmic sources.

While radiation is universal it varies widely at different locations due to differing geological characteristics.

Radiation dose may be measured in Gray (Gy) which refers to absorbed dose in air. It may also be measured in Sieverts (Sv), which refers to effective dose and relates to dose to the whole body. Survey data in this report will be given in Gray, while dose estimation for the critical group will be made in Sieverts.

The accepted value for global average annual radiation dose from all background sources is 2.4 mSv per year, with a range from 1.0 – 13 mSv per year (UNSCEAR 2008). These values are compiled from global data and are consistent with levels observed in Australia (see ARPANSA web site for more information).

Gamma radiation levels are highly variable and dependent on soil concentrations of naturally occurring radionuclides, predominantly uranium, thorium and potassium, and their decay products. It is commonly observed in measurement that dose rates at uranium, mineral sands and rare earths projects are higher than dose rates in areas without known radionuclide presence. Published gamma radiation levels at other mine sites are shown in Table 1.

Table 1 Average Gamma Levels of other Mining Projects with Naturally Occurring Radioactive Materials in Australia

Company - Project, Reference (year published)	Average Gamma Levels (μSvh^{-1})
Toro Energy – Lake Way (on deposit), PER (2011)	0.9
Toro Energy – Lake Way (off deposit), PER (2011)	0.1
Cameco – Yeelirrie (on deposit), PER (2015)	0.85
Cameco – Yeelirrie (off deposit), PER (2015)	0.09
Vimy Resources – Mulga Rock, PER (2015)	0.06 (no surface outcrop)
Arafura Resources – Nolans Bore (on deposit), EIS (2015)	0.8
Arafura Resources – Nolans Bore (off deposit), EIS (2015)	0.25
Australian national average (inferred from ARPANSA, 2005)	0.07

For environmental gamma radiation, a factor of 0.7 is applied to Gray for conversion to Sieverts (UNSCEAR, 2008).

The global average concentration of uranium in soil is approximately 3 ppm, and approximately 10 ppm for thorium (UNSCEAR 2008). Analytical results show that the average concentrations for the Project are higher than global averages. This results in elevated gamma radiation levels as well as radon and thoron concentrations, which are gases generated in the uranium and thorium decay chains.

Radon (Rn_{222}) comes from the uranium decay chain and has a half-life of approximately 3.8 days, while thoron (Rn_{220}) is a different isotope of radon coming from the thorium decay chain. Thoron has a much shorter half-life of 55.6 seconds. Radon and thoron contribute to the inhalation dose by their rapid decay to a series of short lived, alpha emitting progeny, which deliver an internal exposure.

Radon and thoron concentrations in air may be expected to be higher in areas with enhanced radionuclides, but tend to be very dependent upon atmospheric conditions. Concentrations in air are highly variable and are known to show both annual variation due to changes in emanation rates with varying soil moisture as well as diurnal variation. In colder months, night time temperatures drop and create stable atmospheric conditions leading to a build-up in gas concentrations.

Natural radon concentration is variable, with a worldwide average of 10 $Bq.m^{-3}$ (UNSCEAR, 2000). Values in Australia vary and published data from other mine sites can be seen in Table 2.

Table 2 Average Radon and Thoron Concentrations at Mining Projects in Australia

Company – Operation, Reference (year published)	Radon Concentration ($Bq.m^{-3}$)	Thoron Concentration ($Bq.m^{-3}$)
Toro – Lake Way (on deposit), PER (2011)	38	n/a
Toro – Lake Way (regional), PER (2011)	21	n/a
Vimy Resources – Mulga Rock , PER (2015)	25	n/a
Arafura Resources – Nolans Bore (on deposit), EIS (2015)	28.9	120.3
Arafura Resources – Nolans Bore (regional), EIS (2015)	43.7	470.2

It should be noted that thoron concentrations are not generally monitored by uranium operations, as these operations typically have low levels of thorium and corresponding low levels of thoron.

Australia has a long involvement with the mining and processing of radioactive material in the uranium, mineral sands and rare earths industries. The methods for monitoring and measuring radiation are established, and compliance with the robust regulatory framework ensures that exposures to personnel and releases to the environment can be controlled to levels far below those associated with any risk.

Baseline Radiation Levels

Radiation studies at the Project commenced in 2014 (undertaken by Radiation Professionals) with the initial focus on occupational monitoring to satisfy the requirements of the exploration RMP. In 2015, environmental baseline monitoring commenced. This work included both continuous monitoring and static monitoring. Continuous monitoring is used to identify potential diurnal or seasonal variation and static monitoring occurs when levels change relatively slowly or infrequently (for example once off surveys).

The environmental monitoring programs have been implemented to coincide with ongoing occupational monitoring programs during exploration programs. Surveys have been completed over areas that are significant to the operation, prior to any disturbance of local conditions.

The baseline data includes:

- Gamma radiation.
- Radionuclides in dust.
- Radon and thoron concentrations.
- Radionuclides in soil.
- Radionuclides in water (surface and groundwater).

This report is based on data collected in monitoring programs, which have been running for at least 12 months. Monitoring on site is ongoing, and this report will be updated to include any relevant baseline results as they become available. Data is also available in the Yangibana Rare Earths Project Annual Radiation Reports. Results of monitoring conducted by Radiation Professionals are tabulated in Appendix 1.

A number of permanent monitoring locations have been established for passive environmental monitors. At these locations, gamma (via TLD's), passive radon and passive thoron concentrations are measured.

Monitoring sites were selected to cover as much of the project area as possible (Figure 10 and Figure 12). Twelve additional passive monitoring locations have been selected (for monitoring commencing in May 2016) to provide further coverage across the project area. These monitoring stations host radon, thoron and gamma monitors, and were utilised as locations for the majority of airborne dust sampling.

Radiation studies have been aligned where possible to the recommendations of NORM Guideline 3.1 *Pre-operational Monitoring Requirements (DMP 2010*).

Gamma Radiation

Baseline gamma radiation levels have been determined via three methods; handheld instrument gamma surveys, integrating monitors and interpretation of an aerial radiometric survey.

Ground Survey

Monitoring was conducted using ThermoFisher Scientific Radeye GX Survey Meters paired with MC-71 environmentally compensated Geiger Muller (GM) detectors mounted at a height of one meter above the surface. Readings were integrated over one minute, with three measurements taken at each survey point to determine a representative average.

Most project areas (including Bald Hill and Fraser's deposits and the areas designated for development as the processing plant and accommodation facilities) were surveyed at a grid spacing of 100m. The survey grid spacing was increased to 200m over the area of the airstrip due to the low and uniform gamma dose rates observed, as well as the low potential for operational contamination. A total of 416 readings were obtained.

Some Project access roads were surveyed at intervals of approximately 2000m (Figure 7). These results are incorporated in the value for Background locations. As the Project footprint is further refined, surveys will be conducted of all roads and tracks within the Project area.

Results are summarised in Table 3.

Table 3 Ground Gamma Survey

Location	Average ($uGy.h^{-1}$)	Maximum ($uGy.h^{-1}$)	Minimum ($uGy.h^{-1}$)	Number of locations
Bald Hill (over mineralisation)	0.41	1.15	0.19	129
Fraser's (over mineralisation)	0.31	1.26	0.20	65
On Deposit (combined)	0.37	1.26	0.19	194
Processing Plant Area	0.22	0.35	0.18	140
Accommodation Facilities Area	0.25	0.34	0.19	28
Airstrip Area	0.21	0.42	0.16	30
Off Deposit (combined)	0.23	0.42	0.16	198
Other (Background)	0.20	0.24	0.15	24
Other (Exploration)	0.29	0.42	0.22	47

Additional gamma radiation surveys will be conducted over other areas of the project prior to commencement of works.

The monitoring shows that gamma radiation levels are elevated above mineralisation as expected, which is associated with the outcropping ironstone. Average gamma radiation dose rates are 0.23 $\mu Gy.h^{-1}$ in areas away from the outcropping mineralisation, and dose rates averaging 0.37 $\mu Gy.h^{-1}$ over the deposits ranging up to 1.26 $\mu Gy.h^{-1}$. Note that a conversion factor of 0.7 $Sv.Gy^{-1}$ (UNSCEAR, 2008) is applicable when considering the results of monitoring and actual dose rates.

Figure 3 to Figure 8 present the data graphically, showing the variation across the surface for each of the surveys.

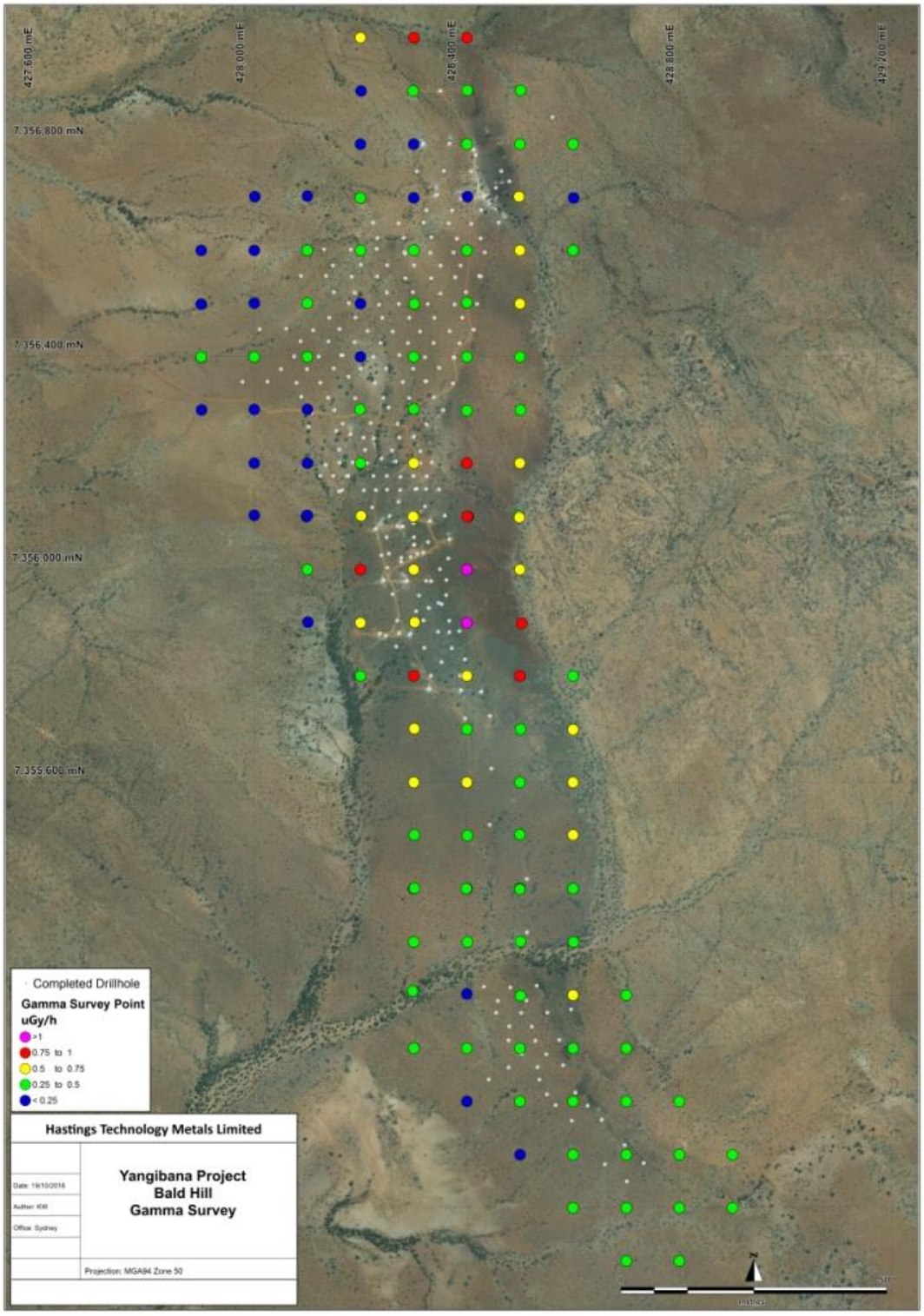

Figure 3 Ground Survey of Bald Hill Deposit (2016)

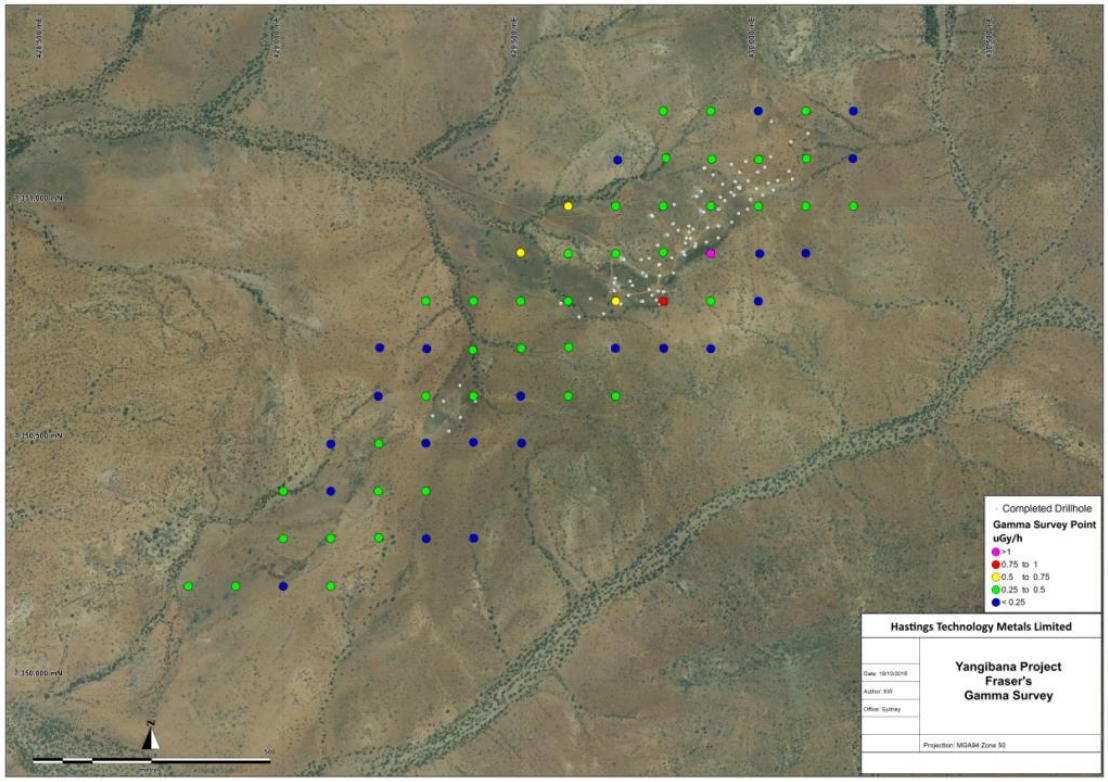

Figure 4 Ground Survey of Fraser's Deposit (2016)

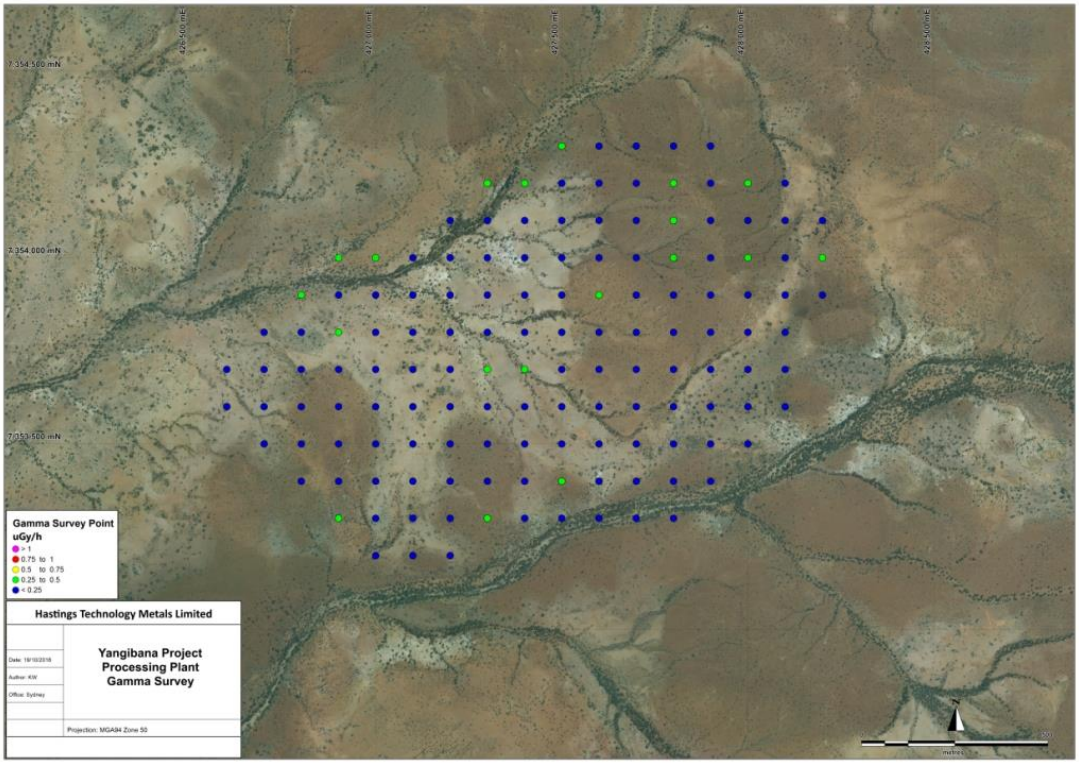

Figure 5 Ground Survey of Proposed Processing Plant Site (2016)

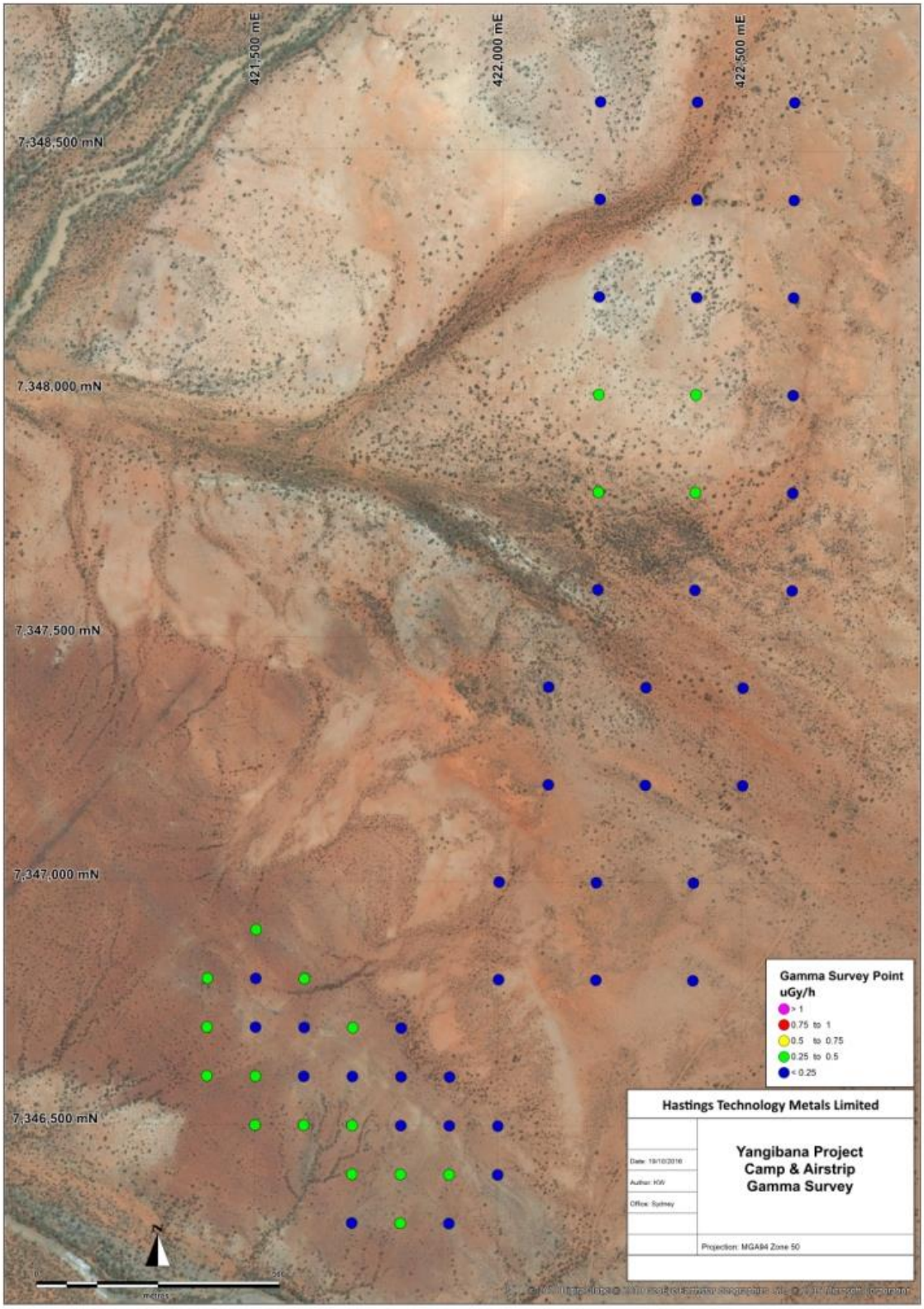

Figure 6 Ground Survey of Proposed Accommodation Camp and Airstrip Locations (2016)

