SMK
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surveying – irrigation – environmental - planning

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8th July 2020

Planning Department
Narrabri Shire Council
PO Box 261
45-48 Maitland Street
Narrabri NSW 2390

By email: Kristind@narrabri.nsw.gov.au

Our Reference: 17-173
NSC Reference: DA2020/0085

Re: Addendum: Proposed increased extraction rate of extractive industry – Lot 77 DP 754937 & Lot 89 DP 821255, 975 Wavehill Road, Tarriaro

Dear Ms. Dawson,

This addendum has been prepared to provide additional information to the Narrabri Shire Council to clarify matters outlined in the Request for Information issued on the 18th June 2020. This document should be assessed in conjunction with the Environmental Impact Assessment prepared by SMK Consultants (June 2020) in support of the proposed increased extraction rate at Wave Hill Quarry.

1. Landowner Consent

A register of office holders for Johnstone Concrete & Landscape Supplies Pty Ltd has been provided as Appendix 1 within this response.

2. Estimated Cost of Works

The proposal does not include any capital works as there is an existing quarry development onsite, including equipment, offices and sediment control measures. The cost of works is therefore limited to the preparation of the Environmental Impact Statement in support of the proposal. This is valued at $150,000.

3. Current Site Survey Plans

A series of plans relating to the existing site and development have been produced and are included in Appendix 2 in the following order:

a) Property plan, showing the property boundary and easement;
b) Site plan showing location of existing (regrowth) vegetation;

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c) Site plan showing existing levels of the land in relation to buildings and roads (2m intervals) and location and uses of buildings on site, based on 2018 aerial imagery;
d) Locality plan showing topography of the site and its locality based on 2018 aerial imagery (10m intervals); and
e) Receptor plan showing location of the buildings on sites adjoining the land.

The receptor plan, showing the locations of buildings and other landuses on lots adjacent to Lot 89 in Deposited Plan 821255, is also included in Figure 1 below. Table 1 provides a description of the uses of buildings on sites adjoining the land.

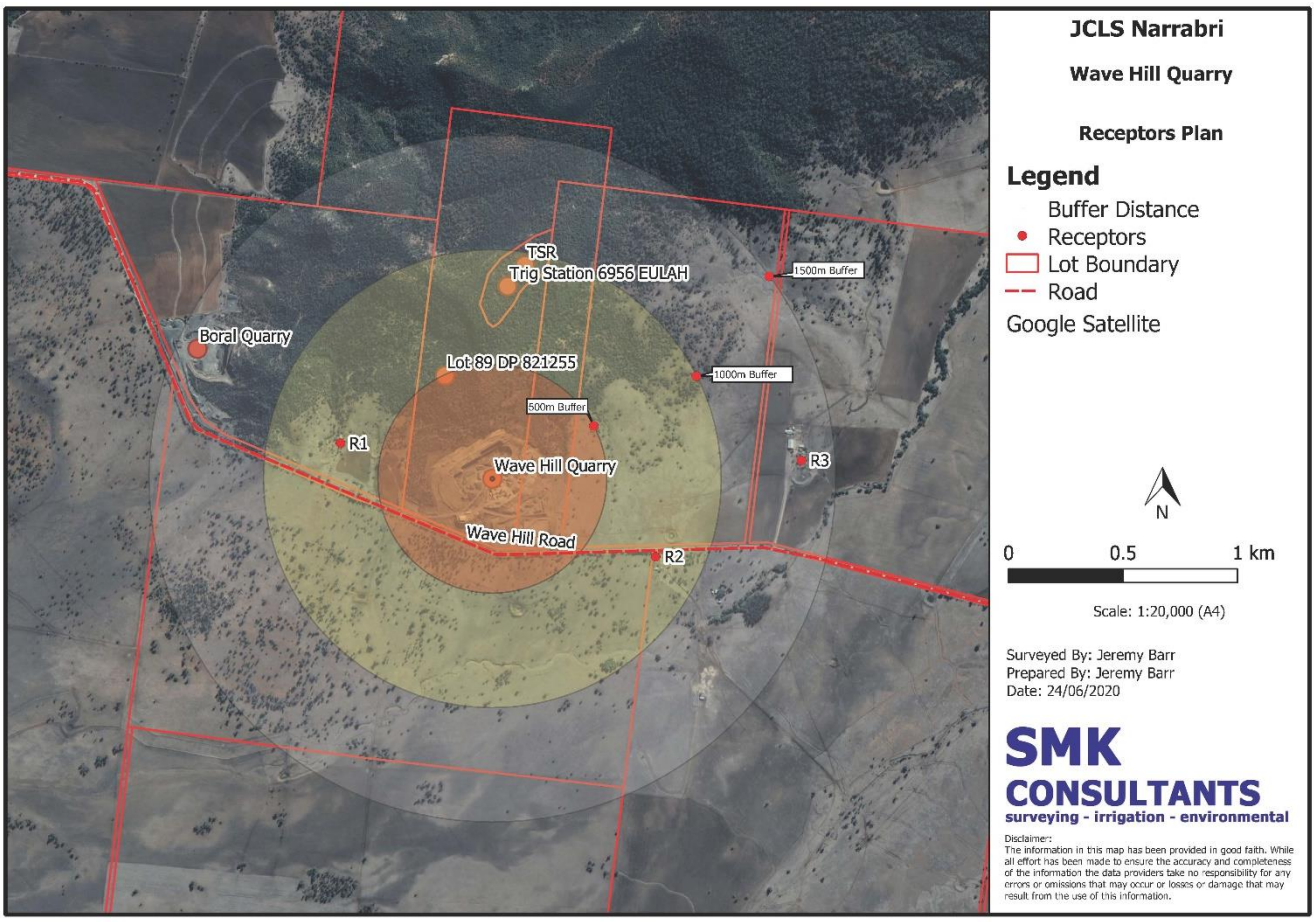

Figure 1: Location of buildings and other landuses on sites adjoining the proposed development.

Table 1 provides additional detail on each of the sensitive receptors in the vicinity of the proposed development.

Table 1: Sensitive Receptors – Wave Hill Quarry

Receptor	Receptor Name	Building Use	Direction from Quarry
R1	Glen Aston	Rural residence	West
R2	Brenowen House	Rural residence	South-East
R3	Wavehill Residence	Rural residence	East

It is noted that additional landuses in the vicinity of the Wave Hill Quarry include:

- Boral Quarry, located west of the quarry site on Lot 1 in DP 1225128

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- A registered trigonometrical site (TS6956) located on a parcel of Crown Land (Lot 88 DP 821255) north of the proposed development.

The location of the Boral Quarry and trigonometrical site are shown in Figure 1 above.

4. Proposed Development Plans

Proposed development plans were prepared relative to the proposed increased extraction rates at the Wave Hill Quarry. These plans are included in Appendix 3 in the following order:

a) Layout of the proposed development showing the areas and extent to be excavated until such a point that the level of the quarry floor reaches the weighbridge level (RL 316.2). Should excavation works be required below the weighbridge level, a revised site plan would be prepared; however, these cannot be accurately drawn at present. If new plans are required, it is recommended that these be conditioned as part of the development approval. The quarry would remain within the approved footprint. Any change to the approved footprint may require an amendment to an approval or a new development application, dependent on the extent of the change in operations.
b) Plan showing a cross section of the existing quarry and the proposed extent to the weighbridge level;
c) Site plan with mapped location of water supply dam and catch drains present throughout the proposed development. Note there are no proposed erosion and sediment control works as part of the proposal;
d) Five-year plan showing area and extent of excavation at current extraction rates (approximately 100,000 tonne per annum). It is noted that the proposed quarry extent to the level of the weighbridge is shown in map (a) described above. At current extraction rates, it would take approximately 20 years to reach the weighbridge level without altering the current setting of the crushing plant. Should the proposal be approved, at maximum annual extraction rates of 500,000 tonne/annum, it would take approximately 4 years to reach the weighbridge level.
e) Rehabilitations plan showing extent of area to be rehabilitated and finished landforms of the site post rehabilitation.

5. Water Demand and Supply

The existing Wave Hill Quarry has a sediment pond with an approximate capacity of 28 ML in the south-eastern section of the development. This captures all runoff generated within the site footprint and has been approved as a pollution control structure during previous development applications.

A bore (GW970345) is also present on site; this was drilled to provide potable water under basic landholder rights during the initial development phase. The bore proved to have an extremely limited water supply of poor quality and was therefore abandoned.

The Wave Hill Quarry has eight (8) water tanks onsite with a total water storage capacity of 221,000 L. Additional detail regarding water storage infrastructure is given in Table 1 below.

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Table 1: Water Storage Tanks at Wave Hill Quarry

Water Use	Water Source	Capacity (L)	No. of Tanks	Total Capacity (L)
Ablutions/Drinking	Rainwater	25,000	3	75,000
Crushing Dust Suppression	Sediment Pond / Groundwater	25,000	4	100,000
Material Modification	Sediment Pond / Groundwater	46,000	1	46,000
Total Water Storage Capacity				**221,000**

There are 5 pumps installed onsite and each of the water storage tanks in the above table is fitted with a 25mm outlet and pipe (flow rate of ≈150 litres/min). A rigid water cart with a capacity of 18,000 L is also available onsite for dust suppression activities on internal roads, and to load water from the bore if required.

It is noted that the proposal does not require any construction works, such there are no water requirements for construction. The operation of the Wave Hill Quarry will require water for modification of quarried materials and for dust suppression activities on roads and in association with the crushing of raw materials. The main crushing and sieving plant is fitted with dust suppression sprays to contain dust from the gravel as it moves between the enclosed crushers. Water requirements for these activities are in the order of 25 ML per annum and the primary water source for these processes will consist of water collected in the existing sediment pond. The use of water obtained from the sediment pond for dust suppression and material modification on the site is considered exempt from a separate water use approval under Clause 35 (a) of the *Water Management (General) Regulation 2018*. This exemption applies to any person for the use of water for any purpose as authorised by a development consent under the *Environmental Planning and Assessment Act 1979*.

Detailed site water balances were prepared for a 90th percentile wet year, 50th percentile median year and 10th percentile dry year. These are included in Section 3.3 of the Soil and Water Management Plan in Appendix 5 of this document. It is noted that the Soil and Water Management Plan, included as Appendix 10 of the EIS lodged with Narrabri Shire Council in June 2020, has been updated and the updated document is included as Appendix 5.

Based on the site water balance for a 50th percentile year, it is estimated that approximately 1.4 ML would be discharged from the sediment pond once every 2 years on average. In the event of a discharge, water would by-wash from the north-eastern corner of the sediment pond and would be captured by catch drains which would direct the water to sediment farm storage dams to the east and south of the property. In the case of an uncontrolled flow, water would have to travel approximately 500 metres along a slope of less than 2.5 % fall before it could enter the Deriah Creek. Under these velocity conditions, silt deposition would occur. The area between the sediment pond and the creek consists of pasture land (grasses and forbs) with areas of open woodland. The grass and forbs would

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provide appropriate filtration of the sediment laden water to minimise potential silt impacts that may degrade water quality in the stream.

Johnstone Concrete and Landscape Supplies (JCLS) have indicated that 25ML (2.1 ML/month) of water would be required on an annual basis during the operational phase of the Wave Hill Quarry. The majority of this water will be sourced from the existing sediment pond, however the site water balance included in the Soil and Water Management Plan (refer to Appendix 5) indicates that on a 10th percentile year, there would be an estimated annual water deficit of 2.4 ML.

During periods of water deficit, it is intended to use an existing groundwater entitlement (WAL 12779) which is currently held by Mr. Brock Ian Johnstone, to provision the quarry. The licence has a total nominal volume of 72 ML and the bore taps the Upper Namoi Zone 5 Valley (Gin's Leap to Narrabri) Groundwater Source. Details of WAL 12779 are included as Appendix 4. The Water Access Licence was primarily purchased to secure a reliable water supply for the Wave Hill Quarry, with any remaining water being sold or utilised for farming operations undertaken by the licence holder. The bore is located on Lot 1 in Deposited Plan 718917 on the Old Gunnedah Road on the southern outskirts of Narrabri. Water will be hauled from this location to the Wave Hill Quarry using a semi water truck with a capacity of 23,000L.

Given the predicted water deficit (2.4 ML) in a 10th percentile dry year and the groundwater entitlements (72ML) held by Mr. Johnstone, it is clear that the proposed development has access to an ample, reliable water supply to ensure the operation of the Wave Hill Quarry.

The Wave Hill Quarry is within the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2019*. Water extraction will be monitored on an ongoing basis to ensure that extraction limits of WAL 12779 are not exceeded. Should the development be impacted by a water source embargo, operations would either cease or would be scaled back to activities which do not require a water supply until the embargo was lifted.

The proposed development will utilise existing water entitlements and storage systems to provide water to the Wave Hill Quarry. No additional water allocations are required as part of this development proposal. The proposal will therefore not require any new licences or approvals under the *Water Act 1912* or the *Water Management Act 2000*.

This response has been prepared to clarify matters raised by Council for the Wave Hill Quarry development application. If Council requires further clarification, please do not hesitate to contact our office should you require any further information or have any questions.

