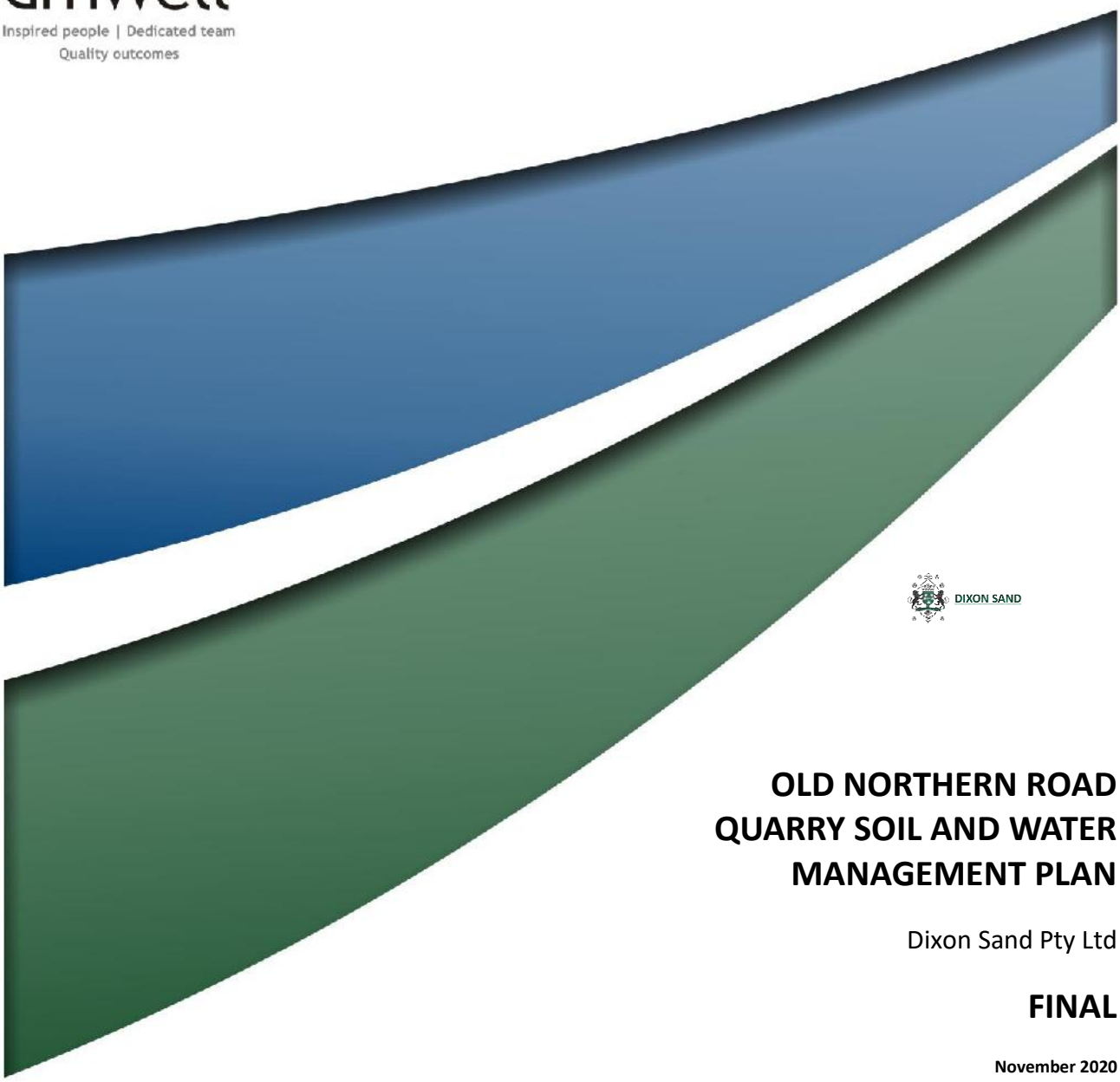
umwelt

Inspired people | Dedicated team
Quality outcomes



DIXON SAND

OLD NORTHERN ROAD QUARRY SOIL AND WATER MANAGEMENT PLAN

Dixon Sand Pty Ltd

FINAL

November 2020

DIXON SAND

OLD NORTHERN ROAD QUARRY SOIL AND WATER MANAGEMENT PLAN

Dixon Sand Pty Ltd

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Dixon Sand Penrith) Pty Ltd

Project Director:	Gabrielle Allan
Project Manager:	Scott Grunsell
Technical Director:	Saul Martinez
Technical Manager:	Chris Bonomini
Report No.	4209_R04_V4
Date:	November 2020

Newcastle

75 York Street
Teralba NSW 2284

Ph. 02 4950 5322

www.umwelt.com.au

Document Status

Rev No.	**Reviewer**		**Approved for Issue**	
	Name	**Date**	**Name**	**Date**
Draft (for Agency consultation)	Chris Bonomini	28/02/2018	Gabrielle Allan	01/03/2018
V1	Chris Bonomini	16/03/2018	Gabrielle Allan	16/03/2018
V2	Chris Bonomini	02/04/2018	Gabrielle Allan	20/04/2018
V3	Chris Bonomini	04/05/2018	Gabrielle Allan	07/05/2018
V4	Hunny Churcher	04/05/2020	David Dixon	04/05/2020
V5	Hunny Churcher	04/11/2020	David Dixon	04/11/2020