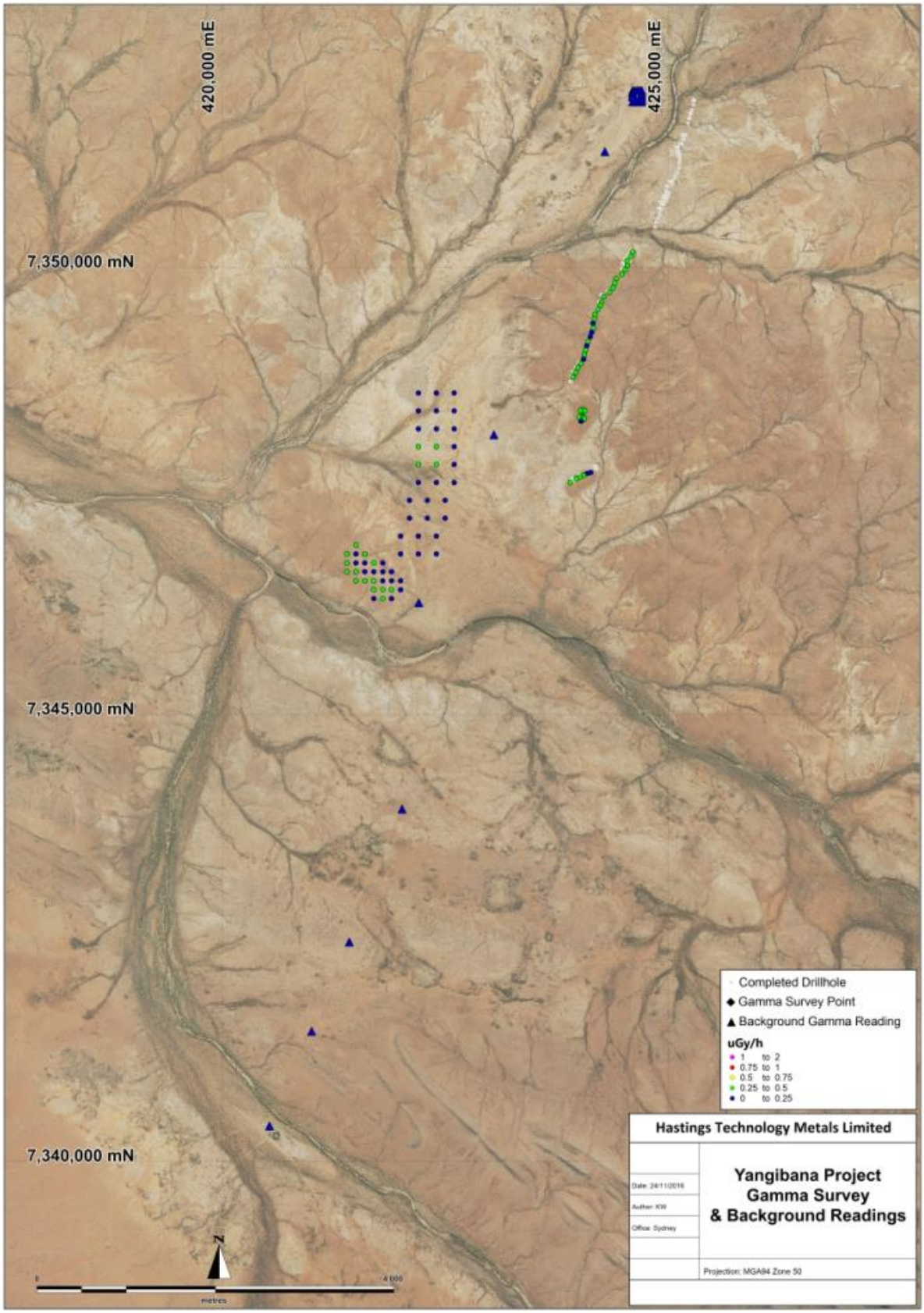

Figure 7 Ground Survey of Background Locations (2016)

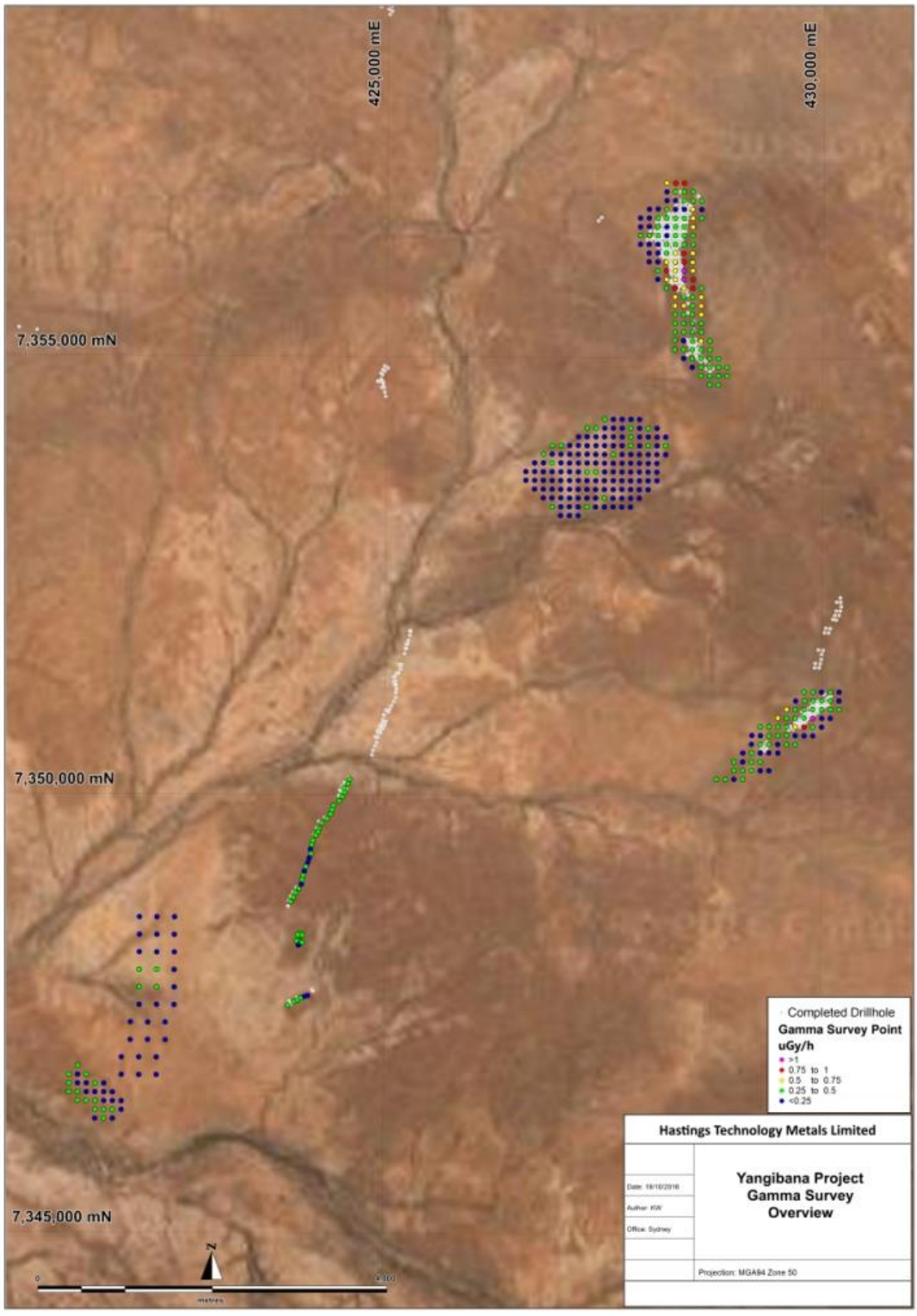

Figure 8 All Ground Survey Results (2016)

Aerial Radiometrics

Aerial geophysical surveying was conducted in 2016, which included radiometrics. Figure 9 provides a pictorial summary of the results. Note that aerial radiometrics measured the gamma radiation from radionuclides in the uranium and thorium decay chains, along with gamma from potassium 40 and cosmic radiation.

The data has been provided for contextual purposes rather than for qualitative analysis and shows the wide variation in natural gamma radiation levels in the region. The higher gamma radiation levels (in the redder colours) are associated with the outcropping ironstone.

Care should be taken to avoid direct comparison of the magnitude of results in each survey, as the measurement techniques and survey geometry vary significantly between the two techniques. General agreement can be seen between the ground survey and the aerial radiometric survey results, with the radiometric map showing higher counts over areas of mineralisation, and lower counts over the areas proposed as sites for the processing plant, accommodation village and airstrip. The indication that the radiological profile of the site is largely defined by the presence and concentration of naturally occurring radionuclides in mineralised material is also shown by the map of results from the ground survey.

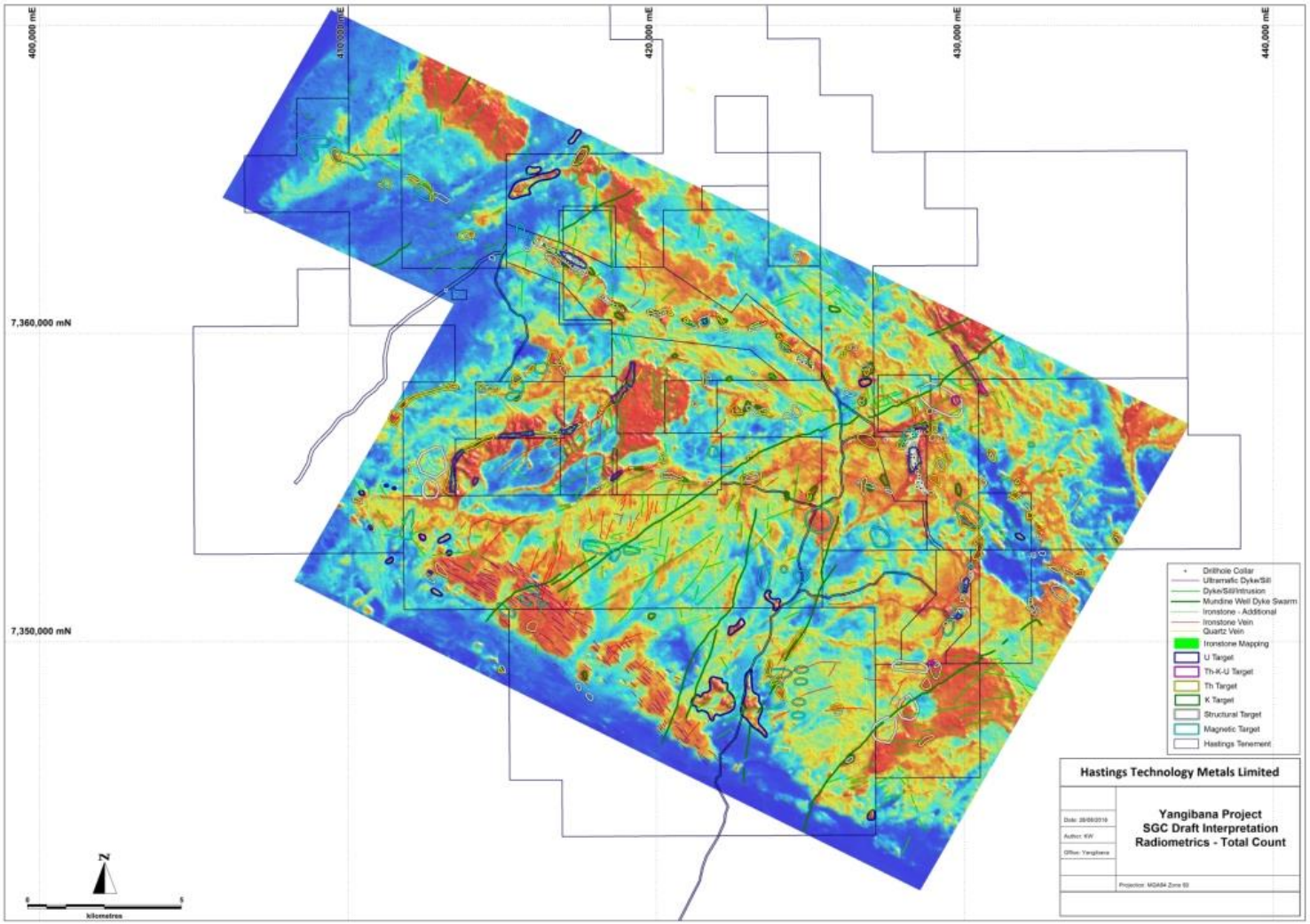

Figure 9 Aerial Radiometric Survey (SGC, 2016)

Positional Gamma

A program of monitoring gamma radiation at the passive monitoring locations using Thermoluminescent Dosimeters (TLDs) supplied by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) Personal Radiation Monitoring Service (PRMS) was initiated in 2015. Two locations were initially selected and the program has expanded since inception to include all passive monitoring stations (at which positional TLDs and passive radon and thoron monitors are located) (Figure 10).

TLDs at Yangibana North sample storage area and Gifford Creek Station have been in place since June 2015, while monitoring commenced at a point over the Yangibana North deposit in November 2015. The program was expanded in May 2016 to include eight additional monitoring positions around the Bald Hill and Fraser's deposits and at one location away from known mineralisation.

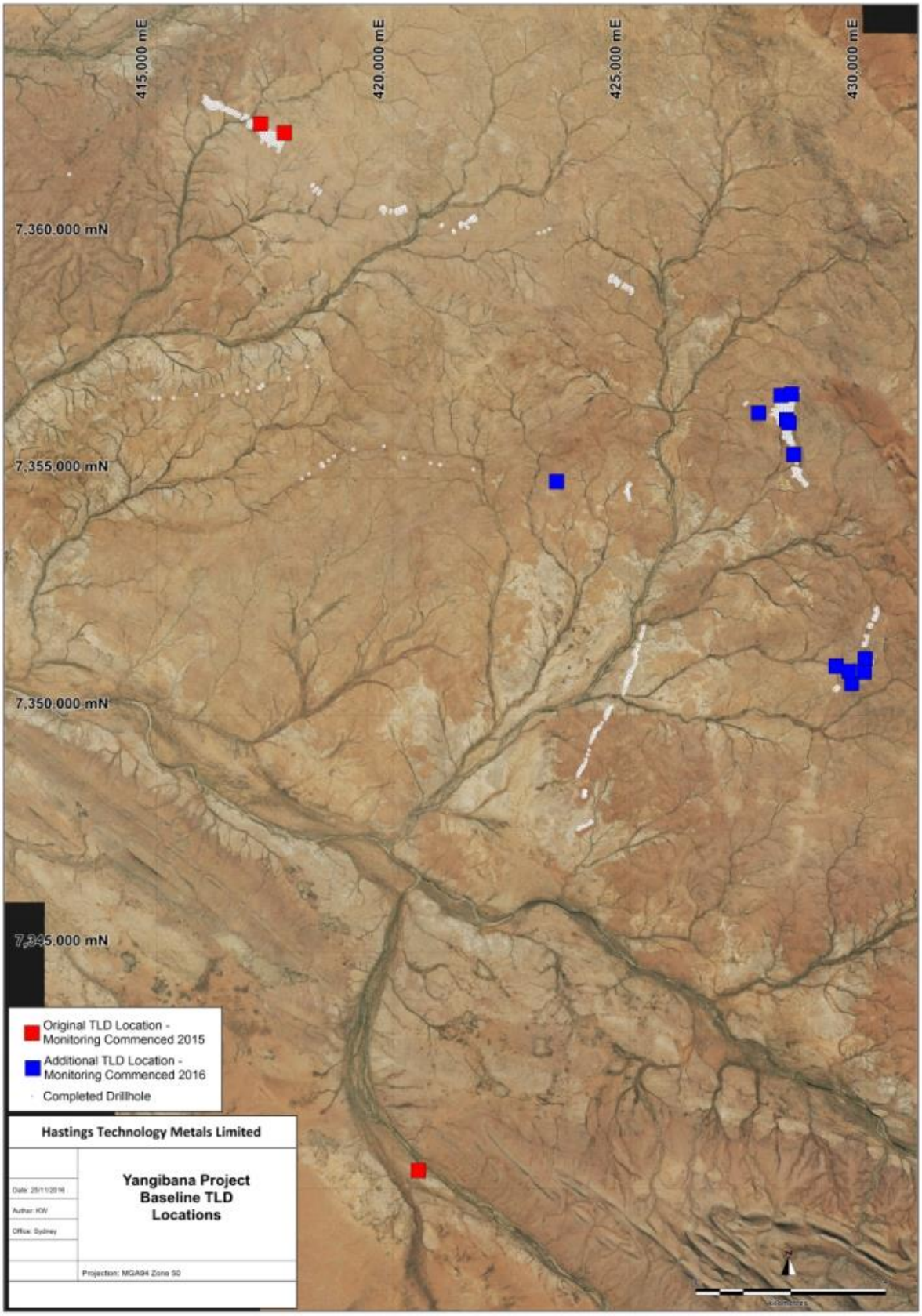

Figure 10 Locations of Thermoluminescent Dosimeters at the Project (2015 onwards)

Results are summarised in Table 4.

Table 4 Positional Gamma (TLD Badges)

Location	Average Dose Rate ($\mu Gy.h^{-1}$)
Gifford Creek Homestead	0.08
Yangibana North (adjacent sample storage yard)	0.18
Yangibana North (over mineralised area)	1.21
Bald Hill South *	0.34
Bald Hill East *	0.37
Frasers East *	0.19
Frasers South *	0.20
Frasers North *	0.18
Hatchet West *	0.14
Bald Hill North A*	0.22
Frasers West A *	0.61

*Result is based on a single monitoring period.

The positional TLDs support gamma survey data, indicating a higher dose rate over the near surface and outcropping mineralisation. The average gamma dose rates are analogous to those presented in Table 1 (Section 2) for other operations with similarly enhanced radionuclides.

Atmospheric Dusts (Long Lived Alpha Activity)

Baseline environmental dust sampling was conducted across the project area from 2015 onwards using low volume pumps (SKC AirLite and SKC Airchek 52) to collect samples over a sampling period of at least four hours. Monitoring sites were selected away from active drilling (Figure 11) to avoid sampling mechanically generated dust from mineral exploration activities.

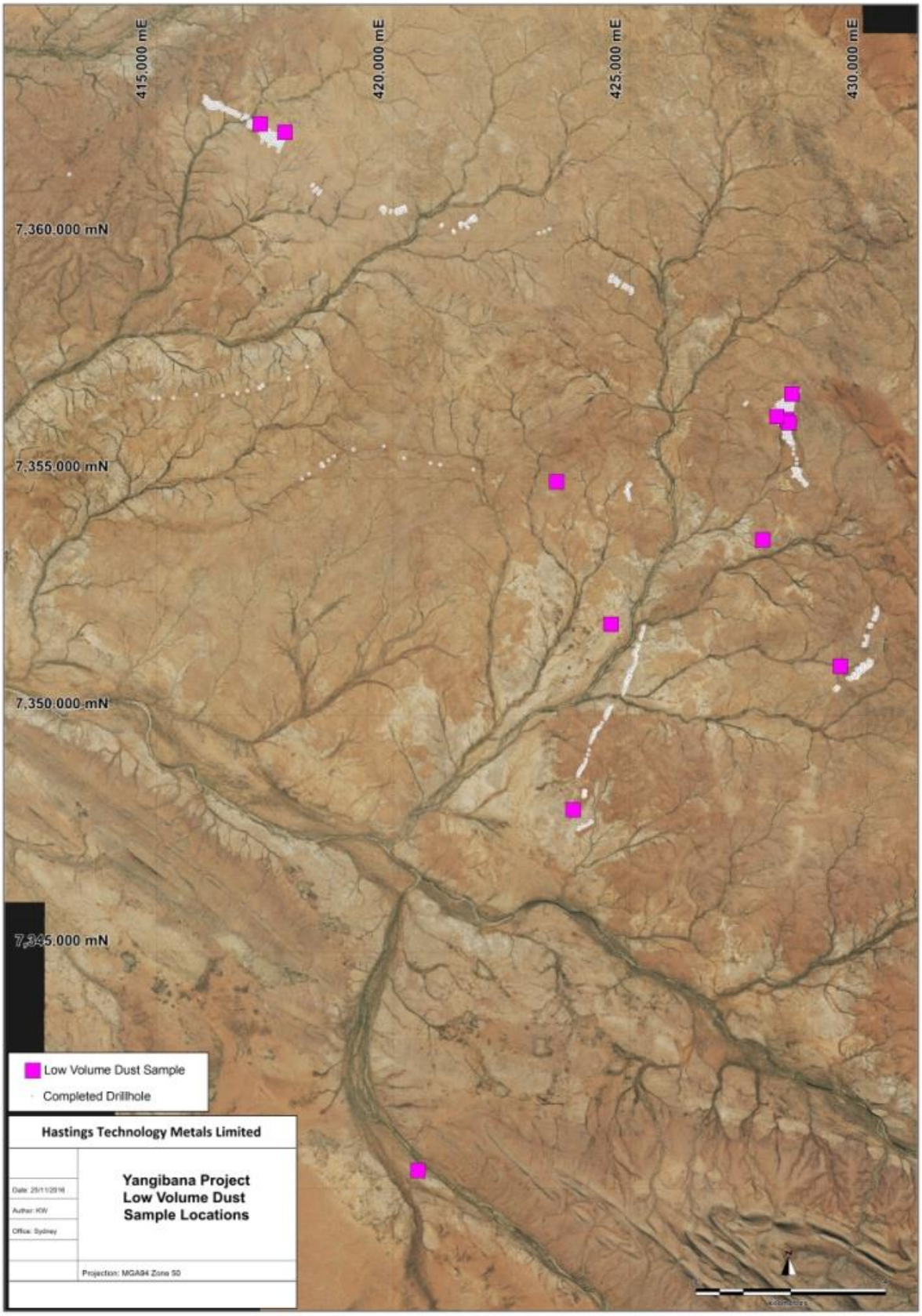

Figure 11 Low Volume Dust Sampling Locations (2015 – 2016)

Filter papers were analysed using a Ludlum 3030e/43-10-1 alpha beta sample counter system for captured long lived alpha activity (LLAA). The results of this analysis were used to determine values for alpha activity concentration in air.