Regards,

Marie Daffy

Environment and Resource Consultant
SMK CONSULTANTS

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Appendix 1: Johnstone Concrete and Landscape Supplies – Register of Office holders

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Johnstone Concrete & Landscape Supplies Pty Ltd
ACN 151 205 882

Register of officeholders
As at 20/02/2020

Name:	Johnstone, Ian Anthony		
Former names:			
Address:	5 River Street YARRAMAN NSW 2400		
Date of birth:	15/01/1951		
Place of birth:	Inglewood QLD		
Position held:	Director	Appointed: 31/05/2011	Ceased: 23/01/2020

Name:	Johnstone, Lee-Anne Robyn		
Former names:			
Address:	5 River Street YARRAMAN NSW 2400		
Date of birth:	10/03/1956		
Place of birth:	Inglewood QLD		
Position held:	Director	Appointed: 31/05/2011	Ceased: 23/01/2020
	Secretary	Appointed: 31/05/2011	Ceased: 23/01/2020

Name:	Johnstone, Brock Ian	
Former names:		
Address:	192 Old Gunnedah Road NARRABRI NSW 2390	
Date of birth:	28/01/1980	
Place of birth:	Inglewood QLD	
Position held:	Director	Appointed: 16/02/2016

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Johnstone Concrete & Landscape Supplies Pty Ltd
ACN 151 205 882

Register of officeholders
As at 20/02/2020

	Secretary	Appointed:	23/01/2020
Other directorships:	Willdo Narrabri Pty Ltd ACN 142 325 317		

Name:	Johnstone, Clinton Lee				
Former names:					
Address:	'Crowsnest' 9 River Street MOREE NSW 2400				
Date of birth:	08/11/1977				
Place of birth:	Inglewood QLD				
Position held:	Director	Appointed:	16/02/2016		
	Secretary	Appointed:	23/01/2020		

Name:	Smith, Karly Sue				
Former names:					
Address:	171 McKenzie Street NARRABRI NSW 2390				
Date of birth:	23/07/1982				
Place of birth:	Toowoomba QLD				
Position held:	Director	Appointed:	16/02/2016	Ceased:	27/08/2019

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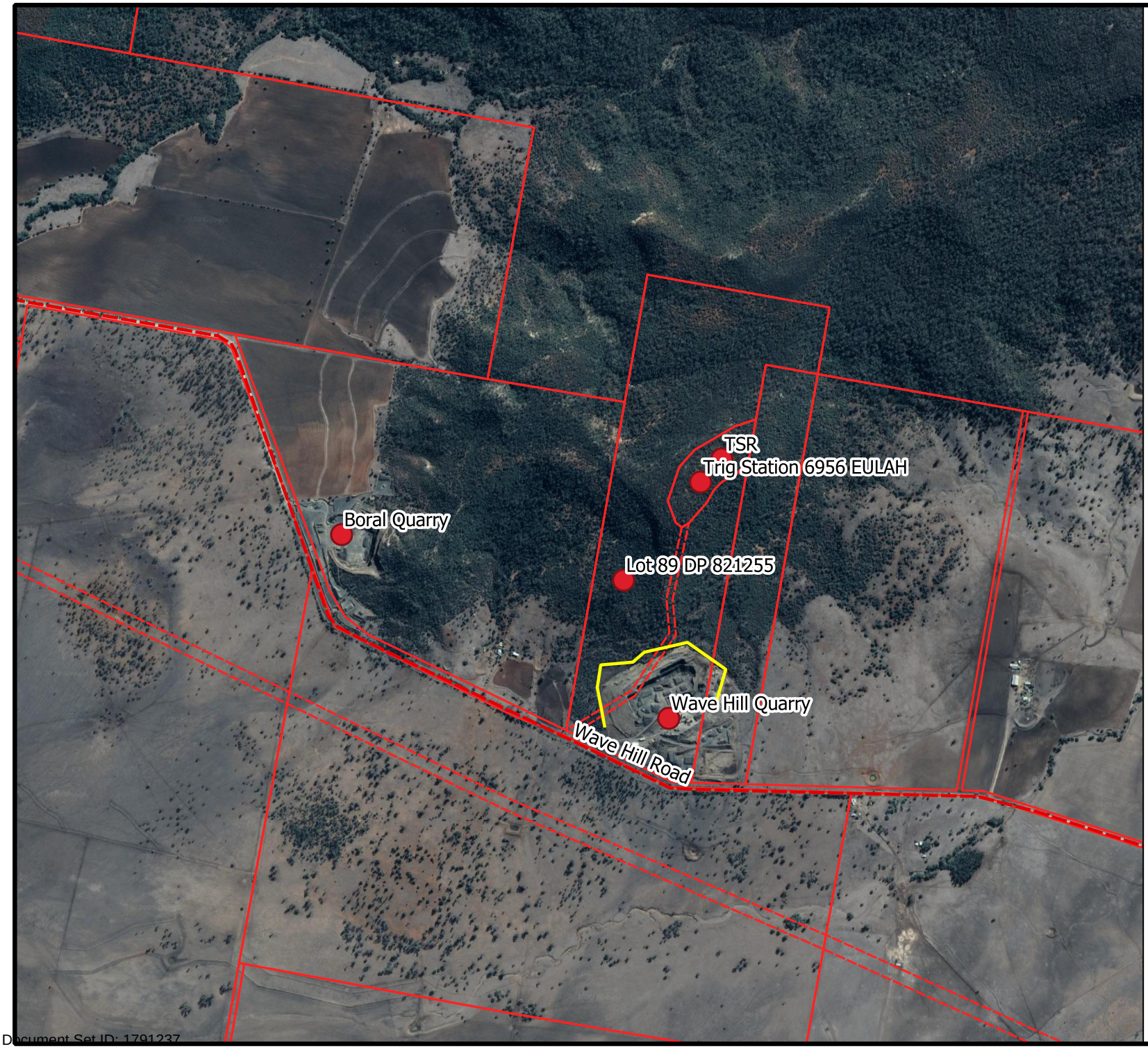
Appendix 2: Current Site Survey Plans

Document Set ID: 1791237
Version: 1, Version Date: 08/07/2020



JCLS Narrabri

Wave Hill Quarry

Property Plan

Legend

- Surveyed Foot Print
- Roads
- Lot Boundary
- Access Easement
- Google Satellite

N

0 0.5 1 km

Scale: 1:20,000 (A4)

Surveyed By: Jeremy Barr
Prepared By: Jeremy Barr
Date: 23/06/2020

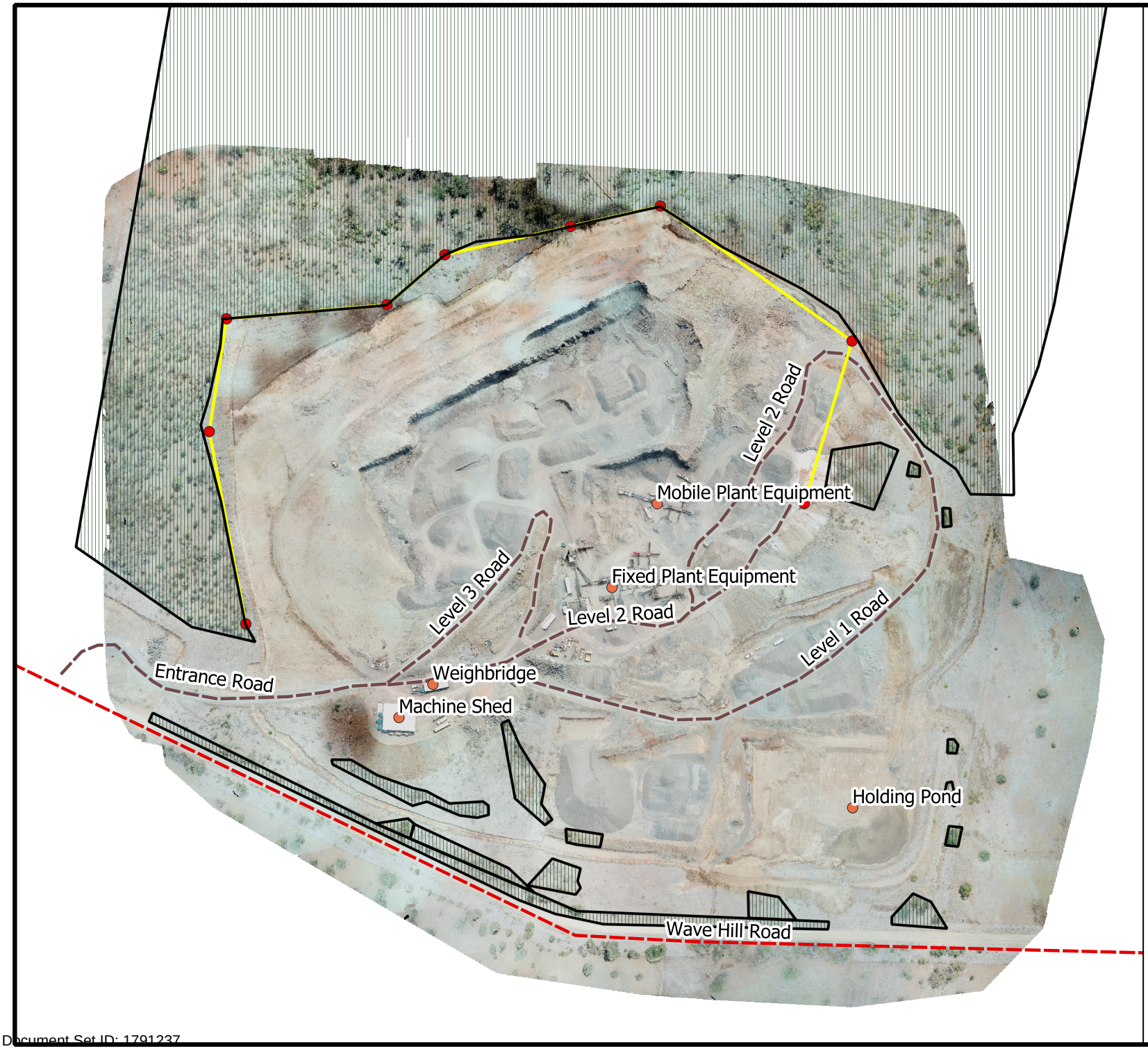
SMK CONSULTANTS
surveying - irrigation - environmental

Disclaimer:
The information in this map has been provided in good faith. While all effort has been made to ensure the accuracy and completeness of the information the data providers take no responsibility for any errors or omissions that may occur or losses or damage that may result from the use of this information.

JCLS Narrabri

Wave Hill Quarry

Vegetation Plan



Legend

- Existing Vegetation
- Lot Boundary
- Approved foot print

SMK Photogrammetry 2018

N

0 50 100 150 200 m

Scale: 1:4,000 (A4)

Surveyed By: Jeremy Barr
Prepared By: Jeremy Barr
Date: 1-7-2020

SMK CONSULTANTS
surveying - irrigation - environmental

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JCLS Narrabri

Wave Hill Quarry

Site Contour Plan 2m

Legend

- Contours 2m
- Approved Foot Print
- Approved Foot Print Marks
- Lot Boundary
- Drainage Lines
- Roads
- Equipment Locations
- Easement

SMK Photogrammetry

N

0 25 50 75 100 125 150 m

Scale: 1:3,000 (A4)

Surveyed By: Jeremy Barr
Prepared By: Jeremy Barr
Date: 23/06/2020

SMK CONSULTANTS
surveying - irrigation - environmental

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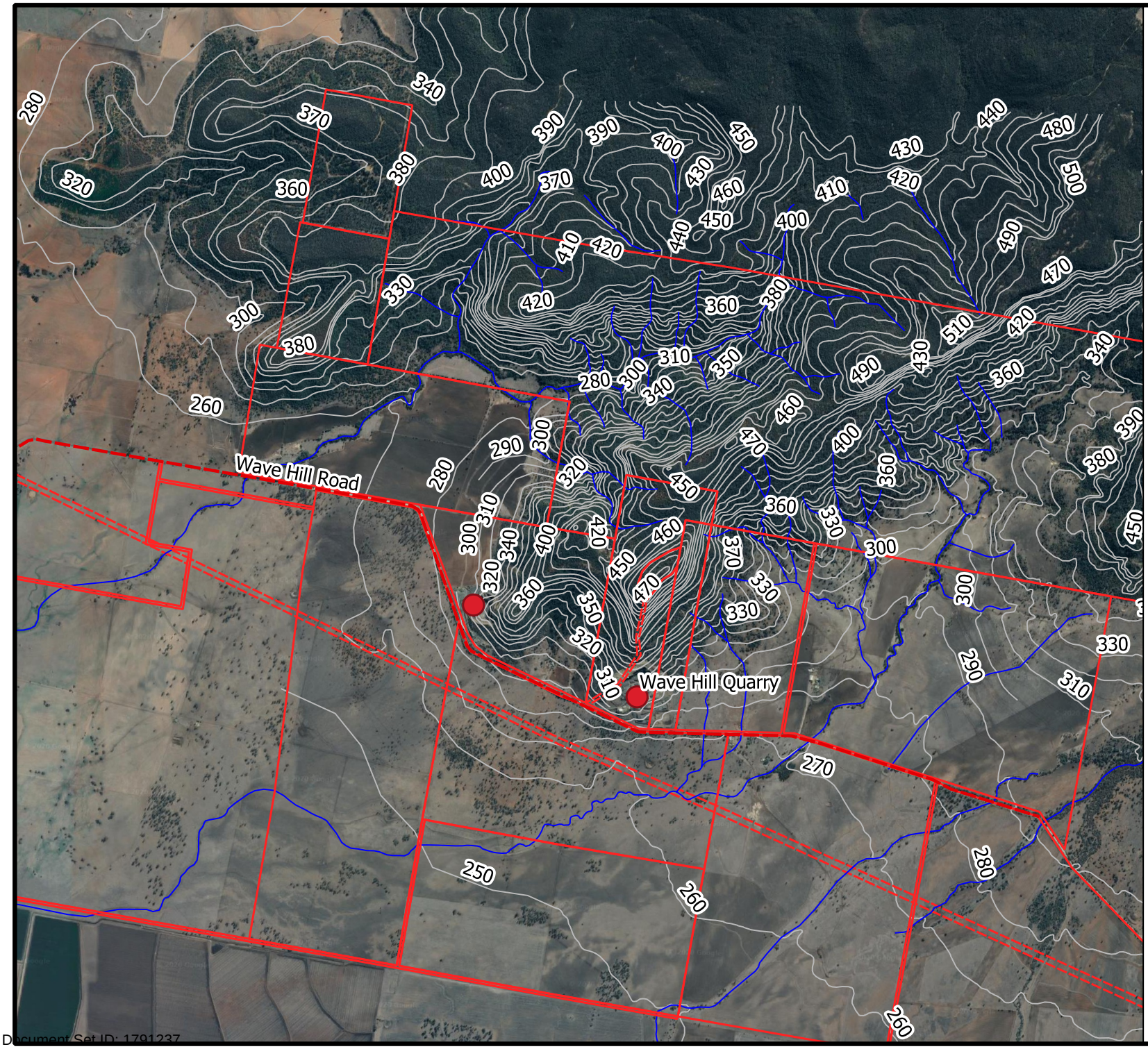

