

## **APPENDIX 9.      BORTOLO RADIATION SURVEY**

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**Surface Gamma Radiation  
Survey of Part of Section 7  
(7B & 7C) of the Sand Quarry  
Site, Cabbage Tree Road,  
Williamtown, NSW**

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6/04/2021

**Bartolo Safety  
Management Service**

Laboratory, Radiation and  
Dangerous Goods Consultant



# **Surface Gamma Radiation Survey of Part of Section 7 (7B & 7C) of the Sand Quarry Site, Cabbage Tree Road, Williamtown, NSW**

**March 2021**

by  
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Date: ...6<sup>th</sup> April, 2021.

Reviewer:

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Signed:

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Date: .....

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## 1.0 Introduction

### Glossary

ARPANSA – Australian Radiation Protection Nuclear Science Agency

Becquerel – the SI unit for radioactive activity is defined as the number of disintegrations per second

EPA – Environmental Protection Agency

Gray – is the SI unit of absorbed dose). It is defined as an energy deposition of one joule per kilogram.

NORM – Naturally Occurring Radioactive Material

Sievert – is the SI unit of equivalent dose. Dose equivalent remains, by definition, the absorbed dose multiplied by the quality factor, Q.

TENORM – Technically Enhanced Naturally Occurring Radioactive Material

## 1.1 Site Description

The site (see Appendix 1), Cabbage Tree Road site Williamtown, has been partly sand mined and is generally an undulating site.

The area Under consideration is deemed as part of Section 7 (7B & 7C) and is being quarried for the sand for use in construction etc.

The site has a total area of approx. 3.6 ha and the survey measurements were taken on 24<sup>th</sup> March 2021.

Additionally, there has been some import in the past of other material to form the access roads, etc.



## 1.2 Purpose

The purpose of this project is to determine if there is any remaining deposits of heavy mineral sands and their associated radioactivity, either left as not being mined or due to man's activities such as stock-piling, vehicle wash-downs or track consolidation.

## 1.3 Scope

The scope of the work being undertaken by Bartolo Safety Management Service is the Geotechnic Surface Gamma Radiation Survey (where the terrain and vegetation permits). Any situations elucidated during the survey will not be part of this work.

Radiological exposure of non-human species was not included within the scope of this assessment, nor was assessment of non-radiological contaminants.

## 1.4 Information and Reference Material

### General

Natural radionuclide content in soil can vary significantly as evidenced by the following ranges of global median values: 16-110 Bq/kg for uranium-238, 11-64 Bq/kg for thorium-232 and 140-850 Bq/kg for potassium-40[3]. Mineral sands can have enhanced concentrations of the naturally occurring radionuclides uranium-238 and thorium-232, as well as their associated decay progeny, which can result in elevated terrestrial air kerma rates. In-situ processing of mineral sands typically separates sands of varying mineralogy by mass, magnetic and electrostatic properties; the main constituents include rutile, ilmenite, zircon, garnet and monazite. A dataset of uranium-238 and thorium-232 concentrations in heavy mineral sands is listed in Table 1.

**TABLE 1:** Typical specific activity concentrations of uranium and thorium in commercially available South East Queensland mineral sands (adapted from Johnston, 1988)<sup>[4]</sup>.

MINERAL PRODUCT	Uranium-238 (Bq/kg)	Thorium-232 (Bq/kg)
Rutile	560 ± 50	70 ± 15
Ilmenite	50 ± 20	64 ± 20
Zircon	3900 ± 300	620 ± 30
Monazite	21000 ± 2000	147000 ± 1900

**(Note: while the radiation dose units in the different State regulations are**

***variously quoted in  $\mu\text{Sv}$  (microsievert) or  $\mu\text{Gy}$  (microgray) these units are identical for gamma radiation in this situation)***

The results of the radiation survey are compared to the limits as set in the following:

A surface radiation survey, as described in EPA Guideline 12 (see below), was conducted to better define radiation levels over the site. There is no justification under **Guideline 12** and **International Commission on Radiation Protection** guidelines for further investigation methods such as sub-surface bore and soil measurements. The process of accurate boring and bore radiation measurements is relatively expensive, with only a very few companies/authorities in Australia doing such work.

### **The International Commission on Radiological Protection (ICRP) recommendations**

The ICRP, an independent international body, recommends upper limits on acceptable radiation dose to occupationally exposed workers (20mSv/yr averaged over 5 years) and members of the public (1mSv/yr). These limits are accepted throughout the world and used as the basis of national laws and regulations. The most recent recommendations were published in 1991 (ICRP 1991) and have been reconfirmed in 2007 (ICRP 103).

This publication introduced a new concept that is relevant to this site; the concept of "intervention". Intervention applies to situations, such as abandoned contaminated sites, where "the sources of exposure and the exposure pathways are already present and the only type of action available is intervention".

These ICRP recommendations have been adopted by the National Health and Medical Research Council (NHMRC 1995) [now controlled by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)] for use in Australia. ARPANSA has also updated and/or released a number of documents such as RPS 9 *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste management in Mining and Mineral Processing* (2005), and RPS 15 *Safety Guide for the Management of Naturally Occurring Radioactive Material (NORM)* (2008). The relevant Commonwealth and State laws and Codes of Practice in turn adopt the NHMRC/ARPANSA recommendations but not all ARPANSA codes have yet been gazetted/mandated or included in the legislation at this time.

### **New South Wales**



NSW Radiation Control Branch Radiation Safety Information Series No 12: ***Clean-up and Disposal of Radioactive Residues from Commercial Operations Involving Mineral Sands.***

This document is based on the 1984 recommendations of the NHMRC and so does not necessarily reflect current international recommendations or limits/constraints. It is also only aimed at active sand mining sites, not “out of control” situations (out of control meaning that the plant and/or company are no longer operational). The limits set in this document do not correlate with current ICRP and National radiation limits. The Radiation Branch of the NSW EPA, however, has not yet produced a revised version, nor does it include reference to the latest relevant ARPANSA Codes.

Action levels are set:

- For high occupancy areas such as dwellings, schools (including playground), businesses factories etc. where occupancies by the same individuals occur regularly on a day by day basis, the remedial action level should be 0.7  $\mu\text{Gy/hr}$  (700 nGy/hr) at 1 m above the ground.
- For intermediate occupancy areas where occupancies are for a few hours per week by the same individuals or by differing individuals and for garden areas, the remedial action level should be 1.0  $\mu\text{Gy/hr}$  (1000 nGy/hr) at 1 m above the ground.
- For roads paths, and other areas with intermittent occupancy the remedial action level should be 2.5  $\mu\text{Gy/hr}$  (2500 nGy/hr) at 1 m above the ground.

#### **Other States**

See Appendice 2

## **2.0 Historic Aspects**

This land has been sand mined in an unusual pattern, probably following a natural depressions where the heavy mineral sands would accumulate due to transport mechanisms such as water run-off and wind erosion. A large portion of this survey area has not been sand mined, and as such contains natural vegetation at natural density for this area and type of ecological community.

The land does not appear to have been developed since the mining, other than a little sand quarrying.



## 3.0 Instruments and Measurement Technique

### 3.1 Instruments

- SAIC Exploranium Model No.: GR130 Serial No.: 9940+GM Gamma ray survey (calibration conducted in June 2020 [see attached sheets Appendix 5] and confirmed on the day by use of an educational Thorium Standard and stabilized using a Cs-137 source);
- As a confirmation of any “high” counts a Radiation Alert “Inspector” (Calibrated June 2020 - see Appendix 6), also used with the wipe test plate for the soil analysis ;
- a Magellan eXplorist 110 GPS unit.

The SAIC equipment measures in Counts per Second, and hence measurements need to be converted to dose rate for comparison with the NSW Guidelines and other documents. To do this the following formula, which is based and derived from the data supplied with the calibration certificates, is used:

$$y = 1.0127x - 1E-11$$

$$R^2 = 1$$

Where:

y – is dose rate in nGy/hr

x – is counts per second

### 3.2 Measurement Techniques

#### Surface Measurements

The proposal was to measure each of the lots as discrete areas with each area measured at approximately 15 metre grid transect using the GPS for tracking of the measurement transects and any other deviations and paths. This whole approach was dependent on the conditions (vegetation, radiation activity, topography, obstructions, and structures), Work health and Safety (WHS) Risk Assessment and as such the measurement transect pattern varied significantly mostly due to terrain and vegetation density. This modification “on-the-run” would continually consider the necessity of accurate and reliable data, and the need for sufficient measurements to capture substantial contamination zones.

The transect patterns that were finalized “on-the-run” are displayed in the Appendix (Appendix 3).

The measurement process is to trek the transect line with the instrument above the ground at about the 1 metre level. Measurements were noted when the auditory level of the instrument changed. Any “high” measurements were defined by moving about the area to determine the limit of the contamination and the highest level. The measurements would then be confirmed by using the RadAlert instrument.

The SAIC Exploranium is set up to record the measurements every two seconds in unique data sets as determined by when the measurement activity is terminated. Two second measurement intervals would equate to approximately 3 metres of normal walking over an easy walking surface. Once the work or area under consideration is completed the Exploranium is then attached to a computer and the data downloaded as a CSV file for assessment and manipulation.

**NOTE:** the measurements as displayed in the relevant appendices **do not** indicate a length of transect but rather in this situation the time and thus difficulty of progress across the terrain.

The information contained in the header of the first column of the results is the following for example:

Using Transect P6-B3 the header is:

**3 16:05:25 10:20:28 cps Live time (s) 2.00**

- The first number is the data set number (hence this is data set 3 for this site)
- The second set 16:05:25 is the date – 25 May 2016
- The third set 10:20:28 is the time – is 10.20.28 AM
- The fourth set of information is cps indicating that the results are in Counts Per Second
- The last piece of information is Live Time (s) 2.00 which means that the measurement and data record is set at 2 second intervals.

### **Cosmic Radiation Component**

The cosmic radiation component of natural background is latitude, longitude and altitude dependent; and has been calculated using United States Federal Aviation Administration Civil Aerospace Medical Institute software ‘CARI-6’. The mean cosmic surface air kerma rate for September was 40.6 nGy/h (0.0406 µSv/h) at 32°



48° 29.05'S 151° 48' 06.73"E, elevation of 18 m, using a dose conversion factor of 1Sv/Gy.

This does not however take into account such things as heavy cloud, rain and dense vegetation canopy which acts as shielding.

The results in the relevant Appendices have not been adjusted by the reduction of the measurements by the 0.0406  $\mu\text{Sv/h}$  factor and this has been incorporated in the data contained in column 3 of the data sets of the relevant appendices.

### **Work, Health and Safety Risk Assessment**

As this work is being conducted in a "remote" location and that there are various risks associated with this type of work (such as slips, trips and falls, snake/spider/tick/insect bites, cuts and abrasions due to vegetation, allergy reactions to plants and other things, and falling limbs and branches) then a risk assessment is required and that this risk assessment is "living" whilst the work is being conducted.

As the risk for some of the hazards are medium and high then the approach BSMS will conduct during the transect measurements will be to change the transects as needed to avoid or minimise such risks.

## 4.0 Survey Results

### 4.1 General

All measurements were completed on the 24<sup>th</sup> March 2021, and the results for the transects that were measured, showed results that in general were not of concern in terms of radiation.

The areas that had the higher though still insignificant in terms of exposure were all associated with the material used for the making/consolidation of the access tracks. The areas that actually were above the general level for these section (but are below the Guideline 12 Limit and are only about 2-3 times the normal background) are highlighted in pale yellow for interest only. The transect that had the highest dose rate was the southern boundary and that coincided with the track./road.

As can be seen from the results the dose range was from 0.0 to 0.5  $\mu\text{Sv/h}$ , which is still reasonably below the 0.7  $\mu\text{Sv/h}$  limit for residential use. Hence there would be no radiological concerns for this area.

## 5.0 Discussion

**NOTE:** The transects were not conducted as planned due to the very dense vegetation in places – this caused loss of direction and the rambling of the transects. It was extremely difficult to walk the planned transects and maintain direction.

On examining the results of the surface gamma radiation survey there are no radioactive concentrations or activities that are of any concern for the proposed use of the land/sand. All locations are below the level of 0.7  $\mu\text{Sv/hr}$  set by the NSW Guideline for residential use.

The results, even when compared to the most restrictive of the guidelines/legislation (WA in this instance), indicate that some of the results would

reach the level of 0.46  $\mu\text{Gy/hr}$  for dwellings (note 0.46  $\mu\text{Gy/hr}$  is equivalent to 0.46  $\mu\text{Sv/hr}$  in this situation; conversion factor of 1:1). These “high” results are very close to the 0.46  $\mu\text{Gy/hr}$  and as such there is no need for any remedial action or intervention.

## References

- ICRP 2007. Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Elsevier 2007.
- NSW Dept of Health. Guidelines for the Clean-up and Disposal of Radioactive Residues from Commercial operations Involving Mineral Sands 1984. Available from NSW DECC (EPA).
- Qld Health Department. Radiation Dose Levels For Properties Where Mineral Sand Residues Are Deposited On The Ground. 1995
- ARPANSA RPS 9 *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste management in Mining and Mineral Processing (2005)*
- ARPANSA RPS 15 *Safety Guide for the Management of Naturally Occurring Radioactive Material (NORM) (2008)*.
- FAA's Civil Aerospace Medical Institute Radiobiology Research Team, *CARI-6*, 2004, United States of America Federal Aviation Administration. p. Computer Freeware.



## APPENDIX 1

## Location and details



Reference	Latitude	Longitude
SE corner	32° 48' 30.57"S	151° 48' 22.08"E
SW corner	32° 48' 30.78"S	151° 48' 06.10"E
NW corner	32° 48' 29.05"S	151° 48' 06.73"E
NE corner	32° 48' 28.63"S	151° 48' 21.53"E
Mkr1	32° 48' 29.85"S	151° 48' 06.47"E
Mkr2	32° 48' 29.53"S	151° 48' 21.81"E
N Brdr 1	32° 48' 29.57"S	151° 48' 09.85"E
N Brdr 2	32° 48' 28.33"S	151° 48' 12.98"E
N Brdr 3	32° 48' 28.96"S	151° 48' 17.73"E
S Brdr 1	32° 48' 32.2"S	151° 48' 10.55"E

## APPENDIX 2      Other States' Relevant Legislation

### Queensland

#### Queensland Health Policy Document: Radiation Dose Levels for Properties where Mineral Sand Residues are Deposited on the Ground

This document is of relevance because it was written in 1995 and incorporates the more recent ICRP concept of "intervention". For some of its recommendations, however, it still refers back to a 1984 NHMRC document.

For practices under control, where technically enhanced radiation sources (TENORM) of mineral sands are deposited on the ground the limits are:

- 0.1  $\mu\text{Sv/hr}$  above the natural background level for dwellings, schools, etc. and
- 0.2  $\mu\text{Sv/hr}$  above the natural background level for parks etc.

Assuming a background level of 0.1  $\mu\text{Sv/hr}$ , the action levels for dwellings, schools, etc. would be 0.2  $\mu\text{Sv/hr}$  and for parks etc. would be 0.3  $\mu\text{Sv/hr}$ . Practices under control refer to situations where the mining company is still operating and has responsibility for the land in question.

For an "out of control" practice (i.e. an intervention situation), where the mining company is not still operating and has no responsibility for the land in question, the action levels including background are:

- for dwellings, schools etc., 0.6  $\mu\text{Sv/hr}$  (600 nGy/hr),
- for parks etc., 1.0  $\mu\text{Sv/hr}$  (1000 nGy/hr) and
- for roads and footpaths, 2.5  $\mu\text{Sv/hr}$  (2500 nGy/hr).

PTO

## Western Australia

### Radiation Health Branch of WA Mines Department Guidelines

The Radiation Health Branch of the West Australian Mines Department set (in 1988) Guidelines for remedial action in areas of enhanced background gamma radiation levels. The action level criteria are:

- for dwellings, 0.46  $\mu\text{Gy/hr}$ ,
- for schools, 0.57  $\mu\text{Gy/hr}$ ,
- for other areas, 0.7  $\mu\text{Gy/hr}$ , and
- for roads, paths etc, 2.5  $\mu\text{Gy/hr}$ .



## APPENDIX 4      GPS Coordinates, and transects

*Map datum WSG84; North Reference – Magnetic;  
Coordinate type – Degree minutes & seconds*

Reference	Latitude	Longitude
SE corner	32° 48' 30.57"S	151° 48' 22.08"E
SW corner	32° 48' 30.78"S	151° 48' 06.10"E
NW corner	32° 48' 29.05"S	151° 48' 06.73"E
NE corner	32° 48' 28.63"S	151° 48' 21.53"E
Mkr1	32° 48' 29.85"S	151° 48' 06.47"E
Mkr2	32° 48' 29.53"S	151° 48' 21.81"E
N Brdr 1	32° 48' 29.57"S	151° 48' 09.85"E
N Brdr 2	32° 48' 28.33"S	151° 48' 12.98"E
N Brdr 3	32° 48' 28.96"S	151° 48' 17.73"E
S Brdr 1	32° 48' 32.2"S	151° 48' 10.55"E

Information Detail	Value
Distance traversed	Approx. 4 km
No. transects	15 (1 perimeter, 1 EW; 13 NS)
No. data Points	Approx 2800



## APPENDIX 4 Surface Gamma Radiation Results

NWcnr - Nbrdr1 (North Boundary)					
1			32	0.03	0.00
21:03:24			33	0.03	0.00
08:59:24 cps			37	0.04	0.00
Live time (s)	cps to micro	solar corrected	28	0.03	0.00
2.00	Sv/h		37	0.04	0.00
66	0.07	0.02	35	0.03	0.00
57	0.06	0.02	36	0.04	0.00
73	0.07	0.03	38	0.04	0.00
60	0.06	0.02	42	0.04	0.00
57	0.06	0.02	38	0.04	0.00
58	0.06	0.02	30	0.03	0.00
49	0.05	0.01	38	0.04	0.00
56	0.06	0.01	42	0.04	0.00
42	0.04	0.00	38	0.04	0.00
48	0.05	0.01	38	0.04	0.00
47	0.05	0.01	30	0.03	0.00
51	0.05	0.01	44	0.04	0.00
36	0.04	0.00	35	0.03	0.00
36	0.04	0.00	28	0.03	0.00
39	0.04	0.00	41	0.04	0.00
34	0.03	0.00	36	0.04	0.00
37	0.04	0.00	42	0.04	0.00
41	0.04	0.00	33	0.03	0.00
33	0.03	0.00	40	0.04	0.00
31	0.03	0.00	28	0.03	0.00
32	0.03	0.00	37	0.04	0.00
38	0.04	0.00	34	0.03	0.00
37	0.04	0.00	46	0.05	0.00
30	0.03	0.00	41	0.04	0.00
45	0.04	0.00	38	0.04	0.00
27	0.03	0.00	36	0.04	0.00
38	0.04	0.00	44	0.04	0.00
40	0.04	0.00	47	0.05	0.01
38	0.04	0.00	34	0.03	0.00
38	0.04	0.00	33	0.03	0.00
44	0.04	0.00	34	0.03	0.00
39	0.04	0.00	37	0.04	0.00
42	0.04	0.00	30	0.03	0.00
35	0.03	0.00	35	0.03	0.00
33	0.03	0.00	39	0.04	0.00
38	0.04	0.00	44	0.04	0.00

35	0.03	0.00
34	0.03	0.00
36	0.04	0.00
34	0.03	0.00
28	0.03	0.00
35	0.03	0.00
37	0.04	0.00
33	0.03	0.00
30	0.03	0.00
30	0.03	0.00
32	0.03	0.00
26	0.03	0.00
28	0.03	0.00
27	0.03	0.00
34	0.03	0.00
36	0.04	0.00
23	0.02	0.00
38	0.04	0.00
32	0.03	0.00
28	0.03	0.00
30	0.03	0.00
30	0.03	0.00
29	0.03	0.00
29	0.03	0.00
28	0.03	0.00
31	0.03	0.00
35	0.03	0.00
33	0.03	0.00
42	0.04	0.00

26	0.03	0.00
34	0.03	0.00
35	0.03	0.00
40	0.04	0.00
43	0.04	0.00
40	0.04	0.00
43	0.04	0.00
43	0.04	0.00
45	0.04	0.00
45	0.04	0.00
42	0.04	0.00
39	0.04	0.00
49	0.05	0.01
38	0.04	0.00
40	0.04	0.00
42	0.04	0.00
44	0.04	0.00
32	0.03	0.00
36	0.04	0.00
42	0.04	0.00
38	0.04	0.00
45	0.04	0.00
43	0.04	0.00
37	0.04	0.00
45	0.04	0.00
46	0.05	0.00
41	0.04	0.00
39	0.04	0.00
41	0.04	0.00
39	0.04	0.00
44	0.04	0.00
40	0.04	0.00
33	0.03	0.00
39	0.04	0.00
42	0.04	0.00
51	0.05	0.01
39	0.04	0.00
43	0.04	0.00
44	0.04	0.00
39	0.04	0.00
51	0.05	0.01
46	0.05	0.00
41	0.04	0.00
42	0.04	0.00
43	0.04	0.00
33	0.03	0.00
45	0.04	0.00

#### Nbrdr1 – Nbrdr2 (North Boundary)

2

21:03:24 09:08:59

cps Live time (s)	cps to micro Sv/h	solar correction
2.00		
29	0.03	0.00
34	0.03	0.00
36	0.04	0.00
31	0.03	0.00
43	0.04	0.00
44	0.04	0.00
33	0.03	0.00
31	0.03	0.00
28	0.03	0.00
37	0.04	0.00



44	0.04	0.00	32	0.03	0.00
50	0.05	0.01	42	0.04	0.00
37	0.04	0.00	49	0.05	0.01
42	0.04	0.00	42	0.04	0.00
42	0.04	0.00	38	0.04	0.00
48	0.05	0.01	45	0.04	0.00
44	0.04	0.00	46	0.05	0.00
40	0.04	0.00	52	0.05	0.01
44	0.04	0.00	57	0.06	0.02
45	0.04	0.00	45	0.04	0.00
47	0.05	0.01	45	0.04	0.00
48	0.05	0.01	46	0.05	0.00
46	0.05	0.00	42	0.04	0.00
39	0.04	0.00	49	0.05	0.01
42	0.04	0.00	45	0.04	0.00
50	0.05	0.01	50	0.05	0.01
39	0.04	0.00	40	0.04	0.00
43	0.04	0.00	38	0.04	0.00
40	0.04	0.00	54	0.05	0.01
42	0.04	0.00	47	0.05	0.01
46	0.05	0.00	45	0.04	0.00
34	0.03	0.00	48	0.05	0.01
39	0.04	0.00	57	0.06	0.02
42	0.04	0.00	56	0.06	0.01
42	0.04	0.00	56	0.06	0.01
40	0.04	0.00	62	0.06	0.02
48	0.05	0.01	41	0.04	0.00
44	0.04	0.00	41	0.04	0.00
43	0.04	0.00	46	0.05	0.00
52	0.05	0.01	52	0.05	0.01
43	0.04	0.00	57	0.06	0.02
52	0.05	0.01	49	0.05	0.01
42	0.04	0.00	49	0.05	0.01
48	0.05	0.01	47	0.05	0.01
45	0.04	0.00	58	0.06	0.02
54	0.05	0.01	47	0.05	0.01
43	0.04	0.00	61	0.06	0.02
53	0.05	0.01	53	0.05	0.01
48	0.05	0.01	45	0.04	0.00
51	0.05	0.01	50	0.05	0.01
45	0.04	0.00	55	0.05	0.01
41	0.04	0.00	52	0.05	0.01
44	0.04	0.00	52	0.05	0.01
49	0.05	0.01	47	0.05	0.01
43	0.04	0.00	43	0.04	0.00
45	0.04	0.00	54	0.05	0.01
41	0.04	0.00	48	0.05	0.01

50	0.05	0.01	55	0.05	0.01
56	0.06	0.01	57	0.06	0.02
54	0.05	0.01	68	0.07	0.03
42	0.04	0.00	62	0.06	0.02
59	0.06	0.02	54	0.05	0.01
52	0.05	0.01	52	0.05	0.01
54	0.05	0.01	59	0.06	0.02
47	0.05	0.01	49	0.05	0.01
53	0.05	0.01	57	0.06	0.02
62	0.06	0.02	49	0.05	0.01
45	0.04	0.00	53	0.05	0.01
56	0.06	0.01	52	0.05	0.01
52	0.05	0.01	55	0.05	0.01
56	0.06	0.01	58	0.06	0.02
49	0.05	0.01	47	0.05	0.01
48	0.05	0.01	46	0.05	0.00
48	0.05	0.01	47	0.05	0.01
61	0.06	0.02	55	0.05	0.01
54	0.05	0.01	49	0.05	0.01
54	0.05	0.01	52	0.05	0.01
65	0.06	0.02	54	0.05	0.01
66	0.07	0.02	43	0.04	0.00
60	0.06	0.02	46	0.05	0.00
50	0.05	0.01	49	0.05	0.01
56	0.06	0.01	43	0.04	0.00
62	0.06	0.02	47	0.05	0.01
57	0.06	0.02	44	0.04	0.00
55	0.05	0.01	54	0.05	0.01
52	0.05	0.01	48	0.05	0.01
53	0.05	0.01	44	0.04	0.00
58	0.06	0.02	58	0.06	0.02
63	0.06	0.02	50	0.05	0.01
50	0.05	0.01	52	0.05	0.01
51	0.05	0.01	53	0.05	0.01
55	0.05	0.01	46	0.05	0.00
59	0.06	0.02	45	0.04	0.00
50	0.05	0.01	46	0.05	0.00
63	0.06	0.02	57	0.06	0.02
56	0.06	0.01	46	0.05	0.00
64	0.06	0.02	43	0.04	0.00
53	0.05	0.01	52	0.05	0.01
54	0.05	0.01	43	0.04	0.00
63	0.06	0.02	54	0.05	0.01
57	0.06	0.02	53	0.05	0.01
56	0.06	0.01	51	0.05	0.01
50	0.05	0.01	47	0.05	0.01
58	0.06	0.02	48	0.05	0.01

43	0.04	0.00
51	0.05	0.01
46	0.05	0.00
38	0.04	0.00
47	0.05	0.01
50	0.05	0.01
44	0.04	0.00
45	0.04	0.00
49	0.05	0.01
45	0.04	0.00
42	0.04	0.00
52	0.05	0.01
43	0.04	0.00
53	0.05	0.01
42	0.04	0.00
44	0.04	0.00
54	0.05	0.01
48	0.05	0.01
48	0.05	0.01
48	0.05	0.01
50	0.05	0.01
47	0.05	0.01
55	0.05	0.01
49	0.05	0.01
32	0.03	0.00
45	0.04	0.00
35	0.03	0.00
41	0.04	0.00
41	0.04	0.00
46	0.05	0.00
42	0.04	0.00
49	0.05	0.01
53	0.05	0.01
46	0.05	0.00
51	0.05	0.01
37	0.04	0.00
55	0.05	0.01
45	0.04	0.00
49	0.05	0.01

#### Nbrdr2 – Nbrdr 3 (North Boundary)

3

21:03:24 09:23:12

cps Live time (s)	cps to micro Sv/h	solar correction
2.00		
49	0.05	0.01

51	0.05	0.01
38	0.04	0.00
49	0.05	0.01
48	0.05	0.01
54	0.05	0.01
45	0.04	0.00
51	0.05	0.01
54	0.05	0.01
43	0.04	0.00
52	0.05	0.01
50	0.05	0.01
67	0.07	0.03
49	0.05	0.01
58	0.06	0.02
55	0.05	0.01
51	0.05	0.01
50	0.05	0.01
42	0.04	0.00
48	0.05	0.01
45	0.04	0.00
52	0.05	0.01
37	0.04	0.00
46	0.05	0.00
56	0.06	0.01
36	0.04	0.00
44	0.04	0.00
56	0.06	0.01
49	0.05	0.01
38	0.04	0.00
51	0.05	0.01
56	0.06	0.01
52	0.05	0.01
55	0.05	0.01
58	0.06	0.02
48	0.05	0.01
49	0.05	0.01
62	0.06	0.02
49	0.05	0.01
57	0.06	0.02
52	0.05	0.01
63	0.06	0.02
56	0.06	0.01
54	0.05	0.01
67	0.07	0.03
54	0.05	0.01
58	0.06	0.02
56	0.06	0.01



57	0.06	0.02	47	0.05	0.01
62	0.06	0.02	60	0.06	0.02
69	0.07	0.03	53	0.05	0.01
61	0.06	0.02	59	0.06	0.02
65	0.06	0.02	62	0.06	0.02
52	0.05	0.01	51	0.05	0.01
68	0.07	0.03	61	0.06	0.02
54	0.05	0.01	54	0.05	0.01
62	0.06	0.02	52	0.05	0.01
51	0.05	0.01	57	0.06	0.02
59	0.06	0.02	54	0.05	0.01
58	0.06	0.02	60	0.06	0.02
49	0.05	0.01	54	0.05	0.01
53	0.05	0.01	54	0.05	0.01
52	0.05	0.01	57	0.06	0.02
53	0.05	0.01	52	0.05	0.01
55	0.05	0.01	56	0.06	0.01
51	0.05	0.01	56	0.06	0.01
60	0.06	0.02	63	0.06	0.02
64	0.06	0.02	55	0.05	0.01
69	0.07	0.03	58	0.06	0.02
64	0.06	0.02	60	0.06	0.02
52	0.05	0.01	64	0.06	0.02
54	0.05	0.01	65	0.06	0.02
69	0.07	0.03	62	0.06	0.02
57	0.06	0.02	56	0.06	0.01
52	0.05	0.01	53	0.05	0.01
50	0.05	0.01	54	0.05	0.01
58	0.06	0.02	69	0.07	0.03
52	0.05	0.01	62	0.06	0.02
56	0.06	0.01	58	0.06	0.02
61	0.06	0.02	55	0.05	0.01
51	0.05	0.01	60	0.06	0.02
56	0.06	0.01	63	0.06	0.02
54	0.05	0.01	55	0.05	0.01
58	0.06	0.02	63	0.06	0.02
48	0.05	0.01	53	0.05	0.01
59	0.06	0.02	56	0.06	0.01
63	0.06	0.02	59	0.06	0.02
53	0.05	0.01	59	0.06	0.02
56	0.06	0.01	61	0.06	0.02
59	0.06	0.02	58	0.06	0.02
52	0.05	0.01	59	0.06	0.02
55	0.05	0.01	56	0.06	0.01
63	0.06	0.02	55	0.05	0.01
61	0.06	0.02	56	0.06	0.01
54	0.05	0.01	46	0.05	0.00



52	0.05	0.01	51	0.05	0.01
58	0.06	0.02	52	0.05	0.01
53	0.05	0.01	60	0.06	0.02
57	0.06	0.02	61	0.06	0.02
58	0.06	0.02	50	0.05	0.01
60	0.06	0.02	54	0.05	0.01
54	0.05	0.01	56	0.06	0.01
53	0.05	0.01	55	0.05	0.01
47	0.05	0.01	55	0.05	0.01
50	0.05	0.01	56	0.06	0.01
49	0.05	0.01	69	0.07	0.03
48	0.05	0.01	51	0.05	0.01
53	0.05	0.01	44	0.04	0.00
56	0.06	0.01	60	0.06	0.02
61	0.06	0.02	63	0.06	0.02
54	0.05	0.01	52	0.05	0.01
47	0.05	0.01	68	0.07	0.03
51	0.05	0.01	52	0.05	0.01
55	0.05	0.01	58	0.06	0.02
60	0.06	0.02	66	0.07	0.02
53	0.05	0.01	57	0.06	0.02
59	0.06	0.02	61	0.06	0.02
53	0.05	0.01	59	0.06	0.02
54	0.05	0.01	62	0.06	0.02
64	0.06	0.02	63	0.06	0.02
56	0.06	0.01	74	0.07	0.03
56	0.06	0.01	69	0.07	0.03
55	0.05	0.01	71	0.07	0.03
57	0.06	0.02	87	0.09	0.04
61	0.06	0.02	80	0.08	0.04
47	0.05	0.01	92	0.09	0.05
55	0.05	0.01	72	0.07	0.03
67	0.07	0.03	72	0.07	0.03
52	0.05	0.01	86	0.08	0.04
56	0.06	0.01	83	0.08	0.04
44	0.04	0.00	77	0.08	0.03
48	0.05	0.01	77	0.08	0.03
64	0.06	0.02	88	0.09	0.05
59	0.06	0.02	88	0.09	0.05
62	0.06	0.02	82	0.08	0.04
58	0.06	0.02	72	0.07	0.03
58	0.06	0.02	79	0.08	0.04
63	0.06	0.02	73	0.07	0.03
47	0.05	0.01	92	0.09	0.05
46	0.05	0.00	81	0.08	0.04
51	0.05	0.01	78	0.08	0.04
50	0.05	0.01	79	0.08	0.04

70	0.07	0.03	72	0.07	0.03
93	0.09	0.05	67	0.07	0.03
82	0.08	0.04	68	0.07	0.03
92	0.09	0.05	75	0.07	0.03
83	0.08	0.04	64	0.06	0.02
82	0.08	0.04	65	0.06	0.02
84	0.08	0.04	79	0.08	0.04
79	0.08	0.04	68	0.07	0.03
67	0.07	0.03	68	0.07	0.03
64	0.06	0.02	60	0.06	0.02
67	0.07	0.03	67	0.07	0.03
69	0.07	0.03	61	0.06	0.02
79	0.08	0.04	55	0.05	0.01
71	0.07	0.03	67	0.07	0.03
73	0.07	0.03	63	0.06	0.02
72	0.07	0.03	63	0.06	0.02
83	0.08	0.04	66	0.07	0.02
84	0.08	0.04	72	0.07	0.03
89	0.09	0.05	60	0.06	0.02
74	0.07	0.03	63	0.06	0.02
73	0.07	0.03	64	0.06	0.02
76	0.07	0.03	55	0.05	0.01
74	0.07	0.03	63	0.06	0.02
80	0.08	0.04	59	0.06	0.02
80	0.08	0.04	63	0.06	0.02
67	0.07	0.03	55	0.05	0.01
68	0.07	0.03	77	0.08	0.03
62	0.06	0.02	67	0.07	0.03
69	0.07	0.03	64	0.06	0.02
64	0.06	0.02	59	0.06	0.02
54	0.05	0.01	75	0.07	0.03
61	0.06	0.02	70	0.07	0.03
55	0.05	0.01	73	0.07	0.03
54	0.05	0.01	65	0.06	0.02
67	0.07	0.03	61	0.06	0.02
62	0.06	0.02	69	0.07	0.03
63	0.06	0.02	56	0.06	0.01
65	0.06	0.02	73	0.07	0.03
60	0.06	0.02	77	0.08	0.03
63	0.06	0.02	60	0.06	0.02
64	0.06	0.02	62	0.06	0.02
70	0.07	0.03	70	0.07	0.03
62	0.06	0.02	78	0.08	0.04
60	0.06	0.02	68	0.07	0.03
66	0.07	0.02	59	0.06	0.02
70	0.07	0.03	59	0.06	0.02
69	0.07	0.03	68	0.07	0.03

