Aus 10 Rhyolite Pty Limited

ABN: 90 002 325 144

2019 Annual Review

for the

Tinda Creek Quarry

Prepared by:

R.W. CORKERY & CO. PTY. LIMITED

March 2020

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Period: 1 January 2019 to 31 December 2019

Prepared for:

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Ref No. 980/10

March 2020

R.W. CORKERY & CO. PTY. LIMITED

Table A
Title Block

Name of operation	Tinda Creek Sand Quarry
Name of operator	Aus 10 Rhyolite Pty Limited t/a Hy-Tec Concrete and Aggregates
Development consent / project approval #	SSD_4978
Name of holder of development consent / project approval	Aus 10 Rhyolite Pty Limited
Mining Lease #	No Mining Lease applicable to site under *Mining Act* (1992).
Name of holder of mining lease	N/A
Water licence #	WAL 24367 / WAL 24381 / WAL 42446
Name of holder of water licence	Aus 10 Rhyolite Pty Limited
MOP/RMP start date	N/A
MOP/RMP end date	N/A
Annual Review start date	1 January 2019
Annual Review end date	31 December 2019
I, Darryl Thiedeke, certify that to the best of my knowledge this audit report is a true and accurate record of the compliance status of the Tinda Creek Quarry for the period 1 January 2019 to 31 December 2019 and that I am authorised to make this statement of behalf of Aus 10 Rhyolite Pty Limited. *Note.* *a) The Annual Review is an 'environmental audit' for the purposes of section 122B(2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, $1 million and for an individual, $250,000.* *b) The Crimes Act 1900 contains other offences relating to false and misleading information: Section 192G (Intention to defraud by false or misleading statement – maximum penalty 5 years imprisonment); Section 307A, 307B and 307C (false or misleading application/information/documents – maximum penalty 2 years imprisonment or $22,000, or both).*	
Name of authorised reporting officer	Darryl Thiedeke
Title of authorised reporting officer	National Planning and Development Manager
Signature of authorised reporting officer	
Date	30/3/20

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PLATES

LIST OF ACRONYMS

AHD	Australian Height Datum
ARI	Average Recurrence Interval
CCC	Community Consultative Committee
DPE	Department of Planning and Environment
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environment Protection Authority
EPL	Environment Protection License
PM	Particulate Matter
RWC	R.W. Corkery and Co. Pty Limited
TSP	Total Suspended Particulates
WAL	Water Access Licence

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1. STATEMENT OF COMPLIANCE

Table 1.1
Statement of Compliance

Were all conditions of the relevant approval(s) complied with?	Yes / No
DC # SSD_4978	No
EPL # 12007	Yes

Table 1.2
Non-compliances

Relevant Approval	Condition #	Condition Description (summary)	Compliance Status	Comment	Where Addressed in Annual Review
SSD_4978	2 (2)	This condition relates to operation of the Quarry in accordance with the conditions of consent	Administrative	A single non-compliance issue was identified during the reporting period as detailed in this table.	See below
SSD_4978	3 (13)	This condition relates to implementation of an approved Water Management Plan – specifically protocols for investigation of non-compliance with groundwater assessment criteria	Low	Monitoring of groundwater levels was not undertaken in November 2019. However, this was due to regional bush fire that restricted access to the Quarry. Monitoring of groundwater levels throughout the reporting period were below the investigation trigger level. An investigation was undertaken in December 2018, July 2019 and February 2020 but not repeated during other months. Declining groundwater levels during the reporting period are considered to have resulted from regional drought conditions and not Quarry operations. This was supported by the investigation in December 2018, July 2019 and February 2020.	Section 7.1

Compliance Status Key

Risk level	*Colour code*	*Description*
High	*Non-compliant*	*Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence.*
Medium	*Non-compliant*	*Non-compliance with:* • *potential for serious environmental consequences, but is unlikely to occur; or* • *potential for moderate environmental consequences but is likely to occur.*
Low	*Non-compliant*	*Non-compliance with:* • *potential for moderate environmental consequences, but is unlikely to occur; or* • *potential for low environmental consequences but is likely to occur.*
Administrative non-compliance	*Non-compliant*	*Only to be applied where the non-compliance does not result in any risk of environmental harm (e.g. submitting a report to government later than required under approval conditions).*

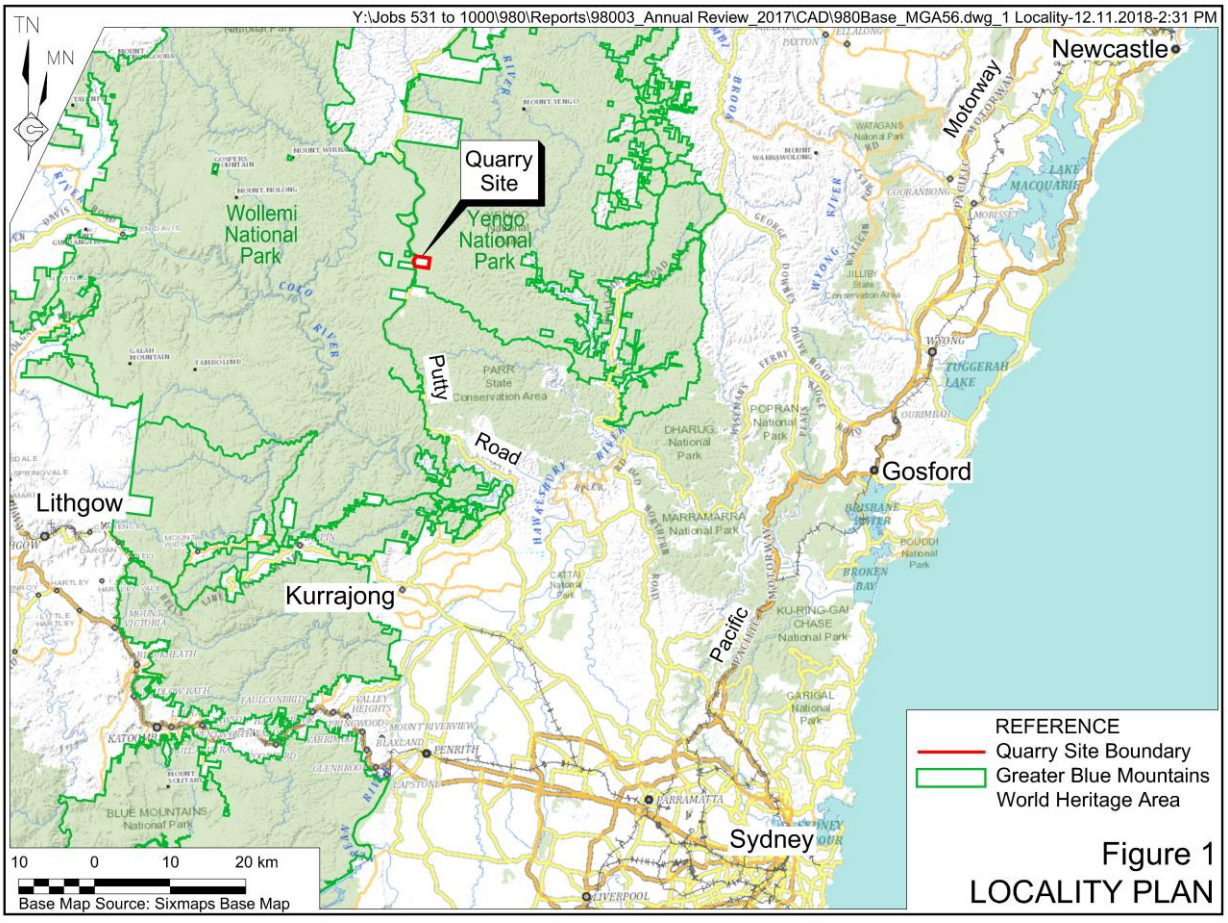
2. INTRODUCTION

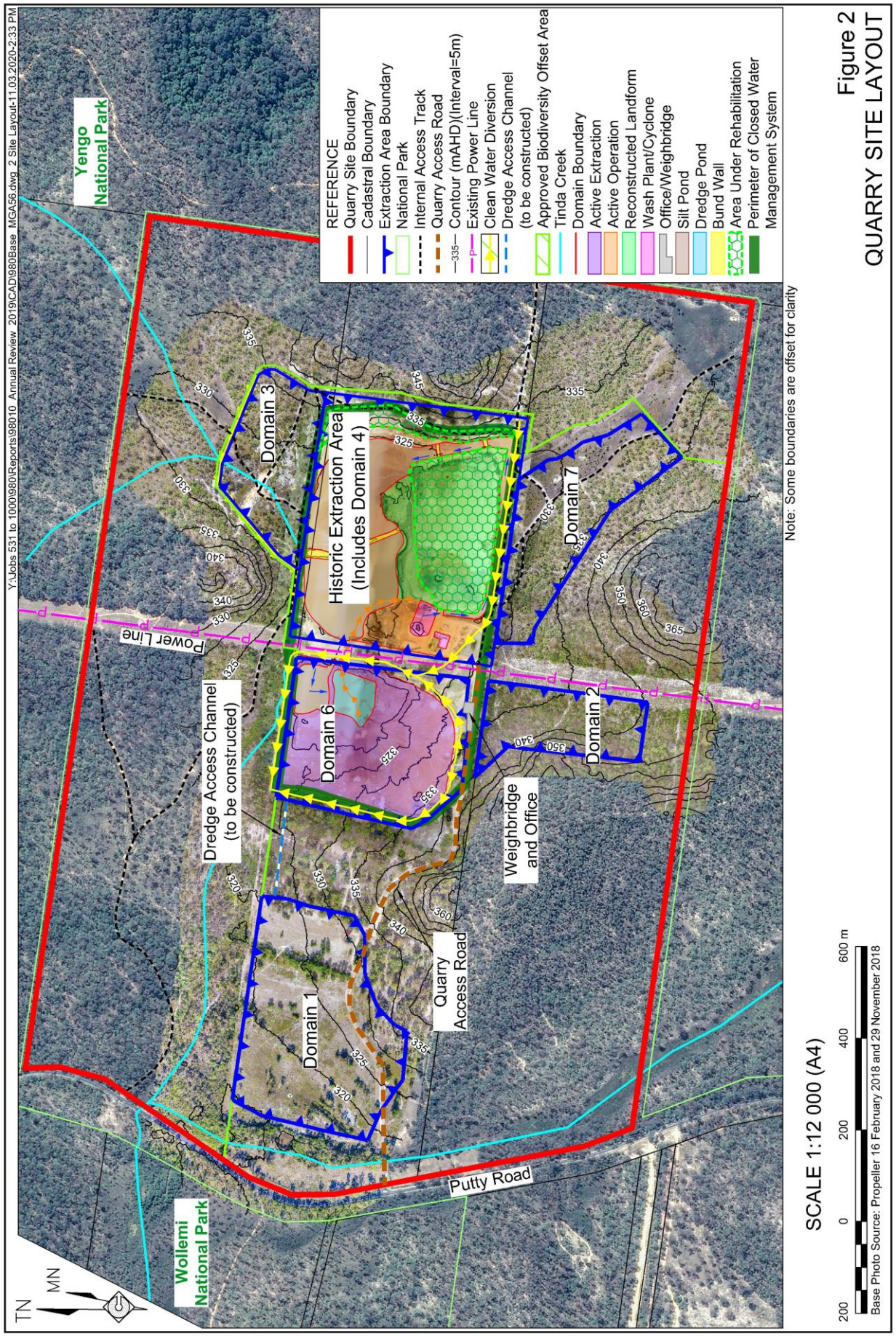
2.1 SCOPE AND FORMAT

This *Annual Review* has been compiled by R.W. Corkery & Co. Pty Limited (RWC) on behalf of Aus 10 Rhyolite Pty Limited. This report is applicable for the period 1 January 2019 to 31 December 2019 ("the reporting period"). The information presented within this *Annual Review* has been prepared based upon observations made during a site visit on 9 and 10 October 2019 and information provided by Hy-Tec.

The Tinda Creek Sand Quarry (the Quarry) is owned and operated by Aus 10 Rhyolite Pty Limited trading as Hy-Tec Concrete and Aggregates hereafter referred to as Hy-Tec. The Quarry Site is located approximately 67km north of Windsor along Putty Road, NSW (see **Figure 1**). Development Consent SSD_4978 (SSD_4978) was granted on 10 April 2015 to permit the extraction and despatch of up to 300 000 tonnes of sand from the Quarry each year for the duration of the Project. **Figure 2** displays the layout of the Quarry.

It is noted that regional environmental issues have directly impacted operations at the Quarry during the reporting period. The prolonged drought experienced throughout NSW has meant that water normally available for processing activities has been scarce. In addition, the Quarry was directly impacted by the Gospers Mountain Bush Fire in late October and throughout November and December 2019. The fire surrounded the Quarry and was kept from site infrastructure only through the efforts of site personnel and the Rural Fire Service. Damage to major infrastructure was avoided but operations were disrupted for an extended period.




Y:\Jobs 531 to 1000\980\Reports\98010_Annual Review_2019\CAD\980Base_MGA56.dwg_2 Site Layout-11.03.2020-2:33 PM
REFERENCE
Quarry Site Boundary
Cadastral Boundary
Extraction Area Boundary
National Park
Internal Access Track
Quarry Access Road
Contour (mAHD)(Interval=5m)
Existing Power Line
Clean Water Diversion
Dredge Access Channel (to be constructed)
Approved Biodiversity Offset Area
Tinda Creek
Domain Boundary
Active Extraction
Active Operation
Reconstructed Landform
Wash Plant/Cyclone
Office/Weighbridge
Silt Pond
Dredge Pond
Bund Wall
Area Under Rehabilitation
Perimeter of Closed Water Management System
Yengo National Park
Wollemi National Park
Domain 1
Domain 2
Domain 3
Domain 6
Domain 7
Historic Extraction Area (Includes Domain 4)
Power Line
Dredge Access Channel (to be constructed)
Quarry Access Road
Weighbridge and Office
Putty Road
TN
MN
Note: Some boundaries are offset for clarity
SCALE 1:12 000 (A4)
200 0 200 400 600 m
Base Photo Source: Propeller 16 February 2018 and 29 November 2018
Figure 2
QUARRY SITE LAYOUT

This *Annual Review* has been prepared in accordance with *Condition 5(4)* of Development Consent SSD_4978 to record the activities and environmental monitoring undertaken at the Quarry during the reporting period and to outline the activities and environmental monitoring planned throughout the next reporting period (1 January 2020 to 31 December 2020). *Condition 5(4)* requires the preparation of a report which must:

a) *describe the development (including rehabilitation) that was carried out in the previous calendar year, and the development that is proposed to be carried out over the current calendar year* (Sections 4, 8 and 11);

b) *include a comprehensive review of the monitoring results and complaints records of the development over the previous calendar year, which includes a comparison of these results against*:

- *the relevant statutory requirements, limits or performance measures/criteria;*
- *the monitoring results of previous years; and*
- *the relevant prediction in the EIS* (Sections 6, 7 and 9);

c) *identify any non-compliance over the last year, and describes what actions were (or are being) taken to ensure compliance* (Section 10);

d) *identify any trends in the monitoring data over the life of the development* (Section 6 and 7);

e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; *and* (Section 6 and 7)

f) *describe what measures will be implemented over the current calendar year to improve the environmental performance of the development* (Sections 6, 7 and 11).

2.2 KEY PERSONNEL CONTACT DETAILS

The key personnel contact names, position and phone numbers are as follows.

Name	Position	24 Hour Contact
Michael Walton	Quarry Manager	0447 391 964

3. APPROVALS

Hy-Tec is required to operate the Tinda Creek Quarry in accordance with a development consent and four licenses, listed in **Table 3.1**.

Table 3.1
Tinda Creek Sand Quarry – Approvals and Licences

Consent/Lease/Licence	Issue Date	Expiry Date	Details / Comments
Development Consent SSD_4978	10/4/2015	31/12/2045	Issued by Department of Planning and Environment
Approval EPBC 2013/7028	4/10/2016	31/12/2045	Issued by the Department of the Environment and Energy
Environment Protection Licence No 12007	11/5/2005	12 May+	Issued by Environment Protection Authority
Water Access License 24381 40 Units	1/9/2014	Continuing	Water Supply Works (Excavation) approval number 10WA112523 issued on 1/7/2011. Valid until 8/11/2025
Water Access License 24367 15 Units	2/2/2012	Continuing	Water Supply Works (Bore) approval number 10WA112531 issued on 1/7/2011. Valid until 13/4/2025
Water Access License 42446 60 Units	20/06/2019	Continuing	No nominated works approval
+ Anniversary Date			

No modifications or variations to the development consent or licenses outlined in **Table 3.1** were sought within the reporting period.

SSD_4978 was granted in accordance with Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) by the Minister for Planning on 10 April 2015 to extract and transport no more than 300 000 tonnes of sand products from the Quarry Site each calendar year until 31 December 2045. SSD_4978 superseded DA 134/95 to allow for the expansion of extraction beyond the previously approved extraction area boundary. Sand extraction within the new approved extraction area commenced in September 2015. DA 134/95 was formally surrendered on 10 December 2015.

Hy-Tec also operates in accordance with Approval EPBC 2013/7028. This approval relates principally to operations that may impact the threatened Koala and small flower Grevillea identified within the Quarry Site. This approval also recognises the world and natural heritage values of the nearby Greater Blue Mountains Area. A compliance review of the conditions of EPBC 2013/7028 is completed annually and placed on the Hy-Tec website. During the reporting period, Hy-Tec remained compliant with the conditions of EPBC 2013/7028.

Hy-Tec also operates the Tinda Creek Quarry in accordance with Environment Protection Licence (EPL) 12007. This licence incorporates standard conditions for extractive industries and includes limits for noise emissions from the Quarry Site.

An internal compliance review of the conditions of SSD_4978 and EPL 12007 is presented as **Appendix 1** with the outcomes discussed in Section 1 and Section 10.

Water Access Licence (WAL) 24381 (40 units) and WAL24367 (15 units) were issued to permit extraction of water from the Sydney Basin North Groundwater Source. Water within this source is managed through the water sharing plan for the *Greater Metropolitan Region Groundwater Sources 2011*. The WALs permit extraction of groundwater in accordance with the conditions provided in the licences. Two Water Supply Works approvals were issued to Hy-Tec on 1 July 2011 by the then Department of Primary Industries (now the Department of Industry – Crown Lands and Water) to permit extraction of groundwater associated with the WALs.

WAL 24367 and the nominated works approval 10WA112531 permit the use of groundwater sourced via a production bore from the underlying aquifer. This water, when required is used to top up the dredge pond to ensure the dredge can operate efficiently. WAL 24381 and the nominated works approval 10WA112523 permits the use of water accessed from the groundwater setting through extraction activities and principally accounts for evaporation from exposed faces. Anecdotally, Quarry personnel have observed very little seepage into operating domains, however this license accounts for the possible evaporation.

Hy-Tec applied for and received an additional 60ML allocation of groundwater from within the Sydney Basin North Groundwater Source under a controlled allocation order in October 2018. Hy-Tec submitted an application to nominate the works approvals associated with the site (10WA112532 and 10WA112531) on WAL42446. The potential impacts associated with additional take of water from groundwater setting have been presented to Water NSW for consideration. Response to this application is expected during the next reporting period.

4. OPERATIONS SUMMARY

4.1 INTRODUCTION

The following subsections provide a summary of activities undertaken during the reporting period. Activities were generally consistent with those described in previous environmental management reporting. **Plates 1** to **5** display a series of photographs of the Tinda Creek Quarry taken in February 2020 that are representative of existing conditions at the Quarry.

Plate 6 presents a photos taken during the Gospers Mountain Bush Fire and immediately afterward.

4.2 CLOSED WATER MANAGEMENT SYSTEM

Condition 12 of Schedule 3 of SSD_4978 requires that the catchment of the closed water system must not exceed 40ha at any one time. The closed water management system includes the area within the clean water diversions (**Figure 2**).

During the reporting period the closed water management system covered an area of 35.6ha.

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Plate 1: Weighbridge Office and Weighbridge - February 2020 (Ref: E980B_009)

Plate 2: Dredge Pond - February 2020 Sand extraction within the Dredge Pond (Ref: E980B_006)

Plate 3: Sand Stockpile and Plant Infrastructure - February 2020 (Ref: E980B_010)

Plate 4: View of erosion sediment controls in the headwaters of Tinda Creek - February 2020 (Ref: E980B_007)

Plate 5: Rehabilitation progress within a rehabilitation area showing signs of new vegetation growth - February 2020
The area is sign-posted to restrict access
(Ref: E980B_002)

Plate 6: Photo during firefighting of Gospers Mountain Fire (left) and after bushfires in November 2019 (right)
(Photo source: HyTec)

4.3 EXTRACTION OPERATIONS

Extraction and processing during the reporting period occurred entirely within Domain 6 (see **Figure 2**). The total volume of sand extracted and processed was 44 354t which is within the limits specified in Condition 6 of Schedule 2 of SSD_4978. Sand was extracted using a cutter-suction dredge throughout the reporting period (refer **Plate 2**).

This process involves the removal of water, sand, silt and clay in the form of a slurry which is then pumped to the processing area and stockpiled prior to transportation (refer **Plate 3**). Sand transported from site during the reporting period and forecast for the 2020 reporting period is displayed in **Table 4.1**.

Table 4.1
Sand Transportation from Site

Material	Approved annual limit (SSD_4978)	2017 reporting period	2018 reporting period	2019 reporting period	2020 reporting period (forecast)
Sand	300 000 t	190 642t	116 865t	46 942t	100 000t
Source: Hy-Tec					

A copy of the annual return for extractive materials submitted to DRG for 2018/2019 is included within **Appendix 2**.

During the reporting period, the reported sand transported from site (46 942t) was similar to the volume of sand produced (44,354t) which is below the 300 000tpa limit approved within the development consent. Sand processing and transport decreased significantly from 2018 due to operational constraints resulting from the lack of water available for production processes as a result of drier than usual conditions and the delay in feedback on the application to nominate a works approval on WAL 42446. In addition, the Quarry was impacted directly by the Gospers Mountain Bush Fire in October, November and December 2019 that saw fire within the Quarry Site and the closure of the Putty Road (only site access) for a lengthy period after the fire had passed.

During the reporting period (and for all historic operations) extraction operations did not exceed the limit of 15m below the natural ground surface described in *Condition 2(6)* of SSD_4978. Hy-Tec has established a site-based standard procedure for survey and confirmation of the depth of extraction. The surveys are undertaken on a monthly basis.

It is expected that sand processing and transportation from site will increase in 2020.

4.4 HOURS OF OPERATION

The permissible operating hours as set out in *Condition 3(3)* of SSD_4978 were adhered to throughout the reporting period. Extended hours for major supply contracts were not required during the reporting period.

4.5 TRANSPORT LEVELS

SSD_4978 specifies that haulage activities at Tinda Creek Quarry should not exceed 34 trucks per day, averaged over a calendar month. A total of 1 273 laden loads were despatched from the Quarry during the reporting period. A summary of the vehicle movements at Tinda Creek Quarry is provided from the Hy-Tec website and are summarised in **Table 4.2**. There were no recorded exceedances of average daily vehicle movements (based on a calendar month averaging period) within the reporting period.

Table 4.2
Monthly Laden Truck Movements at Tinda Creek Quarry

Month	Laden Truck Loads	Mean Daily Laden Truck Loads[1]
January	98	3.2
February	267	9.5
March	220	7.1
April	108	3.6
May	114	3.7
June	38	1.3
July	40	1.3
August	88	2.8
September	75	2.5
October	132	4.3
November	68	2.3
December	26	0.8
Annual Total	**1 273**	**-**
Annual Daily Average	**6**	**-**
Maximum Daily Movements	**18**	**-**
Note 1: Daily despatch averaged over the calendar month is presented, consistent with the requirements of Condition 7 of Schedule 2 of SSD_4978.		
Source: Hy-Tec		

4.6 CONSTRUCTION ACTIVITIES

No construction activities were conducted during the reporting period.

4.7 WASTE MANAGEMENT

Waste management practices continued in accordance with the provisions of the *Protection of the Environment Operations* (Waste) *Regulation 2014* throughout the reporting period. Hy-Tec has engaged licensed waste contractors to recycle and dispose of waste throughout the reporting period.

4.8 NEXT REPORTING PERIOD

Sand extraction and processing from Domain 6 will continue throughout the 2020 reporting period with extraction unlikely to proceed into Domains 1, 2, 3 or 7.

Processing activities will continue, consistent with historic processing activities. Average daily laden truck levels will remain within approved limits.

5. ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

Feedback on the *2018 Annual Review* was provided on 13 September 2019 which confirmed that the report generally satisfied the requirements of SSD_4978.

6. ENVIRONMENTAL PERFORMANCE

6.1 METEOROLOGICAL MONITORING

Hy-Tec installed a meteorological station in July 2016 in accordance with the requirements of *Condition 3(10)* of SSD_4978. The meteorological station complies with the requirements in the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales* guideline. The location of the meteorological station is shown on **Figure 3**.

6.1.1 Rainfall

A summary of the rainfall data for the reporting period is provided in **Table 6.1**. A total of 314.6mm of rain was recorded from 1 January 2019 to 31 December 2019. Total rainfall during 2019 was significantly lower than each of the preceding 10 years, however, rainfall varied between individual months. It is noted that rainfall in 2018 was approximately 46% of the average annual rainfall from previous 10 years (686mm) demonstrating that 2019 was one of the driest years in recent times.

Table 6.1
Summary of Rainfall Records Since 2007

Month	Year												
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
January	50.5	95.5	29.0	48.5	66.5	133.0	138.0	8.0	163.0	272.0	36.2*	25.6	30
February	152.0	146.5	137.5	119.5	47.0	179.0	202.0	64.0	46.5	0.0	34.2*	58.4	25.2
March	80.5	43.0	30.0	85.5	97.0	145.0	103.0	135.2	96.5	0.0	208.0	64.4	86.8
April	61.5	81.5	117.0	26.0	60.0	64.0	63.5	60.5	285.5	0.0	22.4^	13.4	12.4
May	29.0	10.5	56.5	59.5	96.0	-	31.0	0.0	56.5	0.0	16.6	6.2	4.4
June	210.0	94.0	39.5	43.0	85.5	29.0	84.5	29.0	20.5	126.0	54.0	33.0	22
July	13.0	24.5	17.5	38.5	25.5	27.0	18.5	13.0	34.0	55.0	2.6	5.0	12.2
August	107.0	40.5	4.0	13.5	90.0	4.0	11.0	74.5	26.5	36.5	11.6	10.0	26
September	18.5	58.5	21.0	18.0	69.0	27.5	31.5	29.0	26.5	45.5	0.0	20.0	51.6
October	22.0	93.5	85.5	85.0	65.5	17.5	26.5	48.0	34.0	40.4	61.6	88.8	19.6
November	157.5	75.0	31.5	127.5	159.0	70.5	106.5	16.5	141.0	72.2	35.8	13.2	24.4
December	76.0	71.0	103.5	120.5	72.5	18.5	27.0	150	116.0	69.0	65.0	2.8	0
Totals (mm)	**977.5**	**834.0**	**672.5**	**785.0**	**933.5**	**715.0**	**843.0**	**627.7**	**1046.5**	**716.6**	**548.0**	**340.8**	**314.6**

* Estimated from Putty Tea RMS as Quarry weather station out of service.

^ Data downloaded between 31/3/2017 – 9/4/2017 due to weather station fault

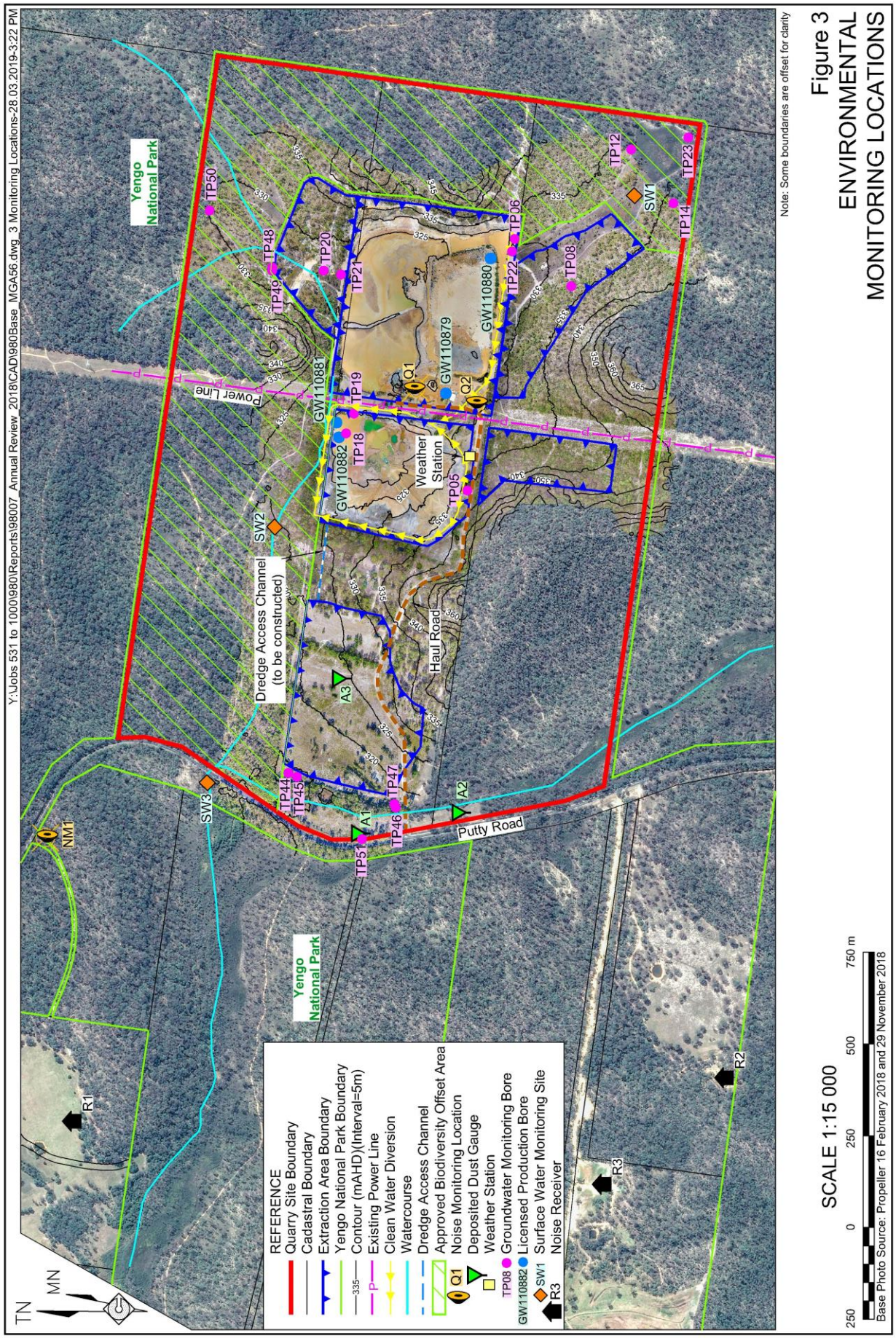


Figure 3
ENVIRONMENTAL
MONITORING LOCATIONS
Note: Some boundaries are offset for clarity
Y:\Jobs 531 to 1000\980\Reports\98007_Annual Review_2018\CAD\980Base_MGA56.dwg_3 Monitoring Locations-28.03.2019-3:22 PM
Yengo National Park
Power Line
Dredge Access Channel (to be constructed)
Haul Road
Putty Road
Weather Station
TP50
TP48
TP49
TP20
TP21
TP19
TP18
TP05
TP06
TP22
TP08
TP12
TP23
TP14
SW1
SW2
SW3
GW110881
GW110882
GW110879
GW110880
Q1
Q2
A1
A2
A3
TP44
TP45
TP47
TP46
TP51
NM1
R1
R2
R3
REFERENCE
Quarry Site Boundary
Cadastral Boundary
Extraction Area Boundary
Yengo National Park Boundary
Contour (mAHD)(Interval=5m)
Existing Power Line
Clean Water Diversion
Watercourse
Dredge Access Channel
Approved Biodiversity Offset Area
Noise Monitoring Location
Deposited Dust Gauge
Weather Station
Groundwater Monitoring Bore
Licensed Production Bore
Surface Water Monitoring Site
Noise Receiver
TN
MN
SCALE 1:15 000
250 0 250 500 750 m
Base Photo Source: Propeller 16 February 2018 and 29 November 2018

6.2 AIR QUALITY

6.2.1 Introduction

Air quality monitoring is required to be undertaken in accordance with the approved *Air Quality Management Plan***.**

6.2.2 Air Quality Criteria

The air quality criteria for the Quarry are provided in *Condition 3(7)* of SSD_4978 and are summarised in **Table 6.2**. Deposited dust (DD) is currently the only air quality parameter that is required to be monitored as specified in the approved *Air Quality Management Plan.* The level of monitoring is considered appropriate as all extraction and processing is essentially a 'wet' process and generates limited dust. Deposited dust levels are used as an indicator of the overall air quality performance of operations.

Table 6.2
Air Quality Criteria

Pollutant	Criterion	Averaging Period
Total suspended particulates (TSP)	90μg/m^3	Annual mean
Particulate matter <10μm (PM_{10}) <10μm (PM_{10})	30μg/m^3	Annual mean
Particulate matter <10μm (PM_{10})	50μg/m^3	24-hour average
Deposited dust	4 g/m^2/month*	Annual mean
* or 2g/m^2/month above the annual background level		

6.2.3 Air Quality Monitoring Results

Monthly deposited dust monitoring was undertaken throughout the reporting period. The location of dust monitoring gauges DG1, DG2 and DG3 are shown on **Figure 3**. **Table 6.3** presents the results of the deposited dust monitoring program over the reporting period.

6.2.4 Analysis of Results

Deposited dust levels were all well below the trigger value at each dust gauge throughout the reporting period, with the exception of one observation in DG3 in the month of November. Deposited dust levels in November were significantly higher than the rest of the year because of the Gospers Mountain Bush Fire. The deposited dust levels in DG3 exceeded the 12-month average limit. Deposited dust levels decreased significantly compared to 2018 deposited dust levels (**Figure 4**) due to the installation of bird deterrence collars on 4 January 2019, which prevented the entry of insects, organic matter, and bird droppings in samples. As a result of the low records, the annual average level is well below the criteria level for the reporting period.

Figure 4 Deposited Dust Levels 2017 to 2019

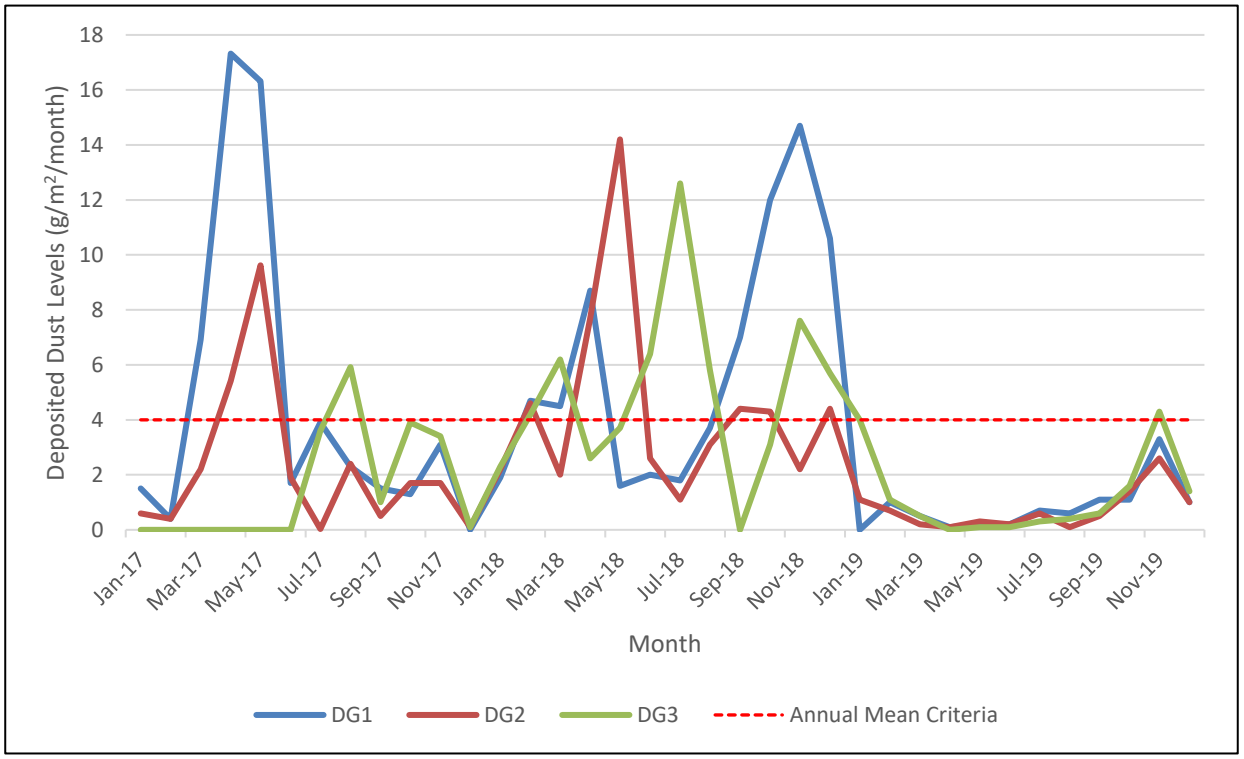


Table 6.3
Measured Performance – Deposited Dust

	Deposited Dust Level[1]			
Date	**DG1**	**DG2**	**DG3**	**Criterion**
January	<0.01	1.1	4.0	-
February	1	0.7	1.1	-
March	0.5	0.2	0.5	-
April	0.1	0.1	<0.1	-
May	0.2	0.3	0.1	-
June	0.2	0.2	0.1	-
July	0.7	0.6	0.3	-
August	0.6	0.1	0.4	-
September	1.1	0.5	0.6	-
October	1.1	1.4	1.6	-
November[2]	3.3	2.6	4.3	-
December	1.0	1.0	1.4	-
Annual Average	**0.9**	**0.7**	**1.3**	**4.0**

Note 1: Units – g/m²/month Red text indicates elevated results

Note 2: Result influenced by the Gospers Mountain Bush Fire

Hy-Tec installed bird deterrence collars on all dust gauges on 4 January 2019 in an effort deter birds from landing on the gauges and introducing matter into the gauge when perching on the edge. It is considered that the bird controls do not influence air flow in the vicinity of the gauges and that the gauges remain consistent with the *Approved methods for the sampling as analysis of air pollutants* (DEC, 2007) The installation of the bird deterrence has resulted in a significant drop in deposited dust levels with the annual average deposited dust levels decreasing to 0.9g/m^2 (DG1), 0.7g/m^2 (DG2), and 1.3g/m^2 (DG3) in 2019 from 6.1g/m^2 (DG1), 4.4g/m^2 (DG2), and 5.5g/m^2 (DG3) in 2018. As these results are more in line with expectations presented in the EIS it is considered that birds were in fact contributing to the dust recorded each month in 2017 and 2018. Hy-Tec will continue to monitor the deposited dust levels during the next reporting period to comply with the approved *Air Quality Management Plan* and to confirm the ongoing effectiveness of the bird controls.

It is noted that the EIS does not include a quantitative assessment of potential air quality impacts as the operation is essentially a 'wet' process and significant air quality impacts were not anticipated.

6.3 OPERATIONAL NOISE

6.3.1 Introduction

Noise monitoring is required to be undertaken in accordance with the conditions listed in the development consent, EPL and approved *Noise Management Plan*. The following subsections provide a brief summary of noise criteria that apply at the Quarry, the results of noise monitoring activities and a discussion of the results recorded during the reporting period.

Following discussions with the DPE in January 2017, it was agreed that additional monitoring would be undertaken to provide an estimate of the contribution of the Quarry to noise levels at residential locations. The results of this monitoring for 2019 are presented in Section 6.3.5 and in **Appendix 3**.

6.3.2 Noise Criteria

Condition 3(4) of SSD_4978 is relevant to noise compliance assessment and sets the criteria for noise generated by the development at any residence on privately-owned land as outlined in **Table 6.4**.

Table 6.4
Noise Monitoring Criteria SSD_4978 (db(A))

	Day / Evening	Night	
Receiver	**LAeq (15 min)**	**LAeq (15min)**	**LA1 (max)**
All receivers	35	35	45

Condition L3 of EPL 12007 is relevant to the noise compliance assessment and stipulates the noise criteria at any monitoring point established under the EPL as outlined in **Table 6.5**.

Table 6.5
Noise Monitoring Criteria EPL 12007 (db(A))

Time Period	Measurement Parameter	Noise level dB(A)
All hours	LAeq (15 minute)	35
All receivers	Lmax OR LA1, 1min	45

6.3.3 Noise Monitoring Results

Attended noise monitoring was undertaken by Muller Acoustic Consulting Pty Ltd (MAC) on 4 April 2019 in accordance with the approved *Noise Management Plan*. A report prepared by MAC is included as **Appendix 3**.

A summary of the attended noise monitoring results at NM1 is provided in **Table 6.6**. In all instances the Quarry contribution to noise levels was <35 $dB_{LAeq\ (15\ minute)}$.

6.3.4 Attended Noise Measurement Compliance Assessment

The compliance assessment summary for R1 (see **Figure 3**) is presented in **Table 6.7** for day and morning shoulder assessment periods and compares operational contributions against the relevant criteria.

The overall contribution of the Quarry to ambient noise was found to be less than 35dB(A) at the time of the monitoring which is within the limits set by both SSD_4978 and EPL 12007. These results indicate that the Quarry is complying with all relevant noise assessment criteria.

The results of the noise monitoring program are also comparable with historic noise monitoring data from Tinda Creek Quarry. Attended noise monitoring conducted in 2016, 2017 and 2018 estimated Quarry noise contribution to be less than 25dB(A) in 2016 and less than 20bB(A) in 2017 and 2018. This indicates that current noise mitigation measures are effective in restricting noise to an acceptable level.

6.3.5 Quarry Noise Predictions at Residences

On 20 January 2017, DPE requested that Hy-Tec undertake additional noise monitoring to record existing noise levels (sound power levels) that were being produced at the Quarry and undertake an assessment to predict the noise impact of the Quarry at nearby privately-owned residences. The request was only made for the year 2017, however Hy-Tec has taken on the initiative to continue to assess the noise levels at surrounding residences that could potentially be impacted by noise generated from Quarry operations.

Sound power levels were measured at locations Q1 and Q2 on 4 April 2019 (see **Figure 3**) with the results of this assessment presented in **Appendix 3**. In summary, it was concluded that Quarry noise at R1, R2, and R3 after taking into consideration the attenuation caused from distance and topography is 28dB(A), 27dB(A), and 28dB(A) at the respective residences. These results all fall well below the criteria nominated by both the SSD_4978 and the EPL12007 of 35dB(A). It is noted that the noise levels are also well below the predicted noise levels modelled during the preparation of the EIS which ranged from <30db(A) to 35db(A) at the nearest receivers.

Table 6.6
Summary of Attended Noise Monitoring at Receiver NM1

Time (hrs)	Measure (dBA re 20μPa)			Descriptor and Noise Contribution (dBA)
	LAmax	LAeq	LA90	
Morning Shoulder (6:00am)	61	39	25	Traffic 60-61 Quarry Hum 29-38 Insects 25-30
Morning Shoulder (6:15am)	70	49	23	Traffic 33-70 Quarry 25-33 Birds 37-44
Morning Shoulder (6:30am)	71	50	22	Traffic 35-71 Resident Talking 40-65 Birds 35-40 Quarry Hum 25-35
Morning Shoulder (6:45am)	72	48	25	Traffic 40-72 Dogs Barking 30-43 Quarry 27-36
Day (7:16am)	66	48	39	Traffic 35-61 Birds 39-50 Quarry Hum 25-32
Day (7:31am)	69	49	39	Traffic 40-70 Quarry Hum 30-40 Insects 35-42
Day (7:46am)	83	48	38	Birds 37-40 Traffic 35-71 Quarry Hum 30-36 Aircraft 41-43 Insects 33-38
Day (8:01am)	64	47	37	Birds 35-40 Traffic 38-64 Quarry 32-36 Insects 35-37

Table 6.7
Day and Morning Shoulder Noise Compliance Assessment at R1

Period	Quarry Noise Contribution $L_{Aeq(15min)}$	Quarry Noise Criteria $L_{Aeq(15min)}$	Compliant
Day	<35	35	Yes
Morning Shoulder	<35	35	Yes

6.4 ABORIGINAL HERITAGE

No actions or impacts related to Aboriginal heritage occurred during the reporting period.

6.5 NON-ABORIGINAL HERITAGE

No actions or impacts related to non-Aboriginal heritage occurred during the reporting period.

7. WATER MANAGEMENT

7.1 GROUNDWATER

7.1.1 Groundwater Quality Monitoring

Groundwater quality monitoring was conducted by Hy-Tec generally in accordance with the approved *Water Management Plan*. Groundwater quality monitoring was undertaken at six-month intervals over the reporting period at the locations shown on **Figure 3**. The groundwater quality assessment trigger values recorded in the approved *Water Management Plan* are presented in **Table 7.1**.

Table 7.1
Groundwater Quality Trigger Criteria

Analyte	Lower Trigger Value	Upper Trigger Value
pH	<4.5	>7.0
Conductivity (µS/cm)	N/A	900
Nitrate (mg/L)	N/A	7.5
Ammonia (mg/L)	N/A	0.2
TRH (C6-C9) (mg/L)	N/A	5.0
TRH (C10-C14) (mg/L)	N/A	5.0
TRH (C15-C28) (mg/L)	N/A	5.0
TRH (C29-C36) (mg/L)	N/A	5.0
Source: Water Management Plan (RWC, 2019) – Table 18		

The results of the groundwater quality monitoring data are outlined in **Tables 7.2** and **7.3**. All results for Total Recoverable Hydrocarbon (TRH) were below the limit of recording and it is assumed there was none present. TRH is not discussed further in this review.