JCLS Narrabri

Wave Hill Quarry

10m Contour Map

Legend

Locality Plan
- Roads
- Quarries
- Lot Boundaries
- Creeks
- Easement
- 10m Contours (SixMaps)

Google Satellite

N

0 1 2 km

Scale: 1:40,000 (A4)

Surveyed By: Jeremy Barr
Prepared By: Jeremy Barr
Date: 23/06/2020

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surveying - irrigation - environmental

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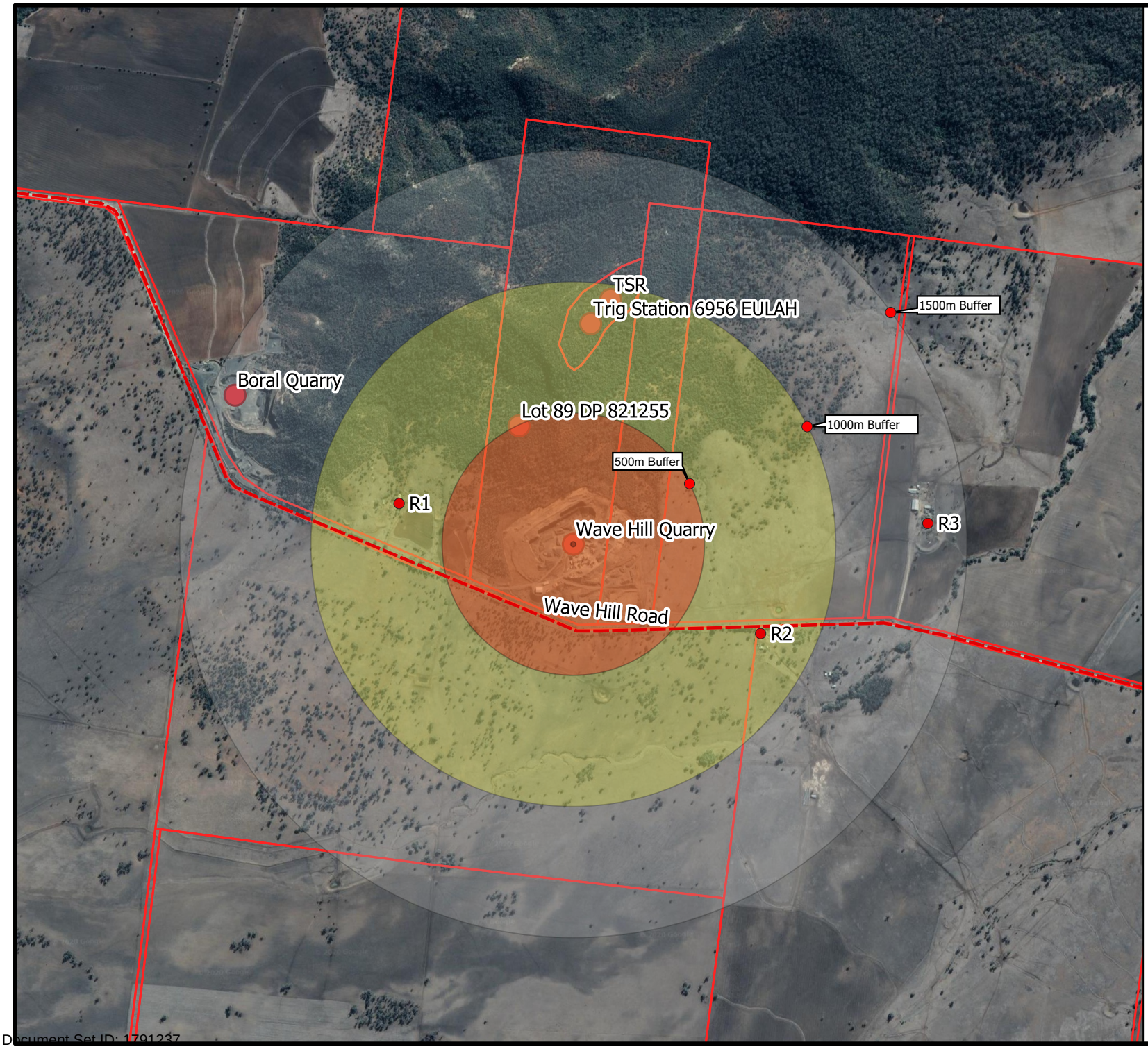
JCLS Narrabri

Wave Hill Quarry

Receptors Plan



Legend

- Buffer Distance
- Receptors
- Lot Boundary
- Road
- Google Satellite

N

0 0.5 1 km

Scale: 1:20,000 (A4)

Surveyed By: Jeremy Barr
Prepared By: Jeremy Barr
Date: 24/06/2020

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Disclaimer:
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Appendix 3: Proposed Development Plans

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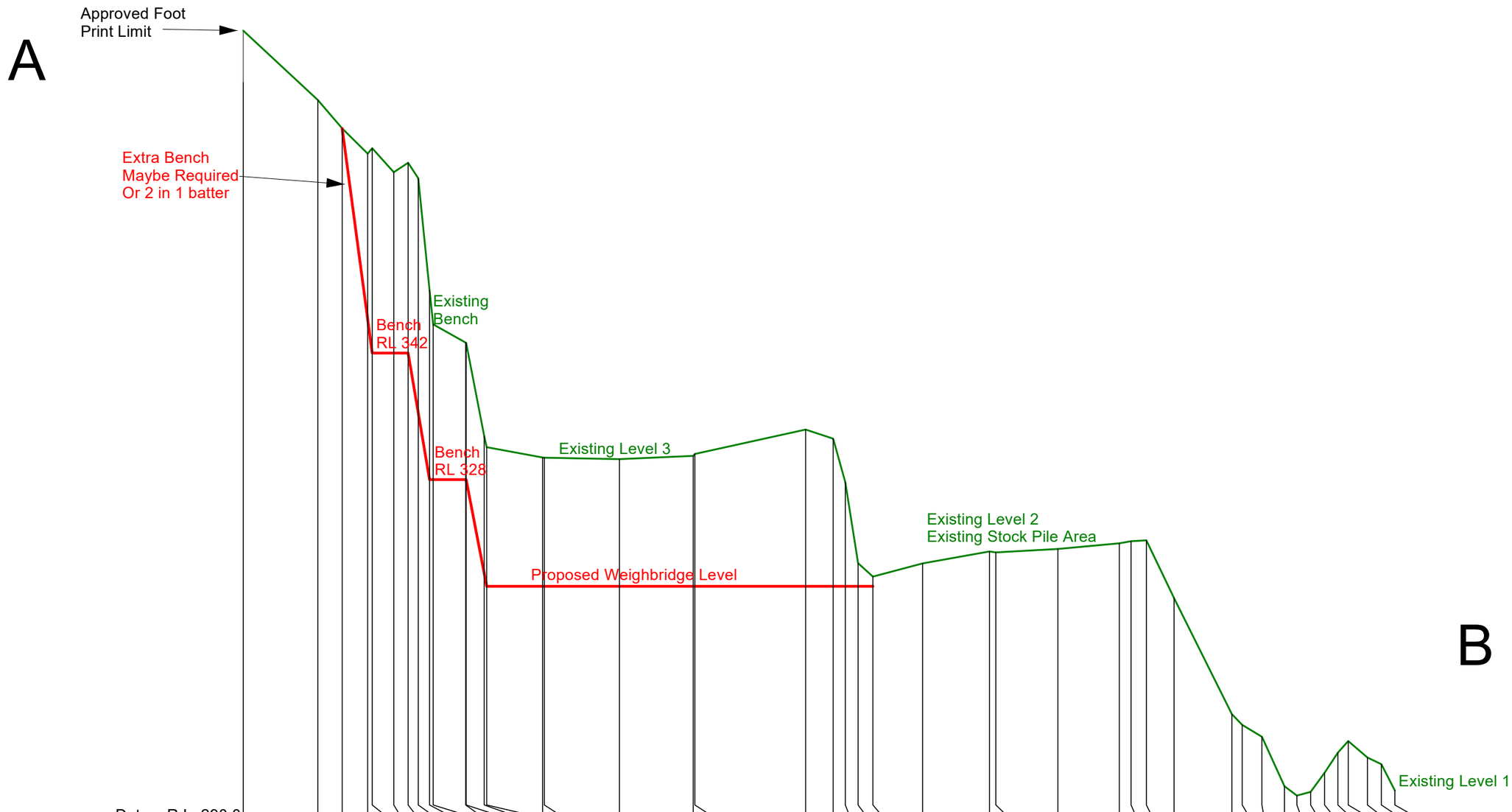
Version: 1, Version Date: 08/07/2020

SCALES: HORIZ 1:2000 VERT DATUM: LOCAL AHD MGA ZONE 56	A3	SMK CONSULTANTS surveying - irrigation - environmental PO BOX 774 MOREE 2400 PHONE (02) 67 521021	CLIENT: JCLS Narrabri	DESCRIPTION:	PLAN REVISION:	DATE	SHEET No. 1 of 1
SURVEYED Jeremy Barr DESIGNED Jeremy Barr CHECKED Peter Taylor	Contours Design Existing Major: 10 m Minor: 2 m		PROJECT: Wave Hill Quarry	Proposed Quarry Extent to Weighbridge Level	A FIRST ISSUE B C	06-07-2020	JOB No. 17-173 COMPUTER FILE (MJO): Wavehill Quarry Proposed Finished Surface - 20 Year Plan



Chainage	Design Quarry	Existing Quarry
0.000		377.68
24.756		369.998
32.850	366.848	366.848
41.337	345.727	364.057
42.835	342.000	364.654
50.000	342.000	362.001
54.751	342.000	363.048
58.114	335.378	361.322
61.862	328.000	348.962
63.066	328.000	345.179
73.862	328.000	343.149
74.037	328.000	343.128
80.045	317.616	332.815
80.864	316.200	331.581
99.437	316.200	330.446
100.000	316.200	330.421
124.955	316.200	330.259
149.473	316.200	330.626
150.000	316.200	330.838
186.799	316.200	333.537
195.959	316.200	332.526
200.000	316.200	327.708
204.258	316.200	318.748
209.152	316.200	317.267
225.664		318.725
247.895		320.052
250.000		319.942
270.591		320.322
291.017		320.948
294.913		321.183
300.000		321.282
309.220		314.882
328.422		302.048
331.843		300.860
338.387		299.544
345.881		294.076
350.000		293.043
354.577		293.449
359.205		295.568
363.637		297.795
367.068		299.070
373.456		297.251
378.089		296.506
382.549		293.599

Scale Horizontal 1:1500 Vertical 1:500

SCALES: HORIZ 1:1500
VERT 1:500
DATUM: LOCAL AHD MGA ZONE 55

A3

SURVEYED Jeremy Barr
DESIGNED Jeremy Barr
CHECKED Peter Taylor

Contours	Design	Existing
Major:		
Minor:		

SMK CONSULTANTS
surveying - irrigation - environmental
PO BOX 774 MOREE 2400
PHONE (02) 67 521021

CLIENT: JCLS Narrabri

PROJECT: Wave Hill Quarry

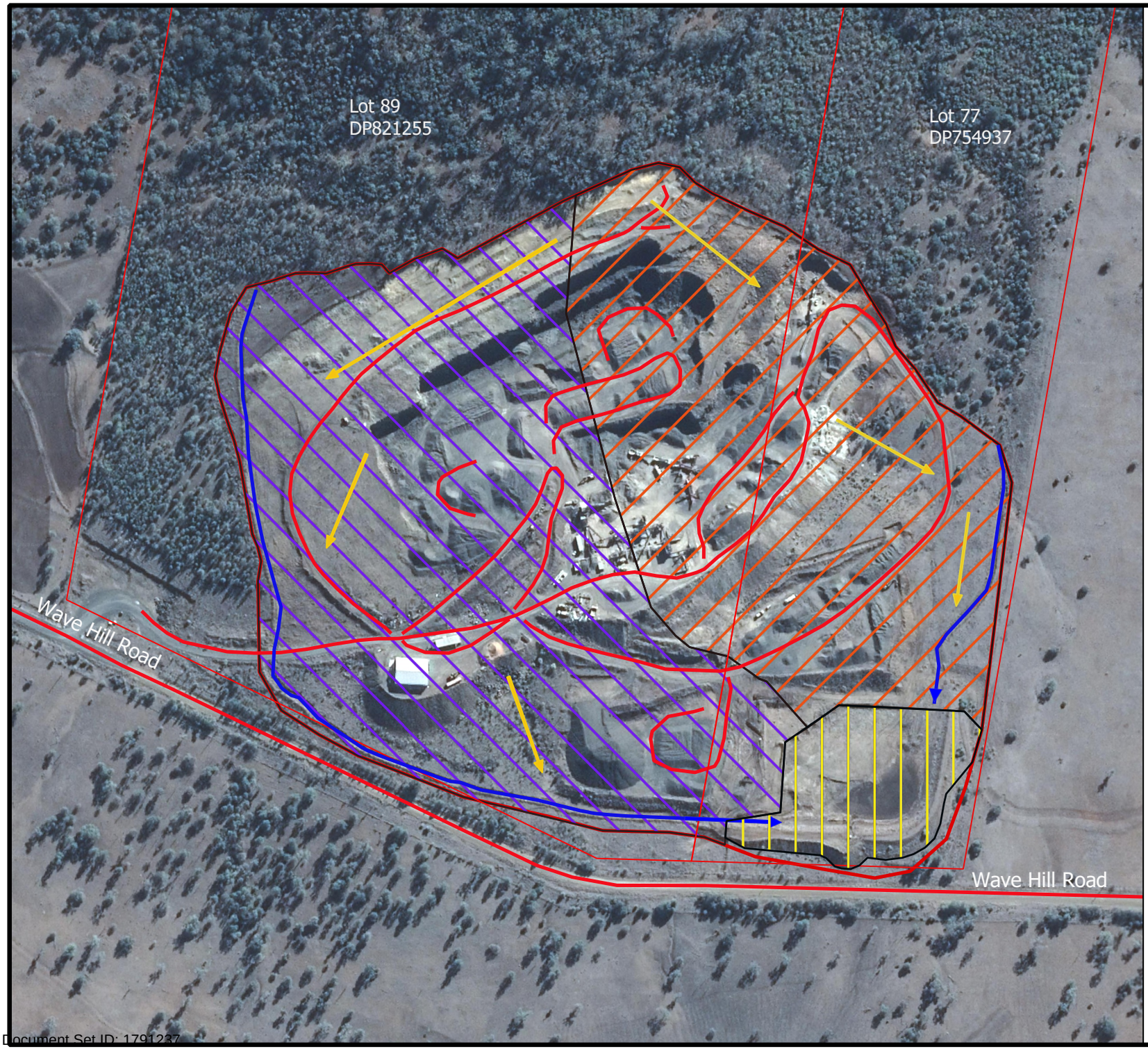
DESCRIPTION:
Plan Showing Proposed Surface
Of Quarry Down to Weighbridge Level