57	0.06	0.02	72	0.07	0.03
70	0.07	0.03	67	0.07	0.03
70	0.07	0.03	63	0.06	0.02
53	0.05	0.01	63	0.06	0.02
68	0.07	0.03	65	0.06	0.02
69	0.07	0.03	61	0.06	0.02
59	0.06	0.02	74	0.07	0.03
61	0.06	0.02	66	0.07	0.02
58	0.06	0.02	54	0.05	0.01
66	0.07	0.02	61	0.06	0.02
60	0.06	0.02	70	0.07	0.03
57	0.06	0.02	61	0.06	0.02
63	0.06	0.02	57	0.06	0.02
63	0.06	0.02	62	0.06	0.02
49	0.05	0.01	76	0.07	0.03
62	0.06	0.02	62	0.06	0.02
71	0.07	0.03	58	0.06	0.02
67	0.07	0.03	56	0.06	0.01
67	0.07	0.03	53	0.05	0.01
66	0.07	0.02	62	0.06	0.02
69	0.07	0.03	69	0.07	0.03
63	0.06	0.02	61	0.06	0.02
72	0.07	0.03	73	0.07	0.03
64	0.06	0.02	58	0.06	0.02
68	0.07	0.03	75	0.07	0.03
63	0.06	0.02	57	0.06	0.02
69	0.07	0.03	54	0.05	0.01
74	0.07	0.03	59	0.06	0.02
65	0.06	0.02	52	0.05	0.01
76	0.07	0.03	62	0.06	0.02
66	0.07	0.02	63	0.06	0.02
63	0.06	0.02	60	0.06	0.02
59	0.06	0.02	52	0.05	0.01
62	0.06	0.02	61	0.06	0.02
71	0.07	0.03	60	0.06	0.02
62	0.06	0.02	66	0.07	0.02
60	0.06	0.02	67	0.07	0.03
60	0.06	0.02	55	0.05	0.01
60	0.06	0.02	67	0.07	0.03
58	0.06	0.02	66	0.07	0.02
62	0.06	0.02	65	0.06	0.02
61	0.06	0.02	63	0.06	0.02
61	0.06	0.02	66	0.07	0.02
66	0.07	0.02	63	0.06	0.02
61	0.06	0.02	61	0.06	0.02
71	0.07	0.03	51	0.05	0.01
72	0.07	0.03	61	0.06	0.02



52	0.05	0.01	69	0.07	0.03
60	0.06	0.02	48	0.05	0.01
66	0.07	0.02	57	0.06	0.02
58	0.06	0.02	55	0.05	0.01
65	0.06	0.02	53	0.05	0.01
65	0.06	0.02	57	0.06	0.02
66	0.07	0.02	55	0.05	0.01
71	0.07	0.03	61	0.06	0.02
64	0.06	0.02	53	0.05	0.01
60	0.06	0.02	55	0.05	0.01
64	0.06	0.02	64	0.06	0.02
61	0.06	0.02	57	0.06	0.02
70	0.07	0.03	52	0.05	0.01
55	0.05	0.01	54	0.05	0.01
66	0.07	0.02	53	0.05	0.01
58	0.06	0.02	59	0.06	0.02
57	0.06	0.02	50	0.05	0.01
70	0.07	0.03	47	0.05	0.01
70	0.07	0.03	51	0.05	0.01
56	0.06	0.01	47	0.05	0.01
59	0.06	0.02	54	0.05	0.01
63	0.06	0.02	42	0.04	0.00
63	0.06	0.02	54	0.05	0.01
58	0.06	0.02	41	0.04	0.00
58	0.06	0.02	43	0.04	0.00
64	0.06	0.02	48	0.05	0.01
49	0.05	0.01	54	0.05	0.01
60	0.06	0.02	46	0.05	0.00
67	0.07	0.03	44	0.04	0.00
62	0.06	0.02	41	0.04	0.00
58	0.06	0.02	48	0.05	0.01
62	0.06	0.02	46	0.05	0.00
61	0.06	0.02	43	0.04	0.00
65	0.06	0.02	33	0.03	0.00
65	0.06	0.02	47	0.05	0.01
62	0.06	0.02	46	0.05	0.00
60	0.06	0.02	44	0.04	0.00
68	0.07	0.03	47	0.05	0.01
52	0.05	0.01	49	0.05	0.01
63	0.06	0.02	40	0.04	0.00
59	0.06	0.02	45	0.04	0.00
69	0.07	0.03	37	0.04	0.00
63	0.06	0.02	41	0.04	0.00
76	0.07	0.03	54	0.05	0.01
61	0.06	0.02	41	0.04	0.00
60	0.06	0.02	39	0.04	0.00
55	0.05	0.01	34	0.03	0.00

39	0.04	0.00
34	0.03	0.00
41	0.04	0.00
33	0.03	0.00
32	0.03	0.00
33	0.03	0.00
32	0.03	0.00
31	0.03	0.00
41	0.04	0.00
37	0.04	0.00
33	0.03	0.00
27	0.03	0.00
33	0.03	0.00
37	0.04	0.00
28	0.03	0.00
33	0.03	0.00
33	0.03	0.00
33	0.03	0.00
27	0.03	0.00
30	0.03	0.00
35	0.03	0.00
33	0.03	0.00
27	0.03	0.00
28	0.03	0.00
35	0.03	0.00
29	0.03	0.00
39	0.04	0.00
37	0.04	0.00
29	0.03	0.00
35	0.03	0.00
30	0.03	0.00
37	0.04	0.00
37	0.04	0.00
32	0.03	0.00
32	0.03	0.00
36	0.04	0.00
32	0.03	0.00
36	0.04	0.00
38	0.04	0.00
33	0.03	0.00
32	0.03	0.00
32	0.03	0.00
31	0.03	0.00
36	0.04	0.00
32	0.03	0.00
34	0.03	0.00
30	0.03	0.00

28	0.03	0.00
29	0.03	0.00
36	0.04	0.00
30	0.03	0.00
30	0.03	0.00
36	0.04	0.00
39	0.04	0.00
34	0.03	0.00
35	0.03	0.00
39	0.04	0.00
37	0.04	0.00
33	0.03	0.00
32	0.03	0.00
31	0.03	0.00
28	0.03	0.00
33	0.03	0.00
31	0.03	0.00
30	0.03	0.00
31	0.03	0.00
43	0.04	0.00
30	0.03	0.00
31	0.03	0.00
33	0.03	0.00
36	0.04	0.00
37	0.04	0.00
35	0.03	0.00
35	0.03	0.00
33	0.03	0.00
36	0.04	0.00
32	0.03	0.00
33	0.03	0.00
36	0.04	0.00
34	0.03	0.00

#### Nbrdr 3 – NE cnr (North Boundary)

4		
21:03:24		
09:45:56 cps Live		
time (s) 2.00	cps to micro Sv/h	solar correction
36	0.04	0.00
38	0.04	0.00
31	0.03	0.00
35	0.03	0.00
38	0.04	0.00
33	0.03	0.00

38	0.04	0.00	40	0.04	0.00
34	0.03	0.00	48	0.05	0.01
35	0.03	0.00	42	0.04	0.00
38	0.04	0.00	50	0.05	0.01
37	0.04	0.00	47	0.05	0.01
29	0.03	0.00	47	0.05	0.01
44	0.04	0.00	38	0.04	0.00
35	0.03	0.00	47	0.05	0.01
37	0.04	0.00	46	0.05	0.00
41	0.04	0.00	46	0.05	0.00
37	0.04	0.00	42	0.04	0.00
33	0.03	0.00	39	0.04	0.00
31	0.03	0.00	42	0.04	0.00
35	0.03	0.00	36	0.04	0.00
35	0.03	0.00	44	0.04	0.00
45	0.04	0.00	43	0.04	0.00
41	0.04	0.00	41	0.04	0.00
32	0.03	0.00	31	0.03	0.00
33	0.03	0.00	35	0.03	0.00
28	0.03	0.00	49	0.05	0.01
33	0.03	0.00	40	0.04	0.00
38	0.04	0.00	43	0.04	0.00
35	0.03	0.00	40	0.04	0.00
40	0.04	0.00	42	0.04	0.00
42	0.04	0.00	43	0.04	0.00
42	0.04	0.00	45	0.04	0.00
37	0.04	0.00	40	0.04	0.00
34	0.03	0.00	48	0.05	0.01
45	0.04	0.00	42	0.04	0.00
32	0.03	0.00	35	0.03	0.00
33	0.03	0.00	30	0.03	0.00
39	0.04	0.00	31	0.03	0.00
30	0.03	0.00	46	0.05	0.00
37	0.04	0.00	39	0.04	0.00
34	0.03	0.00	39	0.04	0.00
47	0.05	0.01	33	0.03	0.00
33	0.03	0.00	41	0.04	0.00
39	0.04	0.00	36	0.04	0.00
44	0.04	0.00	46	0.05	0.00
42	0.04	0.00	35	0.03	0.00
38	0.04	0.00	42	0.04	0.00
42	0.04	0.00	39	0.04	0.00
31	0.03	0.00	49	0.05	0.01
36	0.04	0.00	50	0.05	0.01
42	0.04	0.00	57	0.06	0.02
36	0.04	0.00	60	0.06	0.02
43	0.04	0.00	53	0.05	0.01



45	0.04	0.00
44	0.04	0.00
45	0.04	0.00
46	0.05	0.00
35	0.03	0.00
40	0.04	0.00
46	0.05	0.00
37	0.04	0.00
47	0.05	0.01
48	0.05	0.01
58	0.06	0.02
49	0.05	0.01
49	0.05	0.01
38	0.04	0.00
43	0.04	0.00
45	0.04	0.00
43	0.04	0.00
33	0.03	0.00
30	0.03	0.00
28	0.03	0.00
37	0.04	0.00
36	0.04	0.00
37	0.04	0.00
34	0.03	0.00
34	0.03	0.00
32	0.03	0.00
37	0.04	0.00
32	0.03	0.00
42	0.04	0.00
33	0.03	0.00
37	0.04	0.00
38	0.04	0.00
43	0.04	0.00
40	0.04	0.00
34	0.03	0.00
37	0.04	0.00
34	0.03	0.00
29	0.03	0.00
37	0.04	0.00
32	0.03	0.00
42	0.04	0.00
34	0.03	0.00
35	0.03	0.00
30	0.03	0.00
37	0.04	0.00
37	0.04	0.00

#### NE crnr – SE crnr (East Boundary)

5			
21:03:24			
09:54:40 cps Live			
time (s) 2.00	cps to micro Sv/h	solar correction	
163	0.16	0.12	
146	0.14	0.10	
162	0.16	0.12	
187	0.18	0.14	
186	0.18	0.14	
177	0.17	0.13	
182	0.18	0.14	
178	0.18	0.13	
171	0.17	0.13	
190	0.19	0.15	
177	0.17	0.13	
173	0.17	0.13	
174	0.17	0.13	
189	0.19	0.15	
170	0.17	0.13	
220	0.22	0.18	
167	0.16	0.12	
161	0.16	0.12	
154	0.15	0.11	
162	0.16	0.12	
157	0.15	0.11	

#### SE crnr – Sbrdr 1 (South Boundary)

6			
21:03:24			
09:56:46 cps Live			
time (s) 2.00	cps to micro Sv/h	solar correction	
178	0.18	0.13	
146	0.14	0.10	
180	0.18	0.14	
166	0.16	0.12	
169	0.17	0.13	
193	0.19	0.15	
193	0.19	0.15	
205	0.20	0.16	
157	0.15	0.11	
154	0.15	0.11	
165	0.16	0.12	
165	0.16	0.12	
151	0.15	0.11	

152	0.15	0.11	167	0.16	0.12
159	0.16	0.12	141	0.14	0.10
163	0.16	0.12	147	0.14	0.10
175	0.17	0.13	135	0.13	0.09
140	0.14	0.10	131	0.13	0.09
133	0.13	0.09	152	0.15	0.11
143	0.14	0.10	149	0.15	0.11
138	0.14	0.10	149	0.15	0.11
148	0.15	0.10	173	0.17	0.13
137	0.13	0.09	209	0.21	0.17
144	0.14	0.10	206	0.20	0.16
164	0.16	0.12	181	0.18	0.14
158	0.16	0.11	140	0.14	0.10
125	0.12	0.08	149	0.15	0.11
135	0.13	0.09	152	0.15	0.11
118	0.12	0.08	169	0.17	0.13
127	0.13	0.08	205	0.20	0.16
152	0.15	0.11	270	0.27	0.23
134	0.13	0.09	282	0.28	0.24
143	0.14	0.10	222	0.22	0.18
136	0.13	0.09	264	0.26	0.22
153	0.15	0.11	303	0.30	0.26
142	0.14	0.10	292	0.29	0.25
140	0.14	0.10	294	0.29	0.25
158	0.16	0.11	284	0.28	0.24
160	0.16	0.12	301	0.30	0.26
165	0.16	0.12	283	0.28	0.24
168	0.17	0.12	296	0.29	0.25
188	0.19	0.14	281	0.28	0.24
170	0.17	0.13	299	0.29	0.25
171	0.17	0.13	273	0.27	0.23
168	0.17	0.12	277	0.27	0.23
183	0.18	0.14	287	0.28	0.24
181	0.18	0.14	282	0.28	0.24
187	0.18	0.14	281	0.28	0.24
233	0.23	0.19	287	0.28	0.24
198	0.20	0.15	278	0.27	0.23
187	0.18	0.14	290	0.29	0.24
211	0.21	0.17	298	0.29	0.25
200	0.20	0.16	293	0.29	0.25
209	0.21	0.17	309	0.30	0.26
216	0.21	0.17	315	0.31	0.27
185	0.18	0.14	273	0.27	0.23
179	0.18	0.14	281	0.28	0.24
162	0.16	0.12	280	0.28	0.23
159	0.16	0.12	283	0.28	0.24
164	0.16	0.12	279	0.27	0.23



292	0.29	0.25	361	0.36	0.31
282	0.28	0.24	378	0.37	0.33
283	0.28	0.24	353	0.35	0.31
270	0.27	0.23	348	0.34	0.30
286	0.28	0.24	347	0.34	0.30
286	0.28	0.24	345	0.34	0.30
312	0.31	0.27	347	0.34	0.30
280	0.28	0.23	378	0.37	0.33
287	0.28	0.24	353	0.35	0.31
287	0.28	0.24	371	0.37	0.32
286	0.28	0.24	362	0.36	0.32
302	0.30	0.26	378	0.37	0.33
291	0.29	0.25	357	0.35	0.31
303	0.30	0.26	372	0.37	0.33
287	0.28	0.24	379	0.37	0.33
281	0.28	0.24	360	0.35	0.31
315	0.31	0.27	361	0.36	0.31
266	0.26	0.22	354	0.35	0.31
262	0.26	0.22	396	0.39	0.35
172	0.17	0.13	444	0.44	0.40
170	0.17	0.13	414	0.41	0.37
184	0.18	0.14	435	0.43	0.39
151	0.15	0.11	479	0.47	0.43
165	0.16	0.12	480	0.47	0.43
212	0.21	0.17	433	0.43	0.39
205	0.20	0.16	447	0.44	0.40
184	0.18	0.14	425	0.42	0.38
224	0.22	0.18	487	0.48	0.44
346	0.34	0.30	506	0.50	0.46
377	0.37	0.33	500	0.49	0.45
365	0.36	0.32	469	0.46	0.42
356	0.35	0.31	487	0.48	0.44
345	0.34	0.30	495	0.49	0.45
365	0.36	0.32	501	0.49	0.45
358	0.35	0.31	511	0.50	0.46
361	0.36	0.31	471	0.46	0.42
369	0.36	0.32	459	0.45	0.41
368	0.36	0.32	484	0.48	0.44
345	0.34	0.30	445	0.44	0.40
369	0.36	0.32	495	0.49	0.45
354	0.35	0.31	500	0.49	0.45
368	0.36	0.32	484	0.48	0.44
342	0.34	0.30	486	0.48	0.44
362	0.36	0.32	486	0.48	0.44
370	0.36	0.32	492	0.48	0.44
373	0.37	0.33	486	0.48	0.44
345	0.34	0.30	490	0.48	0.44

461	0.45	0.41
467	0.46	0.42
501	0.49	0.45
471	0.46	0.42
510	0.50	0.46
487	0.48	0.44
453	0.45	0.41
401	0.40	0.35
397	0.39	0.35
368	0.36	0.32
330	0.33	0.28
292	0.29	0.25
313	0.31	0.27
344	0.34	0.30
314	0.31	0.27
354	0.35	0.31
360	0.35	0.31
359	0.35	0.31
358	0.35	0.31
338	0.33	0.29
353	0.35	0.31
299	0.29	0.25
281	0.28	0.24
259	0.26	0.21
273	0.27	0.23
223	0.22	0.18
216	0.21	0.17
199	0.20	0.16
224	0.22	0.18
196	0.19	0.15
159	0.16	0.12
117	0.12	0.07
88	0.09	0.05
102	0.10	0.06
91	0.09	0.05
95	0.09	0.05
104	0.10	0.06
131	0.13	0.09
157	0.15	0.11
131	0.13	0.09
163	0.16	0.12
144	0.14	0.10
121	0.12	0.08
86	0.08	0.04
62	0.06	0.02
59	0.06	0.02
54	0.05	0.01

57	0.06	0.02
61	0.06	0.02
63	0.06	0.02
56	0.06	0.01
45	0.04	0.00
61	0.06	0.02
49	0.05	0.01
58	0.06	0.02
60	0.06	0.02
59	0.06	0.02
64	0.06	0.02
74	0.07	0.03
49	0.05	0.01
55	0.05	0.01
53	0.05	0.01
55	0.05	0.01
52	0.05	0.01
61	0.06	0.02
67	0.07	0.03
61	0.06	0.02
59	0.06	0.02
64	0.06	0.02
55	0.05	0.01
51	0.05	0.01
55	0.05	0.01
60	0.06	0.02
61	0.06	0.02
65	0.06	0.02
61	0.06	0.02
54	0.05	0.01
74	0.07	0.03
59	0.06	0.02
64	0.06	0.02
52	0.05	0.01
51	0.05	0.01
57	0.06	0.02
72	0.07	0.03
64	0.06	0.02
75	0.07	0.03
55	0.05	0.01
68	0.07	0.03
66	0.07	0.02
53	0.05	0.01
63	0.06	0.02
56	0.06	0.01
56	0.06	0.01
63	0.06	0.02

60	0.06	0.02
63	0.06	0.02
55	0.05	0.01
63	0.06	0.02
56	0.06	0.01
59	0.06	0.02
53	0.05	0.01
55	0.05	0.01
59	0.06	0.02
53	0.05	0.01
59	0.06	0.02

38	0.04	0.00
48	0.05	0.01
45	0.04	0.00
52	0.05	0.01
48	0.05	0.01
42	0.04	0.00
50	0.05	0.01
58	0.06	0.02
62	0.06	0.02
51	0.05	0.01
56	0.06	0.01
53	0.05	0.01
55	0.05	0.01
61	0.06	0.02
60	0.06	0.02
54	0.05	0.01
56	0.06	0.01
61	0.06	0.02
54	0.05	0.01
53	0.05	0.01
50	0.05	0.01
55	0.05	0.01
53	0.05	0.01
43	0.04	0.00
45	0.04	0.00
47	0.05	0.01
51	0.05	0.01
46	0.05	0.00
47	0.05	0.01
50	0.05	0.01
44	0.04	0.00
48	0.05	0.01
42	0.04	0.00
45	0.04	0.00
46	0.05	0.00
48	0.05	0.01
44	0.04	0.00
44	0.04	0.00
53	0.05	0.01
46	0.05	0.00
46	0.05	0.00
44	0.04	0.00
44	0.04	0.00
51	0.05	0.01
57	0.06	0.02
65	0.06	0.02
68	0.07	0.03

### Sbrdr 1 – SW crnr (South Boundary)

7		
21:03:24		
10:09:08 cps Live		
time (s) 2.00	cps to micro Sv/h	solar correction
56	0.06	0.01
65	0.06	0.02
62	0.06	0.02
58	0.06	0.02
69	0.07	0.03
71	0.07	0.03
61	0.06	0.02
55	0.05	0.01
59	0.06	0.02
66	0.07	0.02
74	0.07	0.03
59	0.06	0.02
67	0.07	0.03
67	0.07	0.03
64	0.06	0.02
59	0.06	0.02
62	0.06	0.02
61	0.06	0.02
58	0.06	0.02
65	0.06	0.02
55	0.05	0.01
63	0.06	0.02
57	0.06	0.02
53	0.05	0.01
58	0.06	0.02
57	0.06	0.02
52	0.05	0.01
48	0.05	0.01



84	0.08	0.04
94	0.09	0.05
102	0.10	0.06
99	0.10	0.06
82	0.08	0.04
85	0.08	0.04
93	0.09	0.05
101	0.10	0.06
95	0.09	0.05
97	0.10	0.05
86	0.08	0.04
95	0.09	0.05
99	0.10	0.06
102	0.10	0.06
88	0.09	0.05
92	0.09	0.05
88	0.09	0.05
99	0.10	0.06
90	0.09	0.05
85	0.08	0.04
88	0.09	0.05
87	0.09	0.04
98	0.10	0.06

#### SW crnr – NW crnr (West Boundary)

8		
21:03:24		
10:12:30 cps Live		solar
time (s) 2.00	cps to micro Sv/h	correction
78	0.08	0.04
82	0.08	0.04
97	0.10	0.05
97	0.10	0.05
101	0.10	0.06
97	0.10	0.05
102	0.10	0.06
96	0.09	0.05
80	0.08	0.04
95	0.09	0.05
98	0.10	0.06
114	0.11	0.07
92	0.09	0.05
98	0.10	0.06
83	0.08	0.04
87	0.09	0.04

84	0.08	0.04
70	0.07	0.03
63	0.06	0.02
66	0.07	0.02
73	0.07	0.03
72	0.07	0.03
66	0.07	0.02

#### EW 1

1			
21:03:24			
10:56:23 cps Live			solar
time (s) 2.00	cps to micro Sv/h		correction
89	0.09		0.05
74	0.07		0.03
91	0.09		0.05
69	0.07		0.03
79	0.08		0.04
72	0.07		0.03
52	0.05		0.01
45	0.04		0.00
42	0.04		0.00
37	0.04		0.00
39	0.04		0.00
44	0.04		0.00
33	0.03		0.00
31	0.03		0.00
39	0.04		0.00
42	0.04		0.00
33	0.03		0.00
40	0.04		0.00
32	0.03		0.00
25	0.02		0.00
36	0.04		0.00
37	0.04		0.00
32	0.03		0.00
29	0.03		0.00
30	0.03		0.00
31	0.03		0.00
35	0.03		0.00
41	0.04		0.00
31	0.03		0.00
32	0.03		0.00
36	0.04		0.00
34	0.03		0.00
36	0.04		0.00
49	0.05		0.01
40	0.04		0.00
44	0.04		0.00
43	0.04		0.00

43	0.04	0.00	91	0.09	0.05
39	0.04	0.00	80	0.08	0.04
43	0.04	0.00	75	0.07	0.03
38	0.04	0.00	73	0.07	0.03
49	0.05	0.01	63	0.06	0.02
38	0.04	0.00	76	0.07	0.03
46	0.05	0.00	83	0.08	0.04
48	0.05	0.01	79	0.08	0.04
46	0.05	0.00	85	0.08	0.04
50	0.05	0.01	75	0.07	0.03
45	0.04	0.00	82	0.08	0.04
54	0.05	0.01	89	0.09	0.05
52	0.05	0.01	90	0.09	0.05
44	0.04	0.00	89	0.09	0.05
51	0.05	0.01	93	0.09	0.05
55	0.05	0.01	88	0.09	0.05
54	0.05	0.01	105	0.10	0.06
49	0.05	0.01	139	0.14	0.10
55	0.05	0.01	173	0.17	0.13
50	0.05	0.01	152	0.15	0.11
57	0.06	0.02	111	0.11	0.07
66	0.07	0.02	99	0.10	0.06
53	0.05	0.01	109	0.11	0.07
62	0.06	0.02	145	0.14	0.10
49	0.05	0.01	129	0.13	0.09
46	0.05	0.00	152	0.15	0.11
55	0.05	0.01	171	0.17	0.13
56	0.06	0.01	206	0.20	0.16
58	0.06	0.02	222	0.22	0.18
51	0.05	0.01	211	0.21	0.17
49	0.05	0.01	230	0.23	0.19
55	0.05	0.01	222	0.22	0.18
64	0.06	0.02	245	0.24	0.20
60	0.06	0.02	253	0.25	0.21
55	0.05	0.01	286	0.28	0.24
67	0.07	0.03	303	0.30	0.26
68	0.07	0.03	326	0.32	0.28
61	0.06	0.02	285	0.28	0.24
49	0.05	0.01	300	0.30	0.25
60	0.06	0.02	297	0.29	0.25
54	0.05	0.01	299	0.29	0.25
65	0.06	0.02	291	0.29	0.25
54	0.05	0.01	309	0.30	0.26
65	0.06	0.02	296	0.29	0.25
72	0.07	0.03	286	0.28	0.24
79	0.08	0.04	288	0.28	0.24
75	0.07	0.03	285	0.28	0.24
123	0.12	0.08	295	0.29	0.25
136	0.13	0.09	297	0.29	0.25
95	0.09	0.05	278	0.27	0.23
89	0.09	0.05	300	0.30	0.25
78	0.08	0.04	289	0.28	0.24
93	0.09	0.05	297	0.29	0.25
100	0.10	0.06	299	0.29	0.25

300	0.30	0.25
282	0.28	0.24
279	0.27	0.23
295	0.29	0.25
293	0.29	0.25
280	0.28	0.23
304	0.30	0.26
270	0.27	0.23
259	0.26	0.21
255	0.25	0.21
243	0.24	0.20
199	0.20	0.16
192	0.19	0.15
215	0.21	0.17
196	0.19	0.15
186	0.18	0.14
200	0.20	0.16
229	0.23	0.18
193	0.19	0.15
189	0.19	0.15
193	0.19	0.15
218	0.21	0.17
194	0.19	0.15
221	0.22	0.18
187	0.18	0.14
189	0.19	0.15
187	0.18	0.14
148	0.15	0.10
111	0.11	0.07
79	0.08	0.04
89	0.09	0.05
74	0.07	0.03
95	0.09	0.05
85	0.08	0.04
84	0.08	0.04
86	0.08	0.04
84	0.08	0.04
82	0.08	0.04
88	0.09	0.05
76	0.07	0.03
80	0.08	0.04
78	0.08	0.04
73	0.07	0.03
72	0.07	0.03
84	0.08	0.04
72	0.07	0.03
74	0.07	0.03
84	0.08	0.04
75	0.07	0.03
84	0.08	0.04
85	0.08	0.04
87	0.09	0.04
81	0.08	0.04
78	0.08	0.04

79	0.08	0.04
80	0.08	0.04
68	0.07	0.03
84	0.08	0.04
68	0.07	0.03
90	0.09	0.05
80	0.08	0.04
68	0.07	0.03
75	0.07	0.03
61	0.06	0.02
75	0.07	0.03
67	0.07	0.03
71	0.07	0.03
77	0.08	0.03
77	0.08	0.03
70	0.07	0.03
83	0.08	0.04
72	0.07	0.03
72	0.07	0.03
87	0.09	0.04
70	0.07	0.03
67	0.07	0.03
71	0.07	0.03
73	0.07	0.03
74	0.07	0.03
76	0.07	0.03
70	0.07	0.03
73	0.07	0.03
70	0.07	0.03
73	0.07	0.03
69	0.07	0.03
70	0.07	0.03
68	0.07	0.03
64	0.06	0.02
71	0.07	0.03
89	0.09	0.05
83	0.08	0.04
87	0.09	0.04
85	0.08	0.04
79	0.08	0.04
67	0.07	0.03
71	0.07	0.03
78	0.08	0.04
89	0.09	0.05
73	0.07	0.03
72	0.07	0.03
75	0.07	0.03
72	0.07	0.03
76	0.07	0.03
65	0.06	0.02
70	0.07	0.03
67	0.07	0.03
87	0.09	0.04
100	0.10	0.06



101	0.10	0.06	54	0.05	0.01
108	0.11	0.07	63	0.06	0.02
100	0.10	0.06	68	0.07	0.03
120	0.12	0.08	69	0.07	0.03
117	0.12	0.07	68	0.07	0.03
116	0.11	0.07	64	0.06	0.02
103	0.10	0.06	65	0.06	0.02
86	0.08	0.04	73	0.07	0.03
82	0.08	0.04	69	0.07	0.03
64	0.06	0.02	65	0.06	0.02
64	0.06	0.02	63	0.06	0.02
67	0.07	0.03	68	0.07	0.03
58	0.06	0.02	58	0.06	0.02
69	0.07	0.03	71	0.07	0.03
78	0.08	0.04	78	0.08	0.04
72	0.07	0.03	72	0.07	0.03
68	0.07	0.03	64	0.06	0.02
66	0.07	0.02	80	0.08	0.04
67	0.07	0.03	64	0.06	0.02
59	0.06	0.02	70	0.07	0.03
63	0.06	0.02	72	0.07	0.03
65	0.06	0.02	86	0.08	0.04
69	0.07	0.03	72	0.07	0.03
61	0.06	0.02	66	0.07	0.02
69	0.07	0.03	60	0.06	0.02
72	0.07	0.03	65	0.06	0.02
79	0.08	0.04	55	0.05	0.01
71	0.07	0.03	58	0.06	0.02
66	0.07	0.02	58	0.06	0.02
66	0.07	0.02	52	0.05	0.01
68	0.07	0.03	55	0.05	0.01
62	0.06	0.02	57	0.06	0.02
77	0.08	0.03	64	0.06	0.02
65	0.06	0.02	59	0.06	0.02
75	0.07	0.03	59	0.06	0.02
80	0.08	0.04	58	0.06	0.02
70	0.07	0.03	67	0.07	0.03
85	0.08	0.04	58	0.06	0.02
58	0.06	0.02	53	0.05	0.01
70	0.07	0.03	54	0.05	0.01
58	0.06	0.02	59	0.06	0.02
62	0.06	0.02	58	0.06	0.02
68	0.07	0.03	54	0.05	0.01
53	0.05	0.01	54	0.05	0.01
71	0.07	0.03	56	0.06	0.01
58	0.06	0.02	58	0.06	0.02
67	0.07	0.03	58	0.06	0.02
69	0.07	0.03	62	0.06	0.02
62	0.06	0.02	56	0.06	0.01
58	0.06	0.02	57	0.06	0.02
71	0.07	0.03	59	0.06	0.02
60	0.06	0.02	57	0.06	0.02
69	0.07	0.03	54	0.05	0.01
66	0.07	0.02	69	0.07	0.03

53	0.05	0.01	36	0.04	0.00
63	0.06	0.02	40	0.04	0.00
57	0.06	0.02	46	0.05	0.00
47	0.05	0.01	37	0.04	0.00
61	0.06	0.02	51	0.05	0.01
59	0.06	0.02	41	0.04	0.00
62	0.06	0.02	41	0.04	0.00
61	0.06	0.02	47	0.05	0.01
58	0.06	0.02	42	0.04	0.00
56	0.06	0.01	42	0.04	0.00
47	0.05	0.01	49	0.05	0.01
54	0.05	0.01	49	0.05	0.01
44	0.04	0.00	39	0.04	0.00
62	0.06	0.02	50	0.05	0.01
56	0.06	0.01	43	0.04	0.00
59	0.06	0.02	50	0.05	0.01
55	0.05	0.01	46	0.05	0.00
46	0.05	0.00	47	0.05	0.01
49	0.05	0.01	42	0.04	0.00
46	0.05	0.00	47	0.05	0.01
40	0.04	0.00	39	0.04	0.00
56	0.06	0.01	45	0.04	0.00
45	0.04	0.00	42	0.04	0.00
53	0.05	0.01	44	0.04	0.00
46	0.05	0.00	51	0.05	0.01
54	0.05	0.01	37	0.04	0.00
59	0.06	0.02	40	0.04	0.00
48	0.05	0.01	46	0.05	0.00
39	0.04	0.00	39	0.04	0.00
47	0.05	0.01	32	0.03	0.00
44	0.04	0.00	44	0.04	0.00
49	0.05	0.01	40	0.04	0.00
47	0.05	0.01	31	0.03	0.00
43	0.04	0.00	39	0.04	0.00
47	0.05	0.01	40	0.04	0.00
46	0.05	0.00	34	0.03	0.00
53	0.05	0.01	37	0.04	0.00
46	0.05	0.00	36	0.04	0.00
43	0.04	0.00	40	0.04	0.00
52	0.05	0.01	40	0.04	0.00
47	0.05	0.01	32	0.03	0.00
46	0.05	0.00	34	0.03	0.00
59	0.06	0.02	29	0.03	0.00
46	0.05	0.00	31	0.03	0.00
65	0.06	0.02	42	0.04	0.00
41	0.04	0.00	38	0.04	0.00
53	0.05	0.01	38	0.04	0.00
42	0.04	0.00	43	0.04	0.00
43	0.04	0.00	38	0.04	0.00
50	0.05	0.01	40	0.04	0.00
45	0.04	0.00	48	0.05	0.01
50	0.05	0.01			
40	0.04	0.00			
48	0.05	0.01			

NS1		
2		
21:03:24		
11:15:49 cps Live		solar
time (s)	2.00	cps to micro Sv/h
		correction
147	0.14	0.10
153	0.15	0.11
112	0.11	0.07
125	0.12	0.08
106	0.10	0.06
110	0.11	0.07
96	0.09	0.05
97	0.10	0.05
87	0.09	0.04
88	0.09	0.05
75	0.07	0.03
62	0.06	0.02
64	0.06	0.02
53	0.05	0.01
56	0.06	0.01
52	0.05	0.01
51	0.05	0.01
53	0.05	0.01
51	0.05	0.01
52	0.05	0.01
64	0.06	0.02
46	0.05	0.00
48	0.05	0.01
53	0.05	0.01
46	0.05	0.00
56	0.06	0.01
61	0.06	0.02
47	0.05	0.01
54	0.05	0.01
46	0.05	0.00
45	0.04	0.00
50	0.05	0.01
42	0.04	0.00
50	0.05	0.01
58	0.06	0.02
48	0.05	0.01
53	0.05	0.01
46	0.05	0.00
50	0.05	0.01
54	0.05	0.01
51	0.05	0.01
45	0.04	0.00
54	0.05	0.01
41	0.04	0.00
57	0.06	0.02
49	0.05	0.01
44	0.04	0.00
42	0.04	0.00

44	0.04	0.00
44	0.04	0.00
40	0.04	0.00
39	0.04	0.00
34	0.03	0.00
40	0.04	0.00
39	0.04	0.00
31	0.03	0.00
37	0.04	0.00
39	0.04	0.00
39	0.04	0.00
30	0.03	0.00
42	0.04	0.00
33	0.03	0.00
32	0.03	0.00
39	0.04	0.00
36	0.04	0.00
40	0.04	0.00
32	0.03	0.00
28	0.03	0.00
36	0.04	0.00
34	0.03	0.00
35	0.03	0.00
33	0.03	0.00
34	0.03	0.00
27	0.03	0.00
42	0.04	0.00
34	0.03	0.00
37	0.04	0.00
37	0.04	0.00
36	0.04	0.00
36	0.04	0.00
42	0.04	0.00
35	0.03	0.00
27	0.03	0.00
38	0.04	0.00
24	0.02	0.00
37	0.04	0.00
33	0.03	0.00
42	0.04	0.00
41	0.04	0.00
38	0.04	0.00
45	0.04	0.00
39	0.04	0.00
31	0.03	0.00
29	0.03	0.00
40	0.04	0.00
32	0.03	0.00
39	0.04	0.00