Monitoring locations were generally coincident with passive monitoring points (where gamma monitoring by TLD badge and radon and thoron monitoring by passive devices is conducted). In some areas of the Project where passive monitoring has not yet been established, sampling was conducted at a representative point and located by GPS.

All filter papers returned alpha activity results below the minimum detection level (MDL; Table 5). For estimation of values for airborne alpha activity concentration, it has been assumed that any result below the MDL is equivalent to the MDL value. This is a very conservative approach, and results are clear over-estimations.

Table 5 Airborne Activity Concentration

Location	Average (adps.m^{-3})	Maximum (adps.m^{-3})	Minimum (adps.m^{-3})	Number of Samples
On Deposit	0.010	0.019	0.005	15
Off deposit	0.009	0.013	0.005	9

Results are given in adps.m^{-3}, where adps is alpha decays per second (alpha Becquerels) from airborne material captured by sampling. Airborne alpha activity concentrations are similar for all areas of the project, both over the prospects and in areas away from radiologically enhanced mineralisation.

Radon and Thoron

Radon monitoring commenced in 2015 using Landauer Radtrak devices, which were placed at four locations around the Project (Figure 12), with one pair measuring a background location at Gifford Creek Station Homestead, approximately 20 km south of the Project area. Monitors were placed in pairs, one measuring radon only and the other measuring radon and thoron. Subtraction of the radon only exposure value from the combined exposure allows measurement of both radon (Rn_{222}) and thoron (Rn_{220}) at each location. These single use devices provide a measure of the average concentration for the exposure period.

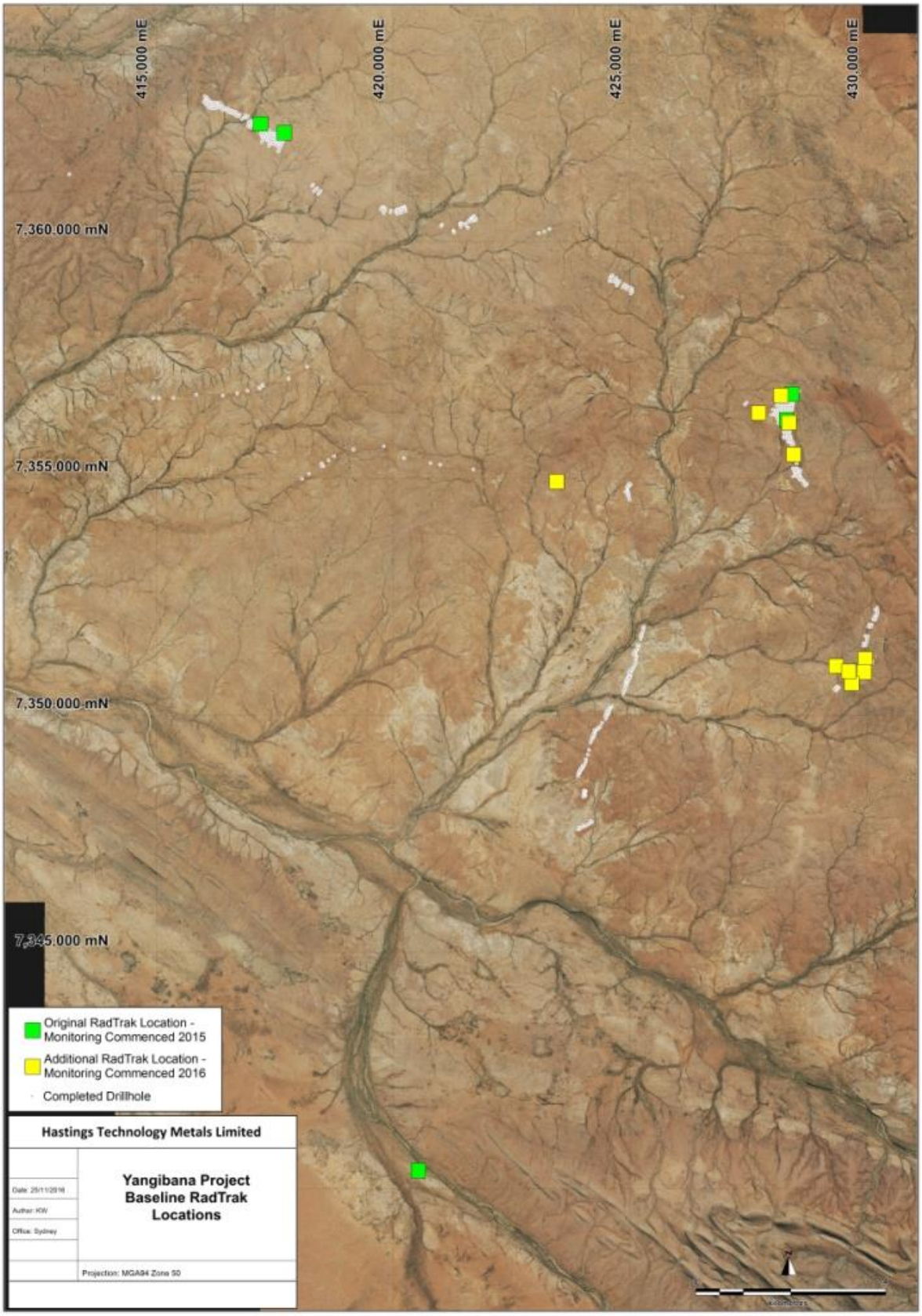

Figure 12 Passive Radon/Thoron Monitoring Locations (2015 onwards)

Monitoring was conducted with reference to:

- AS/NZS 3640: 2009 Workplace atmospheres - Method for sampling and gravimetric determination of inhalable dust;
- Guideline NORM 3.3 *Air monitoring strategies*; and
- Guideline NORM 3.4 *Airborne radioactivity sampling*.

Monitors were replaced at intervals determined by access to site, and exposure periods have ranged from 144 days up to 173 days.

Many of the radon-only monitors returned results below the minimum detection level (MDL). For estimation of values for radon and thoron concentrations, it has been assumed that any result below the MDL is equivalent to the MDL value. This approach is necessary to enable derivation of results for thoron concentration, which are determined by subtraction of the exposure of the radon only monitor from the exposure recorded by the combined radon and thoron monitor. On the advice of the supplier, a correction factor is applied to the difference in exposure values to give thoron concentration (Pearson and Spangler, 1991). This is a conservative approach and radon results (Table 6) are over-estimations, however comparison with data from real time monitoring (Table 7) indicates that the assumption is realistic.

Table 6 Passive Radon/Thoron Monitoring

Location	Average Radon ($Bq.m^{-3}$)	Average Thoron ($Bq.m^{-3}$)
Bald Hill	9.9	24.6
Fraser's	9.9	29.1
Yangibana North	10.4	16.9
Gifford Creek H.S	9.1	15.5

In addition to passive monitoring, real time monitoring was conducted using a portable radon detector (Durridge RAD7, 2010).

The RAD7 was left in the field for five runs of approximately two days each, sampling the air every 30 minutes under a user-defined sampling protocol. Radon results are summarised in Table 7, with Figures 13 - 17 giving graphical representation of each run.

Table 7 Real Time Radon Monitoring

Location	# Cycles	Run Start	Run Stop	Avg. Radon ($Bq.m^{-3}$)	Two-sigma Uncertainty*
Bald Hill South	99	08/13/16 16:01	08/15/16 17:33	14.6	1.8
Gifford Creek Homestead	97	08/17/16 15:57	08/19/16 16:23	5.04	1.1
Bald Hill Central	92	08/20/16 14:55	08/22/16 12:56	7.56	1.4
Exploration Camp	97	08/24/16 12:56	08/26/16 13:28	32.5	2.8
Accommodation Facilities Area	87	9/03/2016 16:45	09/05/16 12:05	43.8	3.4

*Standard Deviation

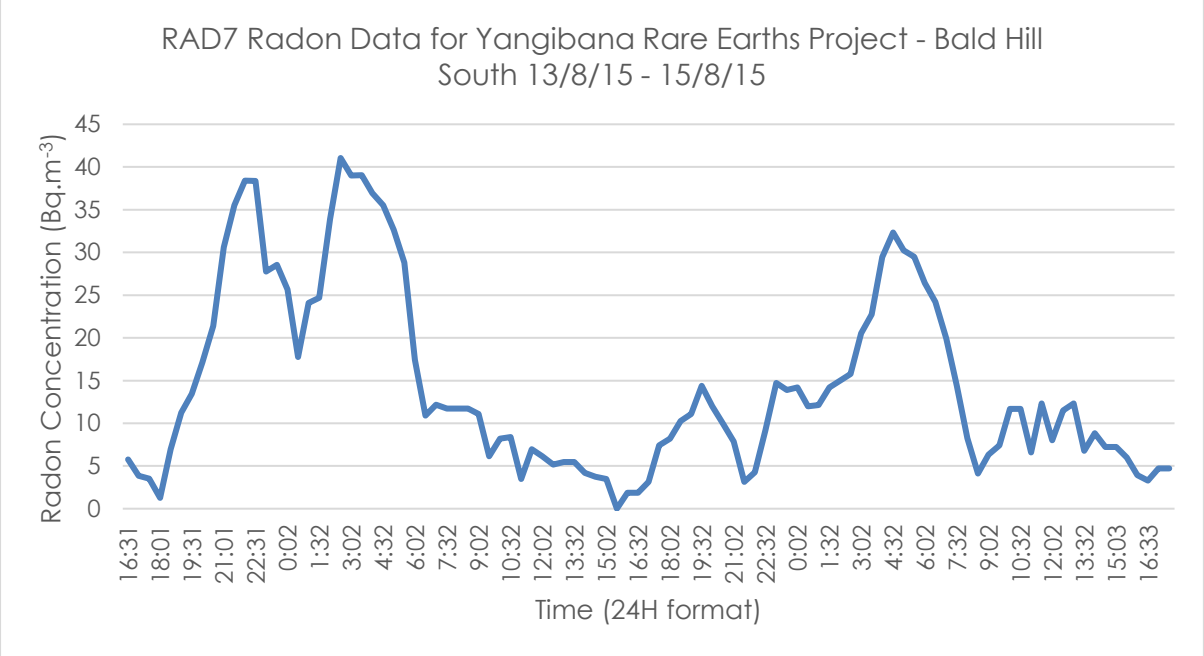

Figure 13 Real Time Radon Monitoring – Bald Hill South

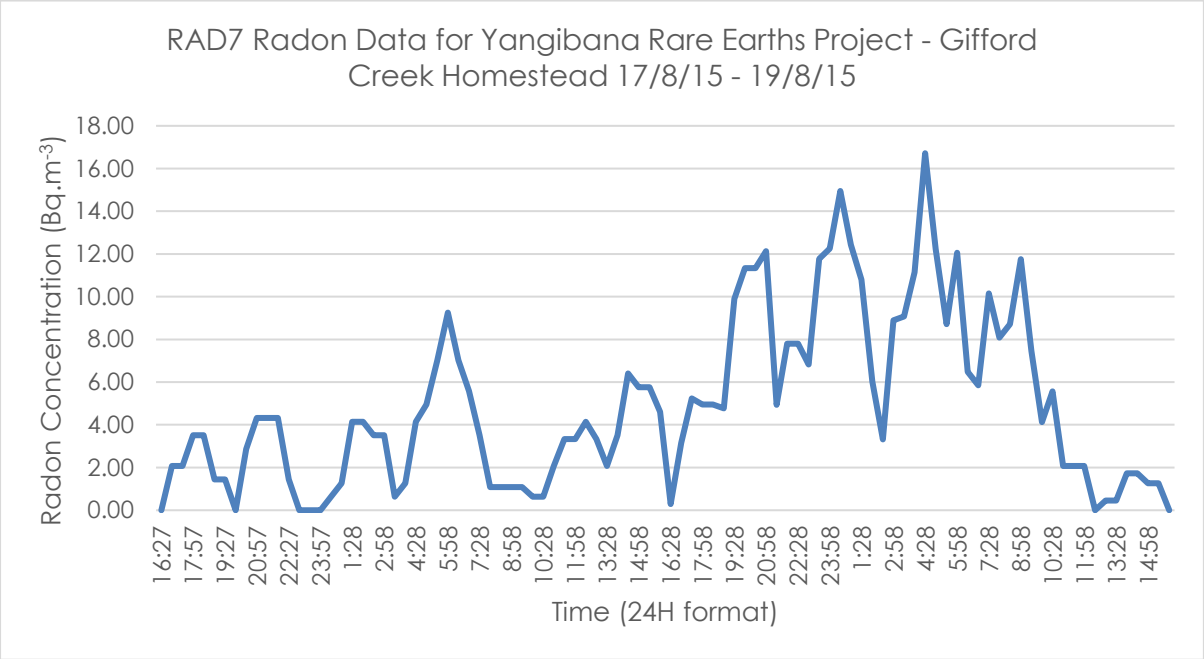

Figure 14 Real Time Radon Monitoring –Gifford Creek Homestead

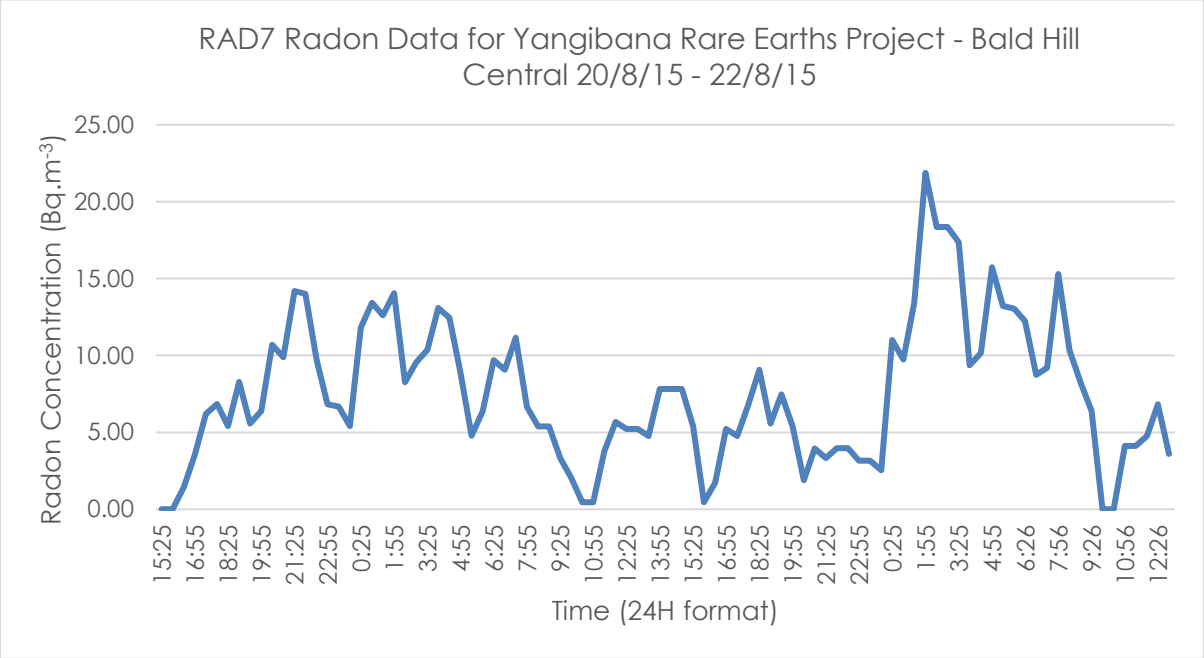

Figure 15 Real Time Radon Monitoring – Bald Hill Central

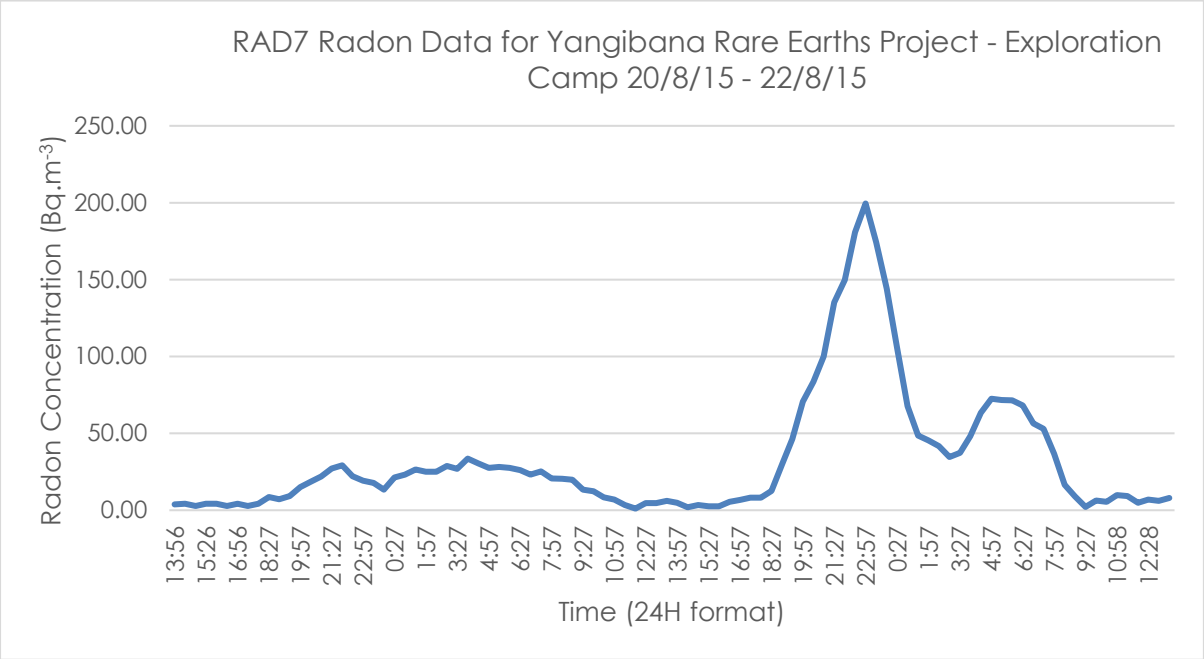

Figure 16 Real Time Radon Monitoring – Exploration Camp (2016)

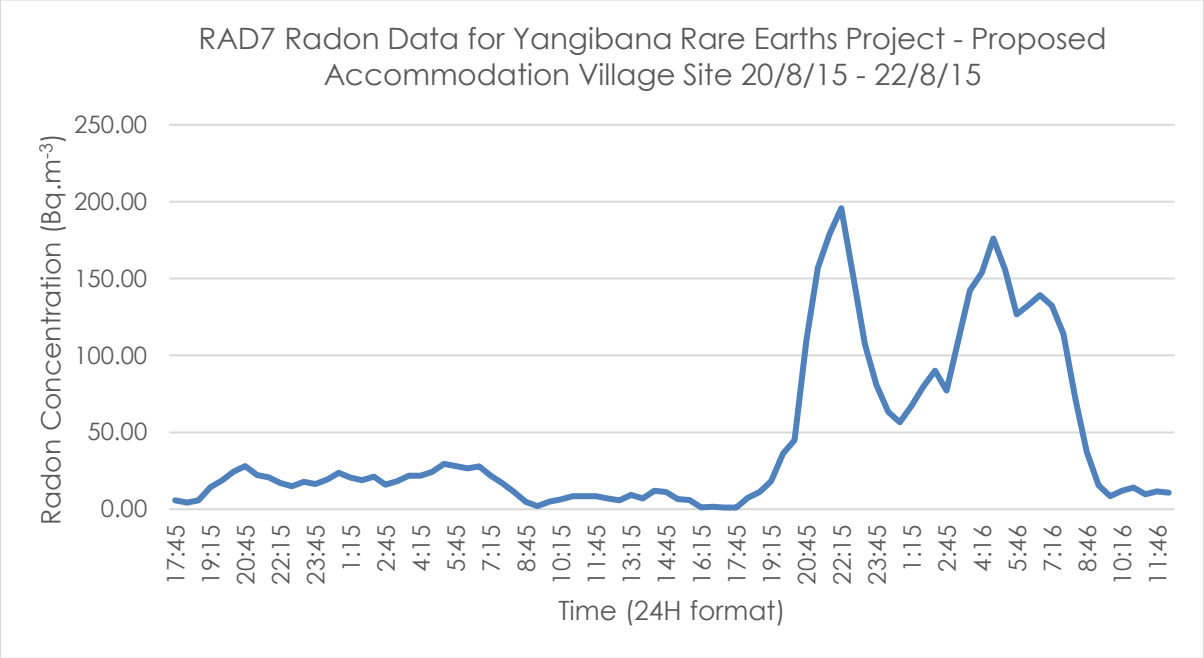

Figure 17 Real Time Radon Monitoring – Proposed Accommodation Village Site

Monitoring was conducted during a period of high winds, which maintains a high degree of mixing in the surface layer of air and prevents the build-up of radon concentrations. Two of the runs illustrate diurnal variation that is typical of natural radon concentrations.

Real time radon monitoring using the Durridge RAD7 returned an average radon concentration of 20.3 $Bq.m^{-3}$, which is consistent with average radon concentrations across much of Australia.