PLAN REVISION:		DATE
A	FIRST ISSUE	07-07-2020
B		
C		

SHEET No. 1 of 1

JOB No. 17-173

COMPUTER FILE (MJO):
Wavehill Quarry Proposed
Finished Surface - Cross Section



Wave Hill Quarry

Quarry Operation
Quarry

Landscape Plan

Legend

Wave Hill Quarry

- Quarry Boundary
- Catchment Area A (West)
- Catchment Area B (East)
- Holding Pond
- Catchment Side Falls
- Drains
- Lot Boundaries
- Road entities

N

0 50 100 150 200 m

Scale: 1:50 (A4)

Surveyed By: Jeremy Barr & Angus Croft
Prepared By: Tarrant Moss
Date: 18/03/2019

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surveying - irrigation - environmental

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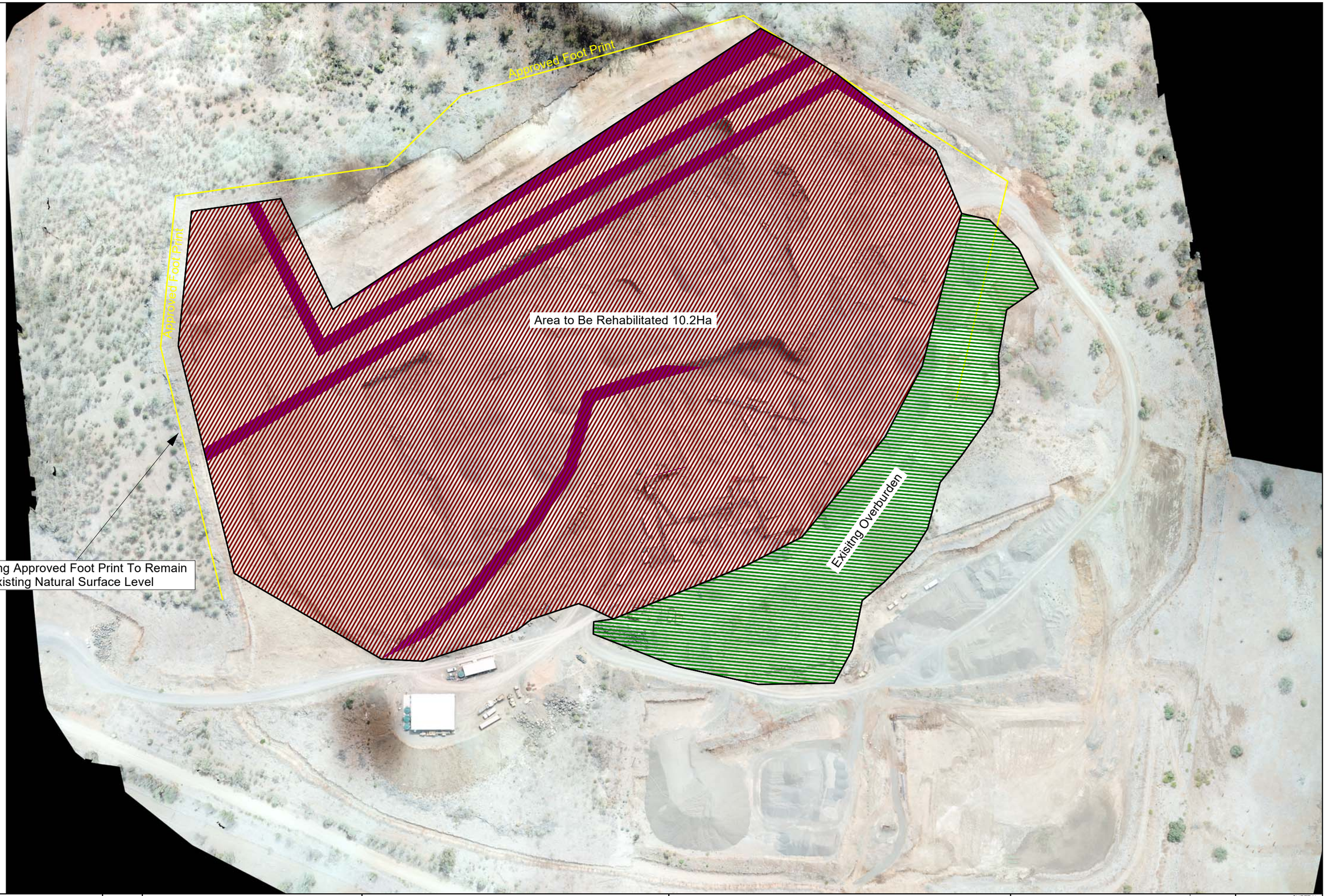
SCALES: HORIZ 1:2000 VERT 1: DATUM: LOCAL AHD MGA ZONE 56	A3	SMK CONSULTANTS surveying - irrigation - environmental PO BOX 774 MOREE 2400 PHONE (02) 67 521021	CLIENT: JCLS Narrabri PROJECT: Wave Hill Quarry	DESCRIPTION: Wave Hill Quarry 5 Year Plan	PLAN REVISION:	DATE	SHEET No. 1 of 1
SURVEYED Jeremy Barr DESIGNED Jeremy Barr CHECKED Peter Taylor	Contours Design Existing Major: 10 m Minor: 2 m				A FIRST ISSUE B C	06-07-2020	JOB No. 17-173 COMPUTER FILE (MJO): Wavehill Quarry Proposed Finished Surface - 5 Year Plan



SCALES: HORIZ 1:2000 VERT 1: DATUM: LOCAL AHD MGA ZONE 52	A3	SMK CONSULTANTS surveying - irrigation - environmental PO BOX 774 MOREE 2400 PHONE (02) 67 521021	CLIENT: JCLS Narrabri	DESCRIPTION:	PLAN REVISION:	DATE	SHEET No. 1 of 1
SURVEYED Jeremy Barr DESIGNED Jeremy Barr CHECKED PAUL COVELL	Contours Design Existing Major: 1.0 m Minor: 0.2 m		PROJECT: Wave Hill Quarry	Wave Hill Quarry Rehabilitaion Map	A FIRST ISSUE	06-07-2020	JOB No. 17-173
					B		COMPUTER FILE (MJO):
					C		Wavehill Quarry Proposed Finished Surface - Veg Map

Appendix 4: Water Licence

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Information about a water licence or approval

Use this tool to search for information about water licences and approvals issued under the *Water Act 1912* or *Water Management Act 2000*.

Select the type of licence or approval and enter the licence or approval number:

- **Water access licence (WAL):** a WAL number starts with the letters 'WAL' followed by several numbers; a WAL also has a reference number that starts with a two digit number, followed by 'AL' and then several numbers.
- **1912 water licence:** a water licence number starts with a two digit number, followed by a two letter code and then several numbers. Note: a PT reference number cannot be entered.
- **Approval:** an approval number starts with a two digit number, followed by a two letter code (WA, UA, CA or FW) and then several numbers.

Search for information about either a:

◉ **Water access licence (WAL) issued under the *Water Management Act 2000***

Water Access Licence (WAL) Number WAL 12779

A WAL number starts with the letters 'WAL' followed by several numbers

Can't find your WAL number? Do you have a reference number? A reference number starts with a two digit number, followed by 'AL' and then several numbers. Use the following tool to find your WAL by entering your reference number. Enter the reference number to find the WAL number.

Notes:

The search results will list the conditions imposed on the water access licence. Any approved water supply work/s nominated on the water access licence are identified by the approval number/s for the work/s.

The information about a water access licence provided in the search results is a summary and may not always be up to date. If you require full and up to date details about a particular water access licence (including current holders, share and extraction component details, encumbrances and notations) you should search the Water Access Licence Register administered by NSW Land Registry Services.

○ *Water Act 1912* Licences and Authorities

○ Approval issued under the *Water Management Act 2000*

Find out if a *Water Act 1912* licence has been converted

○ Water licence conversion status

« Previous Search Print Export

Search Results

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Category [Subcategory]	Status	Water Source	Tenure Type	Management Zone	Share Components (units or ML)
Aquifer	Current	Upper Namoi Zone 5 Namoi Valley (Gin'S Leap To Narrabri) Groundwater Source	Continuing		72.00

Extraction Times or Rates

Subject to conditions water may be taken at any time or rate

Nominated Work Approval(s)

90CA807154

- Conditions

Plan Conditions

Water sharing plan	Upper and Lower Namoi Groundwater Sources
	Take of water
MW0812-00001	This licence entitles its holder to the specified shares in the available water from the specified water source as described in this licence.
MW0697-00001	Where the licence holder is a member of a registered group formed under the plan, the licence holder must not cause or allow the combined restricted extraction calculated to apply to the group in any one year, to be exceeded.
MW0814-00001	The licence holder must only take water under this licence using the water supply work nominated by this licence, unless otherwise allowed by the Act or the plan.
MW0815-00001	The licence holder must comply with the terms of the extraction component specified on this licence, including the times, rates or circumstances in which, and the areas or locations from which, water may be taken under this licence, subject to any extraction restrictions in local impact areas.
MW0821-00001	The licence holder must comply with the water allocation account management rules established by the plan.
MW0820-00001	The licence holder must comply with all restrictions and reductions of extraction rates declared or ordered by the Minister to apply in a local impact area.
MW0818-00001	The licence holder must comply with all applicable available water determination(s).
MW0822-00001	The licence holder must not take water under this licence if the resulting debit from the water allocation account for this licence will exceed the volume of water in the account.
MW0824-00001	The licence holder must not take water through a water supply work located in areas where the extraction is likely to cause an adverse local impact on water levels, water quality, aquifer integrity or on groundwater dependent ecosystems.
MW0819-00001	The licence holder must not take more water than is allowed pursuant to an applicable AWD unless the taking is pursuant to a lawful transfer or assignment under Chapter 3 Part 2 of the Act.
MW0683-00001	The licence holder must not take water for any purpose other than domestic consumption and stock watering purposes or other than in exercising native title rights, through a water supply work

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	nominated on this licence if the water supply work is within 200 m of any high priority groundwater dependent ecosystem listed in Schedule 4 of the plan, or within 200 m of any creek or river, or where impact may occur on aboriginal cultural heritage values, unless the water supply work: (A) only draws water from an aquifer at depths approved by the Minister, and complies with all specifications of the Minister under clause 39 of the plan, or (B) was authorised by licence under the Water Act 1912.
	Water management works
MW0813-00001	The water supply work nominated by this licence is the water supply work authorised by a works approval nominated by this licence.
	Additional conditions
MW0698-00001	The licence holder must comply with the access licence dealing principles as gazetted under section 71Z of the Act and all other access licence dealing rules established by the plan.
MW0823-00001	The licence holder must pay any charge imposed by the Minister under section 114 of the Act or regulations, for the cost of activities or works under the plan.

Other Conditions

NIL

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Appendix 5: Soil and Water Management Plan

SMK
CONSULTANTS

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Soil and Water Management Plan

1 Introduction

The following Soil and Water Management Plan (SWMP) has been prepared to satisfy the Secretary's Environmental Assessment Requirements (SEARs) for the proposed increase in output.

A SWMP is the formal plan designed to control erosion and sedimentation on a building site. It details the specific methods of erosion and sediment control that will be used to meet the specific site conditions at the various stages of construction and operation. In accordance with the SEAR's (dated 11 July 2018) this SWMP has been prepared in accordance with the *Landcom document Managing Urban Stormwater: Soils and Construction, Vol. 1, 4th eds.* (Landcom, 2004) (the 'Blue Book').

The primary part of the SWMP is the provision of a sediment basin for the collection of sand, silt and other sediments generated from within the area to be disturbed. In this case, the quarry operation will involve the continued operation of an existing quarry. No land clearing will take place as part of the proposed works, thereby reducing site exposure to erosion and the generation of sediment. The quarry is, however, regarded as a source of sediments because the area has historically been cleared and quarry operations, including the movement and haulage of quarry materials, are regarded as silt generating activities. There are also several soil and gravel stockpiles onsite, which have the potential to generate sediment laden run-off. Sediment generated within the quarry footprint is deemed a pollutant if it reaches watercourses and therefore must be contained within the site.

There is an existing sediment pond at Wave Hill Quarry, in the south-eastern section of the quarry footprint. This SWMP is intended to ensure that the existing sediment pond system has a sufficient capacity to capture sediment from the rainfall runoff within the quarry footprint, based on the intended site operations. The sediment pond on site is below ground level. Run-off will be stored on site and will solely be released in the event that the sediment pond capacity is exceeded. The site has 2 watershed catchments, identified based on the expected direction and flow of run-off, predicted using available contour information of the site. Run-off from both catchments will drain into the same sediment pond systems via channels and drains.

The area associated with the quarry consists of exposed rock, gravelled haul roads and working areas, and several soil and rock/gravel stockpiles. The quarry area is expected to remain in this condition for longer than 6 months. The entire quarry footprint has been included in the catchment due to the potential to yield sediment. During the year, the water from the sediment pond is utilised for dust suppression activities in the application of water

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to all roads and quarry areas, including crushing equipment. Any suspended solids in the runoff water will be recycled onto all road surfaces.

The Erosion and Sediment Control Operation Plan for Wave Hill Quarry has been included as Appendix 2.