**NS2**

3		
21:03:24		
11:19:39 cps Live		
time (s) 2.00	cps to micro Sv/h	solar correction
29	0.03	0.00
31	0.03	0.00
30	0.03	0.00
40	0.04	0.00
36	0.04	0.00
39	0.04	0.00
31	0.03	0.00
33	0.03	0.00
35	0.03	0.00
34	0.03	0.00
41	0.04	0.00
35	0.03	0.00
38	0.04	0.00
45	0.04	0.00
43	0.04	0.00
51	0.05	0.01
42	0.04	0.00
36	0.04	0.00
48	0.05	0.01
45	0.04	0.00
46	0.05	0.00
46	0.05	0.00
45	0.04	0.00
52	0.05	0.01
49	0.05	0.01
42	0.04	0.00
56	0.06	0.01
44	0.04	0.00
47	0.05	0.01
50	0.05	0.01
37	0.04	0.00
48	0.05	0.01
44	0.04	0.00
58	0.06	0.02
51	0.05	0.01
58	0.06	0.02
54	0.05	0.01
61	0.06	0.02
52	0.05	0.01
65	0.06	0.02
61	0.06	0.02
71	0.07	0.03
50	0.05	0.01
58	0.06	0.02
60	0.06	0.02
62	0.06	0.02
73	0.07	0.03
73	0.07	0.03

59	0.06	0.02
66	0.07	0.02
58	0.06	0.02
50	0.05	0.01
78	0.08	0.04
73	0.07	0.03
76	0.07	0.03
81	0.08	0.04
77	0.08	0.03
76	0.07	0.03
77	0.08	0.03
67	0.07	0.03
75	0.07	0.03
81	0.08	0.04
87	0.09	0.04
107	0.11	0.06
81	0.08	0.04
100	0.10	0.06
107	0.11	0.06
119	0.12	0.08
127	0.13	0.08
144	0.14	0.10
196	0.19	0.15
179	0.18	0.14

**NS3**

4		
21:03:24		
11:22:58 cps Live		
time (s) 2.00	cps to micro Sv/h	solar correction
102	0.10	0.06
110	0.11	0.07
85	0.08	0.04
86	0.08	0.04
80	0.08	0.04
84	0.08	0.04
85	0.08	0.04
74	0.07	0.03
78	0.08	0.04
81	0.08	0.04
85	0.08	0.04
73	0.07	0.03
80	0.08	0.04
75	0.07	0.03
89	0.09	0.05
112	0.11	0.07
105	0.10	0.06
94	0.09	0.05
93	0.09	0.05
91	0.09	0.05
113	0.11	0.07
115	0.11	0.07

92	0.09	0.05	56	0.06	0.01
80	0.08	0.04	49	0.05	0.01
81	0.08	0.04	47	0.05	0.01
85	0.08	0.04	46	0.05	0.00
73	0.07	0.03	56	0.06	0.01
67	0.07	0.03	49	0.05	0.01
65	0.06	0.02	51	0.05	0.01
76	0.07	0.03	47	0.05	0.01
77	0.08	0.03	53	0.05	0.01
71	0.07	0.03	52	0.05	0.01
65	0.06	0.02	48	0.05	0.01
75	0.07	0.03	57	0.06	0.02
62	0.06	0.02	49	0.05	0.01
57	0.06	0.02	57	0.06	0.02
62	0.06	0.02	61	0.06	0.02
62	0.06	0.02	59	0.06	0.02
66	0.07	0.02	59	0.06	0.02
73	0.07	0.03	52	0.05	0.01
69	0.07	0.03	60	0.06	0.02
60	0.06	0.02	60	0.06	0.02
60	0.06	0.02	54	0.05	0.01
57	0.06	0.02	57	0.06	0.02
59	0.06	0.02	56	0.06	0.01
65	0.06	0.02	64	0.06	0.02
61	0.06	0.02	42	0.04	0.00
62	0.06	0.02	63	0.06	0.02
52	0.05	0.01	59	0.06	0.02
59	0.06	0.02	53	0.05	0.01
61	0.06	0.02	59	0.06	0.02
53	0.05	0.01	54	0.05	0.01
58	0.06	0.02	57	0.06	0.02
58	0.06	0.02	53	0.05	0.01
52	0.05	0.01	41	0.04	0.00
60	0.06	0.02	53	0.05	0.01
56	0.06	0.01	65	0.06	0.02
58	0.06	0.02	55	0.05	0.01
56	0.06	0.01	61	0.06	0.02
50	0.05	0.01	50	0.05	0.01
44	0.04	0.00	52	0.05	0.01
56	0.06	0.01	51	0.05	0.01
51	0.05	0.01	50	0.05	0.01
48	0.05	0.01	58	0.06	0.02
50	0.05	0.01	47	0.05	0.01
54	0.05	0.01	46	0.05	0.00
44	0.04	0.00	43	0.04	0.00
49	0.05	0.01	52	0.05	0.01
53	0.05	0.01	53	0.05	0.01
48	0.05	0.01	57	0.06	0.02
51	0.05	0.01	58	0.06	0.02
48	0.05	0.01	66	0.07	0.02
52	0.05	0.01	59	0.06	0.02
54	0.05	0.01			
47	0.05	0.01			
60	0.06	0.02			

NS4			
5			
21:03:24			
11:27:27 cps Live			
time (s) 2.00	cps to micro Sv/h	solar correction	
57	0.06	0.02	
66	0.07	0.02	
62	0.06	0.02	
45	0.04	0.00	
52	0.05	0.01	
65	0.06	0.02	
55	0.05	0.01	
56	0.06	0.01	
47	0.05	0.01	
64	0.06	0.02	
55	0.05	0.01	
48	0.05	0.01	
66	0.07	0.02	
56	0.06	0.01	
63	0.06	0.02	
63	0.06	0.02	
50	0.05	0.01	
55	0.05	0.01	
50	0.05	0.01	
46	0.05	0.00	
68	0.07	0.03	
67	0.07	0.03	
65	0.06	0.02	
70	0.07	0.03	
61	0.06	0.02	
59	0.06	0.02	
69	0.07	0.03	
56	0.06	0.01	
60	0.06	0.02	
63	0.06	0.02	
55	0.05	0.01	
52	0.05	0.01	
57	0.06	0.02	
55	0.05	0.01	
71	0.07	0.03	
60	0.06	0.02	
62	0.06	0.02	
61	0.06	0.02	
63	0.06	0.02	
81	0.08	0.04	
67	0.07	0.03	
63	0.06	0.02	
63	0.06	0.02	
76	0.07	0.03	
59	0.06	0.02	
61	0.06	0.02	
63	0.06	0.02	
60	0.06	0.02	

62	0.06	0.02
104	0.10	0.06
100	0.10	0.06
117	0.12	0.07
134	0.13	0.09
149	0.15	0.11
145	0.14	0.10

NS5			
6			
21:03:24			
11:31:38 cps Live			
time (s) 2.00	cps to micro Sv/h	solar correction	
133	0.13	0.09	
141	0.14	0.10	
135	0.13	0.09	
125	0.12	0.08	
134	0.13	0.09	
128	0.13	0.09	
111	0.11	0.07	
121	0.12	0.08	
88	0.09	0.05	
92	0.09	0.05	
76	0.07	0.03	
70	0.07	0.03	
67	0.07	0.03	
76	0.07	0.03	
64	0.06	0.02	
60	0.06	0.02	
60	0.06	0.02	
60	0.06	0.02	
64	0.06	0.02	
63	0.06	0.02	
65	0.06	0.02	
54	0.05	0.01	
45	0.04	0.00	
59	0.06	0.02	
48	0.05	0.01	
58	0.06	0.02	
46	0.05	0.00	
52	0.05	0.01	
46	0.05	0.00	
63	0.06	0.02	
50	0.05	0.01	
56	0.06	0.01	
42	0.04	0.00	
50	0.05	0.01	
54	0.05	0.01	
52	0.05	0.01	
58	0.06	0.02	
54	0.05	0.01	



52	0.05	0.01
50	0.05	0.01
53	0.05	0.01
64	0.06	0.02
52	0.05	0.01
53	0.05	0.01
43	0.04	0.00
53	0.05	0.01
50	0.05	0.01
51	0.05	0.01
50	0.05	0.01
51	0.05	0.01
41	0.04	0.00
41	0.04	0.00
48	0.05	0.01
43	0.04	0.00
48	0.05	0.01
46	0.05	0.00
41	0.04	0.00
38	0.04	0.00
45	0.04	0.00
38	0.04	0.00
46	0.05	0.00
49	0.05	0.01
53	0.05	0.01
42	0.04	0.00

60	0.06	0.02
60	0.06	0.02
62	0.06	0.02
68	0.07	0.03
77	0.08	0.03
78	0.08	0.04
64	0.06	0.02
60	0.06	0.02
78	0.08	0.04
74	0.07	0.03
81	0.08	0.04
84	0.08	0.04
74	0.07	0.03
93	0.09	0.05
99	0.10	0.06
147	0.14	0.10
156	0.15	0.11
160	0.16	0.12
145	0.14	0.10
165	0.16	0.12
158	0.16	0.11
156	0.15	0.11
175	0.17	0.13
167	0.16	0.12
177	0.17	0.13
167	0.16	0.12
164	0.16	0.12
174	0.17	0.13
162	0.16	0.12

#### NS6

7		
21:03:24		
11:37:14 cps Live		
time (s) 2.00	cps to micro Sv/h	solar correction
45	0.04	0.00
59	0.06	0.02
55	0.05	0.01
50	0.05	0.01
49	0.05	0.01
51	0.05	0.01
52	0.05	0.01
52	0.05	0.01
48	0.05	0.01
54	0.05	0.01
55	0.05	0.01
58	0.06	0.02
54	0.05	0.01
54	0.05	0.01
62	0.06	0.02
62	0.06	0.02
57	0.06	0.02
50	0.05	0.01
58	0.06	0.02

#### NS7

8			
21:03:24			
11:39:51 cps Live			
time (s) 2.00	cps to micro Sv/h	solar correction	
336	0.33	0.29	
321	0.32	0.28	
268	0.26	0.22	
238	0.23	0.19	
234	0.23	0.19	
243	0.24	0.20	
314	0.31	0.27	
308	0.30	0.26	
164	0.16	0.12	
113	0.11	0.07	
113	0.11	0.07	
97	0.10	0.05	
70	0.07	0.03	
94	0.09	0.05	
77	0.08	0.03	
82	0.08	0.04	

82	0.08	0.04	45	0.04	0.00
65	0.06	0.02	40	0.04	0.00
65	0.06	0.02	50	0.05	0.01
66	0.07	0.02	42	0.04	0.00
75	0.07	0.03	50	0.05	0.01
72	0.07	0.03	55	0.05	0.01
73	0.07	0.03	38	0.04	0.00
79	0.08	0.04	53	0.05	0.01
72	0.07	0.03	43	0.04	0.00
70	0.07	0.03	47	0.05	0.01
86	0.08	0.04	40	0.04	0.00
74	0.07	0.03	43	0.04	0.00
70	0.07	0.03	43	0.04	0.00
73	0.07	0.03	37	0.04	0.00
68	0.07	0.03	42	0.04	0.00
75	0.07	0.03	46	0.05	0.00
68	0.07	0.03	43	0.04	0.00
74	0.07	0.03	50	0.05	0.01
83	0.08	0.04	50	0.05	0.01
80	0.08	0.04	48	0.05	0.01
79	0.08	0.04	45	0.04	0.00
77	0.08	0.03	49	0.05	0.01
73	0.07	0.03	48	0.05	0.01
78	0.08	0.04	63	0.06	0.02
60	0.06	0.02	71	0.07	0.03
84	0.08	0.04	67	0.07	0.03
92	0.09	0.05	76	0.07	0.03
76	0.07	0.03	75	0.07	0.03
81	0.08	0.04	63	0.06	0.02
73	0.07	0.03	57	0.06	0.02
68	0.07	0.03	58	0.06	0.02
62	0.06	0.02	75	0.07	0.03
80	0.08	0.04	96	0.09	0.05
80	0.08	0.04	168	0.17	0.12
74	0.07	0.03	233	0.23	0.19
64	0.06	0.02	286	0.28	0.24
64	0.06	0.02	303	0.30	0.26
57	0.06	0.02			
71	0.07	0.03			
76	0.07	0.03			
64	0.06	0.02			
63	0.06	0.02			
65	0.06	0.02			
73	0.07	0.03			
72	0.07	0.03			
<b>NS8</b>			<b>NS9</b>		
9			10		
21:03:24			21:03:24		
11:43:27 cps Live			11:45:39 cps Live		
time (s) 2.00	cps to micro Sv/h	solar correction	time (s) 2.00	cps to micro Sv/h	solar correction
57	0.06	0.02	135	0.13	0.09
51	0.05	0.01	146	0.14	0.10
			164	0.16	0.12
			152	0.15	0.11
			102	0.10	0.06
			71	0.07	0.03
			69	0.07	0.03
			61	0.06	0.02
			86	0.08	0.04

61	0.06	0.02
56	0.06	0.01
53	0.05	0.01
49	0.05	0.01
49	0.05	0.01
48	0.05	0.01
42	0.04	0.00
44	0.04	0.00
44	0.04	0.00
49	0.05	0.01
42	0.04	0.00
41	0.04	0.00
45	0.04	0.00
44	0.04	0.00
39	0.04	0.00
45	0.04	0.00
40	0.04	0.00
42	0.04	0.00
43	0.04	0.00
44	0.04	0.00
42	0.04	0.00
43	0.04	0.00
45	0.04	0.00
46	0.05	0.00
40	0.04	0.00
40	0.04	0.00
34	0.03	0.00
45	0.04	0.00
40	0.04	0.00
43	0.04	0.00
42	0.04	0.00
44	0.04	0.00
45	0.04	0.00
38	0.04	0.00
38	0.04	0.00
37	0.04	0.00
35	0.03	0.00
37	0.04	0.00
40	0.04	0.00
35	0.03	0.00
33	0.03	0.00
32	0.03	0.00

#### NS10

11		
21:03:24		
11:49:24 cps Live		
time (s) 2.00	cps to micro Sv/h	solar correction
33	0.03	0.00
36	0.04	0.00
34	0.03	0.00
30	0.03	0.00

31	0.03	0.00
36	0.04	0.00
36	0.04	0.00
26	0.03	0.00
34	0.03	0.00
36	0.04	0.00
42	0.04	0.00
41	0.04	0.00
44	0.04	0.00
41	0.04	0.00
46	0.05	0.00
47	0.05	0.01
47	0.05	0.01
38	0.04	0.00
42	0.04	0.00
54	0.05	0.01
48	0.05	0.01
45	0.04	0.00
47	0.05	0.01
47	0.05	0.01
43	0.04	0.00
48	0.05	0.01
51	0.05	0.01
48	0.05	0.01
59	0.06	0.02
45	0.04	0.00
44	0.04	0.00
67	0.07	0.03
58	0.06	0.02
58	0.06	0.02
65	0.06	0.02
51	0.05	0.01
60	0.06	0.02
58	0.06	0.02
41	0.04	0.00

#### NS11

12		
21:03:24		
11:52:20 cps Live		
time (s) 2.00	cps to micro Sv/h	solar correction
46	0.05	0.00
44	0.04	0.00
53	0.05	0.01
73	0.07	0.03
57	0.06	0.02
60	0.06	0.02
56	0.06	0.01
42	0.04	0.00
49	0.05	0.01
53	0.05	0.01
54	0.05	0.01



45	0.04	0.00
45	0.04	0.00
44	0.04	0.00
34	0.03	0.00
52	0.05	0.01
45	0.04	0.00
53	0.05	0.01
43	0.04	0.00
53	0.05	0.01
48	0.05	0.01
32	0.03	0.00
51	0.05	0.01
47	0.05	0.01
47	0.05	0.01
50	0.05	0.01
42	0.04	0.00
43	0.04	0.00
49	0.05	0.01
39	0.04	0.00
48	0.05	0.01
43	0.04	0.00
41	0.04	0.00
43	0.04	0.00
41	0.04	0.00
34	0.03	0.00
48	0.05	0.01
38	0.04	0.00
29	0.03	0.00
43	0.04	0.00
32	0.03	0.00
37	0.04	0.00
44	0.04	0.00
54	0.05	0.01
46	0.05	0.00
36	0.04	0.00
38	0.04	0.00
43	0.04	0.00
34	0.03	0.00
39	0.04	0.00
33	0.03	0.00
38	0.04	0.00
32	0.03	0.00
33	0.03	0.00
36	0.04	0.00
29	0.03	0.00
39	0.04	0.00
26	0.03	0.00
25	0.02	0.00
33	0.03	0.00
31	0.03	0.00
28	0.03	0.00
36	0.04	0.00
32	0.03	0.00
28	0.03	0.00

32	0.03	0.00
32	0.03	0.00
37	0.04	0.00
32	0.03	0.00
34	0.03	0.00
43	0.04	0.00
32	0.03	0.00
38	0.04	0.00
33	0.03	0.00
38	0.04	0.00
40	0.04	0.00
41	0.04	0.00
34	0.03	0.00
36	0.04	0.00
37	0.04	0.00
36	0.04	0.00
34	0.03	0.00
39	0.04	0.00
35	0.03	0.00

# NS12

13		
21:03:24		
11:56:46 cps Live		
time (s)	2.00	cps to micro Sv/h
31		0.03
24		0.02
24		0.02
28		0.03
33		0.03
29		0.03
30		0.03
38		0.04
32		0.03
37		0.04
39		0.04
37		0.04
34		0.03
26		0.03
37		0.04
32		0.03
38		0.04
37		0.04
33		0.03
41		0.04
35		0.03
31		0.03
30		0.03
46		0.05
37		0.04
29		0.03
34		0.03
32		0.03

40	0.04	0.00
33	0.03	0.00
40	0.04	0.00
37	0.04	0.00
29	0.03	0.00
33	0.03	0.00
39	0.04	0.00
39	0.04	0.00
37	0.04	0.00
34	0.03	0.00
36	0.04	0.00
40	0.04	0.00
30	0.03	0.00
31	0.03	0.00
29	0.03	0.00
34	0.03	0.00
42	0.04	0.00
36	0.04	0.00
31	0.03	0.00
46	0.05	0.00
51	0.05	0.01
44	0.04	0.00
50	0.05	0.01
55	0.05	0.01
57	0.06	0.02
54	0.05	0.01

### NS13

14		
21:03:24		
11:59:30 cps Live		solar
time (s) 2.00	cps to micro Sv/h	correction
32	0.03	0.00
45	0.04	0.00
43	0.04	0.00
45	0.04	0.00
53	0.05	0.01
43	0.04	0.00
45	0.04	0.00
39	0.04	0.00
37	0.04	0.00
34	0.03	0.00
30	0.03	0.00
38	0.04	0.00
33	0.03	0.00
43	0.04	0.00
37	0.04	0.00
40	0.04	0.00
38	0.04	0.00
31	0.03	0.00
36	0.04	0.00
31	0.03	0.00

37	0.04	0.00
40	0.04	0.00
40	0.04	0.00
46	0.05	0.00
33	0.03	0.00
36	0.04	0.00
30	0.03	0.00
29	0.03	0.00
36	0.04	0.00
32	0.03	0.00
36	0.04	0.00
33	0.03	0.00
38	0.04	0.00
40	0.04	0.00
31	0.03	0.00
37	0.04	0.00
37	0.04	0.00
34	0.03	0.00
35	0.03	0.00
37	0.04	0.00
35	0.03	0.00
38	0.04	0.00
40	0.04	0.00
37	0.04	0.00
33	0.03	0.00
28	0.03	0.00
32	0.03	0.00
43	0.04	0.00
38	0.04	0.00
38	0.04	0.00
37	0.04	0.00
38	0.04	0.00
44	0.04	0.00
37	0.04	0.00
48	0.05	0.01
39	0.04	0.00
32	0.03	0.00
38	0.04	0.00
38	0.04	0.00
41	0.04	0.00
45	0.04	0.00
37	0.04	0.00
35	0.03	0.00
43	0.04	0.00
39	0.04	0.00
35	0.03	0.00
46	0.05	0.00
42	0.04	0.00
34	0.03	0.00
44	0.04	0.00
45	0.04	0.00



## APPENDIX 5 SAIC Exploranium Calibration Certificate



**Queensland  
Government**

**Forensic and Scientific Services  
HSSA | Health Services Support Agency**

### CERTIFICATE OF CALIBRATION

<b>CLIENT:</b>	INMED Healthcare Pty. Ltd. 45 Prime Drive Seven Hills NSW 2147 leeann.sands@inmed.com.au	<b>Laboratory Reference:</b>	20060055
		<b>Client Order Number:</b>	n/a
		<b>Quote Number:</b>	n/a
		<b>Date Received:</b>	16/06/2020
		<b>Date Commenced:</b>	29/06/2020
<b>ATTN:</b>	Leeann Sands	<b>Laboratory Number/s:</b>	19PX422_Environmental

#### INSTRUMENT DESCRIPTION

	Instrument	Detector
Manufacturer:	SAIC Exploranium	
Model:	GR130	
Serial Number:	9940+GM	
Type :	NaI+GM	

#### PRE CALIBRATION CHECKS

Visual Inspection:	Check performed adequately on receipt, during and after the calibration process.
Battery Check:	Check performed adequately on receipt, during and after the calibration process.
High/Low Voltage:	N/A
Self-diagnosis system:	N/A
Desiccant condition:	N/A
Mechanical zero:	No adjustment was necessary.
Check Source Reading:	No check source was supplied.
Background/Leakage:	All calibration measurements were adjusted to take into account the background radiation levels.

#### CALIBRATION CONDITIONS

Detector Reference Point:	The effective measurement point was taken to be the centre of the detector volume.
Instrument Orientation:	The instrument was orientated so that its detector axis was parallel to the surface plane of the calibration pads.
Cosmic Response:	The cosmic response of the instrument was $1.4 \pm 0.7$ nGy/h (Count time - 30 sec). Local cosmic background radiation was 40 nGy/h <sup>1</sup> . (1 - "FAA's Civil Aerospace Medical Institute Radiobiology Research Team, CARI-6. 2004, United States of America Federal Aviation Administration. p. Computer Freeware.")

#### ATMOSPHERIC CONDITIONS

Dry Bulb Temperature:	25 °C
Relative Humidity:	60 %
Atmospheric Pressure:	1014 hPa (765.4 mm Hg)
Height Above Sea Level:	32.4 m

This report overrides all previous reports. The results relate solely to the sample/s as received and are limited to the specific tests undertaken as listed on the report. The results of this report are confidential and are not to be used or disclosed to any other person or used for any other purpose, whether directly or indirectly, unless that use is disclosed or the purpose is expressly authorised in writing by Queensland Health and the named recipient on this report. To the fullest extent permitted by law, Queensland Health will not be liable for any loss or claim (including legal costs calculated on an indemnity basis) which arise because of (a) problems related to the merchantability, fitness or quality of the sample/s, or (b) any negligent or unlawful act or omissions by Queensland Health that is connected with any activities or services provided by Queensland Health under this agreement (including the timing and/or method under which the sample/s were taken, stored or transported).

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**CALIBRATION TRACEABILITY**

The expected air kerma rates 150mm above the Calibration pads are traceable to measurements using a reference High Pressure Ion Chamber (RSS-131ER -SN- 12B0038D) calibrated across a range of energies utilising radioactive sources traceable to NIST standards.

Nuclide /photon source	Emission	Serial Number	Nominal Activity (GBq)	Reference Date
Caesium-137	0.662 MeV gamma	1192GN	0.037	01-July-1984

**CALIBRATION RESULTS - DOSE RATE MODE (Without Stabilization)**

PAD	Expected air Kerma rate (nGy/h)	Cosmic & Bgnd corrected measured Kerma (nGy/h)	Uncertainty (2u) (%) of corrected level	Variation from expected (%)	Calibration Factor
1	9.00	-	-	-	-
2	29.00	56.57	7.1%	95.1%	0.51
3	68.00	121.14	8.6%	78.2%	0.56
4	190.00	365.71	5.3%	92.5%	0.52
5	312.00	645.71	3.3%	107.0%	0.48

**CALIBRATION RESULTS - DOSE RATE MODE (With Stabilization)**

PAD	Expected air Kerma rate (nGy/h)	Cosmic & Bgnd corrected measured Kerma (nGy/h)	Uncertainty (2u) (%) of corrected level	Variation from expected (%)	Calibration Factor
1	9.00	-	-	-	-
2	29.00	44.60	7.6%	53.8%	0.65
3	68.00	120.31	5.5%	76.9%	0.57
4	190.00	392.31	2.8%	106.5%	0.48
5	312.00	623.74	2.2%	99.9%	0.50

**CALIBRATION RESULTS - SPECTRUM MODE (eU, eTh, and K%)**

No results available

This report overrides all previous reports. The results relate solely to the sample/s as received and are limited to the specific tests undertaken as listed on the report. The results of this report are confidential and are not to be used or disclosed to any other person or used for any other purpose, whether directly or indirectly, unless that use is disclosed or the purpose is expressly authorised in writing by Queensland Health and the named recipient on this report. To the fullest extent permitted by law, Queensland Health will not be liable for any loss or claim (including legal costs calculated on an indemnity basis) which arise because of (a) problems related to the merchantability, fitness or quality of the sample/s, or (b) any negligent or unlawful act or omissions by Queensland Health that is connected with any activities or services provided by Queensland Health under this agreement (including the timing and/or method under which the sample/s were taken, stored or transported).

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## COMMENTS

The centre of detector was sitting 150 mm from the surface of calibration pad for all measurements.

Over-Range Response: Not applicable to this environmental level calibration.

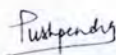
Energy Dependence Factors: The response of the instrument was tested for a range of NORM energies (46keV to 2.612 MeV) using U238; Th232 and progeny and K40 spiked aerated concrete (density=1550kg/m<sup>3</sup>) planar sources shown to be homogenous and produce uniform radiation fields.

Accuracy: For calibration of this instrument, accuracy is dependent on laboratory measurements, transfer standards and stability of the instrument being calibrated. The uncertainty of the corrected measurement tends to be larger at the very low air kerma levels associated with pads #1 & #2. The result for this calibration can be considered reliable to within 20%.

General: Method as described in Radiation & Nuclear Science unit Technical Document RSS14-004 - NORM based Environmental Radiation Calibration Facility - Calibration Procedure (based on published paper: Wallace, J 2016 JER, Establishing a NORM Based Radiation Calibration Facility)

NEXT CALIBRATION DUE 29 June 2021

## PERFORMED BY



Pushendra Chauhan  
Snr Health Physicist  
Radiation & Nuclear Science  
1-Jul-20

## REVIEWED BY



Drew Watson  
Principal Health Physicist  
Radiation & Nuclear Science

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## APPENDIX 6 RadAlert Inspector USB Calibration Certificate



Date: 29/06/2020  
 Customer: Bartolo Safety Management Services  
 Site Address: PO Box 264  
 Jannali  
 NSW, 2226  
 Dosimeter: Inspector  
 S/N: 42104  
 Cal Number: IR045297

Results	
Authority standards	+/- 25
InMed standards	+/- 15

Temp 25.6°C Humidity 30%

Activity MBq	Date	1/2 Life Days	Half Lives	Current Activity
Cs137 1907-41-3	9.117 1/07/2017	10964.6	0.0997756	8.507784755

Energy (MeV)	Fractional Yield	(u/p) air
3.18170E-02	1.99500E-02	1.38188E-01
3.21940E-02	3.64100E-02	1.34970E-01
6.61650E-01	8.51020E-01	2.93111E-02

Distance (cm)	100	60	40	20
Calculated Dose Rate (uSv/hr)	0.649533483	1.804259674	4.0595843	16.238337

NOTE: Source must be flipped before taking measurement

BEFORE					
Background	0.27	Cal Factor	3340	Date	29/06/2020
Measurement	Dose Rate (uSv/hr)	Dosimeter (uSv/hr)	Ref	% Dif	Fail/Pass
100cm	0.95	1	0.6495335	12.39%	PASS
	1.05				
	1				
60cm	2.28	2.25	1.8042597	10%	PASS
	2.37				
	2.1				
40cm	4.55	4.61666667	4.0595843	7%	PASS
	4.6				
	4.7				
20cm	18.3	18.0666667	16.238337	10%	PASS
	17.8				
	18.1				

ADJUSTED					
Background	Cal Factor	Date	#####		
Measurement	Dose Rate (uSv/hr)	Dosimeter (uSv/hr)	Ref	% Dif	Fail/Pass
1		#DIV/0!	0.649533483	#DIV/0!	#DIV/0!
2		#DIV/0!	1.804259674	#DIV/0!	#DIV/0!
3		#DIV/0!	4.059584266	#DIV/0!	#DIV/0!
4		#DIV/0!	16.23833707	#DIV/0!	#DIV/0!

Completed by: J Enderstein



InMed Pty Ltd  
**Service Record**



Please complete all sections, sign and email to [sales@inmed.com.au](mailto:sales@inmed.com.au)

**SERVICE DETAILS**

Service Engineer <b>J Enderstein</b>		Service Record Number	
Start Date <b>29/6/20</b>	Start Time <b>09:00</b>	Finish Date <b>29/6/20</b>	Finish Time <b>09:45</b>

**SERVICE TYPE**

☐ Warranty
 ☐ Charge
 ☐ Contract
 ☐ No Charge

**EQUIPMENT DETAILS**

Brand <b>SE International</b>	Model <b>Inspector</b>
Serial Number <b>42104</b>	Date of Manufacture

**CUSTOMER DETAILS**

Contact Name	Customer P.O
Institution <b>Bartolo Safety Management Services</b>	
Address <b>PO Box 264</b>	
Suburb/City <b>Jannali</b>	State <b>NSW</b> Postcode
Email	

**REPORTED FAULT**

Routine Maintenance	On-site Hours
	Travel Hours

**ACTION TAKEN**

Completed Routine Maintenance according to Manufacturer's Specification.	Count Rate
Completed Radiation Detector Report.	Peak Graph <input type="checkbox"/> Yes <input type="checkbox"/> No
Unit is OK to use.	Laser Aligned <input type="checkbox"/> Yes <input type="checkbox"/> No

In-House Hours <b>0.75</b>
On-Site Hours
Other

**PARTS REPLACED**

Part Number	Description	New S/N	Old S/N	W/H

**CUSTOMER SIGNATURE**

**SERVICE REPRESENTATIVE SIGNATURE**

Last updated 29/3/17

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## **APPENDIX 10. ECOLOGICAL INSPECTION LETTERS**

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Friday, 11 June 2021

Quarry Manager  
Newcastle Sand Pty Ltd  
398 Cabbage Tree Road  
Williamtown NSW 2318

Attention: Shane Burton  
Sent by email to: shane@newcastlesand.com.au

**SUBJECT: Area 7 clearing works undertaken on 30 March & 1 April, 2021**

Dear Shane,

This letter provides a summary of clearing works undertaken across Area 7 on 30 March, and 1 April 2021, following on from preclearing surveys documented in the clearing letter by Wedgetail, on June 10, 2021. All clearing activities were supervised by Wedgetail Ecologists, Kane Blundell and Ashley Owen.

**Hollow bearing trees**

There were 16 habitat trees marked out during the pre-clear survey and 1 additional tree (ID no 106) that was recorded by Kleinfelder in 2016 (**Figure 1**). Tree 106 was inspected and had no hollows remaining. This tree was felled with all other vegetation surrounding the HBT's. Another HBT (ID no 9) was felled indirectly after being hit by adjacent trees being felled on the first day of clearing. Upon inspection, the hollow was mud-filled, and not considered suitable as a habitat feature.

On March 30, 2021, all other HBT's were set aside for 48 hours, and surrounding vegetation cleared to allow any nocturnal fauna the opportunity to self-relocate overnight.

All HBT were inspected upon being soft felled by excavator on April 1, 2021. Of 35 possible hollows (in 17 HBT's), five hollows were considered suitable habitat for fauna to occupy (**Table 1**). One HBT (ID no 16) was left standing. Therefore 5 nestboxes will need to be installed (1 Large, 3 Medium and 1 Small), to offset the hollows that were felled.

**Table 1: Final tally of hollows after clearing took place at Zone 7, Stage 2 & 3 of Newcastle Sand Quarry**

ID no.	Hollows counted prior to being felled			Signs of Use	Hollows counted after being felled			Comments
	Small	Medium	Large		Small	Medium	Large	
1	0	1	0	None	0	0	0	Termite mud

ID no.	Hollows counted prior to being felled			Signs of Use	Hollows counted after being felled			Comments
	Small	Medium	Large		Small	Medium	Large	
2	1	0	0	None	0	0	0	Fire damage
3	2	1	0	None	0	0	0	Fire damage
4	1	1	0	None	0	0	0	Termite mud
5	0	2	0	None	0	0	0	Fire damage
6	0	1	0	None	0	0	0	No hollows found
7	0	1	0	None	0	0	0	Solid, fire damage
8	1	2	1	None	0	1	1	
9	0	0	0	None	0	0	0	Termite mud
10	4	1	0	None	0	0	0	None
11	1	0	0	None	0	0	0	Fire damage
12	2	0	0	None	0	0	0	Fire damage
13	1	3	0	None	0	1	0	Filled with water, fire damage.
14	1	1	0	None	1	0	0	Fire damage, full of water
15	0	1	0	None	0	1	0	Shallow, full of water
16	2	0	1	None				Left standing
106	0	0	2	None	0	0	0	No hollows
<b>TOTAL</b>	<b>16</b>	<b>15</b>	<b>4</b>		<b>1</b>	<b>3</b>	<b>1</b>	

### Relocated Fauna

Fauna was encouraged to self-relocate where possible during clearing. One Eastern Bearded Dragon (*Pogonia barbata*) was captured and relocated (**Table 2** and **Plate 1**). All other fauna were left to self-relocate.

**Table 2: Fauna relocated during Area 7 clearing works at Newcasatle Sand Quarry**

Date	Species	Capture Location	Release Location
30-03-2021	<i>Pogonia barbata</i> (Eastern Bearded Dragon)	N -32807963, E 151.805210	N -32.807835, E 151.805230



**Plate 1: Eastern Bearded Dragon (*Pogonia barbata*) captured and relocated on site**

### Rehabilitation Resources

An abundance of seed was present on a number of *Corymbia gummifera* (Bloodwood) and *Eucalyptus camfieldii* (Stringybark) species that were felled throughout clearing of Area 7. It is recommended that this seed be utilised by storing all plant material and topsoil from this area so as to preserve seed both attached to vegetation, as well as that which is present in the soil seed bank. This can be utilised for during rehabilitation of this area or the adjoining areas that contain the same vegetation communities.