Table 7.2
Water Monitoring Results – 27 March 2019

Bore Hole	pH	EC (µS/cm)	Nitrate (mg/L)	Ammonia (mg/L)
TP05	5.2	130	<0.1	**0.5**
TP06	5.7	105	<0.1	<0.1
TP08	5.4	120	<0.1	<0.1
TP12	5.4	60	<0.1	<0.1
TP14	5.4	70	<0.1	<0.1
TP20	5.4	65	0.60	<0.1
TP21	5.4	60	10.0	<0.1
TP23	5.1	50	0.35	<0.1
TP44	5.5	200	0.13	0.2
TP45	5.6	220	0.31	0.1
TP46	4.8	120	**7.8**	**2.5**
TP47	4.7	160	**15**	**5.3**
TP48	6.1	220	0.53	<0.1
TP49	5.2	240	<0.1	<0.1
TP50	5.0	380	0.49	<0.1
TP51	5.9	90	1.50	<0.1

Table 7.3
Water Monitoring Results – 31 July 2019

Bore Hole	pH	EC (µS/cm)	Nitrate (mg/L)	Ammonia (mg/L)
TP05	5.2	120	<0.1	0.1
TP06	5.8	120	<0.1	<0.1
TP08	5.3	140	<0.1	<0.1
TP12	5.4	60	0.22	<0.1
TP14	5.4	80	<0.1	<0.1
TP20	5.3	75	2.20	<0.1
TP21	5.4	60	7.20	<0.1
TP23	5.6	60	0.97	<0.1
TP44	5.9	200	0.22	<0.1
TP45	5.8	230	0.58	<0.1
TP46	5.6	110	4.70	**0.3**
TP47	4.7	140	**12.00**	**1.9**
TP48	6.4	250	0.93	<0.1
TP49	5.3	240	0.18	<0.1
TP50	5.1	350	1.00	<0.1
TP51	6.3	95	0.49	<0.1

7.1.2 Analysis of Groundwater Quality Results

General observations from the groundwater quality monitoring data are as follows.

- Both bores TP46 and TP47 returned samples with elevated nitrate and ammonia on 27 March 2019 with bore TP46 also returning elevated nitrate results in the sample collected on 31 July 2019 and both bores returning elevated ammonia for the same sample period. These bores are located on the western boundary of the Quarry and are approximately 750m from the closest point of disturbance. These outcomes are consistent with records from 2018 at these locations indicating a local influence that is separate to Quarry operations. It is possible that the elevated nitrate is a result of past agricultural practices (fertiliser application) and elevated ammonia the result of decaying plant matter.

  An elevated ammonia level was returned for bore TP05 on 27 March 2019. However, the result recorded on 31 July 2019 had returned to a level consistent with historic data records. This is considered to be an isolated outcome not indicative of a change to the groundwater setting.

- The slightly acidic pH is consistent with historic data and likely to represent the breakdown of plant material.

- The outcomes for EC are also consistent with historic date and within the assumed trigger levels.

- It is highly unlikely that quarrying activities are impacting groundwater quality.

- pH, conductivity, nitrate and ammonia results are consistent with groundwater monitoring data obtained during previous monitoring campaigns. No distinct temporal trends are evident within the measured parameters.

The EIS noted that the groundwater tended to be slightly acidic due to the generation of organic acid from the breakdown of plant material (min pH = 4.6, max pH = 6.7). The EIS further noted that conductivity was generally very low (min µS/cm = 45, max µS/cm = 1 320). The groundwater quality results are generally consistent with those presented in the EIS and it is unlikely that extractive operations are impacting on the quality of the groundwater.

It is noted that bores TP18 and TP19 have been removed as a part of the development of Domain 6. Additional monitoring bores TP44, 45, 46, 47, 48, 49, 50 and 51 were installed in 2017. Samples were not taken at bore TP22 due to damage to the standpipe. It is considered that bore TP06 provides a suitable substitute for bore TP22 due to the close proximity of these bores.

7.1.3 Groundwater Level Monitoring

Groundwater levels at the monitoring bores were monitored monthly in accordance with the approved *Water Management Plan* except for the month of November 2019 when access to the Quarry was restricted due to the Gospers Mountain Bush Fire. During this period access to the Quarry was not possible as the Putty Road was closed and therefore the groundwater monitoring could not be completed.

Groundwater levels in the monitoring bores are used to assess the impacts of Quarry operations on the surrounding aquifers. This analysis involves assessing the risk of Quarry operations impacting on the Greater Blue Mountains Heritage Area. No significant impacts were anticipated to groundwater flow as a result of quarrying activities.

Table 7.4 presents the drilled depth and groundwater investigation trigger level for each bore within the groundwater monitoring network.

Table 7.4
Groundwater Investigation Trigger Levels

Bore	Drilled Depth (m)	Trigger Level mBGL
TP22	12	4.43
TP06	18	5.91
TP12	15	6.67
TP23	15	6.77
TP14	20	9.08
TP08	18	6.76
TP05	15	8.75
TP18*	18	3.30
TP19*	12	4.79
TP20	12	5.84
TP21	12	5.84
TP44	18.5	3.11
TP45	9	3.36
TP46	20	1.71
TP47	12	0.69
TP48	18	5.85
TP49	10	5.80
TP50	20	7.67
TP51	16	2.49
* Bore no longer accessible Source: Water Management Plan (RWC 2019) - Table 17		

Groundwater level monitoring has been undertaken at 11 groundwater bores since October 2010 (bores TP05, TP06, TP08, TP12, TP14, TP18, TP19, TP20, TP21, TP22, TP23). In March 2018, monitoring also commenced at a further five bores located to the west of the Quarry (TP44, TP45, TP46, TP47, and TP51) and three bores in the vicinity of Domain 3 (TP49, TP48 and TP50). The locations of the monitoring bores are shown on **Figure 3**.

The results of the 2019 groundwater levels monitoring are outlined in **Table 7.5** and displayed in **Figure 5**. The historical groundwater levels are presented in **Figure 6** and **Figure 7** that also includes data from January and February 2020. Monitoring results are displayed for both the original monitoring bores and the newly constructed bores.

Figure 5 2019 Groundwater Level Monitoring Results

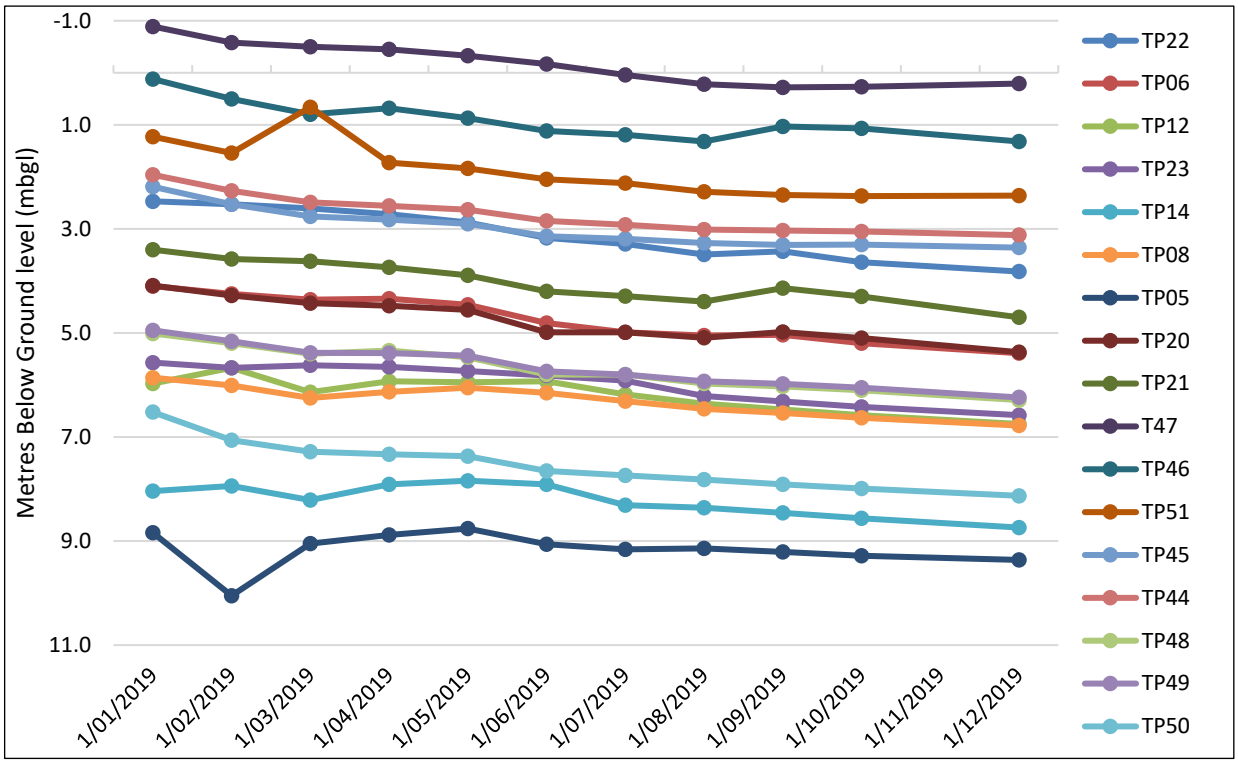


Table 7.5
Results of 2019 Groundwater Levels Monitoring Program

Bore Hole	Trigger	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		Depth to water (mbgs)											
TP22	**4.43**	2.47	2.53	2.61	2.72	2.88	3.17	3.29	3.49	3.43	3.64	-	3.82
TP06	**5.91**	4.1	4.25	4.36	4.34	4.46	4.81	4.99	5.05	5.04	5.20	-	5.39
TP12	**6.67**	5.97	5.67	6.14	5.93	5.95	5.93	6.18	6.36	6.47	6.58	-	**6.75**
TP23	**6.77**	5.57	5.67	5.62	5.65	5.73	5.82	5.92	6.21	6.32	6.42	-	6.58
TP14	**9.08**	8.04	7.94	8.21	7.91	7.84	7.91	8.31	8.36	8.46	8.56	-	8.74
TP08	**6.76**	5.86	6.01	6.25	6.13	6.05	6.15	6.31	6.46	6.54	6.63	-	**6.78**
TP05	**8.75**	**8.84**	**10.05**	**9.05**	**8.88**	**8.76**	**9.06**	**9.16**	**9.14**	**9.21**	**9.28**	**-**	**9.36**
TP20	**5.84**	4.09	4.28	4.43	4.48	4.56	4.99	4.99	5.09	4.98	5.10	-	5.37
TP21	**5.84**	3.4	3.58	3.62	3.74	3.89	4.20	4.29	4.40	4.14	4.30	-	4.70
TP47	**0.69**	-0.89	-0.58	-0.5	-0.45	-0.33	-0.17	0.04	0.22	0.28	0.27	-	0.21
TP46	**1.71**	0.12	0.5	0.8	0.68	0.87	1.12	1.19	1.32	1.03	1.07	-	1.32
TP51	**2.49**	1.23	1.54	0.66	1.73	1.84	2.05	2.12	2.29	2.35	2.37	-	2.36
TP45	**3.36**	2.19	2.53	2.76	2.82	2.90	3.14	3.19	3.27	3.31	3.30	-	3.36
TP44	**3.11**	1.96	2.27	2.49	2.56	2.63	2.85	2.92	3.01	3.03	3.05	-	**3.12**
TP48	**5.85**	5.01	5.2	5.4	5.34	5.47	5.80	5.80	**5.97**	**6.03**	**6.10**	**-**	**6.29**
TP49	**5.80**	4.95	5.16	5.38	5.39	5.44	5.74	5.80	**5.93**	**5.98**	**6.05**	**-**	**6.24**
TP50	**7.67**	6.523	7.06	7.28	7.33	7.37	7.65	**7.74**	**7.82**	**7.91**	**7.99**	**-**	**8.13**

Figure 6 **Hydrography for Site Bores with Monthly Rainfall (Historic Bores)**

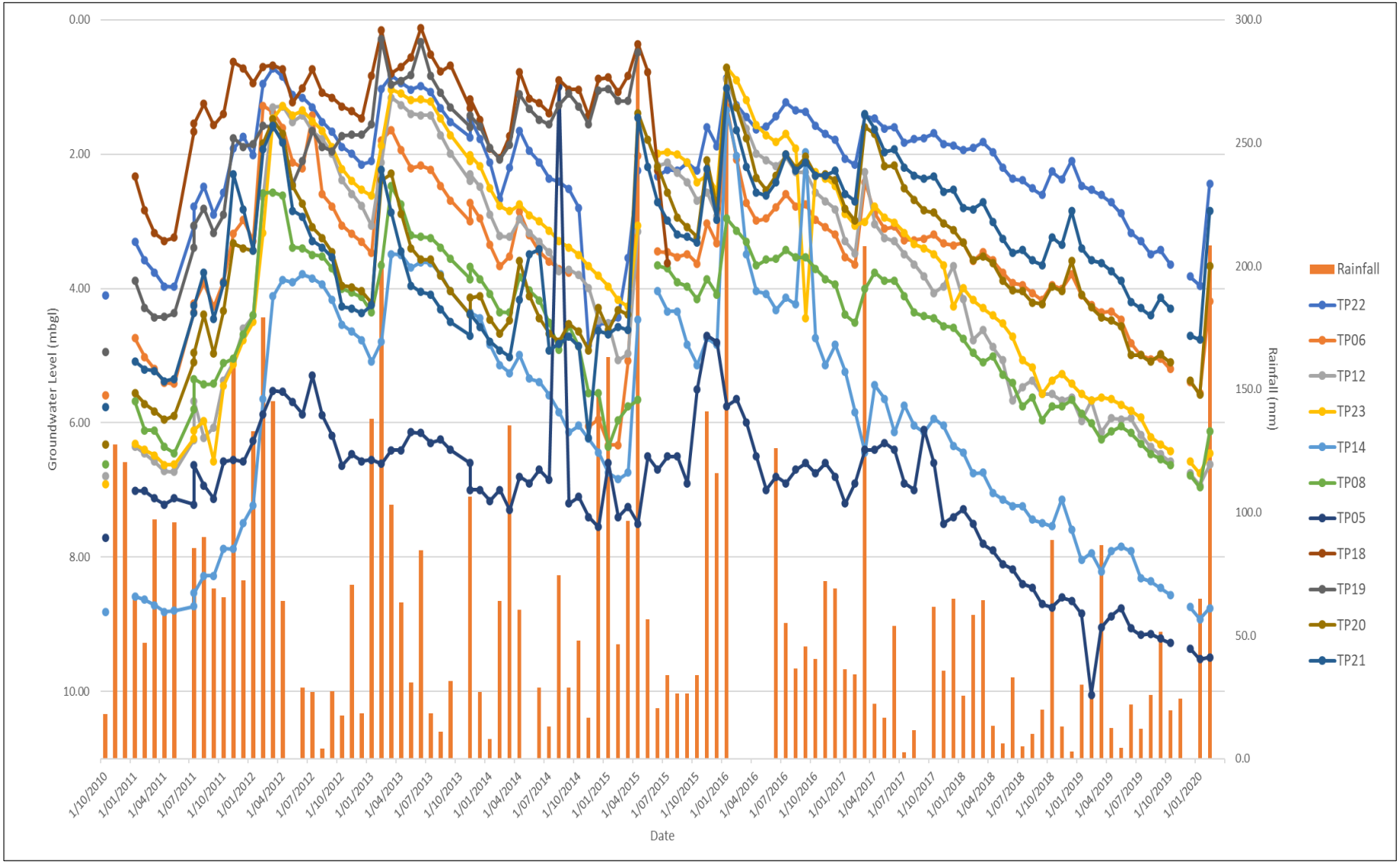
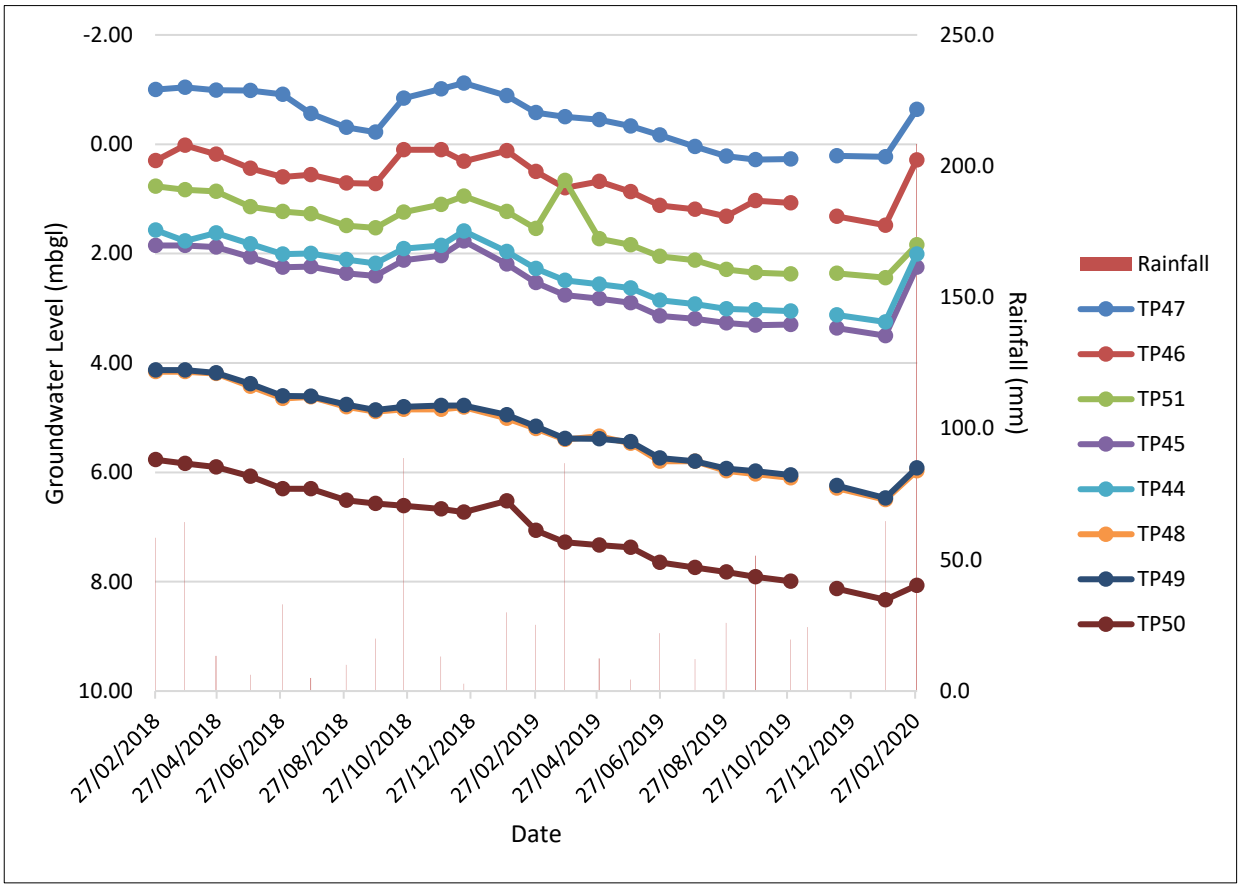


Figure 7 Hydrography for Site Bores with Monthly Rainfall (New Bores)



7.1.4 Analysis of Groundwater Level Results

Figure 5, **Figure 6** and **Figure 7** clearly display the declining trend in groundwater levels evident across all monitoring bores within the monitoring program. A similar trend is evident for all bores excluding occasional results in the first quarter of 2019. Also evident is the response to rainfall in early 2020 from the majority of bores.

Groundwater levels in monitoring bore TP05 were below the investigation trigger levels for the entire reporting period. Groundwater levels at this bore were also below the investigation trigger level in September to December 2018, indicating that this trigger level may no longer be appropriate for this bore. As this bore is located adjacent to the current active extraction area (Domain 6), an investigation of the groundwater levels in the bore was undertaken in December 2018 by Ms Katarina David in December 2018 with the subsequent report submitted to DPIE on 7 December 2018. The investigation concluded that the decline in groundwater levels at TP05 was mostly attributable to a reduction in rainfall. This conclusion was based on comparison with historical data and other bores located upgradient or downgradient and not considered to be influenced by site activities. This is considered to be the case for the ongoing results recorded at this bore.

Groundwater levels below the investigation trigger level have also been recorded for bores TP48, TP49 and TP50 between August and December 2019 with the groundwater level at TP50 also below the trigger level in July 2019. These three bores are located to the northeast of the Quarry in the vicinity of Domain 3. They are also upgradient of the existing extraction area. These results are considered to have been the result of local drought conditions.

The declining trend in groundwater levels has progressed to the extent that all bores were approaching investigation trigger levels (set at 1m below the 90th percentile of historic records) during the reporting period. By December 2019 the groundwater levels were also below the trigger levels at bores TP08, TP12 (both located to the southeast and upgradient of Quarry disturbance) and TP44 (located to the west of the Quarry and approximately 750m from any Quarry disturbance.

It is noted that in July 2019 Katarina David was commissioned to review groundwater conditions at the Quarry for the period from January 2019 to June 2019. This review was updated and expanded to cover the period between January and December 2019 in a second investigation completed in February 2020. The resultant letter reports for each investigation is provided as **Appendix 4**. It was identified that groundwater levels in all bores were displaying a continued declining trend in response to drought conditions.

In summary, the historical groundwater monitoring data presented in **Figure 6** displays the declining trend in groundwater levels across the monitoring network (within and outside the approved Quarry). This trend has continued since February 2017 with occasional changes influenced by rainfall. It is noted that groundwater levels are approaching the investigation trigger at almost all locations, which may warrant consideration of more appropriate trigger levels across the Quarry. It remains to be seen whether drought conditions will persist in 2020, however if this is the case, the declining groundwater levels can expect to continue throughout the next reporting period.

7.1.5 Groundwater Usage

Hy-Tec have the capacity to extract 55 million litres (ML) of water per year under its water access licences and water supply works approvals (see Section 3 and **Table 4**). Following a successful application for additional 60Ml of water allocation, it is expected that this allocation will commence upon issuance of the appropriate documentation. Water extracted from the deeper aquifers was primarily used to fill the dredge pond and for use in dust suppression during extended dry periods.

The approved *Water Management Plan* requires that the quantity of water obtained from production bores is monitored on a monthly basis. **Table 7.6** presents a summary of the groundwater usage from January 2019 until December 2019.

A total of 16.2ML of groundwater was utilised over the reporting period which represents a decrease of 9.1ML compared to 2018. Regardless, this level of water use is higher than historic use and can be attributed to the dry conditions experienced in 2019 and the subsequent need to extract an increased quantity of water for use in the dredging pond and for dust suppression. WAL 24367 permits extraction of 15ML of water per annum (based on a water year (July to June)). It is noted that between July 2018 to June 2019 14.99ML of water was used. Water use therefore remained within licensed levels.

Table 7.6
Groundwater Usage – Meter Reading and Monthly Usage

Date	Meter Reading (KL)	Usage (ML)
January	31609	0.302
February	31610	0.001
March	31620	0.010
April	31650	0.030
May	31850	0.200
June	32050	0.200
July	33767	1.707
August	37428	3.661
September	41385	3.957
October	45690	4.305
November	47528	1.838
December	47529	0.001
Total	**-**	**16.222**

During October and November 2019 water was drawn from the groundwater production bore for firefighting purposes. It is conservatively estimated that towards the end of October and in November 2019 5.0ML of water was used by the Rural Fire Service (RFS) and National Parks and Wildlife Services for continual helicopter passes. The water was taken in bulk using helicopter buckets. To ensure a sufficient volume of water was available for the RFS, Hy-Tec continually pumped groundwater from the production bore during this time. Water use in October and November was approximately 6.1ML, during a time when production was curtailed. Minor volumes of water were also taken from a small dam adjacent to the Putty Road by fire tankers.

7.2 SURFACE WATER

7.2.1 Introduction

The Tinda Creek Quarry is situated near the top of the Tinda Creek catchment. Tinda Creek itself typically experiences intermittent, short duration flows immediately following heavy rainfall events. Previous monitoring, conducted in 2008 and 2015, indicates that quarrying activities have not impacted negatively on the Tinda Creek system and the downstream portions of the creek remain consistent with other creek systems in the vicinity of the Quarry.

The Quarry utilises a closed water management system in order to minimise any potential impacts on downstream water quality, flow regimes and habitats. This system has been successfully implemented for the past 30 years and involves a number of pump lines and catch drains.

Clean water diversion drains have been constructed within the Quarry Site in order to prevent clean runoff entering the operations area (refer **Plate 4**). The diversion drain system shown on **Figure 3** comprises the following components.

- Southern Diversion
- Southern Diversion Extension
- Existing Diversion.

Clean water diversion for operations in Domain 6 were constructed in 2017. No further changes were required during the reporting period.

During the reporting period the closed water management system covered an area of 35.6ha and remained within the limit of 40ha at any one time, as described in *Condition 3(12)* of SSD_4978.

7.2.2 Surface Water Monitoring

Surface water monitoring was conducted generally in accordance with the approved *Water Management Plan* over the reporting period. A summary of the required surface water monitoring is provided in **Table 7.7**.

Table 7.7
Surface Water Monitoring Regime

Monitoring Type	Location	Parameters Monitored	Frequency of Monitoring	Monitoring Method
Dredge Pond Level	Dredge Pond	Level (depth below ground)	Monthly	Observation or dip
Surface Water Quality	Upstream and downstream of Quarry	pH, EC, turbidity	Monthly if water is flowing in Tinda Creek. Samples will also be taken after more than 50mm of rain in 24 hours if water is flowing.	Grab Sample
Drainage Lines and Diversion Drains	Upstream and downstream of quarry	Stability, erosion, and sediment build up	Monthly and event based	Observation and photography
Closed Water Management System	Quarry	Stability, erosion, and sediment build up	Monthly and event based	Observation and photograph

7.2.3 Dredge Pond Water Levels

The *Water Management Plan* requires that dredge pond water levels are assessed on a monthly basis. The depth to water in any operating dredge pond from the adjoining ground surface is to remain less than 10m to avoid triggering further investigations. Documented monthly monitoring of dredge pond levels was undertaken by Hy-Tec from January to December 2019. Water levels were recorded as between 7mbgs and 8mbgs during each survey. Degotardi Smith and Partners were commissioned to survey the depth of the extraction area and depth to water in August 2019. The survey concluded that the water level was 7.58m below ground level and the total depth of extraction was 10.38m. It is noted that the dredge was not operating at the time and that the limit of extraction depth is 15m. On the basis of these results no further investigations were required.

7.2.4 Surface Water Quality

Insufficient water was available to sample upstream and downstream of the Quarry due to the exceptionally dry conditions experienced throughout the reporting period.

7.2.5 Drainage Lines, Diversion Drains and Water Management System

Hy-Tec have implemented a range of measures to ensure sediment movement within the Quarry (in clean water diversion drains) is limited. These measures include the following.

- Construction and maintenance of spoon drains.
- Lining of drains with geofabric and rock armouring.
- Installation of a gabion mattress at the end of drain in the vicinity of Domain 6 to capture sediment and slow the flow of water.
- Installation of rows of hay bales and silt fencing.
- Re-seeding of the drain to establish a suitable ground cover.

Condition M2.1 of the EPL 12007 requires that the licensee undertake monthly inspections of the surface water system at the premises. The monthly inspection must:

- be undertaken immediately upstream and downstream of the Quarry disturbance area;
- include visual inspection for litter, oil and grease and sediment within the surface water system, including diversion channels;
- include visual inspection of the physical integrity of the surface water system, including any signs of erosion; and
- include visual inspection of the water level/flow in Tinda Creek.

A summary of the monitoring data as required by EPL 12007 is presented in **Table 7.8**.

Table 7.8
Results of Surface Water Monitoring - 2019

Observation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Litter	No	No	No	No	No	No	No	No	No	No	No	No
Oil/Grease	No	No	No	No	No	No	No	No	No	No	No	No
Sediment	No	No	No	No	No	No	No	No	No	No	No	No
Erosion	No	No	No	No	No	No	No	No	Yes	No	No	No
Water Level/Flow	No	No	No	No	No	No	No	No	No	No	No	No

Built up sediment was noted within the clean water diversion drain near the weighbridge during the monthly inspections undertaken in April 2019. There was no evident signs of erosion or structural faults in the diversion drain. The sediment did not enter the Tinda Creek system. Maintenance activities within the diversion drains were undertaken.

Throughout the monitoring period, no water was observed in Tinda Creek. This is consistent with the intermittent flows typical of this creek system.

8. REHABILITATION AND LANDSCAPE MANAGEMENT

8.1 REHABILITATION MANAGEMENT

Rehabilitation objectives for the Quarry are described in Schedule 3, Condition 17 of SSD_4978 and reiterated in the approved *Landscape Management Plan* for the Quarry. The objectives for progressive and final rehabilitation of the Quarry include the following.

- The Quarry Site is safe, stable and non-polluting.
- Restore ecosystem function, including maintaining or establishing self-sustaining ecosystems comprised of local native species and habitat, including at least 0.35ha of Mellong Sandmass Sedgeland.
- Surface infrastructure is to be decommissioned and removed (unless the Secretary agrees otherwise).
- Minimise the size, depth, batter slope and the drainage catchment of the final void.
- Ensure that the volume of VENM and ENM detailed in the EIS is imported for rehabilitation of the site.
- Ensure that the surface area of the final voids is no greater than 16ha in total.
- Ensure that final voids are separated from the surface water drainage system, unless the Secretary agrees otherwise.
- Restore alignment and hydraulic function of watercourses, as far as practical.
- Ensure public safety.

Rehabilitation works continued in the 2ha domain in the south-eastern quadrant of the Quarry Site and the north eastern corner of the historic extraction area as shown on **Figure 2**. Rehabilitation works comprised primarily backfilling the area with overburden, silt and clay material. Backfilled areas were then allowed to dry prior to being covered with topsoil, mulch and timber to create a growth medium and habitat areas (refer **Plate 5**). This activity was consistent with the methods and timing presented in the *Landscape Management Plan*.

Hy-Tec considers that the potential for successful rehabilitation of the Quarry Site remains positive. During the life of the Quarry, natural regeneration following bush fire has demonstrated the natural resilience of the vegetation. **Plates 1 to 5** present photos of the Quarry a matter of months after recent fires. The resilience of the vegetation is evident and the speed of regeneration (following rainfall) evident. This is consistent with the response to fires that occurred in October 2013 with Quarry personnel reporting that within a matter of months the vegetation was re-establishing and within one year there was almost no evidence of the fire.

8.2 LANDSCAPE MANAGEMENT

Landscape management was undertaken generally in accordance with the approved *Landscape Management Plan* which was prepared in accordance with *Condition 3(19)* of SSD_4978. Activities involved predominantly weed management, maintenance of clean water diversions and some vegetation maintenance.

During Spring of 2019, Local Land Services initiated a 1080 Wild Dog and Fox Baiting Program within the Hawkesbury and Blue Mountains region. This included the Quarry Site. Two personnel undertook training through Local Land Services for the safe use and management of pindone and 1080. Baits were laid within the Quarry Site and monitored each day. Cameras placed on site during the campaign identified a number of wild dogs and no foxes. Hy-Tec intends to participate in a second campaign scheduled between May and June 2020.

The approved *Landscape Management Plan* includes a range of monitoring activities to be undertaken by Hy-Tec to demonstrate compliance with the objectives and performance criteria for landscape and rehabilitation management. A summary of these activities is provided in **Table 8.1**.

Table 8.1
Ecological Monitoring Requirements at Tinda Creek Quarry

Page 1 of 2

Type of Monitoring	Location	Parameters Monitored	Frequency	Monitoring Method	Responsibility
Rehabilitation	Rehabilitation Areas	Inspections of drainage lines, water management systems and rehabilitation areas	Monthly	Visual Inspection	Quarry Manager
Long-term rehabilitation	Rehabilitation Areas	Soil conditions, erosion, environmental controls	Six Monthly	Field Survey	Quarry Manager
Habitat Assessment	Biodiversity Offset Areas	Erosion, general health of vegetation, floristic structure and diversity, occurrence of weeds, signs of disturbance by stock or humans, evidence of feral animal, evidence of fire, seedling recruitment, characteristic of ground cover, nectar and fruit resources, water resources, fauna usage	Annually unless otherwise agreed	Field Survey	Quarry Manager
Koala	Biodiversity Offset Areas	Targeted Spot Assessment Technique, Call playback surveys, Spotlight surveys	Annually unless otherwise agreed	Field Survey	Quarry Manager
Aquatic Monitoring	Drainage lines upstream and downstream of site.	Stream width and edge habitat, stream features including substrate, vegetation and organic material, site observation including catchment description and local land use practises, and riparian characteristics	Annually	Field Survey and Photography	Quarry Manager
Nest Boxes	Biodiversity Offset Areas	Condition assessment	Annually for first 5 years	Field inspection and LED camera.	Quarry Manager
Threatened Fauna Species Monitoring		Koala, eastern pygmy possum, squirrel glider, forest owls, threatened micro-bat species, diurnal reptiles/amphibians, introduced species	After first 5 years of operation	Diurnal bird area searches, diurnal reptile/amphibian area searches, nocturnal call playback surveys, remote camera surveys, nocturnal Anabat surveys	Quarry Manager

Table 8.1 (Cont'd)
Ecological Monitoring Requirements at Tinda Creek Quarry

Type of Monitoring	Location	Parameters Monitored	Frequency	Monitoring Method	Responsibility
Grevillea parviflora	Biodiversity Offset Areas	Surveys during known flowering period (July to December), stem counts in permanent plots, photo monitoring, habitat quality	Annually for first 5 years	Field Survey	Quarry Manager

8.2.1 Rehabilitation Monitoring

Visual inspections of the areas under active rehabilitation were undertaken monthly during the reporting period (rather than six-monthly) and cross-over with requirements for monitoring of erosion and sediment controls and surface water quality in accordance with the *Water Management Plan*. A summary of the outcomes of monitoring during the reporting period is provided in **Table 8.2**. Visual inspections of the Quarry Site were supplemented by monitoring undertaken by EnviroKey in October 2019 (EnviroKey, 2020) with the outcomes of this monitoring presented in **Appendix 5**.

Table 8.2
Rehabilitation Inspections

Rehabilitation Monitoring Aspect	Comment
Monitoring is to include: • soil conditions and erosion (i.e. stability); • drainage and sediment control structures; • runoff water quality; • germination rates; • plant health; • natural regeneration; and • weed infestation.	Visual inspections were undertaken monthly by the Quarry Manager with photographic evidence of drain conditions and stability recorded. Only minor structural issues were identified in clean water diversion structures during the reporting period. Nonetheless, it is considered that existing erosion and sediment controls were functioning appropriately (see **Plate 4** and Section 7.2.5). There was insufficient water in the clean water diversions to permit water quality testing. Drainage structures are stabilised with vegetation, with some of the monitored areas amongst sedge vegetation containing original vegetation. Weeds identified during site inspections were sprayed and removed or manually removed.

8.2.2 Long-Term Rehabilitation Monitoring

Long-term rehabilitation monitoring was undertaken by EnviroKey in October 2019 (EnviroKey, 2020). The outcomes of this monitoring are described in detail in the monitoring report presented as **Appendix 5** of this report. **Table 8.3** presents an overview of key monitoring aspects and outcomes.

Table 8.3
Long-Term Rehabilitation Monitoring

Rehabilitation Monitoring Aspect	Comment
Monitoring is to: • compare results against rehabilitation objectives and targets • identify possible trends and continuous improvement • link to records of rehabilitation to determine causes and explain results • assess effectiveness of environmental controls implemented • where required, identify modifications required for the monitoring program, rehabilitation practices or areas requiring research • compare flora species present against original seed mix and/or analogue sites • assess vegetation health • assess vegetation structure (e.g. upper, mid and lower storey) • the presence and abundance of any weed species • assessment of natural regeneration/recruitment of new species • where applicable, assess native fauna species diversity and the effectiveness of habitat creation for target fauna species.	The majority of the rehabilitation objectives do not yet apply, however progressive rehabilitation and management of the rehabilitating landscape remains consistent with these objectives (described in Section 8.1). The site is stable, safe and non-polluting and those areas that are undergoing rehabilitation have started to demonstrate features of the Mellong Sandmass woodland communities. EnviroKey (2020) confirmed that the monitoring outcomes for species richness and cover abundance were broadly consistent with the outcomes of 2018 monitoring. There was a minor decrease in species richness that was considered to have resulted from persistent drought conditions. There were weeds present in the rehabilitating areas and on the edges of active site areas, however these are subject to regular weed control activities (manual removal and spraying, as needed). It was noted that the rehabilitation area while having a similar number of native species as those in analogue sites within the proposed biodiversity offset area, did not contain overstorey cover, grass cover or woody materials and featured more exotic species. Rehabilitation controls principally involve weed management and restrictions to access, which have been successful in promoting native vegetation establishment. However, it was noted that the power transmission easement and to a lesser extent Putty Road would be a source of weed populations. Vegetation health, structure and baseline flora records were consistent with the previous records, excepting the decrease in species richness. Comparison with records of field surveys for the EIS presentation indicate that species assemblages remain consistent with historic records. Native fauna surveys have identified a range of native fauna using the Biodiversity Offset Area and habitat features within the site. This included evidence of Koala (scats and scratches)

8.2.3 Biodiversity Offset Area Monitoring

Monitoring within the Biodiversity Offset Area was undertaken by EnviroKey in October 2019 in accordance with the *Landscape Management Plan*. A total of 17 monitoring plots were re-visited for monitoring with locations presented in **Figure 6**. The monitoring demonstrates that there are very little obvious impacts from quarrying activities identified in the Biodiversity Offset Area. **Table 8.4** presents the monitoring aspects and general conclusions of the monitoring campaign. A more detailed review of the monitoring outcomes and the data collected from monitoring plots is provided in **Appendix 5**.

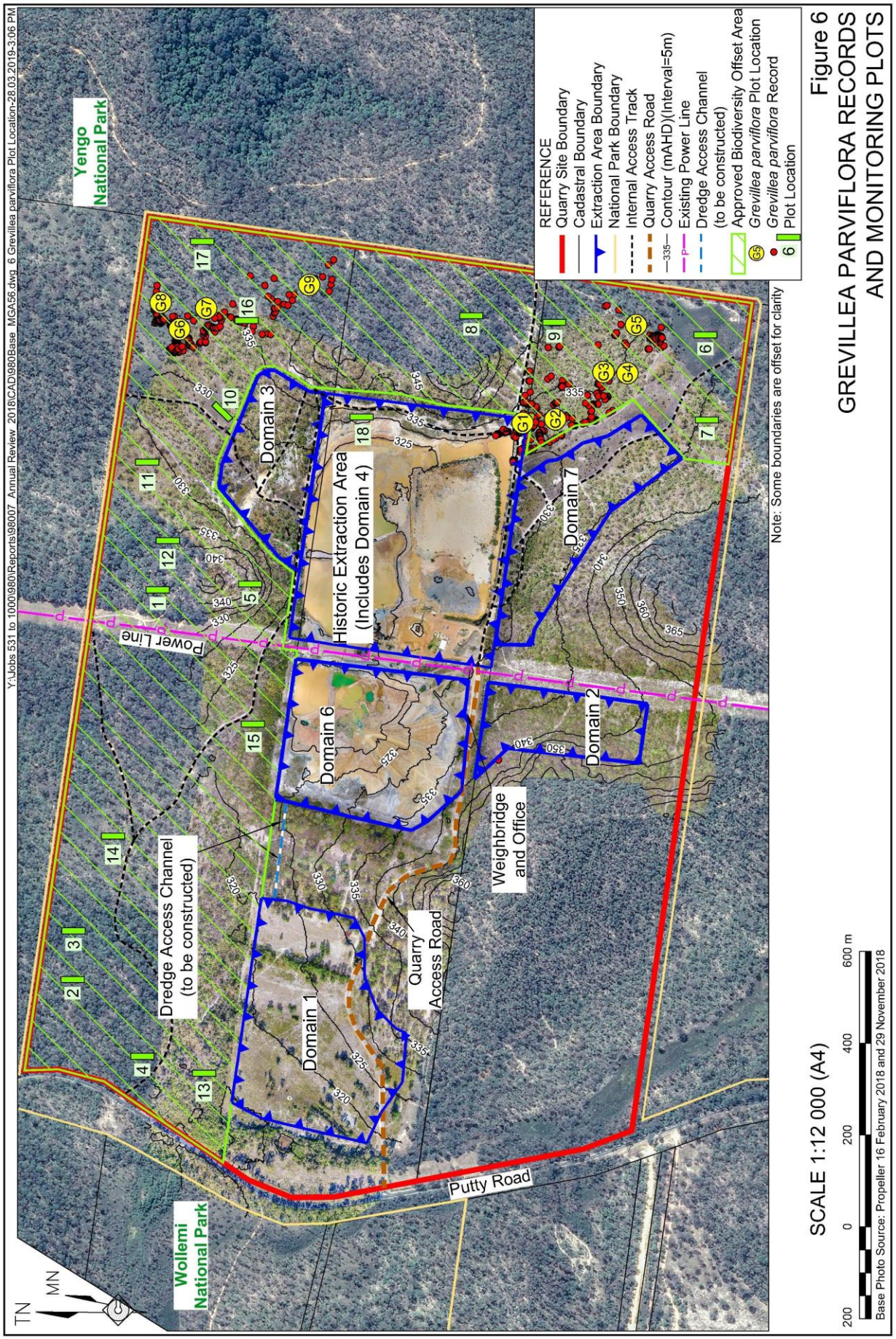


Figure 6
GREVILLEA PARVIFLORA RECORDS AND MONITORING PLOTS

Table 8.4
Biodiversity Offset Area Monitoring

Biodiversity Offset Area Monitoring Aspect	Comment
Monitoring is to include: • general vegetation health • evidence of natural seedling recruitment • occurrence and abundance of weed species • structure and floristics of vegetation cover • signs of disturbance (by stock, people or feral animals) • nature and extent of erosion • evidence of fire • characteristic of ground cover (e.g. leaf litter, rocks, logs and soil) • nectar or fruit resources and perch sites • water resources • secondary evidence of fauna use such as scats, tree scratches or diggings.	Monitoring has indicated that flora species within the Biodiversity Offset Area are broadly comparable to those found in the earlier surveys. Much of the vegetation is in good condition with only minor weed presence on the edges of vegetation zones. The monitoring campaign reviewed the composition, structure, function, general trends and signs of disturbance within the Biodiversity Offset Area. This included overstorey vegetation. While the presence of some weed and feral animal species has been identified, there are only limited signs of disturbance in the Biodiversity Offset Area consistent with past human habitation. There is no obvious evidence of erosion in the Biodiversity Offset Area and water resources were consistent with the dry conditions evident within the Quarry. EnviroKey revisited the Quarry Site on 13 January 2020 to review and advise Hy-Tec on the condition of vegetation within and surrounding the Quarry Site following the Gospers Mountain Fire experienced in October and November 2019. EnviroKey (2020) noted that in some areas the fire had burnt hot and significant impacts were observed. However, in the northern section of the Quarry Site, the canopy is largely intact. Epicormic growth was evident in some areas by January 2020. EnviroKey (2020) also observed some regeneration of the threatened plant Grevilia parviflora within the Quarry Site.

8.2.4 Koala Monitoring

EnviroKey also undertook Koala population monitoring surveys in October 2019 (EnviroKey, 2020) at each of the permanent remnant vegetation monitoring points in areas of potential koala habitat. These surveys were undertaken using a modified Spot Assessment Technique (SAT) methodology and were complemented by call playback and spotlighting surveys.

No Koala were identified during the surveys, however potential Koala scats and scratches were identified on or immediately adjacent to two of the permanent monitoring plots. The results were confounded by the presence of Common Brushtail Possum scats and may have also been caused by Lace Monitor. However, EnviroKey (2020) concluded that the presence of both scats and scratches were likely indicative of Koala. This was later confirmed by Quarry personnel who observed a single Koala passing through the Quarry Site after the fire event.

This supports the conclusion Koalas are still using the property, however, in low numbers as is typical of Hawkesbury sandstone geology.

The approved *Landscape Management Plan* for the Quarry contains a Koala Plan of Management (Appendix 1 of the plan) that specifies performance criteria for Koala management. These include the following:

- No koalas will be harmed as a result of any tree-clearing practices that take place as a result of this Project.
- Potential quarry-induced impacts will not result in the alteration to the floristics, structure or condition of non-cleared areas of potential koala habitat.

No vegetation clearing was required during the reporting period and Quarry personnel have reported no incidents involving Koala vehicle strikes. There is no evidence that there are Quarry-related impacts occurring to Koala habitat.

8.2.5 Aquatic Monitoring

On 3 September 2019, Niche (2019) undertook aquatic monitoring to monitor the river health of Tinda Creek and its tributaries and to assess any potential impacts from Quarry development. A report detailing the methods, outcomes and conclusions of the aquatic monitoring program is provided as **Appendix 6**. The monitoring program is consistent with the previous monitoring presented as Appendix 2 of the *Landscape Management Plan* (Umwelt, 2016).

The monitoring program in 2019 included the following.

- Assessment of stream condition using Riparian and Channel and Environment inventory assessment (RCE).
- Assessment of habitat condition using AUSRIVAS proforma.
- Assessment of water quality against default ANZECC trigger values.
- Assessment of the macroinvertebrate community condition using Stream Invertebrate Grade Number Average Level (SIGNAL).