1.1 Soil and Water Management Principles

The principal objective of surface water management at the Wave Hill Quarry is to reduce the potential for transport of sediment offsite into the nearby drainage lines and Deriah Creek, and the flow-on impact of sedimentation on receiving waters. This is a standard objective of erosion and sedimentation designs and controls, and is achieved by implementing the following principles:

- Directing sediment-laden runoff into designated sediment retention basins;
- Diverting 'clean water' runoff unaffected by the operations away from disturbed areas and offsite; and
- Maintaining sediment control structures to ensure that the designed capacities are maintained for optimum settling of sediments.

1.2 Site Description

The site is located on the lower western slopes of the Nandewar Range, 24 kilometres south east of the town of Narrabri. The Wave Hill Quarry is located 500 metres from the Deriah Creek. Deriah Creek converges with Barra Creek, which joins the Namoi River approximately 10km west of the subject site. Deriah Creek is contained within the Namoi catchment area. The subject area drains to the south-east.

The existing quarry includes a sediment pond to capture direct runoff from the site. All silt generated as a result of rainfall runoff within the quarry area will be captured and settled within the sediment pond. It is therefore considered that there is minimal risk of sediment and silt entering the Deriah Creek. Should runoff from the site exceed the sediment pond capacity, the flow would have to travel approximately 500 m along a slope of less than 2.5 % fall before it could enter the creek. Under these velocity conditions, silt deposition would occur. The area between the sediment pond and the creek consists of pasture land (grasses and forbs) with areas of open woodland. The grass and forbs would appropriately filter the sediment laden water to minimise potential silt impacts that may degrade water quality in the stream.

The quarry has already been constructed and the proposal involves continued extractive operations within the existing footprint. Extraction of materials will involve excavating raw material from the quarry face and bringing the quarry floor below the level of the existing site office and weighbridge (RL 315). Once quarrying ceases, the surface areas would be remediated. Figure 1 presents an aerial image of the Wave Hill property and Figure 2 presents a site plan of the existing Wave Hill Quarry footprint containing a significant basalt resource.

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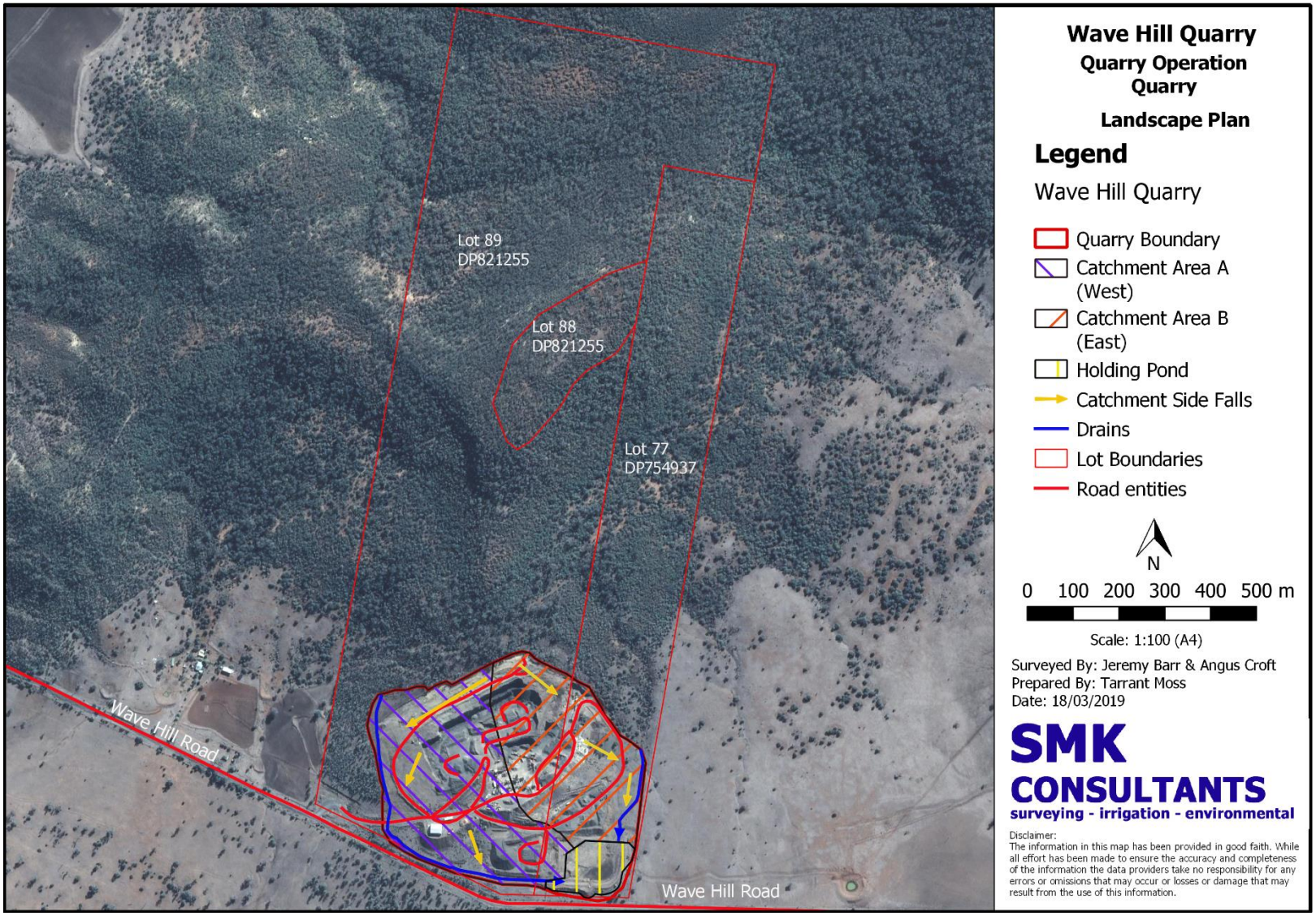

Figure 1: Wave Hill Quarry Site Plan

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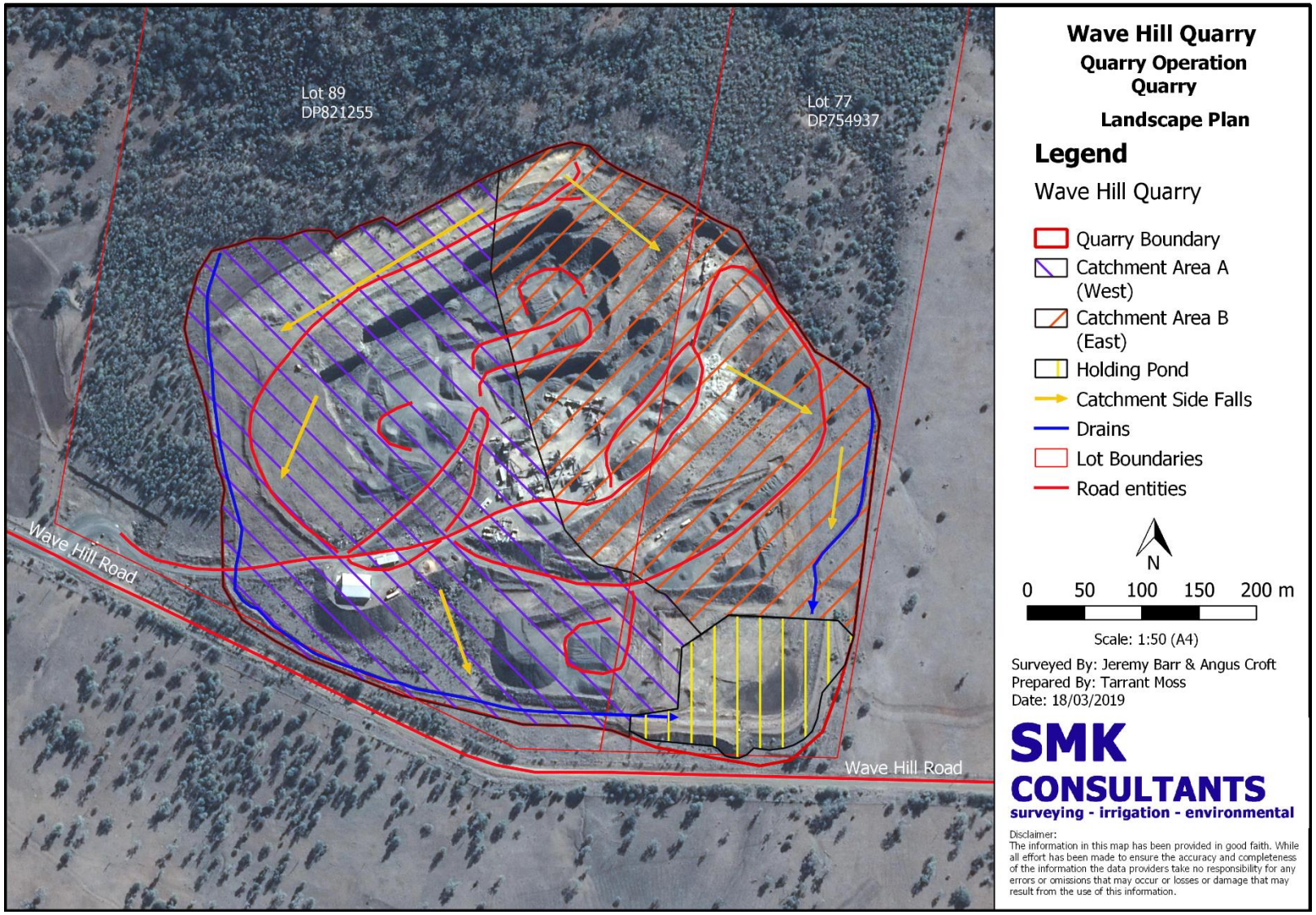

Figure 2: Wave Hill Quarry Footprint

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2 Factors to be Considered

Constraints are classified as either:

- on-site, i.e. relating to soils, landforms, ecology, pollutants and hydrology occurring on the site of the proposed or approved activities; or
- downstream, i.e. relating to aquatic ecosystem sensitivity and the social and aesthetic values of the community.

Based on the identified constraints and opportunities, best management practices (BMPs) have been developed for the site to minimise the potential degradation of soil and water resources and/or other aesthetic/environmental assets while maximising the achievement of outcomes in accordance with principles of Ecologically Sustainable Development (ESD). The recommended constraints to be addressed by the Blue Book are discussed in the sections below. These are in addition to the project-specific constraints discussed elsewhere in the EIS.

2.1 Flooding

This site is in an area undulating with hills, 24 kilometres east of the town of Narrabri. Due to the nature of the site being situated on a hill, the site will not be affected by flood. The sediment pond is located on the downstream of potential runoff from the existing hill and prevents the entrance of flood water and other overland flow water. The sediment pond is located outside of any potential flood areas. In general terms, assessments should identify the 2-year ARI flood event (50% AEP). However, flooding from external areas is not considered an issue and will not be examined.

2.2 Riparian Lands

Waterfront Lands (formally known as Riparian Lands under the Rivers and Foreshores Improvement Act 1948) are those vegetated lands within 40 metres of waterbodies such as rivers, creeks, estuaries, lakes and wetlands. Development on riparian lands is constrained:

- to protect and enhance the social, economic, cultural, spiritual and heritage values of waterfront land for Aboriginal groups and the wider community; and
- to avoid or minimise land degradation, including soil erosion, compaction, geomorphic instability, contamination, acidity, waterlogging, salinity hazards and decline of native vegetation.

The proposed Quarry footprint is not within 40m of a river, creek, estuary, lake or wetland as defined by the Act.

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2.3 Erosion (Rainfall Erosivity & Soil Erodibility)

2.3.1 Rainfall Data & Erosivity

The **rainfall erosivity factor (R),** is a measure of the ability of rainfall to cause erosion. This is a state-wide variable dependent on the total energy within a rainfall event. It is the product of two components, namely:

- total energy; and
- maximum 30-minute intensity for each storm.

The intensity for a 30-min storm event is used in this calculation. Generally, this variable fluctuates across the state per the rainfall intensity that could be expected for the 30-min storm at a particular location. High intensity rain results in high erosion whilst low intensity rain results in low erosion. Erosivity factors for the site can be obtained from Appendix B of the Blue Book.

The Rainfall Erosivity Factor (R) for this site is 1400 with a 2-year 6-hr storm of 7.53 mm/hr.

The proposed quarry site is considered to have a Low Erosion Hazard as shown in the below figure which is an extract from Figure 4.6 of the Blue Book. In comparison, the R-factor varies from up to 7000 along the mid North Coast of the State and approximately 700 in western parts of the state.

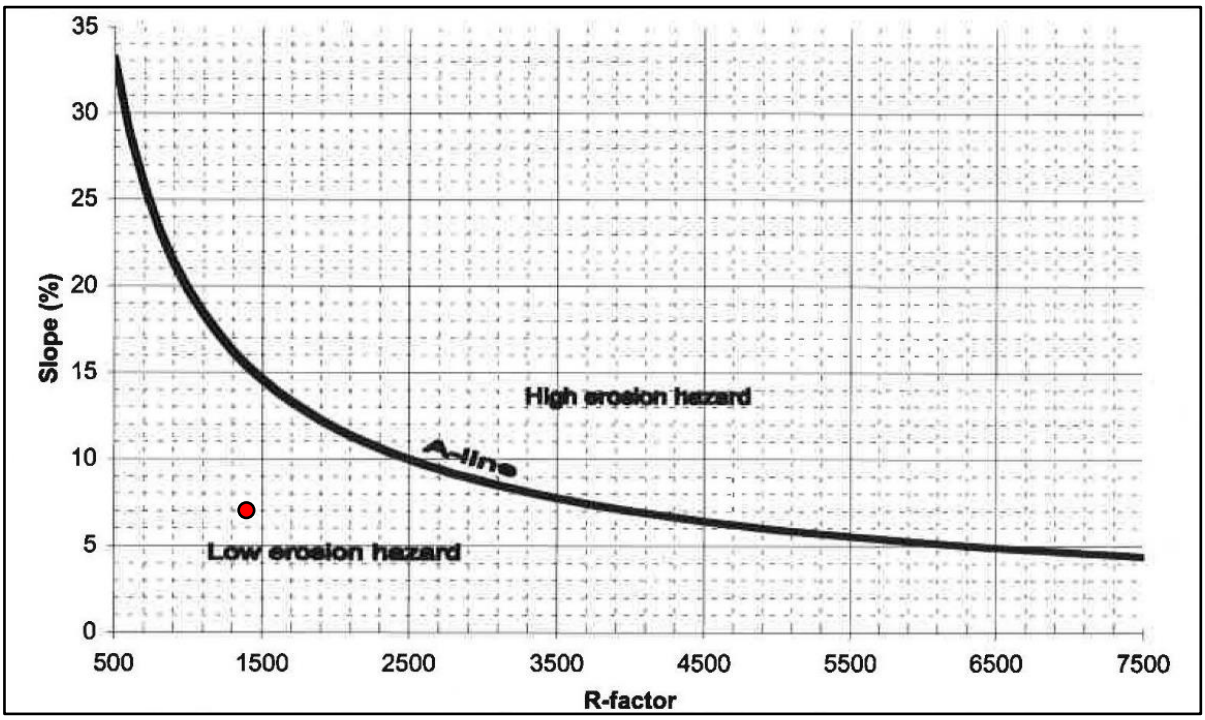

Figure 3: Assessment of Potential Erosion Hazard (Source: Figure 4.6 of the 'Blue Book').