Please contact me if you have any questions,

Yours Sincerely

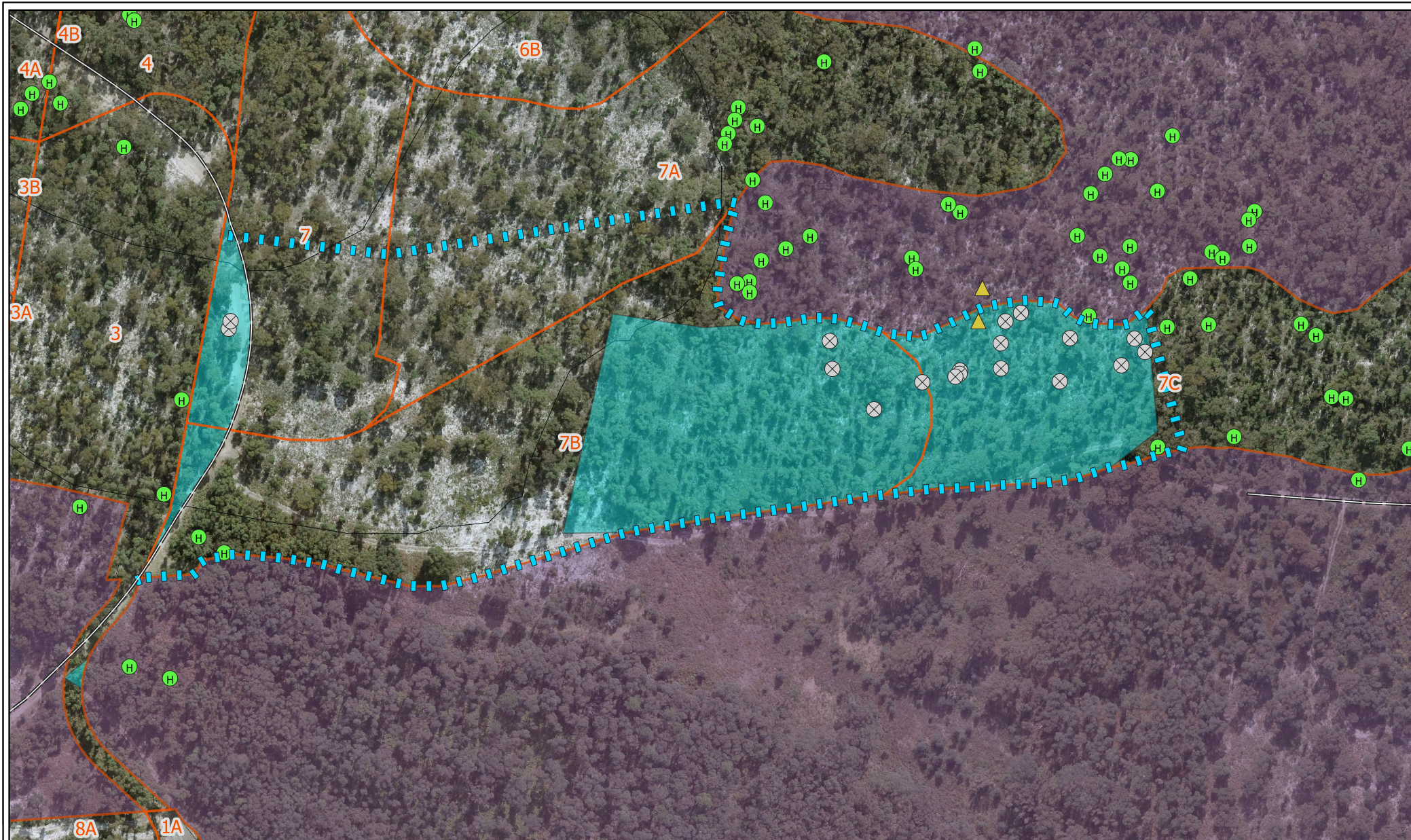
**Ashley Owen**

Ecologist

M: 0430 809 803

[aowen@wedgetail.com.au](mailto:aowen@wedgetail.com.au)

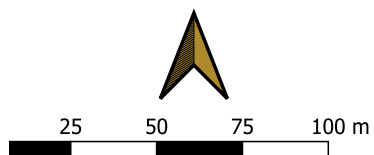




Created by: AOWen  
Date: 08-04-2021



- Track-Vehicular
- contour
- Amphibian Fence
- ⊗ Cleared HBT
- ⊙ Existing HBT
- ▲ Fauna relocation
- Clearing March 21
- Biodiversity Offset Area
- Quarry Operations Plan



**Clearing March & April 2021**

Figure:

**1**

Newcastle Sand  
398 Cabbage Tree Road  
Williamtown NSW





Thursday, 13 May 2021

Quarry Manager  
Newcastle Sand Pty Ltd  
398 Cabbage Tree Road  
Williamtown NSW 2318

**Attention:** Shane Burton  
**Sent by email to:** [shane@newcastlesand.com.au](mailto:shane@newcastlesand.com.au)

**SUBJECT: NESTBOX INSTALLATION – MARCH 2021**

Dear Shane,

On March 29 and 30 2021, an Ecologist from Wedgetail Project Consulting, Kane Blundell, installed nest boxes with the assistance of arborists from Hopper the Tree Lopper. A total of 100 nest boxes were installed within the Onsite Biodiversity Offset Area, with 91 boxes installed north of resource areas 7A, 7B and 7C, and the remaining nine (9) boxes installed north of areas 2 and 10A (**Figure 1**). For each nest box, its location, the tree species, diameter at breast height (DBH), nest box number, aspect, install height and nest box type was recorded (**Table 1**).

Nest boxes were spread throughout the Biodiversity Offset Area, within areas adjacent to the disturbance area, and installed at the recommended heights. The aspect of the nest boxes was determined following recommendations to face away from the resource area whilst maintaining a southerly direction where possible. Micro bat boxes were positioned facing west. The nest box sizes were determined by the species most likely to use them and as such there were 39 micro bat boxes, 33 glider boxes, 26 possum boxes and two additional boxes installed, for which data has not yet been recorded.

Currently, a total of 75 hollows have been removed due to clearing the impact area, and a total of 184 nest boxes have been installed within Onsite Biodiversity Offset Area. A summary of all hollows removed and all nest boxes installed, to date is provided in **Appendix 1**.

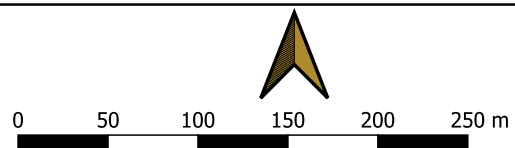




Created by: AOwen  
Date: 08-04-2021



== Track-Vehicular  
 □ Quarry Operations Plan  
 — contour  
 — hydroline  
 ■ Biodiveristy Offset Area



**Nestbox Installation March 2021**

Figure:

**1**

Newcastle Sand  
398 Cabbage Tree Road  
Williamtown NSW



**Table 1: Nest box placement at Newcastle Sand Quarry - March 2021**

Nest box ID	Tree Species	DBH (cm)	Box Type	Aspect	Approx. Height (m)	Easting	Northing
1	<i>C. gummifera</i>	20	Micro Bat	West	4.0	388148	6369395
2	<i>C. gummifera</i>	37	Glider	SW	4.3	388247	6369417
3	TBD	TBD	TBD	TBD	TBD	TBD	TBD
4	<i>C. gummifera</i>	32	Possum	South	3.4	388220	6369395
5	<i>Stringybark</i>	59	Glider	South	3.4	388174	6369402
6	<i>C. gummifera</i>	29	Possum	South	3.6	388203	6369406
7	<i>Stringybark</i>	34	Micro Bat	West	3.8	388172	6369410
8	<i>C. gummifera</i>	27	Micro Bat	West	4.5	388219	6369405
9	<i>C. gummifera</i>	42	Possum	SW	3.3	388303	6369413
10	<i>C. gummifera</i>	36	Possum	SW	3.8	388296	6369389
11	<i>C. gummifera</i>	32	Glider	SW	3.8	388266	6369405
12	<i>C. gummifera</i>	34	Possum	SW	3.8	388302	6369391
13	<i>C. gummifera</i>	38	Glider	South	3.6	388332	6369405
14	<i>C. gummifera</i>	40	Glider	South	3	388312	6369403
15	<i>C. gummifera</i>	34	Possum	South	3.5	388332	6369403
16	<i>Stringybark</i>	32	Micro Bat	West	3.8	388316	6369398
17	<i>C. gummifera</i>	32	Micro Bat	West	3.8	388302	6369395
18	<i>C. gummifera</i>	27	Micro Bat	West	3.6	388237	6369408
19	<i>C. gummifera</i>	30	Micro Bat	West	3.7	388253	6369412
20	<i>Stringybark</i>	36	Micro Bat	West	3.6	388288	6369392

Nest box ID	Tree Species	DBH (cm)	Box Type	Aspect	Approx. Height (m)	Easting	Northing
21	<i>C. gummifera</i>	39	Micro Bat	West	3.6	388389	6369404
22	<i>E. signata</i>	29	Micro Bat	West	3.4	388445	6369397
24	<i>C. gummifera</i>	27	Micro Bat	West	3.2	388482	6369393
25	<i>C. gummifera</i>	30	Micro Bat	West	3.4	388362	6369423
25	<i>E. signata</i>	33	Micro Bat	West	3.1	388556	6369405
26	<i>E. signata</i>	38	Micro Bat	West	3.1	388545	6369397
27	<i>E. signata</i>	29	Micro Bat	West	3.3	388443	6369405
28	<i>A. costata</i>	28	Micro Bat	West	3.3	388574	6369373
29	<i>C. gummifera</i>	28	Micro Bat	West	3.3	388394	6369400
30	<i>C. gummifera</i>	44	Possum	South	3.6	388365	6369407
31	<i>C. gummifera</i>	33	Glider	SW	3.6	388414	6369389
32	<i>C. gummifera</i>	27	Glider	SW	3.5	388544	6369377
33	<i>E. signata</i>	40	Possum	SW	3.8	388413	6369383
34	<i>E. signata</i>	37	Possum	SW	3.4	388445	6369397
35	<i>C. gummifera</i>	48	Possum	South	3.2	388376	6369412
36	<i>C. gummifera</i>	32	Possum	SW	3.3	388391	6369404
37	<i>E. signata</i>	28	Possum	SW	3.2	388530	6369389
38	<i>A. costata</i>	44	Possum	SW	3.4	388505	6369400
39	<i>C. gummifera</i>	31	Possum	SW	3.0	388424	6369392
40	<i>E. signata</i>	40	Possum	SW	3.5	388488	6369407
41	<i>A. costata</i>	31	Possum	SW	3.7	388562	6369399

Nest box ID	Tree Species	DBH (cm)	Box Type	Aspect	Approx. Height (m)	Easting	Northing
42	<i>E. signata</i>	36	Glider	SW	3.2	388512	6369392
43	<i>A. costata</i>	28	Micro Bat	West	3.5	388573	6369384
44	<i>A. costata</i>	30	Micro Bat	West	3.6	388585	6369399
45	<i>A. costata</i>	36	Micro Bat	West	3.0	388601	6369420
46	<i>A. costata</i>	50	Glider	SW	3.6	388718	6369437
47	<i>E. signata</i>	38	Micro Bat	West	3.1	388586	6369413
48	<i>E. signata</i>	25	Micro Bat	West	3.1	388607	6369425
49	<i>E. signata</i>	51	Possum	SW	3.2	388625	6369452
50	<i>C. gummifera</i>	32	Micro Bat	West	3.2	388623	6369421
51	<i>C. gummifera</i>	30	Micro Bat	West	3.3	388627	6369451
52	<i>E. signata</i>	49	Possum	SW	3.4	388590	6369411
53	<i>C. gummifera</i>	26	Micro Bat	West	3.0	388663	6369448
54	TBD	TBD	TBD	TBD	TBD	TBD	TBD
55	<i>C. gummifera</i>	43	Micro Bat	West	3.3	388735	6369424
56	<i>C. gummifera</i>	27	Micro Bat	West	3.2	388640	6369459
57	<i>A. costata</i>	33	Micro Bat	West	3.3	388690	6369450
58	<i>A. costata</i>	70	Glider	SW	3.1	388623	6369420
59	<i>E. signata</i>	42	Glider	SW	3.1	388584	6369392
60	<i>A. costata</i>	32	Glider	SW	3.0	388725	6369471
61	<i>A. costata</i>	42	Glider	SW	3.5	388783	6369397
62	<i>C. gummifera</i>	35	Glider	SW	3.1	388757	6369413



Nest box ID	Tree Species	DBH (cm)	Box Type	Aspect	Approx. Height (m)	Easting	Northing
63	<i>A. costata</i>	38	Possum	SW	3.0	388808	6369332
64	<i>A. costata</i>	35	Micro Bat	West	3.3	388706	6369430
64	<i>A. costata</i>	52	Possum	SW	3.4	388776	6369405
65	<i>A. costata</i>	41	Micro Bat	West	3.2	388744	6369444
66	<i>A. costata</i>	45	Possum	SW	3.9	388802	6369370
67	<i>A. costata</i>	29	Micro Bat	West	3.1	388781	6369326
68	<i>A. costata</i>	42	Possum	SW	3.2	388785	6369417
69	<i>A. costata</i>	43	Glider	SW	3.3	388818	6369387
70	<i>A. costata</i>	45	Micro Bat	West	3.3	388788	6369474
71	<i>A. costata</i>	34	Micro Bat	West	3.0	388810	6369419
72	<i>A. costata</i>	35	Micro Bat	West	3.3	388748	6369470
73	<i>A. costata</i>	40	Micro Bat	West	2.9	388821	6369345
74	<i>A. costata</i>	35	Glider	SW	3.1	388734	6369454
75	<i>A. costata</i>	47	Possum	SW	3.2	388749	6369421
76	<i>A. costata</i>	31	Glider	SW	3.0	388729	6369420
77	<i>A. costata</i>	43	Glider	SW	3.0	388825	6369334
78	<i>C. gummifera</i>	44	Glider	SW	3.5	388773	6369322
79	<i>A. costata</i>	38	Glider	SW	3.5	388780	6369339
80	<i>A. costata</i>	50	Glider	SW	3.1	388792	6369478
81	<i>A. costata</i>	52	Glider	SW	2.9	387986	6369052
82	<i>A. costata</i>	30	Glider	SW	2.9	387949	6369078

Nest box ID	Tree Species	DBH (cm)	Box Type	Aspect	Approx. Height (m)	Easting	Northing
83	<i>A. costata</i>	62	Glider	SW	3.3	388015	6369027
84	<i>A. costata</i>	51	Glider	SW	3.7	387906	6369093
85	<i>A. costata</i>	37	Glider	SW	3.3	388066	6369010
86	<i>Stringybark</i>	41	Possum	SW	3.2	388201	6369443
87	<i>C. gummifera</i>	36	Glider	SW	3.1	388157	6369486
88	<i>C. gummifera</i>	26	Glider	SW	3.1	388140	6369501
89	<i>C. gummifera</i>	34	Glider	SW	3.1	388190	6369442
90	<i>C. gummifera</i>	24	Glider	SW	3.0	388172	6369478
91	<i>C. gummifera</i>	36	Possum	SW	3.4	388190	6369457
92	<i>C. gummifera</i>	26	Glider	SW	3.0	388135	6369502
94	<i>A. costata</i>	41	Glider	SW	3.1	388100	6369521
95	<i>C. gummifera</i>	27	Glider	SW	3.0	388115	6369515
96	<i>A. costata</i>	29	Possum	SW	3.1	387942	6369080
97	<i>Stringybark</i>	28	Micro Bat	West	3.7	388181	6369467
98	<i>A. costata</i>	38	Micro Bat	West	3.2	388079	6369006
99	<i>A. costata</i>	29	Micro Bat	West	3.4	388065	6369008
100	<i>A. costata</i>	41	Micro Bat	West	3.3	388082	6368990
* There are two stringybark species <i>E. camfieldii</i> and <i>E. globoidea</i> present on site							

For any further questions, feel free to contact me.

Yours Sincerely



**Kane Blundell**

Ecologist

M: 0419 999 256

[kblundell@wedgetail.com.au](mailto:kblundell@wedgetail.com.au)



## Appendix 1. Summary of Hollow Removal and Next Box Installation

Year	Hollows recorded in EIS for area disturbed in that year	Hollows recorded in Preclearance Surveys <sup>#</sup>			Hollows Removed	Nest Boxes Installed		
		Small	Medium	Large		Small <sup>1</sup>	Medium <sup>2</sup>	Large <sup>3</sup>
August 2019 to 31 December 2019 Construction	7	7	-	-	6	-	-	-
2020 – Sectors 1A and 2	5	15	46	3	64	7	16	2
						28	30	1
2020 – access road		6			Nil removed			
2020 – Sectors 3,3A, 4, 4A		14			Nil removed			
2021 - Sectors 7B, 7C	-	16	15	4	5	39	33	26
						2 nestboxes, size not yet specified		
Total	99	58	61	7	75	74	79	29
		86				184		
Net balance of hollows removed to hollows installed					109			

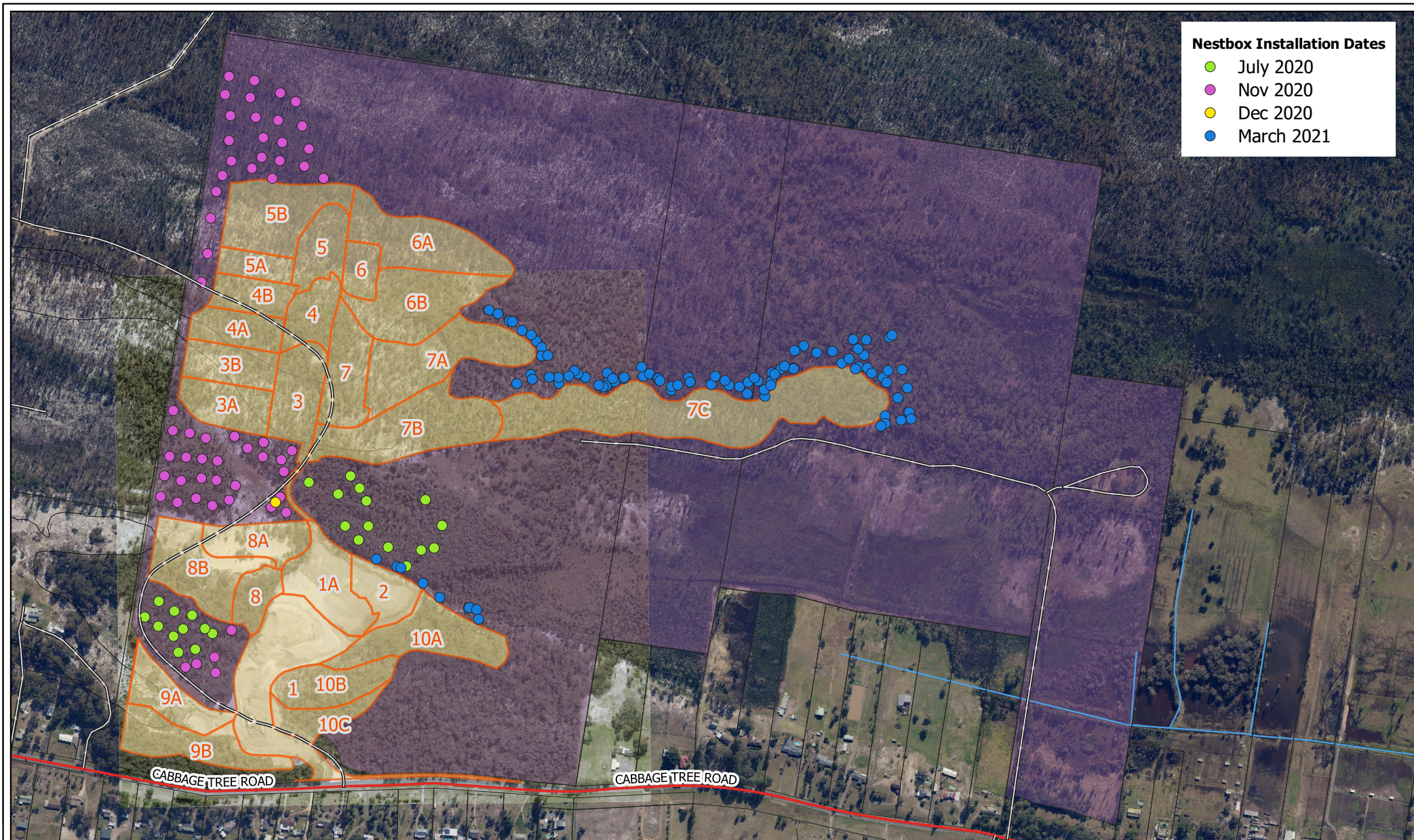
#. Past fires have resulted in burnt and broken limbs likely to result in false identification of hollows when inspecting from the ground level.

1. Small boxes suited to pygmy possums / micro bats.

2. Medium boxes suited to gliders.

3. Large boxes suited to possums.

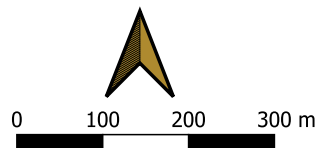




Created by: AOWen  
Date: 08-04-2021



- Arterial Road
- hydroline
- Track-Vehicular
- Biodiversity Offset Area
- Quarry Operations Plan
- PSC\_LotLayer
- contour



## Nestbox Locations

Figure:

**2**

Newcastle Sand  
398 Cabbage Tree Road  
Williamtown NSW



Wednesday, 13 October 2021

Quarry Manager  
Newcastle Sand Pty Ltd  
398 Cabbage Tree Road  
Williamtown NSW 2318

Attention: Shane Burton  
Sent by email to: shane@newcastlesand.com.au

**SUBJECT: Pre-clearance surveys and clearing works of Area 3a-3b**

Dear Shane,

This letter provides a summary of work undertaken on October 7-8, 2021. This includes nocturnal surveys and pre-clearance of, as well as clearing of vegetation in **Section 3a and 3b** at the Newcastle Sand Quarry, 398 Cabbage Tree Road, Williamtown.

**1. Preclearance Surveys**

**1.1 October 7, 2021**

Wedgetail Ecologist, Kane Blundell attended site on October 7, 2021.

A pre-clearance survey was undertaken of areas 3a and 3b, targeting native fauna, specifically the Koala, and confirming the presence of hollows previously identified by a Kleinfelder ecologist on 29 October 2020. The previously identified hollow was not detected and is believed to have possibly been the remnants of a limb burnt in the preceding fires. The resource area was assessed for any other hollow-bearing trees, hollow logs, dead stag trees containing hollows and stick nests. No other hollows or nests were identified in these areas.

During the preclearance, one Lace Monitor (*Varanus varius*) was encountered which immediately retreated up a tree (Plate 1) and was beyond the reach of ecologist to be relocated. The tree was flagged, a GPS location recorded (Figure 1), and the monitor was left to self-relocate.

Below, Table 1 details the tree identified, that appeared to have suitable hollows for fauna. This table includes tree type (dead stag or species (genus) of tree), number of hollows (small – up to 8 cm; medium 8-20cm and large – > 20cm) and any obvious signs of the tree being in current use – this includes scratch marks, scats, feathers, nesting material, animal presence or any other evidence.

The area was also surveyed for the presence and abundance of exotic weed species. The clearing zone contained no large areas of weeds (10m x 10m, according to the Section .22 BRMP) that required demarcation.



**Table 1: Hollow bearing trees identified within Area 3A and 3B at Newcastle Sand Quarry**

ID no.	Collector	Species	Hollows			Signs of Use
			Small	Medium	Large	
1	Mark Dean	<i>Eucalyptus pilularis</i>	1	0	0	None

## 1.2 October 7, 2021

A night survey was undertaken on the 7<sup>th</sup> of October, to identify the presence of fauna within the clearing boundary, targeting threatened species that occur within the region. Koalas (*Phascolarctos cinereus*) and Squirrel-gliders (*Petaurus norfolcensis*) were the target of this survey. Methods used were a combination of meander within the clearing zone with a spotlight to identify eye-shine and call playbacks.

No target threatened species were detected during this survey. No other fauna was detected, including the Lace Monitor previously recorded that afternoon, which appeared to have since self-relocated.

## 2. Tree Clearing Area 3A and 3B

### 2.1 October 8, 2021.

Wedgetail Ecologist, Kane Blundell attended site on October 8, 2021.

Immediately prior to clearing activities, the resource area was again surveyed for fauna, in particular Koalas, and to ensure that the previously detected monitor had relocated. As no hollows or fauna were detected, clearing was commenced with an excavator under the supervision of the ecologist. Trees were carefully inspected once felled with particular attention to trees within the vicinity of the previously identified hollow. There were no hollows detected within felled trees (Table 2).

**Table 2: Final tally of hollows after clearing took place in Area 3A and 3B of Newcastle Sand Quarry**

ID no.	Hollows counted prior to being felled			Signs of Use	Hollows counted after being felled			Comments
	Small	Medium	Large		Small	Medium	Large	
1	1	0	0	None	0	0	0	Undetected

An abundance of seed was present on a number of *Eucalyptus pilularis* (Blackbutt) (Plate 2) and *E. camfieldii* (Stringybark) species that were felled throughout clearing of Area 3a and 3b. Efforts were being made to utilise this seed by separating the seed attached to vegetation (Plate 3), and taking it to be spread over adjoining rehabilitation areas that contain the same vegetation communities.

For any further questions, please do not hesitate to call me.

Sincerely,

**Kane Blundell**

Ecologist

M: 0419 999 256

[kblundell@wedgetail.com.au](mailto:kblundell@wedgetail.com.au)



Plate 1: Lace Monitor spotted during preclear

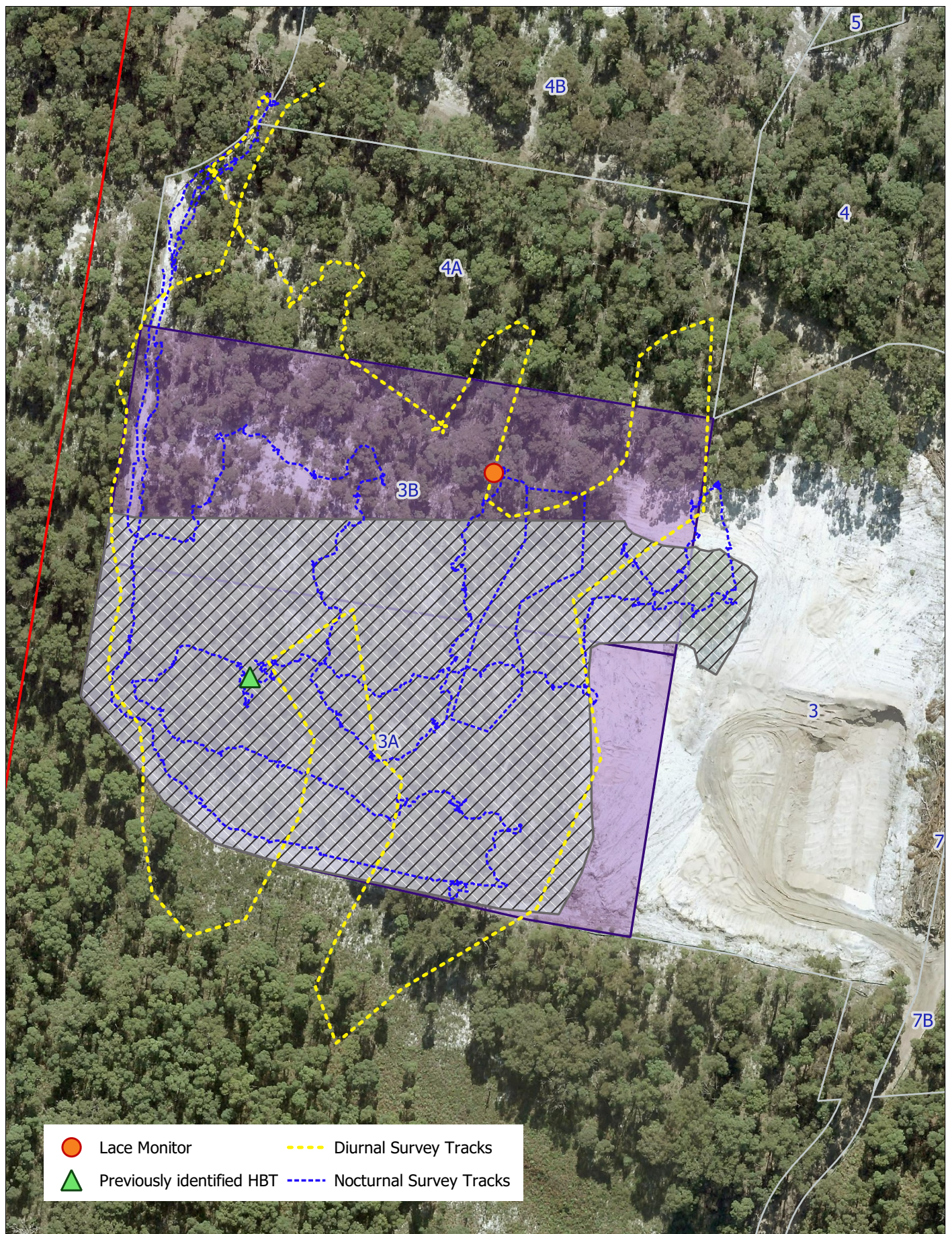


Plate 2: *E. pilularis* seed from clearing area



Plate 3: Native seed being stockpiled for use on rehab areas





- Lace Monitor
- ▲ Previously identified HBT
- Diurnal Survey Tracks
- Nocturnal Survey Tracks

Created by: K.Blundell  
Date:13/10/2021



www.wedgetail.com.au

- Extent of Clearing
- Area 3A/3B
- Quarry Operations Plan (Stages)
- Site\_Boundary



25 50 75 100 m

## Area 3A/3B Clearing October 2021

Figure:

1

Newcastle Sand Pty Ltd  
398 Cabbage Tree Road  
Williamtown NSW



Friday, 11 June 2021

Quarry Manager  
Newcastle Sand Pty Ltd  
398 Cabbage Tree Road  
Williamtown NSW 2318

Attention: Shane Burton  
Sent by email to: shane@newcastlesand.com.au

**SUBJECT: Pre-clearance surveys undertaken prior to clearing of Area 7**

Dear Shane,

This letter provides a summary of work undertaken from March 25 to April 1, 2021. This includes pre-clearance of **Section 7b and 7C**, as well as clearing of three small areas of vegetation at the Newcastle Sand Quarry, 398 Cabbage Tree Road, Williamtown.

**1. Preclearance Surveys**

**1.1 March 25, 2021**

Wedgetail Principal Ecologist, Adam Blundell attended site on March 25, 2021.

A pre-clearance survey was undertaken of all below identified areas, targeting native fauna, specifically the Koala, and confirming the presence of previously identified hollows.

On the section of the Haul Road that connects the northern and southern resources areas, one non habitat tree (Stringybark) was felled. In addition, a small patch of trees between **Section 3** and the existing road were cleared where previously identified HBT trees were noted. These trees were inspected once felled and contained no hollows (**Table 1**).

A small section of vegetation was removed from the bank between the operations area (**Section 1**) and the north western border of **Section 10B**. Five trees required removal as they had died and were leaning over the bank, creating a hazard within the operations area. These dead stags contained no suitable hollows and therefore were not considered habitat trees at the time of clearing.

A pre-clearance survey, and supervision of slashing was undertaken to delineate the boundary of **Section 7** prior to clearing. This facilitated construction of the amphibian fence (**Figure 1**) around the clearing zone (to satisfy requirements of Section 6.4A of the BRMP), as well as to provide access for vehicles and machinery during clearing.

The resource area was assessed for hollow-bearing trees, hollow logs, dead stag trees containing hollows and stick nests.

A total of 17 hollow-bearing trees were identified, marked and numbered across **Section 7**. Pink chalk paint and pink flagging tape were used for marking trees with a "H" and a number, to make them easily

identifiable during clearing operations. One *Banksia* spp. had been identified as a habitat feature in a previous survey undertaken by Kleinfelder in 2016, and hollows were no longer present.

Below, **Table 1** details the trees identified, that appeared to have suitable hollows for fauna. This table includes tree type (dead stag or species (genus) of tree), number of hollows (small – up to 8 cm; medium 8-20cm and large – > 20cm) and any obvious signs of the tree being in current use – this includes scratch marks, scats, feathers, nesting material, animal presence or any other evidence.

The area was also surveyed for the presence and abundance of exotic weed species. The clearing zone contained no large areas of weeds (10m x 10m, according to the Section .22 BRMP) that required demarcation.

**Table 1: Hollow bearing trees present within Area 7 - Stages 2 & 3 at Newcastle Sand Quarry**

ID no.	Collector	Species	Hollows			Signs of Use
			Small	Medium	Large	
1	Adam Blundell	Dead Stag	0	1	0	None
2	Adam Blundell	Bloodwood	1	0	0	None
3	Adam Blundell	Bloodwood	2	1	0	None
4	Adam Blundell	Bloodwood	1	1	0	None
5	Adam Blundell	Bloodwood	0	2	0	None
6	Adam Blundell	Bloodwood	0	1	0	None
7	Adam Blundell	Bloodwood	0	1	0	None
8	Adam Blundell	Bloodwood	1	2	1	None
9	Adam Blundell	Bloodwood	0	0	0	None
10	Adam Blundell	Bloodwood	4	1	0	None
11	Adam Blundell	Bloodwood	1	0	0	None
12	Adam Blundell	Bloodwood	2	0	0	None
13	Adam Blundell	Bloodwood	1	3	0	None
14	Adam Blundell	Bloodwood	1	1	0	None
15	Adam Blundell	Bloodwood	0	1	0	None
16	Adam Blundell	Stringybark	2	0	1	None
106	Luke O'Brien	Banksia or Bloodwood	0	0	2	None

**1.2 March 29, 2021**

A night survey was undertaken on the 29<sup>th</sup> of March by two Wedgetail Ecologists, to identify the presence of fauna within the clearing boundary, targeting threatened species that occur within the region. Koalas (*Phascolarctos cinereus*) and Squirrel-gliders (*Petaurus norfolcensis*) were the target of this survey. Methods used were a combination of meander within the clearing zone, with a spotlight to identify eye-shine, and also call playback.

No target threatened species were detected during this survey, however many grey-headed flying-fox (*Pteropus poliocephalus*) were seen and heard foraging within the site, feeding on the abundance of *Banksia serrata* flower spikes.

This letter will be followed up by an additional letter detailing supervision of planned clearing at Area 7.