In comparison to 2018, the sites monitored were significantly dryer which resulted in less aquatic habitat, poorer water quality and fewer sites able to be sampled. Aquatic environments downstream of Tinda Creek Quarry infrastructure were found to have a good riparian condition and channel morphology although all sites were dry. The macroinvertebrate community had low AUSRIVAS and SIGNAL scores indicative of poor stream health, however this is the result of the streams having limited water and aquatic habitat and hence influenced by natural stressors associated with intermittent/ephemeral streams.

Based on the evidence available, the Quarry is not impacting the health of streams. The predominantly dry conditions continue to influence the aquatic environment and key indicators such as macroinvertebrate presence, water quality and riparian vegetation. Excluding the lack of water there was no evident change to conditions when compared to results from 2015 and 2018 monitoring campaigns.

8.2.6 Nest Box Monitoring

No nesting boxes have been installed at the Quarry and therefore no monitoring has been required to date.

8.2.7 Threatened Fauna Species Monitoring

Threatened fauna monitoring was undertaken by EnviroKey in October 2019, predominantly focused on the Biodiversity Offset Area (EnviroKey, 2020). The outcomes of these surveys are presented in **Appendix 5**.

Four threatened fauna species were identified during the monitoring including the following.

- Koala
- White-bellied Sea-eagle
- Dusky Woodswallow
- Little Lorikeet

There is no indication of Quarry impact to threatened fauna presence within the Biodiversity Offset Area.

8.2.8 *Grevillea parviflora* Monitoring

Monitoring of the condition and persistence of the small flower *Grevillea parviflora* subsp. *parviflora* was undertaken in October 2019 and is considered to provide an indication of the condition of this species for the reporting period. A series of nine 10m x 10m plots were revisited (where they could be identified) within the approved Biodiversity Offset Area to facilitate annual stem counts of the species. The locations of these plots can be seen on **Figure 6**. The goal of this monitoring program is to assess the ongoing viability and health of the species and to ensure the habitat is maintained or improved over the life of the operations. The monitoring results are included in **Table 8.5**.

Table 8.5
Ecological Monitoring Requirements at Tinda Creek Quarry

Plot Number	Stem Count	In Flower	In Fruit	Notes
G1	38	15	0	
G2	7	4	0	Dense *Angophora bakeri* regeneration
G3	25	5	0	
G4	1	0	0	
G5	19	9	0	
G6	35	11	0	
G7	0	0	0	Small number scattered nearby
G8	0	0	0	Two within 5m of plot
G9	0	0	0	Eight within 5m of plot
Source: After EnviroKey (2019) – Table 3				

Monitoring results to date show abundant *Grevillea parviflora* in the vicinity of the Quarry. This clearly shows that operations have not had a deleterious impact on the health of the species and demonstrates the high ecological value of the Biodiversity Offset Area. Monitoring noted several flowering plants with none in fruit. This species is considered to regenerate well following fire based on its occurrence in the vicinity of vegetation with recent/moderately recent fire scars as well as the known association with the Mellong Sand-mass habitat. EnviroKey (2020) noted that due to inaccurate records of plot locations, the exact location of plots may not reflect past monitoring efforts. Where no plants were evident in the assessed plots it was concluded that the plot location may not have been replicated (a conclusion supported by the presence of the plant nearby).

8.2.9 Conclusion

Consistent with previous years, Hy-Tec has continued to operate the Tinda Creek Quarry with minimal evident impact to the surrounding landscape within the Quarry Site, the Biodiversity Offset Area and in aquatic environments downstream of the Quarry. Rehabilitation activities have started to demonstrate preliminary signs of vegetation community establishment consistent with the Mellong Sandmass Swamp Woodland. This indicates that rehabilitation methods have been successful. Rehabilitation progress has been hampered by the recent wildfire, however following rainfall in early 2020 it is understood that regeneration is already evident within the Quarry Site.

EnviroKey (2020) included the following key recommendations.

- The monitoring program should be scaled back in the Biodiversity Offset Area (currently 17 plots) and increased in the rehabilitation areas (currently one plot). This is due to the lack of any evident impact from Quarry operations in the Biodiversity Offset Area and the need to monitor and improve conditions in areas that are subject to rehabilitation.
- With regards the rehabilitation areas, it has been recommended that available topsoil and biomass continue to be applied in these areas to encourage vegetation establishment. Weeding campaigns should focus on the population of African Lovegrass that has established. Direct seeding of eucalypts was recommended to develop an overstorey in rehabilitating areas.
- Recommendations for ongoing management of the Biodiversity Offset Area focused on weed management along edge habitat such as access tracks and consideration of closure of tracks that are no longer in use.

9. COMMUNITY

9.1 COMMUNITY COMPLAINTS

One nonspecific community complaint was recorded to represent a range of phone calls and text messages received in July 2019 regarding concerns about a range of topics arising from the period when the Quarry was controlled by the previous owner and operator. The complainant is known to Hy-Tec and discussions with the complainant continued in August and September 2019.

Complaints will continue to be logged within the complaints register and investigated fully when they are received. The complaints register will continue to be kept in the weighbridge office and updated on the Hy-Tec website on a monthly basis.

9.2 COMMUNITY LIAISON

The Tinda Creek Quarry Community Consultative Committee (CCC) met twice within the reporting period. Meetings were held on 13 May 2019 and 14 October 2019. Minutes of the meetings are provided in **Appendix 7**.

There were no issues raised during the CCC meetings that were considered to be complaints or required investigation by Hy-Tec.

Given the remote location of the Quarry, no further community engagement activities occurred within the reporting period.

10. INCIDENTS AND NON COMPLIANCES DURING THE REPORTING PERIOD

10.1 INTRODUCTION

The following subsections outline incidents and non-compliances that occurred during the reporting period. An internal review of compliance with the conditions of SSD_4978 was undertaken by Hy-Tec and RWC and is included as **Appendix 1**. The operation remained generally compliant with development conditions throughout the reporting period with the exception of the non-compliances listed below.

10.2 INCIDENTS

There were no incidents that threatened or caused material environmental harm and required notification to DPIE or the EPA during the reporting period.

10.3 DEVELOPMENT CONSENT SSD_4978

An Independent Environmental Audit was undertaken on 9 and 10 October 2019 and the report and Hy-Tec's response to the issues raised provided to DPIE on 21 November 2019. It is noted that no non-compliance issues were identified for SSD_4978 during the reporting period.

Hy-Tec was technically not compliant with Condition 13 of Schedule 3 of SSD_4978 due to failure to comply with the approved groundwater monitoring program in November 2019. No manual samples were taken during this period due to regional bush fires limiting access to the Quarry. Each of the monitoring bores is equipped with data loggers that record water levels and may be used as a surrogate for the missing manual data.

It is noted that several records of groundwater levels during the reporting period were below the investigation trigger level established in the approved Water Management Plan for the Quarry. However, no specific investigation was undertaken during the reporting period. This is also technically not compliant with Condition 13 of Schedule 3 of SSD_4978 that requires the implementation of an approved Water Management Plan. A review of groundwater monitoring results was undertaken by Katarina David in July 2019 noting that during the first half of 2019 all bores displayed a similar rate of natural groundwater level decrease which follows a decline in rainfall since January 2019. This review complemented the review undertaken for bore TP05 in December 2018. It is notable that groundwater levels in bore TP05 remained below the investigation trigger level for the duration of the reporting period, indicating that this trigger level may no longer be relevant to the operation. It has generally been concluded that the Quarry operations are not negatively impacting groundwater levels in the vicinity of the Quarry. This is supported by the continued declining trend in groundwater levels evident throughout the reporting period and the fact that the trend is similar for all bores. In addition, the response of water levels to high rainfall events supports the connection with natural recharge processes. Hy-Tec will consult with NRAR regarding the need to modify trigger levels in the Water Management Plan during the next reporting period.

10.4 ENVIRONMENT PROTECTION LICENCE

Operations generally complied with the conditions of EPL 12007 during the reporting period.

10.5 WATER ACCESS LICENCES

An Independent Environmental Audit conducted on 9 October identified that the logbook records for WAL24367 do not record all information required under the conditions of the licence. It was also noted that no logbook is maintained for WAL 24381. The logbook for WAL 24367 has since been amended to include all required information. It is noted that due to very low levels of water drawn into the extraction areas and the fact that this mostly evaporates in place, no logbook records for WAL 24381 have been possible. It is therefore considered impossible to comply with this condition.

10.6 VOLUNTARY UNDERTAKING

During a site inspection and audit by officers of DPE on 6 June 2017, it was identified that equipment and other materials historically stored within the southeast corner of the Quarry Site constituted a breach of *Condition 3(30)* of SSD_4978 in relation to waste management at the Quarry. The material was subsequently removed by Hy-Tec and the Company entered into a voluntary undertaking regarding revegetation in this area. The requirements of the voluntary undertaking were completed in February 2020 after DPIE requested additional evidence of vegetation regeneration. Photos taken within the rehabilitated area between September 2017 and November 2019 (post-fire) are presented in **Appendix 8**. It is noted that this area was significantly impacted by the Gospers Mountain Bush Fire and much of the vegetation has been burnt.

11. ACTIVITIES TO BE COMPLETED IN THE NEXT REPORTING PERIOD

The following operational activities are planned throughout the 2020 reporting period.

- Extraction will continue within Domain 6.
- The production forecast for 2020 is to extract, process and transport approximately 100 000t of sand product.
- Ongoing monitoring and maintenance of erosion and sediment controls and diversion drains.
- Continuation of progressive rehabilitation as practicable. This will primarily continue within south-eastern rehabilitation area.
- Continue landscape management in accordance with the Landscape Management Plan including monitoring campaign and participation in local feral animal control programs, where possible.
- Continuation of water management and dust control measures.
- Continue to monitor deposited dust and confirm the success of bird control measures through review of results against historic trends.
- Waste will continue to be collected by licensed contractors and volumes and dates recorded.
- Continuation of annual LiDAR Survey or other aerial imagery capture of the Quarry Site.
- Continued implementation of all requirements and conditions prescribed under Development Consent SSD_4978, EPL 12007 and approved management plans.

Appendices

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Appendix 1

Internal Compliance Audit (SSD_4978) – 1 January 2019 to 31 December 2019

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Table A1
Internal Compliance Audit of Relevant Conditions of Development Consent SSD_4978 for Tinda Creek Sand Project from 1 January 2019 to 31 December 2019

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 2: ADMINISTRATION CONDITIONS				
Obligation to Minimise Harm to the Environment				
1.	In addition to meeting the specific performance criteria established under this consent, the Applicant shall implement all reasonable and feasible measures to prevent and/or minimise any material harm to the environment that may result from the construction, operation, or rehabilitation of the development.	Y	All management measures were implemented successfully and there was no identified material harm to the environmental during the reporting period.	O
TERMS OF CONSENT				
2.	The Applicant shall carry out the development generally in accordance with the: (a) EIS; (b) Statement of Commitments; and (c) conditions of this consent.	N	A single non-compliance issue was identified during the reporting period as detailed in this table.	O/D
3.	If there is any inconsistency between the above documents, the most recent document shall prevail to the extent of the inconsistency. However, the conditions of this consent shall prevail to the extent of any inconsistency.	Noted		
4.	The Applicant shall comply with any reasonable requirement/s of the Secretary arising from the Department's assessment of: (a) any strategies, plans, programs, reviews, audits, reports or correspondence that are submitted in accordance with this consent; (b) any reports, reviews or audits commissioned by the Department regarding compliance with this consent; or (c) the implementation of any actions or measures contained in these documents.	Y	No requests were received from DPE during the reporting period.	D
LIMITS ON CONSENT				
Extraction Operations				
5.	The Applicant may undertake extraction operations on the site until 31 December 2045.	Noted		
Production Limits				
6.	The Applicant shall not: (a) extract or process more than 300,000 tonnes of sand in any calendar year; or (b) undertake extraction operations beyond 15 m below the natural ground surface.	Y	Approximately 46,942 tonnes of sand were extracted and processed and depth restrictions were not exceeded during the reporting period.	D

Yes = Complied with during 2018 No = Not complied with during 2018 ND = Not Determined
NYA = Not Yet Applicable HNC = Historical Non-Compliance ANC = Administrative Non-Compliance
* = Basis for assessment of compliance D = Documentation/Discussion O = Observation during audit
Yes# / No# = Complied / not complied with and compliance no longer required to be assessed

Table A1 (Cont'd)
Internal Compliance Audit of Relevant Conditions of Development Consent SSD_4978
for Tinda Creek Sand Project from 1 January 2019 to 31 December 2019

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 2: ADMINISTRATION CONDITIONS (Cont'd)				
Transportation Limits				
7.	The Applicant shall not: (a) transport more than 300,000 tonnes of sand from the site in a calendar year; and (b) dispatch more than 34 trucks per day or receive more than 34 trucks per day, averaged over a calendar month.	Y	Product despatch was limited to 46 942 tonnes and truck level limits were not exceeded during the reporting period.	D
SURRENDER OF EXISTING DEVELOPMENT CONSENT				
8.	Within 6 months of the date of this consent, unless the Secretary agrees otherwise, the Applicant shall surrender the development consent (DA 0134/95) for the existing operations on the site in accordance with Section 104A of the EP&A Act. Prior to the surrender of development consent DA 0134/95, the conditions of this consent shall prevail to the extent of any inconsistency with the conditions of that consent.	Y	DA 1034/95 was surrendered on 10 December 2015.	D
STRUCTURAL ADEQUACY				
9.	The Applicant shall ensure that any new buildings and structures, and any alterations, or additions to existing buildings and structures, are constructed in accordance with the relevant requirements of the BCA.	Noted	No new buildings and structures were constructed during the reporting period.	O
DEMOLITION				
10.	The Applicant shall ensure that all demolition work on site is carried out in accordance with Australian Standard AS 2601-2001: The Demolition of Structures, or its latest version.	Noted	No demolition occurred during the reporting period.	O
PROTECTION OF PUBLIC INFRASTRUCTURE				
11.	The Applicant shall: (a) repair, or pay the full costs associated with repairing, any public infrastructure that is damaged by the development; and (b) relocate, or pay the full costs associated with relocating, any public infrastructure that needs to be relocated as a result of the development. *Note: This condition does not apply to any damage to roads caused as a result of general road usage.*	Noted	There was no damage or necessary relocation of public infrastructure during the reporting period.	O
OPERATION OF PLANT AND EQUIPMENT				
12.	The Applicant shall ensure that all plant and equipment used on site is: (a) maintained in a proper and efficient condition; and (b) operated in a proper and efficient manner.	Y	All equipment was maintained and operated in an acceptable manner during the reporting period.	D

Yes = Complied with during 2018 No = Not complied with during 2018 ND = Not Determined
NYA = Not Yet Applicable HNC = Historical Non-Compliance ANC = Administrative Non-Compliance
* = Basis for assessment of compliance D = Documentation/Discussion O = Observation during audit
Yes# / No# = Complied / not complied with and compliance no longer required to be assessed

Table A1 (Cont'd)
Internal Compliance Audit of Relevant Conditions of Development Consent SSD_4978
for Tinda Creek Sand Project from 1 January 2019 to 31 December 2019

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 2: ADMINISTRATION CONDITIONS (Cont'd)				
UPDATING & STAGING STRATEGIES, PLANS OR PROGRAMS				
13.	With the approval of the Secretary, the Applicant may submit any strategies, plans or programs required by this consent on a progressive basis. To ensure the strategies, plans or programs under the conditions of this consent are updated on a regular basis, the Applicant may at any time submit revised strategies, plans or programs to the Secretary for approval. With the agreement of the Secretary, the Applicant may prepare any revised strategy, plan or program without undertaking consultation with all parties under the applicable condition of this consent.	Noted	Not required during the reporting period.	D
14.	Until they are replaced by an equivalent strategy, plan or program approved under this consent, the Applicant shall implement the existing strategies, plans or programs for the site that have been approved under DA 0134/95.	Noted	All management strategies, plans and programs have been updated and approved.	D
PRODUCTION DATA				
15.	The Applicant shall: (a) provide annual quarry production data to DRE using the standard form for that purpose; and (b) include a copy of this data in the Annual Review (see condition 4 of schedule 5).	Y	See **Appendix 2**.	
DEVELOPER CONTRIBUTIONS				
16.	The Applicant shall pay Council road maintenance contributions consistent with Council's Section 94 Contributions Plan, or its latest version.	Y	Road maintenance contributions are paid monthly.	D
SCHEDULE 3: ENVIRONMENTAL PERFORMANCE CONDITIONS				
IDENTIFICATION OF APPROVED LIMITS OF EXTRACTION				
1.	Prior to undertaking extraction operations under this consent, the Applicant shall: (a) engage a registered surveyor to mark out the boundaries of the approved limits of extraction within the site; and (b) submit a survey plan of these boundaries with applicable GPS coordinates to the Secretary.	Y	All relevant boundaries have been surveyed and marked to comply with this condition.	
2.	While extraction operations are being carried out, the Applicant shall ensure that these boundaries are clearly marked at all times.	Noted	All boundaries were clearly marked during the reporting period.	

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<tr><td colspan="5">SCHEDULE 3: ENVIRONMENTAL PERFORMANCE CONDITIONS (Cont'd)</td></tr>
<tr><td colspan="5">HOURS OF OPERATION</td></tr>
<tr><td>3.</td><td>The Applicant shall comply with the operating hours set out in Table 1.
Table 1: Operation Hours
<table>
<tr><th>Activity</th><th>Operating Hours</th></tr>
<tr><td>Extraction operations and deliveries</td><td>7 am to 6 pm, Monday to Friday
7 am to 3 pm, Saturday
No activities on Sundays or Public Holidays</td></tr>
<tr><td>Dispatch</td><td>5 am to 10 pm, Monday to Friday
6 am to 3 pm, Saturday</td></tr>
<tr><td>Construction activities</td><td>7 am to 6 pm, Monday to Friday
8 am to 1 pm, Saturday
No construction to be undertaken on Sundays or Public Holidays</td></tr>
<tr><td>Maintenance activities</td><td>24 hours a day, 7 days per week, providing maintenance activities are inaudible at any privately-owned residence</td></tr>
</table></td><td>Y</td><td>Hy-Tec complied with all approved operating hours during the reporting period.</td><td>D</td></tr>
<tr><td colspan="5">NOISE</td></tr>
<tr><td colspan="5">Noise Criteria</td></tr>
<tr><td>4.</td><td>The Applicant shall ensure that the noise generated by the development does not exceed the criteria in Table 2 at any residence on privately-owned land.
Table 2: Noise criteria dB(A)
<table>
<tr><th rowspan="2">Receiver</th><th>Day/Evening</th><th colspan="2">Night</th></tr>
<tr><th>$L_{Aeq(15\ min)}$</th><th>$L_{Aeq(15\ min)}$</th><th>$L_{A1(max)}$</th></tr>
<tr><td>All receivers</td><td>35</td><td>35</td><td>45</td></tr>
</table></td><td>Y</td><td>Noise monitoring undertaken during the reporting period demonstrates that Hy-Tec complied with this criteria. There were no noise complaints during the reporting period.</td><td>D</td></tr>
<tr><td colspan="5">Operating Conditions</td></tr>
<tr><td>5.</td><td>The Applicant shall:
(a) implement all reasonable and feasible mitigation measures to minimise the construction, operational and road noise of the development;
(b) regularly assess noise monitoring data and relocate, modify and/or stop operations on site to ensure compliance with the noise criteria in this consent;
(c) minimise the noise impacts of the development during meteorological conditions under which the noise criteria in this consent do not apply (see Appendix 6); and
(d) carry out regular noise monitoring to determine whether the development is complying with the relevant conditions of this consent,
to the satisfaction of the Secretary.</td><td>Y</td><td>See previous response. Hy-Tec has not been required to modify operations due to noise-related concerns during the reporting period.</td><td></td></tr>
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<tr><td colspan="5">NOISE (Cont'd)</td></tr>
<tr><td colspan="5">Noise Management Plan</td></tr>
<tr><td>6.</td><td>The Applicant shall prepare and implement a Noise Management Plan for the development to the satisfaction of the Secretary.</td><td>Y</td><td>A Noise Management Plan has been approved by the Secretary and is implemented at the Quarry. The Noise Management Plan is available from the Hy-Tec website.</td><td></td></tr>
<tr><td colspan="5">AIR QUALITY</td></tr>
<tr><td colspan="5">Air Quality Criteria</td></tr>
<tr><td>7.</td><td>The Applicant shall implement all reasonable and feasible avoidance and mitigation measures so that particulate matter emissions generated by the development do not exceed the criteria in Tables 3 to 5 at any residence on privately-owned land.
Table 3: Long-Term Criteria for Particulate Matter
<table>
<tr><th>Pollutant</th><th>Averaging period</th><th>[d] Criterion</th></tr>
<tr><td>Total suspended particulates (TSP)</td><td>Annual</td><td>[a] 90 µg/m3</td></tr>
<tr><td>Particulate matter < 10µm (PM_{10})</td><td>Annual</td><td>[a] 30 µg/m3</td></tr>
</table>
Table 4: Short-Term Criteria for Particulate Matter
<table>
<tr><th>Pollutant</th><th>Averaging period</th><th>[d] Criterion</th></tr>
<tr><td>Particulate matter < 10µm (PM_{10})</td><td>24 hour</td><td>[a] 50 µg/m3</td></tr>
</table>
Table 5: Long-Term Criteria for Deposited Dust
<table>
<tr><th>Pollutant</th><th>Averaging period</th><th>Maximum increase in deposited dust level</th><th>Maximum total deposited dust level</th></tr>
<tr><td>[c] Deposited dust</td><td>Annual</td><td>[b] 2g/m^2/month</td><td>[a] 4g/m^2/month</td></tr>
</table></td><td>Y</td><td>Dust monitoring undertaken during the reporting period indicates that the operation complied with the criteria in this condition.
The introduction of bird deterrence on deposited dust gauges in January 2019 has reduced deposited dust levels significantly. This indicates that previously elevated deposited dust levels are not attributable to Quarry operations.</td><td>D</td></tr>
<tr><td colspan="5">Operating Conditions</td></tr>
<tr><td>8.</td><td>The Applicant shall:
(a) implement all reasonable and feasible measures to minimise the dust emissions of the development;
(b) minimise surface disturbance of the site; and
(c) monitor and report on compliance with the relevant air quality criteria in this consent;
to the satisfaction of the Secretary.</td><td>Y</td><td>Dust impacts were effectively managed during the reporting period.</td><td>D</td></tr>
<tr><td colspan="5">Air Quality Management Plan</td></tr>
<tr><td>9.</td><td>The Applicant shall prepare and implement an Air Quality Management Plan for the development to the satisfaction of the Secretary.</td><td>Y</td><td>An Air Quality Management Plan has been approved by the Secretary and is implemented at the Quarry. The Air Quality Management Plan is available from the Hy-Tec website</td><td></td></tr>
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Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 3: ENVIRONMENTAL PERFORMANCE CONDITIONS (Cont'd)				
METEOROLOGICAL MONITORING				
10.	For the life of the development, the Applicant shall ensure that there is a suitable meteorological station operating in the vicinity of the site that complies with the requirements in the Approved Methods for Sampling of Air Pollutants in New South Wales guideline.	Partial	A meteorological station was installed in July 2016.	D
SOIL AND WATER				
Water Supply				
11.	The Applicant shall ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of operations under the consent to match its available water supply to the satisfaction of the Secretary.	Noted	Water use during the reporting period was within the licence limits for extraction.	D
Operating Conditions				
12.	The Applicant shall: (a) comply with Section 120 of the POEO Act, unless an EPL authorises otherwise; (b) ensure that the catchment of the water management system is not larger than 40 ha, unless the Secretary agrees otherwise; (c) maintain the dredge and silt ponds to capture a 1 in 100 ARI storm event plus adequate freeboard to ensure no offsite discharge; and (d) ensure that the loss of groundwater and surface water to Tinda Creek is no greater than predicted in the EIS.	Y	Hy-Tec contends that his conditions was satisfied during the reporting period. The total catchment area was calculated to be 35.6ha and therefore less than the approved extent.	D
Water Management Plan				
13.	The Applicant shall prepare and implement a Water Management Plan for the development to the satisfaction of the Secretary. This plan must:	N	Groundwater level monitoring was not undertaken in November 2019. Groundwater levels below the investigation trigger level were not always investigated.	D

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Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 3: ENVIRONMENTAL PERFORMANCE CONDITIONS (Cont'd)				
HERITAGE				
Heritage Management Plan				
14.	The Applicant shall prepare and implement a Heritage Management Plan for the development to the satisfaction of the Secretary.	Y	A Heritage Management Plan has been approved by the Secretary and is implemented at the Quarry. The Heritage Management Plan is available from the Hy-Tec website	
LANDSCAPE AND REHABILITATION				
Biodiversity Offset Strategy				
15.	The Applicant shall implement the biodiversity offset strategy described in the EIS, as summarised and revised in Table 6, and shown conceptually in Appendix 5, to the satisfaction of the Secretary. Table 6: Biodiversity Offset Strategy (ha) **Area** / **Offset Type** / **Minimum Size (ha)** On-site Offset Area / Existing vegetation to be enhanced / 106.6	NYA	Hy-Tec has been in discussions with NPWS and DPE regularly regarding the actions necessary to implement the biodiversity offset strategy.	
Security of Offsets				
16.	Within 2 years of this consent, unless otherwise agreed with the Secretary, the Applicant shall make suitable arrangements to provide appropriate long-term security for the offset area, to the satisfaction of the Secretary.	NYA	Hy-Tec is currently planning to secure the offset area under an 88B Instrument under the Conveyancing Act 1919.	
Rehabilitation Objectives				
17.	The Applicant shall rehabilitate the site to the satisfaction of the Secretary. The final landform must: (a) be generally consistent with the proposed rehabilitation strategy in the EIS, and the final landform shown conceptually in Appendices 4 and 5. and	Y	Progressive rehabilitation is consistent with the EIS. The final landform is yet to be developed.	O

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<tr><td colspan="5">SCHEDULE 3: ENVIRONMENTAL PERFORMANCE CONDITIONS (Cont'd)</td></tr>
<tr><td>17. (Cont'd)</td><td>(b) comply with the objectives in Table 7.
Table 7: Rehabilitation Objectives
<table>
<tr><th>Feature</th><th>Objective</th></tr>
<tr><td>Site (as a whole)</td><td>• Safe, stable and non-polluting
• Restore ecosystem function, including maintaining or establishing self-sustaining ecosystems comprised of local native species and habitat, including at least 0.35 ha of Mellong Sandmass Sedgeland</td></tr>
<tr><td>Surface Infrastructure</td><td>• To be decommissioned and removed (unless the Secretary agrees otherwise)</td></tr>
<tr><td>Final Voids</td><td>• Minimise the size, depth, batter slope and the drainage catchment of the final void
• Ensure that the volume of VENM and ENM detailed in the EIS is imported for rehabilitation of the site
• Ensure that the surface area of the final voids is no greater than 16 ha in total
• Separated from the surface water drainage system, unless the Secretary agrees otherwise</td></tr>
<tr><td>Watercourses</td><td>• Restore alignment and hydraulic function, as far as practical</td></tr>
<tr><td>Community</td><td>• Ensure public safety</td></tr>
</table></td><td>Y</td><td>Operations and progressive rehabilitation complied with these objectives during the reporting period.</td><td>O</td></tr>
<tr><td colspan="5">Progressive Rehabilitation</td></tr>
<tr><td>18.</td><td>The Applicant shall rehabilitate the site progressively, that is, as soon as reasonably practicable following disturbance. Interim stabilisation measures must be implemented where reasonable and feasible to control erosion (both wind and water) in disturbed areas that are not active and which are not ready for final rehabilitation.</td><td>Y</td><td>Rehabilitation continued in Domain 4 during the reporting period with this landform progressively being stabilised prior to revegetation.</td><td>O</td></tr>
<tr><td colspan="5">Landscape Management Plan</td></tr>
<tr><td>19.</td><td>The Applicant shall prepare and implement a Landscape Management Plan for the development to the satisfaction of the Secretary.</td><td>Y</td><td>A Landscape Management Plan has been approved by the Secretary and is being implemented at the Quarry.
The Landscape Management Plan is available from the Hy-Tec website</td><td>D</td></tr>
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Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 3: ENVIRONMENTAL PERFORMANCE CONDITIONS (Cont'd)				
Conservation and Rehabilitation Bond				
20.	Within 6 months of the approval of the Landscape Management Plan, the Applicant shall lodge a Conservation and Rehabilitation Bond with the Department to ensure that the biodiversity offset strategy and rehabilitation of the site are implemented in accordance with the performance and completion criteria set out in the plan and relevant conditions of this consent. The sum of the bond shall be determined by: (a) calculating the cost of implementing the biodiversity offset strategy over the next 3 years; (b) calculating the cost of rehabilitating the site, taking into account the likely surface disturbance over the next 3 years of extraction operations; and (c) employing a suitably qualified quantity surveyor or other expert to verify the calculated costs, to the satisfaction of the Secretary.	Y	A conservation and rehabilitation bond was lodged with DPE on 11 December 2017.	D
	Within 3 months of each Independent Environmental Audit (see condition 9 of schedule 5), the Applicant shall review, and if necessary revise, the sum of the Conservation and Rehabilitation Bond to the satisfaction of the Secretary.	NA		
TRANSPORT				
Monitoring of Product Transport				
22.	The Applicant shall keep accurate records of all laden truck movements to and from the site (hourly, daily, weekly, monthly and annually) and publish these records on its website every 6 months.	Y	See Section 4.2.2 of the Annual Review. Truck movement records are also available from the Hy-Tec website.	D
Operating Conditions				
23.	The Applicant shall ensure that: (a) all laden vehicles have appropriate signage, including a contact phone number, so they be easily identified by road users; (b) all laden vehicles entering or exiting the site have their loads covered; (c) all laden vehicles exiting the site are cleaned of sand and other material that may fall on the road, before leaving the site; and (d) no trucks queue at the entrance to the site before 6am.	Y	All laden vehicles complied with these requirements during the reporting period.	D

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Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 3: ENVIRONMENTAL PERFORMANCE CONDITIONS (Cont'd)				
Access Road and Intersection Construction				
24.	Within 12 months from the date of this consent, unless the Secretary agrees otherwise, the Applicant shall upgrade the site access road and its intersection with Putty Road in accordance with applicable AUSTROADS standards, and to the satisfaction of RMS.	Y	Intersection upgrade completed in November 2015.	D
Transport Management Plan				
25.	The Applicant shall prepare and implement a Transport Management Plan for the development to the satisfaction of the Secretary.	Y	A Transport Management Plan has been approved by the Secretary and is implemented at the Quarry. The Transport Management Plan is available from the Hy-Tec website	D
VISUAL				
26.	The Applicant shall: (a) implement all reasonable and feasible measures to minimise the visual and off-site lighting impacts of the development on local residences and road users; and (b) ensure that all external lighting associated with the development complies with the relevant Australian Standards…. to the satisfaction of the Secretary.	Y	Visual amenity was managed effectively during the reporting period. No complaints were received during the reporting period regarding visual impacts.	
BUSHFIRE MANAGEMENT				
27.	The Applicant shall ensure that the development is suitably equipped to respond to any fires on site; and assist the Rural Fire Service, emergency services and National Parks and Wildlife Service as much as practicable if there is a fire in the surrounding area.	Y	Firefighting equipment is readily available at the Quarry an was used during the reporting period. RFS made use of on-site water supplies.	D
WASTE				
28.	The Applicant shall ensure that only certified VENM and ENM is imported to the site to aid in the minimisation of final voids.	Y	No material was imported during the reporting period.	D
29.	The Applicant shall manage on-site sewage treatment and disposal in accordance with the requirements of its EPL, and to the satisfaction of the EPA and Council.	Y	There were no compliance issues with regards to sewerage management during the reporting period.	D
30.	The Applicant shall: (a) minimise the waste generated by the development; (b) ensure that the waste generated by the development is appropriately stored, handled, and disposed of; and (c) report on waste management and minimisation in the Annual Review, to the satisfaction of the Secretary.	Y	Historically stored waste located on the premises was identified as part of site visit by DPE representatives in June 2017. The items were disposed of in September 2017, and the area is being revegetated, in liaison with the DPE and EPA.	D

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Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 4: ADDITIONAL PROCEDURES				
NOTIFICATION OF LANDOWNERS				
1.	As soon as practicable after obtaining monitoring results showing an exceedance of any relevant criteria in schedule 3, the Applicant shall notify affected landowners in writing of the exceedance, and provide regular monitoring results to each affected landowner until the development is again complying with the relevant criteria.	Y	Hy-Tec did not receive monitoring results that indicated impacts at a nearby residence.	D
INDEPENDENT REVIEW				
2.	If an owner of privately-owned land considers the development to be exceeding the relevant criteria in schedule 3, then he/she may ask the Secretary in writing for an independent review of the impacts of the development on his/her land. If the Secretary is satisfied that an independent review is warranted, then within 2 months of the Secretary's decision the Applicant shall:	NYA	No requests for an independent review of impacts of the Quarry were received during the reporting period.	
SCHEDULE 5: ENVIRONMENTAL MANAGEMENT, REPORTING AND AUDITING				
ENVIRONMENTAL MANAGEMENT				
Environmental Management Strategy				
1.	The Applicant shall prepare and implement an Environmental Management Strategy for the development to the satisfaction of the Secretary.	Y	An Environmental Management Strategy has been approved by the Secretary and is implemented at the Quarry. The Environmental Management Strategy Plan is available from the Hy-Tec website.	D
Adaptive Management				
2.	The Applicant shall assess and manage development-related risks to ensure that there are no exceedances of the criteria and/or performance measures in schedule 3. Any exceedance of these criteria and/or performance measures constitutes a breach of this consent and may be subject to penalty or offence provisions under the EP&A Act or EP&A Regulation. Where any exceedance of these criteria and/or performance measures has occurred, the Applicant shall, at the earliest opportunity: (a) take all reasonable and feasible measures to ensure that the exceedance ceases and does not recur;	Y	Groundwater level (Section 7.1) exceedances were recorded in 2019 but are considered to be due to persistent drought conditions.	D

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SCHEDULE 5: ENVIRONMENTAL MANAGEMENT, REPORTING AND AUDITING (Cont'd)				
ENVIRONMENTAL MANAGEMENT (Cont'd)				
Adaptive Management (Cont'd)				
2. (Cont'd)	(b) consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of action; and (c) implement remediation measures as directed by the Secretary; to the satisfaction of the Secretary.			
Management Plan Requirements				
3.	The Applicant shall ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include: (a) detailed baseline data; (b) a description of: • the relevant statutory requirements (including any relevant approval, licence or lease conditions); • any relevant limits or performance measures/criteria; and • the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures; (c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria; (d) a program to monitor and report on the: • impacts and environmental performance of the development; and • effectiveness of any management measures (see (c) above); (e) a contingency plan to manage any unpredicted impacts and their consequences; (f) a program to investigate and implement ways to improve the environmental performance of the development over time; (g) a protocol for managing and reporting any: • incidents; • complaints; • non-compliances with statutory requirements; and • exceedances of the impact assessment criteria and/or performance criteria; and (h) a protocol for periodic review of the plan.	Y	All management plans and strategies have been approved by the Secretary.	D

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SCHEDULE 5: ENVIRONMENTAL MANAGEMENT, REPORTING AND AUDITING (Cont'd)				
ENVIRONMENTAL MANAGEMENT (Cont'd)				
Annual Review				
4.	By the end of December each year, or other timing as may be agreed by the Secretary, the Applicant shall review the environmental performance of the development to the satisfaction of the Secretary.	Y	This document.	D
Revision of Strategies, Plans and Programs				
5.	Within 3 months of a modification to this consent or following the submission of an: (a) annual review under condition 4 above: (b) incident report under condition 7 below; or (c) audit report under condition 9 below, the Applicant shall review, and if necessary revise, the strategies, plans, and programs required under this consent to the satisfaction of the Secretary. *Note: This is to ensure the strategies, plans and programs are updated on a regular basis, and incorporate any recommended measures to improve the environmental performance of the development.*	Y	Correspondence relating to the review of management plans was provided to DPE on 11 July 2018	D
Community Consultative Committee				
6.	The Applicant shall establish and operate a Community Consultative Committee (CCC) for the development to the satisfaction of the Secretary. This CCC must be operated in general accordance with the Guidelines for Establishing and Operating Community Consultative Committees for Mining Developments (Department of Planning, 2007, or its latest version), and be operating within 6 months of the date of this consent.	Y	CCC Meetings were held on 13 May 2019 and 14 October 2019.	D
REPORTING				
Incident Reporting				
7.	The Applicant shall immediately notify the Secretary and any other relevant agencies of any incident that has caused, or threatens to cause, material harm to the environment. For any other incident associated with the Development, the Applicant shall notify the Secretary. Within 7 days of the date of the incident, the Applicant shall provide the Secretary and any relevant agencies with a detailed report on the incident, and such further reports as may be requested.	Y	There were no incidents that threatened or caused material harm to the environment that required notification to DPIE during the reporting period.	

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SCHEDULE 5: ENVIRONMENTAL MANAGEMENT, REPORTING AND AUDITING (Cont'd)				
REPORTING (Cont'd)				
Regular Reporting				
8.	The Applicant shall provide regular reporting on the environmental performance of the development on its website, in accordance with the reporting arrangements in any plans or programs approved under the conditions of this consent.	Y	All relevant documents and monitoring results are available from the Hy-Tec website.	O
INDEPENDENT ENVIRONMENTAL AUDIT				
9.	Within a year of the date of this consent, and every 3 years thereafter, unless the Secretary directs otherwise, the Applicant shall commission and pay the full cost of an Independent Environmental Audit of the development.	Y	An Independent Environment Audit was undertaken on 9 and 10 October 2019.	D
10.	Within 6 weeks of the completion of this audit, unless the Secretary agrees otherwise, the Applicant shall submit a copy of the audit report to the Secretary, together with its response to any recommendations contained in the audit report, including a timetable for the implementation of any measures proposed to address the recommendations in the audit report. If the Applicant intends to defer the implementation of a recommendation, reasons must be documented.	Y	The audit report and response from Hy-tec were provided to DPIE on 21 November 2019	D
11.	Within 6 months of the date of this consent, the Applicant shall: (a) make copies of the following publicly available on its website: • the EIS; • current statutory approvals for the development; • approved strategies, plans and programs required under the conditions of this consent; • a comprehensive summary of the monitoring results of the development, reported in accordance with the specifications in any conditions of this consent, or any approved plans and programs; • a complaints register, which is to be updated monthly; • minutes of CCC meetings; • the annual reviews of the development (for the last 5 years); • any independent environmental audit of the development, and the Applicant's response to the recommendations in any audit; • any other matter required by the Secretary; and (b) keep this information up-to-date, to the satisfaction of the Secretary.	Y	All relevant documents and monitoring results are available from the Hy-Tec website.	D

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Table A2
Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 12007 for Tinda Creek Sand Project from 1 January 2019 to 31 December 2019

Condition No.	Paraphrased Requirement		Compliance	Comment	Basis*
1. Administrative Conditions					
What the licence authorises and regulates					
A1.1	This licence authorises the carrying out of the scheduled activities listed below at the premises specified in A2. The activities are listed according to their scheduled activity classification, fee-based activity classification and the scale of the operation. Unless otherwise further restricted by a condition of this licence, the scale at which the activity is carried out must not exceed the maximum scale specified in this condition.		Yes	Scheduled Activity Fee Based Activity Scale > 100000 - 500000m^3 annual extractive capacity	D
	Scheduled Activity	**Fee Based Activity**	**Scale**		
	Extractive activities	Water-based extractive activity	>100000 – 500000m3 annual extractive capacity		
A1.2	Notwithstanding condition A1.1, the scale of the water-based extractive activity authorised under this licence must not exceed more than 300,000 tonnes of sand extracted or processed in any calendar year, being the amount equivalent to the annual extraction limit approved by the development consent granted under the Environmental Planning and Assessment Act 1979 for the premises specified in A2.		Yes	Water-based extractive activity did not exceed more than 300,000 tonnes of sand extracted or processed during the reporting period.	D
Premises or plant to which this licence applies					
A2.1	The licence applies to the following premises: TINDA CREEK QUARRY 6102 PUTTY ROAD MELLONG NSW 2756 LOT 1 DP 628806, LOT 2 DP 628806, LOT 3 DP 628806 AS DEPICTED IN THE MAP OF THE APPROVED PROJECT AREA FOR SSD 4978 IN CONDITION A2.2		N/A		
A2.2	The premises location is shown on the map below		N/A		

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Table A2 (Cont'd)
Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 12007 for Tinda Creek Sand Project from 1 January 2019 to 31 December 2019

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
Information supplied to the EPA				
A3.1	Works and activities must be carried out in accordance with the proposal contained in the licence application, except as expressly provided by a condition of this licence. In this condition the reference to "the licence application" includes a reference to: a) the applications for any licences (including former pollution control approvals) which this licence replaces under the Protection of the Environment Operations (Savings and Transitional) Regulation 1998; and b) the licence information form provided by the licensee to the EPA to assist the EPA in connection with the issuing of this licence.	Yes	All works and activities were carried out in accordance with SSD_4978 during the reporting period.	
A3.2	Works and activities must be carried out in accordance with the Development Consent for State Significant Development 4978 approved by the Department of Planning and Environment on 10 April 2015.	Yes	All works and activities were carried out in accordance with SSD_4978 during the reporting period.	D
2. Discharges to Air and Water and Applications to Land				
P1 Location of monitoring/discharge points and areas				
P1.1	The following points referred to in the table below are identified in this licence for the purposes of weather and/or noise monitoring and/or setting limits for the emission of noise from the premises.	Yes	A Noise Management Plan has been approved by the Secretary and is implemented at the Quarry. The Noise Management Plan is available from the Hy-Tec website and identifies monitoring locations.	D
	EPA identification no. / **Type of monitoring point** / **Location Description** 1 / Noise monitoring / The boundary of "Receiver 1" as detailed in Figure 6.1 of the document titled "Tinda Creek Sand Quarry Noise Management Plan Final October 2015", submitted to the EPA on 18 November 2015			
3. Limit Conditions				
L1 Pollution of waters				
L1.1	Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.	Yes	There was no evidence or records of pollution as a result of the operation during the reporting period.	D

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Table A2 (Cont'd)
Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 12007 for Tinda Creek Sand Project from 1 January 2019 to 31 December 2019

<table>
<tr><th>Condition No.</th><th>Paraphrased Requirement</th><th>Compliance</th><th>Comment</th><th>Basis*</th></tr>
<tr><td colspan="5">L2 Waste</td></tr>
<tr><td>L2.1</td><td>The licensee must not cause, permit or allow any waste generated outside the premises to be received at the premises for storage, treatment, processing, reprocessing or disposal or any waste generated at the premises to be disposed of at the premises, except as expressly permitted by the licence.</td><td>Yes</td><td>No waste material was received on site during the reporting period.</td><td>D</td></tr>
<tr><td>L2.2</td><td>This condition only applies to the storage, treatment, processing, reprocessing or disposal of waste at the premises if those activities require an environment protection licence.</td><td>Yes</td><td>No waste material was received on site during the reporting period.</td><td>D</td></tr>
<tr><td colspan="5">L3 Noise Limits</td></tr>
<tr><td>L3.1</td><td>Noise generated at the premises that is measured at each noise monitoring point established under this licence must not exceed the noise levels specified in Column 4 of the table below for that point during the corresponding time periods specified in Column 1 when measured using the corresponding measurement parameters listed in Column 2.
POINT 1
<table><tr><th>Time period</th><th>Measurement parameter</th><th>Measurement frequency</th><th>Noise level dB(A)</th></tr><tr><td>All hours</td><td>LAeq (15 minute)</td><td>-</td><td>35</td></tr><tr><td>Night</td><td>Lmax OR LA1,1min</td><td>-</td><td>45</td></tr></table></td><td>Yes</td><td>Noise monitoring undertaken during the reporting period demonstrates that Hy-Tec complied with the criteria. There were no noise complaints during the reporting period.</td><td>D</td></tr>
<tr><td>L3.2</td><td>For the purposes of the table under Condition L3.1 "Night" has the same meaning as in the NSW Industrial Noise Policy (EPA, 2000).</td><td>Noted</td><td></td><td></td></tr>
<tr><td colspan="5">L4 Hours of Operation</td></tr>
<tr><td>L4.1</td><td>Unless permitted by another condition of this licence, activities at the premises must:
a) only be undertaken between 7:00 am and 6:00 pm Monday to Friday;
b) only be undertaken between 7:00 am and 3:00 pm Saturday; and
c) not be undertaken on Sundays or public holidays.</td><td>Yes</td><td>Hy-Tec reports that all hours of operation were complied with during the reporting period.</td><td>D</td></tr>
<tr><td>L4.2</td><td>In addition to the limitations imposed by Condition L4.1, construction activities must not be undertaken:
a) between 7:00 am and 8:00 am Saturdays; and
b) between 1:00 pm and 3:00 pm Saturdays.</td><td>Yes</td><td>No construction activities were undertaken in the reporting period.</td><td>D</td></tr>
</table>

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Table A2 (Cont'd)
Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 12007 for Tinda Creek Sand Project from 1 January 2019 to 31 December 2019