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The total quantity of rainfall over a 5-day period is an important factor in sizing of ponds and allowing the runoff to deposit sediment.

The EPA default is a minimum design of capture for a 90th percentile, 5-day rainfall depth (mm).

The nearest weather station to the quarry is Narrabri Airport, which is located approximately 20km's north west of the quarry. Using the Narrabri Airport annual rainfall data, an annual rainfall of 899.2mm was calculated to be the 'theoretical' 90th percentile wet year based on this data. Using this figure, data was then analysed to find a year closest to this theoretical annual rainfall. The year with the closest real annual rainfall to the theoretical was 1963, which had 865.5mm of rainfall within the year. This is the value used in the following calculations.

The following parameters are based on the Bureau of Meteorology's Intensity Frequency Table for the site (see Appendix 1). The **Rainfall Intensity for a 2 year 6-hour storm is 7.53 mm/hr.** Also, the Rainfall Intensities for the 1, 5, 10, 20, 50 and 100 year can be obtained from the IFD Table for use in the calculation of the peak flow.

Volumetric Runoff coefficient for the site is determined from the soil type found and the total rainfall for the 5-day 90th percentile event.

Table F1 in Appendix F of the Blue Book lists the Soil Hydrologic Groups and rates their ability to absorb water. Sands have high infiltration rates and heavy clays have low infiltration rates and therefore high runoff potential. The predominant soil type on the site is largely comprised of Clay soils with Red and Black Vertosols and Dermosols also present. This could be classed as **Soil Hydrologic Group D** and will have a high runoff potential.

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Table F1 Effect of Ksat and profile infiltration rates on Soil Hydrologic Group

Soil Hydrologic Group	Typical infiltration rate (mm/hr)		K_{sat} (mm/hr)	Rate of infiltration	Runoff potential
	Saturated steady state	Dry soil			
A	25	>250	>120	moderate to very rapid	very low
B	13	200	10-120	moderate to rapid [1]	low to moderate
C	6	125	1-10	slow to moderate [2]	moderate to high
D	3	75	<1	very slow [3]	high

1. Includes soils where the subsoil structure grade is moderate or strong or where the texture is coarser than silty clay.
2. Includes moderately permeable surface soils underlaid by silty clays or silty clay loams with weak sub-angular or angular blocky structures; it includes permeable surface soils overlying massive clays or silty clays.
3. Includes soils where depth is limited by a hardpan, rock, high watertable, or other confining layer.

Figure 4: Effect of Ksat and profile infiltration rates on Soil Hydrologic Group (Source: Table F1 of the 'Blue Book').

Table F2 Appendix F of the manual gives the **runoff coefficient for the site as 0.64 for the site's design rainfall depth of 38.4mm**.

Table F2. Runoff coefficients (Cv) for volumetric data in disturbed catchments (adapted from USDA, 1996)

Soil Hydrologic Group	Design Rainfall depth (mm)							Runoff potential
	<20	21-25	26–30	31–40	41-50	51-60	61-80	
A	0.01	0.05	0.08	0.15	0.22	0.28	0.37	very low
B	0.10	0.19	0.25	0.34	0.42	0.48	0.57	low to moderate
C	0.25	0.35	0.42	0.51	0.58	0.63	0.70	moderate to high
D	0.39	0.50	0.56	0.64	0.69	0.74	0.79	high

Figure 5: Runoff Coefficients (Cv) for Volumetric Data in Disturbed Catchments (Source: Table F2 of the 'Blue Book').

2.3.2 Soil Erodibility

The Soil Erodibility Factor (K) is a measure of the susceptibility of individual soil particles to detachment and transport by rainfall and runoff. Soil texture is the principal component affecting soil erodibility, but structure, organic matter and permeability also contribute.

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Three classes of soil are considered:

- Type D - Fine material (<0.005mm). Classed as dispersible material that will not settle unless flocculated.
- Type C – Coarse grained (33% or less < 0.02mm and 66% or More > 0.02mm). Will settle easily in a sediment retention pond.
- Type F – Fine grained (66% or More < 0.02mm and 33% or Less > 0.02mm). Will require a much longer residence time in the pond to settle.

Soil present within the quarry footprint (stockpiles and remaining areas which have not been cleared) consists of clay dominant material. The remainder of the quarry footprint consists of exposed rock and gravel, including stockpiles, and gravelled haul roads and working areas around the plant areas and site office.

For the purpose of the sediment pond design, the site could be regarded as soil Type F. The soils are regarded as non-dispersive.

To accommodate soil Types D and F section 6.3.4 (d) suggests a 5-day rainfall depth can be adopted as standard in the design of the settling zone.

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3 Catchment Areas (A, B)

The total quarry footprint is 24 hectares. This has been separated into the 2 catchment areas (A & B) as shown on the attached plans. Runoff from both catchment areas will be directed to the same sediment pond.

The design event selected is a five (5) day 90th percentile storm where the total runoff for this five-day period is held onsite to allow settlement of sediment to below the maximum discharge threshold of 50 mg/L total suspended solids as required by NSW legislation. Storms in excess of this design event, may discharge from the site. The sediment pond is considered to capture the first flush from the disturbed area which will contain the majority of sediments. Additional runoff from the catchment is deemed to contain an acceptable level of sediment due to the large dilution levels that will occur.

3.1 Design Pond Size for Type D or F Soil

Design Settling Zone Volume required for the catchment is 5,087 m^3 and the Sediment Storage Volume is 2,543 m^3. The Design Total Basin Volume then should then be 7,631 m^3 (see Appendix 1).

Table 1: Total Basin Volume

Site	C_v	R x-day y-%ile	Total catchment area (ha)	Settling zone volume (m^3)	Sediment storage volume (m^3)	Total volume required (m^3)
A	0.64	38.4	11.6	2851	1425	4276
B	0.64	38.4	9.1	2236	1118	3355
Total				**5087**	**2543**	**7631**

Minimum pond dimensions based on above minimum basin volume with 1.2m water depth and 3:1 batters is shown in Table 2 below. Length to width ratio used was 5:1 L/W ratio.

Table 2: Total Basin Volume

Site	$Q_{tc,0.25}$ (m^3/s)	Area factor	Basin surface area (m^2)	Depth of settling zone (m)	Settling zone volume (m^3)	Sediment storage volume (m^3)	Total basin volume (m^3)	Minimum Basin shape		
								L:W Ratio	Length (m)	Width (m)
A	0.250	4100	1024	0.6	615	615	1229	5	71.6	14.3
B	0.208	4100	851	0.6	511	511	1022	5	65.2	13

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3.2 Discharge

Johnstone Concrete and Landscape Supplies (JCLS) have indicated that 25ML (2.1 ML/month) of water will be used on an annual basis for dust suppression and material modification activities during the operation of the Wave Hill Quarry. Due to the amount of water expected to be used each year for dust suppression, as well as the capacity of the existing pond, then the quarry is only expected to have any discharges when-ever the rainfall event exceeds a 50th Percentile (average) wet year. In this case, discharged water would have been retained within the sediment pond for a sufficient period to allow sufficient settling of sediment before discharge occurs.

3.3 Water Balance

JCLS have indicated that 25ML/year (2.1 ML/month) of water will be used for dust suppression during the operation of the Wave Hill Quarry. The following tables provides a water balance for a 90th percentile wet year, 50th percentile median year and 10th percentile dry year. The water balances indicate the site will have a water deficit based on numerous factors including evaporation and the assumed water use for dust suppression. The estimated water deficit required to maintain these dust suppression measures is 2.4 ML in a 10th percentile dry year.

The use of water obtained from the sediment ponds for dust suppression on the site would be considered exempt from a separate water use approval under Clause 35 (a) of the *Water Management (General) Regulation 2018*. This exemption applies to any person for the use of water for any purpose as authorised by a development consent under the *environmental Planning and Assessment Act 1979.*

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Table 3: Annual Water Balance (90th Percentile Wet Year) - Sediment Pond Storage (ML)

Month	90th Percentile Wet Year Rainfall (mm)	Hard Area Runoff	Soft Area Runoff	Pond Area Runoff	Seepage	Pond Evaporation	Dust Suppression	Monthly Balance	Cumulative Storage Requirement
Jan	59.4	6.8	0.5	0.8	1.22	3.3	2.1	1.5	1.5
Feb	219	25.2	1.8	2.8	4.50	2.7	2.1	20.6	22.1
Mar	53.2	6.1	0.4	0.7	1.09	2.6	2.1	1.5	23.6
Apr	53.5	6.2	0.4	0.7	1.10	1.8	2.1	2.3	25.9
May	119.8	13.8	1.0	1.6	2.46	1.2	2.1	10.6	36.5
Jun	119.9	13.8	1.0	1.6	2.46	0.8	2.1	11.0	47.4
Jul	41.9	4.8	0.3	0.5	0.86	0.9	2.1	1.8	49.3
Aug	1.3	0.1	0.0	0.0	0.03	1.3	2.1	-3.2	46.1
Sep	28.2	3.2	0.2	0.4	0.58	1.7	2.1	-0.6	45.5
Oct	90.1	10.4	0.7	1.2	1.85	2.4	2.1	6.0	51.5
Nov	32.4	3.7	0.3	0.4	0.67	2.8	2.1	-1.1	50.4
Dec	37.8	4.4	0.3	0.5	0.78	3.3	2.1	-1.0	49.4
Total	**856.5**	98.7	7.0	11.1	17.6	24.9	25.0	49.40	51.5

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Table 4: Annual Water Balance (Median Rainfall) - Sediment Pond Storage (ML)

Month	50th Percentile Wet Year Rainfall (mm)	Hard Area Runoff	Soft Area Runoff	Pond Area Runoff	Seepage	Pond Evaporation	Dust Suppression	Monthly Balance	Cumulative Storage Requirement
Jan	108.5	12.5	0.9	1.4	2.23	3.3	2.1	7.2	7.2
Feb	80.3	9.3	0.7	1.0	1.65	2.7	2.1	4.5	11.7
Mar	58.9	6.8	0.5	0.8	1.21	2.6	2.1	2.1	13.8
Apr	19.9	2.3	0.2	0.3	0.41	1.8	2.1	-1.6	12.3
May	27	3.1	0.2	0.4	0.55	1.2	2.1	-0.1	12.1
Jun	17.2	2.0	0.1	0.2	0.35	0.8	2.1	-0.9	11.2
Jul	0.3	0.0	0.0	0.0	0.01	0.9	2.1	-3.0	8.2
Aug	38.6	4.4	0.3	0.5	0.79	1.3	2.1	1.1	9.3
Sep	26.4	3.0	0.2	0.3	0.54	1.7	2.1	-0.8	8.5
Oct	100.9	11.6	0.8	1.3	2.07	2.4	2.1	7.2	15.8
Nov	103.1	11.9	0.8	1.3	2.12	2.8	2.1	7.1	22.8
Dec	103.1	11.9	0.8	1.3	2.12	3.3	2.1	6.6	29.4
Total	**684.2**	**78.8**	**5.6**	**8.9**	**14.1**	**17.4**	**25.0**	**29.43**	**29.4**

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Table 5: Annual Water Balance (10th Percentile Rainfall) - Sediment Pond Storage (ML)

Month	10th Percentile Wet Year Rainfall (mm)	Hard Area Runoff	Soft Area Runoff	Pond Area Runoff	Seepage	Pond Evaporation	Dust Suppression	Monthly Balance	Cumulative Storage Requirement
Jan	71.8	8.3	0.6	0.9	1.36	3.3	2.1	3.1	3.1
Feb	71.8	8.3	0.6	0.9	1.36	2.7	2.1	3.6	6.7
Mar	12.7	1.5	0.1	0.2	0.24	2.6	2.1	-3.2	3.5
Apr	15.8	1.8	0.1	0.2	0.30	1.8	2.1	-2.0	1.5
May	56.1	6.5	0.5	0.7	1.06	1.2	2.1	3.3	4.8
Jun	30.2	3.5	0.2	0.4	0.57	0.8	2.1	0.6	5.4
Jul	10.7	1.2	0.1	0.1	0.20	0.9	2.1	-1.8	3.6
Aug	6.2	0.7	0.1	0.1	0.12	1.3	2.1	-2.6	1.0
Sep	0.6	0.1	0.0	0.0	0.01	1.7	2.1	-3.8	0.0
Oct	35.4	4.1	0.3	0.5	0.67	2.4	2.1	-0.3	0.0
Nov	4.3	0.5	0.0	0.1	0.08	2.8	2.1	-4.4	0.0
Dec	88.4	10.2	0.7	1.1	1.68	3.3	2.1	5.0	5.0
Total	**404.0**	46.5	3.3	5.3	7.7	17.4	25.0	-2.40	6.7

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4 Surface Water Monitoring

The following parameters consider all facets of water control and monitoring associated with the proposed operation of the Wave Hill Quarry.