Water Quality

Groundwater

Water sampling and analysis was conducted by ATC Williams (analysis by Analytical Reference Laboratories, ARL) in 2015 at a number of existing bores in the footprint of the Project (YGBW1 and RC082), within approximately 5 km of the Project (Yangibana Bore and Fraser Well) and the surrounding region (Figure 18). Additional groundwater sampling
(

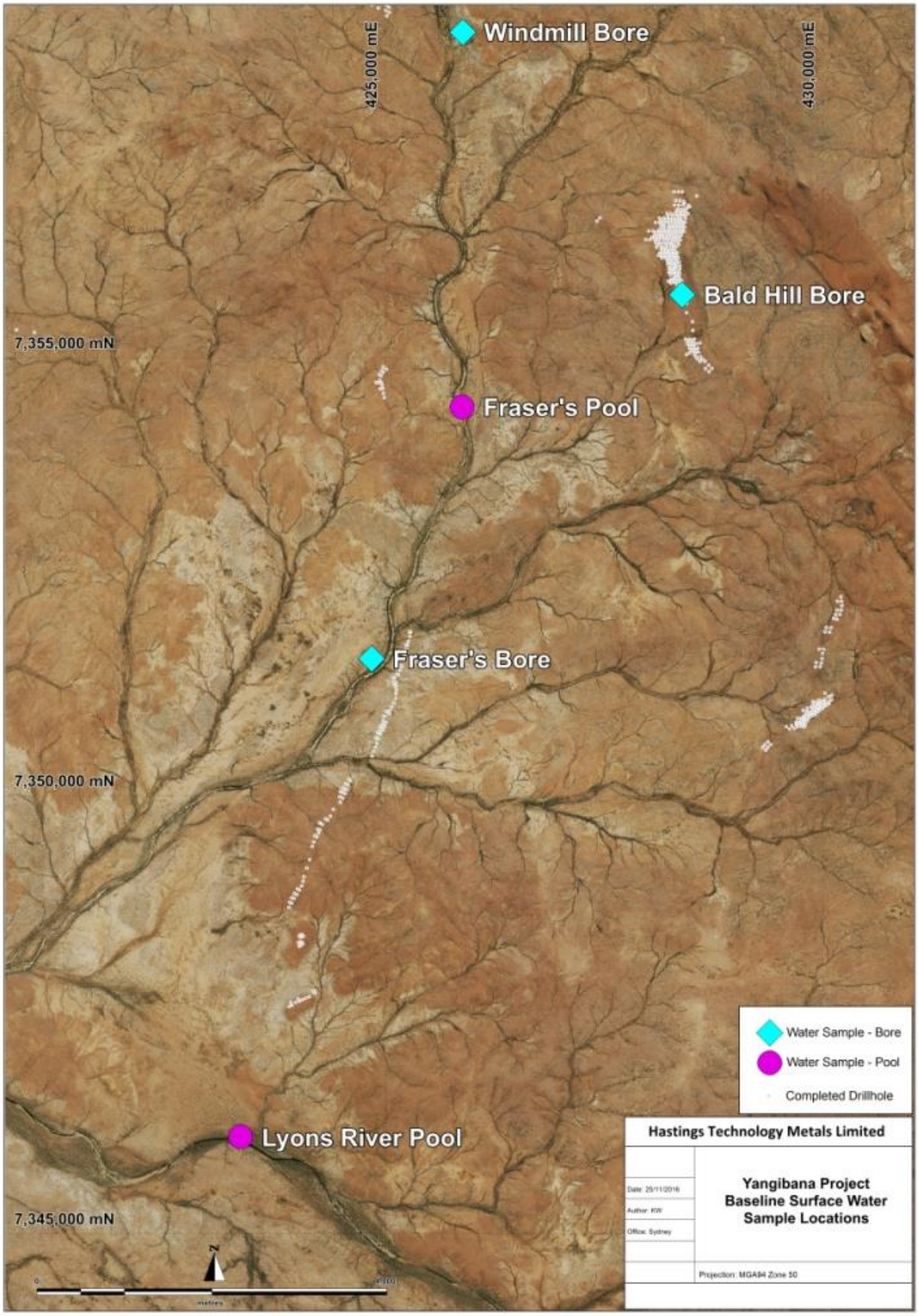

Figure 19) was undertaken by Hastings in 2016 (analysis by ARL) within approximately 5 km of the Project (pastoral bore informally named 'Windmill Bore', Fraser Well) and within the Project footprint (Bald Hill).

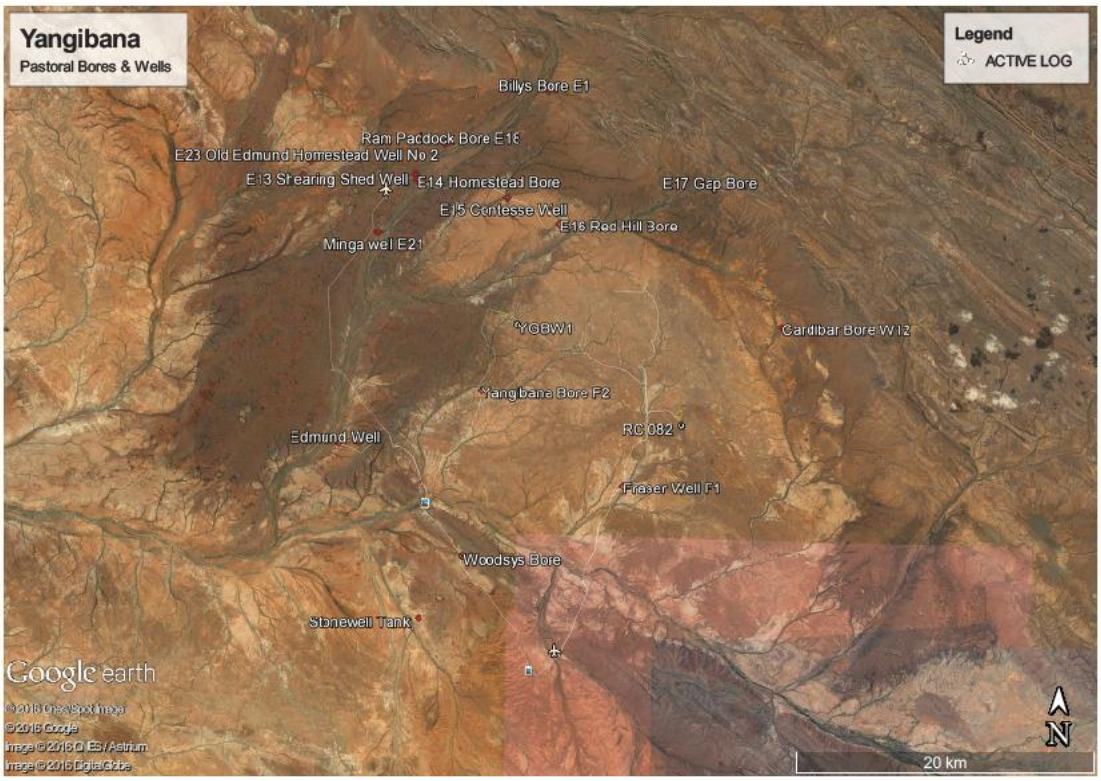

Figure 18 Yangibana pastoral bores and wells (ATC Williams, 2015)

Results for uranium and thorium analysis, commissioned by ATC Williams (

Table 8) and Hastings (Table 9), are shown below, and Appendix 1 includes the results of the full suite of elements tested in the groundwater analysis.

Table 8 Regional Groundwater Analysis (ATC Williams, 2015)

Sampling Location	Total Dissolved Uranium ($mg.L^{-1}$)	Total Dissolved Thorium ($mg.L^{-1}$)
Edmund Homestead	0.004	<0.001
Minga Well	0.004	<0.001
Contessi Bore	0.02	<0.001
Edmund Well	0.038	<0.001
YGBW1	0.016	<0.001
RCO82	0.014	<0.001
Frasers Well	0.025	<0.001
Yangibana Bore	0.029	<0.001
Woodsys Bore	0.009	<0.001
Red Hill 2	0.079	<0.001

Table 9 Regional Groundwater Analysis (Hastings, 2016)

Sampling Location	Total Dissolved Uranium ($mg.L^{-1}$)	Total Dissolved Thorium ($mg.L^{-1}$)
Frasers Well	0.029	0.002
Windmill Bore*	0.038	0.001
Bald Hill	0.029	<0.001

* Informal name assigned to pastoral bore

A sample was collected from an exploration hole (YWRC0003) within the Yangibana West prospect in mid-2015 and sent to ESR Laboratories (New Zealand) for analysis by gamma spectroscopy to determine concentrations of soluble radionuclides (Table 10).

Table 10 Exploration Hole Water Sample Analysis

Sample ID	Ra_{226} (Bq.kg^{-1})	Ra_{228} (Bq.kg^{-1})	Pb_{210} (Bq.kg^{-1})
YW-RC0003A	0.0308 ± 0.0077	0.046 ± 0.019	<0.080

Available data outputs from both ATC Williams and Hastings' commissioned analysis show a high level of regional and local variation.

A conceptual groundwater model (Global Groundwater, 2016) indicates that local groundwater flows are likely to be disorganised and dependent on local porosity and fracturing. At a regional level, flow direction of groundwater within the Project area is likely to follow that of surface water, which is generally from north-east to south-west, draining to the Lyons River.

The geology of the region may result in local groundwater containing naturally higher concentrations of radionuclides than groundwater in regions with lower levels of naturally occurring radioactive material.

Surface water

In October 2016, Hastings collected water samples from two ephemeral pools (LC - Pool 800US and FR – Pool) on the Lyons River, which only flows after heavy rainfall events. The pools are located approximately 5-10 km from the proposed processing plant area
(

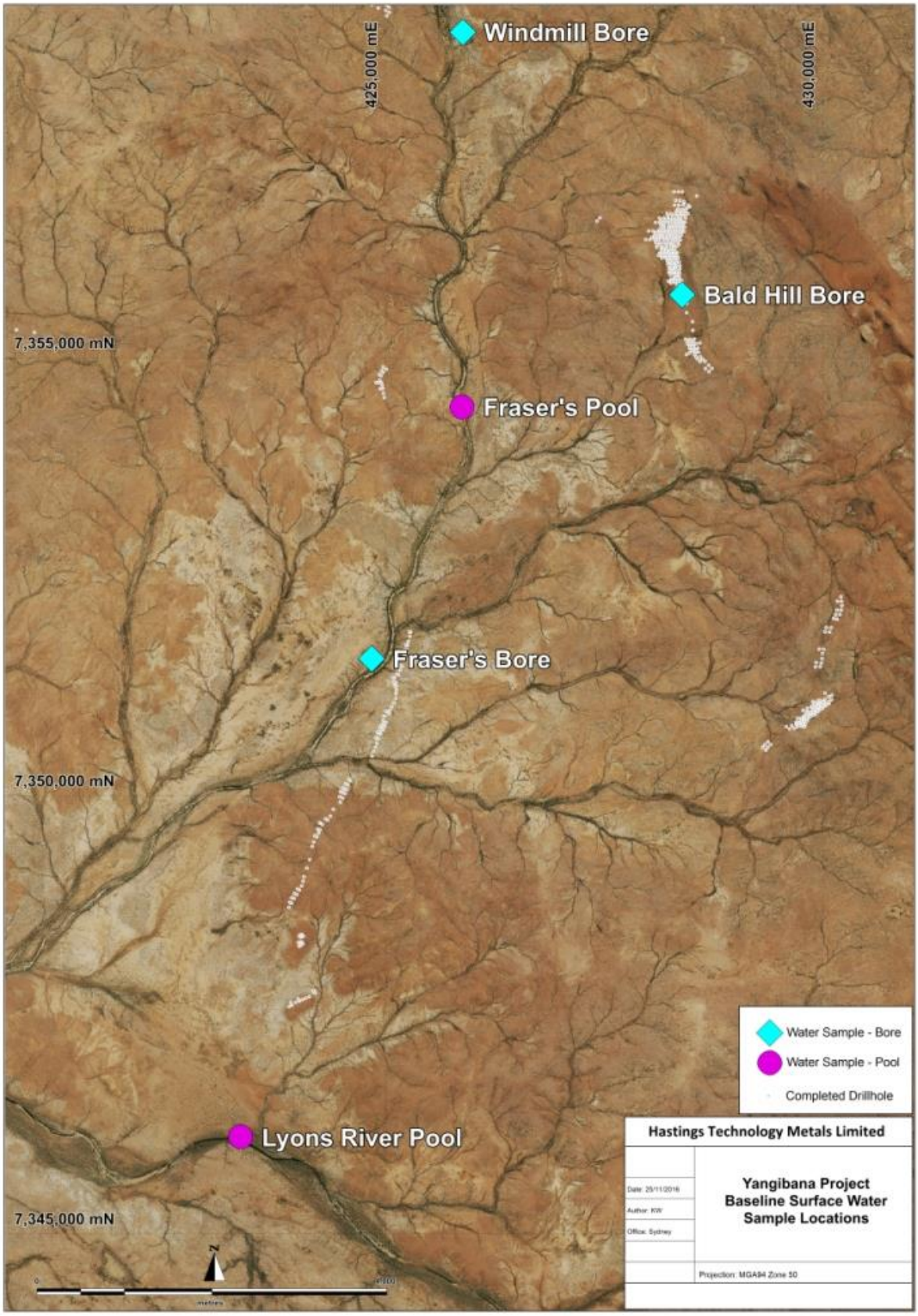
Windmill Bore
425,000 mE
430,000 mE
Bald Hill Bore
7,355,000 mN
Fraser's Pool
Fraser's Bore
7,350,000 mN
Lyons River Pool
7,345,000 mN
Water Sample - Bore
Water Sample - Pool
Completed Drillhole
Hastings Technology Metals Limited
Yangibana Project
Baseline Surface Water
Sample Locations
Projection: MGA94 Zone 50

Figure 19).

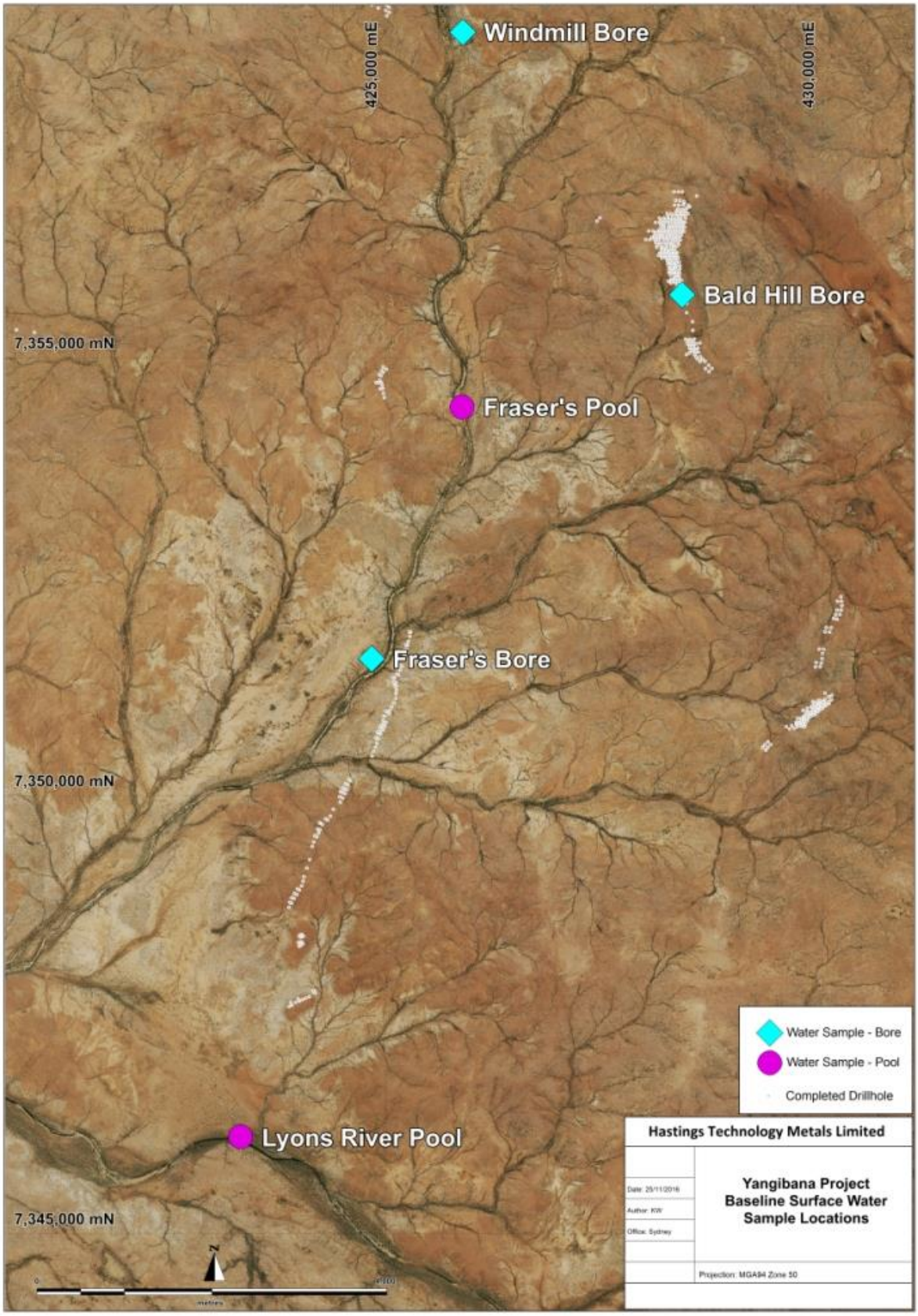

Figure 19 Locations of Surface Water Sampling at the Project (2016)

Water analysis was conducted by Analytical Reference Laboratories (ARL). Thorium and uranium values are shown in Table .

Table 11 Uranium and Thorium Concentration in Lyons River Ephemeral Pool Samples

Location	Total uranium ($mg.L^{-1}$)	Total thorium ($mg.L^{-1}$)
LC-Pool 800US	0.004	<0.001
FR - Pool	0.001	<0.001

Ongoing opportunistic sampling of surface water will provide further data.

Soil

Subsurface soil

Samples were taken from eight drill holes and were analysed by ICPMS (Intertek Genalysis) and gamma spectroscopy (ESR Laboratories). Additionally, data has been made available from ICPMS analysis conducted on drilling samples commissioned by Hastings and completed by Intertek Genalysis.

The eight analysed samples were all taken from below the surface, within or immediately adjacent to mineralisation and were selected to be approximately representative of the Project target resource material (Figure 20). Samples were pulped to homogeneity and analysed by ICPMS (Intertek Genalysis) for total uranium and thorium, and by gamma spectroscopy (ESR) for members of each decay chain.

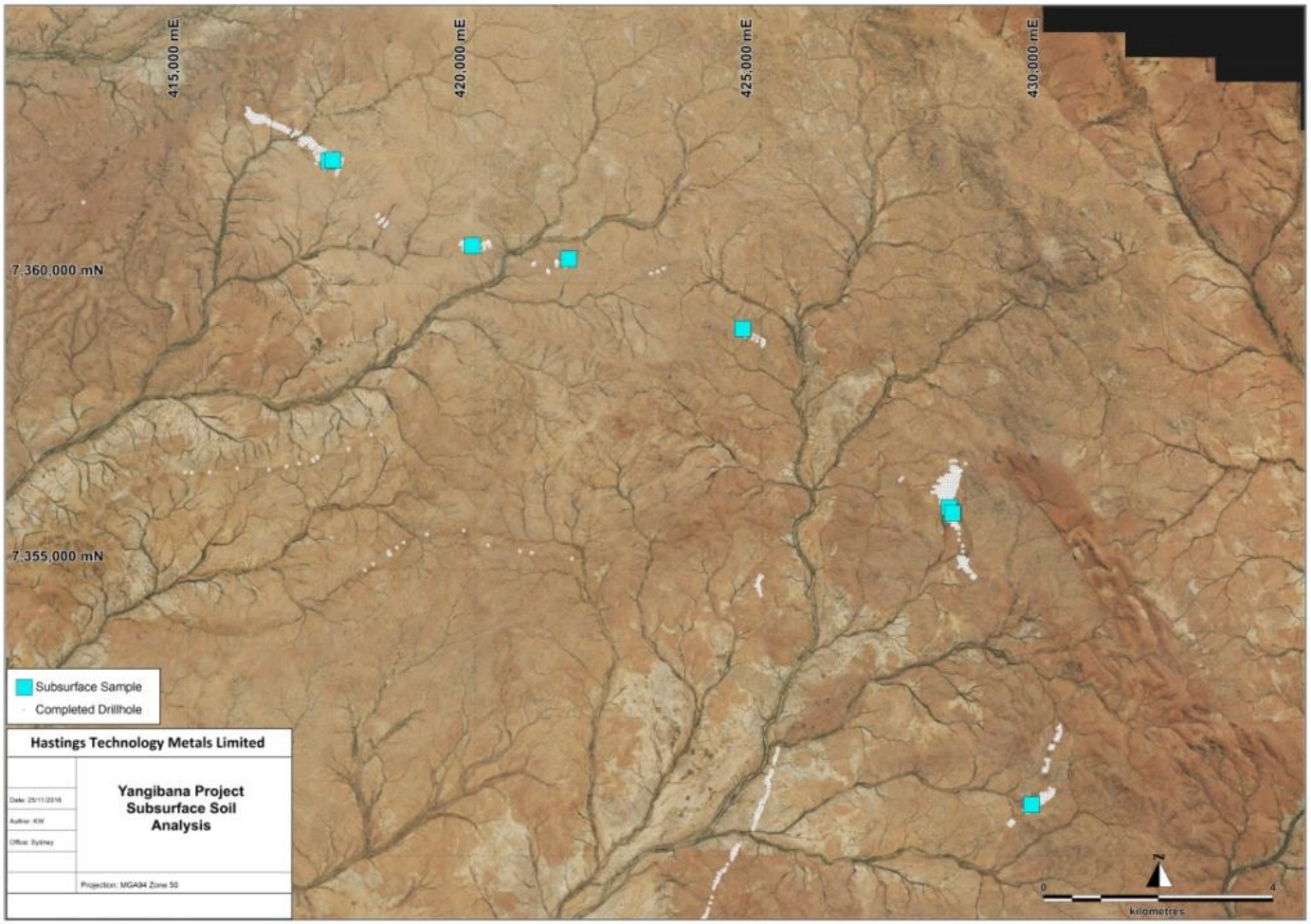

Figure 20 Locations of Sub Surface Soil Sampling (2015)

Analysis (Table) shows that concentrations of uranium and thorium in mineral samples vary widely. Comparison with the wider data set (Hastings, 2016) indicates that higher concentrations of radionuclides are found with the target rare earths oxides in mineralised areas compared to surrounding granites and metamorphics.