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
L4 Hours of Operation (Cont'd)				
L4.3	In addition to the hours of operation specified in Condition L4.1, dispatch activities may be undertaken: a) between 5:00 am and 10:00 pm Monday to Friday; and b) between 6:00 am and 3:00 pm Saturdays	Yes	Hy-Tec reports that dispatch occurred during the approved hours throughout the reporting period.	D
L4.4	Maintenance activities may be undertaken at any time if those activities are inaudible at all residential premises.	Yes	Hy-Tec has confirmed that all maintenance activities were inaudible at residential premises. No noise complaints were received through the reporting period.	D
4. Operating Conditions				
O1 Activities must be carried out in a competent manner				
O1.1	Licensed activities must be carried out in a competent manner. This includes: a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.	Yes	Hy-Tec reports that all activities were carried out in a competent manner during the reporting period. This includes the management of materials and substances used to carry out the operation such as diesel and other hazardous substances. All waste generated by the operation was managed in accordance with the Environmental Management Strategy.	D
O2 Maintenance of plant and equipment				
O2.1	All plant and equipment installed at the premises or used in connection with the licensed activity: a) must be maintained in a proper and efficient condition; and b) must be operated in a proper and efficient manner.	Yes	Hy-Tec reports that all plant and equipment was maintained and operated in a proper and efficient manner.	D
O3 Dust				
O3.1	The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.	Yes	Hy-Tec reports that quarry-generated dust was minimal throughout the reporting period. No complaints relating to dust impacts were received.	D
O3.2	The licensee must ensure that all laden vehicles exiting the site have their loads covered.	Yes	Hy-Tec reports that all loads were covered during the reporting period.	D

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Table A2 (Cont'd)
Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 12007 for Tinda Creek Sand Project from 1 January 2019 to 31 December 2019

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
5. Monitoring and Recording Conditions				
M1 Monitoring Records				
M1.1	The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.	Yes	All monitoring was conducted and retained in accordance with M1 of EPL 12007	D
M1.2	All records required to be kept by this licence must be: a) in a legible form, or in a form that can readily be reduced to a legible form; b) kept for at least 4 years after the monitoring or event to which they relate took place; and c) produced in a legible form to any authorised officer of the EPA who asks to see them.	Yes	All records have been kept in accordance with condition M1 of EPL 12007.	D
M1.3	The following records must be kept in respect of any samples required to be collected for the purposes of this licence: a) the date(s) on which the sample was taken; b) the time(s) at which the sample was collected; c) the point at which the sample was taken; and d) the name of the person who collected the sample.	Yes	Hy-Tec confirms that all relevant details have been recorded for monitoring activities.	D
M2 Environmental Monitoring				
M2.1	a) The licensee must undertake monthly inspections of the surface water management system at the premises. b) The monthly inspections must: (i) be undertaken immediately upstream and downstream of the quarry disturbance area; (ii) include visual inspection of litter, oil and grease and sediment levels within the surface water system, including diversion channels; (iii) include visual inspection of the physical integrity of the surface water management system, including any signs of erosion; and (iv) include visual inspection of the water level and flow in Tinda Creek.	Yes	Monthly inspections of the surface water management system were undertaken throughout the reporting period in accordance with condition M2 of EPL 12007.	D
M3 Recording of pollution complaints				
M3.1	The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.	Yes	A complaints register is maintained, however, no complaints were received during the reporting period.	D

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Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 12007 for Tinda Creek Sand Project from 1 January 2019 to 31 December 2019

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
M3 Recording of pollution complaints (Cont'd)				
M3.2	The record must include details of the following: a) the date and time of the complaint; b) the method by which the complaint was made; c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect; d) the nature of the complaint; e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and f) if no action was taken by the licensee, the reasons why no action was taken.	Yes	A complaints register is maintained, however, no complaints were received during the reporting period.	D
M3.3	The record of a complaint must be kept for at least 4 years after the complaint was made.	Yes	A complaints register is maintained, however, no complaints were received during the reporting period.	D
M3.4	The record must be produced to any authorised officer of the EPA who asks to see them.	NYA	No requests were provided during the reporting period.	D
M4 Telephone complaints line				
M4.1	The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.	Yes	A telephone complaints line was maintained, however, no complaints were received during the reporting period.	D
M4.2	The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.	Yes	The telephone complaints number is displayed on a sign at the front gate of the Quarry.	D
M4.3	The preceding two conditions do not apply until 3 months after: the date of the issue of this licence.	Noted		
M5 Noise Monitoring				
M5.1	To assess compliance with the noise limits specified within this licence, the licensee must undertake operator attended noise monitoring at each specified noise monitoring point in accordance with the table below. POINT 1 Assessment period: All hours when in use; Minimum frequency in a reporting period: Yearly; Minimum duration within assessment period: 1 hour; Minimum number of assessment period: 1 operation day	Yes	Noise monitoring was undertaken by Muller Acoustic Consultants in April 2019 in accordance with the approved Noise Management Plan.	D
M5.2	The licensee must undertake noise monitoring as directed by an authorised officer of the EPA.	NYA	No request was made for additional noise monitoring during the reporting period.	D

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Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
M5 Noise Monitoring (Cont'd)				
M5.3	All noise monitoring required by this licence must be undertaken in accordance with Australian Standard AS 2659.1 - 1998: Guide to the use of sound measuring equipment - Portable sound level meters, or any revisions of that standard that may be made by Standards Australia, and the compliance monitoring guidance provided in the NSW Industrial Noise Policy.	Yes	Noise monitoring was undertaken in accordance with Australian Standard AS 2659.1 – 1998.	D
6. Reporting Conditions				
R1 Annual Return Documents				
R1.1	The licensee must complete and supply to the EPA an Annual Return in the approved form comprising: 1. a Statement of Compliance, 2. a Monitoring and Complaints Summary, 3. a Statement of Compliance - Licence Conditions, 4. a Statement of Compliance - Load based Fee, 5. a Statement of Compliance - Requirement to Prepare Pollution Incident Response Management Plan, 6. a Statement of Compliance - Requirement to Publish Pollution Monitoring Data; and 7. a Statement of Compliance - Environmental Management Systems and Practices. At the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.	Yes	Annual Return submitted to EPA in July 2019.	D
R1.2	An Annual Return must be prepared in respect of each reporting period, except as provided below.	Noted		
R1.3	Where this licence is transferred from the licensee to a new licensee: a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.	Noted		

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Table A2 (Cont'd)
Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 12007 for Tinda Creek Sand Project from 1 January 2019 to 31 December 2019

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
R1 Annual Return Documents (Cont'd)				
R1.4	Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on: a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or b) in relation to the revocation of the licence - the date from which notice revoking the licence operates.	Noted		
R1.5	The Annual Return for the reporting period must be supplied to the EPA via eConnect EPA or by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').	Yes	Annual Return submitted to EPA in July 2019.	D
R1.6	The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.	Noted		
R1.7	Within the Annual Return, the Statements of Compliance must be certified and the Monitoring and Complaints Summary must be signed by: a) the licence holder; or b) by a person approved in writing by the EPA to sign on behalf of the licence holder.	Yes	Compliance declaration was signed by a Director and Company Secretary.	D
R2 Notification of environmental harm				
R2.1	Notifications must be made by telephoning the Environment Line service on 131 555.	Noted		
R2.2	The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.	Noted	No notifications were required during the reporting period.	D
R3 Written Report				
R3.1	Where an authorised officer of the EPA suspects on reasonable grounds that: a) where this licence applies to premises, an event has occurred at the premises; or b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence, and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.	Noted		

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Table A2 (Cont'd)
Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 12007
for Tinda Creek Sand Project from 1 January 2019 to 31 December 2019

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
R3 Written Report (Cont'd)				
R3.2	The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.	Noted		
R3.3	The request may require a report which includes any or all of the following information: a) the cause, time and duration of the event; b) the type, volume and concentration of every pollutant discharged as a result of the event; c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event; d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort; e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants; f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and g) any other relevant matters.	Noted		
R3.4	The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.	Noted		
R4 Other reporting conditions				
Noise Monitoring Results				
R4.1	a) The licensee must submit the results of any noise monitoring undertaken in accordance with the requirements of Condition M5.1 or Condition M5.2 to the EPA within three weeks of the noise monitoring being undertaken. b) The noise monitoring results submitted to the EPA must include: (i) a map of each noise monitoring location in relation to the noise source, including relevant distances; (ii) an analysis of the noise monitoring results;	Yes	A copy of the Noise Monitoring Assessment is available on the Hy-Tec website and was provided to the EPA within the allocated timeframe. No exceedances were recorded during the reporting period.	D

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Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 12007 for Tinda Creek Sand Project from 1 January 2019 to 31 December 2019

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
R4 Other reporting conditions (Cont'd)				
Noise Monitoring Results (Cont'd)				
R4.1 (Cont'd)	(iii) any detected exceedance of the noise limits specified in Condition L4.1; (iv) details of any remedial action taken or proposed to be taken in relation to any exceedance of the noise limits specified in Condition L4.1; (v) details of the prevailing meteorological conditions during the period when the noise monitoring was undertaken; and (vi) confirmation that noise monitoring was/was not undertaken in accordance with Condition M5.3.			
Surface Water Management System reporting				
R4.2	In accordance with section 5.3 of the approved Water Management Plan for the premises, the licensee must notify the EPA when surface water triggers are exceeded and provide a written report to the EPA.	NYA	No surface water triggers were exceeded during the reporting period.	D
R4.3	The report to the EPA must include: a) the results of surface water management system inspections required in condition M2.1 for the month related to the exceedance, including photographs; and b) appropriate mitigation and contingency measures to be implemented within one month of the exceedance being detected.	NYA	No surface water triggers were exceeded during the reporting period.	D
R4.4	The report must be submitted to the EPA within one month of surface water triggers being detected and be directed to the Manager, Sydney Industry Section by email to metro.regulation@epa.nsw.gov.au	NYA	No surface water triggers were exceeded during the reporting period.	D
7. General Conditions				
G1 Copy of licence kept at the premises or plant				
G1.1	A copy of this licence must be kept at the premises to which the licence applies.	Yes	A copy of the licence is available at the Quarry.	D
G1.2	The licence must be produced to any authorised officer of the EPA who asks to see it.	Noted		
G1.3	The licence must be available for inspection by any employee or agent of the licensee working at the premises.	Noted		

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Appendix 2

Return for Extractive Industries – June 2019

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Planning, Industry & Environment

Form S 1

RETURN FOR EXTRACTIVE MATERIALS: YEAR ENDED 30 JUNE 2019

Quote RIMS ID in all correspondence

Quarry Id:	Rims ID: 401060
Operators Name: Address:	AUS-10 RHYOLITE T/AS HY-TEC INDUSTRIES PO BOX 6770 SILVERWATER NSW 1811
Email:	darryl.thiedeke@hy-tec.com.au
Quarry Name: Quarry Address:	TINDA CREEK QUARRY 6102 PUTTY RD, MELLONG NSW 2756

Inquiries please telephone: (02) 4063 6713

Completed or Nil Returns
Email – mineral.royalty@planning.nsw.gov.au
Postal Address (see below)

Please amend name, postal address and location of mine or quarry if incorrect or incomplete.

2018-2019

The return should be completed and forwarded to **Senior Advisory Officer, RESOURCE ECONOMICS, RESOURCE PLANNING & PROJECTS, NSW DEPARTMENT OF PLANNING, INDUSTRY & ENVIRONMENT, PO BOX 344 HUNTER REGION MAIL CENTRE NSW 2310 on or before 31 October 2019**. If completion of the return is unavoidably delayed, an application for extension of time should be requested **before** the due date. If no work was done during the year, a **NIL** return must be forwarded.

The return should relate to the **above quarrying establishment** and should cover the operations of quarrying and treatment (such as crushing, screening, washing etc.) carried out at or near the quarry. A return is required even if the operations are solely of a developmental nature and whether the area being worked is held under a mining title or otherwise.

Director, Resource Planning & Projects

Please complete all of the following information to assist in identifying the location of the Quarry

Typical Geology _____Friable Sandstone / Lacustrine_____

Nearest Town to Quarry ____Wilberforce_____

Local Council Name ___Hawkesbury Shire Council_____

Deposited Plan and Lot Number/s of Quarry _____Lots 1 to 3 DP 628806_____

Email Address of Operator _____darryl.thiedeke@hy-tec.com.au_____

Name of Owner or Licensee _____As above_ _____

Postal Address of Licensee _____As above_____

Licence/Lease Number/s (if any)

From Mineral Resources NSW (Industry & Investment NSW) _____N/A_____

From Department of Lands or other Department _____N/A_____

If any output was obtained from land NOT held under licence from the above Departments, state the Name/s and Address/es of the Owners of the land _____N/A_____

To the best of my knowledge, information entered in this return is correct and no blank spaces left where figures should have been inserted.

- **SIGNATURE of PROPRIETOR or MANAGER** _____ **DATE** _28.10.2019__
- **CONTACT PERSON for this return** _____**Darryl Thiedeke**_____
- **NAME** (Block letters) ____DARRYL THIEDEKE_____ **Telephone** _____0296472866___

SALES During 2018-2019

Production information may be published in aggregated form for statistical reporting. However, production data for individual operations is kept strictly confidential.

Product	Description	Quantity Tonnes
Virgin Materials		
• **Crushed Coarse Aggregates**		
Over 75mm		
Over 30mm to 75mm		
5mm to 30mm		
Under 5mm		
Natural Sand	Washed fine sand	84,424
Manufactured Sand		
Prepared Road Base & Sub Base		
Other Unprocessed Materials		
Recycled Materials		
• **Crushed Coarse Aggregates**		
Over 75mm		
Over 30mm to 75mm		
5mm to 30mm		
Under 5mm		
Natural Sand		
Manufactured Sand		
Prepared Road Base & Sub Base		
Other Unprocessed Materials		
• **River Gravel**		
Over 30mm		
5mm to 30mm		
Under 5mm		
• **Construction Sand**	Excluding Industrial	
• **Industrial Sand**		
Foundry, Moulding		
Glass		
Other (Specify)		
• **Dimension Stone**	Building, Ornamental, Monumental	
Quarried in Blocks		
Quarried in Slabs		
• **Decorative Aggregate**	Including Terrazzo	
• **Loam**	Soil for Topdressing, Garden soil, Horticultural purposes)	
• **TOTAL SITE PRODUCTION**		**84,424**
• **Gross Value ($) of all Sales**	$2.1Mill	
• **Type of Material**	Washed sand - Friable Sandstone / Lacustrine	
• **Number of Full-Time Equivalent (FTE) Employees**	Employees:6	Contractors:0

Please Note: A return for clay based products can be obtained by contacting the inquiry number.

Appendix 3

Noise Monitoring Report

Prepared by Muller Acoustic Consulting Pty Ltd

(Total No. of pages including blank pages = 24)

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Noise Monitoring Assessment

Tinda Creek Quarry
Tinda Creek, NSW

April 2019

Prepared for: RW Corkery & Co Pty Ltd
April 2019
MAC180647RP2

Muller Acoustic Consulting

Document Information

Noise Monitoring Assessment

Tinda Creek Quarry, Tinda Creek, NSW

April 2019

Prepared for: RW Corkery & Co Pty Ltd
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Brooklyn NSW 2083

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Document ID	Status	Date	Prepared By	Signed	Reviewed By	Signed
MAC180647RP2	Draft	23 April 2019	Robin Heaton	Robin Heaton	Oliver Muller	

CONTENTS

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by RW Corkery & Co Pty Limited (RWC) on behalf of Hy-Tec Industries Pty Ltd (Hy-Tec) to complete a Noise Monitoring Assessment (NMA) for the Tinda Creek Quarry, Tinda Creek, NSW (the 'project').

The monitoring has been conducted in accordance with the approved Tinda Creek Quarry Noise Management Plan and in general accordance with Conditions L3.1 and M5 of EPL#12007 (EPL).

The assessment was conducted in accordance with the following documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Environment Protection Licence EPL#12007;
- Umwelt Pty Ltd, Tinda Creek Quarry Noise Management Plan (NMP); and
- Australian Standard AS 1055:2018 - Acoustics - Description and measurement of environmental noise.

The assessment was undertaken on Thursday 4 April 2019 and forms part of the noise monitoring program to address conditions of EPL#12007, and the Noise Management Plan.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

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2 Noise Criteria

2.1 Attended Noise Compliance

Section L3.1 of the Tinda Creek EPL, approved on 3 March 2017, outlines the applicable noise criteria for all privately owned residential receivers surrounding the project. The operating criteria specified in the EPL at all receivers is 35dB $LA_{eq(15min)}$ for all periods and 45dB LA_{max} during the night time period. **Table 1** presents the criteria for privately owned residential receivers surrounding the project, as outlined in the EPL.

Table 1 Noise Criteria

Receiver	All Hours dB(A) $LA_{eq(15min)}$	Night (10pm to 7am) dB(A) LA_{max}
All privately owned residences	35	45

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3 Methodology

3.1 Locality

The project is located on Putty Road, Tinda Creek, NSW approximately 67km north of Windsor, NSW. Receivers in the locality surrounding the project are primarily rural/residential. Putty Road is situated to the west of the site with the Yengo National park bordering the site in all other directions.

3.2 Noise Monitoring Locations

Section M5.1 of the EPL specifies that noise monitoring is to be conducted for a minimum duration of one hour at the boundary of R1, (6255 Putty Road, Mellong) as detailed in Figure 6.1 of the Tinda Creek Noise Management Plan.

It should be noted that access to the property was not possible during the time of the noise measurements. Therefore, attended measurements were conducted at the boundary gate (NM1) of the property, as shown in **Figure 1**.

Following a request from the Department of Environment and Planning (DPE) on 20 January 2017, two additional near-field monitoring locations were selected to quantify project noise levels and limiting noise influence from Putty Road. The locations include a position adjacent to the dam and a second location adjacent to the main plant. The noise levels monitored at these locations were used to quantify the overall sound power of the onsite operations, which was then used to calculate the noise contribution at surrounding noise sensitive receivers (ie R2 and R3).

The three monitoring locations, their MGA 56 coordinates and duration of measurement period are outlined in **Table 2** and are presented graphically in the locality plan shown in **Figure 1**.

Table 2 Receiver Locations

Receiver ID	Receiver Location	Coordinates		Duration	Periods Monitored
R1	6255 Putty Road	284801	6329055	1 Hour	Morning Shoulder, Day
Q1	Dam Plant	286026	6328048	15 mins	Morning Shoulder, Day
Q2	Main Plant	285987	6327885	15 mins	Morning Shoulder, Day

3.3 Assessment Methodology

All noise surveys were conducted in general accordance with the procedures described in Australian Standard AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise" and the EPL. The acoustic instrumentation used carries current NATA calibration and complies with AS IEC 61672.1-2019-Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ±0.5dBA.

Attended noise measurements were carried out using a Svantek Type 1, 971 noise analyser on Thursday 4 April 2019. Four noise measurements of 15 minutes in duration were conducted at NM1 (R1) monitoring location during the day and morning shoulder monitoring periods. Where possible, throughout each survey, the operator quantified the contribution of each significant noise source.

Additionally, unattended noise monitoring was conducted at nearfield locations for a period of one hour during the day and morning shoulder monitoring periods to quantify the noise emissions from the quarry. These measurements were carried out using two Svantek Type 1, 971 noise analysers.

3.4 Operational Log

Transportation activities commenced at 5:30am and work shifts including operation of processing equipment commenced at 7am on the day of the survey. Morning shoulder measurements were conducted from 6am to 7am to capture the onsite loading and transportation operations. Daytime operations commenced at approximately 7am with the daytime monitoring conducted from 7:16am to 8:17am.

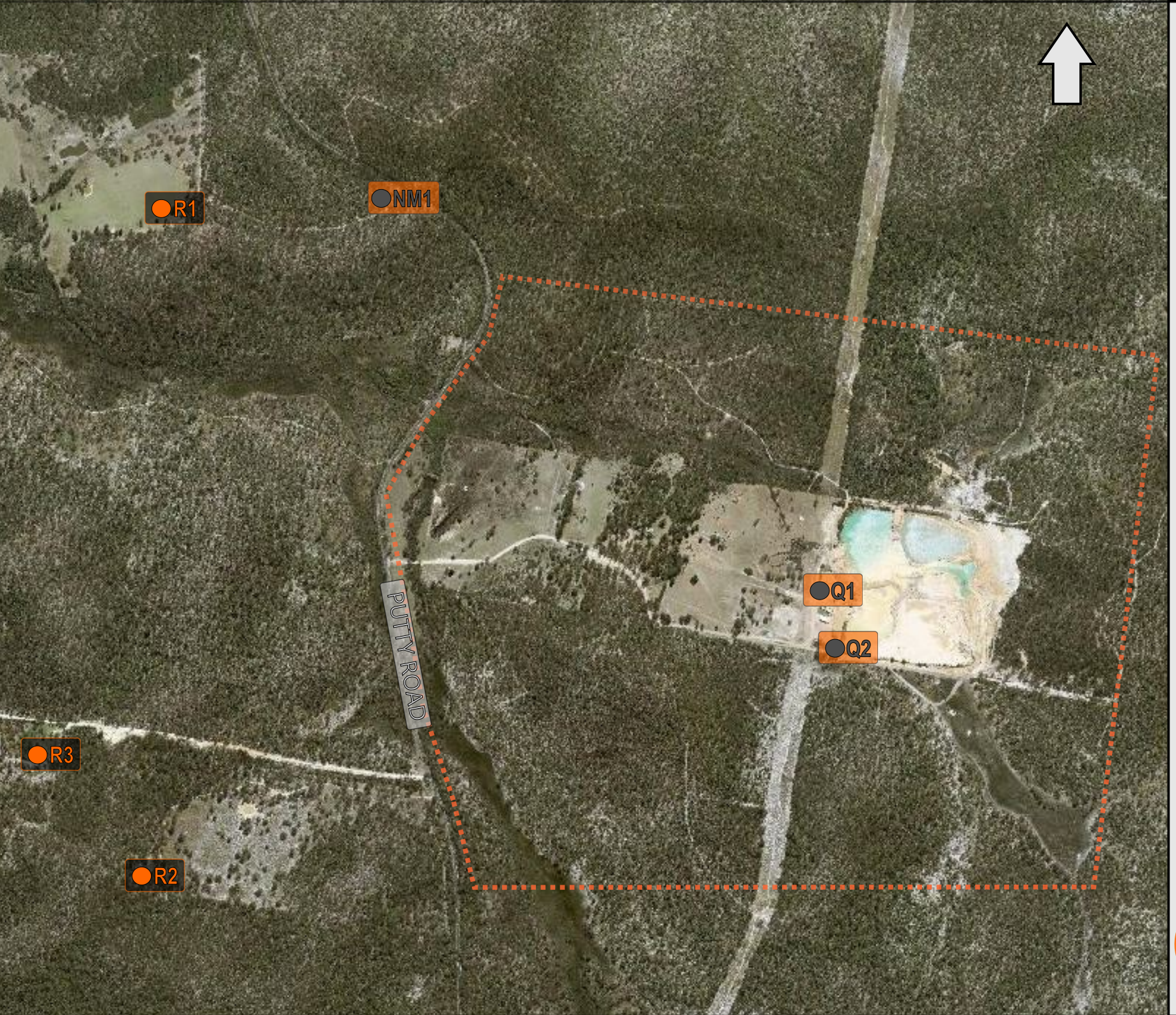

FIGURE 1

LOCALITY PLAN

REF: MAC180647

0 500m

KEY

- R1 — RECEIVER LOCATION
- NM1 — NOISE MONITORING LOCATION
- PROJECT BOUNDARY

MAC
Muller Acoustic Consulting

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4 Results

4.1 Morning Shoulder Results

Four attended noise measurements of 15-minutes in duration were completed during the morning shoulder assessment period at NM1 on Thursday 4 April 2019. **Table 3** presents the monitored noise level contributions and observed meteorological conditions for each measurement.

Table 3 Operator-Attended Noise Survey Results – Morning Shoulder Period, Location NM1

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
04/04/19	06:00	61	39	25	WD: Calm WS: 0m/s Rain: Nil	Traffic 60-61 Quarry Hum 29-38 Insects 25-30
04/04/19	06:15	70	49	23	WD: Calm WS: 0m/s Rain: Nil	Traffic 33-70 Quarry Hum 25-33 Birds 37-44
04/04/19	06:30	71	50	22	WD: Calm WS: 0m/s Rain: Nil	Traffic 35-71 Resident Talking 40-65 Birds 35-40 Quarry Hum 25-35
04/04/19	06:45	72	48	25	WD: Calm WS: 0m/s Rain: Nil	Traffic 40-72 Dogs Barking 30-43 Quarry 27-36
Tinda Creek Quarry $L_{Aeq(15min)}$ Contribution						<35

Unattended noise monitoring was completed during the morning shoulder assessment period at Q1 and Q2 on Thursday 4 April 2019. **Table 4** presents the monitored 15-minute noise levels, observed on-site activities (from audio recordings) and meteorological conditions at the time of measurements.

Table 4 Unattended Noise Survey Results – Morning Shoulder Period, Location Q1 and Q2

Location	Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Onsite Activities
			L_{Amax}	L_{Aeq}	L_{A90}		
Q1	04/04/19	06:30	55	53	52	WD: Calm WS: 0m/s Rain: Nil	Sand Plant and Generator
Q2	04/04/19	06:30	62	59	58		53-60

4.2 Day Assessment Results

Four attended noise measurements of 15-minutes in duration were completed during the daytime assessment period at NM1 on Thursday 4 April 2019. **Table 5** presents the monitored noise level contributions and observed meteorological conditions for each measurement.

Table 5 Operator-Attended Noise Survey Results – Day Period, Location NM1

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
04/04/19	07:16	66	48	39	WD: Calm WS: 0m/s Rain: Nil	Traffic 35-61 Birds 39-50 Quarry Hum 25-32
04/04/19	07:31	69	49	39	WD: Calm WS: 0m/s Rain: Nil	Traffic 40-70 Quarry Hum 30-40 Insects 35-42
04/04/19	07:46	83	48	38	WD: Calm WS: 0m/s Rain: Nil	Birds 37-40 Traffic 35-71 Quarry Hum 30-36 Aircraft 41-43 Insects 33-38
04/04/19	08:01	64	47	37	WD: Calm WS: 0m/s Rain: Nil	Birds 35-40 Traffic 38-64 Quarry 32-36 Insects 35-37
Tinda Creek Quarry $L_{Aeq(15min)}$ Contribution						<35

Unattended noise monitoring was completed during the daytime assessment period at Q1 and Q2 on Thursday 4 April 2019. **Table 6** presents the monitored 15-minute noise levels, observed on-site activities (from audio recordings) and meteorological conditions at the time of measurements.

Table 6 Unattended Noise Survey Results – Day Period, Location Q1 and Q2

Location	Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
			L_{Amax}	L_{Aeq}	L_{A90}		
Q1	04/04/19	07:30	70	65	64	WD: Calm WS: 0m/s Rain:	Sand Plant and Generator 53-60 Onsite Truck 60-75
Q2	04/04/19	07:30	75	60	58	WD: Calm WS: 0m/s Rain: Nil	

5 Noise Compliance Assessment

5.1 Attended Noise Measurement Compliance Assessment

The compliance assessment summary results for R1 are presented in **Table 7** for day and morning shoulder assessment periods and compares project contributions against relevant criteria.

Table 7 Day and Morning Shoulder Noise Compliance Assessment

Period	Quarry Noise Contribution	Quarrying Noise Criteria	Compliant
	dB $LA_{eq(15min)}$	dB $LA_{eq(15min)}$	
Day	<35	35	✓
Morning Shoulder	<35	35	✓

5.2 Calculated DPE Assessment Methodology

From the noise measurements at monitoring location Q1 and Q2 the $LA_{eq(15min)}$ sound power of the quarry was calculated to be 114dBA. The contribution at each of the receivers R1 to R3 has been calculated taking into account loss due to distance and topography. This noise level was propagated to the surrounding noise sensitive receivers, with the calculated received noise level presented in **Table 8.** Results of the calculations generally align with the measured noise contributions from the project and therefore validate compliance.

Table 8 Calculated DPE Compliance Assessment

Receiver	Quarry Sound Power dB	Distance to Receiver m	Distance attenuation dB	Attenuation due to Topography dB	Calculated Quarry Contribution dB $LA_{eq(15min)}$
R1	114	2050	74	12	28
R2	114	2210	75	12	27
R3	114	2030	74	12	28

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6 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment for RW Corkery & Co Pty Limited on behalf of Hy-Tec Industries Pty Ltd for the Tinda Creek Quarry, Tinda Creek, NSW. The assessment was completed to assess the quarry's compliance with the relevant criteria outlined in EPL#12007 for the nominated residential receiver surrounding the quarry.

Operator attended noise monitoring was undertaken on Thursday 4 April 2019 at the nominated monitoring location with quarry noise contributions compared against the relevant criteria.

The assessment has identified that noise emissions generated by Tinda Creek Quarry comply with relevant noise criteria specified in EPL#12007 at the assessed receiver location for both the morning shoulder and daytime monitoring periods.

Furthermore, the calculated noise contribution at two nearfield reference locations demonstrate that project noise contributions satisfy relevant criteria at R1, R2 and R3.

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Appendix A – Glossary of Terms

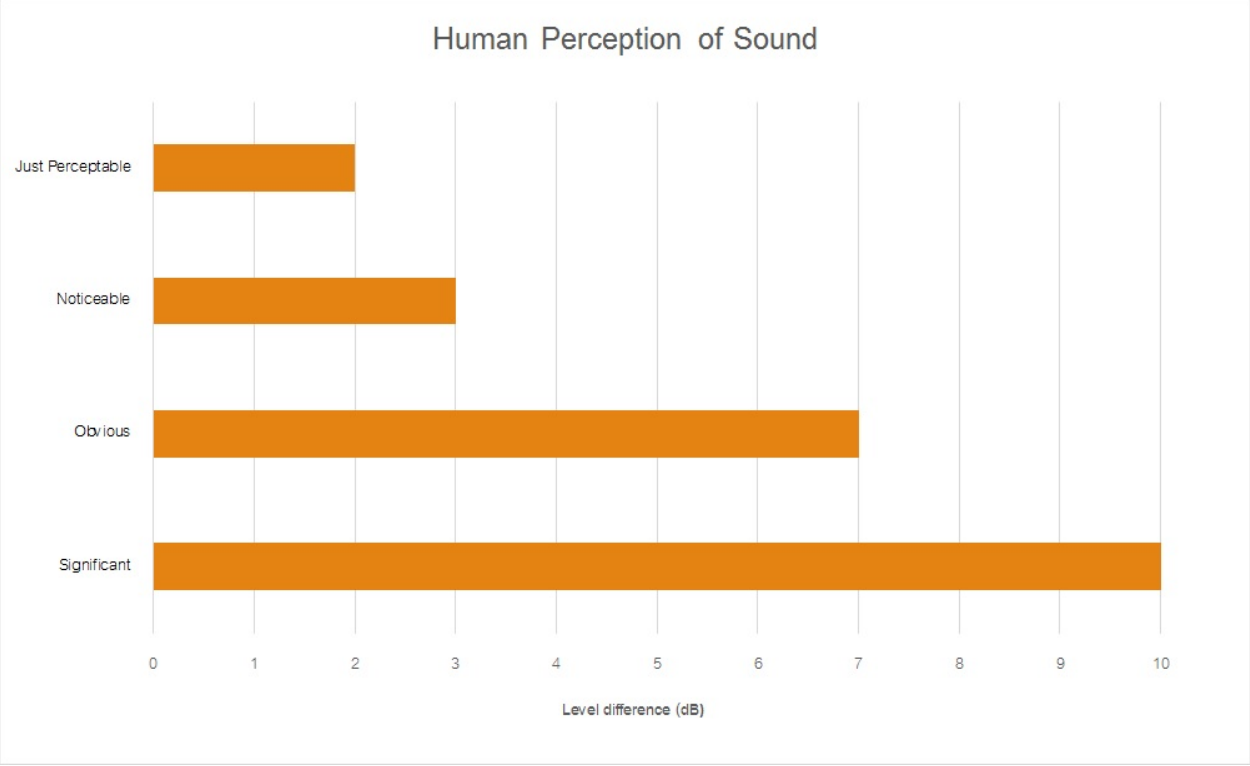
Table A1 provides a number of technical terms have been used in this report.

Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmax	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : = 10.log10 (W/Wo) Where : W is the sound power in watts and Wo is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA	
Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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Appendix 4

Groundwater Investigation Report

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memo

Katarina David

To:	Michael Walton, Bryan Grant and Peter Reeves
From:	Katarina David
CC:	
Date:	14th July 2019
Re:	Summary of groundwater conditions at Tinda Creek quarry – January to June 2019

Dear Michael, Bryan and Peter,

This memo provides groundwater status and changes at Tinda Creek quarry based on the groundwater levels measured in the period from January to June 2019. The groundwater level readings undertaken by Sydney Geotechnics Pty Ltd and Hy-tec staff were also reviewed to understand if any further discrepancies remain. The survey and bore elevation obtained by Hy-tec assisted in preparing the accurate levels in m Australian Height Datum (mAHD) so that they can be compared, and a groundwater map prepared to understand the flow.

Following the collation and analysis of data from monitoring bores at Tinda Creek quarry (Figure 1 and Figure 2) for the period from January to June 2019, the following is the summary of findings:

- During the first half of 2019 all bores show similar rate of natural groundwater level decrease which follows a decline in rainfall since January 2019 (Figure 1). The rainfall residual mass (RM) is shown on the same figure and represents the current rainfall trend based on the long-term data. The RM was below average since the start of 2019.
- The hydrographs for new bores indicate variation in the natural groundwater levels during this time ranging from 0.5 m in TP48 and TP49 to 0.8 m in TP44 and TP45.
- For TP51 the survey was not available at the time of preparation of this memo, therefore the hydrograph represents the depth to water from surface (Figure 2). There was also a significant discrepancy between two sets of readings for June with about 1 m difference. This is expected to be resolved in the next round of monitoring in September 2019.
- Further decrease in groundwater levels is also evident in some dataloggers being exposed to air as the groundwater level recedes.
- The most significant groundwater decline was observed in TP44 and TP45 (0.8 m) located upgradient from the quarry. All other bores including all old bores (Figure 3) showed similar groundwater recedance pattern. The water levels in TP51 are influenced by the replacement of the datalogger at greater depth over the past 18 months and inconsistent manual readings. However, the overall decreasing trend is evident.

- The groundwater flow map was created using the groundwater level data reduced to mAHD (Figure 4). The interpreted contours show the groundwater flow from east and southeast to the west and northwest. There is also a groundwater contribution in the eastern part of the site with groundwater flow form the north to the south.
- The difference in vertical hydraulic gradient (0.6 m) was greatest at piezometer nest TP46 and TP47 during first part of the year. Vertical groundwater gradient is downward from the shallow to deep hydrostratigraphic unit. However, at TP44 and TP45 the vertical gradient is much smaller and it is in the upward direction which indicates that the lower unit (Hawkesbury Sandstone) is confined.
- The review of two manual datasets collected in June indicates that although small differences still remain (<0.1 m) most of the groundwater level data are within the same range. The exception is TP51 bore where over a meter discrepancy was reported.
- The dataloggers need to be checked at each monitoring event to ensure that they are not suspended out of water. The value of datalogger recordings in all site bores has added significant value to the information on the hydraulic response to quarry activities.
- One datalogger units had failed during this period and is being replaced.

Regards,
Katarina David
Principal Hydrogeologist

Attachments
Figures 1 to 4

Figure 1 Hydrographs for new bores

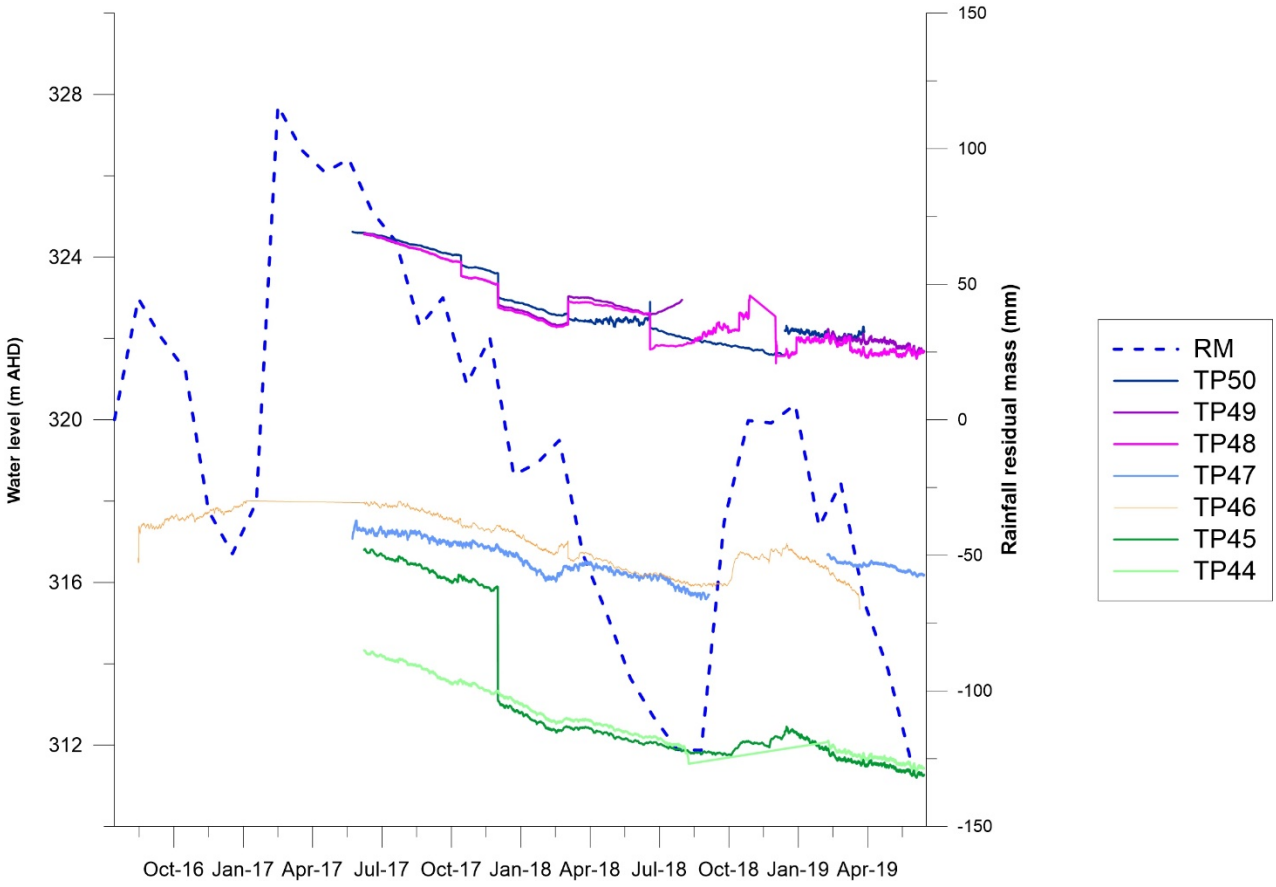


Figure 2 Hydrograph for bore TP51

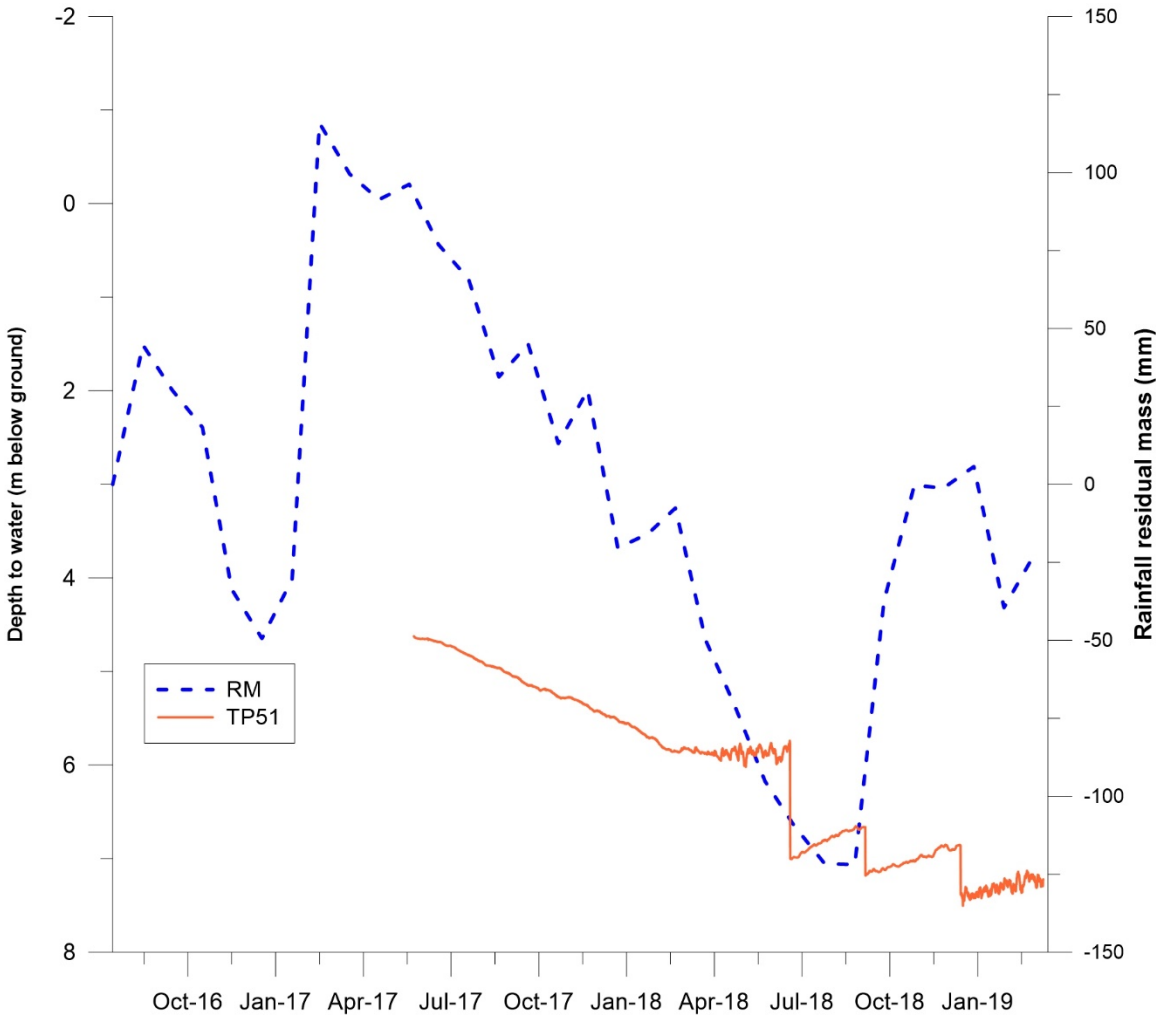


Figure 3 Hydrographs for old bores

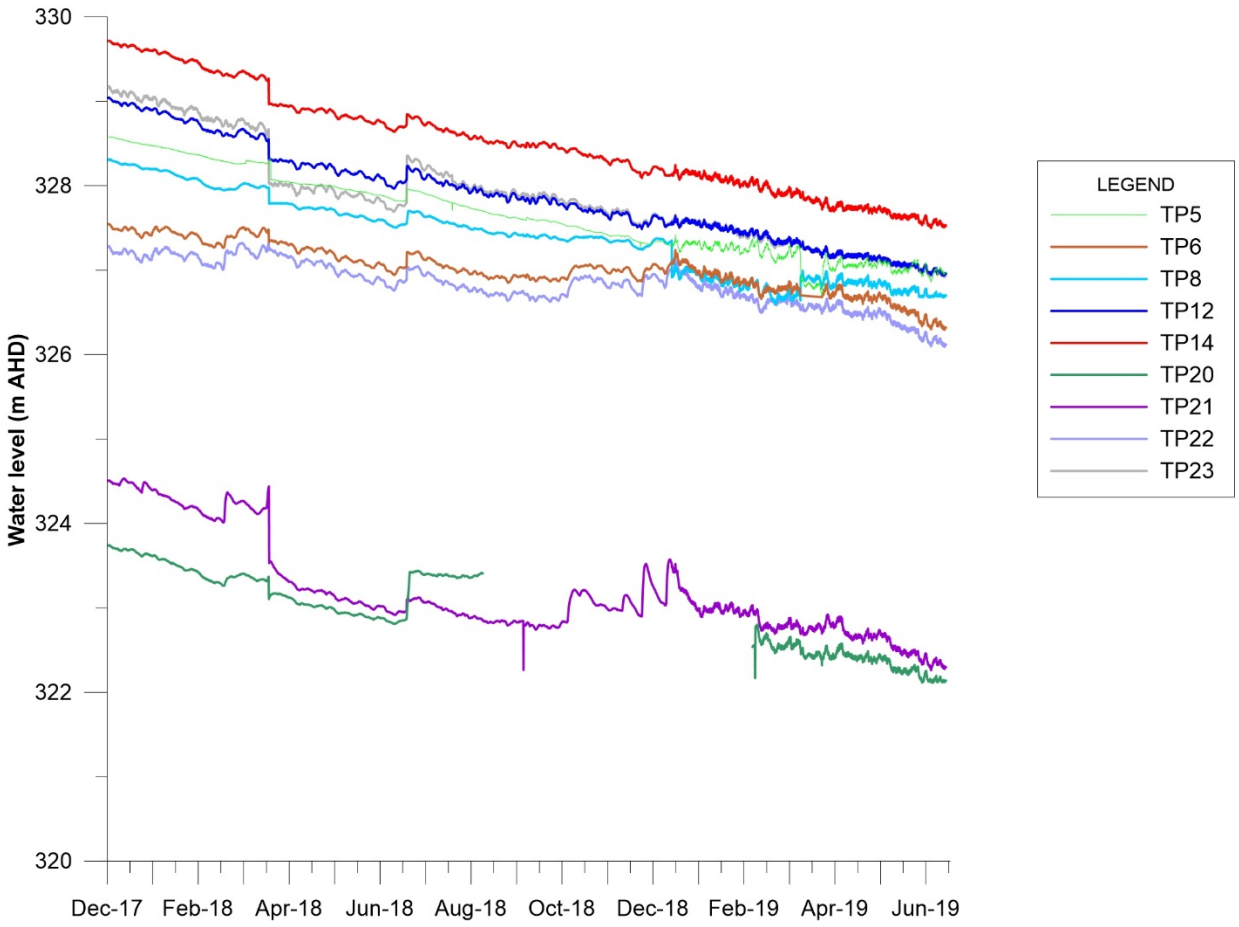
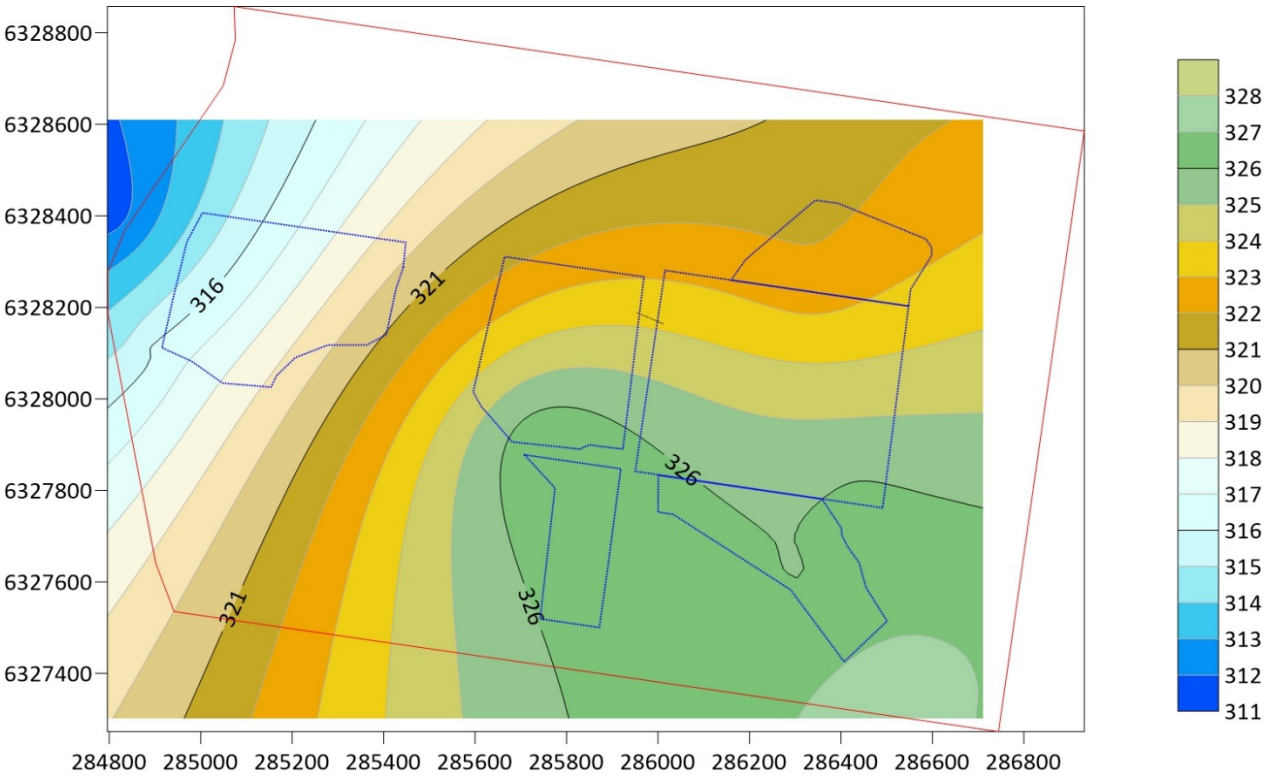


Figure 4 Groundwater flow map with interpreted contours (legend represents the groundwater contours in mAHD)



memo

Katarina David

To:	Michael Walton and Peter Reeves
From:	Katarina David
CC:	
Date:	13th Feb 2020
Re:	Summary of groundwater conditions at Tinda Creek quarry – January to December 2019

Dear Michael and Peter,

Following the collation and analysis of data from monitoring bores at Tinda Creek quarry (Figure 1 and Figure 2) for the period from January to December 2019, the following is the summary of findings:

- Most important trend during the year was continued low rainfall conditions. **Figure 1** shows the residual rainfall mass which represents monthly rainfall deviation from long term average (dotted blue line)
- All hydrographs have responded to a decrease in rainfall with a reduction in groundwater levels. This was significant as the trigger levels had to be reset resulting from dry condition not experienced since the bores were installed over 10 years ago.
- The hydrograph response (in both old and new bores) to rainfall across the site shows a similar natural recession slope during this period. However, the increase in groundwater levels following rainfall in late November 2019 did not occur at the same rate in all bores.
- Hydrographs for bores TP20, TP22, TP8, TP12, TP14, TP47 and TP44 all show stabilization in late November 2019 with no ongoing decrease.
- All hydrographs show similar slope for falling water levels, indicating that the major impact on the groundwater levels was dry weather.
- The maximum and minimum fluctuations (from Dec 2018 to Dec 2019) were observed in bores TP21 and TP46 ranging from 1.91 m to 0.22 m respectively. The difference in the magnitude is due to hydraulic conductivity and the steeper sloping eastern areas compared to almost flat laying western edge of the Quarry. The average change from the previous annual groundwater memo (December 2018) was around 1 m decrease.
- Groundwater flow direction has not been evaluated and this will be provided in the next reporting period in June 2020 given that the accurate survey is available.
- The vertical hydraulic gradient as observed at TP46 and TP47 at the western edge of the quarry was around 1 m similar to last year. Vertical groundwater gradient is upward from the deep to shallow hydrostratigraphic unit which indicates that the lower unit (Hawkesbury Sandstone) is confined.