Table of Contents

1.0 Introduction 1

1.1 Background 1

1.2 Purpose and Scope 1

1.3 Plan Implementation 4

1.3.1 Responsibilities 4

1.3.2 Further Studies 5

1.3.3 Hold Points 5

1.4 Compliance Requirements 5

1.4.1 Development Consent Conditions 5

1.4.2 Environmental Management Commitments 8

1.4.3 Environment Protection Licence 9

1.4.4 Water Licences 9

1.4.5 Stakeholder Consultation 10

1.5 Guidelines and Policies 10

2.0 Soil and Water Context 12

2.1 Surface Water 12

2.1.1 Catchment and Hydrology 12

2.1.2 Soils 12

2.1.2.1 Soil Landscapes 12

2.1.3 Climate 15

2.1.4 Baseline Surface Water Quality 16

2.2 Groundwater 16

2.2.1 Groundwater Sources 16

2.2.2 Groundwater Baseline Conditions 16

2.2.2.1 Lots 1 and 2 Wet Weather Groundwater Levels and Extraction Limits 16

2.2.2.2 Lots 196 and 29 Extraction Limits 17

2.2.2.3 Historical Groundwater Levels 17

2.2.2.4 Water Quality 21

3.0 Water Management System 24

3.1 Surface Water Strategy 24

3.2 Erosion and Sediment Control 28

3.2.1 Soils 28

3.2.2 Sediment Basins 28

3.2.3 General Erosion and Sediment Control Measures. 29

3.2.3.1 Progressive erosion and sediment control plans 29

3.2.3.2 Erosion and sediment control measure design criteria 30

3.2.3.3 Soil and stockpile management 31

3.2.3.4 Diversion Banks and Channels 31
3.2.3.5 Contour Banks and Drains 31
3.2.3.6 Inspections and Maintenance 32
4.0 Water Balance 33
4.1 Water Sources 33
4.2 Water Demands and Losses 33
4.3 Assumptions and Bases 33
4.4 Results 34
5.0 Licensing, Monitoring and Reporting 36
5.1 Surface Water 36
5.1.1 Licences and Permits 36
5.1.2 Monitoring Program 36
5.1.2.1 Receiving Water 36
5.1.2.2 Discharges 36
5.1.2.3 Erosion and Sediment Controls 37
5.1.3 Reporting 37
5.1.3.1 EPL 37
5.1.3.2 Annual Review 37
5.2 Groundwater 37
5.2.1 Licences 37
5.2.2 Monitoring Program 38
5.2.2.1 Extraction Levels and Water Quality 38
5.2.2.2 Groundwater Volumes 40
5.2.3 Reporting 41
5.2.3.1 Annual Review 41
5.2.3.2 Maximum Extraction Depth Map 41
5.2.3.3 DoI Water 41
5.2.3.4 Incident Reporting 41
6.0 Trigger Action Response Plans 42
6.1 Summary of Trigger Values and Criteria for Water Management 43
6.2 Surface Water TARPs 45
6.3 Groundwater TARPS 49
6.3.1 Responsible Impacts Procedure 51
6.4 Incident Response 53
7.0 Review and Improvement 55
7.1 Adaptive Management 55
8.0 References 56

Figures

Figure 1.1	Locality Plan	2
Figure 1.2	Old Northern Road Quarry	3
Figure 2.1	Soil Landscapes	14
Figure 2.2	Surface Water and Groundwater Monitoring Locations	20
Figure 3.1	Water Management System Plan	26
Figure 3.2	Water Managements System Schematic	27
Figure 5.1	Lots 1 and 2 Extraction Limits	39

Tables

Table 1.1	Roles and Responsibilities	4
Table 1.2	Conditions of Consent – Soil and Water	5
Table 1.3	EIS Soil and Water Quality Management Commitments	8
Table 1.4	**Summary of Issues Raised During Agency Consultation**	10
Table 2.1	Annual Rainfall	15
Table 2.2	Average Daily Pan Evaporation	15
Table 2.3	Baseline Surface Water Quality and Trigger Values (June 2018 to June 2020)	16
Table 2.4	Baseline Groundwater Level Statistics and Trigger Values (2003 – 2020)	18
Table 2.5	Baseline Groundwater Water Quality Statistics and Trigger Values (2010 – 2020)	21
Table 3.1	Quarry Catchments	24
Table 3.2	Water Storage Volumes	25
Table 3.3	Sediment Basin Design Criteria	30
Table 4.1	Gross Water Balance Results (ML/year)	34
Table 4.2	50th Percentile Year Water Balance Results	34
Table 4.3	Predicted Off-site Discharge Volumes (ML)	34
Table 5.1	EPL Discharge Criteria and Monitoring Requirements	36
Table 5.2	Maximum Extraction Depth Limits	38
Table 5.3	Groundwater Monitoring Boreholes	40
Table 6.1	All Trigger Values and Criteria for Water Management	43
Table 6.2	Receiving Water Quality TARP	45
Table 6.3	Main Dam Water Quality Outside of Discharge Criteria TARP	47
Table 6.4	Discharge Water Quality TARP	48
Table 6.5	Groundwater Quality TARP	49
Table 6.6	Extraction Depth Exceedance TARP	50
Table 6.7	Groundwater Level TARP	50
Table 6.8	Unforeseen Groundwater Inflow TARP	52
Table 6.1	**Summary of Potential Soil and Water related incidents**	53

Appendices

Appendix 1	Environmental Management Plan Guideline Plan Preparation Checklist
Appendix 2	Agency Correspondence
Appendix 3	Maximum Extraction Depth Map
Appendix 4	Blue Book Standard Drawings

1.0 Introduction

1.1 Background

Dixon Sand Pty Ltd (Dixon Sand) operates the Old Northern Road Quarry (the quarry), a sand extraction and processing operation, located on Old Northern Road, Maroota in New South Wales (NSW). The quarry has been in operation since the early 1980s with Dixon Sand operating the quarry since 1992. The site covers approximately 58.4 hectares (ha) and includes Lot 29 DP752025, Lot 196 DP752025, Lot 1 DP547255 and Lot 2 DP547255 (refer to **Figure 1.1**). The quarry is located in the small rural community of Maroota which supports a number of other sand extraction operations. The quarry is a major supplier of mortar sands to the Sydney metropolitan market.

The quarry operates in accordance with Development Consent (DA) 250-09-01 issued by the Land and Environment Court in 2004. DA 250-09-01 has been subsequently modified on five (5) occasions, most recently in 2017 under Section 75W of the *Environmental Planning and Assessment Act 1979*.

DA 250-09-01 permits the extraction and processing of up to 495,000 tonnes of quarry products per annum, including the processing of extractive material sourced from the Haerses Road Sand Quarry. The consent permits quarrying operations to be carried out on site until 24 May 2042, with continued receipt and processing of material from Haerses Road Sand Quarry permitted until 14 February 2046. The approved extraction areas are shown on **Figure 1.2**.

1.2 Purpose and Scope

The purpose of this Soil and Water Management Plan (SWMP) is to describe the soil and water management strategies, procedures, controls and monitoring programs to be implemented for the management of potential soil and water impacts arising from the operation of Old Northern Road Quarry. This SWMP applies to Lot 29 DP752025, Lot 196 DP752025 and Lots 1 and 2 DP547255 as shown on **Figure 1.1**.

This SWMP addresses the relevant requirements of DA 250-09-01. The DA conditions and Environmental Impact Statement (EIS) management commitments relevant to this plan are provided in **Section 1.4.1**. A checklist of where each condition has been addressed within this document is provided in **Table 1.2**. This plan also outlines the control measures to be implemented as part of the continued operations at the quarry to minimise the potential impacts on soil and water quality.

This SWMP has also been developed in accordance with the requirements of the Department of Planning and Environment's (DPE) *Environment Management Plan Guidelines* (the guidelines). A checklist of where each condition has been addressed within this document is shown in **Appendix 1**.