4.1 Water quality

The proposed sediment pond will collect runoff from within the above ground working area of the quarry. No chemicals associated with vehicles or crushing and sieving machinery material will be disposed of within the sediment pond. Fuel used on the site would be stored in sealed tanks and only used in designated refuelling areas that are isolated from the drainage network through bunding. The pond will primarily capture silty water. Any water used for dust suppression should be assessed in terms of water quality to ensure it is suitable for the proposed use (e.g. salinity levels should be considered).

4.2 Surface and groundwater impacts

Potential impacts on surface water as a result of the construction and operational phases of the project include:

- Pollution of surface water through:
  - Increased turbidity of surface waters due to sediment loss and erosion from stockpiles, haul roads or other disturbed areas.
  - Impurities, incidental minerals or other leachates from the disturbed rocks and soil.
  - Elevated salinity levels, as quarrying can disrupt saline aquifers or allow salt to be leached from freshly shattered overburden.
  - Stormwater runoff from plant and equipment areas, fuel storage areas, chemical spills and uncontrolled surface runoff.
- Increased risk of erosion on slopes through increased flow rates.

The site will need to operate as a bare earth area to avoid vegetative contamination of the quarried material. No ground cover will be present and therefore artificial erosion control or silt capture devices will need to be deployed on an as required basis. Such systems will include the sediment pond and a system of diversion drains to capture and manage the flow of runoff into the pond system at suitable velocities that avoid additional erosion within the quarrying site.

The following mitigation measures should be adopted onsite to ensure protection of surface water quality:

- Maintenance of vegetated buffer zones between the quarry site and watercourses within the region, to enable natural filtration of surface water in the event of a sediment pond overflow;

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- Minimising the disturbed area by working in sections to reduce the exposure area and stabilising disturbed land as soon as possible to minimise erosion;
- A silt fence is to be placed around any top soil stockpiles present onsite;
- Stockpiles are to have a single point of access and are to be rehabilitated upon project completion;
- Silt traps, fences and shakedowns are to be checked weekly and after rain events. Sediment is to be removed once it builds up to a height of 300mm above the upslope height;
- Sediment basins and drains should be inspected on a monthly basis, or following a significant rainfall event;
- Table drains should be inspected on a monthly basis at a minimum, or following a significant rainfall event with particular emphasis on the condition of the land immediately downslope of the discharge point.
- Ensure that the storage and use of hazardous and dangerous materials occurs in accordance with relevant legislation, and ensuring spillages are contained;
- Placing hay bales, silt fences or other suitable control devices in drainage lines within the site to reduce onsite erosion where possible.

The implementation of the appropriate mitigation measures in accordance with the above recommendations and best practice management techniques are considered sufficient to avoid potential contamination of offsite surface waters.

Water required for the operation of the quarry will be sourced primarily from the existing sediment pond and would be supplemented with existing groundwater entitlements when required. Groundwater would be obtained from a bore located on the eastern outskirts of Narrabri, adjacent to JCLS' landscaping business. There would be no increase to the existing licensed entitlements. No additional extraction will ensure that the Quarry does not adversely impact on the drawdown of sourced and/or adjacent aquifer(s).

The available setback from surface water and potential GDE's is substantial providing a sufficient buffer from the Quarry. The provision of suitable drainage and sediment controls will prevent erosion and ensure runoff does not contaminate offsite areas, including waterways and GDE's.

The storage and/or use of hazardous materials which may be used on site will occur in accordance with *National Code of Practice for the Storage and Handling of Workplace Dangerous Goods (2001).* The appropriate storage and handling will ensure such materials do not pose an unacceptable risk in respect to the pollution of groundwater.

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5 Conclusions and Recommendations

All run-off generated within the quarry boundary will continue to be directed towards the existing sediment pond. The largest surge expected to occur on the quarry within a 90th percentile wet year is 51.5ML (see Table 3). However, the quarry will only be required to have a pond size exceeding the minimum 7.63ML capacity (see Table 1). This is to ensure that sediments are sufficiently settled before run-off by-washes the holding pond. The existing holding Pond can hold 28ML at the by-wash level and is therefore large enough to meet the run-off sediment settling requirements, with additional space to hold water for dust suppression purposes.

Wave Hill Quarry is situated on a hillside and therefore has steep drains which direct run-off to the sediment pond. These drains should be inspected regularly to ensure they have stable banks with sufficient height. It is also advised that rip rap rock be considered for drain sections that are already experiencing erosion. The pipe that directs run-off under the entry road must have a diameter large enough to ensure it does not become a choke point.

The water collected will be utilised for dust suppression throughout the operational phase of the quarry. As shown in the water balance, there will be limited water collected from the sediment pond and as such it is expected additional water will be required for dust mitigation measures and for material modification.

JCLS should implement all erosion and sediment controls measures as outlined within this report and included within the attached erosion and sediment control plan (refer to Appendix 2) to ensure that the proposed development does not cause the pollution of water in accordance with Section 120 of the *Protection of the Environment Operation Act 1997*. The proposed mitigation measures, if implemented, are considered sufficient to avoid the potential for impacts to offsite surface and groundwater from the proposed development.

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Appendix 1: Calculations

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IFD Design Rainfall Intensity – mm/hr

Wave Hill Quarry

Location Label:	Narrabri			
Requested coordinate:	Latitude	30.3375	Longitude	149.5625
Nearest grid cell:	Latitude	30.3375	Longitude	149.5625

Table 1: Bureau of Meteorology IFD Table – Holding Pond

	Annual Exceedance Probability (AEP)						
Duration	**63.20%**	**50%**	**20%**	**10%**	**5%**	**2%**	**1%**
1 min	118	134	184	220	255	304	342
2 min	101	115	161	193	225	266	299
3 min	93.5	106	148	177	206	244	274
4 min	87.5	99.3	137	164	191	226	254
5 min	82.4	93.4	129	154	179	212	238
7 min	73.8	83.7	115	137	159	189	213
10 min	64.1	72.6	99.8	119	138	164	185
15 min	52.9	59.9	82.5	98.3	114	136	153
16 min	51.2	58	79.8	95.1	111	132	148
20 min	45.3	51.4	70.8	84.5	98.3	117	132
25 min	39.8	45.2	62.4	74.5	86.7	103	117
30 min	35.7	40.5	56	66.9	77.9	93	105
45 min	27.5	31.3	43.3	51.9	60.5	72.2	81.5
1 hour	22.7	25.8	35.8	42.9	50	59.7	67.4
1.47 hour	17.5	19.9	27.5	33	38.5	45.9	51.8
1.5 hour	17.2	19.6	27.1	32.5	37.9	45.2	51
2 hour	14.1	16	22.2	26.6	30.9	36.9	41.7
3 hour	10.7	12.1	16.7	19.9	23.2	27.7	31.2
4.5 hour	8.1	9.16	12.6	15	17.4	20.7	23.4
6 hour	6.67	7.53	10.3	12.2	14.2	16.9	19.1
9 hour	5.08	5.73	7.81	9.26	10.7	12.8	14.4
12 hour	4.19	4.72	6.43	7.63	8.85	10.6	11.9
18 hour	3.18	3.59	4.9	5.82	6.76	8.07	9.1
24 hour	2.61	2.95	4.04	4.81	5.6	6.69	7.55
30 hour	2.23	2.52	3.47	4.15	4.83	5.78	6.53
36 hour	1.96	2.21	3.06	3.67	4.28	5.13	5.8
48 hour	1.58	1.79	2.49	3.01	3.53	4.23	4.79
72 hour	1.15	1.31	1.84	2.24	2.64	3.17	3.59
96 hour	0.91	1.04	1.46	1.78	2.11	2.54	2.88
120 hour	0.752	0.858	1.21	1.47	1.74	2.1	2.38
144 hour	0.641	0.731	1.03	1.24	1.47	1.78	2.01
168 hour	0.559	0.636	0.886	1.06	1.27	1.53	1.73

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IFD Design Rainfall Intensity – mm/hr

Wave Hill Quarry

Location Label:	Narrabri			
Requested coordinate:	Latitude	30.3375	Longitude	149.5625
Nearest grid cell:	Latitude	30.3375	Longitude	149.5625

Table 2: Bureau of Meteorology IFD Table – Sediment Pond

	Annual Exceedance Probability (AEP)						
Duration	63.20%	50%	20%	10%	5%	2%	1%
1 min	118	134	184	220	255	304	342
2 min	101	115	161	193	225	266	299
3 min	93.5	106	148	177	206	244	274
4 min	87.5	99.3	137	164	191	226	254
5 min	82.4	93.4	129	154	179	212	238
10 min	64.1	72.6	99.8	119	138	164	185
15 min	52.9	59.9	82.5	98.3	114	136	153
18 min	48	54.4	75	89.4	104	124	140
20 min	45.3	51.4	70.8	84.5	98.3	117	132
25 min	39.8	45.2	62.4	74.5	86.7	103	117
30 min	35.7	40.5	56	66.9	77.9	93	105
45 min	27.5	31.3	43.3	51.9	60.5	72.2	81.5
1 hour	22.7	25.8	35.8	42.9	50	59.7	67.4
1.5 hour	17.2	19.6	27.1	32.5	37.9	45.2	51
2 hour	14.1	16	22.2	26.6	30.9	36.9	41.7
3 hour	10.7	12.1	16.7	19.9	23.2	27.7	31.2
4.5 hour	8.1	9.16	12.6	15	17.4	20.7	23.4
6 hour	6.67	7.53	10.3	12.2	14.2	16.9	19.1
9 hour	5.08	5.73	7.81	9.26	10.7	12.8	14.4
12 hour	4.19	4.72	6.43	7.63	8.85	10.6	11.9
18 hour	3.18	3.59	4.9	5.82	6.76	8.07	9.1
24 hour	2.61	2.95	4.04	4.81	5.6	6.69	7.55
30 hour	2.23	2.52	3.47	4.15	4.83	5.78	6.53
36 hour	1.96	2.21	3.06	3.67	4.28	5.13	5.8
48 hour	1.58	1.79	2.49	3.01	3.53	4.23	4.79
72 hour	1.15	1.31	1.84	2.24	2.64	3.17	3.59
96 hour	0.91	1.04	1.46	1.78	2.11	2.54	2.88
120 hour	0.752	0.858	1.21	1.47	1.74	2.1	2.38
144 hour	0.641	0.731	1.03	1.24	1.47	1.78	2.01
168 hour	0.559	0.636	0.886	1.06	1.27	1.53	1.73

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Table 3: Frequency Factor Determination

TABLE 5.1 - Frequency Factors FF_Y for Rational Method in Eastern New South Wales

Frequency Factors FF_Y	Zone in Figure 5.2 A Below 500m	A Above 500m	B Below 500m	B Above 500m	C Below 500m	C Above 500m	D Below 500m	D Above 500m	E Below 500m	E Above 500m	F Below 500m	F Above 500m
			ELEVATION ABOVE OR BELOW 500M.									
FF_1	0.67	0.50	0.62	0.57	0.62	0.89	0.43	0.37	0.38	0.52	0.66	0.69
FF_2	0.81	0.66	0.74	0.70	0.78	0.92	0.58	0.53	0.54	0.64	0.74	0.77
FF_5	0.92	0.85	0.88	0.86	0.90	0.95	0.80	0.77	0.78	0.82	0.87	0.89
FF_{10}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FF_{20}	1.07	1.14	1.12	1.14	1.10	1.05	1.20	1.25	1.26	1.21	1.15	1.10
FF_{50}	*	1.32	*	1.33	*	1.17	1.54	1.74	1.71	1.52	1.39	1.26
FF_{100}	*	1.46	*	1.50	*	1.24	1.80	2.20	2.14	1.78	1.60	1.34

Zones Below 500m	FF_{50}	FF_{100}
A	$FF_{50} = 1.90 - \frac{0.366\, I_{12,50}}{I_{12,2}}$	$FF_{100} = 2.45 - \frac{0.588\, I_{12,50}}{I_{12,2}}$
B	$FF_{50} = 1.99 - \frac{0.366\, I_{12,50}}{I_{12,2}}$	$FF_{100} = 2.57 - \frac{0.588\, I_{12,50}}{I_{12,2}}$
C	$FF_{50} = 1.97 - \frac{0.366\, I_{12,50}}{I_{12,2}}$	$FF_{100} = 2.54 - \frac{0.588\, I_{12,50}}{I_{12,2}}$

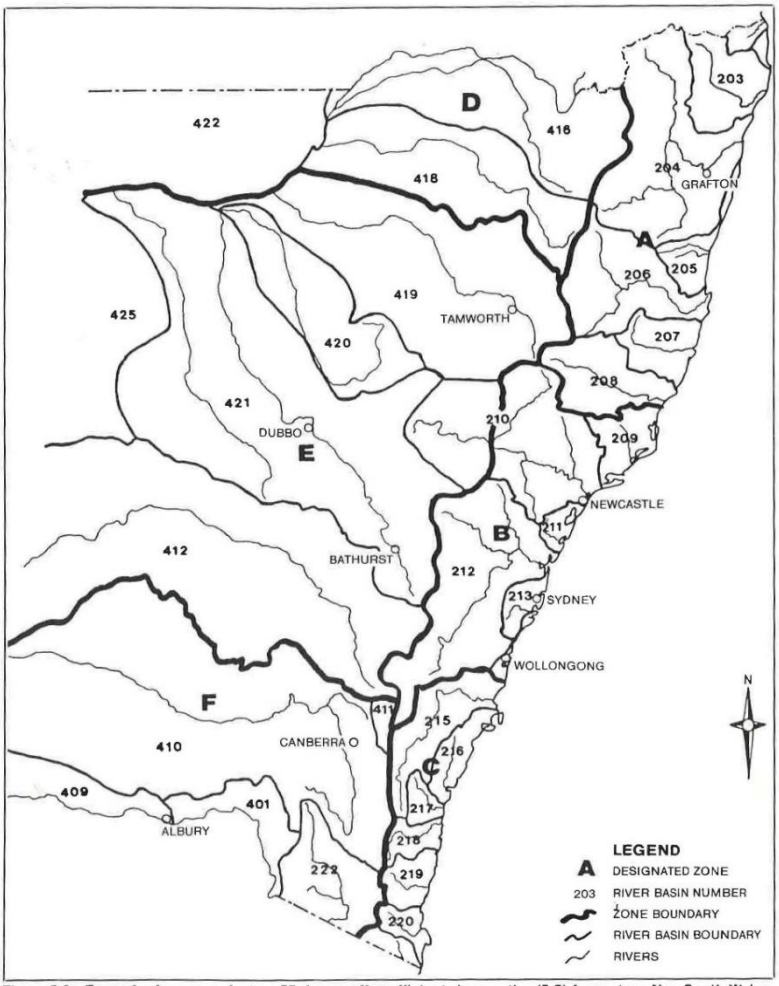

Figure 5.2 - Zones for frequency factors FF_Y for runoff coefficients in equation (5.5) for eastern New South Wales.