- Previous annual report indicated problem with TP48 readings, which were confirmed in this assessment. The datalogger in TP48 has malfunctioned possibly due to fire problems at Tinda Creek during the last quarter of 2019.
- Additional continuous recording issues are observed in TP6 which had unusual datalogger readings and TP23 which had no reading since June 2019.
- The datalogger recordings in all site bores add significant value to the information on the hydraulic response to quarry activities and have enabled preparation of the request to amend the trigger levels.
- Although most loggers were performing satisfactory during the year; however, two units had failed (TP48 and TP23), and one had unusual readings which will be confirmed in the next monitoring period. Failed dataloggers need to be replaced.

Regards,
Katarina David
Principal Hydrogeologist

Attachments :
Figure 1 and Figure 2

Figure 1 Hydrographs for new bores

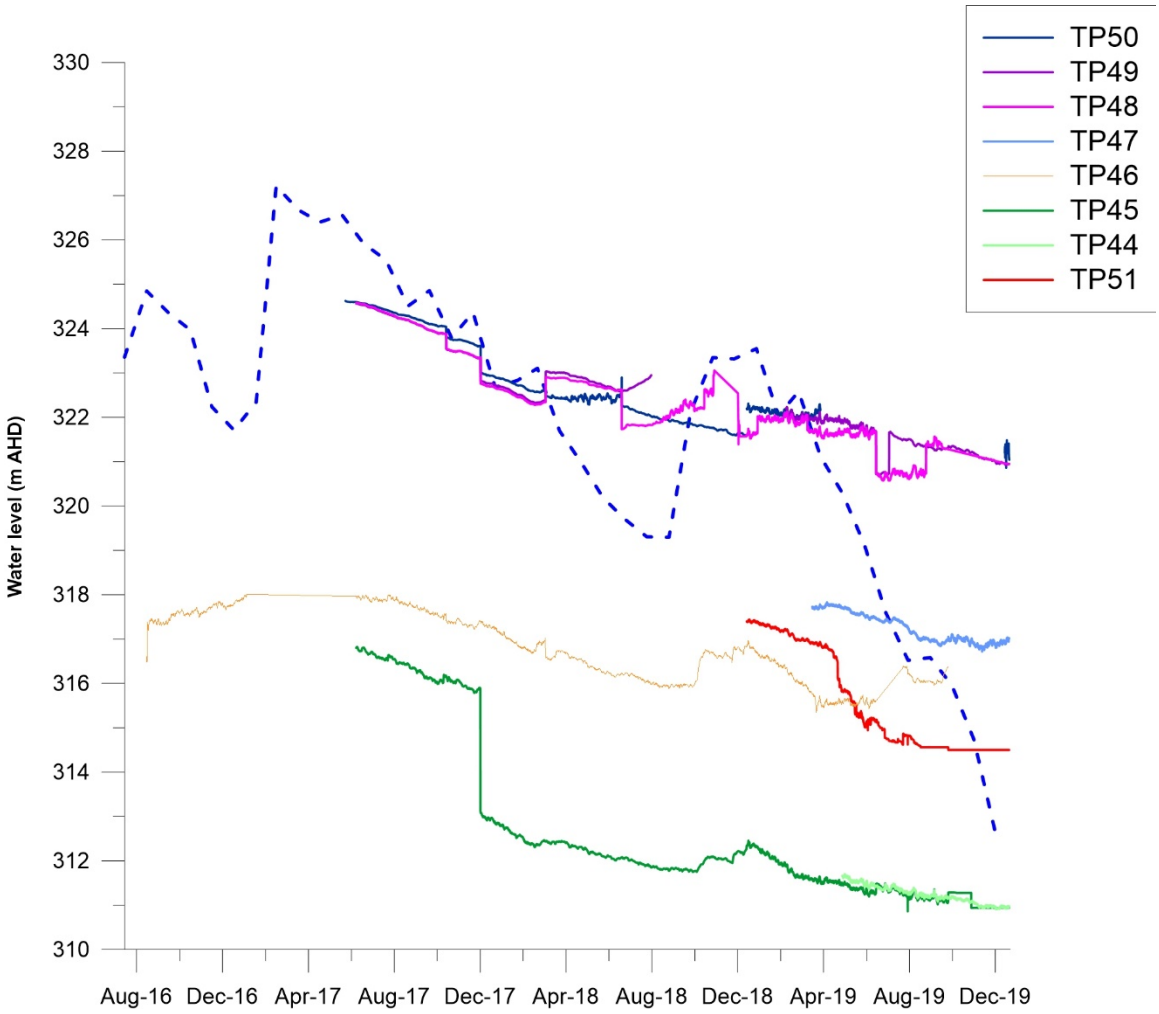
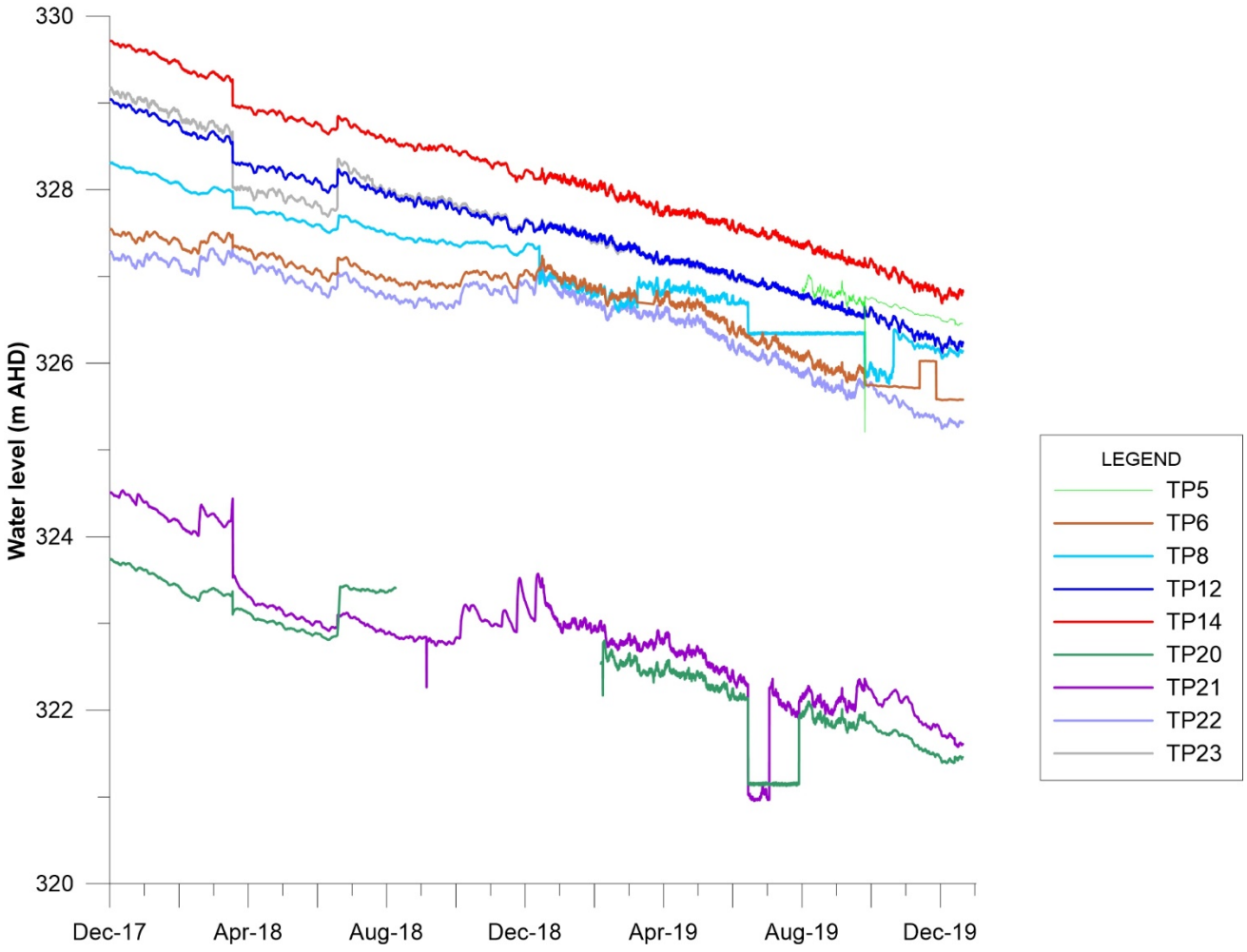


Figure 2 Hydrograph for old bores


330
328
326
324
322
320
Water level (m AHD)
Dec-17
Apr-18
Aug-18
Dec-18
Apr-19
Aug-19
Dec-19
LEGEND
TP5
TP6
TP8
TP12
TP14
TP20
TP21
TP22
TP23

Appendix 5

Offset Vegetation, Revegetation and Koala Monitoring Report 2019

Prepared by EnviroKey Pty Ltd

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Offset vegetation, revegetation and Koala monitoring report 2019

Tinda Creek Quarry

A report prepared for R.W. Corkery and Co. Pty Ltd on behalf of Hy-Tec Concrete and Aggregates (Hy-Tec)

FEBRUAY 2020

Report No. 19.EP-105

Citation

EnviroKey (2020) Offset vegetation, revegetation and Koala monitoring report 2019. A report prepared by EnviroKey for R.W.Corkery and Co Pty Ltd on behalf of Hy-Tec Concrete and Aggregates (Hy-Tec). Report No. 19.EP-105. Final Report. Version 2.0. 06.02.2020

EnviroKey	Project Title:	Offset vegetation, revegetation and Koala monitoring report 2019

Project Identifier :	19.EP-105
Project Location:	\EnviroKey Public\Projects\RWC

Revision	Date	Prepared by (name)	Reviewed by (name)	Approved by (name)
Draft	30.11.2019	HW, MH	SS	Steve Sass (CEnvP)
Draft v2	14.01.2020	SS	-	Steve Sass (CEnvP)
Final	06.02.2020	SS	-	Steve Sass (CEnvP)

Commercial In Confidence

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Table of Contents

Figures, Maps & Tables

1 INTRODUCTION

1.1 BACKGROUND

EnviroKey were engaged by R. W. Corkery and Co. Pty Ltd (RWC) on behalf of Hy-Tec Concrete and Aggregates (Hy-Tec), to carry out the second year of annual vegetation and Koala monitoring as part of the monitoring conditioned in the Tinda Creek Quarry Landscape Management Plan (LMP) (Umwelt, 2016).

Tinda Creek is a sand quarry located 23 kilometres north of Colo Heights in the Hawkesbury City local government area (LGA). The quarry is situated between Wollemi National Park (NPWS, 2001) to the west and Yengo National Park to the east (NPWS, 2019). The regional location is identified within **Map 1**.

The first monitoring survey was undertaken by Niche Environment and Heritage (Niche) in December, 2018 (Niche, 2019). Methodology used by Niche to undertake Koala and vegetation monitoring was based on the monitoring framework provided in the LMP, with the objective of long-term conservation and enhancement of ecological values of the project area and offset areas. The outcomes of that monitoring is used as a baseline against which the monitoring results of the current surveys are compared

1.2 THE PROJECT

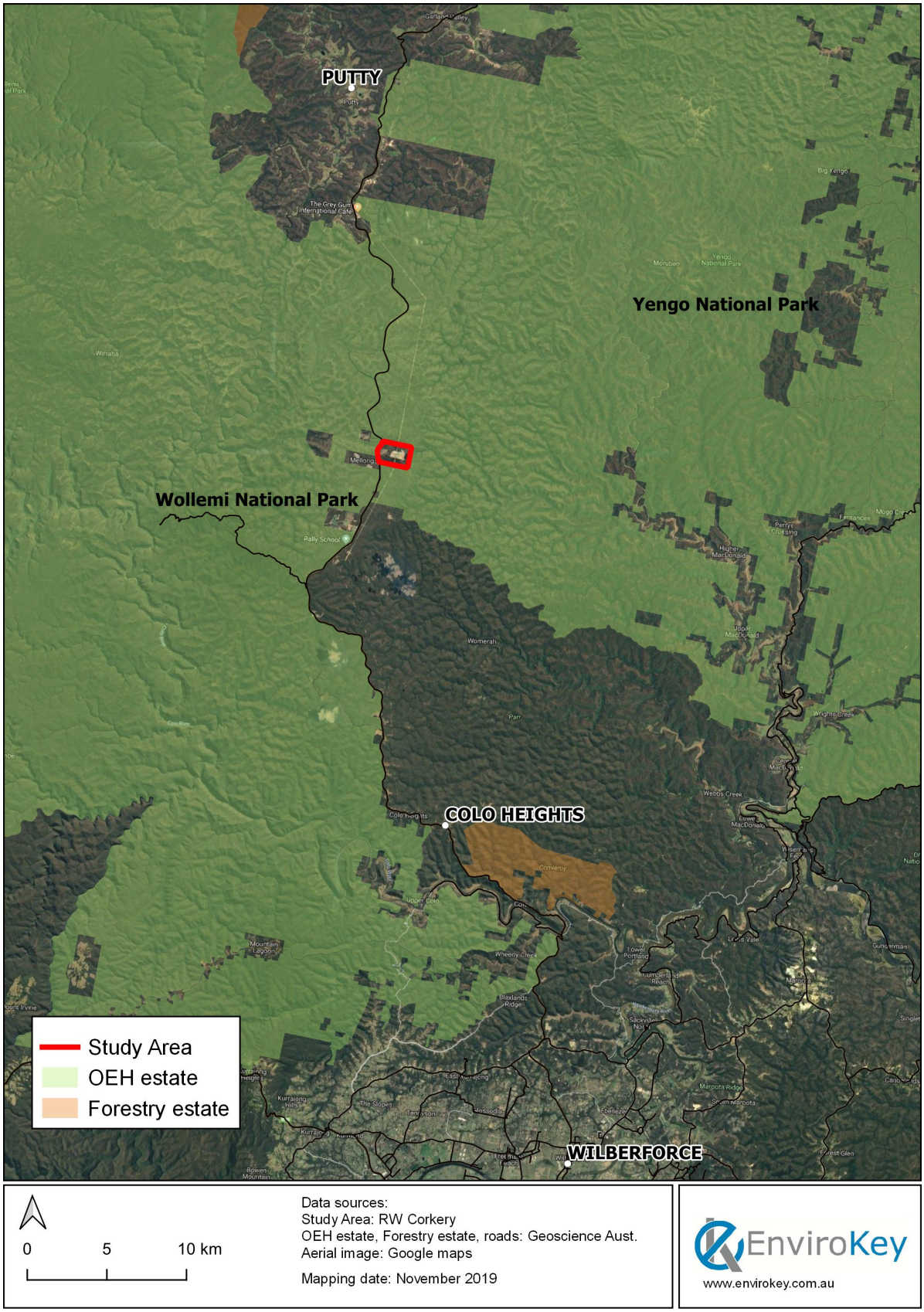
The Tinda Creek Quarry is currently a 300,000 tpa sand resource, approved for extraction from five domains. Throughout the project planning process, Hy-Tec have sought to avoid and minimise potential impacts on the ecological values of the project area which has included the avoidance and minimisation of disturbance to key vegetation communities, fauna habitats and threatened flora locations. About 108 hectares of adjacent land has been set aside for offsetting of the proposed disturbance area and will be managed for conservation in perpetuity with likely transfer into Yengo National Park. This is now referred to as the Biodiversity Offset Area (BOA). The study area, which includes the BOA is show on **Map 2**.

1.3 PURPOSE AND OBJECTIVES

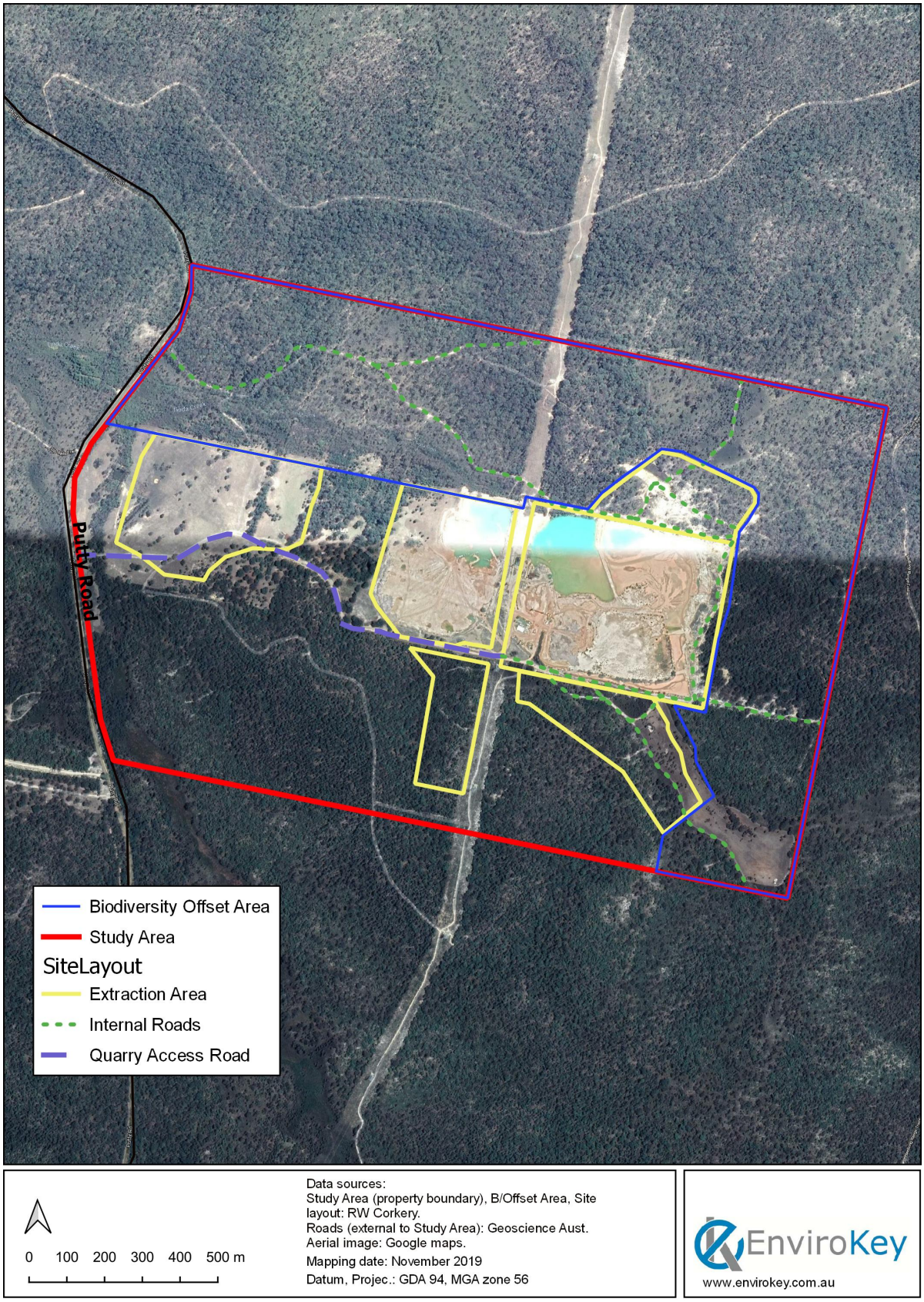
The LMP identifies the Tinda Creek Quarry project area as containing the following key ecological values:

- High conservation native vegetation communities and fauna habitats
- The presence of groundwater dependent ecosystems
- Threatened species habitat, including core habitat for the Koala (as described by SEPP 44).

This monitoring report aims to demonstrate compliance with performance targets and will contribute to on-going general management for the progressive rehabilitation of the quarry pit and ongoing management of the BOA.



Map 1: Regional location of the study area



Map 2: Identification of the Study Area and Biodiversity Offset Area

2 METHODOLOGY

2.1 QUALIFICATIONS AND EXPERIENCE OF PERSONNEL

This report was prepared by suitably qualified and experienced personnel under the authority of a Scientific License (SL100110) issued under Clause 22 of the *National Parks and Wildlife Regulation 2002* and section 122C of the *National Parks and Wildlife Act 1974* by the NSW OEH and an Animal Research Authority (09/2596) approved by, and in accordance with, the Animal Care and Ethics Committee (ACEC) of the Director-General of Industry and Investment NSW. Steve Sass is an Accredited Assessor under the NSW *Biodiversity Conservation Act 2016* (BAAS17047).

Details of the qualifications and experience of these personnel are provided (**Appendix 1**).

2.2 VEGETATION MONITORING

The monitoring design and methodology follows the methods specified in the LMP (Umwelt, 2016). Field sampling was conducted on the 21-25 October 2019 by senior botanist, Mark Harris, and ecologist, Harrison Warne (the previous round of monitoring was conducted in December 2018).

All 18 of the vegetation monitoring plots, established during the 2018 monitoring survey, were resampled in accordance with the methods described in Section 2.1 of the 2018 monitoring report (Niche, 2019). In summary, these comprised the 50x20m plot-transect 'Biometric' method as used in the BioBanking Assessment Methodology (BBAM) (OEH, 2014), with a number of extra parameters also recorded (see Section 2.1. of Niche, 2019).

The 6-point modified Braun-Blanquette cover-abundance score assigned to all species found in the 20mx20m survey plots is identified within **Table 1**.

Table 1: 6-point modified Braun-Blanquette cover-abundance score used in this study.

Score	Cover-abundance
1	Rare, few individuals present (three or less) and cover <5%
2	Common and cover <5%
3	Very abundant and cover nearing 5% OR Cover from 5% to <25%
4	Cover 25% to <50%
5	Cover 50% to <75%
6	Cover 75% or more

2.3 LOCATION OF PLOTS

All previously surveyed plot locations (18 plots) had been permanently marked and mapped and the number of plots stratified based on the quantified vegetation type across the Biodiversity Offset Area and the Rehabilitation Area (Niche, 2019). **Map 3** identifies the plot locations within the study area, while the GPS coordinates of each plot can be found in Appendix 1 of Niche (2019).

2.4 PRESENTATION OF VEGETATION SURVEY DATA

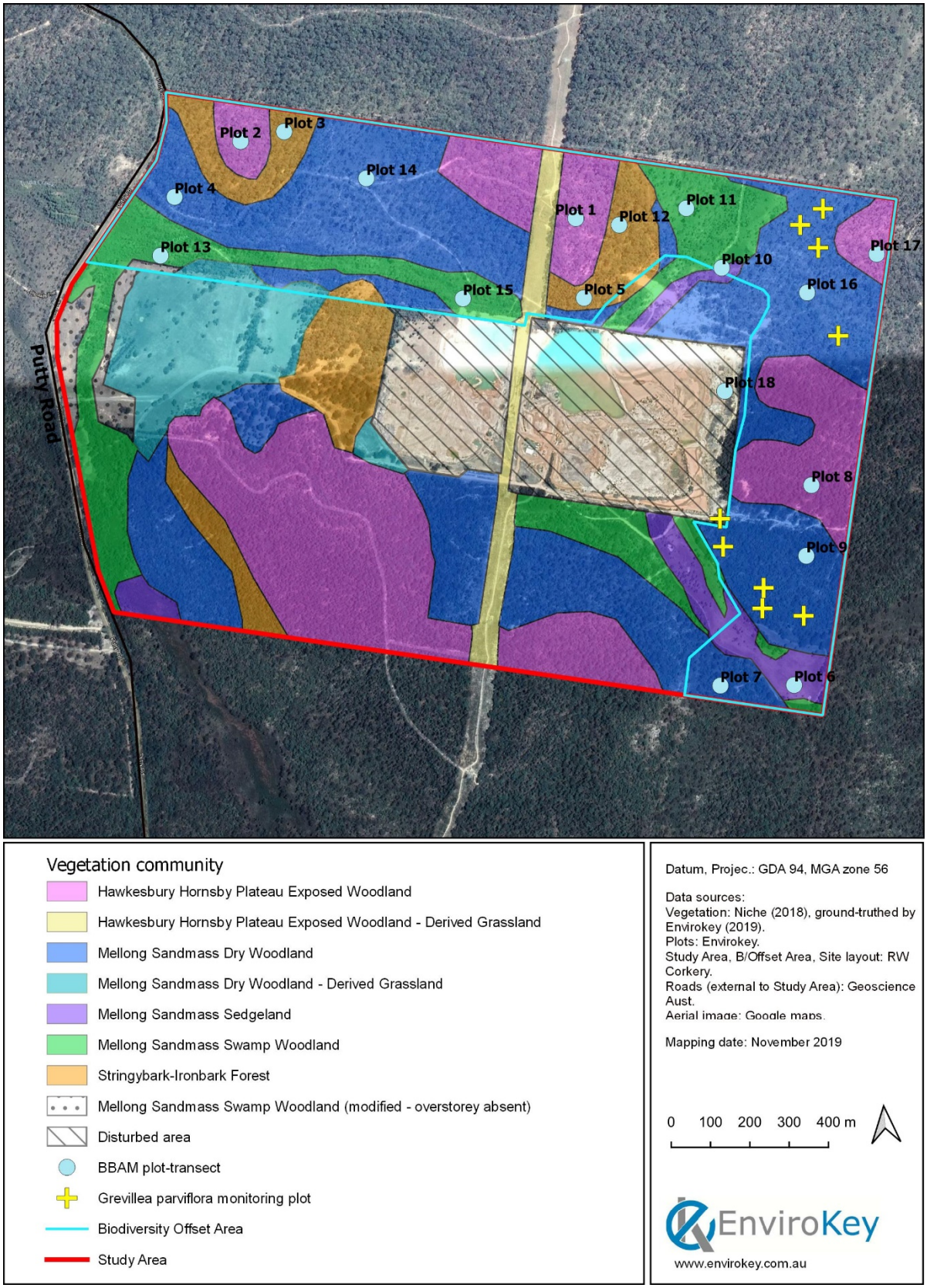
The previous monitoring report (Niche, 2019) included statistical analysis of the plot data. While such analysis techniques provided a detailed initial description and comparison of vegetation community composition and structure (e.g. it was useful in determining which vegetation community the rehabilitation site vegetation best aligned with), it is not deemed necessary on an annual basis. Instead, it is considered that tabulated data, especially that from the 20x50m plot-transects (which was designed by OEH specifically for rapid and simple monitoring of vegetation structure, condition and species richness) is the most appropriate.

2.5 PHOTO REFERENCE POINTS

At the beginning of each transect (southern end for most) a photo reference was taken to allow for visualisation for the changes in vegetation and habitat type over time. The images taken presented in the 2018 field survey report also helped identify the exact plot orientation (Niche,2019). Photo reference points from the 2019 monitoring survey are presented in **Appendix 3**.

2.6 MONITORING OF GREVILLEA PARVIFLORA SUBSP. PARVIFLORA ABUNDANCE PLOTS

All nine of the 10mx10m *Grevillea parviflora* subsp. *parviflora* monitoring plots, established during the 2018 monitoring survey, were resampled, but noting they are unlikely to be in the exact same location as previous year/s, as no information was available to ascertain exactly where each plot occurred in relation to the previously installed single peg at each site. Therefore, this year's data cannot be compared directly to 2018 data. During the current survey, the existing peg was used as the centre-point for each 10x10m quadrat, with the boundaries running due north/south/east/west. Grevillea plots are identified on **Map 3**.



Map 3: Location of the BBAM Plots and Grevillea Plots.

2.7 KOALA POPULATION MONITORING

Koala (listed as Vulnerable under the BC Act and EPBC Act) has been historically recorded in the Tinda Creek region and during the 2018 monitoring survey (Niche, 2019). Koala monitoring followed the methodology established by Niche (2019).

Every mature eucalyptus tree within the marked vegetation plots was carefully inspected by an ecologist familiar with Koala signs. These inspections included scat searches across the entirety of the plot and observing for scratches on the trees. The tree canopy was also thoroughly searched for Koala individuals.

Nocturnal transects were conducted on two nights during the survey period. Two onsite ecologists followed similar transect lines as the previous monitoring surveys (2018). A pre-recorded call of a male Koala was projected approximately every 200 metres, with the intention of simulating another male in the area to call back to the recording.

2.8 LIMITATIONS

The extended dry conditions are likely to have hampered the detection of more cryptic plant species (and annuals), with flowering rates being low at the time of this survey. To help overcome this, the species list from the 2018 monitoring was used as a reference, with the rare/cryptic species found on that list being searched for intensively in each plot during the current survey. Survey timing is also a factor, e.g. most orchids species flower during summer. Some individual plant samples were in a juvenile state or were annual species that had already died. Therefore, not all plants found could be accurately identified.

Many species of fauna are highly mobile, so false absences plague short-term monitoring surveys. This is a major limitation of any ecological study.

3 RESULTS

3.1 VEGETATION MONITORING RESULTS

3.1.1 Species diversity and richness

The current survey found a total of 157 flora species during the plot-transect surveys, comprising 152 native and 5 exotic species (species list per plot, with cover and abundance data, listed in **Appendix 2**). The number of plants, shrubs and ground cover species was consistent with the 2018 field survey, with Plot 8 having the highest number of plants species (38) (**Table 2**).

Table 2: Species richness for the three sub-plots examining: ground cover (4 m^2), shrubs (100 m^2) and all species (400 m^2).

Plot Number	Vegetation Community	No. Plant Species in 20x20m plot	No. Shrub Species in 10x10m plot	No. Ground cover Species in 2x2m plot
Biodiversity Offset Area				
Plot 1	Hawkesbury Hornsby Plateau Exposed Woodland	29	3	6
Plot 2	Hawkesbury Hornsby Plateau Exposed Woodland	27	3	7
Plot 3	Stringybark – Ironbark Forest	22	2	6
Plot 4	Mellong Sandmass Dry Woodland	32	5	6
Plot 5	Stringybark – Ironbark Forest	29	4	5
Plot 6	Mellong Sandmass Sedgeland	10	1	4
Plot 7	Mellong Sandmass Dry Woodland	32	7	9
Plot 8	Hawkesbury Hornsby Plateau Exposed Woodland	38	6	3
Plot 9	Mellong Sandmass Dry Woodland	30	5	12
Plot 10	Mellong Sandmass Sedgeland	15	0	3
Plot 11	Mellong Sandmass Swamp Woodland	26	4	6
Plot 12	Stringybark – Ironbark Forest	20	5	3
Plot 13	Mellong Sandmass Swamp Woodland	19	4	2
Plot 14	Mellong Sandmass Dry Woodland	26	3	6
Plot 15	Mellong Sandmass Swamp Woodland	18	3	5
Plot 16	Mellong Sandmass Dry Woodland	32	5	8

Plot Number	Vegetation Community	No. Plant Species in 20x20m plot	No. Shrub Species in 10x10m plot	No. Ground cover Species in 2x2m plot
Plot 17	Hawkesbury Hornsby Plateau Exposed Woodland	28	4	5
Rehabilitation Area				
Plot 18	Regenerating Mellong Sandmass Woodland	27	4	4

3.1.2 Occurrence and abundance of weeds

Weed occurrence and abundance appears to be similar to that described in the 2018 monitoring report (Niche, 2019). Weeds are only considered to be having a major direct impact in the regeneration area, which is infested with *Eragrostis curvula* (African Lovegrass) along with other less prominent weeds, e.g. plot 18 in that area, contained 38% weed cover, primarily comprising African Lovegrass , with *Andropogon virginicus* (Whisky Grass) and *Stenotaphrum secundatum* (Buffalo Grass) making up the remainder (site shown in **Figure 2**).

Within the biodiversity offset area, minor areas of concern are scattered along the vehicular tracks, the electricity easement and other small areas previously subject to disturbance (**Map 5**). A similar pattern occurs around the fringes of the offset area (e.g. the works site, front paddock and Putty Road), where weeds encroach into bushland for up to 1 or 2 metres in intermittent locations (**Map 5** and site photos below in **Figure 1**).

Figure 1: African Lovegrass and Whiskey Grass, scattered along tracks within biodiversity offset area.

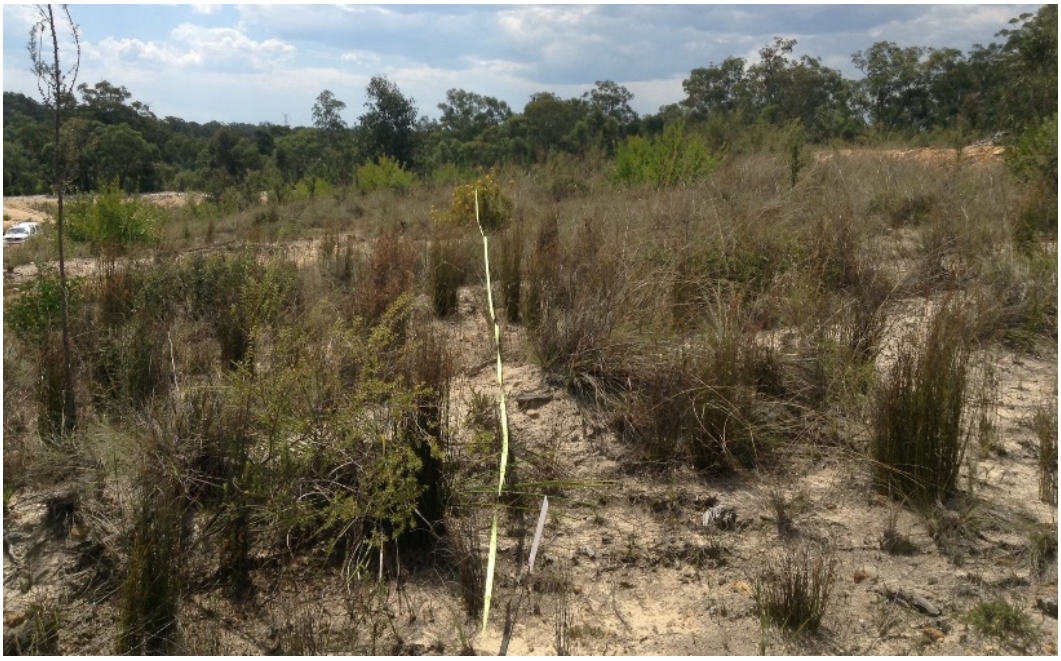


Figure 2: Showing heavy African Lovegrass infestation, a lack of eucalypt regeneration and poor topsoil/mulch/leaflitter cover.

Other weeds found in the offset area (and the works site), all in low abundance only, were *Hypochaeris radicata* (Catsear) and *Conyza bonariensis* (Flaxleaf Fleabane). Two weeds recorded in 2018, *Chloris gayana* (Rhodes Grass) and *Richardia humistrata,* were not found during the 2019 monitoring survey.

3.1.3 Threatened species and habitat

Grevillea parviflora subsp. *parviflora* was recorded at Plot 16, as it was in 2018. Random meanders in the wider vicinity found this species to be proliferating in a similar distribution to that previously mapped. Roughly 40% plants were in flower, none had reached fruiting stage. About a quarter of all plants were considered to be juveniles. The species appears to regenerate following fire, based on its strong occurrence in vegetation with recent/moderately recent fire scars, while being strongly associated with the Mellong Sand-mass habitat, and the recent wildfire (post-2019 monitoring survey) provides an excellent opportunity for future post-fire response monitoring.

Six of the plots had counts of between 1 and 38 individuals (**Table 3**). The three sites lacking any plants are almost certainly due to variation in site location from the last survey (noting that individuals were found adjacent). As with the wider population, approximately 40% of individuals were considered to be juvenile and none were in fruit.

Table 3: Results from 2019 Grevillea parviflora plot monitoring

Site	Count	No. in flower	No in fruit	Comment
1	38	15	0	
2	7	4	0	Dense *Angophora bakeri* regen.
3	25	5	0	
4	1	0	0	
5	19	9	0	
6	35	11	0	
7	0	0	0	Sml No.s scattered near by
8	0	0	0	2 within 5m
9	0	0	0	8 within 5m

No new records of *Grevillea parviflora* subsp. *parviflora* were noted outside of its known distribution in the study area during the current monitoring survey. No other threatened flora species were recorded during the monitoring surveys.

Four threatened fauna species were also detected within the study area during the 2019 monitoring surveys. These being:

- Koala (vulnerable, BC Act and EPBC Act)
- White-bellied Sea-eagle (hunting at large dam) (vulnerable, BC Act)
- Dusky Woodswallow (vulnerable, BC Act)
- Little Lorikeet (vulnerable, BC Act)

The locations of these are provided on **Map 4**.

3.1.4 Composition, structure and function

The BBAM provides a transparent, and rapid method for determining the composition, structure and function of native vegetation. **Table 4** provides the results of the 2019 monitoring surveys for each plot.

Table 4: BBAM structure, function and condition data from the 20x50m plot-transects (2019). (The overstorey regeneration value of 1 means that all overstorey species are regenerating, as assessed over the wider vegetation zone, not just with in the 20x50m plot).

Plot No.	Vegetation community	*Native Plant Species*	*Native Overstorey Species Cover*	*Native Midstorey Species Cover*	*Native ground cover grasses*	*Native ground cover shrubs*	*Native ground cover other*	*Exotic Plant Cover*	*Number trees with hollows*	*Overstorey Regen.*	*Fallen Logs (m)*
1	Hawkesbury Exposed Woodland	29	18	5	6	12	14	0	1	1	38
2	Hawkesbury Exposed Woodland	27	23	10	8	8	26	0	3	1	8
3	Stringybark Ironbark	22	22	34	24	0	8	0	0	1	27
4	Dry Woodland	32	48	22	20	4	46	0	1	1	31
5	Stringybark Ironbark	29	27	25	8	10	18	0	0	1	9
6	Sedge swamp	10	0	0	6	2	60	0	0	0	0
7	Dry Woodland	32	15	15	2	38	42	0	2	1	25
8	Hawkesbury Exposed Woodland	38	20	15	10	6	38	0	3	1	49
9	Dry Woodland	30	14	34	10	24	46	0	1	1	11
10	Sedge Swamp	13	2	0	2	2	82	0	0	1	0
11	Swamp Woodland	26	8	22	6	74	76	0	2	1	25
12	Stringybark Ironbark	20	11	21	40	0	8	0	0	1	37
13	Swamp Woodland	19	2	58	4	6	38	0	0	1	0
14	Dry Woodland	26	22	30	10	18	52	0	3	1	12
15	Swamp Woodland	17	11	46	42	0	70	0	0	1	3
16	Dry Woodland	32	28	29	8	24	62	0	0	1	6
17	Hawkesbury Exposed Woodland	27	30	12	16	18	12	0	0	1	8
18	Revegetation site	27	0	21	0	12	14	38	0	0	0

3.1.5 Overstorey species composition in relation to Koala habitat

Overstorey species composition within the 50 m x 20 m plots was compared with Koala survey data to investigate the eucalypts species (and vegetation communities) preferred by the Koala (**Table 5**). Given that there was only 10 months since the last survey and that no disturbance to native vegetation has occurred in the study area during that period, tree count data was assumed to be the same as previous. The study area contains three preferred feed tree species for the Koala, *Eucalyptus punctata* (Grey Gum), *E. sclerophylla* (Scribbly Gum) and *E. parramattensis* (Parramatta Red Gum), as highlighted in the **Table 5**, below. During the current survey, signs of Koala (scats or tree scratches) were found in five of the 17 offset area vegetation plots, namely plots 1, 4, 7, 11, and 12. Four of these plots (1, 4, 7, 11) contained at least one preferred feed tree species, while one (plot 12) contained none of the eucalypt (however, they are known form nearby, e.g. plot 13). The 2018 monitoring survey found signs of Koala in plots 11 and 13.

Table 5: Overstorey tree stem counts within 0.1 ha plots and koala presence records.

Species	4	7	9	14	16	11	13	15	1	2	8	17	3	5	12
Vegetation Community	**Mellong Sandmass Dry Woodland**					**M S Swamp Woodland**			**Hawkesbury Expose Woodland**				**Stringybark Ironbark**		
Koala signs 2019	**1**	**1**	0	0	0	**1**		0	**1**	1	0	0	0	0	**1**
Koala signs 2018	0	0	0	0	0	**1**	**1**	0	0	0	0	0	0	0	0
Angophora bakeri	7	5	15		10	1						2			1
Angophora costata									9	19		4		5	
Angophora floribunda	14												12	1	5
Corymbia eximia											9	7		8	
Corymbia gummifera									7	6	9			3	1
Eucalyptus crebra														2	
Eucalyptus dead											2				
Eucalyptus fibrosa												3	1	9	5
Eucalyptus parramattensis	1			5	9	4	16	5							
Eucalyptus piperita									1						
Eucalyptus punctata	5								3	1	4				
Eucalyptus sclerophylla	45	5		12	2	3		2							
Eucalyptus sparsifolia									3	7	10	4	11	7	14
Eucalyptus squamosa	1			1											
Total tree stems	**72**	**10**	**26**	**18**	**21**	**9**	**17**	**7**	**24**	**33**	**34**	**20**	**24**	**35**	**35**

3.2 KOALA SURVEYS

3.2.1 Koala distribution and abundance

Koala signs was detected during the 2019 monitoring survey. While no individual Koala were observed and no responses were heard from call playback, Koala scats and signs were detected. This was also the same method of detectability in the 2018 monitoring survey.