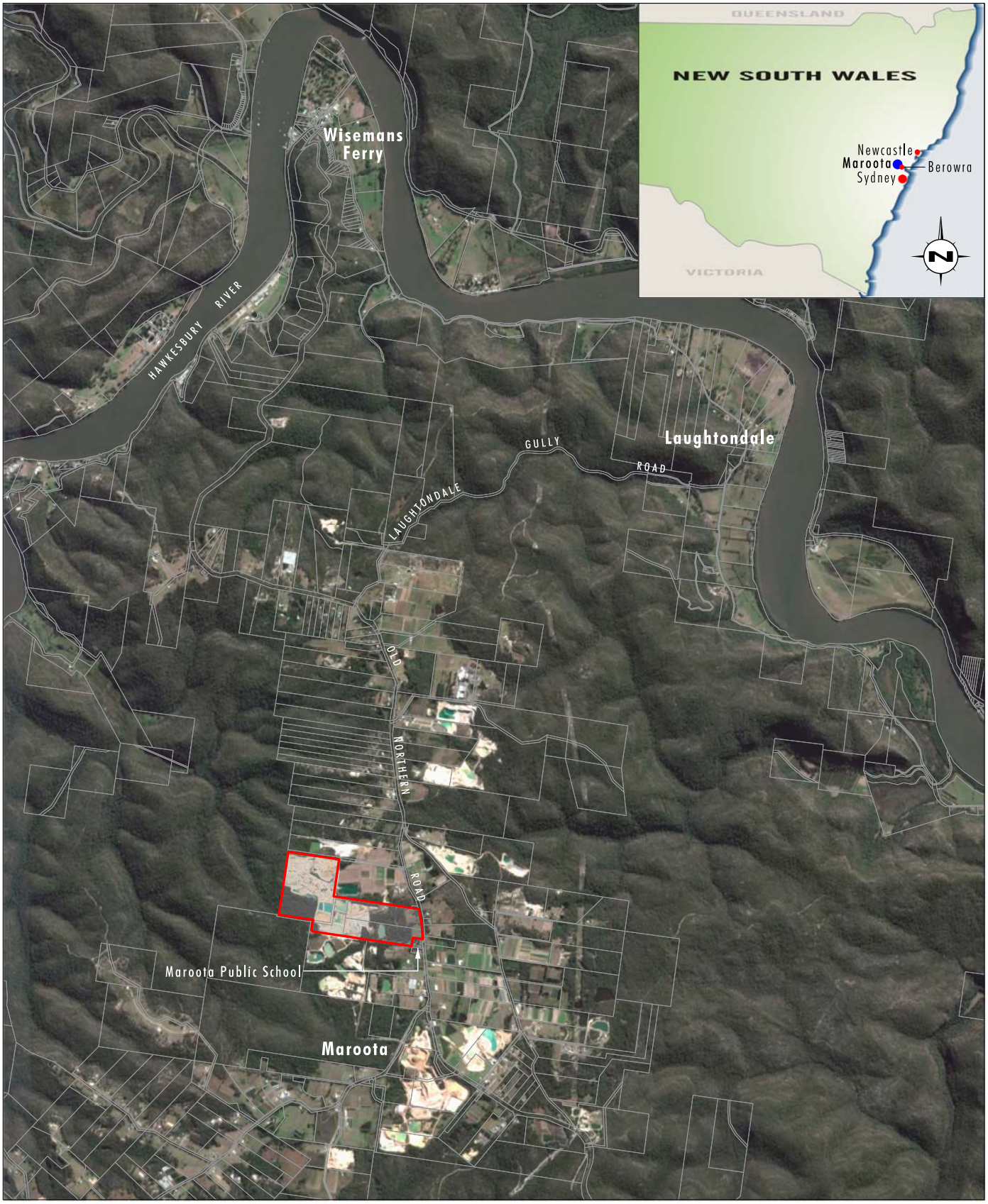


Image Source: Google Earth - DigitalGlobe (2016 - 2017)
Data Source: LPI (2009)

0 1.0 2.0 2.5km
1:50 000

Legend

Old Northern Road Quarry

FIGURE 1.1

Locality Plan

File Name (A4): R04/4209_005.dgn
20180122 9.50

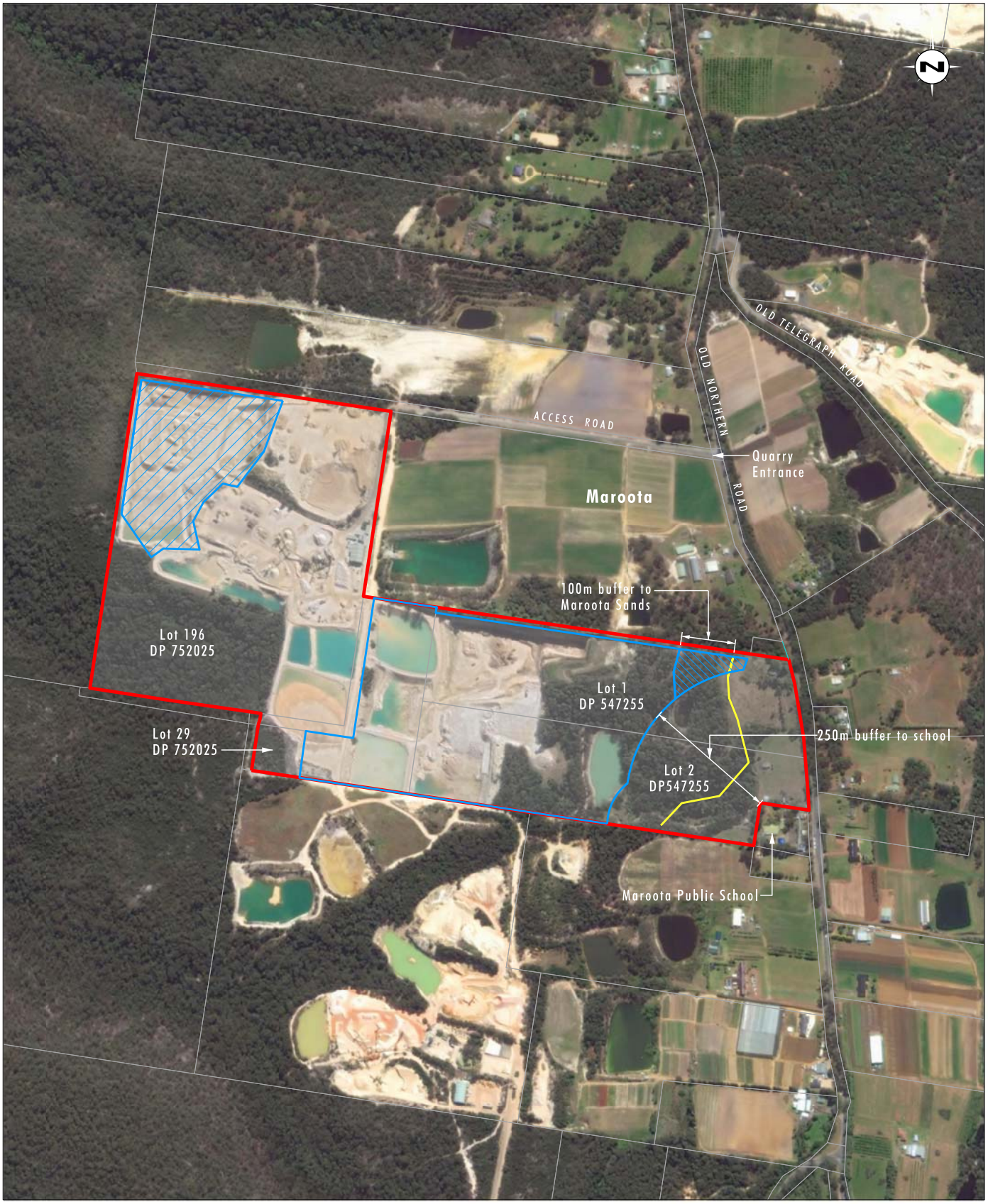


Image Source: Google Earth (2016 - 2017)
Data Source: LPI (2016)