Yours Sincerely

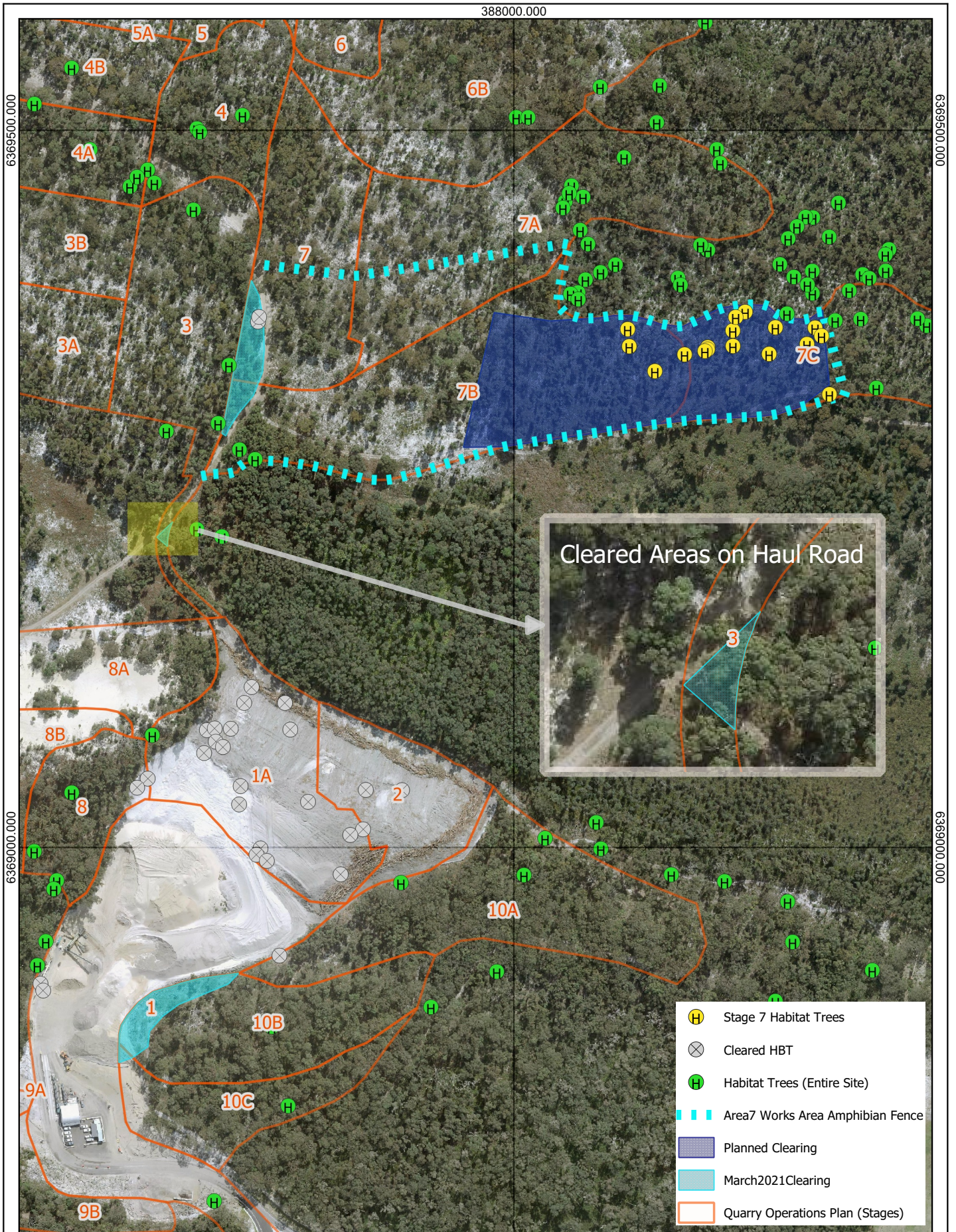
**Kane Blundell**

Ecologist

M: 0419 999 256

[kblundell@wedgetail.com.au](mailto:kblundell@wedgetail.com.au)





Created by: A.Owen  
Date: 10-06-2020

Version: A



0 50 100 150 200 m

**Pre-Clearing**

Figure:  
**1**

**Newcastle Sand**



## **APPENDIX 11. NOISE MONITORING REPORTS**

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Document No: 161267/9253

---

# **ATTENDED NOISE MONITORING QUARTER 1 – MARCH 2021 Newcastle Sands Williamtown, NSW**

---

Prepared for:  
Williamtown Sand Syndicate Pty Ltd  
Cabbage Tree Road  
WILLIAMTOWN NSW 2318

Author:

.....  
**Neil Pennington**  
*B. Sc., B.Math. (Hons) MAIP, MAAS, MASA*  
Principal / Director

March 2021

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## **APPENDIX A Description of Acoustical Terms**

## **APPENDIX B Calibration Certificate**

## EXECUTIVE SUMMARY

Attended noise monitoring has been carried out for the Newcastle Sand (NS) mine on 29-31<sup>st</sup> March 2021. Monitoring was carried out in accordance with requirements of Development Consent (SSD-6125), EPL21264, the Newcastle Sand Noise Management Plan and other relevant Australian Standards and guidelines.

The site was in full operation during the entire survey period.

The site-specific operational criteria were not exceeded at any location or at any time throughout the monitoring period.

Data from those times where noise from NS operations was audible and measureable were analysed using Bruel & Kjaer “*Evaluator*” software. This analysis showed the noise did not contain any tonal, impulsive and low frequency components as per definitions of “modifying factor corrections” in the NSW Noise Policy for Industry. It is acknowledged that the general area is impacted by low and mid-range frequency noise from Cabbage Tree Road and identification of individual sources requires subjective assessment.

NS was compliant with Environmental Protection Licence (EPL) 21264 and Newcastle Sand Development Consent (SSD-6125) for Quarter 1 (March) 2021.



## 1.0 INTRODUCTION

This report presents the results of attended noise compliance monitoring and measurements conducted for Newcastle Sand (NS) on 29<sup>th</sup> – 31<sup>st</sup> March 2021. Monitoring was undertaken in accordance with requirements of Newcastle Sand Noise Management Plan (NMP) dated March 2019. The noise monitoring programme and procedures in the NMP have been developed in accordance with the NS Environmental Protection Licence (EPL) no 21264 and the Newcastle Sand Development Consent (SSD-6125). To aid in the understanding of this report a description of acoustical terms is attached as **Appendix A**.

### 1.1 Noise Monitoring Locations

The NMP (Section 8.1) contains a table (Table 8) detailing recommended locations for attended noise monitoring and corresponding identification numbers for each boundary of the site, as follows.

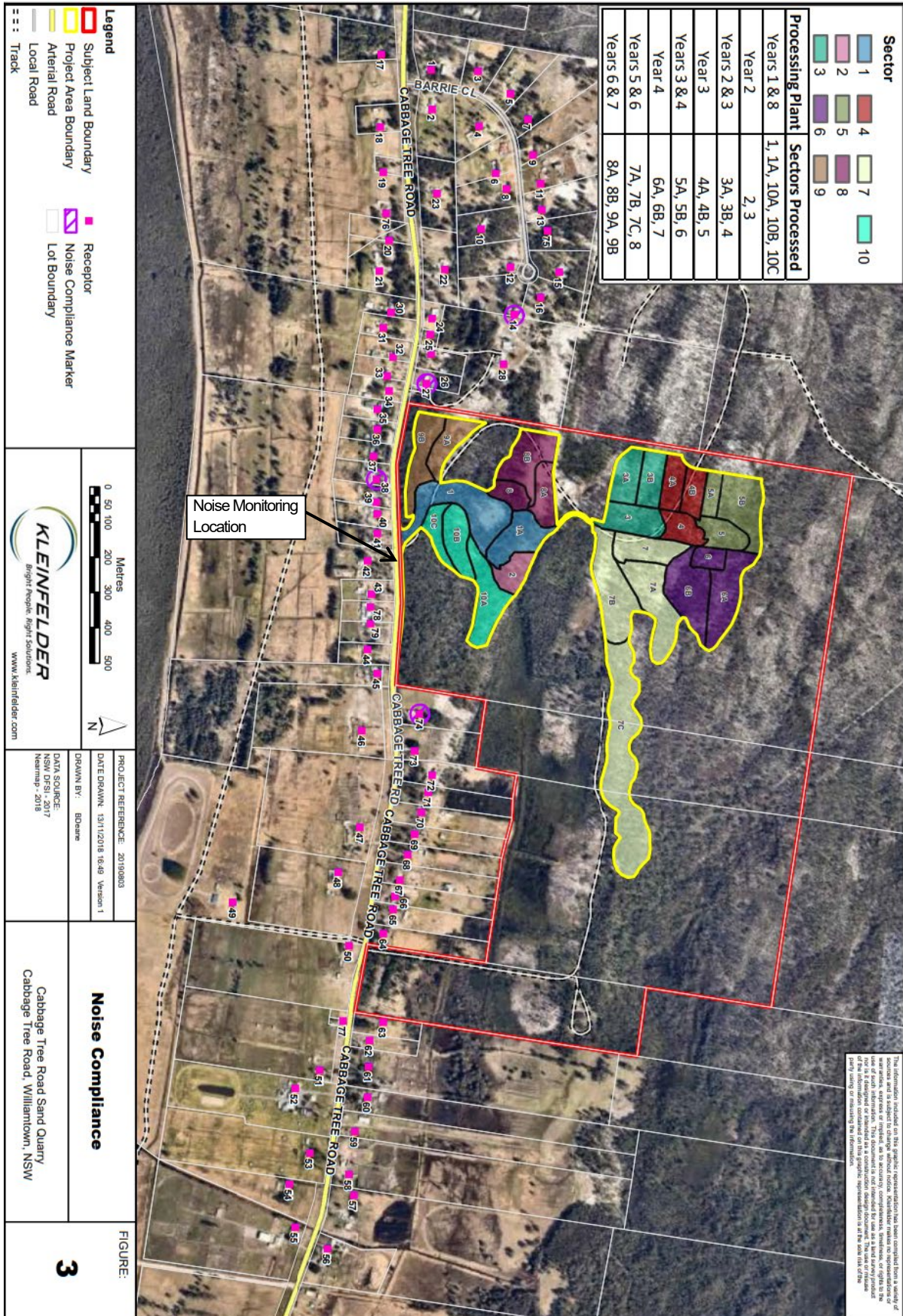
**Table 8: Noise monitoring locations**

Generalised Location	Recommended Receptor ID
Nearest residence to west (at road level)	27
Nearest residence to west elevated on hill crest	14 <sup>1</sup>
Residence due south of quarry	38
Nearest residence to the south east	74

Condition M8.1 of the EPL states that attended noise monitoring is to be undertaken at a location representative of the most affected residences in the noise limit conditions. Monitoring was conducted at receiver number 42 which is representative of receivers south of the site. The monitoring location is also shown on **Figure 1**.

### 1.2 Monitoring Frequency and Duration

EPL21264 indicates that the attended noise monitoring must be conducted quarterly during the morning-shoulder and day periods only. Each quarterly survey is to consist of 30 minute morning-shoulder measurements and 1.5 hour day measurements at one location representative of the most affected residences in the noise limit conditions (in accordance with EPL21264 to be done over a minimum of three consecutive 24 hour periods).



**Figure 1**  
**Noise Monitoring Location**



## 2.0 CRITERIA AND CONDITIONS

### 2.1 Noise Assessment Criteria

The noise assessment criteria are detailed in Condition L3.1 of the. The criteria vary for each receiver monitoring location. The applicable morning-shoulder and day criterion is shown in the tables of results (**Tables 1 - 6 in Section 4.1**). Noise criteria for all residences listed in the EPL are as shown below. The above noise criteria include the requirement that noise levels at day shoulder must not exceed **45 dB(A) L1 (1 min)** (sleep disturbance criterion) at any residence.

Receiver	Day LAeq(15 Min)	Shoulder LAeq(15 Min)	Shoulder LA Max(1 Min)
Any residential receiver	43	39	45

Operational noise generated at the premises must not exceed the noise limits shown in the table above.

### 2.2 Monitoring Location Definition

Condition L3.7 of the EPL states that to determine compliance with the Leq (15 min) operational noise limits the noise measurement equipment must be measured at the most affected point on or within the residential boundary, or at the most affected point within 30m of the dwelling where the dwelling is more than 30m from the boundary.

### 2.3 Applicable Meteorological Conditions

The noise limits apply under all meteorological conditions except for any one of the following;

1. Wind speeds greater than 3m/s at 10m above ground level; or
2. Stability category F temperature inversion conditions and wind speeds greater than 2m/s at 10m above ground level; or
3. Stability category G temperature inversion conditions.

### 2.4 Other Conditions

To determine compliance with the Leq (15 min) operational noise criteria the modification factors in Fact Sheet C of the NSW Noise Policy for Industry must be applied, as appropriate, to the noise levels measured by the noise monitoring equipment.

## 3.0 NOISE MONITORING PROCEDURE

### 3.1 Monitoring Equipment

Attended noise monitoring was conducted with a Brüel & Kjær Type 2250 Precision Sound Analyser. This instrument has Class 1 characteristics as defined in AS IEC61672.1-2004 and has current NATA calibration. Calibration certificates are included in Appendix C. Field calibration is carried out at the start and end of each monitoring period.



A-weighted noise levels were measured over the 15-minute monitoring periods with data acquired at 1 or 2 second statistical intervals and the meter set to “fast” response. Each 1 or 2 second measurement is accompanied by a third-octave band spectrum from 20 - 20k Hz which is required for analysing INP ‘modifying factors’. Time based field notes allow for determination of the relative contributions to the overall noise level of all significant noise sources.

### 3.2 Measurement Analysis

The 15 minute Leq noise level for each monitoring period is shown in the tables below. Where the noise from NS was audible, Bruel & Kjaer “Evaluator” analysis software was used to quantify the contributions of NS and other significant noise sources to the overall noise level. Mine noise from NS is shown in the tables in bold type.

### 3.3 Meteorological Data

Meteorological data used in this report were taken from the Williamstown Bureau of Meteorology Station.

## 4.0 RESULTS AND DISCUSSION

### 4.1 Measured Noise Levels

#### 4.1.1 NS Operations

Measured noise levels at the monitoring location are summarised in **Tables 1 - 6**.

Table 1 NS Operational Noise Monitoring Results – 29 March 2021 (Morning-Shoulder)						
Location	Time	dB(A), Leq	Criterion dB(A) Leq	dB(A), L1 (1min) <sup>1</sup>	Criterion dB(A), L1 (1min) <sup>1</sup>	Identified Noise Sources, LAeq
R42	6:40am	67	39	<20	45	Traffic (67), birds (54), <b>NS (&lt;20)</b>

1. L1 (1 min) from NS mine noise only.

Table 2 NS Operational Noise Monitoring Results – 29 March 2021 (Day)				
Location	Time	dB(A), Leq	Criterion dB(A) Leq	Identified Noise Sources, LAeq
R42	7:30am	64	43	Traffic (64), birds (50), <b>NS (&lt;20)</b>

Table 3 NS Operational Noise Monitoring Results – 30 March 2021 (Morning-Shoulder)						
Location	Time	dB(A), Leq	Criterion dB(A) Leq	dB(A), L1 (1min) <sup>1</sup>	Criterion dB(A), L1 (1min) <sup>1</sup>	Identified Noise Sources, LAeq
R42	6:30am	68	39	<20	45	Traffic (68), birds (52), <b>NS (&lt;20)</b>

1. L1 (1 min) from NS mine noise only.

Table 4 NS Operational Noise Monitoring Results – 30 March 2021 (Day)				
Location	Time	dB(A), Leq	Criterion dB(A) Leq	Identified Noise Sources, LAeq
R42	7:15am	67	43	Traffic (67), birds (54), <b>NS (&lt;20)</b>

Table 5 NS Operational Noise Monitoring Results – 31 March 2021 (Morning-Shoulder)						
Location	Time	dB(A), Leq	Criterion dB(A) Leq	dB(A), L1 (1min) <sup>1</sup>	Criterion dB(A), L1 (1min) <sup>1</sup>	Identified Noise Sources, LAeq
R42	6:30am	66	39	<20	45	Traffic (66), birds (54), <b>NS (&lt;20)</b>

1. L1 (1 min) from NS mine noise only.

Table 6 NS Operational Noise Monitoring Results – 31 March 2021 (Day)				
Location	Time	dB(A), Leq	Criterion dB(A) Leq	Identified Noise Sources, LAeq
R42	7:30am	66	43	Traffic (66), birds (55), <b>NS (&lt;20)</b>

## 4.2 Discussion of Results

The results in **Tables 1-6** show that, under the operating and meteorological conditions at the times, for the 30 minute (morning-shoulder) and 1.5 hour (day) compliance measurement periods, the mine noise from NS was inaudible at the monitoring location. All of the noise measurements were made under compliant meteorological conditions. At the time of this measurement the wind speed at the weather station was less than 3m/s.

### 4.2.1 L1 (1 min)

The noise measurements results in **Tables 1, 3, & 5** (and site observations) show that noise from the operation of NS under the operating and meteorological conditions at the times, did not exceed the L1 (1 min) criterion at the monitoring location. Since L1 (1 min) levels were significantly lower than the criterion, at the operational noise monitoring location, measurements at the residential facade was not considered necessary as compliance was assured.

# **APPENDIX A**

## **DESCRIPTION OF ACOUSTICAL TERMS**



**Table A1**  
**Definition of acoustical terms**

Term	Description
dB(A)	The quantitative measure of sound heard by the human ear, measured by the A-Scale Weighting Network of a sound level meter expressed in decibels (dB).
SPL	Sound Pressure Level. The incremental variation of sound pressure above and below atmospheric pressure and expressed in decibels. The human ear responds to pressure fluctuations, resulting in sound being heard.
STL	Sound Transmission Loss. The ability of a partition to attenuate sound, in dB.
Lw	Sound Power Level radiated by a noise source per unit time re 1pW.
Leq	Equivalent Continuous Noise Level - taking into account the fluctuations of noise over time. The time-varying level is computed to give an equivalent dB(A) level that is equal to the energy content and time period.
L1	Average Peak Noise Level - the level exceeded for 1% of the monitoring period.
L90	"Background" Noise Level - the level exceeded for 90% of the monitoring period.

# **APPENDIX B**

## **CALIBRATION CERTIFICATE**



Australian Calibration Laboratory  
Suite 2, 6-10 Talavera Road, North Ryde NSW 2113, Australia  
Accredited for compliance with ISO/IEC 17025 - Calibration. Laboratory No. 1301



## CERTIFICATE OF CALIBRATION

Certificate No: CAU1901071

Page 1 of 12

### CALIBRATION OF:

Sound Level Meter:	Brüel & Kjær	2250	No: 2747794
Microphone:	Brüel & Kjær	4189	No: 2733511
Preamplifier:	Brüel & Kjær	ZC-0032	No: 15339
Supplied Calibrator:	Brüel & Kjær	None	No: N/A
Software version:	BZ7224 Version 4.6.0	Pattern Approval:	PTB
Instruction manual:	BE1712-22	Identification:	N/A

### CUSTOMER:

Spectrum Acoustics Pty Ltd  
30 Veronica Street  
Cardiff NSW 2285

### CALIBRATION CONDITIONS:

Preconditioning: 4 hours at 23 °C  
Environment conditions: *see actual values in Environmental conditions sections*

### SPECIFICATIONS:

The Sound Level Meter has been calibrated in accordance with the requirements as specified in IEC61672-1:2013 class 1. Procedures from IEC 61672-3:2013 were used to perform the periodic tests.

### PROCEDURE:

The measurements have been performed with the assistance of Brüel & Kjær Sound Level Meter Calibration System B&K 3630 with application software type 7763 (version 8.0 - DB: 8.00) and test procedure 2250-4189.

### RESULTS:

	Initial calibration		Calibration prior to repair/adjustment
X	Calibration without repair/adjustment		Calibration after repair/adjustment

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor  $k = 2$  providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

Date of Calibration: 05/11/2019

Certificate issued: 05/11/2019

Sajeeb Tharayil  
Calibration Technician

Craig Patrick  
Approved signatory

Reproduction of the complete certificate is allowed. Part of the certificate may only be reproduced after written permission.





Document No: 161267/9351

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# **ATTENDED NOISE MONITORING QUARTER 2 – JUNE 2021 Newcastle Sands Williamtown, NSW**

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Prepared for:  
Williamtown Sand Syndicate Pty Ltd  
Cabbage Tree Road  
WILLIAMTOWN NSW 2318

Author:

.....  
**Neil Pennington**  
*B. Sc., B.Math. (Hons) MAIP, MAAS, MASA*  
Principal / Director

July 2021

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## **APPENDIX A Description of Acoustical Terms**

## **APPENDIX B Calibration Certificate**

## EXECUTIVE SUMMARY

Attended noise monitoring has been carried out for the Newcastle Sand (NS) mine on 24, 25 and 28 June 2021. Monitoring was carried out in accordance with requirements of Development Consent (SSD-6125), EPL21264, the Newcastle Sand Noise Management Plan and other relevant Australian Standards and guidelines.

The site was in full operation during the entire survey period.

The site-specific operational criteria were not exceeded at any location or at any time throughout the monitoring period.

Data from those times where noise from NS operations was audible and measurable were analysed using Bruel & Kjaer “*Evaluator*” software. This analysis showed the noise did not contain any tonal, impulsive and low frequency components as per definitions of “modifying factor corrections” in the NSW Noise Policy for Industry. It is acknowledged that the general area is impacted by low and mid-range frequency noise from Cabbage Tree Road and identification of individual sources requires subjective assessment.

NS was compliant with Environmental Protection Licence (EPL) 21264 and Newcastle Sand Development Consent (SSD-6125) for Quarter 2 (June) 2021.



## 1.0 INTRODUCTION

This report presents the results of attended noise compliance monitoring and measurements conducted for Newcastle Sand (NS) on 24, 25 and 28 June 2021. Monitoring was undertaken in accordance with requirements of Newcastle Sand Noise Management Plan (NMP) dated March 2019. The noise monitoring programme and procedures in the NMP have been developed in accordance with the NS Environmental Protection Licence (EPL) no 21264 and the Newcastle Sand Development Consent (SSD-6125). To aid in the understanding of this report a description of acoustical terms is attached as **Appendix A**.

### 1.1 Noise Monitoring Locations

The NMP (Section 8.1) contains a table (Table 8) detailing recommended locations for attended noise monitoring and corresponding identification numbers for each boundary of the site, as follows.

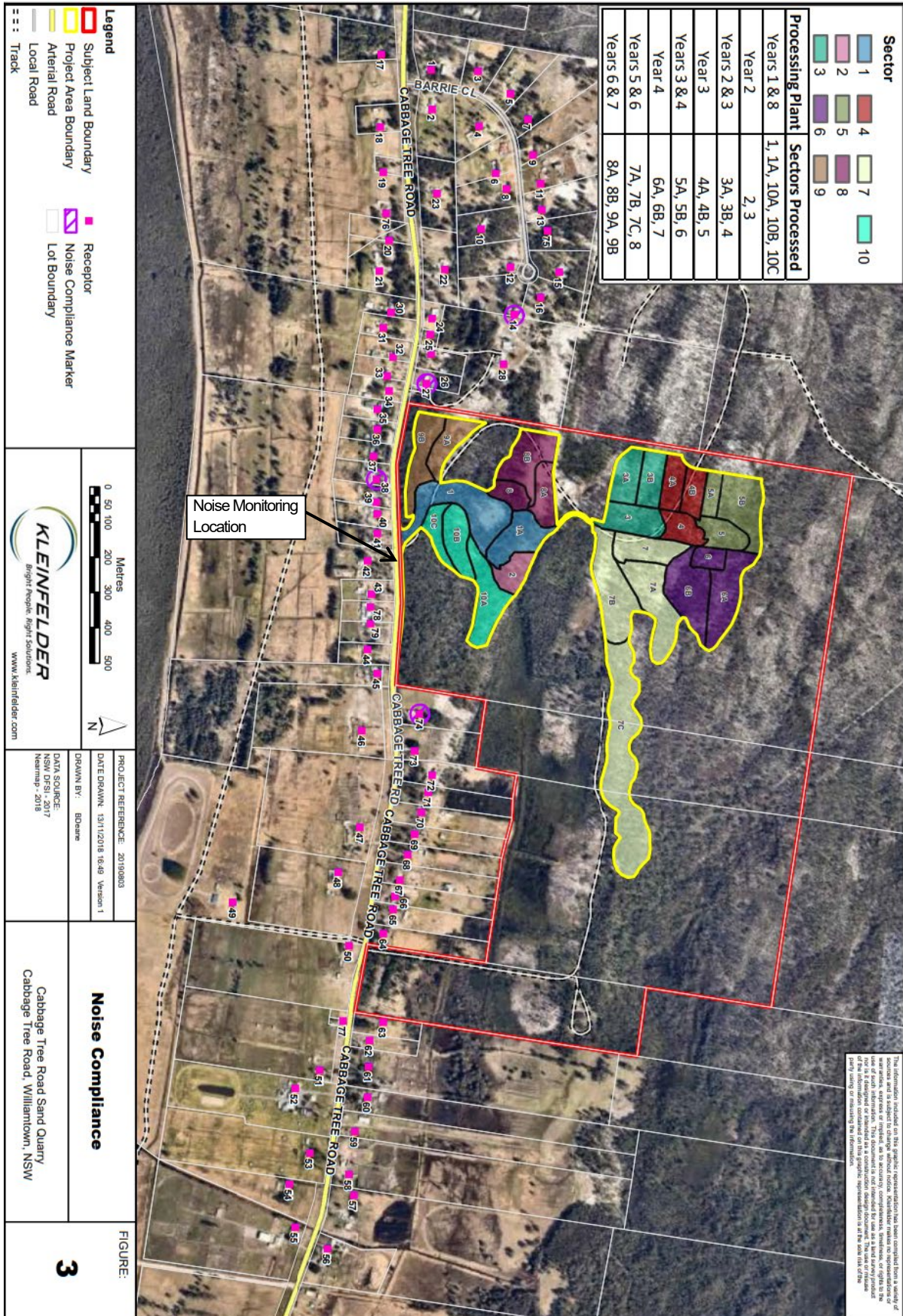
**Table 8: Noise monitoring locations**

Generalised Location	Recommended Receptor ID
Nearest residence to west (at road level)	27
Nearest residence to west elevated on hill crest	14 <sup>1</sup>
Residence due south of quarry	38
Nearest residence to the south east	74

Condition M8.1 of the EPL states that attended noise monitoring is to be undertaken at a location representative of the most affected residences in the noise limit conditions. Monitoring was conducted at receiver number 42 which is representative of receivers south of the site. The monitoring location is also shown on **Figure 1**.

### 1.2 Monitoring Frequency and Duration

EPL21264 indicates that the attended noise monitoring must be conducted quarterly during the morning-shoulder and day periods only. Each quarterly survey is to consist of 30 minute morning-shoulder measurements and 1.5 hour day measurements at one location representative of the most affected residences in the noise limit conditions (in accordance with EPL21264 to be done over a minimum of three consecutive 24 hour periods).



**Figure 1**  
**Noise Monitoring Location**

## 2.0 CRITERIA AND CONDITIONS

### 2.1 Noise Assessment Criteria

The noise assessment criteria are detailed in Condition L3.1 of the. The criteria vary for each receiver monitoring location. The applicable morning-shoulder and day criterion is shown in the tables of results (**Tables 1 - 6 in Section 4.1**). Noise criteria for all residences listed in the EPL are as shown below. The above noise criteria include the requirement that noise levels at day shoulder must not exceed **45 dB(A) L1 (1 min)** (sleep disturbance criterion) at any residence.

Receiver	Day LAeq(15 Min)	Shoulder LAeq(15 Min)	Shoulder LA Max(1 Min)
Any residential receiver	43	39	45

Operational noise generated at the premises must not exceed the noise limits shown in the table above.

### 2.2 Monitoring Location Definition

Condition L3.7 of the EPL states that to determine compliance with the Leq (15 min) operational noise limits the noise measurement equipment must be measured at the most affected point on or within the residential boundary, or at the most affected point within 30m of the dwelling where the dwelling is more than 30m from the boundary.

### 2.3 Applicable Meteorological Conditions

The noise limits apply under all meteorological conditions except for any one of the following;

1. Wind speeds greater than 3m/s at 10m above ground level; or
2. Stability category F temperature inversion conditions and wind speeds greater than 2m/s at 10m above ground level; or
3. Stability category G temperature inversion conditions.

### 2.4 Other Conditions

To determine compliance with the Leq (15 min) operational noise criteria the modification factors in Fact Sheet C of the NSW Noise Policy for Industry must be applied, as appropriate, to the noise levels measured by the noise monitoring equipment.

## 3.0 NOISE MONITORING PROCEDURE

### 3.1 Monitoring Equipment

Attended noise monitoring was conducted with a Brüel & Kjær Type 2250 Precision Sound Analyser. This instrument has Class 1 characteristics as defined in AS IEC61672.1-2004 and has current NATA calibration. Calibration certificates are included in Appendix C. Field calibration is carried out at the start and end of each monitoring period.



A-weighted noise levels were measured over the 15-minute monitoring periods with data acquired at 1 or 2 second statistical intervals and the meter set to “fast” response. Each 1 or 2 second measurement is accompanied by a third-octave band spectrum from 20 - 20k Hz which is required for analysing INP ‘modifying factors’. Time based field notes allow for determination of the relative contributions to the overall noise level of all significant noise sources.

### 3.2 Measurement Analysis

The 15 minute Leq noise level for each monitoring period is shown in the tables below. Where the noise from NS was audible, Bruel & Kjaer “Evaluator” analysis software was used to quantify the contributions of NS and other significant noise sources to the overall noise level. Mine noise from NS is shown in the tables in bold type.

### 3.3 Meteorological Data

Meteorological data used in this report were taken from the Williamstown Bureau of Meteorology Station.

## 4.0 RESULTS AND DISCUSSION

### 4.1 Measured Noise Levels

#### 4.1.1 NS Operations

Measured noise levels at the monitoring location are summarised in **Tables 1 - 6**.

Table 1 NS Operational Noise Monitoring Results – 24 June 2021 (Morning-Shoulder)						
Location	Time	dB(A), Leq	Criterion dB(A) Leq	dB(A), L1 (1min) <sup>1</sup>	Criterion dB(A), L1 (1min) <sup>1</sup>	Identified Noise Sources, LAeq
R42	6:43am	65	39	<20	45	Traffic (65), birds (48), <b>NS (&lt;20)</b>

1. L1 (1 min) from NS mine noise only.

Table 2 NS Operational Noise Monitoring Results – 24 June 2021 (Day)				
Location	Time	dB(A), Leq	Criterion dB(A) Leq	Identified Noise Sources, LAeq
R42	7:31am	68	43	Traffic (68), birds (44), <b>NS (&lt;20)</b>

Table 3 NS Operational Noise Monitoring Results – 25 June 2021 (Morning-Shoulder)						
Location	Time	dB(A), Leq	Criterion dB(A) Leq	dB(A), L1 (1min) <sup>1</sup>	Criterion dB(A), L1 (1min) <sup>1</sup>	Identified Noise Sources, LAeq
R42	6:31am	64	39	<20	45	Traffic (64), birds (46), <b>NS (&lt;20)</b>

1. L1 (1 min) from NS mine noise only.

Table 4 NS Operational Noise Monitoring Results – 25 June 2021 (Day)				
Location	Time	dB(A), Leq	Criterion dB(A) Leq	Identified Noise Sources, LAeq
R42	7:13am	64	43	Traffic (64), birds (45), <b>NS (&lt;20)</b>

Table 5 NS Operational Noise Monitoring Results – 28 June 2021 (Morning-Shoulder)						
Location	Time	dB(A), Leq	Criterion dB(A) Leq	dB(A), L1 (1min) <sup>1</sup>	Criterion dB(A), L1 (1min) <sup>1</sup>	Identified Noise Sources, LAeq
R42	6:32am	67	39	<20	45	Traffic (67), birds (48), <b>NS (&lt;20)</b>

1. L1 (1 min) from NS mine noise only.

Table 6 NS Operational Noise Monitoring Results – 28 June 2021 (Day)				
Location	Time	dB(A), Leq	Criterion dB(A) Leq	Identified Noise Sources, LAeq
R42	7:30am	68	43	Traffic (68), birds (44), <b>NS (&lt;20)</b>

## 4.2 Discussion of Results

The results in **Tables 1-6** show that, under the operating and meteorological conditions at the times, for the 30 minute (morning-shoulder) and 1.5 hour (day) compliance measurement periods, the mine noise from NS was inaudible at the monitoring location. All of the noise measurements were made under compliant meteorological conditions. At the time of this measurement the wind speed at the weather station was less than 3m/s.

### 4.2.1 L1 (1 min)

The noise measurements results in **Tables 1, 3, & 5** (and site observations) show that noise from the operation of NS under the operating and meteorological conditions at the times, did not exceed the L1 (1 min) criterion at the monitoring location. Since L1 (1 min) levels were significantly lower than the criterion, at the operational noise monitoring location, measurements at the residential facade was not considered necessary as compliance was assured.

# **APPENDIX A**

## **DESCRIPTION OF ACOUSTICAL TERMS**



**Table A1**  
**Definition of acoustical terms**

Term	Description
dB(A)	The quantitative measure of sound heard by the human ear, measured by the A-Scale Weighting Network of a sound level meter expressed in decibels (dB).
SPL	Sound Pressure Level. The incremental variation of sound pressure above and below atmospheric pressure and expressed in decibels. The human ear responds to pressure fluctuations, resulting in sound being heard.
STL	Sound Transmission Loss. The ability of a partition to attenuate sound, in dB.
Lw	Sound Power Level radiated by a noise source per unit time re 1pW.
Leq	Equivalent Continuous Noise Level - taking into account the fluctuations of noise over time. The time-varying level is computed to give an equivalent dB(A) level that is equal to the energy content and time period.
L1	Average Peak Noise Level - the level exceeded for 1% of the monitoring period.
L90	"Background" Noise Level - the level exceeded for 90% of the monitoring period.

# **APPENDIX B**

## **CALIBRATION CERTIFICATE**

**Brüel & Kjær** 

Australian Calibration Laboratory  
Suite 2, 6-10 Talavera Road, North Ryde NSW 2113, Australia  
Accredited for compliance with ISO/IEC 17025 - Calibration. Laboratory No. 1301



## CERTIFICATE OF CALIBRATION

Certificate No: CAU1901071

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### CALIBRATION OF:

Sound Level Meter:	Brüel & Kjær	2250	No: 2747794
Microphone:	Brüel & Kjær	4189	No: 2733511
Preamplifier:	Brüel & Kjær	ZC-0032	No: 15339
Supplied Calibrator:	Brüel & Kjær	None	No: N/A
Software version:	BZ7224 Version 4.6.0	Pattern Approval:	PTB
Instruction manual:	BE1712-22	Identification:	N/A

### CUSTOMER:

Spectrum Acoustics Pty Ltd  
30 Veronica Street  
Cardiff NSW 2285

### CALIBRATION CONDITIONS:

Preconditioning: 4 hours at 23 °C  
Environment conditions: *see actual values in Environmental conditions sections*

### SPECIFICATIONS:

The Sound Level Meter has been calibrated in accordance with the requirements as specified in IEC61672-1:2013 class 1. Procedures from IEC 61672-3:2013 were used to perform the periodic tests.

### PROCEDURE:

The measurements have been performed with the assistance of Brüel & Kjær Sound Level Meter Calibration System B&K 3630 with application software type 7763 (version 8.0 - DB: 8.00) and test procedure 2250-4189.