As suggested in the 2018 monitoring by Niche (2019), potential scats and scratch trees are consistent but not definitive evidence of Koala presence. The high abundance of Brush-tailed Possum and resulting possum scats appear superficially similar to Koala scats.

Scratch trees were recorded at a number of sites. The age and density of scratches was also noted as being either a high, moderate or low use tree. An abundance of Possum and Lace Monitor could be responsible for many of the marks left on the trees, however in some instances, both scats and scratch marks consistent with Koala make their presence considerably likely (**Figure 3**).

Figure 3: Scratch trees potential evidence of Koala presence.

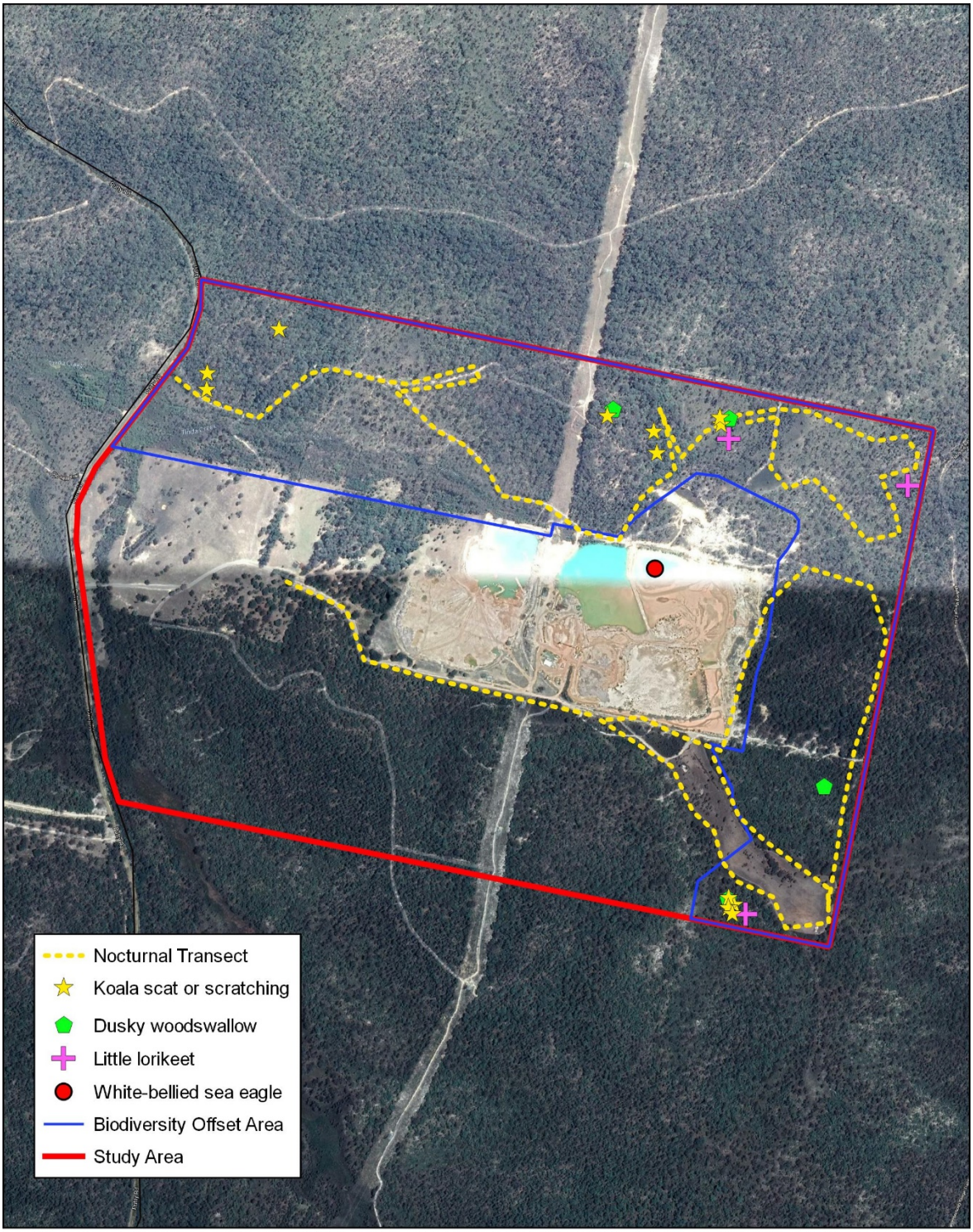
3.3 OTHER FAUNA SPECIES

During nocturnal transects all vertebrate species were recorded (**Table 6**). No threatened species were recorded during the nocturnal transects. The large number of frog species recorded is due to the permanent water within the Tinda Creek Quarry Project Area. It is likely that other species of frog such as Red-crowned Broodfrog (*Pseudophryne australis*) (previously recorded by Niche, 2019) were undetected due to lack of ephemeral water in the BOA.

Table 6: Species recorded during nocturnal surveys.

Common Name	Scientific Name	Nocturnal 1	Nocturnal 2
Bleating Tree Frog	*Litoria dentata*	Y	
Broad-palmed Rocket Frog	*Litoria latopalmata*	Y	Y
Clicking Froglet	*Crinia signifera*	Y	
Common Brushtail Possum	*Trichosurus vulpecula*	Y	Y
Eastern Sedge Frog	*Litoria fallax*	Y	Y
Eastern Stone Gecko	*Diplodactylus vittatus*	Y	
Emerald-spotted Tree Frog	*Litoria peronii*	Y	Y

Common Name	Scientific Name	Nocturnal 1	Nocturnal 2
Fallow Deer	*Dama dama*	Y	
Ornate Burrowing Frog	*Platyplectrum ornatum*	Y	
Red-necked Wallaby	*Macropus rufogriseus*	Y	Y
Southern Boobook	*Ninox novaeseelandiae*		Y
Striped Marsh Frog	*Limnodynastes peronii*	Y	
Sugar Glider	*Petaurus breviceps*		Y



Map 4: Nocturnal transect locations and threatened species recording during the 2019 monitoring survey

4 DISCUSSION

4.1 VEGETATION MONITORING

The results of the 2019 monitoring survey are broadly comparable to the 2018 monitoring survey. In 2018, 166 native and 7 exotic species were recorded. The 2019 reduction in species richness (and related species diversity) since the last monitoring survey is as expected, given the exceptionally long period of dry conditions and above average temperatures having been experienced through both 2018 and 2019. Not surprisingly, it was mainly annuals and the more sensitive perennial forbs/herbaceous plants found during 2018 that were depauperate in the 2019 monitoring survey, e.g. *Brunonia australis*, *Thysanotus* sp., *Wahlenbergia* sp., *Glycine tabacina*, *Liparophyllum exaltatum*, various lilies/wetland species, various orchids (4 recorded December 2018, 1 recorded in 2019). Three species not previously recorded on site were found this monitoring survey: *Burchardia umbellata*, *Cryptostylis* sp. and *Stypandra glauca*. It is also noted that most of the species not found this survey were only found at a single site in 2018; and at very low cover/abundance (i.e. typically 0.1 % cover and <=3 individuals). This pattern is reflected in a comparison of results from the 2mx2m sub-plots, whereby common and abundant groundcover species enabled similar species richness to be recorded this year as the last, but with this year's 20x20m plots consistently having less species, indicating that insufficient rare species were present (or detectible) to increase species richness counts significantly as survey area increased (**Table 2**).

Therefore, the current drop in species richness and diversity is not of concern, with all vegetation across the biodiversity offset area, not just that within formal survey plots, considered to be in good condition overall, considering the current climatic conditions, with species richness and diversity being typical for each community type and considering any previous land uses and disturbances, including fire (natural and human induced), land clearing, timber extraction and recent activities in certain areas, e.g. slashing around a hydrology survey point (2018), encroaching into part of Plot 6.

4.2 VEGETATION COMPOSITION, STRUCTURE AND FUNCTION

At the time of the current field surveys (October 2019), the study area had not been subjected to any significant disturbance since the previous surveys of 2018. The only change in vegetation condition, as determined from the 20mx20m plots was that species richness had decreased over the year since the last survey, as discussed previously. Other than this factor, all other attributes are similar to those recorded in 2018 (any variation between years in hollow-bearing tree and fallen log values are likely a result of inconsistency between assessors as no major disturbance was recorded). The BBAM assessment results are provided in **Table 4** . Of note is the current condition of the Site 18 (within the rehabilitation area) compared to the others that are generally in good condition. For example Site 18, despite containing a similar number of native species to many of the offset area sites, has no overstorey cover, no native grass cover, no fallen log habitat and has a dense cover of exotic species.

At the time of the 2019 monitoring survey, scattered weeds were present along most tracks. They were also scattered at the fringes of the extraction area, the cleared electricity easement, the cleared front paddock and to a lesser extent the Putty Road edge. Physical disturbance to native vegetation/habitat was a minor issue, with a few areas having been disturbed, e.g. where vehicle turn around near hydrology monitoring sites.

4.3 WEEDS

The transmission line that traverses the study area, as well as Putty Road to a lesser extent, are likely to be source populations for weeds. With disturbances around the study area, weeds then become established. **Map 5** identifies the locations of key weed invasions into native vegetation and we recommend these are key monitoring and control locations.

There may also be an opportunity to close irrelevant vehicle tracks with the biodiversity offset area, and allow them to naturally regenerate. Currently, some weed species are within the track itself, or within 1 metre of it. By allowing the vegetation to regenerate over the track, weed invasion into adjoining native vegetation would be greatly minimised.

4.4 KOALA MONITORING

The presence of a Koala population using the study area was confirmed during the 2019 monitoring surveys. However, the November 2019 wild fire is likely to have had a significant negative impact on the Koala population given that they are typically in low numbers across Hawksbury sandstone geology. The wild fire was not caused by the quarry operations, nor was the ignition point within the study area. Nonetheless, prior to the wild fire, it is probable that Koalas in the Tinda Creek area were already occurring at a low density across the landscape given the results of the 2018 and 2019 monitoring surveys.

4.5 GOSPERS MOUNTAIN WILDFIRE

The Gospers Mountain Wildfire started as the result of a lightning strike on October 26, 2019. 16 days later, on November 12, 2019, the bushfire impacted the site at around 11pm. Significantly, almost all of the site was burnt.

Post-wildfire, two ecologists visited the site once the Putty Road was reopened and the area was considered safe to enter for the purpose of a post-fire inspection. This inspection was carried out on January 13, 2020.

The wildfire entered the site on the southern and south-east flank where, the bushfire appears to have burnt hot, given the level of impact observed. All trees have been impacted, with a complete loss of canopy observed. In the northern portions of the site, the canopy is largely intact confirming the wildfire was significantly cooler through this area.

Epicormic growth was observed throughout areas where the canopy was completely removed, and is a typical response by eucalypts in response to damage by fire or drought related stress.

Despite dry conditions due to the drought, post-fire regeneration is occurring consistently with the timeframe of the bushfire event.

The wildfire also impacted the known population of *Grevillea parviflora* subsp. *parviflora* throughout the site. Based on our inspection, it is likely that all known plants were burnt by this wildfire. Some regeneration was observed in the post-fire environment and all from suckering. No seedling recruitment was observed, however, with an absence of any rain post-fire to the time of the field inspection (two months), this is not surprising.

While inappropriate fire regimes are considered a threat to this species (high frequency fires) as these can result in a decline in soil seedbank and reduced seedling recruitment, fires are also listed as an activity known to assist this species. It is too early to ascertain if the Gospers Mountain Wildfire has had a positive or negative impact on the population within the site.

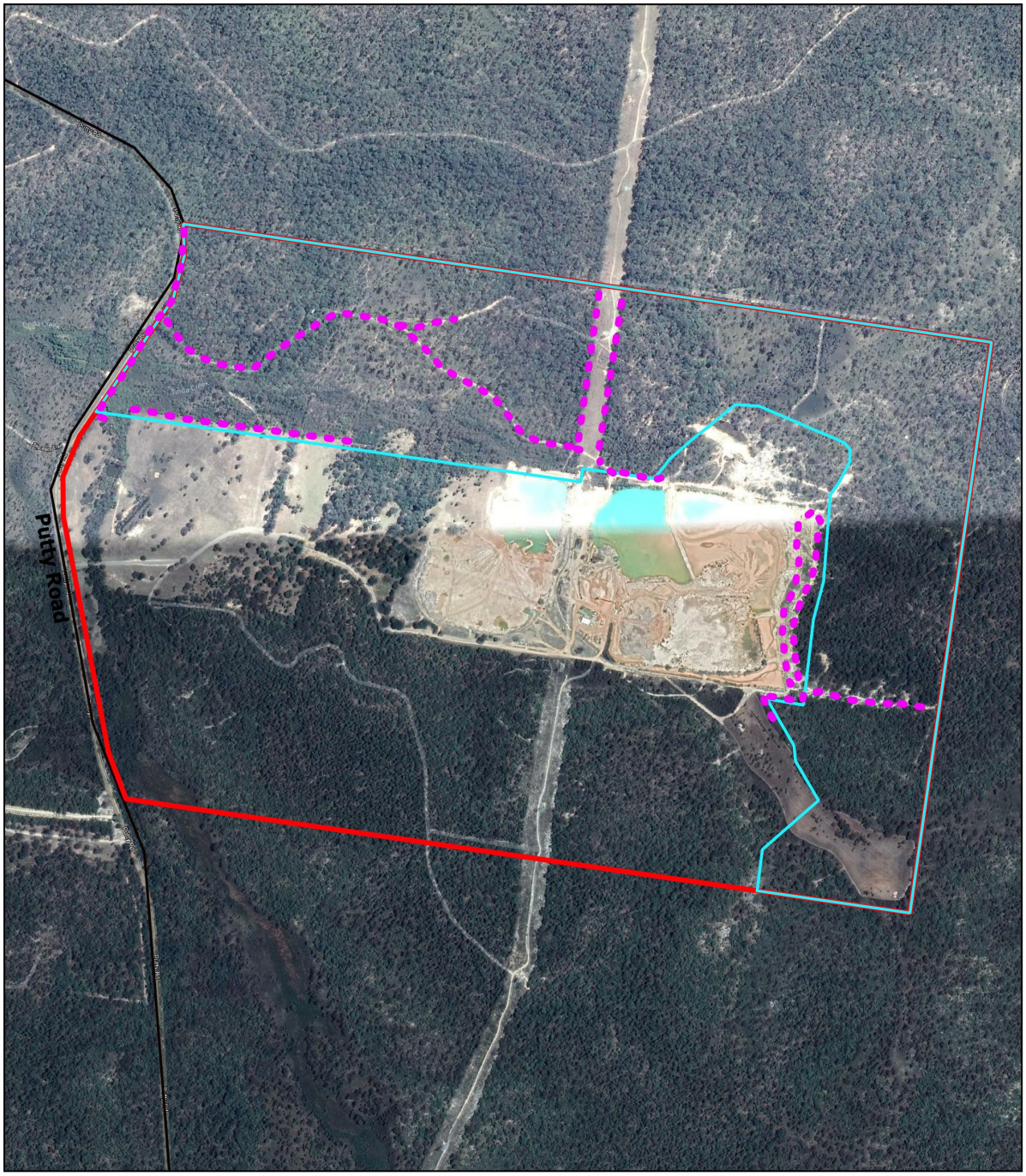
One individual Koala has been sighted by Tinda Quarry personnel within the site post-fire. No significant injuries including burns were noted on the individual. The animal was observed walking along the ground and continued to walk through the site and into the adjacent Yengo National Park.

The wildfire is now more than 512,000 hectares in size and was recently announced (12/01/2020) as 'contained'.

Figure 4: Vegetation that has been subjected to a hot wildfire in the south-eastern portion of the site (at main Grevillea population area)

It is not expected that the presence of the Quarry operations would hamper post fire regeneration, however weed management will be important to ensure that weeds do not spread to regenerating areas.

Figure 5: Vegetation that has been subjected to a cooler wildfire in the northern portion of the site (noting canopy largely intact)



Map 5: Recommended weed monitoring and control locations.

4.6 LANDSCAPE MANAGEMENT PERFORMANCE CRITERIA

The approved LMP contains a set of performance criteria for both the rehabilitation and the Biodiversity offset area. **Table 7** provides commentary of the matters reviewed during the monitoring survey and a response.

Table 7: Landscape Management Performance Criteria

Aspect	Performance Criteria	Comments
Rehabilitation Area		
Native vegetation	Revegetation area contains flora species characteristic of the native vegetation communities of the study area	The flora assemblage present during the 2019 monitoring survey contained species that are characteristic of the Mellong Sand-mass vegetation communities. This would be considered to be an acceptable level of regeneration given the current dry conditions. However, post-wildfire, all vegetation was substantially burnt.
	Second generation tree seedlings are present, or likely to be (ie, evidence of fruiting of native species observed)	Tree species were germinating in the regeneration area, but these were not sufficiently advanced to have flowered. With consideration of the age and very dry conditions, this is acceptable. However, post-November 2019, the wildfire substantially burnt all vegetation.
	More than 75 per cent of trees are healthy and growing (i.e. have achieved sustained growth and development) as indicated by Long Term Monitoring and reference to Analogue Sites 1 to 3.	The trees within the rehabilitation area were growing albeit slowly. However, this was likely due to the extremely dry conditions in 2018/19. All vegetation was substantially burnt during the November 2019 wildfire.
Weeds	There is no weed infestation in excess of that observed at analogue sites in extant native vegetation.	Weed species are present in both the regeneration and adjacent remnant areas. However, cover and abundance is substantially greater within the regeneration area, influenced mostly by African Lovegrass which is likely to have had a negative influence on native species. This weed is going to be difficult to remove given the extensive seed bank likely to be present. However, the November 2019 wildfire has substantially burnt all of this vegetation including weeds. Weed control will be required if African Lovegrass density begins to negatively affect native plant species germination and growth.
Pest Species	There is no increase in evidence of pest species at the time of the inspection above baseline conditions	Pest species including deer are present within the study area, as they occur throughout Wollemi and Yengo National Parks directly adjacent to the study area. Control within the

Aspect	Performance Criteria	Comments
		study area will be all but impossible given that these species will continue to move from the national park into unoccupied habitat within the study area.
Biodiversity Offset Area		
Vegetation communities and Fauna habitat	No adverse affect of quarrying on vegetation community/fauna habitat extent or condition	There is no obvious adverse effects of quarrying on the vegetation communities of the Biodiversity offset area. The number of dead or dying trees does not appear to differ from surrounding areas that are also under significant stress from a severe rainfall deficit.
	Persistence of threatened species and their habitat within the biodiversity offset area	A number of threatened species occur within the biodiversity offset area, including a population of *Grevillea parviflora*. No change in the Grevillea population was noted. A slight increase in Koala evidence was collected above the 2018 monitoring survey. The November 2019 wildfire has burnt all known individuals of the Grevillea population. Two months post-fire, some regeneration was observed in the Grevillea parviflora as well as a koala was observed within the Quarry site post fire.
Weeds	There is no weed infestation greater than 25m^2 in area	No. Weeds occur along some of the access tracks, but their extent is not considered significant. Native flora species dominate the offset area.
	There are no Weeds of National Significance in the Biodiversity Offset Area	No weed species recorded are listed as 'Weeds of National Significance'.
Pest Species	No significant populations of pest fauna species are present	Pest animal species including foxes, deer, goats and pigs were recorded on or near the study area. The adjacent national parks are likely to provide habitat over large areas. No pest species was recorded in high abundance. The presence of pest species in the Biodiversity areas is not likely to have been influenced (positively or negatively) by the presence at Quarry operations.

5 RECOMMENDATIONS

Based on the results of our field survey, **EnviroKey** make the following recommendations with regard to the rehabilitation, the monitoring program and the offset area.

5.1 MONITORING PROGRAM

EnviroKey recommends a review of the monitoring program. The monitoring program in its current form provides no real benefit to monitoring the effects of the quarry operations on the BOA as those operations are excluded from that area. The key points we wish to make include:

1. There are a substantial number of BBAM plots in the BOA, all of which take considerable effort to monitor, with no real value in the data being collected given that the quarry operates outside of the BOA, so it is unlikely that impacts would occur there.

   We recommend the removal of all BBAM plots with the exception of one plot from the Biodiversity Offset Area. An additional two BBAM plots (making a total of 3 plots) within the Regeneration Area should be established to determine the success (or failure) of the Regeneration Area. We also recommend that monitoring frequency be changed to every two years.

2. Monitoring threatened fauna species (including Koala) is problematic given their relatively low abundance in the landscape and in some instances, they are highly mobile. The BOA was found to be relatively unchanged between the 2018 and 2019 monitoring survey, with minor changes likely from the severity of dry conditions, not the result of quarry operations. Further, the use of threatened fauna species as surrogates to determine vegetation or habitat changes is unreliable given the above factors and their absence during monitoring does not indicate their permanent absence from the study area.

   We recommend that Fauna Monitoring, including Koala cease given the intense nature of the November 2019 wildfire and the resulting severe reduction in native vegetation within the study area including the Biodiversity Offset Area.

   We recommend that monitoring of the Grevillea parviflora subsp. parviflora population continue every 12 months in the post-fire environment.

5.2 SPECIFIC ACTIONS IN THE REHABILITATION AREA

EnviroKey recommend the following actions be undertaken in the rehabilitation area:

1. The topsoil has eroded away over much of the revegetation embankment. It is unlikely to be feasible to replace the soil, therefore, import organic material including brush, mulch and leaf litter to help slow down overland water flow, increase water filtration

and to improve soil characteristics. Any future embankment creation should incorporate contour banks.

2. It is probable that the top soil used last time contained African Lovegrass seed. Therefore, any soil imported for revegetation in the future should only be sourced from a location known to be free of this weed. If this is not feasible, then weed monitoring and control would be required from the early stages of rehabilitation/following soil importation, on a regular ongoing basis (monitor at least three-monthly, control as necessary), so that weeds do not establish.
3. To improve fauna habitat in the short to medium term in the Regeneration Area, import logs/large woody debris (at least 10cm diameter and at least 10m in length per 1000m^2), and scatter it across the site.
4. Direct tree (and shrub) seeding: The current survey found parts of the rehabilitation area were devoid of eucalypts (which includes the genera *Angophora* and *Corymbia*, not just Eucalyptus). While they would normally be expected to regenerate naturally over the longer term, the heavy cover of African love grass may hinder this. Therefore, the planting of eucalypt seedlings is recommended to increase species diversity and compete with weeds for light, water and other resources (including the creation of leaf litter/soil conditions unfavourable to the exotic grasses). The previous and current monitoring found that some native shrubs have regenerated naturally.

   This would require appropriate timing and conditions for seed to successfully germinate, i.e. avoiding the winter/frost period, during wet conditions and when sufficient mulch/leaf litter/brush covers the soil to prevent seeds being washed away.

   Seeds should be sourced from the native tree and shrub seed bank indicated in the 2018 monitoring report. If this is not available, they should be sourced from local provenance only.

5.3 SPECIFIC ACTIONS IN THE BIODIVERSITY OFFSET AREA

EnviroKey recommend the following actions be undertaken in the Biodiversity Offset Area:

1. Minimise driving and physical disturbance (e.g. grading, slashing) on and adjacent to the access tracks and within the electricity easement to curb the spread of weed seed. It is recommend to close surplus tracks for them to naturally regenerate.
2. Do not use slashing as a weed control method, as it can cause weeds to proliferate. Given the sparse cover of weeds along the tracks, it is recommended to spot spray weed on foot and by hand only, to minimise weed seed being spread by vehicles and avoid herbicide overspray killing native plants nearby. It is important that adjacent native plants remain alive to maintain competition against weeds.
3. Monitor weeds visually at least every three months and spray as necessary to prevent seed-set. Always assess the efficacy of the control method over time (e.g. if native plants are inadvertently killed and weed cover is not decreasing, cease weed control and reassess methods).

4. Given that the study area was subject to an intense wild fire in November 2019 after our 2019 monitoring survey, no recommendations are made with regard to fire management.

6 CONCLUSION

This report details the results of the second year of monitoring at the Tinda Creek Quarry. The data contained within demonstrates that the management of the BOA and Rehabilitation Area is achieving the conservation objectives outlined in the LMP.

Overall, the BOA remains secure and not infested with exotic flora species. The Rehabilitation Area is regenerating as well as can be expected in significantly dry conditions that have been occurring for the last 2 years and these dry conditions appear to be ongoing. The quarry operations do not appear to be having an adverse impact on the Biodiversity Offset Area.

EnviroKey recommend a review of the monitoring program. The monitoring program in its current form provides little value to monitor potential impacts of the quarry on the BOA given that there are no quarry operations within the BOA. Monitoring should be redirected to the Regeneration Area. Monitoring threatened fauna species (including Koala) is problematic given their relatively low abundance in the landscape and in some instances, they are highly mobile. The BOA was found to be relatively unchanged between the 2018 and 2019 monitoring survey, with the minor changes likely a result of the severe dry conditions, not the result of quarry operations. Further, the use of threatened fauna species as surrogates to determine vegetation or habitat changes is unreliable given the above factors and their absence during monitoring does not indicate their permanent absence from the study area.

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8 APPENDICES

APPENDIX 1 – QUALIFICATIONS AND EXPERIENCE OF PERSONNEL

Name and Qualifications	Experience
Steve Sass B.App.Sci (Env.Sci) (Hons), GradCert.CaptVertMngt (CSU) Director / Principal Ecologist NSW Biodiversity Accredited Assessor (BAAS17047) Certified Environmental Practitioner, EIANZ Member, Ecological Consultants Association of NSW	Steve is a highly experienced Ecologist having undertaken hundreds of terrestrial and aquatic ecological surveys and assessments across Australia since 1992. He has an in-depth working knowledge of environmental and biodiversity legislation across all states and territories which allows him to provide detailed and accurate assessments and formulate practical solutions to clients and specific projects on a case-by-case basis. He is a current NSW Biodiversity Accredited Assessor (BAAS17047) by the DPIE. Steve is a past Councillor of the Ecological Consultants Association of NSW. Steve was appointed 'Expert' status for a number of threatened fauna species listed under the *Biodiversity Conservation Act 2016.* Previous and current research holds Steve in high regard within both the scientific and ecological consultants' community. To date, Steve has published, submitted or has in preparation, thirty-three manuscripts within scientific journals, many of which are related to threatened species survey, monitoring or management. Steve has extensive experience in NSW. Over the past 15 years, he has completed or provided specialist biodiversity advice to more than 1,200 environmental assessments for projects such as residential and industrial developments, highway upgrades and telecommunications, water, sewerage, energy, mining and electricity network infrastructure projects. For this study, Steve was the Project Manager and primary author of this report.
Harrison Warne B.Sc (Ecology & Zoology) James Cook University Ecologist	Harrison graduated from James Cook University, Townsville with a Bachelor of Science (Ecology and Zoology) in 2017. For the past five years, Harrison, under the guidance of Principal Ecologist Steve Sass, has worked on dozens of biodiversity projects in southern and western NSW including the Biodiversity assessment for the now approved Nyngan Scandium Mine, the Thackaringa Cobalt Project and an REF for proposed safety improvements along the Princes Highway between Cobargo and Bega. For this project Harrison lead the fauna surveys and was the primary author of the report.
Mark Harris Senior Botanist/Specialist GIS	Mark is a highly experienced Botanist having undertaken flora surveys across eastern and central Australia. He has more than 12 years' experience in Biodiversity Assessment and Planning which includes the Sydney Basin. Mark has extensive experience with the flora and vegetation communities of the region confirmed by his two-year tenure with the State-wide Native Vegetation Mapping Project. This includes the 3-year landscape monitoring of the Liverpool Military Area (c. 25,000 hectares). Mark is also a highly experienced GIS specialist having completed hundreds of maps for biodiversity assessments. He has extensive experience with ArcMap which will ensure that the highest quality mapping output is produced for this consultancy.

APPENDIX 2 – VEGETATION MONITORING RESULTS

Table 8: Floristic data, sites 1-6. (Br/Bl = Braun Blanquet cover/abundance score as described in Methods; * = exotic species)

Family	Species	Common Name	Plot 1 Cover	Plot 1 Br/Bl	Plot 2 Cover	Plot 2 Br/Bl	Plot 3 Cover	Plot 3 Br/Bl	Plot 4 Cover	Plot 4 Br/Bl	Plot 5 Cover	Plot 5 Br/Bl	Plot 6 Cover	Plot 6 Br/Bl
Acanthaceae	*Brunoniella australis*	Blue Trumpet							0.1	1				
Adiantaceae	*Cheilanthes sieberi*	Rock Fern					0.2	2						
Adiantaceae	*Pellaea falcata*	Sickle Fern					0.1	1						
Anthericaceae	*Caesia parviflora*	Pale Grass-lily												
Anthericaceae	*Laxmannia gracilis*	Slender Wire Lily												
Apiaceae	*Centella asiatica*	Indian Pennywort												
Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort												
Apiaceae	*Platysace ericoides*		0.1	2	0.1	2								
Apiaceae	*Xanthosia atkinsoniana*		0.3	2										
Apiaceae	*Xanthosia pilosa*	Woolly Xanthosia			0.1	1								
Asteraceae	*Asteraceae sp.*	A daisy (forb)									0.1	1		
Asteraceae	*Calotis sp.*	A Burr-daisy									0.1	1		
Asteraceae	*Conyza bonariensis**	Flaxleaf Fleabane											0.1	1

Family	Species	Common Name	Plot 1 Cover	Plot 1 Br/Bl	Plot 2 Cover	Plot 2 Br/Bl	Plot 3 Cover	Plot 3 Br/Bl	Plot 4 Cover	Plot 4 Br/Bl	Plot 5 Cover	Plot 5 Br/Bl	Plot 6 Cover	Plot 6 Br/Bl
Asteraceae	*Epaltes australis*	Spreading Nut-heads												
Asteraceae	*Helichrysum sp.*													
Asteraceae	*Lagenifera stipitata*	Blue Bottle-daisy					0.1	1						
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood												
Asteraceae	*Senecio sp.*	A Senecio			0.1	1								
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak												
Clusiaceae	*Hypericum gramineum*	Small St John's Wort					0.1	2	0.1	1			0.1	1
Colchicaceae	*Burchardia umbellata*	Milkmaids												
Colchicaceae	*Wurmbea dioica*	Early Nancy												
Convolvulaceae	*Dichondra repens*	Kidney Weed					0.2	2						
Cyperaceae	*Carex sp.*												0.5	2
Cyperaceae	*Chorizandra cymbaria*												50	5
Cyperaceae	*Cyathochaeta diandra*								30	4				
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge					0.1	1						
Cyperaceae	*Schoenus brevifolius*													
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	1	2			1	2			2	2		
Dilleniaceae	*Hibbertia cistiflora subsp. cistiflora*													
Dilleniaceae	*Hibbertia obtusifolia*	Hoary Guinea Flower	0.2	1	0.5	2								

Family	Species	Common Name	Plot 1 Cover	Plot 1 Br/Bl	Plot 2 Cover	Plot 2 Br/Bl	Plot 3 Cover	Plot 3 Br/Bl	Plot 4 Cover	Plot 4 Br/Bl	Plot 5 Cover	Plot 5 Br/Bl	Plot 6 Cover	Plot 6 Br/Bl
Dilleniaceae	*Hibbertia riparia*								0.2	2				
Dilleniaceae	*Hibbertia serpyllifolia*	Hairy Guinea Flower												
Ericaceae	*Brachyloma daphnoides*	Daphne Heath	0.3	2	0.1	1					0.2	1		
Ericaceae	*Leucopogon muticus*	Blunt Beard-heath												
Ericaceae	*Melichrus procumbens*	Jam Tarts												
Ericaceae	*Monotoca elliptica*	Tree Broom-heath	0.3	1										
Euphorbiaceae	*Amperea xiphoclada*													
Fabaceae (Faboideae)	*Bossiaea heterophylla*	Variable Bossiaea	0.3	2							0.1	1		
Fabaceae (Faboideae)	*Bossiaea obcordata*	Spiny Bossiaea												
Fabaceae (Faboideae)	*Bossiaea scolopendria*													
Fabaceae (Faboideae)	*Daviesia genistifolia*	Broom Bitter Pea	0.1	1	0.2	1								
Fabaceae (Faboideae)	*Daviesia ulicifolia*	Gorse Bitter Pea									0.1	1		
Fabaceae (Faboideae)	*Dillwynia glaberrima*													
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine			0.1	1	0.1	2						

Family	Species	Common Name	Plot 1 Cover	Plot 1 Br/Bl	Plot 2 Cover	Plot 2 Br/Bl	Plot 3 Cover	Plot 3 Br/Bl	Plot 4 Cover	Plot 4 Br/Bl	Plot 5 Cover	Plot 5 Br/Bl	Plot 6 Cover	Plot 6 Br/Bl
Fabaceae (Faboideae)	*Gompholobium grandiflorum*	Large Wedge Pea	0.4	2	0.2	2			0.3	1	0.2	1		
Fabaceae (Faboideae)	*Gompholobium minus*	Dwarf Wedge Pea												
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla	0.1	1										
Fabaceae (Faboideae)	*Hovea linearis*		0.1	1										
Fabaceae (Faboideae)	*Hovea longifolia*	Rusty Pods	0.1	1										
Fabaceae (Faboideae)	*Oxylobium sp.*								0.1	1				
Fabaceae (Faboideae)	*Phyllota phylicoides*	Heath Phyllota												
Fabaceae (Faboideae)	*Podolobium ilicifolium*	Prickly Shaggy Pea	1	3	5	3					0.3	2		
Fabaceae (Faboideae)	*Pultenaea scabra*		0.1	1	0.2	1								
Fabaceae (Mimosoideae)	*Acacia brownii*	Heath wattle												
Fabaceae (Mimosoideae)	*Acacia parvipinnula*	Silver-stemmed Wattle			1	2	7	3	5	3				
Fabaceae (Mimosoideae)	*Acacia penninervis var. penninervis*	Mountain Hickory							0.2	1				

Family	Species	Common Name	Plot 1 Cover	Plot 1 Br/Bl	Plot 2 Cover	Plot 2 Br/Bl	Plot 3 Cover	Plot 3 Br/Bl	Plot 4 Cover	Plot 4 Br/Bl	Plot 5 Cover	Plot 5 Br/Bl	Plot 6 Cover	Plot 6 Br/Bl
Fabaceae (Mimosoideae)	*Acacia terminalis*	Sunshine Wattle												
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	Prickly Moses	5	3										
Goodeniaceae	*Coopernookia barbata*	Purple Goodenia												
Goodeniaceae	*Dampiera stricta*								0.1	1				
Goodeniaceae	*Goodenia heterophylla*													
Goodeniaceae	*Goodenia paniculata*													
Goodeniaceae	*Goodenia sp.*		0.1	2										
Goodeniaceae	*Scaevola ramosissima*	Purple Fan-flower	0.1	2	0.1	1								
Haloragaceae	*Gonocarpus micranthus subsp. ramosissimus*												a	a
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort							0.1	1				
Iridaceae	*Patersonia longifolia*		0.1	2	0.1	1			0.1	1	0.1	2		
Iridaceae	*Patersonia sericea*	Silky Purple-Flag	0.2	2										
Juncaceae	*Juncus planifolius*													
Juncaceae	*Juncus sp.*	A Rush											3	3
Lamiaceae	*Prostanthera denticulata*	Rough Mint-bush			0.1	1								
Lauraceae	*Cassytha glabella*													
Lindsaeaceae	*Lindsaea linearis*	Screw Fern							0.1	2				

Family	Species	Common Name	Plot 1 Cover	Plot 1 Br/Bl	Plot 2 Cover	Plot 2 Br/Bl	Plot 3 Cover	Plot 3 Br/Bl	Plot 4 Cover	Plot 4 Br/Bl	Plot 5 Cover	Plot 5 Br/Bl	Plot 6 Cover	Plot 6 Br/Bl
Lobeliaceae	*Pratia purpurascens*	Whiteroot	0.1	1			0.1	1	0.1	2				
Lomandraceae	*Lomandra cylindrica*										0.1	2		
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush												
Lomandraceae	*Lomandra filiformis subsp. filiformis*		0.2	2	0.2	2	0.1	2			0.1	2		
Lomandraceae	*Lomandra glauca*	Pale Mat- rush												
Lomandraceae	*Lomandra longifolia*	Spiny- headed Mat- rush	0.2	1	0.2	2	0.3	2	0.1	1				
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush	0.1	2	0.1	2			0.1	1				
Lomandraceae	*Lomandra obliqua*		2	2	0.1	2					0.1	2		
Myrtaceae	*Angophora bakeri*	Narrow-leaved Apple							3	2				
Myrtaceae	*Angophora costata*	Sydney Red Gum	5	3	10	3					5	2		
Myrtaceae	*Angophora floribunda*	Rough-barked Apple					15	3	5	3				
Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush											2	2
Myrtaceae	*Callistemon linearis*	Narrow-leaved Bottlebrush												
Myrtaceae	*Corymbia eximia*	Yellow Bloodwood									2	2		

Family	Species	Common Name	Plot 1 Cover	Plot 1 Br/Bl	Plot 2 Cover	Plot 2 Br/Bl	Plot 3 Cover	Plot 3 Br/Bl	Plot 4 Cover	Plot 4 Br/Bl	Plot 5 Cover	Plot 5 Br/Bl	Plot 6 Cover	Plot 6 Br/Bl
Myrtaceae	*Corymbia gummifera*	Red Bloodwood	3	3	2	2					2	2		
Myrtaceae	*Eucalyptus fibrosa*	Red Ironbark												
Myrtaceae	*Eucalyptus parramattensis subsp. parramattensis*													
Myrtaceae	*Eucalyptus piperita*	Sydney Peppermint	6	3							15	3		
Myrtaceae	*Eucalyptus punctata*	Grey Gum	2	2					2	1				
Myrtaceae	*Eucalyptus sclerophylla*	Hard-leaved Scribbly Gum							35	4				
Myrtaceae	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark	10	2	15	3	15	3			5	3		
Myrtaceae	*Leptospermum juniperinum*	Prickly Tea-tree							1	2			0.5	2
Myrtaceae	*Leptospermum polygalifolium*	Tantoon							0.2	1				
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree							5	3				
Myrtaceae	*Melaleuca thymifolia*	Thyme Honey-myrtle							5	3			0.2	1
Myrtaceae	*Micromyrtus ciliata*	Fringed Heath- myrtle												
Orchidaceae	*Caleana major*	Large Duck Orchid												
Orchidaceae	*Dipodium roseum*													

Family	Species	Common Name	Plot 1 Cover	Plot 1 Br/Bl	Plot 2 Cover	Plot 2 Br/Bl	Plot 3 Cover	Plot 3 Br/Bl	Plot 4 Cover	Plot 4 Br/Bl	Plot 5 Cover	Plot 5 Br/Bl	Plot 6 Cover	Plot 6 Br/Bl
Orchidaceae	*Microtis sp.*													
Phormiaceae	*Dianella caerulea var. producta*						0.1	1						
Phormiaceae	*Dianella longifolia*	Blueberry Lily	0.3	2	0.5	2	0.1	1	0.2	1	0.2	1		
Phormiaceae	*Stypandra glauca*	Nodding Blue Lily												
Phormiaceae	*Thelionema caespitosum*	Tufted Blue Lily												
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge	0.1	2	0.1	2								
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry	0.1	1										
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn			0.1	1								
Poaceae	*Andropogon virginicus**	Whisky Grass												
Poaceae	*Anisopogon avenaceus*	Oat Speargrass	15	3					0.2	2				
Poaceae	*Aristida ramosa*	Purple Wiregrass												
Poaceae	*Aristida vagans*	Threeawn Speargrass			0.1	1	0.1	1	0.1	2				
Poaceae	*Austrostipa sp.*	A Speargrass												
Poaceae	*Chloris gayana**	Rhodes Grass											0.1	1
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass	0.2	2							0.2	2		

Family	Species	Common Name	Plot 1 Cover	Plot 1 Br/Bl	Plot 2 Cover	Plot 2 Br/Bl	Plot 3 Cover	Plot 3 Br/Bl	Plot 4 Cover	Plot 4 Br/Bl	Plot 5 Cover	Plot 5 Br/Bl	Plot 6 Cover	Plot 6 Br/Bl
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog Grass					5	3	0.2	2				
Poaceae	*Entolasia marginata*	Bordered Panic					0.1	1						
Poaceae	*Entolasia stricta*	Wiry Panic	1	3	3	2	0.5	2	0.5	2	2	2	0.3	2
Poaceae	*Eragrostis brownii*	Brown's Lovegrass					0.1	2						
Poaceae	*Eragrostis curvula**	African Lovegrass					0.1	1						
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass	0.1	1										
Poaceae	*Imperata cylindrica*	Blady Grass							2	2	2	2		
Poaceae	*Microlaena stipoides*	Weeping Grass	0.1	2			35	4	0.5	2				
Poaceae	*Panicum simile*	Two-colour Panic			0.2	2								
Poaceae	*Poa sieberiana*	Snowgrass							0.5	2	0.2	2		
Poaceae	*Rytidosperma pallidium*	Redanther Wallaby Grass												
Poaceae	*Rytidosperma sp.*				1	2	0.2	1						
Poaceae	*Stenotaphrum secundatum**	Buffalo Grass												
Poaceae	*Themeda triandra*	Kangaroo Grass	0.1	1					0.2	2				
Proteaceae	*Banksia marginata*	Silver Banksia	0.5	2										

Family	Species	Common Name	Plot 1 Cover	Plot 1 Br/Bl	Plot 2 Cover	Plot 2 Br/Bl	Plot 3 Cover	Plot 3 Br/Bl	Plot 4 Cover	Plot 4 Br/Bl	Plot 5 Cover	Plot 5 Br/Bl	Plot 6 Cover	Plot 6 Br/Bl
Proteaceae	*Banksia serrata*	Old-man Banksia												
Proteaceae	*Banksia spinulosa*	Hairpin Banksia							5	3				
Proteaceae	*Conospermum ericifolium*													
Proteaceae	*Grevillea mucronulata*													
Proteaceae	*Grevillea parviflora subsp. parviflora*	Small-flower Grevillea												
Proteaceae	*Hakea dactyloides*	Finger Hakea							2	1	0.2	1		
Proteaceae	*Isopogon anemonifolius*	Broad-leaf Drumsticks	0.2	1							1	2		
Proteaceae	*Isopogon anethifolius*	Narrow-leaf Drumsticks	3	4										
Proteaceae	*Lomatia silaifolia*	Crinkle Bush	0.5	2										
Proteaceae	*Persoonia levis*	Broad- leaved Geebung												
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung	3	2	3	2	0.3	1	0.2	1	1	2		
Proteaceae	*Persoonia oblongata*				5	3			0.5	1				
Proteaceae	*Petrophile pulchella*	Conesticks												
Proteaceae	*Xylomelum pyriforme*	Woody Pear	0.5	1										
Pteridaceae	*Adiantum aethiopicum*	Common MaidenHair Fern												
Ranunculaceae	*Clematis aristata*	Old Man's Beard												

Family	Species	Common Name	Plot 1 Cover	Plot 1 Br/Bl	Plot 2 Cover	Plot 2 Br/Bl	Plot 3 Cover	Plot 3 Br/Bl	Plot 4 Cover	Plot 4 Br/Bl	Plot 5 Cover	Plot 5 Br/Bl	Plot 6 Cover	Plot 6 Br/Bl
Restionaceae	*Leptocarpus tenax*												0.5	2
Restionaceae	*Lepyrodia scariosa*												15	3
Rubiaceae	*Opercularia diphylla*	Stinkweed			0.1	2			0.1	1				
Rubiaceae	*Pomax umbellata*	Pomax	0.1	2							0.1	1		
Rutaceae	*Boronia parviflora*	Swamp Boronia							0.1	1				
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart												
Santalaceae	*Exocarpos strictus*	Dwarf Cherry	0.3	1							0.2	1		
Solanaceae	*Solanum prinophyllum*	Forest Nightshade												
Stackhousiaceae	*Stackhousia nuda*													
Stylidiaceae	*Stylidium graminifolium*	Grass Triggerplant			0.1	1								
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower												
Xanthorrhoeaceae	*Xanthorrhoea sp.*		0.1	1										
Zamiaceae	*Macrozamia spiralis*		2	2	0.2	1					2	2		

Table 9: Floristic data, sites 7-12. (Br/Bl = Braun Blanquet cover/abundance score as described in Methods; * = exotic species)

Family	Species	Common Name	Plot 7 Cover	Plot 7 Br/Bl	Plot 8 Cover	Plot 8 Br/Bl	Plot 9 Cover	Plot 9 Br/Bl	Plot 10 Cover	Plot 10 Br/Bl	Plot 11 Cover	Plot 11 Br/Bl	Plot 12 Cover	Plot 12 Br/Bl
Acanthaceae	*Brunoniella australis*	Blue Trumpet												
Adiantaceae	*Cheilanthes sieberi*	Rock Fern											0.3	2
Adiantaceae	*Pellaea falcata*	Sickle Fern												
Anthericaceae	*Caesia parviflora*	Pale Grass-lily	0.1	1					0.1	1				
Anthericaceae	*Laxmannia gracilis*	Slender Wire Lily												
Apiaceae	*Centella asiatica*	Indian Pennywort												
Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort												
Apiaceae	*Platysace ericoides*		0.5	2			0.2	2			0.1	1		
Apiaceae	*Xanthosia atkinsoniana*		0.2	2			0.3	2						
Apiaceae	*Xanthosia pilosa*	Woolly Xanthosia												
Asteraceae	*Asteraceae sp.*	A daisy (forb)												
Asteraceae	*Calotis sp.*	A Burr-daisy												