Table 12 Sample Origin and Lithology: Uranium and Thorium Content

Hole ID	Metre from	Metre to	Lithology Description (from Field Logs)	U (ppm)	Th (ppm)
BHRC007	21	22	Fenitic Granite (interburden between two ironstone lenses).	32.3	2520.7
BHDD027	14.5	14.9	Strongly weathered granite, immediate FW to Ironstone	10.9	1177.1
FRRC009	104	105	Ironstone	143.6	1309.2
KGRC005	71	72	Ironstone	50.2	1510.6
HKRC005	11	12	Fenetic Granite with 40% ironstone	5.2	1382.2
LERC007	9	10	Fenitic Granite, immediate HW to ironstone	15.8	1870.7
YGRC024	37	38	Ironstone	20.9	1245.5
YGRC028	39	40	Ironstone and quartz (10%).	62.2	2454.5

All samples were taken from material within or immediately adjacent to mineralisation, and uranium and thorium concentrations are consequently higher than for non-mineralised material (Hastings, 2016).

Radionuclide analysis (Table and Table) indicates that decay progeny of the uranium and thorium series' are in approximate secular equilibrium with their parent radionuclides. Secular equilibrium describes a state in which the amount of a radionuclide remains constant because its rate of decay is equal to its rate of generation (or to the rate of decay of its parent radionuclide). For the uranium and thorium decay chains, this means that material containing 1 $Bq.g^{-1}$ head of chain (uranium or thorium) in secular equilibrium will also contain 1 $Bq.g^{-1}$ of all decay species of the parent radionuclide.

Table 13 Uranium Series Equilibrium in sub-Surface Material

Hole ID	U ($Bq.kg^{-1}$)	Radium-226 ($Bq.kg^{-1}$)	Lead-210 ($Bq.kg^{-1}$)
BHRC007	398.77	400 ± 30	410 ± 110
BHDD027	134.57	153 ± 13	126 ± 34
FRRC009	1772.84	1790 ± 110	1650 ± 400
KGRC005	619.75	681 ± 44	660 ± 170
HKRC005	64.20	58.9 ± 6.2	47 ± 32
LERC007	195.06	157 ± 14	152 ± 55
YGRC024	258.02	410 ± 28	327 ± 82
YGRC028	767.90	841 ± 56	860 ± 220

Table 14 Thorium Series Equilibrium in sub-Surface Material

Hole ID	Th ($Bq.kg^{-1}$)	Radium-228 ($Bq.kg^{-1}$)	Thorium-228 ($Bq.kg^{-1}$)
BHRC007	10246.75	10410 ± 740	11100 ± 1700
BHDD027	4784.96	4760 ± 340	4870 ± 760
FRRC009	5321.95	4960 ± 340	5160 ± 800
KGRC005	6140.65	6200 ± 440	5790 ± 900
HKRC005	5618.70	5130 ±360	4710 ± 730
LERC007	7604.47	7180 ± 510	6350 ± 980
YGRC024	5063.01	5380 ± 380	5600 ± 880
YGRC028	9977.64	9390 ± 660	9500 ± 1500

Results generally indicate equilibrium, within the tolerance of detection and sampling error. Ironstone samples generally show negative U/Ra_{226} equilibrium (U/Ra_{226} <1), which may indicate some uranium leaching. One sample (from location YGRC024) indicates a stronger negative equilibrium, but still within the range that may be attributed to uranium leaching.

Based on analysis, material from the Project may be considered to be in secular equilibrium for both uranium and thorium decay chains.

Hastings collected samples of the first metre of material removed from holes drilled under exploration programs. This material was analysed by ICPMS for a number of metals, including uranium and thorium (Table).

Table 15 Surface Material Uranium and Thorium Analysis

Project Area	Uranium (ppm)			Thorium (ppm)		
	Average	Maximum	Minimum	Average	Maximum	Minimum
Bald Hill	10.2	44.6	2.4	142.8	1134.5	18.1
Fraser's	6.7	14.1	1.9	52.5	132.7	20.2
Yangibana North	10.7	26.4	2.5	321.6	1472.5	21.4

Average values are considerably higher than the global averages of 10 ppm thorium and 3 ppm uranium (UNSCEAR, 2000) but this is expected as the sample locations were all within mineralised areas.

Uranium values in surface material (up to 1m depth) are relatively consistent across the Project, although thorium concentrations show variation. This should be considered in the context of the deposit as a whole, understanding that thorium is more closely associated with the mineralisation. Ironstone hosting the target mineralisation exists as a planar intrusion in local granites, with surface outcropping material dipping back below the surface at an angle of approximately 45 degrees. The variable and elevated thorium results (compared to non-mineralised material) are from analysis of material within exploration areas and are expected to have an enhanced thorium content.

Available surface gamma dose rate data shows a correlation with surface soil radionuclide concentrations, supporting the indication that the surface dose rate is highly influenced by the mineralisation.

Topsoil

A single topsoil sample was taken from a location in the Gossan prospect area of the Project site and sent to ESR (New Zealand) for analysis by ICPMS and gamma spectroscopy, which returned the results shown in Table . Additional collections are planned.

Table 16 Topsoil Sample Radionuclide Analysis

Sample ID	Elemental Analysis £, $, *		Potassium Mass % £		Radionuclide Analysis			
	Uranium ($mg.kg^{-1}$)	Thorium ($mg.kg^{-1}$)	Potassium ($Bq.kg^{-1}$)	Potassium (Mass %)	Ra^{226} ($Bq.kg^{-1}$)	Ra^{228} ($Bq.kg^{-1}$)	Pb^{210} ($Bq.kg^{-1}$)	Th^{228} ($Bq.kg^{-1}$)
RP-1163/ CS-002	0.368	7.87	1080 ± 120	3.49 ± 0.40	16.9 ± 1.4	36.5 ± 2.7	30.3 ± 5.1	38.6 ± 4.1

£ This method is not part of the scope of accreditation to ISO 17025.
$ Analysis performed by Centre for Trace Element Analysis, Dept of Chemistry, University of Otago
* Estimated uncertainty based on duplicate analysis is 10%.

Conclusion

Baseline radiation monitoring data from the project shows that the mineralised material defines a locally increased gamma field across the project tenements. This was supported by three different programs measuring gamma radiation i.e. ground survey using environmentally compensated GM (Geiger Muller) detectors, aerial radiometric survey and passive Thermoluminescent Dosimeters (TLDs).

Dust and airborne parameters determined alpha activity levels, which were found to be similar in areas both on and off the resource. Due to limitations in the methodology, these levels were likely to be over-estimated and considered high by global standards.

Radon and thoron monitoring, using passive Radtrak and real time monitoring using a Durridge RAD7 portable radon monitor, 'on' and 'off' the resource and at Gifford Creek Station, showed that radon and thoron levels and their natural variability are within ranges described as background (UNSCEAR, 2000).

Soil monitoring to-date has focused on determining levels of radionuclides within the targeted mineralisation. As expected, radionuclide levels are high but also variable. Secular equilibrium has been demonstrated in samples from mineralised material.

Water samples collected from 11 bores over the broader Project area were tested for uranium and thorium. Results showed levels were very low and far below the guideline values listed in the Australian Drinking Water Guidelines.

The results set a standard for the operation, and may be referenced as a benchmark for ongoing or final remediation of project areas, or as criteria following any spill or excursion from operational infrastructure.

The adoption of an 'optimisation in design' philosophy would mitigate against the accrual of a significant remediation legacy, and would assist the operation to embed the ICRP System of Radiation Protection into the operation in the same way that other safety controls are now standard.

Ongoing monitoring and assessment will increase the value of this report, and revisions will be made as monitoring programs return data for inclusion.

Quality management

Radiation Professionals operates under a Quality Management System (aligned with ISO 9001) that includes:

- implementation of systems, standard procedures and documents;
- maintenance of records and data to a consistent standard;
- engagement of ISO or NATA accredited testing facilities for external analysis;
- employment of applicable technologies, and monitoring methods; and
- maintenance and calibration of equipment by accredited facilities in line with manufacturer specifications

All radiological survey results and resulting reports are deemed as quality records and will be retained for the operating life time of the Yangibana Rare Earths Project.

Abbreviations

List the relevant abbreviations used in the report here.

Activity	Amount of radioactive material in a sample, measured in Becquerels, where 1 Bq = 1 atomic decay per second.
Alpha radiation	High energy, comparatively low speed particle radiation emitted from a decaying atom. Consist of two protons and two neutrons forming a particle that is identical to a double-ionised helium nucleus. Alpha radiation is weakly penetrating (may be stopped by a sheet of paper) but highly ionising and is considered an internal radiation hazard.
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
Becquerel / Bq	Unit of Activity (see above); named after the discoverer of natural radioactivity.
Beta radiation	High energy, high speed electron or positron emitted by a decaying atom. Beta radiation is moderately penetrating (may be stopped by a few centimetres of low atomic mass material e.g. plastic or wood). Considered primarily an internal hazard, but also as an external hazard due to its penetrative qualities.
Critical Groups/ Representative Persons	The group within proximity to an activity who are most likely to receive elevated radiation doses as a consequence of that activity.
DMP	Department of Mines and Petroleum (Western Australia).
Dose	See also: Gray, Sievert. May refer to absorbed dose (measured in Gray (Gy)), committed dose, equivalent dose, or effective dose (measured in Sieverts (Sv)). Describes a measure of risk to health.
Gamma radiation	Electromagnetic radiation like x-rays, emitted from the nucleus of an atom. Highly penetrating but weakly ionising, and considered an external radiation hazard.
Gray / Gy	Unit of absorbed dose. Describes the energy deposited per mass of a given medium by ionising radiation.
IAEA	International Atomic Energy Agency

ICRP	International Commission on Radiological Protection
LLAA	Long lived alpha emitters (dose from which is measured as mSv/yr) means the presence in airborne dust of any of the alpha particle emitting radionuclides in the uranium decay series, except for those
Member of Public	A person not occupationally exposed to radiation
NORM	Naturally Occurring Radioactive Material.
ppm	Parts per million, a measure of the concentration of an element in ore.
Radionuclide	Also radioisotope, a radioactive form of an element.
Radon	Decay product of radium, an inert gas; similar to argon, neon, helium etc.
Radon progeny / radon daughters / radon decay products / RnDP	Po_{218}, Pb_{214}, Bi_{214} and Po_{214}. Short lived radionuclide breakdown products of the decay of Radon-222
Rare earths	Rare earth metals/elements, comprising the lanthanide series plus scandium and yttrium. Found naturally in the earth's crust and used in a range of industrial and technological applications.
Representative Persons	See Critical Groups.
RMP	Radiation Management Plan.
Sievert / Sv	Unit of effective dose. Effective dose is used to describe the stochastic or long term effect of exposure to ionising radiation on the whole body. It takes into account the type of radiation, and is a summed equivalent dose for all tissues of the body to give a whole body equivalent dose.
Tailings	Wet or dry waste product from processing.

Thorium	90th element in the Periodic Table, found in low concentrations in rocks and soil (~10ppm). The predominant isotope is Th_{232} which decays very slowly through a series of other isotopes to a stable isotope of lead.
TLD Badge	Thermo-luminescent Dosimeter, personal radiation badge, records time-integrated gamma dose.
tpa	Tonnes per annum, used to describe input/throughput of a process or processing plant.
TREO	Total rare earth oxides.
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
Uranium	92nd element in the Periodic Table. A radioactive element found in small amounts in most rocks and soils (~3ppm). U_{238} decays very slowly. Uranium is most commonly used in nuclear power plants to generate energy and to create radioisotopes for use in research, industry and medicine

References

[1] Arafura Resources Ltd (2016) Nolans Rare Earths Project Environmental Impact Statement – Radiation Report

[2] ARPANSA (2005) RPS9, Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing

[3] ARPANSA (2014) RPSC-2, Code of Practice for the Safe Transport of Radioactive Material

[4] Cameco Australia Pty Ltd (2015) Yeelirrie Uranium Project Public Environmental Review – Radiation Technical Report

[5] Ecoscape (2016a) Yangibana Rare Earths Project Vegetation and Flora Assessment Report. A report prepared by Ecoscape for Hastings Technology Metals Ltd.

[6] Ecoscape (2016b) Yangibana Rare Earths Project Terrestrial Fauna Assessment. A report prepared by Ecoscape for Hastings Technology Metals Ltd.

[7] Ecoscape (2016c) Yangibana Rare Earths Project Subterranean Fauna Assessment. A report prepared by Ecoscape for Hastings Technology Metals Ltd.

[8] Global Groundwater (2016) Yangibana Rare Earths Project Conceptual Hydrogeological Assessment. A report prepared by Global Groundwater for Hastings Technology Metals Ltd.

[9] JDA and Associates (2016) Yangibana Rare Earths Project Surface Water Assessment. A report prepared by JDA and Associates for Hastings Technology Metals Ltd.

[10] Landloch (2016a) Yangibana Rare Earths Project Soils Assessment. A report prepared by Landloch for Hastings Technology Metals Ltd.

[11] Landloch (2016b) Yangibana Rare Earths Project Waste Rock Characterisation Assessment. A report prepared by Landloch for Hastings Technology Metals Ltd.

[12] Pacific Environment (2016) Yangibana Rare Earths Project Air Quality Assessment Report. A report prepared by Pacific Environment for Hastings Technology Metals Ltd.

[13] Pearson M.D and Spangler R. R (1991) Calibration of a-Track Monitors for Measurement of Thoron (^{220}Rn), Health Physics Vol 60. No. 5 (May) pp 697 - 701

[14] Radiation Professionals (2016) Radiation Characterisation Report. A report prepared by Radiation Professionals for Hastings Technology Metals Ltd

[15] Trajectory, and Graham Campbell and Associates 2016. Yangibana Rare Earths Project Waste Characterisation Assessment. A report prepared by Trajectory, and Graham Campbell and Associates for Hastings Technology Metals Ltd.

[16] NHMRC (now ARPANSA) (1985) RHS 13, Code of Practice for the Disposal of Radioactive Wastes by the User

[17] NHMRC (now ARPANSA) (1992) RHS 35, Code of practice for the near-surface disposal of radioactive waste in Australia

[18] Standards Australian (2004) AS 3640: 2004. Workplace atmospheres -Method for sampling and gravimetric determination of inhalable dust,

[19] Standards Australian (2009) AS/NZS 1715:2009 Selection, use and maintenance of respiratory protective equipment

[20] Toro Energy Ltd (2011) Wiluna Uranium Project Environmental Review and Management Program – Radiation Baseline Report

[21] UNSCEAR (2000) Sources and Effects of Ionising Radiation Vol I: (Sources) Report of the United Nations Scientific Committee on the Effects of Atomic Radiation to the General Assembly with Scientific Annexes

[22] UNSCEAR (2008) Sources and Effects of Ionising Radiation Volume I: (Sources) Report to the General Assembly with Scientific Annexes A and B

[23] Vimy Resources Ltd (2015) Mulga Rock Uranium Project Public Environmental Review – Radiation Report

[24] WA Department of Mines and Petroleum (2010) *Managing naturally occurring radioactive material (NORM) in mining and mineral processing — guideline (2nd edition)*: Resources Safety, Department of Mines and Petroleum, Western Australia

[25] Western Australia (1975) *Radiation Safety Act.*

[26] Western Australia (1983) Radiation Safety (General) Regulations

[27] Western Australia (2002) Radiation Safety (Transport of Radioactive Substances) Regulations

[28] Western Australia (1994) Mines Safety and Inspection Act

[29] Western Australia (1995) Mines Safety and Inspection Regulations

Appendices

Appendix 1 - Monitoring and Analysis Results

All GPS coordinates are reported in UTM format, using the WGS84 map datum. The Project lies within Map 50K.

Passive monitoring stations and dust sampling were conducted at common monitoring locations.

Monitoring Location ID	WP Number	Easting	Northing
Bald Hill Central	WP32	428303	7356235
Bald Hill East	WP282	428356	7356169
Bald Hill North A	WP22	428411	7356774
Bald Hill North B	WP284	428185	7356746
Bald Hill South	WP281	428451	7355500
Bald Hill West	WP283	427714	7356377
Frasers East	WP287	429940	7350911
Frasers North	WP289	429963	7351188
Frasers South	WP286	429678	7350670
Frasers West A	WP256	429348	7351036
Frasers West B	WP290	429616	7350927
Gifford Creek Homestead	WP80	420534	7340392
Hatchet West	WP194	423450	7354928
Yangibana North	WP119	417204	7362476
Yangibana North Bag Farm	WP144	417705	7362287

Gamma Survey

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
1/05/2016	BHA1	Bald Hill baseline	428400	7357000	10870/19018	725	773	751		750
1/05/2016	BHA2	Bald Hill baseline	428300	7357000	10870/19018	721	713	772		735
1/05/2016	BHA3	Bald Hill baseline	428200	7357000	10870/19018	519	521	516		519
1/05/2016	BHA4	Bald Hill baseline	428200	7356800	10870/19018	191	168	211	180	188
1/05/2016	BHA5	Bald Hill baseline	428300	7356800	10870/19018	194	183	191		189
1/05/2016	BHA6	Bald Hill baseline	428400	7356800	10870/19018	251	246	283		260
1/05/2016	BHA7	Bald Hill baseline	428500	7356800	10870/19018	279	297	301		292
1/05/2016	BHA8	Bald Hill baseline	428600	7356800	10870/19018	240	209	216		222
1/05/2016	BHA9	Bald Hill baseline	428600	7356600	10870/19018	337	302	337		325
1/05/2016	BHA10	Bald Hill baseline	428500	7356600	10870/19018	514	509	486		503
1/05/2016	BHA11	Bald Hill baseline	428400	7356600	10870/19018	262	296	277		278
1/05/2016	BHA12	Bald Hill baseline	428300	7356600	10870/19018	210	210	223		214
1/05/2016	BHA13	Bald Hill baseline	428200	7356600	10870/19018	259	256	264		260
1/05/2016	BHA14	Bald Hill baseline	428100	7356600	10870/19018	271	258	261		263
1/05/2016	BHA15	Bald Hill baseline	428000	7356600	10870/19018	173	182	169		175
1/05/2016	BHA16	Bald Hill baseline	427900	7356600	10870/19018	171	187	217	168	186
1/05/2016	BHA17	Bald Hill baseline	428500	7356400	10870/19018	408	431	402		414
1/05/2016	BHA18	Bald Hill baseline	428400	7356400	10870/19018	322	341	340		334
1/05/2016	BHA19	Bald Hill baseline	428300	7356400	10870/19018	362	356	384		367

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
1/05/2016	BHA20	Bald Hill baseline	428200	7356400	10870/19018	166	171	146	144	157
1/05/2016	BHA21	Bald Hill baseline	428100	7356400	10870/19018	245	294	246	256	260
1/05/2016	BHA22	Bald Hill baseline	428000	7356400	10870/19018	291	298	306		298
1/05/2016	BHA23	Bald Hill baseline	427900	7356400	10870/19018	264	265	303		277
1/05/2016	BHA24	Bald Hill baseline	428000	7356200	10870/19018	180	211	177	180	187
1/05/2016	BHA25	Bald Hill baseline	428100	7356200	10870/19018	195	201	231		209
1/05/2016	BHA26	Bald Hill baseline	428200	7356200	10870/19018	285	301	298		295
1/05/2016	BHA27	Bald Hill baseline	428300	7356200	10870/19018	529	535	520		528
1/05/2016	BHA28	Bald Hill baseline	428400	7356200	10870/19018	744	741	668	709	716
1/05/2016	BHA29	Bald Hill baseline	428500	7356200	10870/19018	454	505	503	478	485
1/05/2016	BHA30	Bald Hill baseline	428500	7356000	10870/19018	582	585	606		591
1/05/2016	BHA31	Bald Hill baseline	428400	7356000	10870/19018	855	862	854		857
1/05/2016	BHA32	Bald Hill baseline	428300	7356000	10870/19018	498	511	519		509
1/05/2016	BHA33	Bald Hill baseline	428200	7356000	10870/19018	723	728	654	729	709
1/05/2016	BHA34	Bald Hill baseline	428100	7356000	10870/19018	231	201	196		209
1/05/2016	BHA35	Bald Hill baseline	428200	7355800	10870/19018	244	221	270	219	239
1/05/2016	BHA36	Bald Hill baseline	428300	7355800	10870/19018	706	774	674	675	707
1/05/2016	BHA37	Bald Hill baseline	428400	7355800	10870/19018	585	556	573		571
1/05/2016	BHA38	Bald Hill baseline	428500	7355800	10870/19018	678	649	628		652
1/05/2016	BHA39	Bald Hill baseline	428600	7355800	10870/19018	285	262	257		268
1/05/2016	BHA40	Bald Hill baseline	428600	7355600	10870/19018	486	500	492		493
1/05/2016	BHA41	Bald Hill baseline	428500	7355600	10870/19018	394	438	416		416
1/05/2016	BHA42	Bald Hill baseline	428400	7355600	10870/19018	415	414	451		427