### RESULTS:

	Initial calibration		Calibration prior to repair/adjustment
X	Calibration without repair/adjustment		Calibration after repair/adjustment

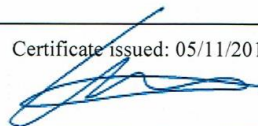
The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor  $k = 2$  providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

Date of Calibration: 05/11/2019

Certificate issued: 05/11/2019



Sajeeb Tharayil  
Calibration Technician



Craig Patrick  
Approved signatory

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Document No: 161267/9435

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# ATTENDED NOISE MONITORING QUARTER 3 – SEPTEMBER 2021 Newcastle Sands Williamtown, NSW

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Prepared for:  
Williamtown Sand Syndicate Pty Ltd  
Cabbage Tree Road  
WILLIAMTOWN NSW 2318

Author:

.....  
**Neil Pennington**  
*B. Sc., B.Math. (Hons) MAIP, MAAS, MASA*  
Principal / Director

November 2021

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## **APPENDIX A Description of Acoustical Terms**

## **APPENDIX B Calibration Certificate**

## EXECUTIVE SUMMARY

Attended noise monitoring has been carried out for the Newcastle Sand (NS) quarry on 28, 29 and 30 September 2021. Monitoring was carried out in accordance with requirements of Development Consent (SSD-6125), EPL21264, the Newcastle Sand Noise Management Plan and other relevant Australian Standards and guidelines.

Monitoring was conducted by Neil Pennington (Principal/Director, Spectrum Acoustics).

The site was in full operation during the entire survey period.

The site-specific operational criteria were not exceeded at any location or at any time throughout the monitoring period.

Data from those times where noise from NS operations was audible and measurable were analysed using Bruel & Kjaer “*Evaluator*” software. This analysis showed the noise did not contain any tonal, impulsive and low frequency components as per definitions of “modifying factor corrections” in the NSW Noise Policy for Industry. It is acknowledged that the general area is impacted by low and mid-range frequency noise from Cabbage Tree Road and identification of individual sources requires subjective assessment.

NS was compliant with Environmental Protection Licence (EPL) 21264 and Newcastle Sand Development Consent (SSD-6125) for Quarter 3 (September) 2021.



## 1.0 INTRODUCTION

This report presents the results of attended noise compliance monitoring and measurements conducted for Newcastle Sand (NS) on 28, 29 and 30 September 2021. Monitoring was undertaken in accordance with requirements of Newcastle Sand Noise Management Plan (NMP) dated March 2019. The noise monitoring programme and procedures in the NMP have been developed in accordance with the NS Environmental Protection Licence (EPL) no 21264 and the Newcastle Sand Development Consent (SSD-6125). To aid in the understanding of this report a description of acoustical terms is attached as **Appendix A**.

### 1.1 Noise Monitoring Locations

The NMP (Section 8.1) contains a table (Table 8) detailing recommended locations for attended noise monitoring and corresponding identification numbers for each boundary of the site, as follows.

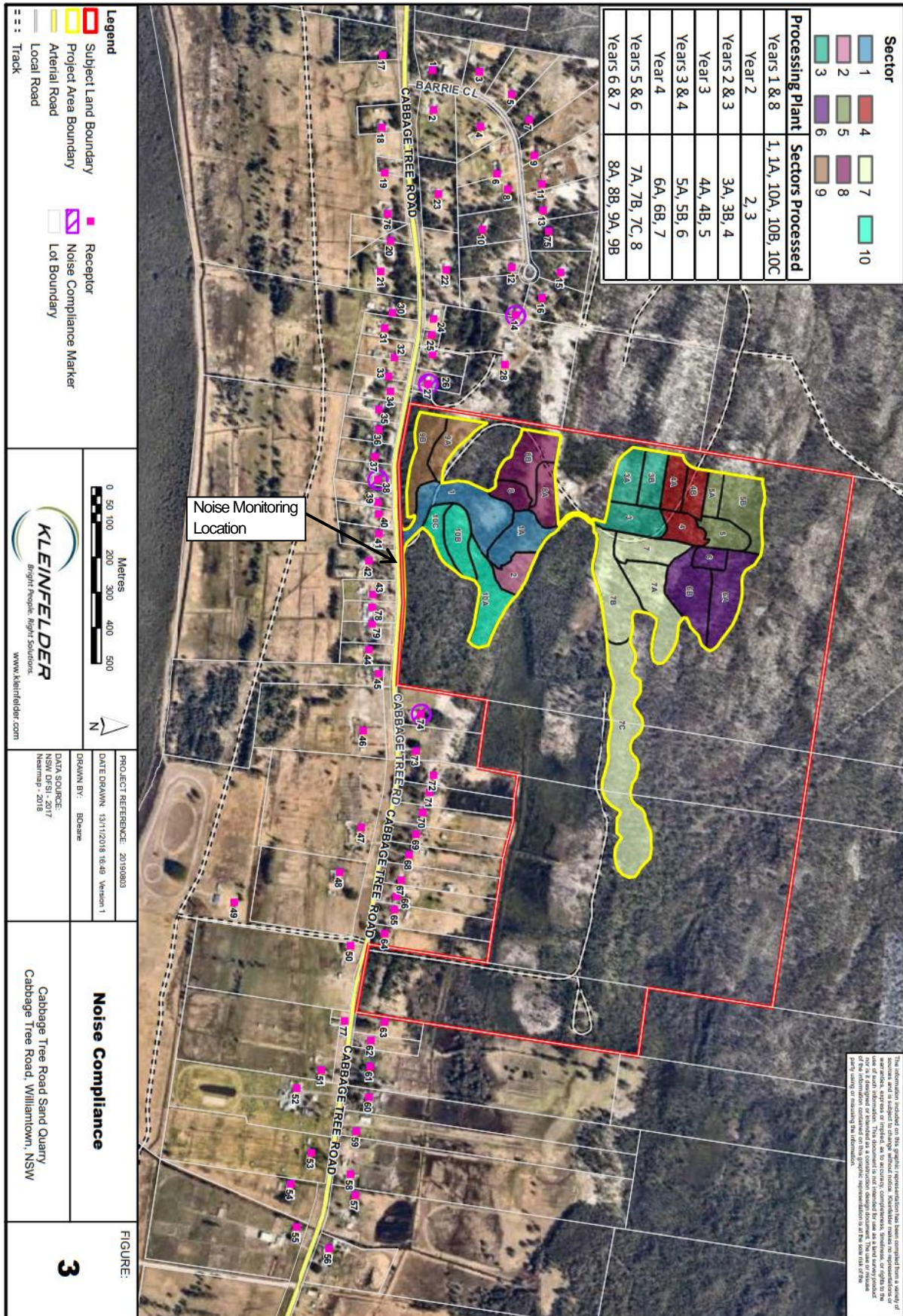
**Table 8: Noise monitoring locations**

Generalised Location	Recommended Receptor ID
Nearest residence to west (at road level)	27
Nearest residence to west elevated on hill crest	14 <sup>1</sup>
Residence due south of quarry	38
Nearest residence to the south east	74

Condition M8.1 of the EPL states that attended noise monitoring is to be undertaken at a location representative of the most affected residences in the noise limit conditions. Monitoring was conducted at receiver number 42 which is representative of receivers south of the site. The monitoring location is also shown on **Figure 1**.

### 1.2 Monitoring Frequency and Duration

EPL21264 indicates that the attended noise monitoring must be conducted quarterly during the morning-shoulder and day periods only. Each quarterly survey is to consist of 30 minute morning-shoulder measurements and 1.5 hour day measurements at one location representative of the most affected residences in the noise limit conditions (in accordance with EPL21264 to be done over a minimum of three consecutive 24 hour periods).



**Figure 1**  
**Noise Monitoring Location**



## 2.0 CRITERIA AND CONDITIONS

### 2.1 Noise Assessment Criteria

The noise assessment criteria are detailed in Condition L3.1 of the. The criteria vary for each receiver monitoring location. The applicable morning-shoulder and day criterion is shown in the tables of results (**Tables 1 - 6 in Section 4.1**). Noise criteria for all residences listed in the EPL are as shown below. The above noise criteria include the requirement that noise levels at day shoulder must not exceed **45 dB(A) L1 (1 min)** (sleep disturbance criterion) at any residence.

Receiver	Day LAeq(15 Min)	Shoulder LAeq(15 Min)	Shoulder LA Max(1 Min)
Any residential receiver	43	39	45

Operational noise generated at the premises must not exceed the noise limits shown in the table above.

### 2.2 Monitoring Location Definition

Condition L3.7 of the EPL states that to determine compliance with the Leq (15 min) operational noise limits the noise measurement equipment must be measured at the most affected point on or within the residential boundary, or at the most affected point within 30m of the dwelling where the dwelling is more than 30m from the boundary.

### 2.3 Applicable Meteorological Conditions

The noise limits apply under all meteorological conditions except for any one of the following;

1. Wind speeds greater than 3m/s at 10m above ground level; or
2. Stability category F temperature inversion conditions and wind speeds greater than 2m/s at 10m above ground level; or
3. Stability category G temperature inversion conditions.

### 2.4 Other Conditions

To determine compliance with the Leq (15 min) operational noise criteria the modification factors in Fact Sheet C of the NSW Noise Policy for Industry must be applied, as appropriate, to the noise levels measured by the noise monitoring equipment.

## 3.0 NOISE MONITORING PROCEDURE

### 3.1 Monitoring Equipment

Attended noise monitoring was conducted with a Brüel & Kjær Type 2250 Precision Sound Analyser. This instrument has Class 1 characteristics as defined in AS IEC61672.1-2004 and has current NATA calibration. Calibration certificates are included in Appendix C. Field calibration is carried out at the start and end of each monitoring period.



A-weighted noise levels were measured over the 15-minute monitoring periods with data acquired at 1 or 2 second statistical intervals and the meter set to “fast” response. Each 1 or 2 second measurement is accompanied by a third-octave band spectrum from 20 - 20k Hz which is required for analysing INP ‘modifying factors’. Time based field notes allow for determination of the relative contributions to the overall noise level of all significant noise sources.

### 3.2 Measurement Analysis

The 15 minute Leq noise level for each monitoring period is shown in the tables below. Where the noise from NS was audible, Bruel & Kjaer “Evaluator” analysis software was used to quantify the contributions of NS and other significant noise sources to the overall noise level. Quarry noise from NS is shown in the tables in bold type.

### 3.3 Meteorological Data

Meteorological data used in this report were taken from the Williamstown Bureau of Meteorology Station.

## 4.0 RESULTS AND DISCUSSION

### 4.1 Measured Noise Levels

#### 4.1.1 NS Operations

Measured noise levels at the monitoring location are summarised in **Tables 1 - 6**.

Table 1 NS Operational Noise Monitoring Results – 28 September 2021 (Morning-Shoulder)						
Location	Time	dB(A), Leq	Criterion dB(A) Leq	dB(A), L1 (1min) <sup>1</sup>	Criterion dB(A), L1 (1min) <sup>1</sup>	Identified Noise Sources, LAeq
R42	6:40am	66	39	<20	45	Traffic (66), birds (54), <b>NS (&lt;20)</b>

1. L1 (1 min) from NS quarry noise only.

Table 2 NS Operational Noise Monitoring Results – 28 September 2021 (Day)				
Location	Time	dB(A), Leq	Criterion dB(A) Leq	Identified Noise Sources, LAeq
R42	7:01am	65	43	Traffic (65), birds (47), <b>NS (&lt;20)</b>

Table 3 NS Operational Noise Monitoring Results – 29 September 2021 (Morning-Shoulder)						
Location	Time	dB(A), Leq	Criterion dB(A) Leq	dB(A), L1 (1min) <sup>1</sup>	Criterion dB(A), L1 (1min) <sup>1</sup>	Identified Noise Sources, LAeq
R42	6:44am	65	39	<20	45	Traffic (66), birds (52), <b>NS (&lt;20)</b>

1. L1 (1 min) from NS quarry noise only.

Table 4 NS Operational Noise Monitoring Results – 29 September 2021 (Day)				
Location	Time	dB(A), Leq	Criterion dB(A) Leq	Identified Noise Sources, LAeq
R42	7:00am	67	43	Traffic (67), birds (48), <b>NS (&lt;20)</b>

Table 5 NS Operational Noise Monitoring Results – 30 September 2021 (Morning-Shoulder)						
Location	Time	dB(A), Leq	Criterion dB(A) Leq	dB(A), L1 (1min) <sup>1</sup>	Criterion dB(A), L1 (1min) <sup>1</sup>	Identified Noise Sources, LAeq
R42	6:42am	64	39	<20	45	Traffic (64), birds (50), <b>NS (&lt;20)</b>

1. L1 (1 min) from NS quarry noise only.

Table 6 NS Operational Noise Monitoring Results – 30 September 2021 (Day)				
Location	Time	dB(A), Leq	Criterion dB(A) Leq	Identified Noise Sources, LAeq
R42	7:05am	67	43	Traffic (67), birds (45), <b>NS (&lt;20)</b>

## 4.2 Discussion of Results

The results in **Tables 1-6** show that, under the operating and meteorological conditions at the times, for the 30 minute (morning-shoulder) and 1.5 hour (day) compliance measurement periods, the quarry noise from NS was inaudible at the monitoring location. All of the noise measurements were made under compliant meteorological conditions. At the time of this measurement the wind speed at the weather station was less than 3m/s.

### 4.2.1 L1 (1 min)

The noise measurements results in **Tables 1, 3, & 5** (and site observations) show that noise from the operation of NS under the operating and meteorological conditions at the times, did not exceed the L1 (1 min) criterion at the monitoring location. Since L1 (1 min) levels were significantly lower than the criterion, at the operational noise monitoring location, measurements at the residential facade was not considered necessary as compliance was assured.

# **APPENDIX A**

## **DESCRIPTION OF ACOUSTICAL TERMS**



**Table A1**  
**Definition of acoustical terms**

Term	Description
dB(A)	The quantitative measure of sound heard by the human ear, measured by the A- Scale Weighting Network of a sound level meter expressed in decibels (dB).
SPL	Sound Pressure Level. The incremental variation of sound pressure above and below atmospheric pressure and expressed in decibels. The human ear responds to pressure fluctuations, resulting in sound being heard.
STL	Sound Transmission Loss. The ability of a partition to attenuate sound, in dB.
Lw	Sound Power Level radiated by a noise source per unit time re 1pW.
Leq	Equivalent Continuous Noise Level - taking into account the fluctuations of noise over time. The time-varying level is computed to give an equivalent dB(A) level that is equal to the energy content and time period.
L1	Average Peak Noise Level - the level exceeded for 1% of the monitoring period.
L90	"Background" Noise Level - the level exceeded for 90% of the monitoring period.

# **APPENDIX B**

## **CALIBRATION CERTIFICATE**

**Brüel & Kjær** 

Australian Calibration Laboratory  
Suite 2, 6-10 Talavera Road, North Ryde NSW 2113, Australia  
Accredited for compliance with ISO/IEC 17025 - Calibration. Laboratory No. 1301



## CERTIFICATE OF CALIBRATION

Certificate No: CAU1901071

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### CALIBRATION OF:

Sound Level Meter:	Brüel & Kjær	2250	No: 2747794
Microphone:	Brüel & Kjær	4189	No: 2733511
Preamplifier:	Brüel & Kjær	ZC-0032	No: 15339
Supplied Calibrator:	Brüel & Kjær	None	No: N/A
Software version:	BZ7224 Version 4.6.0	Pattern Approval:	PTB
Instruction manual:	BE1712-22	Identification:	N/A

### CUSTOMER:

Spectrum Acoustics Pty Ltd  
30 Veronica Street  
Cardiff NSW 2285

### CALIBRATION CONDITIONS:

Preconditioning: 4 hours at 23 °C  
Environment conditions: *see actual values in Environmental conditions sections*

### SPECIFICATIONS:

The Sound Level Meter has been calibrated in accordance with the requirements as specified in IEC61672-1:2013 class 1. Procedures from IEC 61672-3:2013 were used to perform the periodic tests.

### PROCEDURE:

The measurements have been performed with the assistance of Brüel & Kjær Sound Level Meter Calibration System B&K 3630 with application software type 7763 (version 8.0 - DB: 8.00) and test procedure 2250-4189.

### RESULTS:

	Initial calibration		Calibration prior to repair/adjustment
X	Calibration without repair/adjustment		Calibration after repair/adjustment

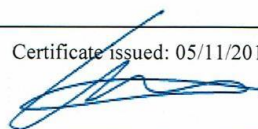
The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor  $k = 2$  providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

Date of Calibration: 05/11/2019

Certificate issued: 05/11/2019



Sajeeb Tharayil  
Calibration Technician



Craig Patrick  
Approved signatory

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Document No: 161267/9480

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# ATTENDED NOISE MONITORING QUARTER 4 – DECEMBER 2021 Newcastle Sands Williamtown, NSW

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Prepared for:  
Williamtown Sand Syndicate Pty Ltd  
Cabbage Tree Road  
WILLIAMTOWN NSW 2318

Author:

.....  
**Neil Pennington**  
*B. Sc., B.Math. (Hons) MAIP, MAAS, MASA*  
Principal / Director

January 2022

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## **APPENDIX A Description of Acoustical Terms**

## **APPENDIX B Calibration Certificate**

## EXECUTIVE SUMMARY

Attended noise monitoring has been carried out for the Newcastle Sand (NS) quarry on 15, 16 and 17 December 2021. Monitoring was carried out in accordance with requirements of Development Consent (SSD-6125), EPL21264, the Newcastle Sand Noise Management Plan and other relevant Australian Standards and guidelines.

Monitoring was conducted by Neil Pennington (Principal/Director, Spectrum Acoustics).

The site was in full operation during the entire survey period.

The site-specific operational criteria were not exceeded at any location or at any time throughout the monitoring period.

Data from those times where noise from NS operations was audible and measurable were analysed using Bruel & Kjaer “*Evaluator*” software. This analysis showed the noise did not contain any tonal, impulsive and low frequency components as per definitions of “modifying factor corrections” in the NSW Noise Policy for Industry. It is acknowledged that the general area is impacted by low and mid-range frequency noise from Cabbage Tree Road and identification of individual sources requires subjective assessment.

NS was compliant with Environmental Protection Licence (EPL) 21264 and Newcastle Sand Development Consent (SSD-6125) for Quarter 4 (December) 2021.



## 1.0 INTRODUCTION

This report presents the results of attended noise compliance monitoring and measurements conducted for Newcastle Sand (NS) on 15, 16 and 17 December 2021. Monitoring was undertaken in accordance with requirements of Newcastle Sand Noise Management Plan (NMP) dated March 2019. The noise monitoring programme and procedures in the NMP have been developed in accordance with the NS Environmental Protection Licence (EPL) no 21264 and the Newcastle Sand Development Consent (SSD-6125). To aid in the understanding of this report a description of acoustical terms is attached as **Appendix A**.

### 1.1 Noise Monitoring Locations

The NMP (Section 8.1) contains a table (Table 8) detailing recommended locations for attended noise monitoring and corresponding identification numbers for each boundary of the site, as follows.

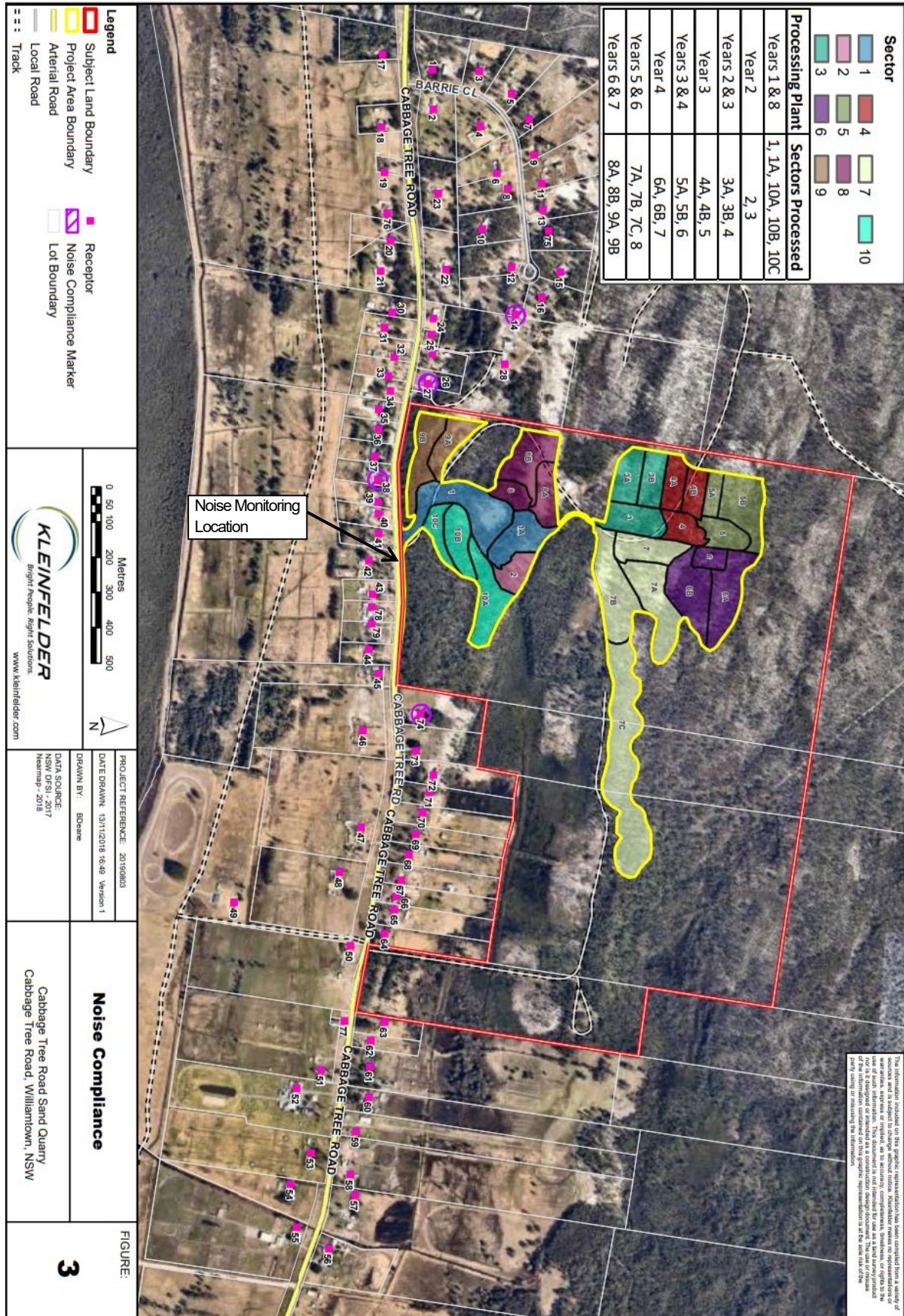
**Table 8: Noise monitoring locations**

Generalised Location	Recommended Receptor ID
Nearest residence to west (at road level)	27
Nearest residence to west elevated on hill crest	14 <sup>1</sup>
Residence due south of quarry	38
Nearest residence to the south east	74

Condition M8.1 of the EPL states that attended noise monitoring is to be undertaken at a location representative of the most affected residences in the noise limit conditions. Monitoring was conducted at receiver number 42 which is representative of receivers south of the site. The monitoring location is also shown on **Figure 1**.

### 1.2 Monitoring Frequency and Duration

EPL21264 indicates that the attended noise monitoring must be conducted quarterly during the morning-shoulder and day periods only. Each quarterly survey is to consist of 30 minute morning-shoulder measurements and 1.5 hour day measurements at one location representative of the most affected residences in the noise limit conditions (in accordance with EPL21264 to be done over a minimum of three consecutive 24 hour periods).



**Figure 1**  
**Noise Monitoring Location**

## 2.0 CRITERIA AND CONDITIONS

### 2.1 Noise Assessment Criteria

The noise assessment criteria are detailed in Condition L3.1 of the. The criteria vary for each receiver monitoring location. The applicable morning-shoulder and day criterion is shown in the tables of results (**Tables 1 - 6 in Section 4.1**). Noise criteria for all residences listed in the EPL are as shown below. The above noise criteria include the requirement that noise levels at day shoulder must not exceed **45 dB(A) L1 (1 min)** (sleep disturbance criterion) at any residence.

Receiver	Day LAeq(15 Min)	Shoulder LAeq(15 Min)	Shoulder LA Max(1 Min)
Any residential receiver	43	39	45

Operational noise generated at the premises must not exceed the noise limits shown in the table above.

### 2.2 Monitoring Location Definition

Condition L3.7 of the EPL states that to determine compliance with the Leq (15 min) operational noise limits the noise measurement equipment must be measured at the most affected point on or within the residential boundary, or at the most affected point within 30m of the dwelling where the dwelling is more than 30m from the boundary.

### 2.3 Applicable Meteorological Conditions

The noise limits apply under all meteorological conditions except for any one of the following;

1. Wind speeds greater than 3m/s at 10m above ground level; or
2. Stability category F temperature inversion conditions and wind speeds greater than 2m/s at 10m above ground level; or
3. Stability category G temperature inversion conditions.

### 2.4 Other Conditions

To determine compliance with the Leq (15 min) operational noise criteria the modification factors in Fact Sheet C of the NSW Noise Policy for Industry must be applied, as appropriate, to the noise levels measured by the noise monitoring equipment.

## 3.0 NOISE MONITORING PROCEDURE

### 3.1 Monitoring Equipment

Attended noise monitoring was conducted with a Brüel & Kjær Type 2250 Precision Sound Analyser. This instrument has Class 1 characteristics as defined in AS IEC61672.1-2004 and has current NATA calibration. Calibration certificates are included in Appendix C. Field calibration is carried out at the start and end of each monitoring period.



A-weighted noise levels were measured over the 15-minute monitoring periods with data acquired at 1 or 2 second statistical intervals and the meter set to “fast” response. Each 1 or 2 second measurement is accompanied by a third-octave band spectrum from 20 - 20k Hz which is required for analysing INP ‘modifying factors’. Time based field notes allow for determination of the relative contributions to the overall noise level of all significant noise sources.

### 3.2 Measurement Analysis

The 15 minute Leq noise level for each monitoring period is shown in the tables below. Where the noise from NS was audible, Bruel & Kjaer “Evaluator” analysis software was used to quantify the contributions of NS and other significant noise sources to the overall noise level. Quarry noise from NS is shown in the tables in bold type.

### 3.3 Meteorological Data

Meteorological data used in this report were taken from the Williamstown Bureau of Meteorology Station.

## 4.0 RESULTS AND DISCUSSION

### 4.1 Measured Noise Levels

#### 4.1.1 NS Operations

Measured noise levels at the monitoring location are summarised in **Tables 1 - 6**.

Table 1 NS Operational Noise Monitoring Results – 15 December 2021 (Morning-Shoulder)						
Location	Time	dB(A), Leq	Criterion dB(A) Leq	dB(A), L1 (1min) <sup>1</sup>	Criterion dB(A), L1 (1min) <sup>1</sup>	Identified Noise Sources, LAeq
R42	6:32am	75	39	<20	45	Traffic (75), birds (52), <b>NS (&lt;20)</b>

1. L1 (1 min) from NS quarry noise only.

Table 2 NS Operational Noise Monitoring Results – 15 December 2021 (Day)				
Location	Time	dB(A), Leq	Criterion dB(A) Leq	Identified Noise Sources, LAeq
R42	7:15am	76	43	Traffic (76), birds (49), <b>NS (&lt;20)</b>

Table 3 NS Operational Noise Monitoring Results – 16 December 2021 (Morning-Shoulder)						
Location	Time	dB(A), Leq	Criterion dB(A) Leq	dB(A), L1 (1min) <sup>1</sup>	Criterion dB(A), L1 (1min) <sup>1</sup>	Identified Noise Sources, LAeq
R42	6:30am	78	39	<20	45	Traffic (78), birds (49), <b>NS (&lt;20)</b>

1. L1 (1 min) from NS quarry noise only.

Table 4 NS Operational Noise Monitoring Results – 16 December 2021 (Day)				
Location	Time	dB(A), Leq	Criterion dB(A) Leq	Identified Noise Sources, LAeq
R42	7:15am	77	43	Traffic (77), birds (46), <b>NS (&lt;20)</b>

Table 5 NS Operational Noise Monitoring Results – 17 December 2021 (Morning-Shoulder)						
Location	Time	dB(A), Leq	Criterion dB(A) Leq	dB(A), L1 (1min) <sup>1</sup>	Criterion dB(A), L1 (1min) <sup>1</sup>	Identified Noise Sources, LAeq
R42	6:31am	76	39	<20	45	Traffic (76), birds (52), <b>NS (&lt;20)</b>

1. L1 (1 min) from NS quarry noise only.

Table 6 NS Operational Noise Monitoring Results – 17 December 2021 (Day)				
Location	Time	dB(A), Leq	Criterion dB(A) Leq	Identified Noise Sources, LAeq
R42	7:15am	77	43	Traffic (77), birds (47), <b>NS (&lt;20)</b>

## 4.2 Discussion of Results

The results in **Tables 1-6** show that, under the operating and meteorological conditions at the times, for the 30 minute (morning-shoulder) and 1.5 hour (day) compliance measurement periods, the quarry noise from NS was inaudible at the monitoring location. All of the noise measurements were made under compliant meteorological conditions. At the time of this measurement the wind speed at the weather station was less than 3m/s.

### 4.2.1 L1 (1 min)

The noise measurements results in **Tables 1, 3, & 5** (and site observations) show that noise from the operation of NS under the operating and meteorological conditions at the times, did not exceed the L1 (1 min) criterion at the monitoring location. Since L1 (1 min) levels were significantly lower than the criterion, at the operational noise monitoring location, measurements at the residential facade was not considered necessary as compliance was assured.

# **APPENDIX A**

## **DESCRIPTION OF ACOUSTICAL TERMS**



**Table A1**  
**Definition of acoustical terms**

Term	Description
dB(A)	The quantitative measure of sound heard by the human ear, measured by the A- Scale Weighting Network of a sound level meter expressed in decibels (dB).
SPL	Sound Pressure Level. The incremental variation of sound pressure above and below atmospheric pressure and expressed in decibels. The human ear responds to pressure fluctuations, resulting in sound being heard.
STL	Sound Transmission Loss. The ability of a partition to attenuate sound, in dB.
Lw	Sound Power Level radiated by a noise source per unit time re 1pW.
Leq	Equivalent Continuous Noise Level - taking into account the fluctuations of noise over time. The time-varying level is computed to give an equivalent dB(A) level that is equal to the energy content and time period.
L1	Average Peak Noise Level - the level exceeded for 1% of the monitoring period.
L90	"Background" Noise Level - the level exceeded for 90% of the monitoring period.

# **APPENDIX B**

## **CALIBRATION CERTIFICATE**



Australian Calibration Laboratory  
Suite 4.03, Level 4, 3 Thomas Holt Drive, Macquarie Park NSW 2113, Australia  
Accredited for compliance with ISO/IEC 17025 - Calibration. Laboratory No. 1301



## CERTIFICATE OF CALIBRATION

Certificate No: CAU2100868

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### CALIBRATION OF:

Sound Level Meter:	Brüel & Kjær	2250	No: 2747794
Microphone:	Brüel & Kjær	4189	No: 2733511
Preamplifier:	Brüel & Kjær	ZC-0032	No: 15339
Supplied Calibrator:	Brüel & Kjær	4231	No: 2466354
Software version:	BZ7224 Version 4.6	Pattern Approval:	PTB
Instruction manual:	BE1712-22	Identification:	N/A

### CUSTOMER:

Spectrum Acoustics Pty Ltd  
Suite 1, 12 Alma Road  
New Lambton NSW 2305

### CALIBRATION CONDITIONS:

Preconditioning:	4 hours at 23 °C
Environment conditions:	see actual values in <i>Environmental conditions</i> sections

### SPECIFICATIONS:

The Sound Level Meter has been calibrated in accordance with the requirements as specified in IEC61672-1:2013 class 1. Procedures from IEC 61672-3:2013 were used to perform the periodic tests. The measurements included in this document are traceable to Australian/National standards.

### PROCEDURE:

The measurements have been performed with the assistance of Brüel & Kjær Sound Level Meter Calibration System B&K 3630 with application software type 7763 (version 8.3 - DB: 8.30) and test procedure 2250-4189.

### RESULTS:

	Initial calibration		Calibration prior to repair/adjustment
X	Calibration without repair/adjustment		Calibration after repair/adjustment

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor  $k = 2$  providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

Date of Calibration: 06/12/2021

Certificate issued: 06/12/2021

Sajeeb Tharayil  
Calibration Technician

Craig Patrick  
Approved signatory

Reproduction of the complete certificate is allowed. Part of the certificate may only be reproduced after written permission.

## **APPENDIX 12. PFAS EXPOSURE PATHWAYS REVIEW**

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# Williamtown Sand Syndicate – Per- and Polyfluoroalkyl Substances Annual Risk Review

398 Cabbage Tree Road, Williamtown, New South Wales, 2318

20222347.001A

01 April 2022



Level 1, 95 Coventry Street, South  
Melbourne, VIC 3205  
Phone: +61 3 9907 6000



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01 April 2022

20222347.001A

Jonathan Berry  
Principal Advisor  
Wedgetail Project Consulting  
PO Box 898,  
Newcastle, NSW 2300

**Attention: Jonathan Berry**

**Subject:** Williamtown Sand Syndicate – Per- and Polyfluoroalkyl Substances Annual Risk Review  
398 Cabbage Tree Road, Williamtown, New South Wales, 2318

## Executive Summary

Kleinfelder Australia were engaged by Wedgetail Project Consulting, on behalf of the Williamtown Sand Syndicate (WSS) to undertake a review of the 2021 quarrying activities at Newcastle Sand and determine whether these activities have changed the potential for local residents to be exposed to per- and polyfluoroalkyl substances (PFAS). Regional PFAS contamination in the quarry area is related to contamination at and from the Department of Defence (DoD) Williamtown Royal Australian Air Force Base ("the Base"). PFAS has been identified in sediment, surface water, groundwater and biota (terrestrial and aquatic) within and surrounding the Base.

The Newcastle Sand quarry is located at 398 Cabbage Tree Road, Williamtown ("the Site") and is situated partially within the New South Wales Environment Protection Authority (EPA) defined Williamtown Management Area (WMA). The Site is located within the WMA broader management zone, defined as an area where PFAS could be identified at the current time and into the future. EPA precautionary advice to minimise PFAS exposure within the broader management zone includes avoiding the use of groundwater and surface water and consuming home-grown produce.

This report forms the requirement to Schedule 3 Condition 48 in the Development Consent SSD-6125 which requires an assessment of whether or not quarrying operations are increasing the risk of PFAS exposure for local residents and the environment.

Since 2007, the DoD have been investigating the PFAS presence in various media at and surrounding the Base. The investigations have included multiple rounds of soil, sediment, surface water and groundwater sampling within the EPA defined WMA. Off-Base PFAS surface water and groundwater, PFAS fate and transport models and human and ecological health risk assessments have also been conducted. The human health risk assessment identified four "risk zones", designated zones A through D and corresponding with a risk hierarchy such that Zone A is the highest risk and Zone D is the lowest. Part of the Site is situated within the low-risk zone C, with the north-western Site area located outside the defined risk zones. Zones C and D broadly correspond with the WMA broader management area.

The principal PFAS of concern with the Base and WMA is PFOS, which generally comprises >60% of the PFAS present.

A review of the available information, that includes the Site setting, PFAS sampling and analysis undertaken at the Site and those conducted by the DoD at the Base and surrounding area leads to the following conclusions:

- PFAS migration from primary or secondary Base sources is unlikely to reach the Site.
- PFAS are not present in Site soil.
- In surface water, PFAS are present in the sample collected in the eastern-most Site area (SW4), with 13 out of 24 samples analysed having PFOS concentrations ranging from 0.01 to 0.04 µg/L.