0 100 250 500m
1:10 000

Legend

- Old Northern Road Quarry
- Approved Extraction Limits
- Extraction Area with Maximum Extraction Depth of 127.5m AHD
- Extraction Area Limited to 2m Above Wet Weather Groundwater Level
- Limit of Maroota Tertiary Sands Groundwater Source

FIGURE 1.2

Old Northern Road Quarry

1.3 Plan Implementation

1.3.1 Responsibilities

Environmental management at the quarry is the responsibility of all employees and contractors, with the Quarry Manager having overall responsibility for environmental management of the operations. Environmental responsibilities are included in the position description of all employees.

Roles and responsibilities for implementation of this SWMP for key personnel at the quarry are outlined in **Table 1.1**.

Table 1.1 Roles and Responsibilities

Role	Accountabilities for this document
Quarry Manager	• Provide sufficient resources for the implementation of this plan • Coordinate the review of this plan in accordance with the requirements of the Development Consent • Oversee the implementation of this plan • Have working knowledge of this plan • Coordinate the implementation of water management measures and strategies in accordance with this plan • Ensure that the quarry has sufficient water for all stages of the development, and if necessary, adjust the operations to match available water supply • Ensure the quarry is managed within the capacity of the quarry water management system • Be aware of the environmental legislative requirements associated with the quarry and take measure to ensure compliance • Ensure employees are competent through training and awareness programs
Environmental Officer	• Coordinate the water monitoring program described in this plan • Evaluate and report monitoring results as required by the Development Consent and EPL • Coordinate water related incidents investigations and reporting as required by legislation and internal standards and guidelines • Provide primary contact for complaints and supply follow-up information to any complainant • Initiate investigations of complaints as received from the public or government agency • Prepare a report to government agencies or neighbours following a notifiable incident • Undertaken regular review of this Plan in accordance with the requirements of the Development Consent.
All employees and contractors	• Comply with all requirements in this plan • Report all potential environmental incidents to the Quarry Manager immediately • Operate in a manner that minimises risks of incidents to themselves, fellow workers or the surrounding environment • Seek approval from the Quarry Manager prior to making changes to infrastructure/processes which may result in increased dust emission risk. • Follow any instructions provided by the Quarry Manager

1.3.2 Further Studies

Dixon Sand has no requirements under their Conditions of Consent to undertake any further studies for the SWMP.

1.3.3 Hold Points

Dixon Sand has two hold point requirement under their Conditions of Consent:

- Condition 15 Schedule 3 – Prior to commencing works associated with Modification 4, the Applicant must install additional monitoring bores within the MTSGS buffer zone within Lot 2 DP 547255 (south of MW2), including at least one deep monitoring bore that targets the regional groundwater table and at least one shallow groundwater monitoring bore. This requirement has been completed with BH8 and BH9 installed in September 2015 in accordance with this condition.

- Condition 19 Schedule 3 – The Applicant must consult with DPI Water prior to commencement of operations in Strip 4 (as shown in the figure in **Appendix 2**) on Lots 1 and 2 DP 547255 and, if required, obtained a permit under the *Fisheries Management Act 1994* for works to be carried out on the site. This condition is yet to be triggered.

1.4 Compliance Requirements

1.4.1 Development Consent Conditions

Table 1.2 presents the consolidated consent conditions relating to soil and water management at the quarry.

Table 1.2 Conditions of Consent – Soil and Water

Condition	Requirement	Section/s Addressed
Schedule 2 – Administrative Conditions		
Limits of Extraction		
15.	**Buffer Zones** The applicant must maintain the fenced buffer zones between the approved limits of extraction and nearby land uses or sensitive environmental areas. The boundary of the buffer zones must be located: (f) not less than 100 m from the mapped extent of the MTSGS, with the exception of the area in the north of Lot 1 DP 547255 shown in blue edging in the figure in Appendix 2.	Sections 2.2.2 and 5.2.2.1
17.	**Maximum Extraction Depth** Extraction below a depth of 15.24 m below original ground level is restricted to Lot 196 DP 752025 within the hatched area shown in the figure in Appendix 2 and to a depth not greater than 127.5 m AHD.	Sections 2.2.2 and 5.2.2.1
18.	Extraction on Lot 29 DP 752025 is limited to a depth not greater than 15.24 m below original ground level.	Sections 2.2.2 and 5.2.2.1
19.	Extraction on Lots 1 and 2 DP 547255, with the exception of the MTSGS buffer zone, is limited to a depth not greater than 170 m AHD in the east, gradually reducing to 153 m AHD in the west, and as shown conceptually in the figure in Appendix 4**.**	Sections 2.2.2 and 5.2.2.1

Condition	Requirement	Section/s Addressed
20.	The Applicant must ensure that no extraction occurs with 2 m of the highest recorded wet weather groundwater level within the MTSGS buffer zone.	Sections 2.2.2 and 5.2.2.1
21.	The Applicant must: (a) establish the highest recorded wet weather groundwater level within the MTSGS buffer zone based on all available (and at least 12 months) site specific groundwater monitoring data; (b) engage a suitably qualified and experienced expert to establish the maximum depths to which extraction can be undertaken within the MTSGS buffer zone to comply with condition 20 above; and (c) submit a Maximum Extraction Depth Map (contour map or similar) for the development, which demonstrates compliance with conditions 17 to 20 above (inclusive), to the Secretary for approval within 3 months of the approval of Modification 5.	Sections 2.2.2, 5.2.2.1, 5.2.3 and Appendix 3
22.	The Applicant must comply with the extraction depths specified in the Maximum Extraction Depth Map to the satisfaction of the Secretary.	Section 0
23.	Within 3 months of the completion of the Independent Environmental Audit (see condition 13 of Schedule 5), the Applicant must review and update the Maximum Extraction Depth Map for the development to the satisfaction of the Secretary.	Section 5.2.3
Schedule 3 – Specific Environmental Conditions		
Water Supply		
12.	The Applicant must 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. *Note: Under the Water Act 1912 and/or the Water Management Act 2000, the Applicant is required to obtain all necessary water licences for the development.*	Section 4.0
Water Discharges		
13.	The Applicant must comply with the discharge limits in any EPL, or with section 120 of the POEO Act.	Section 5.1
Groundwater Management		
14.	The Applicant must ensure that all bores and associated groundwater monitoring equipment for the development are maintained, and/or replaced if necessary, throughout the life of the development, to the satisfaction of DPI Water. *Note: MW4 may be removed immediately prior to quarrying in that area.*	Section 0
15.	Prior to commencing works associated with Modification 4, the Applicant must install additional monitoring bores within the MTSGS buffer zone within Lot 2 DP 547255 (south of MW2), including at least one deep monitoring bore that targets the regional groundwater table and at least one shallow groundwater monitoring bore. *Note: This condition does not establish a new requirement to undertake these actions following the approval of Modification 5. Rather, it continues the previous requirement to undertake these actions.*	Section 0 (BH8 and BH9)
16.	Seepage of groundwater from the MTSGS buffer zone into the quarry pit must be measured and recorded (if there is sufficient water volume to pump and measure).	Section 0