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
1/05/2016	BHA43	Bald Hill baseline	428300	7355600	10870/19018	525	483	494		501
1/05/2016	BHA44	Bald Hill baseline	428300	7355400	10870/19018	244	240	234		239
1/05/2016	BHA45	Bald Hill baseline	428400	7355400	10870/19018	282	266	285		278
1/05/2016	BHA46	Bald Hill baseline	428500	7355400	10870/19018	288	297	286		290
1/05/2016	BHA47	Bald Hill baseline	428600	7355400	10870/19018	484	478	477		480
2/05/2016	BHA48	Bald Hill baseline	428800	7354700	10870/19018	213	217	204		211
2/05/2016	BHA49	Bald Hill baseline	428700	7354700	10870/19018	217	229	232		226
2/05/2016	BHA50	Bald Hill baseline	428600	7354800	10870/19018	248	238	258		248
2/05/2016	BHA51	Bald Hill baseline	428700	7354800	10870/19018	228	253	249		243
2/05/2016	BHA52	Bald Hill baseline	428800	7354800	10870/19018	195	281	316		264
2/05/2016	BHA53	Bald Hill baseline	428900	7354800	10870/19018	302	274	282		286
2/05/2016	BHA54	Bald Hill baseline	428900	7354900	10870/19018	241	231	235		236
2/05/2016	BHA55	Bald Hill baseline	428800	7354900	10870/19018	355	320	354		343
2/05/2016	BHA56	Bald Hill baseline	428700	7354900	10870/19018	223	228	226		226
2/05/2016	BHA57	Bald Hill baseline	428600	7354900	10870/19018	247	249	252		249
2/05/2016	BHA58	Bald Hill baseline	428500	7354900	10870/19018	191	215	219		208
2/05/2016	BHA59	Bald Hill baseline	428400	7355000	10870/19018	210	206	194		203
2/05/2016	BHA60	Bald Hill baseline	428500	7355000	10870/19018	225	180	219	213	209
2/05/2016	BHA61	Bald Hill baseline	428600	7355000	10870/19018	283	244	282		270
2/05/2016	BHA62	Bald Hill baseline	428700	7355000	10870/19018	263	268	241		257
2/05/2016	BHA63	Bald Hill baseline	428800	7355000	10870/19018	220	275	248	226	242
2/05/2016	BHA64	Bald Hill baseline	428700	7355100	10870/19018	266	295	273		278
2/05/2016	BHA65	Bald Hill baseline	428600	7355100	10870/19018	278	296	329	306	302

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
2/05/2016	BHA66	Bald Hill baseline	428500	7355100	10870/19018	201	238	234	245	230
2/05/2016	BHA67	Bald Hill baseline	428400	7355100	10870/19018	217	245	249		237
2/05/2016	BHA68	Bald Hill baseline	428300	7355100	10870/19018	210	209	215	247	220
1/05/2016	WP25	Bald Hill baseline	428501	7356901	520/19020	258	243	249	229	245
1/05/2016	WP155	Bald Hill baseline	428401	7356901	520/19020	375	457	388	405	406
1/05/2016	WP156	Bald Hill baseline	428299	7356900	520/19020	316	288	252	310	292
1/05/2016	WP157	Bald Hill baseline	428201	7356900	520/19020	187	186	217		197
1/05/2016	WP158	Bald Hill baseline	428001	7356701	520/19020	213	216	191		207
1/05/2016	WP159	Bald Hill baseline	428100	7356702	520/19020	218	209	219		215
1/05/2016	WP160	Bald Hill baseline	428200	7356699	520/19020	306	269	216	214	251
1/05/2016	WP161	Bald Hill baseline	428300	7356699	520/19020	200	209	178		196
1/05/2016	WP162	Bald Hill baseline	428401	7356701	520/19020	220	249	211	244	231
1/05/2016	WP163	Bald Hill baseline	428498	7356701	520/19020	495	513	486		498
1/05/2016	WP164	Bald Hill baseline	428601	7356699	520/19020	220	244	224		229
1/05/2016	WP165	Bald Hill baseline	428500	7356500	520/19020	567	543	557		556
1/05/2016	WP166	Bald Hill baseline	428400	7356502	520/19020	357	360	391		369
1/05/2016	WP167	Bald Hill baseline	428301	7356500	520/19020	304	334	313		317
1/05/2016	WP168	Bald Hill baseline	428200	7356500	520/19020	243	225	229		232
1/05/2016	WP169	Bald Hill baseline	428100	7356501	520/19020	241	258	250		250
1/05/2016	WP170	Bald Hill baseline	428000	7356501	520/19020	243	204	224		224
1/05/2016	WP171	Bald Hill baseline	427900	7356499	520/19020	207	246	235		229
1/05/2016	WP172	Bald Hill baseline	427901	7356300	520/19020	228	201	247		225
1/05/2016	WP173	Bald Hill baseline	428000	7356301	520/19020	210	240	229		226

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
1/05/2016	WP174	Bald Hill baseline	428100	7356301	520/19020	225	202	213		213
1/05/2016	WP175	Bald Hill baseline	428199	7356301	520/19020	231	249	258		246
1/05/2016	WP176	Bald Hill baseline	428300	7356302	520/19020	360	324	361		348
1/05/2016	WP177	Bald Hill baseline	428400	7356299	520/19020	459	491	481		477
1/05/2016	WP178	Bald Hill baseline	428501	7356300	520/19020	304	318	303		308
1/05/2016	WP179	Bald Hill baseline	428498	7356101	520/19020	435	397	403		412
1/05/2016	WP180	Bald Hill baseline	428402	7356100	520/19020	836	795	846		826
1/05/2016	WP181	Bald Hill baseline	428301	7356099	520/19020	643	625	680	625	643
1/05/2016	WP182	Bald Hill baseline	428098	7356100	520/19020	207	237	217		220
1/05/2016	WP183	Bald Hill baseline	428000	7356102	520/19020	195	204	192		197
1/05/2016	WP184	Bald Hill baseline	428100	7356102	520/19020	201	186	192		193
1/05/2016	WP185	Bald Hill baseline	428201	7356101	520/19020	571	586	585		581
1/05/2016	WP186	Bald Hill baseline	428299	7356100	520/19020	660	642	693		665
1/05/2016	WP187	Bald Hill baseline	428401	7356100	520/19020	781	790	802		791
1/05/2016	WP188	Bald Hill baseline	428499	7356098	520/19020	469	504	495		489
1/05/2016	WP189	Bald Hill baseline	428503	7355899	520/19020	813	751	761	765	773
1/05/2016	WP190	Bald Hill baseline	428400	7355900	520/19020	1196	1095	1102	1026	1105
1/05/2016	WP191	Bald Hill baseline	428302	7355901	520/19020	512	537	506		518
1/05/2016	WP192	Bald Hill baseline	428200	7355900	520/19020	595	613	617		608
1/05/2016	WP193	Bald Hill baseline	428101	7355901	520/19020	186	199	201		195
2/05/2016	WP196	Bald Hill baseline	428600	7355699	520/19020	696	712	649	669	682
2/05/2016	WP197	Bald Hill baseline	428501	7355700	520/19020	471	477	497		482
2/05/2016	WP198	Bald Hill baseline	428400	7355700	520/19020	301	302	309		304

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
2/05/2016	WP199	Bald Hill baseline	428301	7355701	520/19020	564	544	554		554
2/05/2016	WP200	Bald Hill baseline	428301	7355501	520/19020	414	428	416		419
2/05/2016	WP201	Bald Hill baseline	428401	7355500	520/19020	366	356	364		362
2/05/2016	WP202	Bald Hill baseline	428500	7355502	520/19020	433	375	409		406
2/05/2016	WP203	Bald Hill baseline	428600	7355501	520/19020	599	523	578		567
2/05/2016	WP204	Bald Hill baseline	428600	7355400	520/19020	421	443	402	403	417
2/05/2016	WP205	Bald Hill baseline	428500	7355399	520/19020	322	282	293	310	302
2/05/2016	WP206	Bald Hill baseline	428399	7355400	520/19020	265	259	268		264
2/05/2016	WP207	Bald Hill baseline	428301	7355401	520/19020	285	252	276		271
2/05/2016	WP208	Bald Hill baseline	428300	7355300	520/19020	296	293	272		287
2/05/2016	WP209	Bald Hill baseline	428401	7355300	520/19020	243	268	277		263
2/05/2016	WP210	Bald Hill baseline	428501	7355301	520/19020	317	333	298		316
2/05/2016	WP211	Bald Hill baseline	428601	7355300	520/19020	424	453	423		433
2/05/2016	WP212	Bald Hill baseline	428700	7355200	520/19020	411	387	378		392
2/05/2016	WP213	Bald Hill baseline	428600	7355200	520/19020	483	453	540	481	489
2/05/2016	WP214	Bald Hill baseline	428501	7355199	520/19020	273	241	246		253
2/05/2016	WP215	Bald Hill baseline	428400	7355202	520/19020	229	247	226		234
2/05/2016	WP216	Bald Hill baseline	428298	7355208	520/19020	249	253	250		251
3/05/2016	YFA1	Frasers baseline	429800	7351200	10870/19018	220	235	261		239
3/05/2016	YFA2	Frasers baseline	429900	7351200	10870/19018	248	247	226		240
3/05/2016	YFA3	Frasers baseline	430000	7351200	10870/19018	182	201	226		203
3/05/2016	YFA4	Frasers baseline	430100	7351200	10870/19018	246	231	260		246

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
3/05/2016	YFA5	Frasers baseline	430200	7351200	10870/19018	213	189	222		208
3/05/2016	YFA6	Frasers baseline	430200	7351000	10870/19018	212	221	197		210
3/05/2016	YFA7	Frasers baseline	430100	7351000	10870/19018	235	200	197	233	216
3/05/2016	YFA8	Frasers baseline	430000	7351000	10870/19018	335	359	343		346
3/05/2016	YFA9	Frasers baseline	429900	7351000	10870/19018	395	423	379		399
3/05/2016	YFA10	Frasers baseline	429800	7351000	10870/19018	391	371	363		375
3/05/2016	YFA11	Frasers baseline	429700	7351000	10870/19018	286	337	306	304	308
3/05/2016	YFA12	Frasers baseline	429600	7351000	10870/19018	534	582	535	563	554
3/05/2016	YFA13	Frasers baseline	429300	7350800	10870/19018	228	201	214		214
3/05/2016	YFA14	Frasers baseline	429400	7350800	10870/19018	285	302	301		296
3/05/2016	YFA15	Frasers baseline	429500	7350800	10870/19018	306	312	330		316
3/05/2016	YFA16	Frasers baseline	429600	7350800	10870/19018	353	360	333		349
3/05/2016	YFA17	Frasers baseline	429700	7350800	10870/19018	501	453	446	483	471
3/05/2016	YFA18	Frasers baseline	429800	7350800	10870/19018	494	672	690	682	635
3/05/2016	YFA19	Frasers baseline	429900	7350800	10870/19018	219	231	228		226
3/05/2016	YFA20	Frasers baseline	430000	7350800	10870/19018	197	218	205		207
3/05/2016	YFA21	Frasers baseline	429700	7350600	10870/19018	212	222	181	224	210
3/05/2016	YFA22	Frasers baseline	429600	7350600	10870/19018	229	205	253		229
3/05/2016	YFA23	Frasers baseline	429500	7350600	10870/19018	208	203	200		204
3/05/2016	YFA24	Frasers baseline	429400	7350600	10870/19018	291	277	282		283
3/05/2016	YFA25	Frasers baseline	429300	7350600	10870/19018	206	222	219		216
3/05/2016	YFA26	Frasers baseline	429200	7350600	10870/19018	189	181	188		186
3/05/2016	YFA27	Frasers baseline	429100	7350400	10870/19018	201	217	204		207

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
3/05/2016	YFA28	Frasers baseline	429200	7350400	10870/19018	214	212	216		214
3/05/2016	YFA29	Frasers baseline	429300	7350400	10870/19018	218	207	226		217
3/05/2016	YFA30	Frasers baseline	429100	7350200	10870/19018	228	189	215		211
3/05/2016	YFA31	Frasers baseline	429000	7350200	10870/19018	198	195	205		199
3/05/2016	YFA32	Frasers baseline	428900	7350200	10870/19018	222	219	216		219
3/05/2016	YFA33	Frasers baseline	428800	7350200	10870/19018	199	200	229		209
3/05/2016	YFA34	Frasers baseline	429000	7350400	10870/19018	244	253	251		249
3/05/2016	WP221	Frasers baseline	429704	7351097	520/19020	186	204	205		198
3/05/2016	WP222	Frasers baseline	429806	7351101	520/19020	356	354	378		363
3/05/2016	WP223	Frasers baseline	429902	7351099	520/19020	281	297	273		284
3/05/2016	WP224	Frasers baseline	430001	7351098	520/19020	262	219	258		246
3/05/2016	WP225	Frasers baseline	430101	7351100	520/19020	334	307	331		324
3/05/2016	WP226	Frasers baseline	430199	7351100	520/19020	216	243	247		235
3/05/2016	WP227	Frasers baseline	430100	7350901	520/19020	192	219	207		206
3/05/2016	WP228	Frasers baseline	430003	7350900	520/19020	213	222	214		216
3/05/2016	WP229	Frasers baseline	429900	7350900	520/19020	1212	1227	1210		1216
3/05/2016	WP230	Frasers baseline	429800	7350903	520/19020	324	282	293		300
3/05/2016	WP231	Frasers baseline	429700	7350900	520/19020	372	335	346		351
3/05/2016	WP232	Frasers baseline	429600	7350900	520/19020	262	264	258		261
3/05/2016	WP233	Frasers baseline	429500	7350902	520/19020	469	517	528	499	503
3/05/2016	WP234	Frasers baseline	429203	7350702	520/19020	196	196	204		199
3/05/2016	WP235	Frasers baseline	429302	7350700	520/19020	219	203	206		209
3/05/2016	WP236	Frasers baseline	429399	7350697	520/19020	292	304	288		295

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
3/05/2016	WP237	Frasers baseline	429501	7350701	520/19020	282	288	312		294
3/05/2016	WP238	Frasers baseline	429601	7350703	520/19020	258	259	276		264
3/05/2016	WP239	Frasers baseline	429699	7350701	520/19020	232	226	225		228
3/05/2016	WP240	Frasers baseline	429801	7350701	520/19020	222	202	219		214
3/05/2016	WP241	Frasers baseline	429900	7350700	520/19020	175	212	195	192	194
3/05/2016	WP242	Frasers baseline	429502	7350501	520/19020	202	195	196		198
3/05/2016	WP243	Frasers baseline	429400	7350503	520/19020	205	189	197		197
3/05/2016	WP244	Frasers baseline	429300	7350501	520/19020	231	233	226		230
3/05/2016	WP245	Frasers baseline	429201	7350500	520/19020	315	343	334		331
3/05/2016	WP246	Frasers baseline	429100	7350499	520/19020	202	194	211		202
3/05/2016	WP247	Frasers baseline	429000	7350300	520/19020	243	274	286		268
3/05/2016	WP248	Frasers baseline	429100	7350301	520/19020	262	269	263		265
3/05/2016	WP249	Frasers baseline	429201	7350302	520/19020	258	237	232		242
3/05/2016	WP250	Frasers baseline	429301	7350300	520/19020	195	187	210		197
3/05/2016	WP251	Frasers baseline	429401	7350301	520/19020	204	198	175	178	189
21/08/2016	AUER29	Pre drilling, FSW	424580	7350130	10870/19018	253	259	244		252
21/08/2016	AUER30	Pre drilling, FSW	424600	7350180	10870/19018	216	229	204		216
21/08/2016	AUER02	Pre drilling, FSW	424540	7350030	10870/19018	334	354	324		337
21/08/2016	AUER01	Pre drilling, FSW	424535	7350080	10870/19018	291	316	276		294
21/08/2016	AUER03	Pre drilling, FSW	424515	7349980	10870/19018	252	243	246		247
21/08/2016	AUER04	Pre drilling, FSW	424480	7349930	10870/19018	304	327	301		311
21/08/2016	AUER05	Pre drilling, FSW	424415	7349880	10870/19018	225	247	252		241

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
21/08/2016	AUER06	Pre drilling, FSW	424400	7349830	10870/19018	244	232	222		233
21/08/2016	AUER07	Pre drilling, FSW	424380	7349780	10870/19018	294	294	301		296
21/08/2016	AUER08	Pre drilling, FSW	424340	7349730	10870/19018	274	234	229		246
21/08/2016	AUER09	Pre drilling, FSW	424280	7349680	10870/19018	261	274	291		275
21/08/2016	AUER10	Pre drilling, FSW	424250	7349615	10870/19018	234	235	237		235
21/08/2016	AUER11	Pre drilling, FSW	424240	7349580	10870/19018	223	234	225		227
21/08/2016	AUER12	Pre drilling, FSW	424210	7349540	10870/19018	213	264	213	216	227
21/08/2016	AUER13	Pre drilling, FSW	424180	7349480	10870/19018	259	261	264		261
21/08/2016	AUER14	Pre drilling, FSW	424170	7349430	10870/19018	228	210	204		214
21/08/2016	AUER15	Pre drilling, FSW	424155	7349380	10870/19018	210	196	192		199
21/08/2016	AUER16	Pre drilling, FSW	424160	7349330	10870/19018	265	231	207	243	237
21/08/2016	AUER17	Pre drilling, FSW	424140	7349280	10870/19018	190	177	189		185
21/08/2016	AUER18	Pre drilling, FSW	424125	7349230	10870/19018	195	222	190		202
21/08/2016	AUER19	Pre drilling, FSW	424100	7349180	10870/19018	240	222	253		238
21/08/2016	AUER20	Pre drilling, FSW	424085	7349130	10870/19018	204	220	192		205
21/08/2016	AUER21	Pre drilling, FSW	424070	7349080	10870/19018	225	208	231		221
21/08/2016	AUER22	Pre drilling, FSW	424060	7349030	10870/19018	220	261	243		241
21/08/2016	AUER23	Pre drilling, FSW	424050	7348980	10870/19018	225	198	201		208
21/08/2016	AUER24	Pre drilling, FSW	424020	7348930	10870/19018	238	244	253		245
21/08/2016	AUER25	Pre drilling, FSW	423985	7348880	10870/19018	235	243	231		236
21/08/2016	AUER26	Pre drilling, FSW	423960	7348830	10870/19018	271	255	244		257
21/08/2016	AUER27	Pre drilling, FSW	423930	7348780	10870/19018	243	219	213		225

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
22/08/2016	FSW35	Pre drilling, FSW	424025	7348410	10870/19018	235	210	225		223
22/08/2016	FSW34	Pre drilling, FSW	424045	7348420	10870/19018	219	229	228		225
22/08/2016	FSW32	Pre drilling, FSW	424050	7348395	10870/19018	321	337	336		331
22/08/2016	FSW31	Pre drilling, FSW	424030	7348390	10870/19018	360	328	370		353
22/08/2016	FSW33	Pre drilling, FSW	424065	7348400	10870/19018	214	238	219		224
22/08/2016	FSW36	Pre drilling, FSW	424015	7348405	10870/19018	246	264	280		263
22/08/2016	FSW37	Pre drilling, FSW	424045	7348330	10870/19018	231	270	256		252
22/08/2016	FSW38	Pre drilling, FSW	424025	7348330	10870/19018	249	231	234		238
22/08/2016	FSW39	Pre drilling, FSW	424000	7348330	10870/19018	240	250	244		245
22/08/2016	FSW42	Pre drilling, FSW	424020	7348285	10870/19018	201	184	207		197
22/08/2016	FSW41	Pre drilling, FSW	424040	7348300	10870/19018	175	208	198		194
22/08/2016	FSW40	Pre drilling, FSW	424060	7348315	10870/19018	249	228	225		234
22/08/2016	FSW43	Pre drilling, FSW	424130	7347710	10870/19018	193	192	216		200
22/08/2016	FSW44	Pre drilling, FSW	424090	7347700	10870/19018	180	220	216	216	208
22/08/2016	FSW45	Pre drilling, FSW	424050	7347680	10870/19018	220	226	204		217
22/08/2016	FSW46	Pre drilling, FSW	424010	7347660	10870/19018	250	258	240		249
22/08/2016	FSW47	Pre drilling, FSW	423970	7347640	10870/19018	261	244	244		250
22/08/2016	FSW49	Pre drilling, FSW	423900	7347600	10870/19018	250	246	244		247
29/08/2016	1	Camp - SW cnr	424600	7351850	10870/19018	171	177	183		177
29/08/2016	2	Camp - South	424625	7351850	10870/19018	184	222	187		198
29/08/2016	3	Camp - South	424650	7351850	10870/19018	204	213	186		201
29/08/2016	4	Camp - South	424675	7351850	10870/19018	198	172	214		195