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Site Data Sheet

Site name: Wave Hill Quarry
Site location: 24 km South East of Township of Narrabri, NSW
Co-ordinates: MGA Zone 56 E 212543 N 6631524
Precinct: Narrabri
Description of site: An existing quarry on the southern side of a hill 24km south east of Narrabri with a paddock on its eastern boundary and a road along its southern boundary. No vegetation clearance will take place.

Table 4: Site Area

Site area	Site		Remarks
	A	B	
Total catchment area (ha)	11.6	9.1	Includes roads and sheds
Disturbed catchment area (ha)	11.6	9.1	

Table 5: Soil Analysis

Soil Landscape	The quarry hill is largely comprised of Sandy Gravel with Red and Black Vertosols and Dermosols also present. Sandy gravel road base as covering.		DIPNR mapping (if relevant)
Soil Texture Group	F	F	See Sections 6.3.3(c), (d) & (e)

Table 6: Rainfall Data

Design rainfall depth (days)	5	5	See Sections 6.3.4 (d) and (e)
Design rainfall depth (percentile)	90	90	See Sections 6.3.4 (f) and (g)
x-day, y-percentile rainfall event	38.4	38.4	See Section 6.3.4 (h)
Rainfall intensity: 2-year, 6-hour storm	7.53	7.53	See IFD chart for the site
Rainfall erosivity (R-factor)	1400	1400	Automatic calculation from above data

Comments: The two catchments have been separated based on how the run-off is expected to flow over the quarry, as theorised using available contour information of the landscape.

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Storm Flow Calculations

Peak flow is given by the Rational Formula:

$$Qy = 0.00278 \times C_{10} \times F_Y \times I_{y,\,tc} \times A$$

where:

Q_y is peak flow rate (m^3/sec) of average recurrence interval (ARI) of "Y" years

C_{10} is the runoff coefficient (dimensionless) for ARI of 10 years. Rural runoff coefficients are given in Volume 2, figure 5 of Pilgrim (1998), while urban runoff coefficients are given in Volume 1, Book VIII, figure 1.13 of Pilgrim (1998) and construction runoff coefficients are given in Appendix F

F_y is a frequency factor for "Y" years. Rural values are given in Volume 1, Book IV, Table 1.1 of Pilgrim (1998) while urban coefficients are given in Volume 1, Book VIII, Table 1.6 of Pilgrim (1998)

A is the catchment area in hectares (ha)

$I_{y,\,tc}$ is the average rainfall intensity (mm/hr) for an ARI of "Y" years and a design duration of "tc" (minutes or hours)

Time of concentration (t_c) = $0.76 \times (A/100)^{0.38}$ hrs (Volume 1, Book IV of Pilgrim, 1998)

= 0.34 Hours (Rural)

= **20.11 Minutes (Rural)**

Note: For urban catchments the time of concentration should be determined by more precise calculations or reduced by a factor of 50 per cent.

Table 7: Peak Flow Calculations 1

Site	A (ha)	tc (mins)	Rainfall Intensity, I, mm/hr						C_{10}
			$1_{yr,tc}$	$5_{yr,tc}$	$10_{yr,tc}$	$20_{yr,tc}$	$50_{yr,tc}$	$100_{yr,tc}$	
A	11.6	20	45.3	70.8	84.5	111	117	132	0.9
B	9.1	18	48	75	89.4	104	124	140	0.9

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Table 8: Peak Flow Calculations 2

ARI years	Frequency Factor (F_Y)	Peak Flows		Comment
		A	B	
		(m^3/s)	(m^3/s)	
1 $_{yr, tc}$	0.38	0.500	0.415	
5 $_{yr, tc}$	0.78	1.603	1.332	
10 $_{yr, tc}$	1	2.452	2.035	
20 $_{yr, tc}$	1.23	3.963	2.923	
50 $_{yr, tc}$	1.71	5.807	4.828	
100 $_{yr, tc}$	2.14	8.198	6.821	

Volume of Sediment Basins: *Type C* Soils (Not Used)

Basin volume = settling zone volume + sediment storage volume

Settling Zone Volume

The settling zone volume for Type C soils is calculated to provide capacity to allow the design particle (e.g. 0.02 mm in diameter) to settle in the peak flow expected from the design storm (e.g. 0.25-year ARI). The volume of the basin's settling zone (V) can be determined as a function of the basin's surface area and depth to allow for particles to settle. Peak flow/discharge for the 0.25-year, ARI storm is given by the Rational Formula:

Q tc, 0.25 = 0.5 x [0.00278 x C10 x Fy x I 1yr, tc x A] (m3/sec)

where:

Q tc,0.25	=	flow rate (m3/sec) for the 0.25 ARI storm event
C10	=	runoff coefficient (dimensionless for ARI of 10 years)
Fy	=	frequency factor for 1 year ARI storm
I 1 yr,tc	=	average rainfall intensity (mm/hr) for the 1-year ARI storm
A	=	area of catchment in hectares (ha)

Basin surface area (A) = area factor x Qtc, 0.25 m2

Particle settling velocities under ideal conditions (Section 6.3.5(e))

Particle Size	Area Factor
0.100	170

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0.050	635
0.020	4100

Volume of settling zone = basin surface area x depth (Section 6.3.5(e)(ii))

Sediment Storage Zone Volume

In the standard calculation, the sediment storage zone is 100 percent of the setting zone. However, designers can work to capture the 2-month soil loss as calculated by the RUSLE (Section 6.3.5(e)(iv)), in which case the "Detailed Calculation" spreadsheets should be used.

Table 9: Total Basin Volume

Site	$Q_{tc,\ 0.25}$ (m^3/s)	Area factor	Basin surface area (m^2)	Depth of settling zone (m)	Settling zone volume (m^3)	Sediment storage volume (m^3)	Total basin volume (m^3)	Minimum Basin shape		
								L:W Ratio	Length (m)	Width (m)
A	0.250	4100	1024	0.6	615	615	1229	5	71.6	14.3
B	0.208	4100	851	0.6	511	511	1022	5	65.2	13

Volume of Sediment Basins: Type D and Type F Soils

Basin volume = settling zone volume + sediment storage zone volume

Settling Zone Volume

The settling zone volume for Type F and Type D soils is calculated to provide capacity to contain all runoff expected from up to the y-percentile rainfall event. The volume of the basin's settling zone (V) can be determined as a function of the basin's surface area and depth to allow for particles to settle and can be determined by the following equation:

V = 10 x Cv x A x Ry-%ile, x-day (m3)

where:

10 = a unit conversion factor

Cv = the volumetric runoff coefficient defined as that portion of rainfall that runs off as stormwater over the x-day period

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R = is the x-day total rainfall depth (mm) that is not exceeded in y percent of rainfall events. (See Sections 6.3.4(d), (e), (f), (g) and (h)).

A = total catchment area (ha)

Sediment Storage Zone Volume

In the standard calculation, the sediment storage zone is 50 percent of the setting zone. However, designers can work to capture the 2-month soil loss as calculated by the RUSLE (Section 6.3.4(i)(ii)), in which case the "Detailed Calculation" spreadsheets should be used.

Table 10: Total Basin Volume

Site	C_v	R x-day y-%ile	Total catchment area (ha)	Settling zone volume (m^3)	Sediment storage volume (m^3)	Total basin volume (m^3)
A	0.64	38.4	11.6	2851	1425	4276
B	0.64	38.4	9.1	2236	1118	3355

Note: These "Standard Calculation" spreadsheets relate only to low erosion hazard lands as identified in figure 4.6 where the designer chooses to not use the RUSLE to size sediment basins. The more "Detailed Calculation" spreadsheets should be used on high erosion hazard lands as identified by figure 4.6 or where the designer chooses to run the RUSLE in calculations.

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Appendix 2: Erosion and Sediment Control Plan

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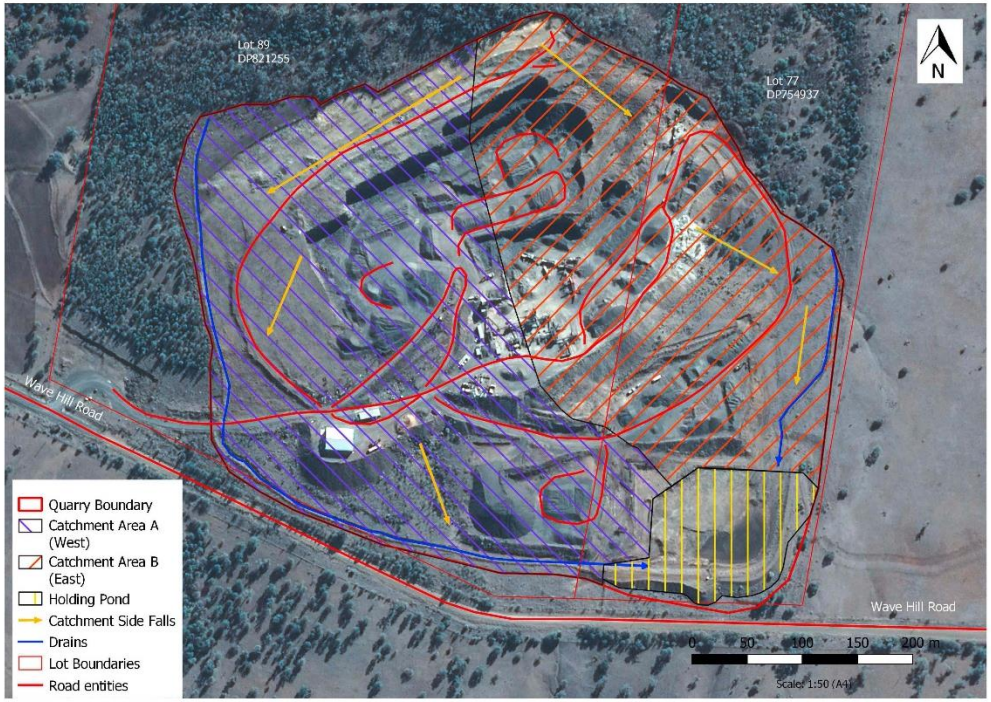
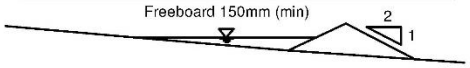


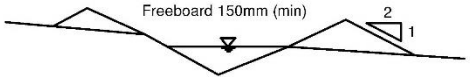
RUN-OFF CONTROL AND MITIGATION PARAMETERS

. Water from the holding pond can continue to be used for dust suppression provided it is uncontaminated
. The contractor is to ensure all operation areas are to remain in a bare state for the minimum amount of time possible.
. During the time that these areas are left exposed, all efforts must be taken to ensure the subject area is not eroded
. Any topsoil that is to be stripped is to be placed in a designated top soil stockpile
. Any top soil stockpiles are to be placed on suitably higher ground and a silt fence is to be built surrounding the stockpile
. Stockpiles are to have one access only and are to be rehabilitated on operation completion
. Silt traps/fences/shakedowns are to be checked weekly and after rain events and sediment is to be removed once it builds up to a height of 300mm from top of upslope side.
. Dust is to be minimised during operation with watering of the site when required
. The sediment basins and drains should be inspected monthly, or following a significant rainfall event
. It is up to the contractor to manage sediment and erosion control to suit the varying stages of opration and make sure all placement of devices and management of devices is up to best practice guidelines.
. Each table drain should be inspected at least monthly, or following heavy rainfall with particular emphasis on the condition of land immediately down-slope of the discharge point. Any maintenance work should be completed within 7 days of the initial inspection
. The bund surrounding the crushing and seiving plant should be inspected monthly or following a significant rainfall event and necessary repairs be conducted as soon as possible
. In the case of an overflow occuring, there are two sets of appropriate sample bottles supplied by a NATA registered laboratory held on the site for sampling of any overflows from the primary storage.

Catch drains and V-Drains are designed to be open channels that collect runoff and desposit sediment to designed sediment controls.



CATCH DRAIN TYPICAL SECTION



V-DRAIN TYPICAL SECTION

Holding Pond Parameters and Subsequent Details Table:
Catchment Area = 20.7ha
Allowable Free-Board Depth = 1m
Batter Ratio = 2:1
Required Capacity = 7.63ML*
90th Percentile Capacity = 51.5ML**
Approximate Current Capacity = 27.6ML
*Capacity was calculated using a 90th-Percentile 5-Day storm
**Capacity was calculated using a 90th Percentile Year Rainfall Event

SEDIMENT POND USAGE DURING OPERATION

A monthly inspection shoud be undertaken for: the sediment holding pond, diversion structures, and the quarry sump.
The following information should be recorded during the inspection:
- General condition.
- Evidence of overflow and condition of downstream catchment.
- Water colour, eg. highly turbid, brown, clear etc.
- Evidence of eroding surfaces.
- Evidence of sediment discharge.
- Approximate retained capacity.

SCALES: HORIZ 1:1000 VERT - DATUM: LOCAL AHD MGA ZONE 56	A3	SMK CONSULTANTS surveying - irrigation - environmental PO BOX 774 MOREE 2400 PHONE (02) 67 521021	CLIENT: Johnstone Concrete	DESCRIPTION: Wave Hill Quarry Site Plan During Operation Report	PLAN REVISION: A FIRST ISSUE / B / C	DATE 29-06-2020	SHEET No 1 of 1
SURVEYED J.BARR DESIGNED I.MOSS CHECKED M.CANNIGAN	Contours Design Existing Major: 1.0 m Minor: 0.2 m		PROJECT: Wave Hill Quarry				LOG No. COMPUTER FILE (MUC) Quarry Report Draft 2 - Draft Plan 2

SMK CONSULTANTS