Condition	Requirement	Section/s Addressed
17.	The Applicant must ensure that groundwater in the regional groundwater source managed under the *Water Sharing Plan for the Greater Metropolitan Groundwater Sources 2011* is not intercepted or contaminated by its operations. In the event of this groundwater being intercepted or contaminated, operations are to cease within the vicinity of the affected area and the Applicant must consult with the Secretary and DPI Water to determine the basis upon which extraction may recommence. *Note: Perched groundwater lenses that are above the regional groundwater source and are outside the MTSGS buffer zone may be intercepted however Water Access Licences must be held to account for all groundwater taken.*	Section 0 and Section 6.2
18.	In the event that the regional groundwater table is intercepted by any on-site dams, the Applicant must carry out remedial works, such as backfilling to the depth of the water table, to the satisfaction of the Secretary.	Section 6.2
Soil and Water Management		
19.	The Applicant must consult with DPI Water prior to commencement of operations in Strip 4 (as shown in the figure in Appendix 2) on Lots 1 and 2 DP 547255 and, if required, obtain a permit under the *Fisheries Management Act 1994* for works to be carried out on the site.	Section 5.1.1
20.	The Applicant must prepare a Soil and Water Management Plan for the development to the satisfaction of the Secretary. This plan must:	This plan
	(a) be prepared by a suitably qualified and experienced person/s approved by the Secretary;	Appendix 2
	(b) be prepared in consultation with the EPA and DPI Water;	Appendix 2
	(c) be submitted to the Secretary for approval within 3 months of the approval of Modification 5, unless otherwise agreed by the Secretary; and	Appendix 2
	(d) include a:	

	(i) Site Water Balance that includes:
	• details of:
	  ○ sources and security of water supply;
	  ○ water use and management on site;
	  ○ any off-site water transfers; and
	  ○ reporting procedures; and
	• measures to be implemented to minimise clean water use on site;
		Section 4.0

	(ii) Surface Water Management Plan, that includes:	This plan
	• a program for obtaining detailed baseline data on surface water flows and quality in water bodies that could potentially be affected by the development;	Section 5.1.2

	• a detailed description of the surface water management system on site including the:
	  ○ clean water diversion system;
	  ○ erosion and sediment controls;
	  ○ dirty water management system; and
	  ○ water storages; and
		Section 3.0

Condition	Requirement	Section/s Addressed

	• a program to monitor and report on:
	  ○ any surface water discharges;
	  ○ the effectiveness of the water management system;
	  ○ the quality of water discharged from the site to the environment; and
	  ○ surface water flows and quality in local watercourses; and
		Section 5.1

	(iii) Groundwater Management Plan that includes:	This Plan
	• detailed management measures to ensure that quarrying operations, other than monitoring bores, do not intercept the highest recorded wet weather groundwater level within the MTSGS buffer zone and/or the regional groundwater table within the Sydney Basin Central Groundwater Source;	Section 0
	• a protocol to obtain appropriate water licence(s) to cover the volume of any unforeseen groundwater inflows into the quarry from the quarry face or floor; and	Section 6.2

	• a monitoring program to manage potential impacts, if any, on any alluvium and associated surface water source near the proposed extraction area that includes:
	  ○ identification of a methodology for determining threshold water level criteria;
	  ○ contingency measures in the event of a breach of thresholds; and
	  ○ a program to regularly report on monitoring.
		Section 0, Section 5.2.3 and 6.3

	The Applicant must implement the Soil and Water Management Plan as approved by the Secretary.	

1.4.2 Environmental Management Commitments

In accordance with Condition 2 Schedule 2 of the Development Consent, the quarry must be developed and operated generally in accordance with the environmental impact assessment reports prepared for the development. **Table 1.3** summarises the safeguards and management controls relating to soil and water quality management that have been identified in the environmental impact assessment reports prepared for DA 250-09-01 and subsequent modifications.

Table 1.3 EIS Soil and Water Quality Management Commitments

Source	Description	Section/s Addressed
EIS (ERM 2001)	**Section 5.1.1 Pre Extraction** **ii. Water Management and Erosion/Sediment Control** Prior to extraction, the initial water management controls will be constructed for stage 1 works. These include construction of the clean water diversion drain around strip 1, and implementation of temporary sediment controls in drainage lines to catch any sediment laden runoff from clearing works. Groundwater wells will be checked to ensure they are functional and their location reviewed in terms of the latest extraction plan, to check whether they require relation prior to extraction.	Section 3.0

Source	Description	Section/s Addressed
EIS (ERM 2001)	**Section 5.1.2 Extraction** **i. Water Management and Erosion/Sediment Control** Water management and erosion/sediment controls will be implemented as described in Chapter 2. These include clean water diversion drains around the eastern side of the extraction strips. A drainage channel will be formed in the extracted floor of the quarry, which will be directed to void on Lot 29. Silt traps will be excavated into this channel at intervals. A detailed Water Management Strategy will be developed for each strip prior to its extraction, locating all required water management and erosion/sediment controls. Regular surveys of extraction depth, combined with monthly groundwater level monitoring will ensure extraction does not occur within two metres of the wet weather high groundwater level. The majority of groundwater monitoring wells are within buffer areas. One well is within the active extraction area of Strip 6 and one is close to the western boundary of the Shale-Sandstone transition Forest buffer. These wells will be removed as extraction occurs within these strips.	Section 3.0
EA MOD 3 and MOD 4 (Nexus Environmental Planning 2011 & 2013)	**Draft Statement of Commitments** **Section 4.3 Groundwater** Dixon Sand is committed to the continued monitoring of the borehole network to ensure that suitable data are obtained with regard to the behaviour of groundwater as per the current licensing requirements.	Section 5.2

1.4.3 Environment Protection Licence

The quarry operates under Environment Protection Licence (EPL) 3916, issued under the NSW *Protection of the Environment Operations (POEO) Act 1997*, which includes conditions relating to water quality discharge criteria and monitoring of discharge to waters from the quarry's water management system (WMS). **Section 5.2.1** details the EPL conditions.