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
29/08/2016	5	Camp - SE cnr	424700	7351850	10870/19018	201	187	186		191
29/08/2016	6	Camp - East	424700	7351875	10870/19018	177	195	198		190
29/08/2016	7	Camp - East	424700	7351900	10870/19018	175	183	191		183
29/08/2016	8	Camp - East	424700	7351925	10870/19018	165	157	165		162
29/08/2016	9	Camp - East	424700	7351950	10870/19018	172	180	195		182
29/08/2016	10	Camp - NE cnr	424700	7351975	10870/19018	183	153	192		176
29/08/2016	11	Camp - North	424675	7351975	10870/19018	177	172	166		172
29/08/2016	12	Camp - North	424650	7351975	10870/19018	172	160	187		173
29/08/2016	13	Camp - North	424625	7351975	10870/19018	157	183	177		172
29/08/2016	14	Camp - NW cnr	424600	7351975	10870/19018	177	150	187		171
29/08/2016	15	Camp - West	424600	7351950	10870/19018	171	183	162		172
29/08/2016	16	Camp - West	424600	7351925	10870/19018	141	162	169	166	160
29/08/2016	17	Camp - West	424600	7351900	10870/19018	160	174	174		169
17/08/2016		Gifford Creek H.S	420531	7340392	520/19020	142	151	156	129	145
17/08/2016		Road (GC HS to Camp)	421003	7341451	520/19020	167	167	145		160
17/08/2016		Road (GC HS to Camp)	421426	7342450	520/19020	154	166	154		158
17/08/2016		Road (GC HS to Camp)	422016	7343937	520/19020	140	132	149		140
17/08/2016		Road (GC HS to Camp)	422204	7346246	520/19020	191	149	198		179
17/08/2016		Road (GC HS to Camp)	423046	7348125	520/19020	183	202	187		191
17/08/2016		Road (GC HS to Camp)	424288	7351291	520/19020	184	197	187		189
1/09/2016	CAMP001	Camp baseline	421900	7346300	10870/19018	189	204	205		199

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
1/09/2016	CAMP002	Camp baseline	421800	7346300	10870/19018	208	222	225		218
1/09/2016	CAMP003	Camp baseline	421700	7346300	10870/19018	190	202	202		198
1/09/2016	CAMP004	Camp baseline	421700	7346400	10870/19018	214	222	210		215
1/09/2016	CAMP005	Camp baseline	421800	7346400	10870/19018	192	226	243	213	219
1/09/2016	CAMP006	Camp baseline	421900	7346400	10870/19018	219	241	214		225
1/09/2016	CAMP007	Camp baseline	422000	7346400	10870/19018	180	177	192		183
1/09/2016	CAMP008	Camp baseline	422000	7346500	10870/19018	177	169	151		166
1/09/2016	CAMP009	Camp baseline	421900	7346500	10870/19018	186	208	193		196
1/09/2016	CAMP010	Camp baseline	421800	7346500	10870/19018	195	199	177		190
1/09/2016	CAMP011	Camp baseline	421700	7346500	10870/19018	225	210	198		211
1/09/2016	CAMP012	Camp baseline	421600	7346500	10870/19018	204	199	225		209
1/09/2016	CAMP013	Camp baseline	421500	7346500	10870/19018	228	214	220		221
1/09/2016	CAMP014	Camp baseline	421400	7346600	10870/19018	227	243	210		227
1/09/2016	CAMP015	Camp baseline	421500	7346600	10870/19018	280	276	291		282
1/09/2016	CAMP016	Camp baseline	421600	7346600	10870/19018	201	213	195		203
1/09/2016	CAMP017	Camp baseline	421700	7346600	10870/19018	180	171	198		183
1/09/2016	CAMP018	Camp baseline	421800	7346600	10870/19018	193	196	176		188
1/09/2016	CAMP019	Camp baseline	421900	7346600	10870/19018	168	159	150		159
1/09/2016	CAMP020	Camp baseline	421800	7346700	10870/19018	169	183	180		177
1/09/2016	CAMP021	Camp baseline	421700	7346700	10870/19018	210	198	235	231	219
1/09/2016	CAMP022	Camp baseline	421600	7346700	10870/19018	217	210	192		206
1/09/2016	CAMP023	Camp baseline	421500	7346700	10870/19018	199	210	189		199
1/09/2016	CAMP024	Camp baseline	421400	7346700	10870/19018	235	217	234		229

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
1/09/2016	CAMP025	Camp baseline	421400	7346800	10870/19018	229	226	232		229
1/09/2016	CAMP026	Camp baseline	421500	7346800	10870/19018	211	183	209		201
1/09/2016	CAMP027	Camp baseline	421600	7346800	10870/19018	225	214	199		213
1/09/2016	CAMP028	Camp baseline	421500	7346900	10870/19018	252	247	225		241
1/09/2016	YAS001	Airstrip baseline	422400	7346800	10870/19018	168	156	144		156
1/09/2016	YAS002	Airstrip baseline	422200	7346800	10870/19018	171	148	157		159
1/09/2016	YAS003	Airstrip baseline	422000	7346800	10870/19018	143	132	150		142
1/09/2016	YAS004	Airstrip baseline	422000	7347000	10870/19018	147	126	139		137
1/09/2016	YAS005	Airstrip baseline	422200	7347000	10870/19018	157	135	132	142	142
1/09/2016	YAS006	Airstrip baseline	422400	7347000	10870/19018	162	123	139	155	145
1/09/2016	YAS007	Airstrip baseline	422500	7347200	10870/19018	161	148	147		152
1/09/2016	YAS008	Airstrip baseline	422300	7347200	10870/19018	144	156	157		152
1/09/2016	YAS009	Airstrip baseline	422100	7347200	10870/19018	138	147	159		148
1/09/2016	YAS010	Airstrip baseline	422100	7347400	10870/19018	138	136	157		144
1/09/2016	YAS011	Airstrip baseline	422300	7347400	10870/19018	183	169	160		171
1/09/2016	YAS012	Airstrip baseline	422500	7347400	10870/19018	135	150	147		144
1/09/2016	YAS013	Airstrip baseline	422600	7347600	10870/19018	180	150	160		163
1/09/2016	YAS014	Airstrip baseline	422400	7347600	10870/19018	174	165	180		173
1/09/2016	YAS015	Airstrip baseline	422200	7347600	10870/19018	157	165	178		167
1/09/2016	YAS016	Airstrip baseline	422200	7347800	10870/19018	240	243	222		235
1/09/2016	YAS017	Airstrip baseline	422400	7347800	10870/19018	216	222	216		218
1/09/2016	YAS018	Airstrip baseline	422600	7347800	10870/19018	162	162	181		168

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
1/09/2016	YAS019	Airstrip baseline	422600	7348000	10870/19018	162	189	168		173
1/09/2016	YAS020	Airstrip baseline	422400	7348000	10870/19018	324	256	321	300	300
1/09/2016	YAS021	Airstrip baseline	422200	7348000	10870/19018	328	357	357		347
1/09/2016	YAS022	Airstrip baseline	422200	7348200	10870/19018	181	172	190		181
1/09/2016	YAS023	Airstrip baseline	422400	7348200	10870/19018	192	184	169		182
1/09/2016	YAS024	Airstrip baseline	422600	7348200	10870/19018	186	162	183		177
1/09/2016	YAS025	Airstrip baseline	422600	7348400	10870/19018	154	141	157		151
1/09/2016	YAS026	Airstrip baseline	422400	7348400	10870/19018	168	159	148		158
1/09/2016	YAS027	Airstrip baseline	422200	7348400	10870/19018	195	180	163		179
1/09/2016	YAS028	Airstrip baseline	422200	7348600	10870/19018	150	144	175		156
1/09/2016	YAS029	Airstrip baseline	422400	7348600	10870/19018	148	210	196	188	186
1/09/2016	YAS030	Airstrip baseline	422600	7348600	10870/19018	159	175	169		168
2/09/2016	YPP001	Processing Plant baseline	428200	7353900	10870/19018	181	210	184		192
2/09/2016	YPP002	Processing Plant baseline	428200	7354000	10870/19018	213	234	194		214
2/09/2016	YPP003	Processing Plant baseline	428200	7354100	10870/19018	180	210	180		190
2/09/2016	YPP004	Processing Plant baseline	428100	7354200	10870/19018	182	208	205		198
2/09/2016	YPP005	Processing Plant baseline	428100	7354100	10870/19018	191	204	210		202
2/09/2016	YPP006	Processing Plant baseline	428100	7354000	10870/19018	192	208	185		195
2/09/2016	YPP007	Processing Plant baseline	428100	7353900	10870/19018	174	150	165		163
2/09/2016	YPP008	Processing Plant baseline	428100	7353800	10870/19018	192	217	210		206
2/09/2016	YPP009	Processing Plant baseline	428100	7353700	10870/19018	201	201	219		207
2/09/2016	YPP010	Processing Plant baseline	428100	7353600	10870/19018	168	156	189		171

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
2/09/2016	YPP011	Processing Plant baseline	428000	7353500	10870/19018	189	204	210		201
2/09/2016	YPP012	Processing Plant baseline	428000	7353600	10870/19018	168	195	187		183
2/09/2016	YPP013	Processing Plant baseline	428000	7353700	10870/19018	207	186	180		191
2/09/2016	YPP014	Processing Plant baseline	428000	7353800	10870/19018	180	204	189		191
2/09/2016	YPP015	Processing Plant baseline	428000	7353900	10870/19018	210	193	189		197
2/09/2016	YPP016	Processing Plant baseline	428000	7354000	10870/19018	215	207	213		212
2/09/2016	YPP017	Processing Plant baseline	428000	7354100	10870/19018	195	201	199		198
2/09/2016	YPP018	Processing Plant baseline	428000	7354200	10870/19018	225	211	222		219
2/09/2016	YPP019	Processing Plant baseline	427900	7354300	10870/19018	208	213	193		205
2/09/2016	YPP020	Processing Plant baseline	427900	7354200	10870/19018	186	199	187		191
2/09/2016	YPP021	Processing Plant baseline	427900	7354100	10870/19018	177	201	186		188
2/09/2016	YPP022	Processing Plant baseline	427900	7354000	10870/19018	222	193	202		206
2/09/2016	YPP023	Processing Plant baseline	427900	7353900	10870/19018	198	192	171		187
2/09/2016	YPP024	Processing Plant baseline	427900	7353800	10870/19018	201	174	198		191
2/09/2016	YPP025	Processing Plant baseline	427900	7353700	10870/19018	169	168	178		172
2/09/2016	YPP026	Processing Plant baseline	427900	7353600	10870/19018	168	178	157		168
2/09/2016	YPP027	Processing Plant baseline	427900	7353500	10870/19018	174	180	178		177
2/09/2016	YPP028	Processing Plant baseline	427900	7353400	10870/19018	162	177	174		171
2/09/2016	YPP029	Processing Plant baseline	427800	7353300	10870/19018	168	171	168		169
2/09/2016	YPP030	Processing Plant baseline	427800	7353400	10870/19018	156	183	161		167
2/09/2016	YPP031	Processing Plant baseline	427800	7353500	10870/19018	171	174	168		171
2/09/2016	YPP032	Processing Plant baseline	427800	7353600	10870/19018	159	195	183	183	180
2/09/2016	YPP033	Processing Plant baseline	427800	7353700	10870/19018	201	192	195		196

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
2/09/2016	YPP034	Processing Plant baseline	427800	7353800	10870/19018	186	201	199		195
2/09/2016	YPP035	Processing Plant baseline	427800	7353900	10870/19018	181	199	186		189
2/09/2016	YPP036	Processing Plant baseline	427800	7354000	10870/19018	240	222	216		226
2/09/2016	YPP037	Processing Plant baseline	427800	7354100	10870/19018	213	220	225		219
2/09/2016	YPP038	Processing Plant baseline	427800	7354200	10870/19018	207	202	226		212
2/09/2016	YPP039	Processing Plant baseline	427800	7354300	10870/19018	204	208	186		199
2/09/2016	YPP040	Processing Plant baseline	427700	7354300	10870/19018	207	201	187		198
2/09/2016	YPP041	Processing Plant baseline	427700	7354200	10870/19018	196	174	180		183
2/09/2016	YPP042	Processing Plant baseline	427700	7354100	10870/19018	192	193	207		197
2/09/2016	YPP043	Processing Plant baseline	427700	7354000	10870/19018	229	216	183	186	204
2/09/2016	YPP044	Processing Plant baseline	427700	7353900	10870/19018	207	207	196		203
2/09/2016	YPP045	Processing Plant baseline	427700	7353800	10870/19018	187	190	192		190
2/09/2016	YPP046	Processing Plant baseline	427700	7353700	10870/19018	181	178	168		176
2/09/2016	YPP047	Processing Plant baseline	427700	7353600	10870/19018	186	171	186		181
2/09/2016	YPP048	Processing Plant baseline	427700	7353500	10870/19018	180	204	204		196
2/09/2016	YPP049	Processing Plant baseline	427700	7353400	10870/19018	171	184	163		173
2/09/2016	YPP050	Processing Plant baseline	427700	7353300	10870/19018	153	165	168		162
2/09/2016	YPP051	Processing Plant baseline	427600	7353300	10870/19018	186	159	175		173
2/09/2016	YPP052	Processing Plant baseline	427600	7353400	10870/19018	172	171	180		174
2/09/2016	YPP053	Processing Plant baseline	427600	7353500	10870/19018	177	177	192		182
2/09/2016	YPP054	Processing Plant baseline	427600	7353600	10870/19018	186	177	169		177
2/09/2016	YPP055	Processing Plant baseline	427600	7353700	10870/19018	168	163	174		168
2/09/2016	YPP056	Processing Plant baseline	427600	7353800	10870/19018	190	216	192		199

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
2/09/2016	YPP057	Processing Plant baseline	427600	7353900	10870/19018	252	192	207	188	210
2/09/2016	YPP058	Processing Plant baseline	427600	7354000	10870/19018	213	190	207		203
2/09/2016	YPP059	Processing Plant baseline	427600	7354100	10870/19018	205	184	192		194
2/09/2016	YPP060	Processing Plant baseline	427600	7354200	10870/19018	181	186	162		176
2/09/2016	YPP061	Processing Plant baseline	427600	7354300	10870/19018	189	183	184		185
2/09/2016	YPP062	Processing Plant baseline	427500	7354300	10870/19018	226	210	223		220
2/09/2016	YPP063	Processing Plant baseline	427500	7354200	10870/19018	189	187	178		185
2/09/2016	YPP064	Processing Plant baseline	427500	7354100	10870/19018	152	177	148		159
2/09/2016	YPP065	Processing Plant baseline	427500	7354000	10870/19018	201	216	195		204
2/09/2016	YPP066	Processing Plant baseline	427500	7353900	10870/19018	174	180	174		176
2/09/2016	YPP067	Processing Plant baseline	427500	7353800	10870/19018	162	174	174		170
2/09/2016	YPP068	Processing Plant baseline	427500	7353700	10870/19018	172	178	156		169
2/09/2016	YPP069	Processing Plant baseline	427500	7353600	10870/19018	165	151	151		156
2/09/2016	YPP070	Processing Plant baseline	427500	7353500	10870/19018	184	166	141	159	163
2/09/2016	YPP071	Processing Plant baseline	427500	7353400	10870/19018	213	217	201		210
2/09/2016	YPP072	Processing Plant baseline	427500	7353300	10870/19018	174	177	198		183
2/09/2016	YPP073	Processing Plant baseline	427400	7353300	10870/19018	159	177	148		161
2/09/2016	YPP074	Processing Plant baseline	427400	7353400	10870/19018	160	184	150	145	160
2/09/2016	YPP075	Processing Plant baseline	427400	7353500	10870/19018	153	159	156		156
2/09/2016	YPP076	Processing Plant baseline	427400	7353600	10870/19018	159	159	168		162
2/09/2016	YPP077	Processing Plant baseline	427400	7353700	10870/19018	204	226	211		214
3/09/2016	YPP078	Processing Plant baseline	427400	7353800	10870/19018	148	153	151		151
3/09/2016	YPP079	Processing Plant baseline	427400	7353900	10870/19018	148	168	171		162

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
3/09/2016	YPP080	Processing Plant baseline	427400	7354000	10870/19018	153	144	150		149
3/09/2016	YPP081	Processing Plant baseline	427400	7354100	10870/19018	192	175	190		186
3/09/2016	YPP082	Processing Plant baseline	427400	7354200	10870/19018	241	244	232		239
3/09/2016	YPP083	Processing Plant baseline	427300	7354200	10870/19018	247	210	241		233
3/09/2016	YPP084	Processing Plant baseline	427300	7354100	10870/19018	193	168	177		179
3/09/2016	YPP085	Processing Plant baseline	427300	7354000	10870/19018	156	172	172		167
3/09/2016	YPP086	Processing Plant baseline	427300	7353900	10870/19018	207	181	184		191
3/09/2016	YPP087	Processing Plant baseline	427300	7353800	10870/19018	192	174	175		180
3/09/2016	YPP088	Processing Plant baseline	427300	7353700	10870/19018	207	204	217		209
3/09/2016	YPP089	Processing Plant baseline	427300	7353600	10870/19018	129	157	154		147
3/09/2016	YPP090	Processing Plant baseline	427300	7353500	10870/19018	172	198	199		190
3/09/2016	YPP091	Processing Plant baseline	427300	7353400	10870/19018	172	189	200		187
3/09/2016	YPP092	Processing Plant baseline	427300	7353300	10870/19018	196	240	222		219
3/09/2016	YPP093	Processing Plant baseline	427200	7353200	10870/19018	198	175	172		182
3/09/2016	YPP094	Processing Plant baseline	427200	7353300	10870/19018	192	189	198		193
3/09/2016	YPP095	Processing Plant baseline	427200	7353400	10870/19018	199	202	190		197
3/09/2016	YPP096	Processing Plant baseline	427200	7353500	10870/19018	189	198	199		195
3/09/2016	YPP097	Processing Plant baseline	427200	7353600	10870/19018	174	180	184		179
3/09/2016	YPP098	Processing Plant baseline	427200	7353700	10870/19018	171	156	171		166
3/09/2016	YPP099	Processing Plant baseline	427200	7353800	10870/19018	168	156	150		158
3/09/2016	YPP100	Processing Plant baseline	427200	7353900	10870/19018	169	156	171		165
3/09/2016	YPP101	Processing Plant baseline	427200	7354000	10870/19018	219	210	192		207
3/09/2016	YPP102	Processing Plant baseline	427200	7354100	10870/19018	189	186	181		185

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
3/09/2016	YPP103	Processing Plant baseline	427100	7354000	10870/19018	163	171	181		172
3/09/2016	YPP104	Processing Plant baseline	427100	7353900	10870/19018	153	166	177		165
3/09/2016	YPP105	Processing Plant baseline	427100	7353800	10870/19018	186	151	169		169
3/09/2016	YPP106	Processing Plant baseline	427100	7353700	10870/19018	183	157	166		169
3/09/2016	YPP107	Processing Plant baseline	427100	7353600	10870/19018	162	153	174		163
3/09/2016	YPP108	Processing Plant baseline	427100	7353500	10870/19018	178	174	180		177
3/09/2016	YPP109	Processing Plant baseline	427100	7353400	10870/19018	165	168	157		163
3/09/2016	YPP110	Processing Plant baseline	427100	7353300	10870/19018	171	159	183		171
3/09/2016	YPP111	Processing Plant baseline	427100	7353200	10870/19018	165	148	163		159
3/09/2016	YPP112	Processing Plant baseline	427000	7353200	10870/19018	178	189	169		179
3/09/2016	YPP113	Processing Plant baseline	427000	7353300	10870/19018	204	204	213		207
3/09/2016	YPP114	Processing Plant baseline	427000	7353400	10870/19018	202	186	186		191
3/09/2016	YPP115	Processing Plant baseline	427000	7353500	10870/19018	172	193	186		184
3/09/2016	YPP116	Processing Plant baseline	427000	7353600	10870/19018	198	161	144	172	169
3/09/2016	YPP117	Processing Plant baseline	427000	7353700	10870/19018	163	190	165		173
3/09/2016	YPP118	Processing Plant baseline	427000	7353800	10870/19018	171	168	186		175
3/09/2016	YPP119	Processing Plant baseline	427000	7353900	10870/19018	178	186	181		182
3/09/2016	YPP120	Processing Plant baseline	427000	7354000	10870/19018	225	216	216		219
3/09/2016	YPP121	Processing Plant baseline	426900	7354000	10870/19018	213	249	225		229
3/09/2016	YPP122	Processing Plant baseline	426900	7353900	10870/19018	189	201	198		196
3/09/2016	YPP123	Processing Plant baseline	426900	7353800	10870/19018	277	282	310		290
3/09/2016	YPP124	Processing Plant baseline	426900	7353700	10870/19018	186	180	174		180
3/09/2016	YPP125	Processing Plant baseline	426900	7353600	10870/19018	201	175	177		184

Date	Point	Point Description	GPS Coordinates		Serial Nos.	Gamma Readings (cpm)				Mean Value (cpm)
			Easting	Northing	Monitor/ Detector	Reading 1	Reading 2	Reading 3	Reading 4	
3/09/2016	YPP126	Processing Plant baseline	426900	7353500	10870/19018	207	213	198		206
3/09/2016	YPP127	Processing Plant baseline	426900	7353400	10870/19018	208	177	196		194
3/09/2016	YPP128	Processing Plant baseline	426900	7353300	10870/19018	225	222	213		220
3/09/2016	YPP129	Processing Plant baseline	426800	7353400	10870/19018	204	207	210		207
3/09/2016	YPP130	Processing Plant baseline	426800	7353500	10870/19018	219	199	201		206
3/09/2016	YPP131	Processing Plant baseline	426800	7353600	10870/19018	193	192	216		200
3/09/2016	YPP132	Processing Plant baseline	426800	7353700	10870/19018	186	195	189		190
3/09/2016	YPP133	Processing Plant baseline	426800	7353800	10870/19018	204	205	213		207
3/09/2016	YPP134	Processing Plant baseline	426800	7353900	10870/19018	243	256	255		251
3/09/2016	YPP135	Processing Plant baseline	426700	7353800	10870/19018	175	175	195		182
3/09/2016	YPP136	Processing Plant baseline	426700	7353700	10870/19018	159	168	168		165
3/09/2016	YPP137	Processing Plant baseline	426700	7353600	10870/19018	175	196	180		184
3/09/2016	YPP138	Processing Plant baseline	426700	7353500	10870/19018	181	202	198		194
3/09/2016	YPP139	Processing Plant baseline	426600	7353600	10870/19018	160	183	198		180
3/09/2016	YPP140	Processing Plant baseline	426600	7353700	10870/19018	171	172	190		178

Radiometric Survey

Surveys were completed by Southern Geoscience Consultants, and images were generated and supplied by Hastings for this report.