Family	Species	Common Name	Plot 7 Cover	Plot 7 Br/Bl	Plot 8 Cover	Plot 8 Br/Bl	Plot 9 Cover	Plot 9 Br/Bl	Plot 10 Cover	Plot 10 Br/Bl	Plot 11 Cover	Plot 11 Br/Bl	Plot 12 Cover	Plot 12 Br/Bl
Asteraceae	*Conyza bonariensis**	Flaxleaf Fleabane												
Asteraceae	*Epaltes australis*	Spreading Nut-heads												
Asteraceae	*Helichrysum sp.*		0.1	1										
Asteraceae	*Lagenifera stipitata*	Blue Bottle-daisy			0.1	2								
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood											0.5	1
Asteraceae	*Senecio sp.*	A Senecio											0.1	1
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak									0.5	1	2	1
Clusiaceae	*Hypericum gramineum*	Small St John's Wort												
Colchicaceae	*Burchardia umbellata*	Milkmaids												
Colchicaceae	*Wurmbea dioica*	Early Nancy												
Convolvulaceae	*Dichondra repens*	Kidney Weed												
Cyperaceae	*Carex sp.*													
Cyperaceae	*Chorizandra cymbaria*													
Cyperaceae	*Cyathochaeta diandra*		10	3			0.5	2	0.1	1				

Family	Species	Common Name	Plot 7 Cover	Plot 7 Br/Bl	Plot 8 Cover	Plot 8 Br/Bl	Plot 9 Cover	Plot 9 Br/Bl	Plot 10 Cover	Plot 10 Br/Bl	Plot 11 Cover	Plot 11 Br/Bl	Plot 12 Cover	Plot 12 Br/Bl
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge	0.1										1	2
Cyperaceae	*Schoenus brevifolius*													
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	0.5	2	0.5	2	0.2	1					10	3
Dilleniaceae	*Hibbertia cistiflora subsp. cistiflora*										1	2		
Dilleniaceae	*Hibbertia obtusifolia*	Hoary Guinea Flower	0.2	2			0.2	1			0.1	2		
Dilleniaceae	*Hibbertia riparia*										2	2		
Dilleniaceae	*Hibbertia serpyllifolia*	Hairy Guinea Flower							0.1	1				
Ericaceae	*Brachyloma daphnoides*	Daphne Heath	0.5	2	0.5	1	5	3	0.5	2	0.2	1		
Ericaceae	*Leucopogon muticus*	Blunt Beard-heath			8	3								
Ericaceae	*Melichrus procumbens*	Jam Tarts	0.2	1			0.2	1						
Ericaceae	*Monotoca elliptica*	Tree Broom-heath	0.2	1										
Euphorbiaceae	*Amperea xiphoclada*						0.1	1						
Fabaceae (Faboideae)	*Bossiaea heterophylla*	Variable Bossiaea	5	3			3	2						

Family	Species	Common Name	Plot 7 Cover	Plot 7 Br/Bl	Plot 8 Cover	Plot 8 Br/Bl	Plot 9 Cover	Plot 9 Br/Bl	Plot 10 Cover	Plot 10 Br/Bl	Plot 11 Cover	Plot 11 Br/Bl	Plot 12 Cover	Plot 12 Br/Bl
Fabaceae (Faboideae)	*Bossiaea obcordata*	Spiny Bossiaea	0.3	1										
Fabaceae (Faboideae)	*Bossiaea scolopendria*		0.4	2	0.5	2	0.5	2						
Fabaceae (Faboideae)	*Daviesia genistifolia*	Broom Bitter Pea	0.2	2	0.1	1					1	1		
Fabaceae (Faboideae)	*Daviesia ulicifolia*	Gorse Bitter Pea												
Fabaceae (Faboideae)	*Dillwynia glaberrima*		0.1	1			0.2	2			0.1	1		
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine												
Fabaceae (Faboideae)	*Gompholobium grandiflorum*	Large Wedge Pea			0.3	2	0.5	2						
Fabaceae (Faboideae)	*Gompholobium minus*	Dwarf Wedge Pea									0.1	1		
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla												
Fabaceae (Faboideae)	*Hovea linearis*		0.2	2			0.1	1						
Fabaceae (Faboideae)	*Hovea longifolia*	Rusty Pods												

Family	Species	Common Name	Plot 7 Cover	Plot 7 Br/Bl	Plot 8 Cover	Plot 8 Br/Bl	Plot 9 Cover	Plot 9 Br/Bl	Plot 10 Cover	Plot 10 Br/Bl	Plot 11 Cover	Plot 11 Br/Bl	Plot 12 Cover	Plot 12 Br/Bl
Fabaceae (Faboideae)	*Oxylobium sp.*													
Fabaceae (Faboideae)	*Phyllota phylicoides*	Heath Phyllota	2	2			0.2	2						
Fabaceae (Faboideae)	*Podolobium ilicifolium*	Prickly Shaggy Pea			4	2								
Fabaceae (Faboideae)	*Pultenaea scabra*													
Fabaceae (Mimosoideae)	*Acacia brownii*	Heath wattle	0.5	1										
Fabaceae (Mimosoideae)	*Acacia parvipinnula*	Silver-stemmed Wattle									1	1	15	3
Fabaceae (Mimosoideae)	*Acacia penninervis var. penninervis*	Mountain Hickory			0.2	1								
Fabaceae (Mimosoideae)	*Acacia terminalis*	Sunshine Wattle			0.2	2								
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	Prickly Moses			0.2	1								
Goodeniaceae	*Coopernookia barbata*	Purple Goodenia												
Goodeniaceae	*Dampiera stricta*		0.2	2			2	2	0.3	2	0.2	2		

Family	Species	Common Name	Plot 7 Cover	Plot 7 Br/Bl	Plot 8 Cover	Plot 8 Br/Bl	Plot 9 Cover	Plot 9 Br/Bl	Plot 10 Cover	Plot 10 Br/Bl	Plot 11 Cover	Plot 11 Br/Bl	Plot 12 Cover	Plot 12 Br/Bl
Goodeniaceae	*Goodenia heterophylla*													
Goodeniaceae	*Goodenia paniculata*		0.2	2										
Goodeniaceae	*Goodenia sp.*													
Goodeniaceae	*Scaevola ramosissima*	Purple Fan-flower	0.1	1										
Haloragaceae	*Gonocarpus micranthus subsp. ramosissimus*													
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort	0.1	1	0.1	2					0.1	2		
Iridaceae	*Patersonia longifolia*				0.1	1	0.1	1	0.1	1	0.1	2		
Iridaceae	*Patersonia sericea*	Silky Purple-Flag	0.2	2										
Juncaceae	*Juncus planifolius*								30	4				
Juncaceae	*Juncus sp.*	A Rush	0.1	1										
Lamiaceae	*Prostanthera denticulata*	Rough Mint-bush												
Lauraceae	*Cassytha glabella*				0.1	2								
Lindsaeaceae	*Lindsaea linearis*	Screw Fern	0.1	2			0.2	2						
Lobeliaceae	*Pratia purpurascens*	Whiteroot			0.1	2								

Family	Species	Common Name	Plot 7 Cover	Plot 7 Br/Bl	Plot 8 Cover	Plot 8 Br/Bl	Plot 9 Cover	Plot 9 Br/Bl	Plot 10 Cover	Plot 10 Br/Bl	Plot 11 Cover	Plot 11 Br/Bl	Plot 12 Cover	Plot 12 Br/Bl
Lomandraceae	*Lomandra cylindrica*		0.1	1										
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush									0.1	1		
Lomandraceae	*Lomandra filiformis subsp. filiformis*				0.1	1								
Lomandraceae	*Lomandra glauca*	Pale Mat- rush												
Lomandraceae	*Lomandra longifolia*	Spiny- headed Mat- rush			0.2	1					0.1	1		
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush	0.1	1										
Lomandraceae	*Lomandra obliqua*		0.5	3	1	2								
Myrtaceae	*Angophora bakeri*	Narrow-leaved Apple	7	3			15	3						
Myrtaceae	*Angophora costata*	Sydney Red Gum												
Myrtaceae	*Angophora floribunda*	Rough- barked Apple											5	3
Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush												

Family	Species	Common Name	Plot 7 Cover	Plot 7 Br/Bl	Plot 8 Cover	Plot 8 Br/Bl	Plot 9 Cover	Plot 9 Br/Bl	Plot 10 Cover	Plot 10 Br/Bl	Plot 11 Cover	Plot 11 Br/Bl	Plot 12 Cover	Plot 12 Br/Bl
Myrtaceae	*Callistemon linearis*	Narrow-leaved Bottlebrush												
Myrtaceae	*Corymbia eximia*	Yellow Bloodwood			10	3								
Myrtaceae	*Corymbia gummifera*	Red Bloodwood			3	1								
Myrtaceae	*Eucalyptus fibrosa*	Red Ironbark											5	3
Myrtaceae	*Eucalyptus parramattensis subsp. parramattensis*										15	3		
Myrtaceae	*Eucalyptus piperita*	Sydney Peppermint												
Myrtaceae	*Eucalyptus punctata*	Grey Gum			5	3								
Myrtaceae	*Eucalyptus sclerophylla*	Hard-leaved Scribbly Gum	8	3			2	1			1	2		
Myrtaceae	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark			5	3								
Myrtaceae	*Leptospermum juniperinum*	Prickly Tea-tree							0.1	1	1	1		
Myrtaceae	*Leptospermum polygalifolium*	Tantoon												

Family	Species	Common Name	Plot 7 Cover	Plot 7 Br/Bl	Plot 8 Cover	Plot 8 Br/Bl	Plot 9 Cover	Plot 9 Br/Bl	Plot 10 Cover	Plot 10 Br/Bl	Plot 11 Cover	Plot 11 Br/Bl	Plot 12 Cover	Plot 12 Br/Bl
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree	1	4	2	2	1	2	0.1	1				
Myrtaceae	*Melaleuca thymifolia*	Thyme Honey-myrtle							0.1	1	3	2		
Myrtaceae	*Micromyrtus ciliata*	Fringed Heath- myrtle							0.3	2	5	3		
Orchidaceae	*Caleana major*	Large Duck Orchid	0.1	1										
Orchidaceae	*Dipodium roseum*						0.1	1						
Orchidaceae	*Microtis sp.*								0.1	1				
Phormiaceae	*Dianella caerulea var. producta*													
Phormiaceae	*Dianella longifolia*	Blueberry Lily	0.1	2	0.2	2	0.2	2			0.1	1		
Phormiaceae	*Stypandra glauca*	Nodding Blue Lily			0.1	2								
Phormiaceae	*Thelionema caespitosum*	Tufted Blue Lily												
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge			0.1	1								
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry			0.1	2								

Family	Species	Common Name	Plot 7 Cover	Plot 7 Br/Bl	Plot 8 Cover	Plot 8 Br/Bl	Plot 9 Cover	Plot 9 Br/Bl	Plot 10 Cover	Plot 10 Br/Bl	Plot 11 Cover	Plot 11 Br/Bl	Plot 12 Cover	Plot 12 Br/Bl
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn									10		10	3
Poaceae	*Andropogon virginicus**	Whisky Grass												
Poaceae	*Anisopogon avenaceus*	Oat Speargrass					0.1	1						
Poaceae	*Aristida ramosa*	Purple Wiregrass									0.1	2		
Poaceae	*Aristida vagans*	Threeawn Speargrass			3	2							0.1	1
Poaceae	*Austrostipa sp.*	A Speargrass	0.1	1										
Poaceae	*Chloris gayana**	Rhodes Grass												
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass												
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog Grass												
Poaceae	*Entolasia marginata*	Bordered Panic												
Poaceae	*Entolasia stricta*	Wiry Panic	1	2	5	3	0.3	2	0.2	1	0.3	2	5	3
Poaceae	*Eragrostis brownii*	Brown's Lovegrass											0.1	1

Family	Species	Common Name	Plot 7 Cover	Plot 7 Br/Bl	Plot 8 Cover	Plot 8 Br/Bl	Plot 9 Cover	Plot 9 Br/Bl	Plot 10 Cover	Plot 10 Br/Bl	Plot 11 Cover	Plot 11 Br/Bl	Plot 12 Cover	Plot 12 Br/Bl
Poaceae	*Eragrostis curvula**	African Lovegrass												
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass												
Poaceae	*Imperata cylindrica*	Blady Grass											25	4
Poaceae	*Microlaena stipoides*	Weeping Grass			1	2							25	4
Poaceae	*Panicum simile*	Two-colour Panic							0.5	2			0.1	1
Poaceae	*Poa sieberiana*	Snowgrass												
Poaceae	*Rytidosperma pallidium*	Redanther Wallaby Grass												
Poaceae	*Rytidosperma sp.*													
Poaceae	*Stenotaphrum secundatum**	Buffalo Grass												
Poaceae	*Themeda triandra*	Kangaroo Grass	0.1	1	0.1	1								
Proteaceae	*Banksia marginata*	Silver Banksia												
Proteaceae	*Banksia serrata*	Old-man Banksia	1	2	0.2	1	15	3						

Family	Species	Common Name	Plot 7 Cover	Plot 7 Br/Bl	Plot 8 Cover	Plot 8 Br/Bl	Plot 9 Cover	Plot 9 Br/Bl	Plot 10 Cover	Plot 10 Br/Bl	Plot 11 Cover	Plot 11 Br/Bl	Plot 12 Cover	Plot 12 Br/Bl
Proteaceae	*Banksia spinulosa*	Hairpin Banksia	1	2			1	2			2	2		
Proteaceae	*Conospermum ericifolium*						0.5	2	0.3	2				
Proteaceae	*Grevillea mucronulata*				5	3								
Proteaceae	*Grevillea parviflora subsp. parviflora*	Small-flower Grevillea												
Proteaceae	*Hakea dactyloides*	Finger Hakea	0.5	2			5	3			10	3		
Proteaceae	*Isopogon anemonifolius*	Broad-leaf Drumsticks	0.5	2	0.2	2	0.4	2	0.2	1	2	2		
Proteaceae	*Isopogon anethifolius*	Narrow-leaf Drumsticks												
Proteaceae	*Lomatia silaifolia*	Crinkle Bush	0.2	1			0.1	1						
Proteaceae	*Persoonia levis*	Broad- leaved Geebung			1	1								
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung	1	1	2	2	0.5	2			2	2	1	1
Proteaceae	*Persoonia oblongata*		0.1	1	0.2	2			0.1	1				
Proteaceae	*Petrophile pulchella*	Conesticks									60	5		
Proteaceae	*Xylomelum pyriforme*	Woody Pear												

Family	Species	Common Name	Plot 7 Cover	Plot 7 Br/Bl	Plot 8 Cover	Plot 8 Br/Bl	Plot 9 Cover	Plot 9 Br/Bl	Plot 10 Cover	Plot 10 Br/Bl	Plot 11 Cover	Plot 11 Br/Bl	Plot 12 Cover	Plot 12 Br/Bl
Pteridaceae	*Adiantum aethiopicum*	Common MaidenHair Fern											0.1	1
Ranunculaceae	*Clematis aristata*	Old Man's Beard											0.1	1
Restionaceae	*Leptocarpus tenax*						0.1	1	40	4	60	5		
Restionaceae	*Lepyrodia scariosa*		0.1	1					20	3				
Rubiaceae	*Opercularia diphylla*	Stinkweed												
Rubiaceae	*Pomax umbellata*	Pomax												
Rutaceae	*Boronia parviflora*	Swamp Boronia												
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart												
Santalaceae	*Exocarpos strictus*	Dwarf Cherry			0.5	1								
Solanaceae	*Solanum prinophyllum*	Forest Nightshade	0.1	1									0.1	1
Stackhousiaceae	*Stackhousia nuda*				0.1	1			0.1	1				
Stylidiaceae	*Stylidium graminifolium*	Grass Triggerplant												
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower	0.2	2			0.3	2	0.2	2				

Family	Species	Common Name	Plot 7 Cover	Plot 7 Br/Bl	Plot 8 Cover	Plot 8 Br/Bl	Plot 9 Cover	Plot 9 Br/Bl	Plot 10 Cover	Plot 10 Br/Bl	Plot 11 Cover	Plot 11 Br/Bl	Plot 12 Cover	Plot 12 Br/Bl
Xanthorrhoeaceae	*Xanthorrhoea sp.*				0.1	1								
Zamiaceae	*Macrozamia spiralis*													

Table 10: Floristic data, sites 13-18. (Br/Bl = Braun Blanquet cover/abundance score as described in Methods; * = exotic species)

Family	*Species*	Common Name	Plot 13 Cover	Plot 13 Br/Bl	Plot 14 Cover	Plot 14 Br/Bl	Plot 15 Cover	Plot 15 Br/Bl	Plot 16 Cover	Plot 16 Br/Bl	Plot 17 Cover	Plot 17 Br/Bl	Plot 18 Cover	Plot 18 Br/Bl
Fabaceae (Mimosoideae)	*Acacia brownii*	Heath wattle							2	2	1	2	0.1	1
Fabaceae (Mimosoideae)	*Acacia parvipinnula*	Silver-stemmed Wattle	1	1			1	1						
Fabaceae (Mimosoideae)	*Acacia penninervis var. penninervis*	Mountain Hickory												
Fabaceae (Mimosoideae)	*Acacia terminalis*	Sunshine Wattle												
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	Prickly Moses									0.5	2		

Family	*Species*	Common Name	Plot 13 Cover	Plot 13 Br/Bl	Plot 14 Cover	Plot 14 Br/Bl	Plot 15 Cover	Plot 15 Br/Bl	Plot 16 Cover	Plot 16 Br/Bl	Plot 17 Cover	Plot 17 Br/Bl	Plot 18 Cover	Plot 18 Br/Bl
Pteridaceae	*Adiantum aethiopicum*	Common MaidenHair Fern												
Casuarinaceae	*Allocasuarina littoralis*	Black She- Oak												
Euphorbiaceae	*Amperea xiphoclada*													
Poaceae	*Andropogon virginicus**	Whisky Grass	0.1	1									1	2
Myrtaceae	*Angophora bakeri*	Narrow- leaved Apple			2	1			20	3	5	3		
Myrtaceae	*Angophora costata*	Sydney Red Gum									7	3		
Myrtaceae	*Angophora floribunda*	Rough- barked Apple			2	1								
Poaceae	*Anisopogon avenaceus*	Oat Speargrass												
Poaceae	*Aristida ramosa*	Purple Wiregrass			0.2	2								
Poaceae	*Aristida vagans*	Threeawn Speargrass												
Asteraceae	*Asteraceae sp.*	A daisy (forb)												
Poaceae	*Austrostipa sp.*	A Speargrass												

Family	*Species*	Common Name	Plot 13 Cover	Plot 13 Br/Bl	Plot 14 Cover	Plot 14 Br/Bl	Plot 15 Cover	Plot 15 Br/Bl	Plot 16 Cover	Plot 16 Br/Bl	Plot 17 Cover	Plot 17 Br/Bl	Plot 18 Cover	Plot 18 Br/Bl
Proteaceae	*Banksia marginata*	Silver Banksia					1	1	2	2				
Proteaceae	*Banksia serrata*	Old-man Banksia							8	3				
Proteaceae	*Banksia spinulosa*	Hairpin Banksia			3	2			1	1				
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry												
Rutaceae	*Boronia parviflora*	Swamp Boronia												
Fabaceae (Faboideae)	*Bossiaea heterophylla*	Variable Bossiaea									0.5	2	1	2
Fabaceae (Faboideae)	*Bossiaea obcordata*	Spiny Bossiaea												
Fabaceae (Faboideae)	*Bossiaea scolopendria*													
Ericaceae	*Brachyloma daphnoides*	Daphne Heath	1	2					0.2	2	0.2	1		
Acanthaceae	*Brunoniella australis*	Blue Trumpet												
Colchicaceae	*Burchardia umbellata*	Milkmaids							0.1	2				
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn												
Anthericaceae	*Caesia parviflora*	Pale Grass- lily												

Family	*Species*	Common Name	Plot 13 Cover	Plot 13 Br/Bl	Plot 14 Cover	Plot 14 Br/Bl	Plot 15 Cover	Plot 15 Br/Bl	Plot 16 Cover	Plot 16 Br/Bl	Plot 17 Cover	Plot 17 Br/Bl	Plot 18 Cover	Plot 18 Br/Bl
Orchidaceae	*Caleana major*	Large Duck Orchid												
Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush	0.4	1										
Myrtaceae	*Callistemon linearis*	Narrow- leaved Bottlebrush			0.2	1	0.5	1					0.3	2
Asteraceae	*Calotis sp.*	A Burr-daisy											0.1	1
Cyperaceae	*Carex sp.*													
Lauraceae	*Cassytha glabella*													
Apiaceae	*Centella asiatica*	Indian Pennywort					0.1	2						
Adiantaceae	*Cheilanthes sieberi*	Rock Fern												
Poaceae	*Chloris gayana**	Rhodes Grass												
Cyperaceae	*Chorizandra cymbaria*													
Ranunculaceae	*Clematis aristata*	Old Man's Beard												
Proteaceae	*Conospermum ericifolium*													
Asteraceae	*Conyza bonariensis**	Flaxleaf Fleabane												

Family	*Species*	Common Name	Plot 13 Cover	Plot 13 Br/Bl	Plot 14 Cover	Plot 14 Br/Bl	Plot 15 Cover	Plot 15 Br/Bl	Plot 16 Cover	Plot 16 Br/Bl	Plot 17 Cover	Plot 17 Br/Bl	Plot 18 Cover	Plot 18 Br/Bl
Goodeniaceae	*Coopernookia barbata*	Purple Goodenia									0.1	1		
Myrtaceae	*Corymbia eximia*	Yellow Bloodwood									7	3		
Myrtaceae	*Corymbia gummifera*	Red Bloodwood												
Cyperaceae	*Cyathochaeta diandra*				25	4			5	3			0.1	1
Goodeniaceae	*Dampiera stricta*				0.1	1			0.1	1			0.1	2
Fabaceae (Faboideae)	*Daviesia genistifolia*	Broom Bitter Pea											0.1	1
Fabaceae (Faboideae)	*Daviesia ulicifolia*	Gorse Bitter Pea												
Phormiaceae	*Dianella caerulea var. producta*													
Phormiaceae	*Dianella longifolia*	Blueberry Lily	0.1	2			0.1	1	0.1	2	0.2	2		
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass												
Convolvulaceae	*Dichondra repens*	Kidney Weed					0.1	2						
Fabaceae (Faboideae)	*Dillwynia glaberrima*		0.1	1					0.5	2				
Orchidaceae	*Dipodium roseum*													

Family	*Species*	Common Name	Plot 13 Cover	Plot 13 Br/Bl	Plot 14 Cover	Plot 14 Br/Bl	Plot 15 Cover	Plot 15 Br/Bl	Plot 16 Cover	Plot 16 Br/Bl	Plot 17 Cover	Plot 17 Br/Bl	Plot 18 Cover	Plot 18 Br/Bl
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog Grass												
Poaceae	*Entolasia marginata*	Bordered Panic												
Poaceae	*Entolasia stricta*	Wiry Panic	0.1	1			30	4	1	2	2	2		
Asteraceae	*Epaltes australis*	Spreading Nut-heads			0.1	1							0.1	1
Poaceae	*Eragrostis brownii*	Brown's Lovegrass	0.1	1	2	2								
Poaceae	*Eragrostis curvula**	African Lovegrass											30	4
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass												
Myrtaceae	*Eucalyptus fibrosa*	Red Ironbark									5	3		
Myrtaceae	*Eucalyptus parramattensis subsp. parramattensis*		10	3	5	3	7	3	7	3				
Myrtaceae	*Eucalyptus piperita*	Sydney Peppermint												
Myrtaceae	*Eucalyptus punctata*	Grey Gum												

Family	*Species*	Common Name	Plot 13 Cover	Plot 13 Br/Bl	Plot 14 Cover	Plot 14 Br/Bl	Plot 15 Cover	Plot 15 Br/Bl	Plot 16 Cover	Plot 16 Br/Bl	Plot 17 Cover	Plot 17 Br/Bl	Plot 18 Cover	Plot 18 Br/Bl
Myrtaceae	*Eucalyptus sclerophylla*	Hard-leaved Scribbly Gum	1	1	20	3	2	1	10	3				
Myrtaceae	*Eucalyptus sparsifolia*	Narrow- leaved Stringybark									15	3		
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart	0.2	1										
Santalaceae	*Exocarpos strictus*	Dwarf Cherry									0.5	1		
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine												
Fabaceae (Faboideae)	*Gompholobium grandiflorum*	Large Wedge Pea									2	2		
Fabaceae (Faboideae)	*Gompholobium minus*	Dwarf Wedge Pea			0.1	1								
Haloragaceae	*Gonocarpus micranthus subsp. ramosissimus*		0.1	2										
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort							0.1	2				
Goodeniaceae	*Goodenia heterophylla*										0.1	1		
Goodeniaceae	*Goodenia paniculata*													
Goodeniaceae	*Goodenia sp.*													

Family	*Species*	Common Name	Plot 13 Cover	Plot 13 Br/Bl	Plot 14 Cover	Plot 14 Br/Bl	Plot 15 Cover	Plot 15 Br/Bl	Plot 16 Cover	Plot 16 Br/Bl	Plot 17 Cover	Plot 17 Br/Bl	Plot 18 Cover	Plot 18 Br/Bl
Proteaceae	*Grevillea mucronulata*												1	2
Proteaceae	*Grevillea parviflora subsp. parviflora*	Small-flower Grevillea							0.2	2				
Proteaceae	*Hakea dactyloides*	Finger Hakea			2	2								
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla												
Asteraceae	*Helichrysum sp.*													
Dilleniaceae	*Hibbertia cistiflora subsp. cistiflora*													
Dilleniaceae	*Hibbertia obtusifolia*	Hoary Guinea Flower												
Dilleniaceae	*Hibbertia riparia*													
Dilleniaceae	*Hibbertia serpyllifolia*	Hairy Guinea Flower					0.1	1					0.3	2
Fabaceae (Faboideae)	*Hovea linearis*													
Fabaceae (Faboideae)	*Hovea longifolia*	Rusty Pods												
Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort					0.1	2						

Family	*Species*	Common Name	Plot 13 Cover	Plot 13 Br/Bl	Plot 14 Cover	Plot 14 Br/Bl	Plot 15 Cover	Plot 15 Br/Bl	Plot 16 Cover	Plot 16 Br/Bl	Plot 17 Cover	Plot 17 Br/Bl	Plot 18 Cover	Plot 18 Br/Bl
Clusiaceae	*Hypericum gramineum*	Small St John's Wort												
Poaceae	*Imperata cylindrica*	Blady Grass					0.2	2						
Proteaceae	*Isopogon anemonifolius*	Broad-leaf Drumsticks			0.4	1			0.2	1			0.2	1
Proteaceae	*Isopogon anethifolius*	Narrow-leaf Drumsticks												
Juncaceae	*Juncus planifolius*													
Juncaceae	*Juncus sp.*	A Rush												
Asteraceae	*Lagenifera stipitata*	Blue Bottle-daisy												
Anthericaceae	*Laxmannia gracilis*	Slender Wire Lily											0.1	2
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge												
Restionaceae	*Leptocarpus tenax*				10	3			30	4				
Myrtaceae	*Leptospermum juniperinum*	Prickly Tea-tree	25	4	0.3	1	5	3	0.5	2			0.2	1
Myrtaceae	*Leptospermum polygalifolium*	Tantoon	25	4			60	5					0.2	2

Family	*Species*	Common Name	Plot 13 Cover	Plot 13 Br/Bl	Plot 14 Cover	Plot 14 Br/Bl	Plot 15 Cover	Plot 15 Br/Bl	Plot 16 Cover	Plot 16 Br/Bl	Plot 17 Cover	Plot 17 Br/Bl	Plot 18 Cover	Plot 18 Br/Bl
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree							0.2	1			0.2	2
Restionaceae	*Lepyrodia scariosa*		30	4	15	3			1	2			0.1	1
Ericaceae	*Leucopogon muticus*	Blunt Beard-heath											0.2	1
Lindsaeaceae	*Lindsaea linearis*	Screw Fern												
Lomandraceae	*Lomandra cylindrica*				0.1	2								
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush									0.2	2		
Lomandraceae	*Lomandra filiformis subsp. filiformis*													
Lomandraceae	*Lomandra glauca*	Pale Mat- rush							0.2	2	0.1	2		
Lomandraceae	*Lomandra longifolia*	Spiny- headed Mat- rush							0.1	1			0.1	1
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many- flowered Mat-rush									0.1	2		
Lomandraceae	*Lomandra obliqua*										0.2	2		
Proteaceae	*Lomatia silaifolia*	Crinkle Bush												
Zamiaceae	*Macrozamia spiralis*										0.2	1		

Family	*Species*	Common Name	Plot 13 Cover	Plot 13 Br/Bl	Plot 14 Cover	Plot 14 Br/Bl	Plot 15 Cover	Plot 15 Br/Bl	Plot 16 Cover	Plot 16 Br/Bl	Plot 17 Cover	Plot 17 Br/Bl	Plot 18 Cover	Plot 18 Br/Bl
Myrtaceae	*Melaleuca thymifolia*	Thyme Honey-myrtle			5	3			6	3			0.4	2
Ericaceae	*Melichrus procumbens*	Jam Tarts							0.1	1	0.2	1		
Poaceae	*Microlaena stipoides*	Weeping Grass					0.2	2						
Myrtaceae	*Micromyrtus ciliata*	Fringed Heath-myrtle			0.2	1			0.3	1				
Orchidaceae	*Microtis sp.*													
Ericaceae	*Monotoca elliptica*	Tree Broom-heath									0.3	1		
Rubiaceae	*Opercularia diphylla*	Stinkweed												
Fabaceae (Faboideae)	*Oxylobium sp.*													
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood												
Poaceae	*Panicum simile*	Two-colour Panic												
Iridaceae	*Patersonia longifolia*				0.2	1			2	2			0.1	2
Iridaceae	*Patersonia sericea*	Silky Purple-Flag												
Adiantaceae	*Pellaea falcata*	Sickle Fern												

Family	*Species*	Common Name	Plot 13 Cover	Plot 13 Br/Bl	Plot 14 Cover	Plot 14 Br/Bl	Plot 15 Cover	Plot 15 Br/Bl	Plot 16 Cover	Plot 16 Br/Bl	Plot 17 Cover	Plot 17 Br/Bl	Plot 18 Cover	Plot 18 Br/Bl
Proteaceae	*Persoonia levis*	Broad- leaved Geebung							0.1	1				
Proteaceae	*Persoonia linearis*	Narrow- leaved Geebung	0.2	1	3	2			0.5	1	11	3		
Proteaceae	*Persoonia oblongata*		2	2	8	3			0.1	1			1	2
Proteaceae	*Petrophile pulchella*	Conesticks												
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge									0.1	1		
Fabaceae (Faboideae)	*Phyllota phylicoides*	Heath Phyllota												
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower	0.1	1										
Apiaceae	*Platysace ericoides*				0.2	2							0.1	1
Poaceae	*Poa sieberiana*	Snowgrass												
Fabaceae (Faboideae)	*Podolobium ilicifolium*	Prickly Shaggy Pea									2	2		
Rubiaceae	*Pomax umbellata*	Pomax												
Lobeliaceae	*Pratia purpurascens*	Whiteroot					0.1	2						
Lamiaceae	*Prostanthera denticulata*	Rough Mint-bush												

Family	*Species*	Common Name	Plot 13 Cover	Plot 13 Br/Bl	Plot 14 Cover	Plot 14 Br/Bl	Plot 15 Cover	Plot 15 Br/Bl	Plot 16 Cover	Plot 16 Br/Bl	Plot 17 Cover	Plot 17 Br/Bl	Plot 18 Cover	Plot 18 Br/Bl
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	1	2					5	3			0.1	2
Fabaceae (Faboideae)	*Pultenaea scabra*										8	3		
Poaceae	*Rytidosperma pallidium*	Redanther Wallaby Grass									10	3		
Poaceae	*Rytidosperma sp.*				1	2								
Goodeniaceae	*Scaevola ramosissima*	Purple Fan-flower											0.1	1
Cyperaceae	*Schoenus brevifolius*						50	5						
Asteraceae	*Senecio sp.*	A Senecio												
Solanaceae	*Solanum prinophyllum*	Forest Nightshade												
Stackhousiaceae	*Stackhousia nuda*													
Poaceae	*Stenotaphrum secundatum**	Buffalo Grass											0.2	2
Stylidiaceae	*Stylidium graminifolium*	Grass Triggerplant											0.1	1
Phormiaceae	*Stypandra glauca*	Nodding Blue Lily												

Family	*Species*	Common Name	Plot 13 Cover	Plot 13 Br/Bl	Plot 14 Cover	Plot 14 Br/Bl	Plot 15 Cover	Plot 15 Br/Bl	Plot 16 Cover	Plot 16 Br/Bl	Plot 17 Cover	Plot 17 Br/Bl	Plot 18 Cover	Plot 18 Br/Bl
Phormiaceae	*Thelionema caespitosum*	Tufted Blue Lily					0.1	1						
Poaceae	*Themeda triandra*	Kangaroo Grass	0.1	2					0.2	2			0.1	1
Colchicaceae	*Wurmbea dioica*	Early Nancy			0.1									
Xanthorrhoeaceae	*Xanthorrhoea sp.*													
Apiaceae	*Xanthosia atkinsoniana*													
Apiaceae	*Xanthosia pilosa*	Woolly Xanthosia												
Proteaceae	*Xylomelum pyriforme*	Woody Pear												

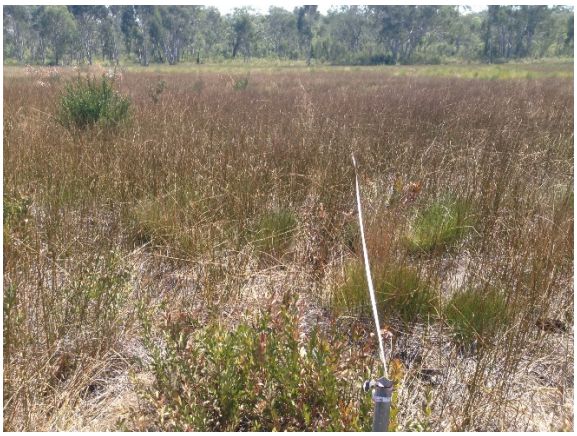
APPENDIX 3 – PHOTO POINT MONITORING

BBAM 2

BBAM 3

BBAM 4

BBAM 5



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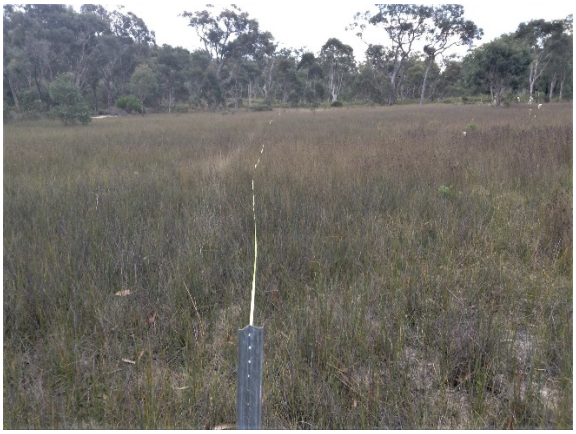

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Appendix 6

Aquatic Monitoring Report Spring 2019

Prepared by Niche Environment and Heritage Pty Ltd

(Total No. of pages including blank pages = 36)

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niche Environment and Heritage

Aquatic Monitoring Report

Spring 2019

Prepared for Tinda Creek Quarry Pty Ltd | 25 September 2019

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Document control

Project number	Client	Project manager	LGA
5179	Hy-Tech	Matthew Russell	Lithgow

Version	Author	Review	Status	Date
D1	David Wilkinson	Matthew Russell	Draft	13/9/2019
Rev1	David Wilkinson		Draft	18/9/2019
Rev 2	Matthew Russell		Final	25/9/2019

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Executive summary

An aquatic monitoring program was established as a requirement of the Landscape Management Plan (LMP) for the Tinda Creek Quarry. The program involves survey and analytical methods for measuring macroinvertebrates, stream health, water quality and catchment-riparian conditions.

The aim of the monitoring program is to monitor the river health of Tinda Creek and its tributaries. The monitoring includes:

- Assessment of stream condition using Riparian and Channel and Environment inventory assessment (RCE)
- Assessment of habitat condition using AUSRIVAS proforma
- Assessment of water quality against default ANZECC trigger values
- Assessment of the macroinvertebrate community condition using Stream Invertebrate Grade Number Average Level (SIGNAL) and AUSRIVAS.

In comparison to 2018, the sites were significantly dryer which resulted in less aquatic habitat, poorer water quality and fewer sites able to be sampled. Aquatic environments downstream of Tinda Creek Quarry infrastructure were found to have a good riparian condition and channel morphology. The macroinvertebrate community had low AUSRIVAS and SIGNAL scores indicative of poor stream health, however this is the result of the streams having limited water and aquatic habitat and hence influenced by natural stressors associated with intermittent/ephemeral streams.

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Glossary and abbreviations

ANZECC	Australian and New Zealand Environment and Conservation Council
Anthropogenic	Caused or produced by humans
Aquatic macroinvertebrates	Animals that have no backbone, are visible with the naked eye and spend all or part of their life in water
AUSRIVAS	Australian Rivers Assessment System
CMA	Catchment Management Area
Drainage	Natural or artificial means for the interception and removal of surface or subsurface water.
Ecology	The study of the relationship between living things and the environment.
Ephemeral	Existing for a short amount of time.
Habitat	The place where a species, population or ecological community lives (whether permanently, periodically or occasionally).
LMP	Landscape Management Plan
RCE inventory	Riparian and Channel and Environment inventory assessment.
Riparian	Relating to the banks of a natural waterway.
SIGNAL	Stream Invertebrate Grade Number Average Level. SIGNAL2 scores are indicative only and pollution does not refer to just anthropogenic sources. Environmental stress may result in poor water quality occurring naturally in waterways such as those conditions found in ephemeral streams. Low family richness and the occurrence of pollution tolerant invertebrates can give a low SIGNAL score even though they are a natural condition
Stress	Response to a stressor such as an environmental condition or a stimulus.

1. Introduction

1.1 Background

As part of the Tinda Creek Quarry Landscape Management Plan (LMP), a macroinvertebrate monitoring program within the Tinda Creek system and its tributaries was established to monitor changes to the system over time and assess possible influence from Quarry operations. The program includes methods for assessing stream health through the monitoring of macroinvertebrates, water quality and catchment-riparian conditions.

A baseline survey and assessment of eight sites was conducted in August 2007 shorty after a period of heavy rainfall and runoff. Following the 2015 approval for expansion of the Quarry, another survey was conducted in November 2015 to update the baseline records. Hy-Tec has committed to annual monitoring under the approved Landscape Management Plan. Niche were engaged to conduct aquatic monitoring in spring 2018 and 2019.

1.2 Catchment characteristics

The aquatic habitats surrounding the Tinda Creek Quarry include:

- Tinda Creek, a tributary of Wollemi Creek which joins the Colo River approximately 16km to the west of the project area;
- Ephemeral drainage lines that flow to Tinda Creek;
- Artificially created diversion channels; and
- Farm dam sites.

Tinda Creek is an ephemeral/intermittent stream which flows to the west away from the Quarry grounds. It has been diverted around the eastern and northern boundaries of the current operation zone via small earth drainage channels.

Tinda Creek is met by ephemeral second order drainage lines on the northern boundary of the Quarry. These lines do not hold water due to the substrate having a high concentration of sand and silt, and as such, are usually dry due to the sandy substrate having such a high permeability.

Two small former farm dams are located within the property to the north of the Quarry. These dams are overgrown with vegetation.

1.3 Aim

The aim of the aquatic monitoring program is to assess the health of Tinda Creek and its tributaries to ensure that the expanded quarry operations do not result in adverse impacts to the health of the downstream creek system. Specifically, in regards to aquatic environment and aquatic habitat health of the Greater Blue Mountains World Heritage Area. The monitoring includes:

- Assessment of stream condition using RCE
- Assessment of habitat condition using AUSRIVAS
- Assessment of water quality against default ANZECC trigger values
- Assessment of the macroinvertebrate community condition using SIGNAL and AUSRIVAS.

2. Methods

2.1 Location of monitoring sites

A total of eight sites were surveyed along the Tinda Creek system and its tributaries (Figure 1, Table 1) consistent with the baseline monitoring conducted in 2015 and monitoring in 2018. This included sites upstream and sites downstream of operations of the Quarry and therefore provides both reference and test sites for monitoring.

Table 1: Location of monitoring sites

Site	Stream	Location	Easting	Northing
Site 1	Tinda Creek	Tinda Creek Upstream of Quarry	286599	6327354
Site 2	Tinda Creek	Tinda Creek Upstream of Quarry	286400	6328390
Site 3	Tinda Creek Diversion Channel	Tinda Creek Diversion channel within Quarry	286405	6327957
Site 4	Tinda Creek	Tinda Creek Downstream of Quarry	285711	6328427
Site 5	Tributary of Tinda Creek	Tinda Creek Tributary	284913	6328247
Site 6	Tinda Creek	Tinda Creek downstream of Quarry	284048	6328633
Site 7	Tinda Creek	Tinda Creek downstream of Quarry	282998	6328847
Site 8	Tributary of Tinda Creek	Tinda Creek tributary (Outside of Quarry influence)	284476	6329656

2.1.1 Site 1 – Tinda Creek, Upstream of Quarry

Site 1 is situated on the upper reaches of Tinda Creek, upstream and to the southeast of Quarry activities. In this location, Tinda Creek lacks a defined drainage channel, being characterised by an open, sandy floodplain. As Site 1 is located upstream of the quarry, it will be monitored as a reference site.

2.1.2 Site 2 – Tinda Creek, Upstream of Quarry

Site 2 is located upstream and to the north of the Quarry and is downstream of a former farm dam. Site 2 is located on a section of an upper tributary of Tinda Creek formed as a constructed drainage channel with an open floodplain. As Site 2 is located upstream of the Quarry, it will be monitored as a reference site.

2.1.3 Site 3 – Tinda Creek Quarry – Clean Water Diversion

Site 3 is situated along a clean water diversion channel that was constructed to divert overland flows around the eastern edge of the Quarry and to the north towards Tinda Creek. The diversion channel is generally less than 2m in width. Site 3 comprises a test site.

2.1.4 Site 4 – Downstream of the Quarry

Site 4 is located downstream of the Quarry along a section of Tinda Creek that occurs just upstream of a small former farm dam. Tinda Creek at Site 4 comprises a defined drainage channel which supports a number of small, isolated pools. As Site 4 is situated downstream of the Quarry, it will be monitored as a test site.

2.1.5 Site 5 – Tinda Creek Tributary

Site 5 comprises a tributary of Tinda Creek that runs generally parallel to the eastern side of Putty Road and joins Tinda Creek just upstream of the road culvert. The tributary at this site comprises a series of wide pools interspersed with narrower sections. Site 5 will be monitored as a reference site.

As the creek bed was dry, monitoring was undertaken from a small dam that forms part of the watercourse. It is understood that this dam is fed by groundwater (nearby groundwater monitoring bores indicate artesian conditions) and that this water source is often used for firefighting activities.

2.1.6 Site 6 – Tinda Creek, West of Putty Road

Site 6 is situated on Tinda Creek, approximately 0.75km downstream of Putty Road. Site 6, comprises a shallow channel with broad floodplain. As Site 6 is downstream of the quarry, it will be monitored as a test site.

2.1.7 Site 7 – Tinda Creek, Far West of Putty Road

Site 7 is positioned along Tinda Creek, approximately 2km downstream of Putty Road. Site 7 comprises a broad, open channel. As Site 7 is downstream of the Quarry, it will be monitored as a test site.

2.1.8 Site 8 – Tinda Creek, northern territory

Site 8 is located upstream of Putty Road within a tributary of Tinda Creek to the north of the Quarry that is not influenced by Quarry operations. The site is directly above the culvert under Putty Road and comprises a broad open channel. Given that Site 8 occurs in a tributary that could not be affected by the quarry operations it is monitored as a reference site.

Drawn by: Philip Rofe File: T:\spatial\projects\a4200\a4216_TindaCreek_VegKoala_NSWMaps\report\4216_Figure_1_Aquatic.mxd Last updated: 3/1/2019 3:38:34 PM

niche Environment and Heritage

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m

GDA 1994 MGA Zone 56

Niche PM: Matthew Russell
Niche Proj. #: 5179
Client: Hy-Tech

Subject Area

Tinda Creek Aquatic Monitoring

Figure 1

public/NSW_Imagery:

v2.0

2.2 Field methods

The field survey was undertaken on the 3 September 2019. Field methods were consistent with standardised techniques for field sampling as prescribed by AUSRIVAS (Turak *et al*. 2000). The AUSRIVAS methods of sampling both pools and riffles has been modified for this program, as no suitable in-stream riffle features were present. A summary of the survey methods used at each of the eight sites is provided in Table 2.

Application of some methods were limited at most of the sites as the sites were dry at the time of the survey.