No further approvals are anticipated to be required with respect to the water management under the POEO Act.

1.4.4 Water Licences

There are three groundwater access licences for the quarry land holding for a share in the Sydney Basin Central Groundwater Source. The following water access licenses apply to the site:

- WAL 24341 (30 units share in Sydney Basin Central Groundwater Source)
- WAL 24325 (80 units share in Sydney Basin Central Groundwater Source)
- WAL 43270 (150 units share in Sydney Basin Central Groundwater Source)

This allows for the abstraction of up to 260 ML/year from two bores on Lot 196.

1.4.5 Stakeholder Consultation

In accordance with Condition 20 Schedule 3 of the Development Consent, this SWMP has been prepared in consultation with the Environment Protection Authority (EPA) and Department of Industry (DoI) Water. A draft copy of this plan was provided to the EPA and DoI Water on 1 March 2018. Comments were received from EPA on 15 March 2018. A follow-up request for comments was made to DoI Water on 16 April 2018 and 2 May 2018, however at the time of submission of this plan to DPE, no comments had been received from DoI Water.

A copy of correspondence provided by these agencies is provided in **Appendix 2** and a summary of the issues raised and how these were addressed is provided in **Table 1.4**.

Table 1.4 Summary of Issues Raised During Agency Consultation

Issue	Response
EPA	
With regard to the sediment basin design criteria specified in Table 3.3 of the draft SWMP, please give details of material specifications to ensure the stability of bund walls and that sediment water contained will not infiltrate the ground in sediment basins	Additional detail of the sediment basin construction design criteria has been provided in **Section 3.2.3.2.**
With regard to Table 3.3, which states that the emergency spillway will be designed to be structurally sound for the 100- year ARI storm event, please give details of the material specification and construction to achieve this.	Additional detail of the emergency spillway construction design criteria has been provided in **Section 3.2.3.2**.
Specify the measures proposed in the event of dirty construction/operational water (e.g. water in the main dam) and/or water to be discharge offsite exceeded the water quality criteria specified in the environmental protection licence EPL 3916.	An additional trigger action response plan has been added in **Table 6.1** to address circumstances where water quality in the Main Dam is outside of discharge criteria.
As runoff and discharges from the quarry site flow to Jackson Swamp, a freshwater floodplain at the Hawksbury River approximately 2 km north west of the quarry, please specify measures to ensure that any discharges that flows from the quarry will not affect the wetland species of significance in the Hawkesbury area.	As discussed in **Section 3.1**, the WMS for the quarry contains all runoff from within quarry disturbance areas and any discharge from the WMS is required to meet the water quality standards established by conditions of the quarry's EPL.
DoI Water	
No comments received.	-

1.5 Guidelines and Policies

Receiving water quality standards and trigger values are derived from *The Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Environment and Conservation Council, 2000).

The following guidelines are relevant to the management of sediment and erosion control on site:

- *Managing Urban Stormwater – Soils and Construction, Volume 1* (the Blue Book) (Landcom, 2004); and

- *Managing Urban Stormwater – Soils and Construction, Volume 2E*: Mines and Quarries (DECC, 2008).

Construction standards for sediment basins and sediment basin emergency spillways and to prevent seepage from the sediment basins all sediment basins are set out in *Appendix B – Sediment Basin Design and Operation of Best Practice Erosion and Sediment Control* (International Erosion Control Association – Australasia – Draft document revision, https://www.austieca.com.au/documents/item/697, December 2016).

The *NSW Aquifer Interference Policy* (DPI Office of Water 2012) applies to aquifer interference activities. Old Northern Road Quarry is not permitted to extend to within 2 metres of the wet weather groundwater level of the local regional groundwater table (Sydney Basin Central Groundwater Source) or the perched water within the buffer zone to protect the Maroota Tertiary Sands Groundwater Source. For this reason, interference with groundwater levels in the relevant aquifers in the vicinity of the quarry is not predicted and therefore the quarry is compliant with the Aquifer Interference Policy. Groundwater risks associated with aquifer interference are managed by way of the Trigger Action Response Plan (TARP) process outlined in **Section 6.2**.

2.0 Soil and Water Context

The soil and water context of the site is discussed in detail in Section 4.4 to Section 4.6 of the EIS (ERM 2001), and Sections 3.5 and 3.14 of the MOD 4 EA (Nexus Environmental Planning Pty Ltd 2013). A summary of this context and recent monitoring data is provided in the following sections.

2.1 Surface Water

2.1.1 Catchment and Hydrology

The quarry is located within the Hawkesbury River catchment. Water use within the catchment is regulated under the *Water Sharing Plan (WSP) for the Greater Metropolitan Region Unregulated River Water Sources* which commenced on 1 July 2011.

The WSP covers an area of approximately 32,500 km^2, from Shoalhaven Heads in the south, Broken Bay in the north, Lithgow to the west and Goulburn to the south west. The WSP encompasses 87 management zones that are grouped into six (6) water sources. The subject site falls within the catchments for the Hawksbury and Lower Nepean Rivers and specifically within the Upper Hawkesbury River Management Zone (Cattai Creek to Colo River).

The quarry site slopes gently from east to west from approximately 225 mAHD at Old Northern Road to approximately 172 mAHD at western boundary of Lot 29. Runoff from land outside the quarry water management system and discharges from the quarry site flow via ephemeral tributaries to Jacksons Swamp at the Hawkesbury River approximately 2 km north west of the quarry. Jacksons Swamp is a freshwater floodplain or reed swamp with some brackish sections and supports wetland species of significance in the Hawkesbury area.

As a consequence of the highly porous nature of the disturbed quarry catchments, a significant proportion of runoff rapidly infiltrates exposed surfaces as groundwater recharge.

2.1.2 Soils

2.1.2.1 Soil Landscapes

As shown on the NSW Office of Environment and Heritage (NSW OEH) "eSPade" website (accessed 13 December 2017) the site is covered by primarily by two soil landscapes: the Sydney Town and the Colo Heights (Soil Landscape of St Albans 1:100 000 Sheet, 1997). There is a very small portion of the Hawksbury Soil Landscape located on the eastern most border of the site. The distribution of these soil landscapes are shown on **Figure 2.1**.

The Sydney Town soil landscape covers the majority of the site and occurs on undulating to rolling low hills and moderately inclined slopes on Hawksbury Sandstone in the Macdonald Ranges. Soils are characterised as loose brown sandy loam topsoil overlying earth bright brown sandy clay loam subsoil on crests and slopes. Topsoil is strongly acidic (pH 4.5) to slightly acidic (pH 6.5) and subsoils are moderately acidic (pH 5.0) to slightly acidic (pH 6.0). The soils have a very high erosion hazard, are highly permeable and subject to permanent localised waterlogging. They are strongly acidic and sodic/dispersible soils with very low fertility and have high potential aluminium toxicity. When subject to concentrated flows the soil has a high erodibility and under non-concentrated flows the erodibility is low to moderate. Both topsoils and subsoils have low wind erodibility (NSW Department of Land and Water Conservation, Sydney 1997).