- Detections of PFOS concentrations in all thirteen samples are attributed to background levels and not quarrying operations, hence no increased exposure risk to receptors from quarrying operations has been identified.
- The PFAS in this area is likely sourced from an irrigation channel that is at or near the level of the major channel to the east.
- PFAS are generally not considered present in groundwater. While there have been three sporadic 6:2 FTS occurrences and one PFOS occurrence, these are not considered to represent widespread contamination within the aquifer onsite.
- In 2021 PFAS in the wash plant and sands were assessed:
  - PFAS were below the laboratory LOR in the water entering the wash plant.
  - Low PFAS concentrations (PFOS and PFHxS) were reported in two of five processed water samples.
  - PFAS were below the laboratory LOR in raw feed and processed sand samples.
  - Low PFAS concentrations were reported in wash plant fines (silt and organic material) in three of four samples. The reported concentrations do not exceed the screening criteria.
  - Based on the wash plant sample results, it is probable that a minor PFAS source is present in the wash plant or within the silt and organic material.
- The floor of the quarry is based on maintaining a 0.7m buffer above the maximum predicted ground water level. The only occurrence during 2021 where groundwater levels approached this were following over 460mm of rain in March 2021, where levels at BH1 and BH2 exceeded the adopted Trigger Action Response Plan (TARP) levels.
- At the highest groundwater table levels, quarry floor levels remained at worst 652mm above the groundwater table at all times and did not intercept groundwater. The nearest current quarry floor at that time was located over 130m from BH2. Given there was no interception of groundwater and groundwater is not contaminated, this is unlikely to have resulted in any increased risk to on, or off Site receptors.

The DoD-commissioned human health risk assessment (HRA) determined that the Site is within PFAS Risk Zone C for impacts originating from the Base. This quarry PFAS risk assessment review for 2021 compared the upper exposure scenario (i.e., highest concentration) for risk zone C detailed within the DOD HRA with potential exposures from the quarry and concludes:

- The only product produced onsite where repeatable PFAS detections have occurred and have a potential risk to nearby residents and ecological receptors is the wash plant fines (silt and organic material) where the stockpiled fines could be transported from the Site via dust dispersion. This is unlikely as:
  - Dust mitigation measures undertaken by Newcastle Sand are likely to reduce this risk, and the fines form an agglomerated matrix, more consolidated and bound than existing silts and clays onsite.
  - The PFAS concentrations are below the human and ecological health screening criteria and the risk is therefore acceptable.
  - Fines are approved for use within rehabilitation or to be blended for use as a landscaping product. With the repeated detections of PFAS, prior to offsite removal and sale of the material it will be necessary to assess concentrations within this material to ensure it is suitable and consistent with relevant criteria.
- Other quarrying operations will not increase the PFAS risk to residents because:
  - The only location within the Site boundary that PFAS appear to be routinely present is SW4, which is more than 450 m southeast from the proposed quarry areas, lower in elevation and directly connected to known higher PFAS contamination areas associated with the RAAF Base.
  - PFAS reported at other Site monitored locations are sporadic and do not indicate PFAS contamination is present.
  - Quarrying operations could result in the establishment of a short-term groundwater mound, however, this is unlikely to change the current groundwater flow regime.
  - The Base PFAS groundwater plumes are not estimated to intersect the eastern Site boundary prior to 2050, with the predicted PFAS concentrations unlikely to exceed human health drinking water criteria until significantly after 2050, if at all.
  - Historical prevailing wind directions and dust mitigation measures undertaken by the quarry operator will not result in additional PFAS impacts to nearby residents.





# 1 INTRODUCTION & OBJECTIVES

Wedgetail Project Consulting commissioned Kleinfelder to undertake a review of DoD and the NSW EPA information regarding PFAS contamination that originated from the Williamstown Royal Australian Air Force (RAAF) Base (“the Base”). The Site is within the NSW EPA declared WMA.

The WMA was established by the NSW EPA following DoD commissioned testing of sediment, soil, groundwater, surface water and aquatic and terrestrial biota which identified a large area affected by PFAS contamination originally sourced from the Base (**Figure 1**). The EPA management area is comprised of three zones:

- Primary – high PFAS concentrations have been observed.
- Secondary – low PFAS concentrations have been identified.
- Broader – topography and hydrology are used to suggest that PFAS could be identified in the future.

The Site is within the broader management area where the Site’s eastern boundary is 1.4 km from the Base’s western boundary.

In accordance with Condition 48 of the quarry approval note an annual review of the current available PFAS information relating to PFAS exposure pathways for contamination originating from the Base is required to be conducted. The review is to assess if the quarrying activities have resulted in an increased PFAS exposure for local residents. Condition 48 states the following:

*“In conjunction with preparation of each Annual Review, unless otherwise agreed with the Secretary, the Applicant shall engage a suitably qualified and experienced independent expert, approved by the Secretary, to review the currently available information on exposure pathways for PFAS contamination originating from the Williamstown RAAF Base, as may be applicable to local residents and the development. This report must assess whether or not quarrying operations are increasing the risk of PFAS exposure for local residents and/or the environment, to the satisfaction of the Secretary. The Applicant must ensure that the Review of PFAS Exposure Pathways reports are placed on its website and are available to the CCC and any interested person on request.”*

## 2 OBJECTIVE

The objective of this review is to assess if the quarrying activities have resulted in an increased PFAS exposure for local residents.

## 3 SITE SETTING

The site is located approximately 1.4 km to the southwest of the Base’s western boundary. The general land use in the vicinity of the Site is large-lot residential and farming. Residential properties are located to the Site’s east, west and south with larger conservation reserves on the northern boundaries. The Tilligerry Habitat Reserve forms part of the western and northern Site boundaries.

The Williamstown area receives a mean annual rainfall of 1,100 mm, with the highest rainfall months typically between January and June, where the monthly mean rainfall typically exceeds 100 mm (Bureau of Meteorology weather station 061078). Mean monthly temperatures range between 17°C and 28°C, indicating the climate is warm temperate. The prevailing 9 AM wind directions at the Base are north-westerly (25%) and westerly (22%), i.e., away from the Site. Calm is the third most common observation (15%). Wind directions toward the Site are north-easterly (6%) and easterly (5%). Predominant 3 PM wind directions are south-easterly (24%) and southerly (16%). Afternoon wind directions toward the Site are easterly (14%) and north-easterly (8%).

Geologically the Site is located within the Tomago Sandbeds, a linear series of shallow sand dunes that cover approximately 200 km<sup>2</sup> between Newcastle and Lemon Tree Passage, that have a mean thickness of 20 metres<sup>1</sup>. The beds were deposited from the Hunter and Karuah rivers during a period of high sea level and overlies clay and rock. The aquifer is the Tomago Sandbeds, with the underlying clay and rock generally acting as a barrier to vertical groundwater migration. The DoD 2020 groundwater hydraulic gradients indicate a potential southerly groundwater flow direction and compared to 2019 a groundwater mound is present to the south of Lake Cochran (**Figure 2**).

<sup>1</sup> Crosbie, R.S., 2003. Regional scaling of groundwater recharge. PhD Thesis, University of Newcastle.

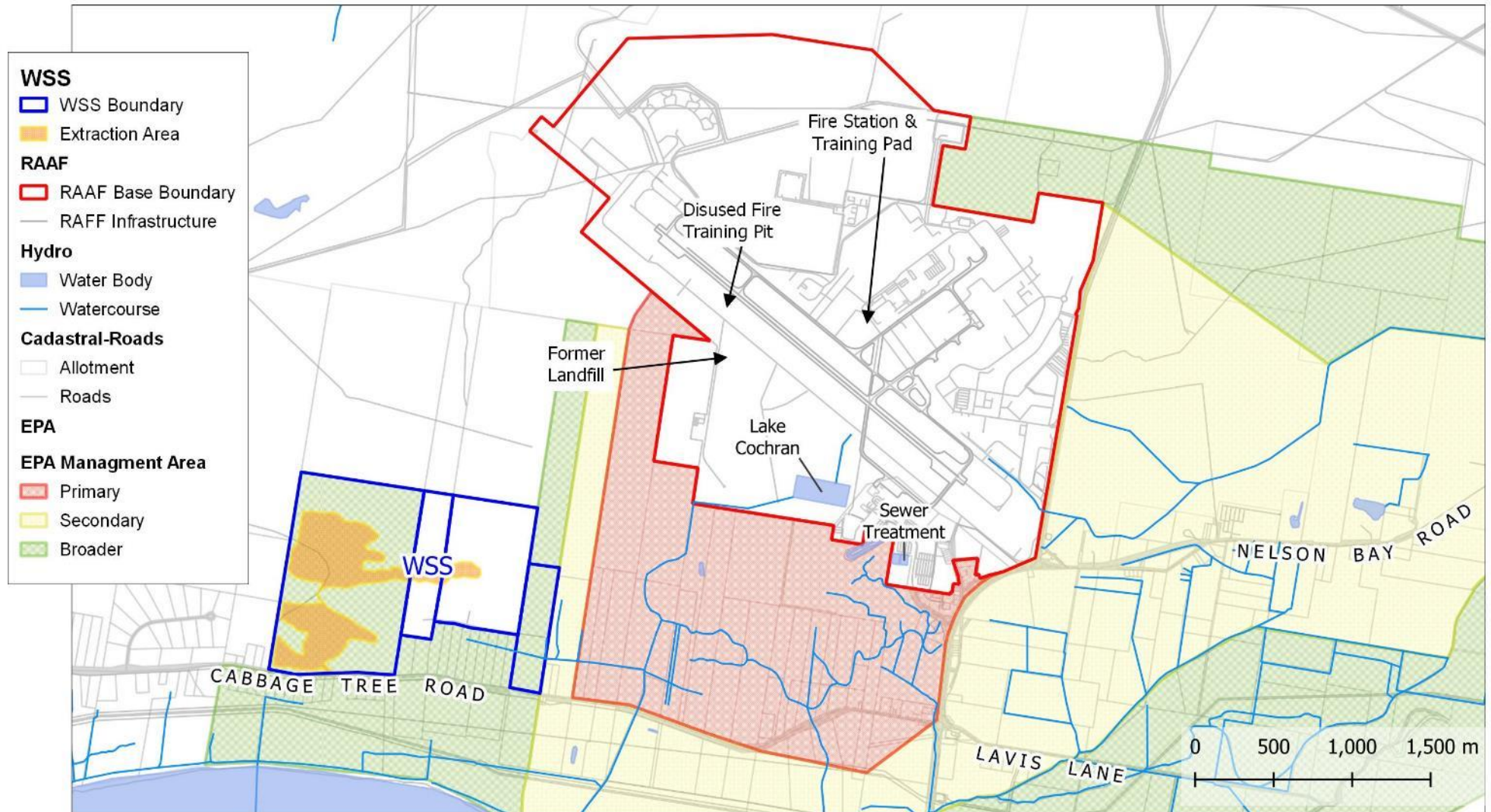
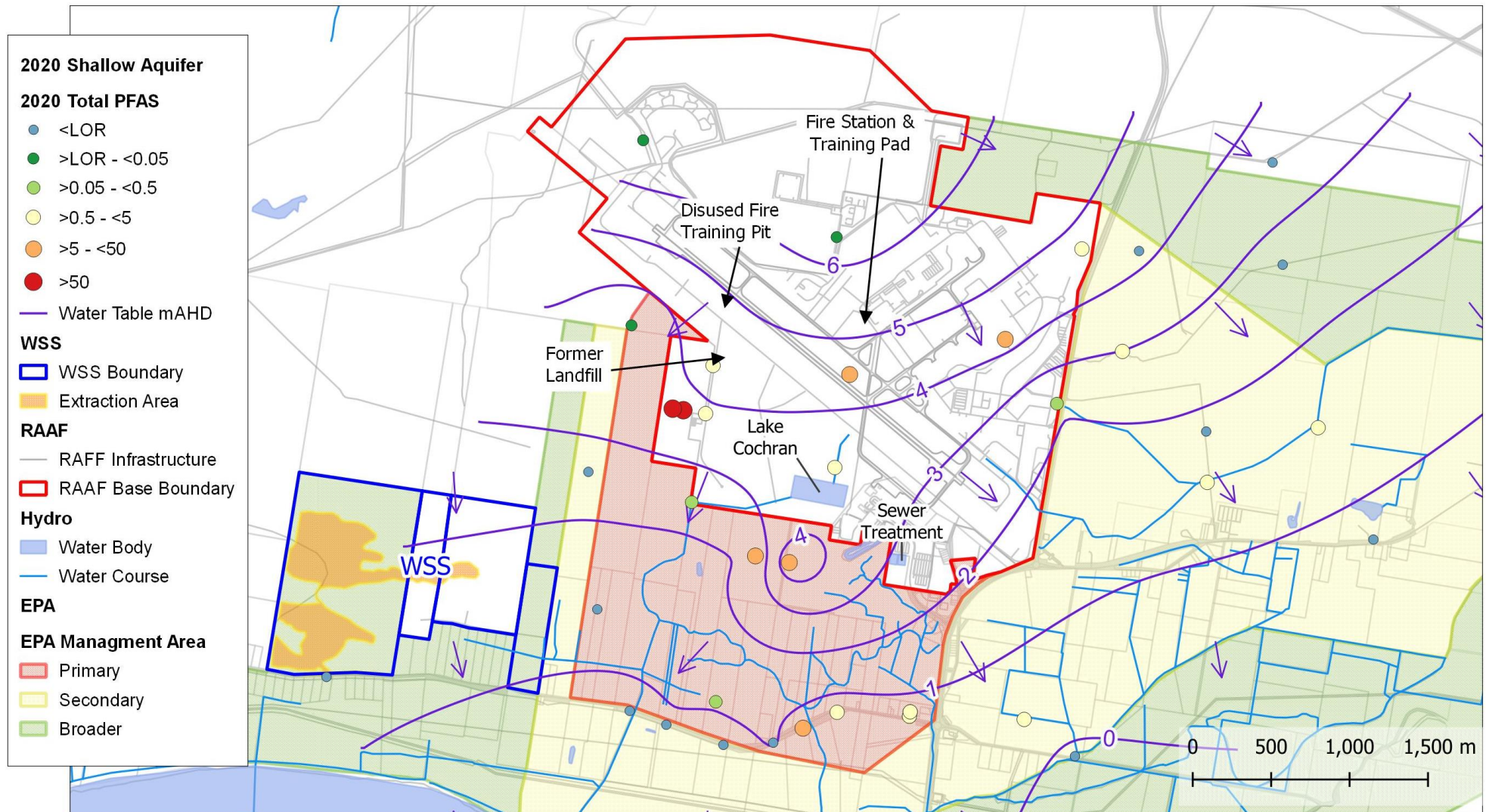


Figure 1. Site regional context.







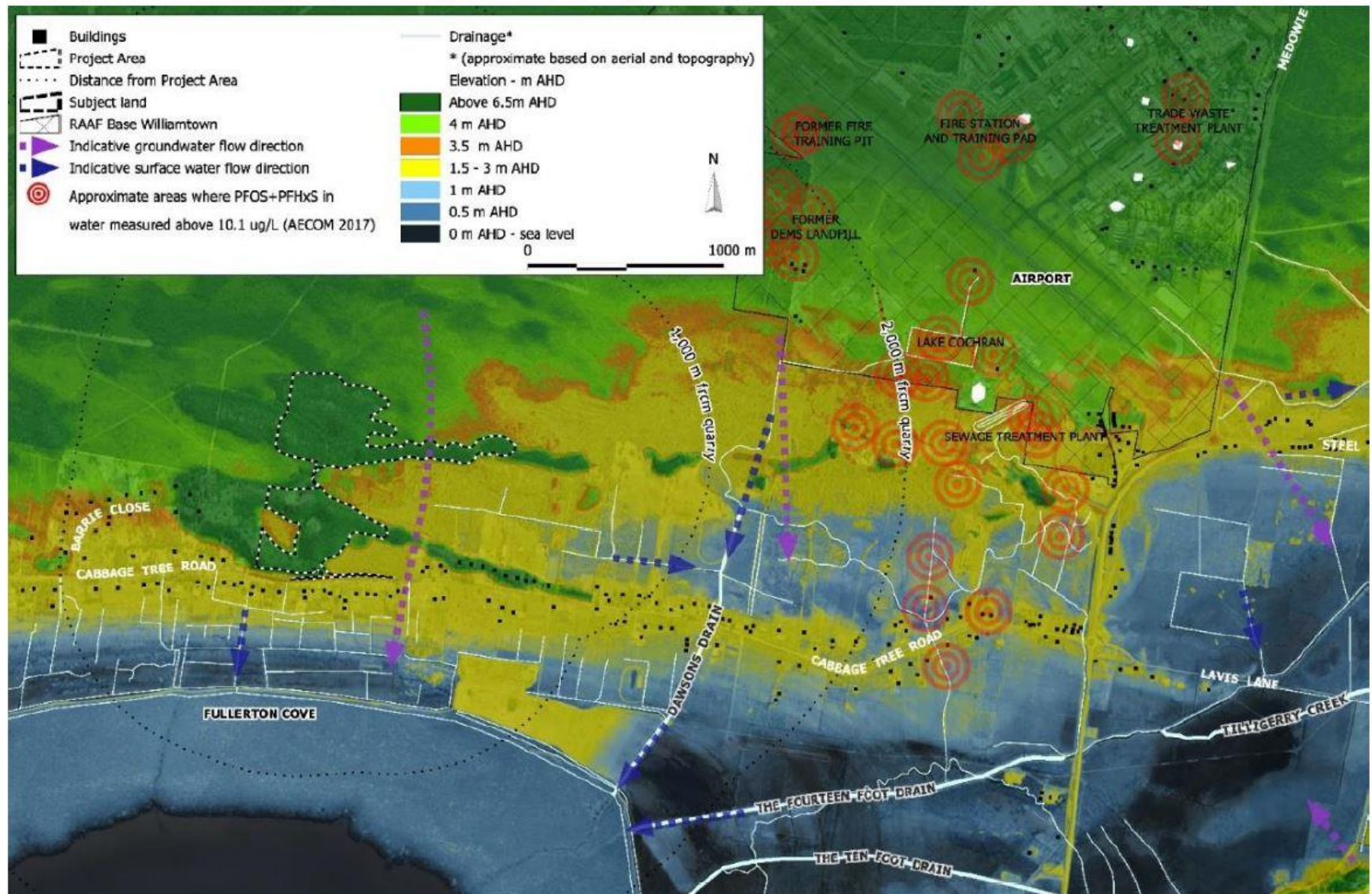


Figure 3. Elevation and drainage network of the project area and subject land in relation to surrounding lands.





The Tomago Sandbeds aquifer form an important water resource in the area. The low salinity groundwater combined with relatively shallow water table depth (mean depth 1.5 m below ground level) have, historically resulted in the extensive use of the resource as a stock watering, irrigation and drinking water supply.

There is a well-developed man-made surface waterway network within the Williamstown area. Site surface water runoff may discharge to two unnamed surface water channels; one channel discharges directly to Fullerton Cove and the other joins Dawsons Drain, approximately 650 metres from the Site's eastern boundary. Within the Base Lake Cochran acts as a stormwater collection point which also discharges to the off-Base Dawsons Drain and ultimately Fullerton Cove to the South. An extract from the SWMP has been included as Figure 3 and shows the current mapping of the drainage network.

## 4 2020 AND 2021 QUARRYING ACTIVITIES SUMMARY

The subject land where the quarry is located occupies four land titles and has an area of 175 hectares (ha), with the quarry disturbance area occupying approximately 43 ha. Approximately 3.25 megatonnes of sand is planned to be quarried from elevated areas over a period of up to 15 years. Sand will be excavated from an elevation of 24 mAHD to an elevation no less than 0.7 metres above the highest estimated water table elevation. The anticipated minimum excavation elevations are approximately 5.6 mAHD in the north and 3.8 mAHD in the south.

Groundwater is not being extracted by the Site operators for quarrying operations, which rely on water sourced from Hunter Water. WSS have commenced a comprehensive groundwater and surface water monitoring program to monitor water levels and quality from the Site and to ensure that sand is not extracted from an elevation less than 0.7 metres above the maximum estimated water table elevation.

Various works have occurred at the Site throughout 2021 (see **Figure 1** of Kleinfelder<sup>2</sup>). Planned vegetation clearing occurred to the north of the initial sand stockpiling area (Sector 7B) during April 2021. A wash plant was constructed within the central area of Sector 1 between the months of March and July 2021 and has since been developed to operate an additional sand washing conveyer belt. Sector 3 (west of Sector 7B) has been developed over the last six months of 2021, with clearing occurring to the west (Sectors 3A and 3B).

## 5 SUMMARY OF PFAS INVESTIGATIONS IN THE WMA

PFAS contamination of surface water, groundwater, sediment and aquatic and terrestrial biota within and surrounding the Base has been reported by both the NSW EPA and DoD. A list of reports is available at [www.defence.gov.au/environment/pfas/Williamtown/publications.asp](http://www.defence.gov.au/environment/pfas/Williamtown/publications.asp).

The contamination is understood to have been the result of the use of aqueous film-forming foam used during firefighting and emergency response training. The known PFAS contamination sources at the Base are:

- Primary sources – Fire station, two landfills and a disused fire training pit.
- Secondary sources – Lake Cochran, the trade waste treatment plant (eastern Base area) and sewage treatment plant.
  - The trade waste treatment plant is not considered a possible source for PFAS contamination that may occur at the Site.

The surface soil samples collected outside the Base boundaries have been predominantly collected across the southern boundary, south of Lake Cochran and the sewerage treatment area. The PFOS + PFHxS concentrations, which generally make up approximately 90% of the total PFAS concentrations in the Williamstown Management Area, in the off-Base surface soil samples range between the laboratory limit of reporting (LOR), 0.2 and 375 micrograms per kilogram (µg/kg). Two soil samples were collected between the Site and the Base's western boundary. The PFOS + PFHxS concentrations in soil were 0.5 and 0.7 µg/kg, with the closest sample to the Site 350 metres northeast (1.3 km from the disused fire training pit (i.e., a primary PFAS source) and 1.1 km from a former landfill (i.e., a secondary PFAS source).

PFOS + PFHxS concentrations above the laboratory LOR (>0.2 to <10 µg/L) have been observed in all surface water samples collected from channels that receive discharge from the Base. Based on the local drainage network, surface water is not considered a likely pathway for PFAS from the Base to the Site under normal flow

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<sup>2</sup> Kleinfelder, 2022. Annual water quality monitoring results Cabbage Tree Road Sand Quarry, NSW.



conditions. However, backwash flooding is considered likely during high rainfall events and could impact upon the Site.

On- and off-Base PFAS groundwater investigations have focused on the Tomago Sandbeds aquifer with shallow and deep groundwater samples collected and analysed. This review focusses on PFAS concentrations in the shallow aquifer.

The 2020 groundwater Base PFAS monitoring results are summarised in **Figure 2** (above). PFOS + PFHxS concentrations above the laboratory LOR were observed to the south of Lake Cochran, beneath the disused fire training burn-pit, former landfill and current fire station and training pad. From the data reviewed it is evident that there is a groundwater mound to the south of Lake Cochran, suggesting the lake is providing groundwater recharge and is consistent with high PFOS + PFHxS concentrations observed down-gradient from the Lake.

The Site is not directly down-hydraulic gradient from any known primary or secondary Base PFAS source, as shown on **Figure 2**.

With regards to the Base groundwater fate and transport model, four “unidentified” PFAS sources (surface water, soil and or groundwater) located to the Site’s south were identified. It is possible that one of these sources, located near the Cabbage Tree Road Dawsons Drain bridge, is associated with the Lake Cochran discharge. The other three low PFAS concentration occurrences are located to the Base’s south and cannot be directly linked to the source at the Base. The three locations are:

- One Base groundwater monitoring well and three residential monitoring wells located on Cabbage Tree Road, directly south of the Site.
- Groundwater from a residential well located 550 metres to the Site’s south.
- Groundwater from a residential well located to the south of lot DP629503. It is noted PFAS were not present above the laboratory LOR in a 2019 groundwater sample from MW139 located approximately 75 metres up-hydraulic gradient from the residential well.

The PFAS groundwater fate and transport model estimated:

- The Base PFAS groundwater plume areas may expand through PFAS dispersion and diffusion.
- That by 2050:
  - The disused fire training pit and former landfill plumes may merge, although it is noted that the merged plume is unlikely to intersect the Site’s eastern boundary.
  - The Lake Cochran PFAS plume should not intersect the Site’s eastern boundary.
- The probable Lake Cochran sourced off-Base groundwater “unidentified” PFAS occurrence is beneath the Site’s DP814078 parcel (eastern Site area) and has total PFAS concentrations between 0.01 and 0.07 µg/L.

## 6 SITE PFAS REVIEW

PFAS investigations commissioned by WSS at the Site have involved submission of soil, surface water and groundwater samples to a laboratory that has National Association of Testing Authorities (NATA) accreditation to determine PFAS concentrations in the submitted media. All laboratory results discussed in this report have been compared to the site-specific trigger values established in the Soil and Water Management Plan (SWMP, 2021).

Surface and groundwater sampling locations are shown on (below).

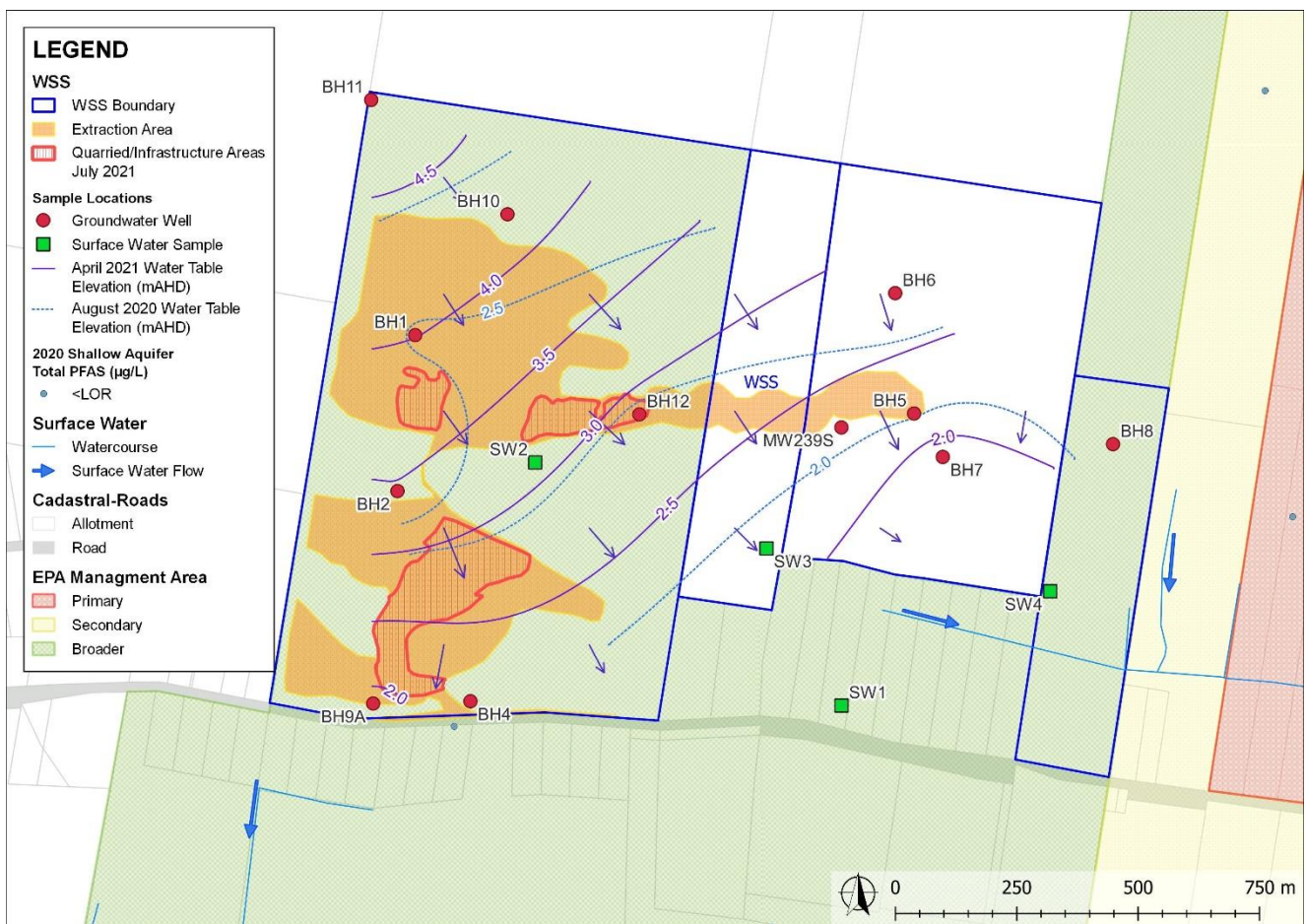
### 6.1 Soil

Sixteen soil samples collected from 10 bore holes between 7 and 17 December 2016 were submitted for PFAS analysis. The samples were all collected from elevated Site areas where sand quarrying is proposed to be undertaken. All samples, including two samples collected within the eastern Site area, i.e., closest to the Base were reported to have total PFAS concentrations below the laboratory LOR.

### 6.2 Surface Water

Surface water is monitored at four Site locations. Forty surface water samples collected from the four locations between January and December 2021 were submitted for PFAS analysis. The 2021 surface water results are summarised below:

- At surface sample location SW1, PFOS was reported at a concentration of 0.01 µg/L (equal to the laboratory LOR) in February 2021, and remains below the adopted site-specific trigger value of 0.07 µg/L. PFOS concentrations were reported below the laboratory LOR in all other months of 2021.
- SW2 was dry during January and February 2021 and all PFAS compounds were below the laboratory LOR in the following months.
- PFAS was reported below the laboratory LOR from all samples collected from SW3.
- At the SW4 location:
  - PFOS was reported above the laboratory LOR in January to March 2021 (yet below the site-specific trigger value), and at concentrations equivalent to the LOR in May 2021.
  - PFHxS was reported above the laboratory LOR in January 2021 (yet below the site-specific trigger value), and at a concentration equal to the laboratory LOR in March 2021.
  - SW4 is located on a drainage channel connecting to Dawsons Drain. PFOS detected at this location is likely due to backwater flooding during high rainfall events from Base-related impacts present within Dawsons Drain to the east.



**Figure 4. April 2021 and August 2020 water table elevations and sampling locations.**

### 6.3 Groundwater

Groundwater samples were collected using high-density polyethylene HydraSleeves, with the samples transferred directly into laboratory supplied PFAS specific sample containers. The method is considered suitable for the collection of water samples to assess for non-volatile chemicals<sup>3</sup>.

Twelve groundwater monitoring wells have been installed and sampled at the Site (BH01 to BH12). MW239S, located within the DP629503 land parcel, was installed during the DoD investigations. Groundwater from the well was reported to have 0.03 µg/L PFOS in March 2017, however, during WSS monitoring (sampled once in 2019,

<sup>3</sup> Environment Protection Authority Victoria, 2000. Groundwater sampling guidelines. Publication 669.



five times in 2020 and 11 times in 2021) PFAS were below the laboratory LOR. BH10 was dry between installation and April 2021 and two wells have been decommissioned (BH3 and BH9) with BH9A installed as a replacement for BH9 in September 2020.

During the 2021 monitoring, the majority of wells (BH1, BH2, BH4, BH6, BH7, BH8, BH9A, BH10, BH11, BH12 & MW239S) were sampled on a monthly basis, up until September 2021 when the scope of work changed. BH12 became an annual sampling location, while BH8 was sampled on a quarterly basis for the remaining months of 2021.

### Water Table Elevation

During the 2021 monitoring period, the maximum water table elevation was in general recorded in April and are historically the highest recorded within the well network and were up to 1.5 m above the elevation recorded in August 2020 (**Figure 4**). The water table elevation contours indicate a southeasterly groundwater flow direction, consistent with the 2019 and 2020 contours.

The floor of the quarry is based on maintaining a 0.7m buffer above the maximum predicted ground water level. The only occurrence during 2021 where levels approached this were following over 460mm of rain in March 2021 recorded at the Williamstown RAAF weather station (# 61078), where:

- Groundwater levels within BH2 exceeded adopted Trigger Action Response Plan (TARP) levels:
  - The 17 March 2021 groundwater sampling event showed levels 1.25m lower than maximum predicted.
  - The 22 April 2021 groundwater sampling event showed levels 0.34m lower than maximum predicted (i.e. TARP Level 1).
  - The 20 May 2021 groundwater sampling event showed levels 0.54m lower than maximum predicted (i.e. TARP Level 0).
  - The logger showed a potential exceedance of the maximum predicted groundwater level of 3.8m AHD by 48mm on 3 April 2021, noting dip and logger levels varied by 39 to 192mm between March and May. This may have been equivalent to TARP level 2 or 3.
  - The logger shows levels were potentially within 0.5m (i.e. TARP Level 1) of the maximum predicted level from 23 March 2021 to 4 June 2021.
- Groundwater Levels within BH1 exceeded TARP Level 1 (i.e. within 0.5m of maximum) on 22 April 2021 by 12mm. All other months were at TARP Level 0.
- It should be noted, quarry floor levels remained at worst 652mm above the groundwater table at all times and did not intercept groundwater. The nearest current quarry floor is located over 130m from BH2. Given there was no interception of groundwater and groundwater is not contaminated, this resulted in no increased risk to on, or off-Site receptors.

In the long-term, groundwater rainfall recharge within the sands is likely to be relatively rapid. The removal of sand above the Site aquifer may result in short-term groundwater mounding, due to increased infiltration and lower evapotranspiration with the mound dissipating due to the high effective porosity of the sands. If a groundwater mound does form beneath the quarried areas, it would be unlikely to significantly change the groundwater flow direction and is more likely to result in producing a steeper off-Site hydraulic gradient. The likelihood that the quarrying would lead to increased groundwater flow from the Base to the Site area is very low.

### PFAS

In 2016 and 2017, seven groundwater samples were analysed for PFAS with all concentrations reported below the laboratory LOR.

From the 2019 WSS monitoring, a low 6:2 FTS concentration (0.19 µg/L) was reported for BH6 groundwater and a low PFDS equal to the LOR (0.02 µg/L) was reported for BH4 groundwater, however, the concentrations were below the laboratory LOR in follow-up samples.

Between January and December 2020, groundwater samples from ten monitoring wells (total = 68 samples) were submitted to the laboratory for PFAS concentration determination. One groundwater sample from BH9 (August) was reported to have a total PFAS concentration of 0.14 µg/L, with all other samples below the laboratory LOR. The PFAS above the LOR was 6:2 FTS.

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6:2 FTS is rarely above the laboratory LOR in the Base water samples (37 out of 176 groundwater samples had low 6:2 FTS concentrations ( $<0.34 \mu\text{g/L}$ ) and four out of 27 surface water samples had low 6:2 FTS concentrations ( $<0.35 \mu\text{g/L}$ ) during the 2020 DoD monitoring.

In 2021, 87 Site groundwater samples were submitted to the laboratory for PFAS analysis, with one sample (BH4) reported to have PFAS above the LOR;  $0.15 \mu\text{g/L}$  6:2 FTS in the November 2021 groundwater monitoring event.