Positional Gamma

Badge Number	Location	Badge Start Date	Badge End Date	Radiation Type	Monitor Dose (µGy)
M1519-34414	WP144 - Yangibana North Bag Farm	21/06/2015	11/11/2015	Photon	380
M1542-093314	WP80 - Gifford Creek H.S.	2/11/2015	4/05/2016	Photon	390
M1542-093315	WP144 - Yangibana North Bag Farm	2/11/2015	4/05/2016	Photon	850
M1542-093316	WP119 - Yangibana North	2/11/2015	4/05/2016	Photon	4520
M1617-85665	WP281 - Bald Hill South	26/05/2016	4/09/2016	Photon	820
M1617-85666	WP282 - Bald Hill East	26/05/2016	4/09/2016	Photon	900
M1617-85667	WP286 - Frasers East	26/05/2016	4/09/2016	Photon	450
M1617-85668	WP287 - Frasers South	26/05/2016	4/09/2016	Photon	480
M1617-85669	WP289 - Frasers North	26/05/2016	4/09/2016	Photon	430
M1617-85671	WP194 - Hatchet West	26/05/2016	4/09/2016	Photon	340
M1617-85672	WP22 - Bald Hill North A	26/05/2016	4/09/2016	Photon	540
M1617-85673	WP80 - Gifford Creek H.S.	26/05/2016	4/09/2016	Photon	180
M1617-85674	WP256 - Frasers West A	26/05/2016	4/09/2016	Photon	1470
M1617-85675	WP119 - Yangibana North	26/05/2016	4/09/2016	Photon	3370
M1617-85676	WP144 - Yangibana North Bag Farm	26/05/2016	4/09/2016	Photon	570

Atmospheric Dusts (Long Lived Alpha Activity)

Sample ID	Location	Easting	Northing	Date of Sample	Filter Activity (aBq)	Runtime (min)	Average Flow ($L.min^{-1}$)	MDL (aBq)
RP104	Bald Hill Bag Farm			27/05/2015	<MDL	445	1.95	0.009
RP115	Bald Hill Background			25/05/2015	<MDL	510	2.10	0.009
RP300	WP80 - Gifford Creek H.S.	420527	7340392	19/06/2015	<MDL	525	3.00	0.009
RP-006	WP22 - Bald Hill North A	428415	7356774	1/05/2016	<MDL	440	1.95	0.009
RP-001	WP80 - Gifford Creek H.S.	420527	7340392	2/05/2016	<MDL	515	1.95	0.009
RP-002	WP194 - Hatchet West	423450	7354926	2/05/2016	<MDL	420	1.95	0.009
RP-004	WP22 - Bald Hill North A	423411	7356774	2/05/2016	<MDL	290	1.95	0.009
RP-104	WP32 - Bald Hill Central	428307	7356238	2/05/2016	<MDL	275	1.93	0.009
RP-008	WP80 - Gifford Creek H.S.	420527	7340392	3/05/2016	<MDL	500	1.95	0.009
RP-205	WP194 - Hatchet West	423450	7354926	3/05/2016	<MDL	500	1.95	0.009
RP-019	WP256 - Frasers West A	429438	7351036	3/05/2016	<MDL	415	1.95	0.009
RP-000	WP80 - Gifford Creek H.S.	420527	7340392	4/05/2016	<MDL	515	1.95	0.009
RP-102	WP256 - Frasers West A	429438	7351036	4/05/2016	<MDL	430	2.00	0.009
RP-201	WP194 - Hatchet West	423450	7354926	4/05/2016	<MDL	370	1.90	0.009
RP-109	WP144 - Yangibana North (Bag Farm)	417715	7362298	4/05/2016	<MDL	370	1.95	0.009
RP-214	WP119 - Yangibana North	417198	7362472	4/05/2016	<MDL	245	1.95	0.009
RP-100	WP32 - Bald Hill Central	428307	7356238	12/08/2016	<MDL	450	3.00	0.009
RP-104	WP282 - Bald Hill East	428356	7356169	13/08/2016	<MDL	458	3.00	0.009
RP-105	Bald Hill (WP174)	428100	7356301	14/08/2016	<MDL	470	3.00	0.009
RP-013	Frasers			15/08/2016	<MDL	655	3.00	0.009

Sample ID	Location	Easting	Northing	Date of Sample	Filter Activity (aBq)	Runtime (min)	Average Flow ($L.min^{-1}$)	MDL (aBq)
RP-309	WP144 - Yangibana North (Bag Farm)	417715	7362298	16/08/2016	<MDL	490	3.00	0.009
RP-001	Auer access road	423800	7348000	24/08/2016	<MDL	570	2.90	0.009
RP-200	Temporary Camp 2016	424600	7351920	29/08/2016	<MDL	625	2.95	0.009
RP-002	Proposed Process Plant (YP033)	427800	7353700	2/09/2016	<MDL	310	3.00	0.009

Radon and Thoron

Radtrak Passive Radon/Thoron Detectors

Detector Number	Detector Type	Start Date	End Date	Location	Exposure (pCi/day)	Exposure ($Bq.m^{-3}.day^{-1}$)	Avg. Radon Conc. ($Bq.m^{-3}$)	Avg. Thoron Conc. ($Bq.m^{-3}$)
4917710	Radon	17/06/2015	11/11/2015	WP22 - Bald Hill North A	*30.0	1110	*8	
4942231	Radon/Thoron	17/06/2015	11/11/2015	WP22 - Bald Hill North A	73.7 ± 5.59	2728		14.6
4917645	Radon	17/06/2015	11/11/2015	WP32 - Bald Hill Central	*30.0	1110	*8	
4942340	Radon/Thoron	17/06/2015	11/11/2015	WP32 - Bald Hill Central	94.1 ± 6.72	3483		21.4
4917390	Radon	18/06/2015	11/11/2015	WP119 - Yangibana North	54.6 ± 4.01	2021	14	
4942295	Radon/Thoron	18/06/2015	11/11/2015	WP119 - Yangibana North	143.5 ± 9.1	5308		29.8
4917368	Radon	19/06/2015	11/11/2015	WP144 - Yang North Bag Farm	*30.0	1110	*8	
4942209	Radon/Thoron	19/06/2015	11/11/2015	WP144 - Yang North Bag Farm	92.3 ± 6.63	3415		21.0
4917421	Radon	20/06/2015	11/11/2015	WP80 - Gifford Creek H.S	*30.0	1110	*8	
4942311	Radon/Thoron	20/06/2015	11/11/2015	WP80 - Gifford Creek H.S	66.3 ± 5.15	2454		12.4
4917638	Radon	17/06/2015	2/05/2016	WP32 - Bald Hill Central	** Monitor Damaged			
4942399	Radon/Thoron	17/06/2015	2/05/2016	WP32 - Bald Hill Central	328.6 ± 15.2	12158		
4917709	Radon	11/11/2015	2/05/2016	WP22 - Bald Hill North A - a	36.0 ± 2.68	1332	8	
4942384	Radon/Thoron	11/11/2015	2/05/2016	WP22 - Bald Hill North A - a	139.9 ± 8.6	5176		29.4
4917610	Radon	11/11/2015	2/05/2016	WP22 - Bald Hill North A - b	65.8 ± 4.51	2436	14	
4942240	Radon/Thoron	11/11/2015	2/05/2016	WP22 - Bald Hill North A - b	147.4 ± 8.9	5452		23.1
4917665	Radon	11/11/2015	2/05/2016	WP80 - Gifford Creek H.S	50.5 ± 3.60	1867	11	
4942232	Radon/Thoron	11/11/2015	2/05/2016	WP80 - Gifford Creek H.S	100.8 ± 6.7	3730		14.3

Detector Number	Detector Type	Start Date	End Date	Location	Exposure (pCi/day)	Exposure ($Bq.m^{-3}.day^{-1}$)	Avg. Radon Conc. ($Bq.m^{-3}$)	Avg. Thoron Conc. ($Bq.m^{-3}$)
4942336	Radon	11/11/2015	4/05/2016	WP144 – Yang North Bag Farm	** Monitor Damaged			
4942277	Radon/Thoron	11/11/2015	4/05/2016	WP144 - Yang North Bag Farm	** Monitor Damaged			0.0
4917588	Radon	11/11/2015	25/05/2016	WP119 - Yangibana North	** Monitor Damaged			
4942218	Radon/Thoron	11/11/2015	25/05/2016	WP119 - Yangibana North	294.2 ± 14.1	10885		
5508141	Radon	25/05/2016	4/09/2016	WP119 - Yangibana North	*<MDL		*<MDL	17.2
4992993	Radon/Thoron	25/05/2016	4/09/2016	WP119 - Yangibana North	65.1±5.32	2410		
5508164	Radon	4/05/2016	4/09/2016	WP144 – Yang North Bag Farm	*<MDL	1110	*<MDL	*<MDL
4993033	Radon/Thoron	4/05/2016	4/09/2016	WP144 - Yang North Bag Farm	*<MDL	1110		
5508135	Radon	25/05/2016	4/09/2016	WP283 - Bald Hill West	*<MDL	1110	*<MDL	18.5
4992987	Radon/Thoron	25/05/2016	4/09/2016	WP283 - Bald Hill West	69.9±5.62	2587		
5508158	Radon	25/05/2016	4/09/2016	WP283 - Bald Hill West	*<MDL	1110	*<MDL	19.9
4993006	Radon/Thoron	25/05/2016	4/09/2016	WP283 - Bald Hill West	71.8±5.73	2658		
5508124	Radon	2/05/2016	4/09/2016	WP32 - Bald Hill Central	*<MDL	1110	*<MDL	34.4
4992985	Radon/Thoron	2/05/2016	4/09/2016	WP32 - Bald Hill Central	119.8±8.3	4433		
5508143	Radon	25/05/2016	4/09/2016	WP281 - Bald Hill South	*<MDL	1110	*<MDL	27.8
4993000	Radon/Thoron	25/05/2016	4/09/2016	WP281 - Bald Hill South	88.1±6.68	3261		
5508156	Radon	25/05/2016	4/09/2016	WP282 - Bald Hill East	*<MDL	1110	*<MDL	37.1
4993007	Radon/Thoron	25/05/2016	4/09/2016	WP282 - Bald Hill East	108.3±7.8	4007		
5508138	Radon	25/05/2016	4/09/2016	WP284 - Bald Hill North B	*<MDL	1110	*<MDL	9.3
4992990	Radon/Thoron	25/05/2016	4/09/2016	WP284 - Bald Hill North B	48.9±4.24	1808		
5508155	Radon	2/05/2016	4/09/2016	WP22 - Bald Hill North A	*<MDL	1110	*<MDL	33.1

Detector Number	Detector Type	Start Date	End Date	Location	Exposure (pCi/day)	Exposure ($Bq.m^{-3}.day^{-1}$)	Avg. Radon Conc. ($Bq.m^{-3}$)	Avg. Thoron Conc. ($Bq.m^{-3}$)
4992992	Radon/Thoron	2/05/2016	4/09/2016	WP22 - Bald Hill North A	114.1±8.0	4220		
5508131	Radon	2/05/2016	4/09/2016	WP194 - Hatchet West	61.0±5.12	2255	18	*<MDL
4993063	Radon/Thoron	2/05/2016	4/09/2016	WP194 - Hatchet West	66.1±5.38	2446		
5508221	Radon	4/05/2016	4/09/2016	WP256 - Frasers West A	*<MDL	1110	*<MDL	15.9
4993026	Radon/Thoron	4/05/2016	4/09/2016	WP256 - Frasers West A	69.0±5.56	2552		
5508169	Radon	26/05/2016	4/09/2016	WP289 - Frasers North	*<MDL	1110	*<MDL	62.2
4992996	Radon/Thoron	26/05/2016	4/09/2016	WP289 - Frasers North	158.3±10.1	5858		
5508152	Radon	2/05/2016	4/09/2016	WP80 - Gifford Creek H.S	*<MDL	1110	*<MDL	19.9
4993012	Radon/Thoron	2/05/2016	4/09/2016	WP80 - Gifford Creek H.S	80.5±6.25	2977		
5508174	Radon	26/05/2016	15/09/2016	WP290 - Frasers West B	*<MDL	1110	*<MDL	39.7
4993022	Radon/Thoron	26/05/2016	15/09/2016	WP290 - Frasers West B	121.7±8.4	4504		
5508149	Radon	26/05/2016	15/09/2016	WP286 - Frasers East	*<MDL	1110	*<MDL	23.8
4992995	Radon/Thoron	26/05/2016	15/09/2016	WP286 - Frasers East	84.3±6.47	3119		
5508145	Radon	26/05/2016	15/09/2016	WP287 - Frasers South	*<MDL	1110	*<MDL	*<MDL
4992988	Radon/Thoron	26/05/2016	15/09/2016	WP287 - Frasers South	39.3±3.55	1455		

Water Quality

Groundwater

Analysis of regional groundwater samples collected by ATC Williams was completed by Analytical Reference Laboratories (2015) and provided to Radiation Professionals by ATC Williams:

Sample Description		Edmund HST	Minga Well	Contessi Bore	Edmund Well	YGBWBI	RCO81	Frasers Well	Yangibana Bore	Woodsys Bore	Red Hill 2
Aluminium - Total	mg/L	<0.1	<0.1	<0.1	0.2	0.2	1.8	<0.1	<0.1	<0.1	0.9
Iron - Total	mg/L	0.15	0.07	0.03	0.22	0.34	2.3	0.02	0.02	<0.01	1.5
Sulphur - Dissolved	mg/L	96	38	17	110	25	35	52	60	79	250
Calcium - Dissolved	mg/L	66	39	30	79	61	60	47	120	110	250
Magnesium - Dissolved	mg/L	90	58	48	100	38	43	40	75	110	130
Sodium - Dissolved	mg/L	280	150	70	610	150	340	550	350	380	620
Aluminium - Dissolved	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	0.8	<0.1	<0.1	<0.1	<0.1
Barium - Dissolved	mg/L	0.02	0.04	0.16	0.04	0.23	0.08	0.04	0.03	0.03	0.07
Beryllium - Dissolved	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Boron - Dissolved	mg/L	1	0.5	0.26	1.4	0.36	0.61	0.83	0.55	0.8	2.1
Chromium - Dissolved	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium - Dissolved	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cobalt - Dissolved	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper - Dissolved	mg/L	<0.01	<0.01	0.02	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron - Dissolved	mg/L	0.07	<0.01	<0.01	<0.01	<0.01	0.26	<0.01	<0.01	<0.01	0.19
Lead - Dissolved	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Manganese - Dissolved	mg/L	<0.01	<0.01	<0.01	<0.01	0.07	0.01	<0.01	<0.01	<0.01	0.87
Molybdenum - Dissolved	mg/L	<0.01	0.01	0.01	0.01	0.03	0.02	0.02	<0.01	<0.01	0.01
Nickel - Dissolved	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver - Dissolved	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium - Dissolved	mg/L	0.76	0.41	0.3	1.1	0.52	0.58	0.52	0.92	0.82	2.2
Tin - Dissolved	mg/L	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Sample Description		Edmund HST	Minga Well	Contessi Bore	Edmund Well	YGBWBI	RCO81	Frasers Well	Yangibana Bore	Woodsys Bore	Red Hill 2
Titanium - Dissolved	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01
Vanadium - Dissolved	mg/L	0.04	0.05	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Zinc - Dissolved	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony - Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic - Dissolved	mg/L	0.003	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.004
Selenium - Dissolved	mg/L	0.007	0.003	<0.001	0.003	0.005	0.008	0.005	0.005	0.003	<0.001
Silicon - Dissolved	mg/L	32	36	30	23	24	20	24	23	26	31
Thorium - Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium - Dissolved	mg/L	0.004	0.004	0.02	0.038	0.016	0.014	0.025	0.029	0.009	0.079
pH	pH units	8.6	8.2	8.5	7.9	7.8	7.4	8	7.5	7.7	7.2
Total Dissolved Solids	mg/L	1400	920	600	2200	870	1300	1600	1600	1800	2800
Total Suspended Solids	mg/L	<5	<5	7	17	5	84	<5	<5	<5	76
Alkalinity	mg$CaCO_3$/L	300	520	360	430	300	370	410	360	440	440
Alkalinity to pH9.5	mg$CaCO_3$/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Acidity to pH9.5	mgCaCO3/L	82	120	77	130	95	110	93	120	140	200
Total Phosphorus	mg/L	0.09	0.12	0.06	0.07	0.13	0.11	0.14	0.04	0.12	0.39
Sulphate	mg/L	330	110	45	320	73	100	160	180	250	830
Chloride	mg/L	270	110	95	810	240	410	570	530	590	710
Fluoride	mg/L	1.4	2.3	2.5	2.9	2.1	3	3	2.2	1.3	4
Nitrate-N	mg/L	8.97	6.5	0.05	17	11	21	12	18	12.98	<0.01
Hardness	mg$CaCO_3$/L	535	336	273	609	309	327	282	608	728	1160

Analysis of the sample collected by Radiation Professionals from within the Project area was completed by ESR Laboratories, New Zealand (2015). Results of this analysis are tabulated in the body of the report (Table 10).

Analysis of groundwater samples collected by Hastings was completed by Analytical Reference Laboratories (2016) and provided to Radiation Professionals by Hastings:

Sample Description		Windmill	Bald Hill	FR - Bore
Chloride	mg/L	460	320	510
Sulphate	mg/L	360	110	170
Nitrate-N	mg/L	15	17	11
Sodium - Dissolved	mg/L	280	240	420
Potassium - Dissolved	mg/L	15	11	9.1
Calcium - Dissolved	mg/L	160	86	53
Magnesium - Dissolved	mg/L	88	52	41
Aluminium - Total	mg/L	<0.1	<0.1	0.1
Iron - Total	mg/L	<0.01	0.19	0.84
Arsenic - Total	mg/L	0.001	<0.001	<0.001
Cadmium - Total	mg/L	<0.002	<0.002	<0.002
Chromium - Total	mg/L	<0.01	<0.01	<0.01
Copper - Total	mg/L	<0.01	<0.01	<0.01
Mercury - Total	mg/L	<0.0002	<0.0002	<0.0002
Nickel - Total	mg/L	<0.01	<0.01	<0.01
Lead - Total	mg/L	<0.01	<0.01	<0.01
Zinc - Total	mg/L	<0.01	0.03	<0.01
Selenium - Total	mg/L	0.009	0.009	0.005
Uranium - Total	mg/L	0.038	0.029	0.029
Thorium - Total	mg/L	0.001	<0.001	0.002
pH	pH units	7.5	7.3	7.3
Total Dissolved Solids	mg/L	1600	980	1400
Total Suspended Solids	mg/L	<5	<5	5
Alkalinity	mg $CaCO_3$/L	270	270	290

Surface Water

Surface water samples were analysed by Analytical Reference Laboratories (2016) and provided to Radiation Professionals by Hastings:

Sample Description		LC - Pool 800US	FR- Pool
Chloride	mg/L	430	30
Sulphate	mg/L	290	<1
Nitrate-N	mg/L	<0.01	<0.01
Sodium - Dissolved	mg/L	290	23
Potassium - Dissolved	mg/L	23	22
Calcium - Dissolved	mg/L	38	43
Magnesium - Dissolved	mg/L	88	17
Aluminium - Total	mg/L	<0.1	<0.1
Iron - Total	mg/L	0.08	0.45
Arsenic - Total	mg/L	0.001	0.002
Cadmium - Total	mg/L	<0.002	<0.002
Chromium - Total	mg/L	<0.01	<0.01
Copper - Total	mg/L	<0.01	<0.01
Mercury - Total	mg/L	<0.0002	<0.0002
Nickel - Total	mg/L	<0.01	<0.01
Lead - Total	mg/L	<0.01	<0.01
Zinc - Total	mg/L	<0.01	<0.01
Selenium - Total	mg/L	<0.001	<0.001
Uranium - Total	mg/L	0.004	0.001
Thorium - Total	mg/L	<0.001	<0.001
pH	pH units	9.6	8.1
Total Dissolved Solids	mg/L	1200	330
Total Suspended Solids	mg/L	6	<5
Alkalinity	mg $CaCO_3$/L	140	190

Soil

Sub Surface Soil

Homogeneous pulps of drilling samples were analysed using ICPMS by Intertek Genalysis to give total uranium and thorium. Splits of these samples were provided to Radiation Professionals by Hastings and were analysed using gamma spectroscopy by ESR Laboratories, New Zealand (2015) for other radionuclides. Analysis of the sample collected by Radiation Professionals from within the project area was completed by ESR Laboratories, New Zealand (2015). Results of this analysis are tabulated in the body of the report (Table 13 and Table 14).

Topsoil

Drilling samples were analysed by Intertek Genalysis using ICPMS (2014 – 2016) and results were provided to Radiation Professionals by Hastings. These results were used to give average uranium and thorium concentrations for Project areas.

Analysis of the sample collected by Radiation Professionals from within the project area was completed by ESR Laboratories, New Zealand (2015). Results of this analysis are tabulated in the body of the report (Table).