The remainder of the site is covered by the Colo Heights Soil Landscape. These soils occur on undulating to rolling sideslopes and moderately broad crests on Wianamatta Group shales in the Macdonald Ranges and on the Blue Mountains Plateau. The soils are moderately deep to deep (50-150 cm), moderately well to imperfectly drained Red Podzolic Soils. The dominant soil materials are brownish black pedal clay loam topsoil overlying reddish brown light clay subsoil. The soils are strongly acid, stony soils of low fertility. Topsoils have a moderate erodibility when subjected to both concentrated and non-concentrated flows. Subsoils have a moderate erodibility when subjected to non-concentrated flows and a very high erodibility when subject to concentrated flows. Both topsoils and subsoils have a low wind erodibility (NSW Department of Land and Water Conservation, Sydney 1997).

Some of the site is characterised as “disturbed terrain” under the soil landscape map’s available on eSpade (OEH, 2017), reflecting the existing extractive operations at the site. Disturbed terrain occurs where there has been disturbance by human activity (in this instance construction of a quarry) including the complete disturbance, removal or burial of soil. Disturbed terrain soils are highly variable and are dependent on the nature of the fill material and may include mass movement hazard, steep slopes, impermeable soils, poor drainage, low fertility and toxic materials (NSW Department of Land and Water Conservation, Sydney 1997).

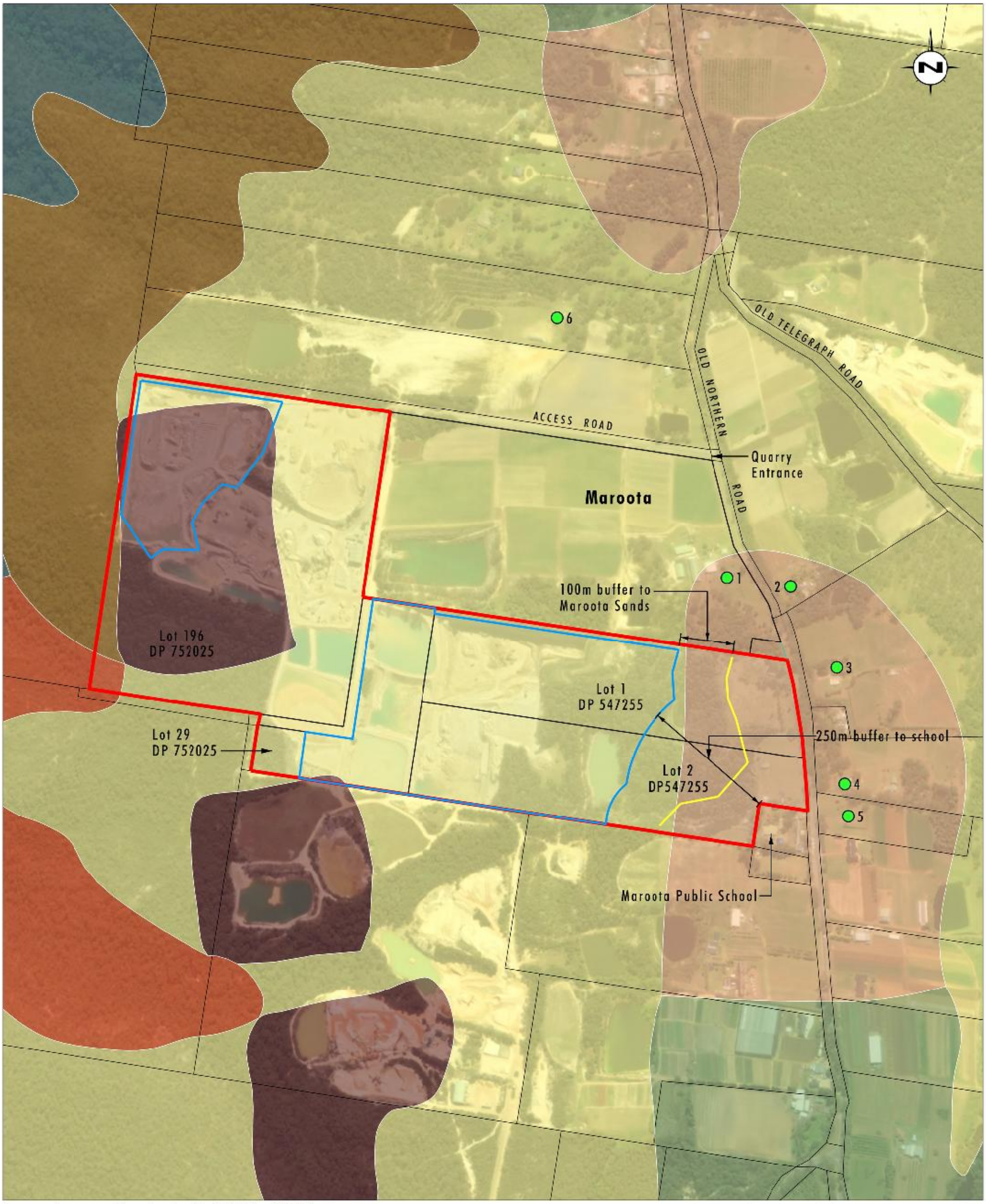


Image Source: Google Earth (2016 - 2017)
Data Source:

0 100 250 500m

Legend

- Old N…
- Approv…
- Limit … source
- Residen…
- Colo H…
- Disturb…
- Gymea
- Hawk…
- Maroo…
- Sydney…
- Watag…

FIGURE 2.1

Soil …

File Name
20180207

2.1.3 Climate

For water balance considerations it is important to have data that contains the long term climate records for a site (i.e. typically greater than 100 years). There are numerous Bureau of Meteorology (BoM) stations located in the region surrounding the quarry that record daily rainfall. Long term daily rainfall data is available for Old Telegraph Road, Maroota (Station 067014) located approximately 1 km south-east of the quarry with daily rainfall records from 1925 to date. Although the data available is missing some periods of data (i.e. 1954 to 1965), and has patchy data during some periods (i.e. 1986 to 2013), a comparison of long term climate records indicates that the available good quality data captures the long term rainfall variation (i.e. long term wet and dry periods).

The daily rainfall data for the Old Telegraph Road BoM station is summarised in **Table 2.1**. The rainfall analysis undertaken excludes rainfall years with excessive numbers of missing records.