### Groundwater Summary

- 2021 water table elevations are generally higher than in previous years. In particular, there was less than the allowable 0.5 m separation between the inferred groundwater maximum level and measured groundwater elevation at BH1 and BH2 in April 2021 (however returned to more average conditions by the following month).
- The increase in water table elevation is a consequence of the high rainfall between January and March 2021.
- The potential groundwater flow direction is consistent with the observed 2019 and 2020 directions.
- A low 6:2 FTS concentration was reported in a groundwater sample from BH4. Low 6:2 FTS concentrations have previously been reported in groundwater samples from BH6 ( $0.19 \mu\text{g/L}$ , December 2019) BH9 ( $0.14 \mu\text{g/L}$ , August 2020). 6:2 FTS is not a COPC at the Base and is therefore unlikely to represent PFAS migration from the Base.

## 6.4 Wash Plant and Sand Samples

With the approval of a Wash Plant addition to the quarry, a condition of the approval included monitoring for PFAS within the wash plant water and sediment. To provide a greater understanding of PFAS distribution at the Site, the wash plant water (input and output), sediment, and sand (input and output) were submitted to the laboratory for PFAS analysis. The laboratory results are summarised below:

- Wash plant water input - One sample with all PFAS reported below the LOR.
- Wash plant water output - Five samples collected monthly from August to December:
  - PFOS concentrations in samples collected in October and December were  $0.01$  and  $0.03 \mu\text{g/L}$ , respectively (laboratory LOR =  $0.01 \mu\text{g/L}$ ). The concentrations are below the adopted criteria ( $0.07 \mu\text{g/L}$ ).
- Four wash plant fines samples (comprising silt and organic particles) were collected from the plant between August and November 2021.
  - Low PFOS (2 samples August and November, both  $0.0005 \text{ mg/kg}$ ) and PFOA (2 samples 19 and 27 August,  $0.0006$  and  $0.0043 \text{ mg/kg}$ , respectively) concentrations were reported for the samples, remaining below the site-specific trigger values.
  - All PFAS compounds were below the LOR in September 2021.
- PFAS concentrations in one raw feed sample (RFS, September 2021) were reported below the LOR.
- PFAS concentrations in two washed samples (SAND1 and WASHED) were below the LOR.

Based on the wash plant waste (fines) sample results, a minor PFAS source within the wash plant could be considered. However, it is also likely that low PFAS concentrations within wash plant inputs are concentrated on the silt and organic material.

## 7 DOD HUMAN HEALTH RISK ASSESSMENT REVIEW

In 2016 the DoD engaged AECOM to undertake an off-Base human health risk assessment (HHRA). The off-Base HHRA was updated in 2017. A summary of the findings of the updated HHRA and relevance to the Site area are provided below.

The HHRA evaluated the potential health risks in the Williamstown area to residents (including recreational and commercial fishers and beef farmers) and non-residents (commercial fishers, council workers and visitors) from exposure to PFAS under both typical and upper exposure scenarios. The exposure scenarios are:

- Typical exposure scenario:
  - Representative of PFAS concentrations that a general or average receptor is likely to be exposed. This is applicable to the majority of the population.
- Upper exposure scenario:



- Calculated based on the PFAS concentration upper 95th percentile in the relevant media and is applicable for receptors that may be in close proximity to media with elevated PFAS concentrations within a localised area, such as a residential groundwater well.
- The upper exposure scenario is considered suitable for quarry workers who would have a generally high risk though ingestion (incidental and via inhalation) and residents near the quarry.

Based on the Stage 2B investigation outcomes the HHRA divided the off-Base areas into zones based on the potential risk that PFAS posed. The Site's local area was designated Risk Zone C (low risk), with the risk zone encompassing the entire eastern Site area and the southern proposed extraction area. For reference the northern extraction area is not within an identified risk zone.

The HHRA determined risks for Risk Zone C upper exposure scenarios (pathways) are:

- Ingestion and contact with groundwater – acceptable.
- Dermal contact with soil and Ingestion of soil and dust – acceptable.
- Consumption of homegrown eggs – **elevated**.
- Consumption of locally grown fruit and vegetables – acceptable.
- Incidental ingestion of surface water – **elevated**.
- Surface water contact – acceptable.
- Incidental ingestion and contact with sediment – acceptable.
- Consumption of beef and milk – **elevated**.

### 7.1 Relevance of Potential On- and Off-Site Exposures

The HHRA determined potential exposure pathways listed above are considered suitable for off-Site residents and on-Site quarry personnel. For nearby residents and quarry personnel, the comparison of the HHRA upper exposure scenario is considered conservative:

- For dust inhalation/soil ingestion because:
  - PFAS have not been reported above the laboratory limit of reporting in soil samples.
  - Dust mitigation measures are required during quarrying activities.
- For groundwater exposure because:
  - The quarry base will not extend to a depth closer than 0.7 metres to the highest estimated water table elevation, hence groundwater management will not be required and groundwater discharge to surface water as a result of quarrying activities will not occur.
  - PFAS have essentially not been identified above the laboratory LOR in Site groundwater, hence PFAS present in groundwater from nearby residential wells is unlikely to have been sourced from the Site and may be diluted by Site derived groundwater.
  - The designation of Risk Zone C in the Site area was partially based on a very low PFOS concentration from one well, a concentration that was not subsequently repeated.
  - Groundwater migration from the Base is unlikely to reach the eastern property before 2050, by which time quarrying operations will have ceased and any complete PFAS migration pathways will be unlikely.
- While SW1 and SW4 are both down gradient of the Site and have detectable PFAS concentrations above the LOR, the hydraulic connection via surface water is limited due to high infiltration.

Based on the above, the potential for increased PFAS exposure to residents resulting from quarrying activities is considered unlikely.

## 8 CONCLUSIONS

A review of the currently available information regarding the PFAS contamination originating from the Base and assessed Site derived soil, groundwater and surface water data was undertaken to determine whether quarrying operations will increase the PFAS exposure to nearby residents.

During 2021, sand quarrying activities were ongoing at the Site and expanded into the northern Site area.

Considering the information reviewed, the following is concluded:

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- Base-sourced PFAS is and has historically been unlikely to be transported to the Site via wind, surface water or groundwater – the Site does not appear to have received PFAS from the Base and does not appear to be acting as a local tertiary PFAS source.
- A PFAS (predominantly PFOS with minor other PFAS) surface water source appears to be close to SW4 (within the eastern Site area). However, PFOS concentrations in the surface water remain below the adopted criteria.
- The source close to SW4 is attributed to backwash flooding withing the drainage network from Dawsons Creek, reporting to the Base. PFAS sources are not considered to be present within the Site, hence risks to receptors from quarrying operations are acceptable.
- The water table did not exceed the maximum predicted water table elevation by 50mm at BH2 associated with a significant rainfall event. The quarry floor remained 650mm above this level, no increased exposure to groundwater was observed during 2021.
- The regular PFAS detections within the wash plant fines requires further investigation to determine source and suitability of material if used offsite (including the PFAS TCLP requirements).

## 9 RECOMMENDATIONS

Development of a numerical groundwater flow model that allows for the effects of increased infiltration in the sand extraction areas to be quantitatively assessed should be considered.

If you require additional information or clarification, please contact the undersigned at (03) 9907 6000. This report should be read in conjunction with the Kleinfelder Statement of Limitations (attached).

Sincerely,

Kleinfelder Australia Pty Ltd

Stuart Graham (PhD – Geochemistry)

Associate Hydrogeologist

Attachments – Kleinfelder Statement of Limitations

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# KLEINFELDER STATEMENT OF LIMITATIONS

This report has been prepared by Kleinfelder Australia Pty Ltd (Kleinfelder) and may be used only by the Client and its designated representatives or relevant statutory authorities and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report.

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report cannot be reproduced without the written authorisation of Kleinfelder and then can only be reproduced in its entirety.

The findings and conclusions contained within this report are relevant to the conditions of the site and the state of legislation currently enacted in the relevant jurisdiction in which the site is located as at the date of this report.

Additionally, the findings and conclusions contained within this report are made following a review of certain information, reports, correspondence and data noted by methods described in this report including information supplied by the client or its assigns. Kleinfelder has designed and managed the program for this report in good faith and in a manner that seeks to confirm the information provided and test its accuracy and completeness. However, Kleinfelder does not provide guarantees or assurances regarding the accuracy, completeness and validity of information and data obtained from these sources and accepts no responsibility for errors or omissions arising from relying on data or conclusions obtained from these sources.

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Table 1  
Groundwater Analytical Data - PFA

[illegible]



**KLEINFELDER**  
Bright People. Right Solutions.

**Notes:**

- - Not analysed
- - Less than laboratory limit of reporting
- - Microsome per litre
- \*\*\* 99% Level of protection in freshwater
- <sup>1</sup> Soil and Water Management Plan July 2021
- <sup>2</sup> Domestic duplicate value used
- <sup>3</sup> Domestic triplicate value used
- <sup>4</sup> Recreational water

<sup>a</sup> BHSa 15/09/2020 Sample required dilution prior to extraction due to matrix interferences. LOR values have been adjusted accordingly

Table 2  
Surface Water Analytical Data - PFAS  
Williamstown Sand Syndicate

[illegible]

**Notes:**  
 - - Not analysed  
 < - Less than laboratory limit of reporting  
 µg/L - Micrograms per litre  
 \*\*\* 99% Level of protection in freshwater  
<sup>1</sup> Criteria is 1 mg/l  
<sup>2</sup> - Denotes duplicate value used.  
<sup>3</sup> - Denotes triplicate value used.  
<sup>4</sup> Recreation water

Table 3  
Wash Plant Sediment Analytical Data - PFAS  
Williamtown Sand Syndicate

Analyte	Perfluoroalkyl Sulfonic Acids							Perfluoroalkyl Carboxylic Acids										Perfluoroalkyl Sulfonamides							(n:2) Fluorotelomer Sulfonic Acids				Sum of PFAS				
	Perfluorobutane sulfonic acid (PFBS)	Perfluoropentane sulfonic acid (PFPeS)	Perfluorohexane sulfonic acid (PFHxS)	Perfluoroheptane sulfonate (PFHpS)	Perfluorooctane sulfonic acid (PFOS)	Perfluorodecane sulfonic acid (PFDS)	Perfluorobutanoic acid (PFBA)	Perfluoropentanoic acid (PFPeA)	Perfluorohexanoic acid (PFHxA)	Perfluoroheptanoic acid (PFHpA)	Perfluorooctanoic acid (PFOA)	Perfluorononanoic acid (PFNA)	Perfluorodecanoic acid (PFDA)	Perfluoroundecanoic acid (PFUnDA)	Perfluorododecanoic acid (PFDoDA)	Perfluorotridecanoic acid (PFTriDA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorooctane sulfonamide (FOSA)	N-Methylperfluorooctane sulfonamide (MeFOSA)	N-Ethylperfluorooctane sulfonamide (EtFOSA)	N-Methylperfluorooctane sulfonamide (MeFOSA)	N-Ethylperfluorooctane sulfonamide (EtFOSE)	N-Methylperfluorooctane sulfonamide (MeFOSA)	N-Ethylperfluorooctane sulfonamide (EtFOSE)	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	6:2 Fluorotelomer sulfonic acid (6:2 FTS)	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	Sum of PFHxS and PFOS	Sum of PFAS (WADER List)	Sum of PFAS		
LOR	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0005	0.0002	0.0005	0.0005	0.0005	0.0005	0.0002	0.0002	0.0005	0.0005	0.0005	0.0005	0.0005	0.0002	0.0002	0.0002	
Units	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	mq/kg	
Adopted Site Specific Trigger Values (SWMP 2021) <sup>1</sup>	-	-	0.01	-	0.01	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01	-	-	
HEPA NEMP 2020***	-	-	-	-	-	-	-	-	-	-	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	
Sample Name	Sample Date																																
WPF	19-Aug-21	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0002	< 0.0002	< 0.0002	0.0006	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0006	< 0.0002	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0002	< 0.0002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0002	0.0006	0.0006
WPF (secondary)	27-Aug-21	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0005	< 0.0002	< 0.001	< 0.0002	< 0.0002	0.0043	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0006	< 0.0002	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0002	< 0.0002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0005	0.0048	0.0048
SAND1 (secondary)	27-Aug-21	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0005	< 0.0002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0002	< 0.0002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0002	< 0.0002	< 0.0002
RFS	22-Sep-21	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0005	< 0.0002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0002	< 0.0002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0002	< 0.0002	< 0.0002
WASHED	22-Sep-21	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0005	< 0.0002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0002	< 0.0002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0002	< 0.0002	< 0.0002
WPF	22-Sep-21	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0005	< 0.0002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0002	< 0.0002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0002	< 0.0002	< 0.0002
WPF	19-Nov-21	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0005	< 0.0002	< 0.001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0005	< 0.0002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0002	< 0.0002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0005	0.0005	0.0005

Notes:  
 - - Not analysed  
 < - Less than laboratory limit of reporting  
 mq/kg - Milligrams per kilogram  
 \*\*\* - Soil Human Health Screening Criteria  
<sup>1</sup> Soil and Water Management Plan July 2021



Table 4  
Wash Plant Water Analytical Data - PFAS  
Williamtown Sand Syndicate

Analyte	Perfluoroalkyl Sulfonic Acids						Perfluoroalkyl Carboxylic Acids										Perfluoroalkyl Sulfonamides										(n:2) Fluorotelomer Sulfonic Acids				Sum of PFAS		
	Perfluorobutane sulfonic acid (PFBS)	Perfluoropentane sulfonic acid (PFPeS)	Perfluorohexane sulfonic acid (PFHxS)	Perfluoroheptane sulfonate (PFHpS)	Perfluorooctane sulfonic acid (PFOS)	Perfluorodecane sulfonic acid (PFDS)	Perfluorobutanoic acid (PFBA)	Perfluoropentanoic acid (PFPeA)	Perfluorohexanoic acid (PFHxA)	Perfluoroheptanoic acid (PFHpA)	Perfluorooctanoic acid (PFOA)	Perfluorononanoic acid (PFNA)	Perfluorodecanoic acid (PFDA)	Perfluoroundecanoic acid (PFUnDA)	Perfluorododecanoic acid (PFDoDA)	Perfluorotridecanoic acid (PFTeDA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorooctanesulfonamide (FOSA)	N-Methyl-perfluorooctanesulfonamide (MeFOSA)	N-Ethyl-perfluorooctanesulfonamide (EtFOSA)	N-Methyl-perfluorooctanesulfonamide (MeFOSA)	N-Ethyl-perfluorooctanesulfonamide (EtFOSE)	N-Methyl-perfluorooctanesulfonamide (MeFOSE)	N-Ethyl-perfluorooctanesulfonamide (EtFOSE)	N-Ethyl-perfluorooctanesulfonamide (MeFOSE)	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	6:2 Fluorotelomer sulfonic acid (6:2 FTS)	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	Sum of PFHxS and PFOS	Sum of PFAS (WADER List)	Sum of PFAS	
LOR	0.02	0.02	0.02	0.02	0.01	0.02	0.1	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.05	0.02	0.05	0.05	0.05	0.05	0.02	0.02	0.05	0.05	0.05	0.05	0.05	0.01	0.01	0.01	
Units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Adopted Site Specific			0.07		0.07						0.56																			0.07			
HEPA NEMP 2020***					0.13						19																						
HEPA NEMP 2020 <sup>4</sup>											5.6																			0.7			
Sample Name	Sample Date																																
INPUT	22-Sep-21	< 0.02	< 0.02	< 0.02	< 0.02	< 0.01	< 0.02	< 0.1	< 0.02	< 0.02	< 0.02	< 0.01	< 0.02	< 0.02	< 0.02	< 0.02	< 0.05	< 0.02	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.02	< 0.02	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.01	< 0.01	< 0.01
WPW	19-Aug-21	< 0.02	< 0.02	< 0.02	< 0.02	< 0.01	< 0.02	< 0.1	< 0.02	< 0.02	< 0.02	< 0.01	< 0.02	< 0.02	< 0.02	< 0.02	< 0.05	< 0.02	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.02	< 0.02	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.01	< 0.01	< 0.01
	22-Sep-21	< 0.02	< 0.02	< 0.02	< 0.02	< 0.01	< 0.02	< 0.1	< 0.02	< 0.02	< 0.02	< 0.01	< 0.02	< 0.02	< 0.02	< 0.02	< 0.05	< 0.02	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.02	< 0.02	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.01	< 0.01	< 0.01
	13-Oct-21	< 0.02	< 0.02	< 0.02	< 0.02	<b>0.01</b>	< 0.02	< 0.1	< 0.02	< 0.02	< 0.02	< 0.01	< 0.02	< 0.02	< 0.02	< 0.02	< 0.05	< 0.02	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.02	< 0.02	< 0.05	< 0.05	< 0.05	< 0.05	<b>0.01</b>	<b>0.01</b>	<b>0.01</b>	
	16-Nov-21	< 0.02	< 0.02	< 0.01	< 0.02	< 0.01	< 0.02	< 0.1	< 0.02	< 0.02	< 0.02	< 0.01	< 0.02	< 0.02	< 0.02	< 0.02	< 0.05	< 0.02	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.02	< 0.02	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.01	< 0.01	< 0.01
	15-Dec-21	< 0.02	< 0.02	< 0.01	< 0.02	<b>0.03</b>	< 0.02	< 0.1	< 0.02	< 0.02	< 0.02	< 0.01	< 0.02	< 0.02	< 0.02	< 0.02	< 0.05	< 0.02	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.02	< 0.02	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	<b>0.03</b>	<b>0.03</b>	<b>0.03</b>

**Notes:**

-- Not analysed

< - Less than laboratory limit of reporting

µg/L - Micrograms per litre

\*\*\* 95% Level of protection in freshwater - slightly to moderately disturbed systems

<sup>1</sup> Soil and Water Management Plan July 2021

<sup>4</sup> Recreation water



## **APPENDIX 13. TRUCK MONITORING RECORDS**

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**Monthly Summary of Traffic Movements**

*(as per Condition 26 of Consent SSD\_6125)*

Date	Total	Approved Maximum*	Percentage of Approved Movements
4-Jan	6	116	5.2%
5-Jan	6	116	5.2%
6-Jan	12	116	10.3%
7-Jan	26	116	22.4%
8-Jan	23	116	19.8%
11-Jan	47	116	40.5%
12-Jan	24	116	20.7%
13-Jan	22	116	19.0%
14-Jan	34	116	29.3%
15-Jan	36	116	31.0%
16-Jan	12	90	13.3%
18-Jan	69	116	59.5%
19-Jan	72	116	62.1%
20-Jan	59	116	50.9%
21-Jan	55	116	47.4%
22-Jan	44	116	37.9%
23-Jan	5	90	5.6%
25-Jan	16	116	13.8%
27-Jan	35	116	30.2%
28-Jan	21	116	18.1%
29-Jan	22	116	19.0%
30-Jan	3	90	3.3%
<b>Total trucks this month</b>	<b>649</b>		
<b>Approved maximum for month*</b>		<b>2886</b>	<b>22.5%</b>

\* Maximum approved haulage as per Condition 23 of Consent SSD\_6125:

- 6 trucks per hour from 6am to 7am Monday to Friday.
- 10 trucks per hour from 7am to 6pm Monday to Friday.
- 10 trucks per hour from 7am to 4pm on Saturday.
- No haulage on Public Holidays.

**The weighbridge and ticketing system is routinely calibrated and managed by an accredited external business to ensure the sale and transport of sand from the quarry is consistent with approved haulage limits and operational times.**

### Monthly Summary of Traffic Movements

(as per Condition 26 of Consent SSD\_6125)

Date	Total	Approved Maximum*	Percentage of Approved Movements
1-Feb	35	116	30.2%
2-Feb	21	116	18.1%
3-Feb	22	116	19.0%
4-Feb	26	116	22.4%
5-Feb	26	116	22.4%
6-Feb	4	90	4.4%
8-Feb	40	116	34.5%
9-Feb	43	116	37.1%
10-Feb	46	116	39.7%
11-Feb	38	116	32.8%
12-Feb	48	116	41.4%
13-Feb	12	90	13.3%
15-Feb	75	116	64.7%
16-Feb	74	116	63.8%
17-Feb	50	116	43.1%
18-Feb	25	116	21.6%
19-Feb	35	116	30.2%
20-Feb	1	90	1.1%
22-Feb	78	116	67.2%
23-Feb	77	116	66.4%
24-Feb	63	116	54.3%
25-Feb	86	116	74.1%
26-Feb	49	116	42.2%
27-Feb	7	90	7.8%
<b>Total trucks this month</b>	<b>981</b>		
<b>Approved maximum for month*</b>		<b>2680</b>	<b>36.6%</b>

\* Maximum approved haulage as per Condition 23 of Consent SSD\_6125:

- 6 trucks per hour from 6am to 7am Monday to Friday.
- 10 trucks per hour from 7am to 6pm Monday to Friday.
- 10 trucks per hour from 7am to 4pm on Saturday.
- No haulage on Public Holidays.

The weighbridge and ticketing system is routinely calibrated and managed by an accredited external business to ensure the sale and transport of sand from the quarry is consistent with approved haulage limits and operational times.

**Monthly Summary of Traffic Movements**
*(as per Condition 26 of Consent SSD\_6125)*

Date	Total	Approved Maximum*	Percentage of Approved Movements
1-Mar	34	116	29.3%
2-Mar	34	116	29.3%
3-Mar	34	116	29.3%
4-Mar	33	116	28.4%
5-Mar	45	116	38.8%
6-Mar	6	90	6.7%
8-Mar	41	116	35.3%
9-Mar	40	116	34.5%
10-Mar	34	116	29.3%
11-Mar	42	116	36.2%
12-Mar	42	116	36.2%
13-Mar	7	90	7.8%
15-Mar	35	116	30.2%
16-Mar	28	116	24.1%
17-Mar	31	116	26.7%
18-Mar	16	116	13.8%
19-Mar	11	116	9.5%
22-Mar	3	116	2.6%
24-Mar	17	116	14.7%
25-Mar	29	116	25.0%
26-Mar	37	116	31.9%
27-Mar	12	90	13.3%
29-Mar	34	116	29.3%
30-Mar	32	116	27.6%
31-Mar	63	116	54.3%
<b>Total trucks this month</b>	<b>740</b>		
<b>Approved maximum for month*</b>		<b>3028</b>	<b>24.4%</b>

\* Maximum approved haulage as per Condition 23 of Consent SSD\_6125:

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- 10 trucks per hour from 7am to 6pm Monday to Friday.
- 10 trucks per hour from 7am to 4pm on Saturday.
- No haulage on Public Holidays.

**The weighbridge and ticketing system is routinely calibrated and managed by an accredited external business to ensure the sale and transport of sand from the quarry is consistent with approved haulage limits and operational times.**

### Monthly Summary of Traffic Movements

(as per Condition 26 of Consent SSD\_6125)

Date	Total	Approved Maximum*	Percentage of Approved Movements
1-Apr	66	116	56.9%
6-Apr	48	116	41.4%
7-Apr	64	116	55.2%
8-Apr	66	116	56.9%
9-Apr	33	116	28.4%
10-Apr	2	90	2.2%
12-Apr	46	116	39.7%
13-Apr	85	116	73.3%
14-Apr	88	116	75.9%
15-Apr	79	116	68.1%
16-Apr	73	116	62.9%
17-Apr	35	90	38.9%
19-Apr	61	116	52.6%
20-Apr	45	116	38.8%
21-Apr	32	116	27.6%
22-Apr	29	116	25.0%
23-Apr	34	116	29.3%
24-Apr	9	90	10.0%
26-Apr	32	116	27.6%
27-Apr	48	116	41.4%
28-Apr	30	116	25.9%
29-Apr	38	90	42.2%
30-Apr	23	116	19.8%
<b>Total trucks this month</b>	<b>1066</b>		
<b>Approved maximum for month*</b>		<b>2912</b>	<b>36.6%</b>

\* Maximum approved haulage as per Condition 23 of Consent SSD\_6125:

- 6 trucks per hour from 6am to 7am Monday to Friday.
- 10 trucks per hour from 7am to 6pm Monday to Friday.
- 10 trucks per hour from 7am to 4pm on Saturday.
- No haulage on Public Holidays.

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### Monthly Summary of Traffic Movements

(as per Condition 26 of Consent SSD\_6125)

Date	Total	Approved Maximum*	Percentage of Approved Movements
1-May	8	90	8.9%
3-May	29	116	25.0%
4-May	29	116	25.0%
5-May	43	116	37.1%
6-May	18	116	15.5%
7-May	17	90	18.9%
8-May	1	90	1.1%
10-May	39	116	33.6%
11-May	30	116	25.9%
12-May	58	116	50.0%
13-May	48	116	41.4%
14-May	45	90	50.0%
15-May	10	116	8.6%
17-May	48	116	41.4%
18-May	69	116	59.5%
19-May	73	116	62.9%
20-May	61	116	52.6%
21-May	66	116	56.9%
22-May	4	90	4.4%
24-May	60	116	51.7%
25-May	26	116	22.4%
26-May	22	116	19.0%
27-May	28	116	24.1%
28-May	30	116	25.9%
29-May	6	90	6.7%
31-May	28	116	24.1%
<b>Total trucks this month</b>	<b>896</b>		
<b>Approved maximum for month*</b>		<b>2886</b>	<b>31.0%</b>

\* Maximum approved haulage as per Condition 23 of Consent SSD\_6125:

- 6 trucks per hour from 6am to 7am Monday to Friday.
- 10 trucks per hour from 7am to 6pm Monday to Friday.
- 10 trucks per hour from 7am to 4pm on Saturday.
- No haulage on Public Holidays.

The weighbridge and ticketing system is routinely calibrated and managed by an accredited external business to ensure the sale and transport of sand from the quarry is consistent with approved haulage limits and operational times.

### Monthly Summary of Traffic Movements

(as per Condition 26 of Consent SSD\_6125)

Date	Total	Approved Maximum*	Percentage of Approved Movements
1-Jun	27	116	23.3%
2-Jun	29	116	25.0%
3-Jun	13	116	11.2%
4-Jun	46	116	39.7%
5-Jun	4	90	4.4%
7-Jun	21	116	18.1%
8-Jun	28	116	24.1%
9-Jun	49	116	42.2%
10-Jun	51	116	44.0%
11-Jun	13	116	11.2%
12-Jun	4	90	4.4%
15-Jun	48	116	41.4%
16-Jun	40	116	34.5%
17-Jun	29	116	25.0%
18-Jun	40	116	34.5%
19-Jun	8	90	8.9%
21-Jun	49	116	42.2%
22-Jun	43	116	37.1%
23-Jun	29	116	25.0%
24-Jun	23	116	19.8%
25-Jun	33	116	28.4%
26-Jun	6	90	6.7%
28-Jun	28	116	24.1%
29-Jun	16	116	13.8%
30-Jun	35	116	30.2%
<b>Total trucks this month</b>	<b>712</b>		
<b>Approved maximum for month*</b>		<b>2912</b>	<b>24.5%</b>

\* Maximum approved haulage as per Condition 23 of Consent SSD\_6125:

- 6 trucks per hour from 6am to 7am Monday to Friday.
- 10 trucks per hour from 7am to 6pm Monday to Friday.
- 10 trucks per hour from 7am to 4pm on Saturday.
- No haulage on Public Holidays.

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### Monthly Summary of Traffic Movements

(as per Condition 26 of Consent SSD\_6125)

Date	Total	Approved Maximum*	Percentage of Approved Movements
1-Jul	32	116	27.6%
2-Jul	35	116	30.2%
3-Jul	11	90	12.2%
5-Jul	27	116	23.3%
6-Jul	34	116	29.3%
7-Jul	36	116	31.0%
8-Jul	34	116	29.3%
9-Jul	31	116	26.7%
10-Jul	2	90	2.2%
12-Jul	43	116	37.1%
13-Jul	50	116	43.1%
14-Jul	34	116	29.3%
15-Jul	55	116	47.4%
16-Jul	49	116	42.2%
17-Jul	3	90	3.3%
19-Jul	44	116	37.9%
20-Jul	29	116	25.0%
21-Jul	55	116	47.4%
22-Jul	63	116	54.3%
23-Jul	37	116	31.9%
24-Jul	5	90	5.6%
26-Jul	58	116	50.0%
27-Jul	33	116	28.4%
28-Jul	39	116	33.6%
29-Jul	24	116	20.7%
30-Jul	36	116	31.0%
31-Jul	4	90	4.4%
<b>Total trucks this month</b>	<b>903</b>		
<b>Approved maximum for month*</b>		<b>3002</b>	<b>30.1%</b>

\* Maximum approved haulage as per Condition 23 of Consent SSD\_6125:

- 6 trucks per hour from 6am to 7am Monday to Friday.
- 10 trucks per hour from 7am to 6pm Monday to Friday.
- 10 trucks per hour from 7am to 4pm on Saturday.
- No haulage on Public Holidays.

The weighbridge and ticketing system is routinely calibrated and managed by an accredited external business to ensure the sale and transport of sand from the quarry is consistent with approved haulage limits and operational times.

### Monthly Summary of Traffic Movements

(as per Condition 26 of Consent SSD\_6125)

Date	Total	Approved Maximum*	Percentage of Approved Movements
2-Aug	37	116	31.9%
3-Aug	37	116	31.9%
4-Aug	70	116	60.3%
5-Aug	58	116	50.0%
6-Aug	66	116	56.9%
7-Aug	8	90	8.9%
9-Aug	65	116	56.0%
10-Aug	54	116	46.6%
11-Aug	68	116	58.6%
12-Aug	73	116	62.9%
13-Aug	60	116	51.7%
14-Aug	7	90	7.8%
16-Aug	28	116	24.1%
17-Aug	46	116	39.7%
18-Aug	56	116	48.3%
19-Aug	57	116	49.1%
20-Aug	41	116	35.3%
21-Aug	8	90	8.9%
23-Aug	39	116	33.6%
24-Aug	15	116	12.9%
25-Aug	25	116	21.6%
26-Aug	43	116	37.1%
27-Aug	62	116	53.4%
28-Aug	10	90	11.1%
30-Aug	53	116	45.7%
31-Aug	52	116	44.8%
<b>Total trucks this month</b>	<b>1138</b>		
<b>Approved maximum for month*</b>		<b>2912</b>	<b>39.1%</b>

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- 10 trucks per hour from 7am to 6pm Monday to Friday.
- 10 trucks per hour from 7am to 4pm on Saturday.
- No haulage on Public Holidays.

The weighbridge and ticketing system is routinely calibrated and managed by an accredited external business to ensure the sale and transport of sand from the quarry is consistent with approved haulage limits and operational times.



### Monthly Summary of Traffic Movements

(as per Condition 26 of Consent SSD\_6125)

Date	Total	Approved Maximum*	Percentage of Approved Movements
1-Sep	51	116	44.0%
2-Sep	55	116	47.4%
3-Sep	48	116	41.4%
4-Sep	9	90	10.0%
6-Sep	50	116	43.1%
7-Sep	47	116	40.5%
8-Sep	35	116	30.2%
9-Sep	41	116	35.3%
10-Sep	42	116	36.2%
11-Sep	15	90	16.7%
13-Sep	46	116	39.7%
14-Sep	18	116	15.5%
15-Sep	26	116	22.4%
16-Sep	44	116	37.9%
17-Sep	49	116	42.2%
18-Sep	12	90	13.3%
20-Sep	54	116	46.6%
21-Sep	32	116	27.6%
22-Sep	46	116	39.7%
23-Sep	48	116	41.4%
24-Sep	45	116	38.8%
25-Sep	17	90	18.9%
27-Sep	37	116	31.9%
28-Sep	66	116	56.9%
29-Sep	79	116	68.1%
30-Sep	75	116	64.7%
<b>Total trucks this month</b>	<b>1087</b>		
<b>Approved maximum for month*</b>		<b>2912</b>	<b>37.3%</b>

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- 10 trucks per hour from 7am to 6pm Monday to Friday.
- 10 trucks per hour from 7am to 4pm on Saturday.
- No haulage on Public Holidays.

The weighbridge and ticketing system is routinely calibrated and managed by an accredited external business to ensure the sale and transport of sand from the quarry is consistent with approved haulage limits and operational times.

## Monthly Summary of Traffic Movements

(as per Condition 26 of Consent SSD\_6125)

Date	Total	Approved Maximum*	Percentage of Approved Movements
1-Oct	67	116	57.8%
2-Oct	8	90	8.9%
5-Oct	81	116	69.8%
6-Oct	69	116	59.5%
7-Oct	80	116	69.0%
8-Oct	64	116	55.2%
9-Oct	18	90	20.0%
11-Oct	57	116	49.1%
12-Oct	20	116	17.2%
13-Oct	25	116	21.6%
14-Oct	14	116	12.1%
15-Oct	35	116	30.2%
16-Oct	3	90	3.3%
18-Oct	40	116	34.5%
19-Oct	44	116	37.9%
20-Oct	74	116	63.8%
21-Oct	71	116	61.2%
22-Oct	74	116	63.8%
23-Oct	11	90	12.2%
25-Oct	69	116	59.5%
26-Oct	79	116	68.1%
27-Oct	59	116	50.9%
28-Oct	62	116	53.4%
29-Oct	32	116	27.6%
30-Oct	12	90	13.3%
<b>Total trucks this month</b>	<b>1168</b>		
<b>Approved maximum for month*</b>		<b>2886</b>	<b>40.5%</b>

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- 10 trucks per hour from 7am to 6pm Monday to Friday.
- 10 trucks per hour from 7am to 4pm on Saturday.
- No haulage on Public Holidays.

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## Monthly Summary of Traffic Movements

(as per Condition 26 of Consent SSD\_6125)

Date	Total	Approved Maximum*	Percentage of Approved Movements
1-Nov	51	116	44.0%
2-Nov	37	116	31.9%
3-Nov	45	116	38.8%
4-Nov	50	116	43.1%
5-Nov	37	116	31.9%
6-Nov	12	90	13.3%
8-Nov	40	116	34.5%
9-Nov	38	116	32.8%
10-Nov	33	116	28.4%
11-Nov	30	116	25.9%
12-Nov	18	116	15.5%
13-Nov	1	9	11.1%
15-Nov	51	116	44.0%
16-Nov	43	116	37.1%
17-Nov	63	116	54.3%
18-Nov	60	116	51.7%
19-Nov	35	116	30.2%
20-Nov	14	90	15.6%
22-Nov	42	116	36.2%
23-Nov	26	116	22.4%
24-Nov	24	116	20.7%
25-Nov	36	116	31.0%
26-Nov	13	116	11.2%
29-Nov	30	116	25.9%
30-Nov	33	116	28.4%
<b>Total trucks this month</b>	<b>862</b>		
<b>Approved maximum for month*</b>		<b>2912</b>	<b>29.6%</b>

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- 10 trucks per hour from 7am to 6pm Monday to Friday.
- 10 trucks per hour from 7am to 4pm on Saturday.
- No haulage on Public Holidays.

The weighbridge and ticketing system is routinely calibrated and managed by an accredited external business to ensure the sale and transport of sand from the quarry is consistent with approved haulage limits and operational times.



(as per Condition 26 of Consent SSD 6125)

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\* Maximum approved haulage as per Condition 23 of Consent SSD 6125:

- 6 trucks per hour from 6am to 7am Monday to Friday.
- 10 trucks per hour from 7am to 6pm Monday to Friday.
- 10 trucks per hour from 7am to 4pm on Saturday.
- No haulage on Public Holidays.

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