Table 2: Summary of methods at each site

Site	Macroinvertebrate sampling	AusRivAS habitat assessment	RCE assessment	Photo monitoring
Site 1			X	X
Site 2			X	X
Site 3			X	X
Site 4	X	X	X	X
Site 5	X	X	X	X
Site 6	X	X	X	X
Site 7	X	X	X	X
Site 8	X	X	X	X

2.2.1 Aquatic habitat and stream condition

Riparian, Channel and Environment inventory assessment (RCE)

The RCE Inventory (Chessman *et al*. 1997) provides a comparative measure of stream condition by assessing both the stream and its riparian environment in terms of habitat diversity, habitat condition and the degree of human-induced disturbance. Thirteen categories each receive a score between one and four based on their condition, resulting in an accumulated score of between 13 and 52. The maximum score (52) indicates a stream with little or no obvious physical disruption and the lowest score (13) indicates a heavily channelled stream without any riparian vegetation. This assessment provided an assessment of the general condition of the stream and must be interpreted accordingly.

Habitat description

A description of aquatic habitat was also produced using the AUSRIVAS proforma. The survey is a rapid visual assessment used to describe the habitat based on the following parameters:

- Geomorphology
- Channel diversity
- Bank stability
- Riparian vegetation and adjacent land use
- Water quality
- Macrophytes
- Local impacts and land use practices.

Macro-invertebrate sampling

Macro-invertebrate sampling was to be undertaken at sites 4-8 in accordance with AusRivAS protocol (Turak et al., 2004), where possible. This is due to the fact that sites 1-3 do not typically hold sufficient water to allow for sampling. The lack of sufficient water in these sites is a result of the ephemeral nature of the streams in the project area and the sandy substrate.

2.2.2 Water quality

Surface water quality was measured *in situ* using a Yeokal 611 water quality probe at each site. The following variables were recorded:

- Temperature (°C)
- Conductivity (µS/cm)
- pH
- Dissolved oxygen (DO)(% saturation and mg/L)
- Turbidity (NTU).

Alkalinity (mg $CaCO_3$/L) was measured with a standard titration kit. Water quality data were compared with the ANZECC (2000) default guideline values to physical and chemical stressors for protection of slightly upland aquatic ecosystems in South-Eastern Australia.

2.2.3 Macroinvertebrates

Samples of macroinvertebrates were collected from pool edges for a length of 10 metres, either as a continuous line or in disconnected segments. Sampling in segments was often undertaken to ensure the sampling of sub-habitats such as macrophyte beds, bank overhangs, submerged branches and root mats. Segmented sampling was also employed where pool length was short and it was logistically difficult to sample in a continuous line (e.g. in-stream logs). A 250 µm dip net was drawn through the water with short sweeps towards the bank to dislodge benthic fauna while scraping submerged rocks and debris, sides of the stream bank and the bed substrate (Plate 1). Further sweeps in the water column targeted the suspended fauna.

Plate 1: Sampling method

Each sample was rinsed from the net onto a white sorting tray from which animals were picked using forceps, pipettes and or paint brushes. Each tray was picked for a minimum period of 40 minutes, after which they were picked at 10 minute intervals for either a total of one hour or until no new specimens had been found. Care was taken to collect cryptic and fast moving animals, in addition to those that were conspicuous or slow. The animals collected at each site were placed into a labelled jar containing 70% ethanol.

Laboratory methods-invertebrate identification

Macroinvertebrate samples were identified to family level with the exception of Oligochaeta (to class), Polychaeta (to class), Ostracoda (to subclass), Nematoda (to phylum), Nemertea (to phylum), Acarina (to order) and Chironomidae (to subfamily). Keys used to identify taxa included:

- Centre for Freshwater Ecosystems (n.d.) – Identification Key and Ecology of Australian Freshwater Invertebrates. http://www.mdfrc.org.au/bugguide/.
- Dean, J., Rosalind, M., St Clair, M., and Cartwright, D. (2004) Identification keys to Australian families and genera of caddis-fly larvae (Trichoptera) Cooperative Research Centre for Freshwater Ecology.
- Gooderham, J. and Tsyrlin, E. (2002) The Waterbug Book: A guide to the Freshwater Macroinvertebrates of Temperate Australia, CSIRO Publishing.
- Hawking and Theischinger (1999) A guide to the identification of larvae of Australian families and to the identification of ecology of larvae from NSW.
- Madden, C. (2010) Key to genera of Australian Chironomidae. Museum Victoria Science Reports 12, 1-31.
- Madden, C. (2011) Draft identification key to families of Diptera larvae of Australian inland waters La Trobe University.
- Smith, B. (1996) Identification keys to the families and genera of bivalve and gastropod molluscs found in Australian inland waters Murray Darling Freshwater Research Centre.

2.3 Data analysis

2.3.1 SIGNAL: (Stream Invertebrate Grade Number Average Level) scores

The revised SIGNAL2 biotic index developed by Chessman (2003a and 2003b) was used to determine the "environmental quality" of sites. This method assigns grade numbers to each macroinvertebrate family or taxa found, based largely on their response to a range of environmental conditions (Table 3). The sum of all grade numbers for that habitat is then divided by the total number of families recorded in each habitat to calculate the SIGNAL2 index. A weighted SIGNAL2 score was also calculated (see Chessman 2003b). The SIGNAL2 index therefore uses the average sensitivity of macroinvertebrate families to present a snapshot of biotic integrity at a site.

Table 4 provides a broad guide for interpreting the health of the site according to the SIGNAL2 score of the site.

Table 3: SIGNAL Grade and the Level of Pollution Tolerance

SIGNAL Grade	Pollution Tolerance
10-8	Indicates a greater sensitivity to pollution
7-5	Indicates a sensitivity to pollution
4-3	Indicates a tolerance to pollution
2-1	Indicates a greater tolerance to pollution

Table 4: Guide to interpreting the SIGNAL2 scores

SIGNAL2 Score	Habitat quality
Greater than 6	Healthy habitat
Between 5 and 6	Mild pollution
Between 4 and 5	Moderate pollution
Less than 4	Severe pollution

(Source: Gooderham and Tsyrlin 2002)

*Note that SIGNAL2 scores are indicative only and that pollution does not refer to just anthropogenic pollution. Environmental stress may result in poor water quality occurring naturally in waterways. Low family richness and the occurrence of pollution tolerant invertebrates can give a low SIGNAL score even when they are in natural condition.

2.3.2 Opportunistic observations

Opportunistic visual observations of aquatic fauna were recorded during the surveys at each site.

3. Results

3.1 Weather conditions

The survey was conducted on 3 September 2019. The weather was mild (approximately 23°C) with light/moderate winds. There was low rainfall in late August leading up to the survey date (Figure 2). Monthly records of rainfall taken at the Quarry indicate that rainfall during 2019 was approximately 40% of the average annual rainfall from preceding years. The Quarry and the surrounding aquatic environment have therefore been affected by persistent dry conditions.

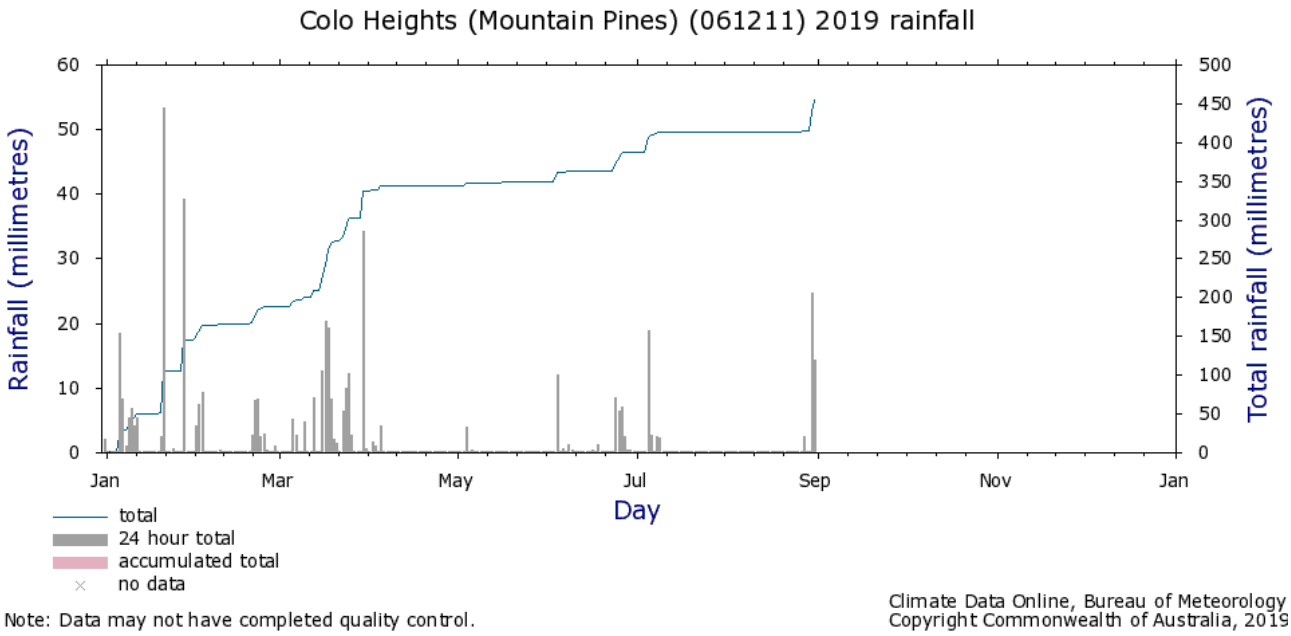

Figure 2: Rainfall data for January-September 2019

3.2 Aquatic habitat/condition

The aquatic habitat of the study area comprised pools with no active riffles. All except two sites had good riparian and channel health (RCE score 40 or above) (Table 5). Most sites exhibited stable banks and native riparian cover.

Table 5: RCE inventory scores (2019)

Site	Spring 2018
Site 1	41
Site 2	28 (Constructed diversion channel)
Site 3	27 (Constructed diversion channel)
Site 4	45
Site 5	46
Site 6	46
Site 7	46
Site 8	46

An RCE score greater than 40 indicates a stream considered to be in good condition with potential for higher biodiversity values. RCE Scores of 20-40 indicate a stream is in moderate condition and below 20 indicates that the stream is in very poor condition

3.2.1 Site 1 Tinda Creek upstream of the quarry

The aquatic habitat at Site 1 (Plate 2) at the time of the spring 2019 monitoring surveys is detailed in Table 6.

Site 1 Downstream | Site 1 Upstream

Plate 2: Site 1

Table 6: Site 1 habitat results

	Attribute	Site 1
	Photograph	Plate 2
Riparian	RCE score	41
	Vegetation	Canopy absent. Scattered Parramatta red gum (*Eucalyptus parramattensis)* regenerating within this location. Mid-story absent. Groundcover dominated by sedge, low shrub, herb and grasses. (*Leptocarpus tenax; juncus species; lepyrodia scatiosa; Schoenus brevifolius; Entolasia stricta; Gonocarpus micranthus; Melaleuca thymifolia; kMicromyrtus ciliate* and *Dampiera stricta.*
	Stream shading	Low; <5%
	Exotic vegetation	-
Stream characteristics	Modal width (m)	-
	Substrate	Majority sand and silt
	Flow/depth	No flow
	Macrophytes/algae	Absent
	Water quality observations	Very dry
Comments		Lacking defined drainage channel. Open sandy floodplain.

3.2.2 Site 2 Tinda Creek upstream of the quarry

The aquatic habitat at Site 2 (Plate 3) at the time of the spring 2019 monitoring surveys is detailed in Table 7.

Site 2 Downstream | Site 2 Upstream

Plate 3: Site 2

Table 7: Site 2 habitat results

	Attribute	Site 2
	Photograph	Plate 3
Riparian	RCE score	28 (Constructed drainage channel)
	Vegetation	Canopy consisted of sparse Scribbly Gums (*Eucalyptus haemastoma*), with a scattered grass/shrub land dominated by *Chorizandra spaerocephala.*
	Stream shading	Low/Moderate
	Exotic vegetation	-
Stream characteristics	Modal width (m)	<1m
	Substrate	Sand 80%, Silt 20%
	Flow/depth	No flow
	Macrophytes/algae	Absent-
	Water quality observations	Very dry
Comments		Constructed channel to drain farm dam

3.2.3 Site 3 Tinda Creek Diversion channel within Quarry

The aquatic habitat at Site 3 (Plate 4) at the time of the spring 2019 monitoring surveys is detailed in Table 8.

Site 3 Downstream | Site 3 Upstream

Plate 4: Site 3

Table 8: Site 3 habitat results

	Attribute	Site 3
	Photograph	Plate 4
Riparian	RCE score	27 (Constructed channel)
	Vegetation	Canopy absent. Mid-story absent. Groundcover dominated by *Chorizandra spaerocephala.*
	Stream shading	Low/none
	Exotic vegetation	-
Stream characteristics	Modal width (m)	<2m
	Substrate	Sand 70%, silt 30%
	Flow/depth	No flow
	Macrophytes/algae	Absent
	Water quality observations	Very dry
Comments		Dry. Very loose banks.

3.2.4 Site 4 Tinda Creek Downstream of Quarry

The aquatic habitat at Site 4 (Plate 5) at the time of the spring 2019 monitoring surveys is detailed in Table 9.

Site 4 Downstream | Site 4 Upstream

Plate 5: Site 4

Table 9: Site 4 habitat results

	Attribute	Site 4
	Photograph	Plate 5
Riparian	RCE score	45
	Vegetation	Canopy composed of *Eucalyptus haemastoma (<5%).* Mid-story dominated by small trees and tall shrubs. Ground cover was sparse with signs of slight die back and dominated by *Chorizandra spaerocephala.*
	Stream shading	Moderate
	Exotic vegetation	-
Stream characteristics	Modal width (m)	<2m
	Substrate	Pebble 5%, 80% silt, 15% sand
	Flow/depth	No flow
	Macrophytes/algae	Absent
	Water quality observations	Very dry
Comments		Signs of erosion of banks

3.2.5 Site 5 Tinda Creek Tributary

The aquatic habitat at Site 5 (Plate 6) at the time of the spring 2019 monitoring surveys is detailed in Table 10.

Site 5 Downstream | Site 5 Upstream

Plate 6: Site 5

Table 10: Site 5 habitat results

	Attribute	Site 5
	Photograph	Plate 6
Riparian	RCE score	46
	Vegetation	Canopy present and comprised of *Eucalyptus haemastoma*, Mid-story supporting dense cover of small trees and tall shrubs (*Acacia spp* and *Cassurina spp*).There was a reduction in ground cover (when compared to previous surveys), but dominated by regenerative Cat-tailed bulrush (Typha), Round headed bristle sedge (*Chorizandra spaerocephala*).
	Stream shading	Low-Moderate
	Exotic vegetation	-
Stream characteristics	Modal width (m)	<4m
	Substrate	Silt 90%, sand 10%
	Flow/depth	No flow
	Macrophytes/algae	Absent
	Water quality observations	Very dry
Comments		Riparian and macrophyte vegetation present, but dry. Evidence of sediment movements by use of excavator on edge of dam.

3.2.6 Site 6 Tinda Creek downstream of Quarry

The aquatic habitat at Site 6 (Plate 7) at the time of the spring 2019 monitoring surveys is detailed in Table 11.

Site 6 Downstream | Site 6 Upstream

Plate 7: Site 6

Table 11: Site 6 habitat results

	Attribute	Site 6
	Photograph	Plate 7
Riparian characteristics	RCE score	46
	Vegetation	Forest Red Gum (*Eucalyptus tereticornis*), White Stringybark (*E. globoidea)* dominated the canopy vegetation. The mid-storey was dominated by small trees and tall shrubs. The ground cover consisted of by native grasses, herbs and ferns.
	Stream shading	Moderate/High
	Exotic vegetation	-
Stream characteristics	Modal width (m)	<3m
	Substrate	Sand 20%, silt 80%
	Flow/depth	No flow
	Macrophytes/algae	Absent
	Water quality observations	Very dry
Comments		No flow, browning of grass and groundcover vegetation due to lack of rain

3.2.7 Site 7 Tinda Creek downstream of Quarry

The aquatic habitat at Site 7 (Plate 8) at the time of the spring 2019 monitoring surveys is detailed in Table 12.

Site 7 Downstream | Site 7 Upstream

Plate 8: Site 7

Table 12: Site 7 habitat results

	Attribute	Site 7
	Photograph	Plate 8
Riparian characteristics	RCE score	46
	Vegetation	Canopy vegetation included Grey Gums (*Eucalyptus punctata*) and Scribbly Gums (*Eucalyptus haemastoma*). The ground cover consisted of by native grasses, herbs and ferns, as well as macrophytes.
	Stream shading	Low/moderate
	Exotic vegetation	-
Stream characteristics	Modal width (m)	<5m
	Substrate	Silt 100%
	Flow/depth	No flow
	Macrophytes/algae	Cat tail Bulrush (*Typha*)
	Water quality observations	Very dry
Comments		No Surface water. Overgrown creek bed. Evidence of large mammal resting ground.

3.2.8 Site 8 Tinda Creek tributary (Outside of Quarry influence)

The aquatic habitat at Site 8 (Plate 7) at the time of the spring 2019 monitoring surveys is detailed in Table 13.

Site 8 Downstream | Site 8 Upstream

Plate 9: Site 8

Table 13: Site 8 habitat results

	Attribute	Site 8
	Photograph	Plate 7
Riparian characteristics	RCE score	46
	Vegetation	Canopy vegetation included Grey Gums (*Eucalyptus punctata*) and Scribbly Gums (*Eucalyptus haemastoma*). The mid-storey was dominated by tall shrubs. The ground cover consisted of by native grasses, herbs and ferns along with Eucalyptus and Casuarina regeneration.
	Stream shading	Moderate/High
	Exotic vegetation	-
Stream characteristics	Modal width (m)	<2m
	Substrate	Pebble 30%, sand 20%, silt50%
	Flow/depth	No flow/<1m
	Macrophytes/algae	Absent-
	Water quality observations	Turbid/Isolated pool
Comments		Isolated stagnant pool. Animal activity at water edge

3.3 Water quality

Water samples were only possible at two of the eight sites. Site 5 water sample was taken from the connected dam due to the creek being dry. It is noted that water for firefighting was taken from this dam over 24 and 25 August (9 days prior to monitoring) which may have influenced water quality characteristics particularly turbidity. The water sample at Site 8 was taken from a remnant small pool within the mostly dry stream channel.

The results (Table 14) show that temperature ranged between 10.13 – 12.56 °C; the warmest being Site 8. Conductivity ranged between 97-256 µ/cm; the highest recorded in Site 5. All sites were within the ANZECC trigger values for conductivity (30-350 µS/cm). Turbidity ranged 62.2-171.7 NTU with the highest recorded in Site 5. Dissolved Oxygen (DO) values were moderate to low (between 48.4 and 76.6 % sat) and were below ANZECC trigger values (80-110%). Site 5 pH reading exceeded ANZECC trigger values. Alkalinity registered as 20 $CaCO_3$/L for both Site 5 and 8.

Table 14: Water quality results

Site acronym	Temp (C°)	Conductivity (µS/cm)	Turbidity (NTU)	Dissolved Oxygen (% sat)	pH*	Alkalinity (mg $CaCa_3$/L)
Site 1	-	-	-	-	-	-
Site 2	-	-	-	-	-	-
Site 3	-	-	-	-	-	-
Site 4	-	-	-	-	-	-
Site 5	10.13	256	**171.7**	76.6	**8.36**	20
Site 6	-	-	-	-	-	-
Site 7	-	-	-	-	-	-
Site 8	12.56	97	**62.2**	48.4	7.46	20

ANZECC trigger values for upland streams: Electrical conductivity (30-350 µS/cm), Turbidity (6-50 NTU), pH (6.5-8), Dissolved Oxygen (80-110%). Text in bold indicate those variables that exceed the default trigger values.

Note: For some waterways, default ANZECC trigger values do not reflect typical background water quality and chemistry. Therefore an assessment of water quality monitoring data against default values can suggest the condition of the waterway is outside the normal range, or polluted, when in fact it is 'clean', or vice versa.

3.4 Macroinvertebrates

AUSRIVAS and SIGNAL2 results for the two sampled sites are provided in Table 15. Raw data is provided in Annex 1.

Table 15. Macroinvertebrate results

Site acronym	Number of Taxa	SIGNAL2 weighted score	AUSRIVAS score
Site 1	-	-	
Site 2	-	-	
Site 3	-	-	
Site 4	-	-	
Site 5	12	3.35	B
Site 6	-	-	-
Site 7	-	-	-
Site 8	14	3.19	B

The number of taxa at the three sites ranged from 12 to 14, with the most taxa observed at Site 8 within in a tributary located to the north of the site. The least taxa observed were in the dam connected to Site 5, a tributary of Tinda Creek. AUSRIVAS score showed that the stream could be impaired as they are dissimilar to modelled reference macroinvertebrate communities with both sites scoring in Band B. The SIGNAL2 scores indicate that the streams may have a dominance of pollution-tolerant taxa (Table 4). Pollution-sensitive taxa Leptoceridae (SIGNAL 6) were observed at both sites. Other pollution-sensitive taxa (SIGNAL ≥6) were Acarina (SIGNAL 6) at both sites. The SIGNAL biplot (Figure 3), indicates that no sites have favourable aquatic habitat and all locations are exhibiting some form of pollution or natural stress. However, this appears typical for streams in the area as Site 8 also is present in this quadrant.

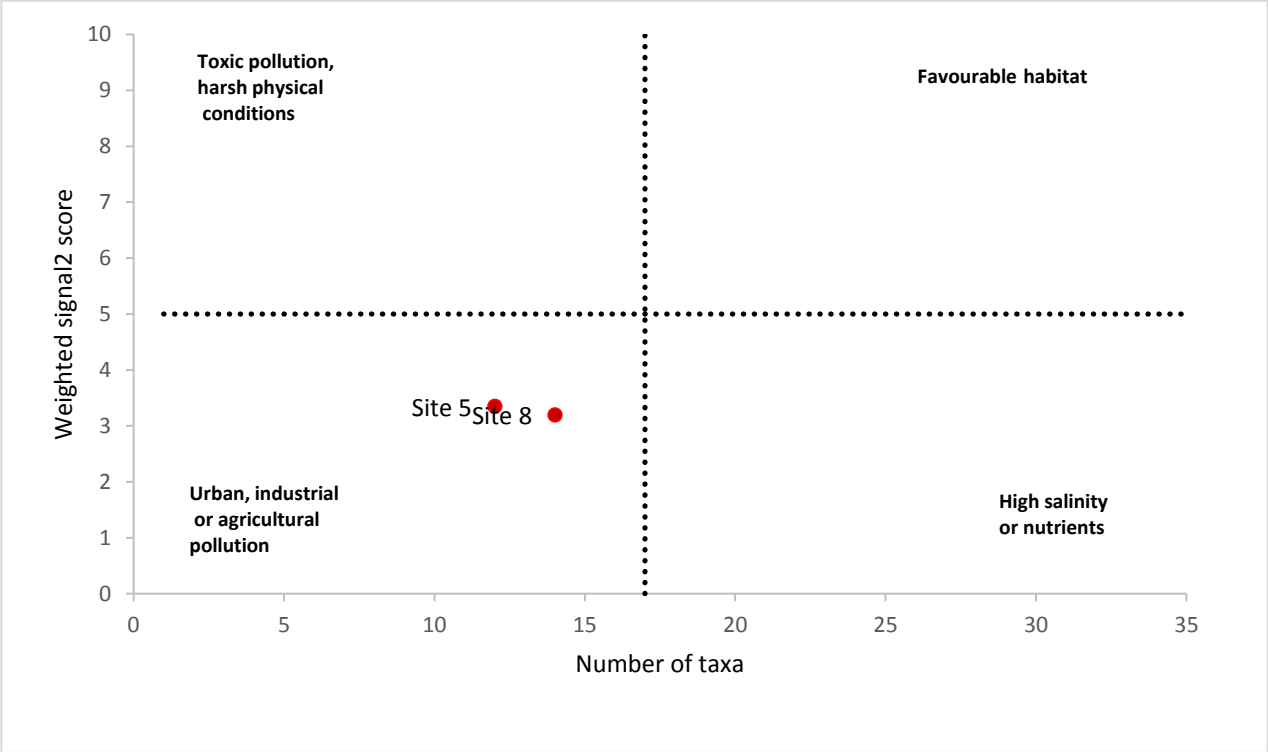

Figure 3. SIGNAL2 Bi-plot

There appears to be no general trend in SIGNAL2 scores in comparison to previous results (Table 16), however there were small site differences at the two sites. This included a decrease in SIGNAL2 score at Site 5. Site 8 increased slightly. The two scores were similar to previous results, with Site 5 and 8 having the same difference (0.19). Site 4, 6 and 7 were not sampled in 2019 due to insufficient surface water. The AUSRIVAS score at Site 5 and Site 8 showed improved stream health despite low rainfall in the proceeding months (

Table 17).

Table 16. Weighted SIGNAL2 scores (2015, 2018 and 2019)

Site	SIGNAL2 weighted Spring 2015	SIGNAL2 weighted Spring 2018	SIGNAL2 weighted Spring 2019
Site 4	2.25	DRY	DRY
Site 5	2	3.54	3.35
Site 6	3.5	2.6	DRY
Site 7	4.66	DRY	DRY
Site 8	2.5	3	3.19

Table 17. AUSRIVAS (2018 - 2019)

Site	AUSRIVAS 2018	AUSRIVAS 2019
Site 4	DRY	DRY
Site 5	D	B
Site 6	C	DRY
Site 7	DRY	DRY
Site 8	C	B

3.5 Other fauna

No fish species or other aquatic species were observed during field surveys.

4. Discussion

4.1 RCE scores

The findings from spring 2019 monitoring are relatively similar to the results from previous assessment (Niche 2018) and showing moderate to good channel and riparian health at most sites. RCE scores were approximately 40 or above indicating good or near good condition, with the exception of two sites (Sites 2 and 3). The low scores are due to the nature of these sites as they have been modified by human activity.

4.2 SIGNALs scores and macroinvertebrate communities

No test sites could be sampled because of the lack of aquatic habitat, only reference sites Site 5 and Site 8 were sampled. Despite poor AUSRIVAS and low-moderate SIGNAL2 scores, the streams are in reasonable health as they exhibit vegetative characteristics, macroinvertebrate fauna, and stream condition that are typical of intermittent streams which are under natural low flow stress. This monitoring shows an increase in stream health at Site 5 and 8 despite low rainfall observed in the preceding month. The reason for this increase in unclear however the score still indicates ecological impairment to the waterway. There appears to be no obvious disturbance resulting from the Tinda Creek Quarry operations at downstream sites, despite the lack of water in the system.

The results in general are consistent with macroinvertebrate communities representative of low flow/intermittent streams, the fauna of which consist of generally pollution-tolerant organisms resulting in the streams having low SIGNAL2 and AUSRIVAS scores. Low SIGNAL 2 scores were similarly observed in 2018 and 2015.

4.3 Water quality

Field parameters measured continue to be relatively consistent and are within the expected range typical for disturbed intermittent streams. The measured parameters are characteristic of the low flow environment in these streams e.g. low dissolved oxygen. The elevated turbidity observed at Site 5 is likely the result of recent use by animals (kangaroos, wallabies, and deer). The dam was also previously utilised for firefighting on 24th-25th August, nine days prior to field sampling which may also contributed to the elevated turbidity. While pH also exceeded guidelines at Site 5, this is thought to be the result of local water chemistry, disturbances, and low water levels and not related to the quarry activities.

5. Conclusion and recommendations

5.1 Conclusions

The general health of the vegetation and waterways of the eight sites was found to be in moderate to good health. All sites but two had RCE scores above 40. As all test sites were dry, only reference sites (Site 5 and Site 8) were able to have AUSRIVAS/SIGNAL macroinvertebrate samples and water quality measurements taken.

Sites downstream of Tinda Creek Quarry operations continue to exhibit good riparian and channel morphology however all sites were dry. The macroinvertebrate community at reference sites is in reasonable health despite some poor AUSRIVAS and low to moderate SIGNAL2 scores. Water quality was consistent with what would be expected for ephemeral/intermittent streams in the area at the reference locations, however it is acknowledged that Site 5 is affected by local disturbances from animal and firefighting activities. Apart from lack of water there appears to be no major changes in stream health since previous monitoring (Niche 2018) and (Umwelt 2015). As such, these results indicate that Tinda Creek Quarry's operations do not appear to be having an impact on the health of the streams downstream of the project area.

6. References

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Turak E., Waddell N., and Johnstone G. (2000) NSW AUSRIVAS Sampling and Processing Manual. Department of Environment and Conservation.

Umwelt. (2015) Aquatic sampling and condition assessment – Tinda Creek Sand Quarry. Prepared for AUS-10 Rhyolite Pty ltd.

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Websites

http://ausrivas.ewater.com.au/

http://www.mdfrc.org.au/bugguide/

Annex 1. Macroinvertebrate survey results

Site	Site 5	Site 8
Sphaeriidae	1	
Planorbidae		3
Baetidae	2	
Hemicorduliidae	2	2
Synthemistidae		1
Corixidae	10	
Micronectidae	6	2
Notonectidae	11	
Veliidae		9
Dytiscidae		14
Hydrophilidae		7
Ceratopogonidae	9	
Chironominae	11	22
Tanypodinae	3	1
Culicidae		1
Hydrochidae		21
Leptoceridae	2	1
Gelastrocoridae		1
Cladocera	1	
Mites (Acarina)	3	3

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Our services

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Terrestrial
Freshwater
Marine and coastal
Research and monitoring
Wildlife Schools and training

Heritage management
Aboriginal heritage
Historical heritage
Conservation management
Community consultation
Archaeological, built and landscape values

Environmental management and approvals
Impact assessments
Development and activity approvals
Rehabilitation
Stakeholder consultation and facilitation
Project management

Environmental offsetting
Offset strategy and assessment (NSW, QLD, Commonwealth)
Accredited BAM assessors (NSW)
Biodiversity Stewardship Site Agreements (NSW)
Offset site establishment and management
Offset brokerage
Advanced Offset establishment (QLD)

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Appendix 7

Minutes of Tinda Creek Quarry Community Consultative Committee

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TINDA CREEK SAND PROJECT
COMMUNITY CONSULTATIVE COMMITTEE
MINUTES OF MEETING HELD MONDAY 13TH MAY 2019
ON SITE AT MELLONG

	NAME	ORGANISATION
PRESENT	Lisa Andrews (LA)	Independent Chairperson
	Jane Robinson (JR)	Putty Community Association delegate
	David Cilento (DC)	Hy-Tec
	Lee Attard (LAt)	Hy-Tec
	Michael Walton (MW)	Hy-Tec
APOLOGIES	Ray Campbell (RC)	Community Representative
	Darryl Thiedeke (DT)	Hy-Tec
ABSENT	Bruce Mansell (BM)	Community Representative
	Brigitte Lewis (BL)	Community Representative

The CCC Meeting was opened at 9.08am

<table>
<tr><td>WELCOME & INTRODUCTIONS</td><td>The chair welcomed all present and thanked them for their attendance.</td><td></td></tr>
<tr><td>APOLOGIES</td><td>As above.</td><td></td></tr>
<tr><td>DECLARATION OF INTEREST</td><td>LA declared that she is an approved Independent Chairperson with the Department of Planning and Environment, appointed by the Secretary to chair this CCC and engaged by Hy-Tec.</td><td>No changes to members' previous declarations</td></tr>
<tr><td>BUSINESS ARISING</td><td>In accordance with the guidelines, the minutes from the previous meeting held on 15th October 2018 were finalised on 21st November 2018.

Action Items:

<table>
<tr><th>ITEM</th><th>ISSUE</th><th>RESPONSIBILITY</th></tr>
<tr><td>1</td><td>Write to stakeholder groups (Putty Community Association, Rural Fire Service, Colo Heights School P&C) seeking potential representation on the CCC</td><td>LA
(Complete 5/11/19)</td></tr>
</table>

The demolition works on Lot 1 have been completed.
The transfer of the approved off-set area (106 hectares) to the National Parks and Wildlife Service is nearing completion. Negotiations are continuing, however, it is looking like NPWS will hold ownership with Hy-Tec being granted approval to maintain the land via an access agreement or caveat on the property. DP&E staff are assisting with this process.
</td><td>One nomination received from Putty Community Association. Nil response from other stakeholder groups.</td></tr>
<tr><td>CORRESPONDENCE</td><td>As per emailed with the meeting notice on 26th April 2019 with one additional item:

26/10/18 – Email to CCC members with the draft minutes from 15/10/18 for review
26/10/18 – Letter to Ray Campbell with the same information
</td><td></td></tr>
</table>

	• 5/11/18 – Letters to stakeholder groups seeking representatives to join the CCC (Putty RFS, Putty Community Association & Colo Heights Public School P & C Association). • 5/11/18 – Letter to Hawkesbury Council seeking an LGA delegate on this CCC. • 12/11/18 - Email from Putty Community Association nominating their secretary Jane Robinson as a potential delegate on the CCC • 21/11/18 - Email to CCC members with the finalised minutes • 21/11/18 – Email to Ray Campbell with the same information • 27/2/19 - Letter to DPE with report for new stakeholder membership • 1/3/19 – Letter from DPE endorsing Jane Robinson from the Putty Community Association as a new stakeholder member on this CCC • 16/3/19 – Email to Jane Robinson, congratulating her on her endorsement on the CCC and including previous minutes and the Planning guidelines under which this CCC operates • 15/4/19 – Email form Darry Thiedeke with an apology for this meeting • 26/4/19 – Email to members with a Meeting Notice, Agenda & Correspondence Report for this meeting • 26/4/19 – Letter to Ray Campbell with the same information. • 10/5/18 – Email to members with a reminder for this meeting.	
REPORT/PROJECT UPDATE	• Due to lack of rain, production is low. • Hy-Tec will apply to modify its consent for the water catchment by adjusting boundaries in its closed water area to capture water via diversion channels. • All water used on site is rain water, not ground water and is recycled/reused. The water is needed to wash the sand to take the fines out. These operations do not effect water resources to surrounding properties. • Rehabilitation works undertaken are doing really well. DP&E Compliance staff have been on site to inspect the works. • One area of previously disturbed bushland, which was used by the previous owner as a storage area, has been cleaned up and rehabilitated over the past two years. The drought had affected the regrowth, but the rain in October 2018 and March 2019 now has the area thriving. • The area has been soil tested for contamination and the planting seeds were collected from site to create tube stock that were grown and planted. It has now been sectioned off to protect it from site traffic and local fauna. • Anything contentious in this area was removed from site and taken to licenced facilities with appropriate certification provided to DP&E. • JR enquired whether there were any cultural heritage sites registered. DC responded that there are no cultural sites, however, there is an endangered vegetation species. This area has been sectioned off and is protected. • MW advised that wild dog and fox baiting has been carried out by the NSW government Local Land Services along the powerline corridor.	**See attached water graph for statistical data.**

	• LAt informed members that VENM & ENM is DA consented to be imported for capping purposes. All material is certified and meets Hy-Tec's licence requirements. Nil has occurred in the past 12 month period. • MW confirmed that there have been no complaints received in the past 6 months. Drivers are continuing to abide by the Code of Conduct. • The 2018 Annual Review has been lodged with DP&E, which included the rehabilitation of the old storage area. DP&E have acknowledged receipt of the document and queried information provided regarding the bore water levels having dropped. A hydrologist has reviewed the data and determined that it is due to the dry weather conditions. There are 20 bores on site that are monitored every month. • MW advised that Hy-Tec continue to support the Colo Heights Public School and the local RFS. • In February, the RFS used the front area of the site for firefighting purposes, taking water from the front dam. *www.hy-tec.com.au/quarry-documentation	**AR will be available on the project website* when approved by DP&E.**
GENERAL BUSINESS	• JR advised that the Putty Community Fare will be held on 6th October at the hall, inviting and encouraging members to attend. • The new Windsor Bridge is under construction with works expected to continue for 12 -18 months. There does not appear to be any impact on deliveries. • The two competitor sand mines (Freemans Reach and land near the Monastery) are both being assessed by Hawkesbury City Council and other government departments. • JR enquired whether Hy-Tec provide apprenticeships, as there is a need for youth employment opportunities in the area. • DC responded that they don't operate an apprenticeship scheme, however, employ engineering students who are moved around each of the Hy-Tec sites to obtain experience and knowledge. • MW confirmed there are 6 permanent staff on site with contractors used when needed. • Production, previously 7-8 hours per day has been reduced to 2-3 hours due to the lack of rain. • Hy-Tec continue to operate in accordance with its approach of having minimal impact on the environmental footprint through effective environmental management and rehabilitation.	
NEXT MEETING	Monday 14th October 2019 commencing at 9am (on site).	**LA to contact BM & BL to offer alternate meeting time.**

Meeting closed at 9.55am with LA thanking all for their attendance.

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TINDA CREEK SAND PROJECT
COMMUNITY CONSULTATIVE COMMITTEE
MINUTES OF MEETING HELD MONDAY 14TH OCTOBER 2019
ON SITE AT MELLONG

	NAME	ORGANISATION
PRESENT	Lisa Andrews (LA)	Independent Chairperson
	David Cilento (DC)	Hy-Tec – NSW General Manager
	Michael Walton (MW)	Hy-Tec – Quarry Manager
	Greg Burnett (GB)	Hy-Tec – Operations Manager NSW
	Mitchell Noble (MN)	Hy-Tec – Health, Safety & Environment Manager
	Brigitte Lewis (BL)	Community Representative
	Ray Campbell (RC)	Community Representative
APOLOGIES	Bruce Mansell (BM)	Community Representative
	Jane Robinson (JR)	Putty Community Association delegate
	Darryl Thiedeke (DT)	Hy-Tec – National Planning & Development Manager

The CCC Meeting was opened at 9.07am

WELCOME & INTRODUCTIONS	The chair welcomed all present and thanked them for their attendance. GB & MN were introduced. LA attempted to dial JR into the meeting as she was travelling for business and still wanted to participate in the meeting.	**Attempt to contact JR was unsuccessful.**
APOLOGIES	As above. DC advised that Lee Attard had left company and started his own business.	
DECLARATION OF INTEREST	LA declared that she is an approved Independent Chairperson with the Department of Planning and Environment, appointed by the Secretary to chair this CCC and engaged by Hy-Tec.	**No changes to members' previous declarations**
BUSINESS ARISING	In accordance with the guidelines, the minutes from the previous meeting held on 13th May 2019 were finalised on 27th May 2019. **Action Items:** **ITEM** / **ISSUE** / **RESPONSIBILITY** 1 / LA to contact BM & BL to offer alternate meeting time. / LA (Complete 17/5/19)	**This item moved to General Business for discussion.**
CORRESPONDENCE	Emailed with the meeting notice on 30/9/19 with one additional item: • 17/5/19 – Email to BM & BL asking if CCC start time needs to be altered • 20/5/19 – Email to CCC members with the draft minutes from 13/5/19 for review • 27/5/19 - Email to CCC members with the finalised minutes • 27/5/19 – Email to Ray Campbell with the same information • 15/7/19 – Email from Jane Robinson (PCA) providing a copy of the latest Putty People, publication. • 30/9/19 – Email to members with a Meeting Notice, Agenda & Correspondence Report for this meeting • 30/9/19 – Letter to Ray Campbell with the same information.	**LA read out email from AQUAS and sought feedback from CCC members. Issues for inclusion in audit: Traffic and rehabilitation, including end of mine life. MW commented**

	• 8/10/19 – Email from James Hart from AQUAS consulting advising that he has been appointed as the Independent Environmental Auditor and seeking any input from the CCC on issues to concentrate on.	**that the auditor went through these and other issues on the 9th and 10th October. Action: LA to advise AQUAS.**
REPORT/PROJECT UPDATE	• MW advised that due to lack of rain, production output and sales has been low. Stating rainfall figures of 2019: 271mm of rain year to date 2018: 341mm rain 2017:5 48mm rain Making it almost the driest period in100 years for the region. • This has impacted on the available process water on the site, therefore production levels are down. • RC enquired on whether the business is still viable with MW stating that Hy-Tec have invested a lot of money into the site and still had its regular concrete suppliers that it delivers to. Confirming that the company is there for the long term. Hy-Tec has submitted bonds to EPA, which ensures rehabilitation of the site is undertaken, so won't walk away from the project. • DC advised that employees have been concentrating on the rehabilitation work and water program during the down time. • Hy-Tec has updated its site Water Management Plan resubmitted and approved by the NSW Department of Planning in August 2019. The Water Management Plan for the Tinda Creek Quarry has been prepared to satisfy Condition 13 of Schedule 3 of Development Consent SSD 4978 (SSD 4978). However, the principle objective of the Plan is to provide a practical and accessible document to guide the management of surface water and groundwater resources at the Quarry. • Work continues on capping and re-top soiling the rehabilitation area. • The lack of rain has caused Hy-Tec to stop planting any regrowth vegetation, however, the existing planting from 12-18 months ago, is growing well (grevilleas, banksias, black wattle, etc) and is now at a reasonable height. Unfortunately, the recent plantings from 8 months ago is not growing due to the drought conditions being experienced. • RC advised that he has been contacted by Neville Diamond who has raised his concerns regarding ground water impacts from the sand mining activities, as well as other issues, all that have historically been raised and responded to by both Hy-Tec and NSW government departments. DC advised that Mr Diamond had contacted Hy-Tec management and spoken with Lee Attard to address his concerns. LA commented that Mr Diamond has contacted her as well. • MW advised that officers from the NSW Police Rural Crime Squad had visited the site and discussed with staff an incident involving a horse that had been shot at a nearby property. As part of their investigations officers were seeking any photographic footage from dash cameras in trucks that may have recorded suspicious vehicles parked along and adjacent to Putty Rd in the area. • MW advised that DPIE Compliance Officers have visited the mine site and are happy with the progress of rehabilitation. The disturbed area in the south east of the quarry, cleared and	

	used for storage by the previous owners, has now been rehabilitated. Three monthly updates and photographs of the area are provided to DPIE. • No VENM & ENM has been accepted on the sand quarry in the past 12 months, although Hy-Tec are consented to receive this for use in rehabilitation of the site. Any material received needs to meet strict environmental licencing requirements administered by the EPA prior to being used for rehabilitation purposes. BL commented that fill recently placed on the skirmish site at East Kurrajong was contaminated. • BL advised that the Colo Progress Association is lobbying Hawkesbury City Council that the clean-up of illegal dump sites needs to occur swiftly and that the Greater Hawkesbury Region needs regular monitoring to stop the dumping of waste. • MW advised that LLS has undertaken a second round of dog and fox baiting in the area for the spring of 2019, stating that the power line corridors from the Hunter Valley to Sydney and to Bathurst are of particular concern. LLS also highlighted the impact the wild dogs and foxes have on the native wildlife in the region. • DC advised that no new complaints have been received. However, they have lodged the issues raised by Mr Diamond in his conversation with Lee Attard as a complaint of historical nature and issues in their register. • RC sought clarification on the water used for processing of sand. MW confirmed that all process water used on site is re-used multiple times in the water and sand washing circuits, with the water predominately sourced from rain water, with approximately 5% lost to absorption or evaporation. Minimal water is sourced from licenced bores on the site. • MW advised that ground water monitoring continues to be undertaken by an independent hydrologist. LA requested that a summary of the water table monitoring data be presented at the next CCC. • No complaints received regarding transport issues, with drivers continuing to abide by the Code of Conduct. • MW advised that the annual review for 2019 is underway, in conjunction with the independent environmental audit. • The bio-diversity reporting officers will be on site next week. • The independent hydrologist (Katerina David) has the latest data information from all bores on the site, which is currently being reviewed to analyse the water table management. • MW advised that in the last six months, a small donation has been made to the Colo Heights Public School (truckload of sand). • NPWS & RFS used water from the front dam to assist with firefighting activities at the duck farm on Putty Rd and surrounding bushfires in National Parks in recent months. • BL advised that Colo Heights RFS are currently fund raising for a better GPS system and assistance with their satellite phone costs. They have purchased one infra-red heat sensor gun, however, need another one.	**Action: G/Water monitoring data to be presented at next CCC.**
GENERAL BUSINESS	• RC – discussions on the new Windsor Bridge and potential problems in the event of a flood. Positives were also discussed regarding improved traffic flow that will come with the new improved bridge for the wider community. • MW advised the LLS enquired whether there were any neighbours that may be interested in being part of the dog and fox-baiting program in 2020. If so, to contact LLS direct:	

	Jacob French l Biosecurity Officer Local Land Services Greater Sydney Level 4 2-6 Station Street l PO Box 4515 l Penrith Westfield NSW 2750 F: 02 47242198 l M: 0438 073 749 E: jacob.french@lls.nsw.gov.au W: www.lls.nsw.gov.au • BL commented on the wombats that are being affected by mange due to foxes in the region. • MW stated that no rabbits or foxes have been recorded during the baiting program, only multiple wild dogs and some cats. • BL enquired whether deer were now being included in the program. Yes – now classed as feral animals.	
MEETING SCHEDULE FOR 2020	LA asked if the CCC wished to keep the same schedule of meetings for 2020, ie May and October and whether the starting time suited. It was agreed to keep to the same cycle, accordingly: **Monday 4th May 2020 and Monday 12th October 2020, commencing at 9am on site.**	**Ongoing: LA to text BL.**

Meeting closed at 10.00am with LA thanking all for their attendance.

ACTION ITEMS

ITEM	ISSUE	RESPONSIBILITY
1	Contact AQUAS and advise of CCC's feedback for inclusion in the Independent Environmental Audit.	LA (Complete 15/10/19)
2	Summary of groundwater monitoring data presentation to be provided at the next CCC.	MW

Appendix 8

Photos for Voluntary Undertaking

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Voluntary Undertaking Photo Series

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