Table 2.1 Annual Rainfall

Statistic	Annual Rainfall (mm)
10th percentile	577
50th percentile	899
90th percentile	1185

In the region surrounding the quarry, there is only one BoM station which currently records daily evaporation data, the University of Western Sydney (UWS) Hawkesbury Campus (Station 067021). The UWS BoM Station is located approximately 26 km south-west of the quarry.

Annual pan evaporation recorded at the UWS Hawkesbury Campus (Station 067021) has been analysed for years 1973 to 2016. Analysis of the historical record shows an expected trend of evaporation increasing during the summer months and decreasing during the winter months. Average daily evaporation data for each month of the year is shown in **Table 2.2**.

Table 2.2 Average Daily Pan Evaporation

Month	Average Daily Pan Evaporation (mm/day)
January	5.9
February	5
March	3.9
April	3
May	2.1
June	1.7
July	1.9
August	2.6
September	3.8
October	4.7
November	5.1
December	5.7

2.1.4 Baseline Surface Water Quality

Receiving water surface water quality has previously been monitored at a spring that discharges to an un-named creek in the south west of Lot 196 downstream of the quarry's licenced discharge point (LDP). However, due to issues with being able to safely access the monitoring location (SW19), sampling was ceased after July 2005. Quarterly surface water quality monitoring recommenced in June 2018 which also included visual observation of flow in the stream to allow an understanding of water quality variations under different flow conditions, i.e. no flow, low flow, high flow. **Table 2.3** presents the statistics for the receiving water quality data with the 20th percentile and 80th percentile results being the adopted site specific trigger values for pH and the 80th percentile results being the adopted trigger values for Total Suspended Solids (TSS) and turbidity. The trigger values were calculated from the two year baseline data from June 2018 to June 2020.

Table 2.3 Baseline Surface Water Quality and Trigger Values (June 2018 to June 2020)

Parameter	Minimum	20th Percentile	50th Percentile	80th Percentile	Maximum
pH	4.0	4.1	4.2	4.3	4.7
TSS (mg/L)	0.2	2.0	3.0	5.0	9.0
Turbidity (NTU)	0.1	0.2	0.2	1.1	2.2

Note: Where water quality results were recorded below the limit of detection, the limit of detection was taken to be the result.

2.2 Groundwater

2.2.1 Groundwater Sources

The quarry site lies over the Sydney Basin Central Groundwater Source and a number of shallow perched aquifers. These perched aquifers are not hydraulically connected to the regional groundwater source and have been previously incorrectly identified as the upper unsaturated part of the regional aquifer. The Greater Metropolitan Region Groundwater Source WSP, the applicable WSP for the quarry site, indicates that Lots 1 and 2 also overlay the Maroota Tertiary Sands Groundwater Source (MTSGS), however, drilling logs and independent geological reports have not identified this groundwater source under the site (RPS Aquaterra, 2012). However, a 100 m extraction buffer from the mapped extent of the MTSGS, with the exception of the hatched area in the north of Lot 1 (refer to **Figure 1.2**), has been established as a condition of the development consent. Development consent conditions also require the quarry to operate at least two metres above the wet weather groundwater level of the Sydney Basin Central Groundwater Source and within the hatched area in the north of Lot 1 (refer to **Figure 1.2**).

There are several groundwater abstraction bores located within 1 km of the quarry, however, all bores are deep and target the Sydney Central Basin groundwater source rather than the shallow perched aquifers.

2.2.2 Groundwater Baseline Conditions

2.2.2.1 Lots 1 and 2 Wet Weather Groundwater Levels and Extraction Limits

Groundwater assessments were undertaken by RPS Aquaterra and Australian Groundwater Technologies (AGT) in 2012 and 2013 respectively to establish the wet weather groundwater level of the regional aquifer on Lots 1 and 2 DP 547255 such that the depth of extraction could be established.

Following detailed site specific investigations it was concluded that the regional groundwater table level is approximately 168 mAHD at the eastern extent of the approved extraction area and approximately 151 mAHD at the western extent of the approved extraction area. Therefore the extraction limits for Lots 1 and 2 are 170 mAHD at the eastern extent of the approved extraction area, gradually reducing to approximately 153 mAHD at the western extent of the approved extraction area.

Extraction has also been limited to at least 100 m from the mapped extent of the MTSGS (refer to **Figure 1.2**), except within the hatched area shown in **Figure 1.2** where extraction can occur down to within 2 m of the highest recorded wet weather groundwater levels within the MTSGS buffer zone. Golder Associates were engaged by Dixon Sand to analyse groundwater level monitoring data, establish the highest recorded wet weather groundwater level within the MTSGS buffer zone and prepare a maximum extraction depth map. The maximum extraction depth map was submitted to DPE on 16 February 2018 and is included as **Appendix 3**.

The groundwater monitoring program that is undertaken by Dixon Sand to ensure sand extraction does not extend into the 2 m buffer above the wet weather groundwater level and monitor any potential impacts on the regional groundwater source is presented in **Section 5.2.2**.

2.2.2.2 Lots 196 and 29 Extraction Limits

Extraction beneath 15.24 m below original ground level on Lot 196 DP 752025 is restricted to within the hatched area shown in **Figure 1.2** and to a depth not greater than 127.5 mAHD.

Extraction on Lot 29 DP 752025 is limited to a depth not greater than 15.24 m below the original ground level.

2.2.2.3 Historical Groundwater Levels

Table 2.4 presents the baseline groundwater level statistics with the 20th percentile and 80th percentile results being the adopted site specific trigger values with respect to groundwater levels, calculated using long term groundwater levels commencing 2003 to date. Long term historical groundwater levels are presented in **Chart 2.1** while groundwater level monitoring data for the 2019 monitoring period are presented in **Chart 2.2**. Groundwater monitoring locations are presented on **Figure 2.2** and detailed groundwater bore information is presented in **Table 5.3** in **Section 5.2**. Groundwater levels in boreholes that are located within the localised perched aquifers have historically exhibited greater levels of fluctuation than the deeper boreholes located within the regional groundwater table. Analysis of groundwater levels in these boreholes and rainfall has demonstrated that these fluctuations can be attributed to groundwater recharge associated from rainfall infiltration.

Table 2.4 Baseline Groundwater Level Statistics and Trigger Values (2003 – 2020)

Monitoring Location	Minimum	20th Percentile	50th Percentile	80th Percentile	Maximum
MW1	173.1	176.0	177.5	178.3	180.0
MW2	191.2	194.3	199.0	200.3	202.1
MW3	173.6	175.1	177.4	178.4	180.3
MW5	158.4	162.1	162.6	162.9	164.0
BH1	106.1	106.2	106.2	107.1	107.5
BH2	162.1	165.0	165.0	166.7	167.9
BH3	158.1	160.5	161.0	161.7	162.1
BH6	161.7	164.1	164.7	165.5	166.2
BH7	157.0	160.0	160.4	161.2	162.1
BH8	189.2	189.5	189.8	189.9	190.3
BH9	157.8	161.3	163.0	163.8	164.4

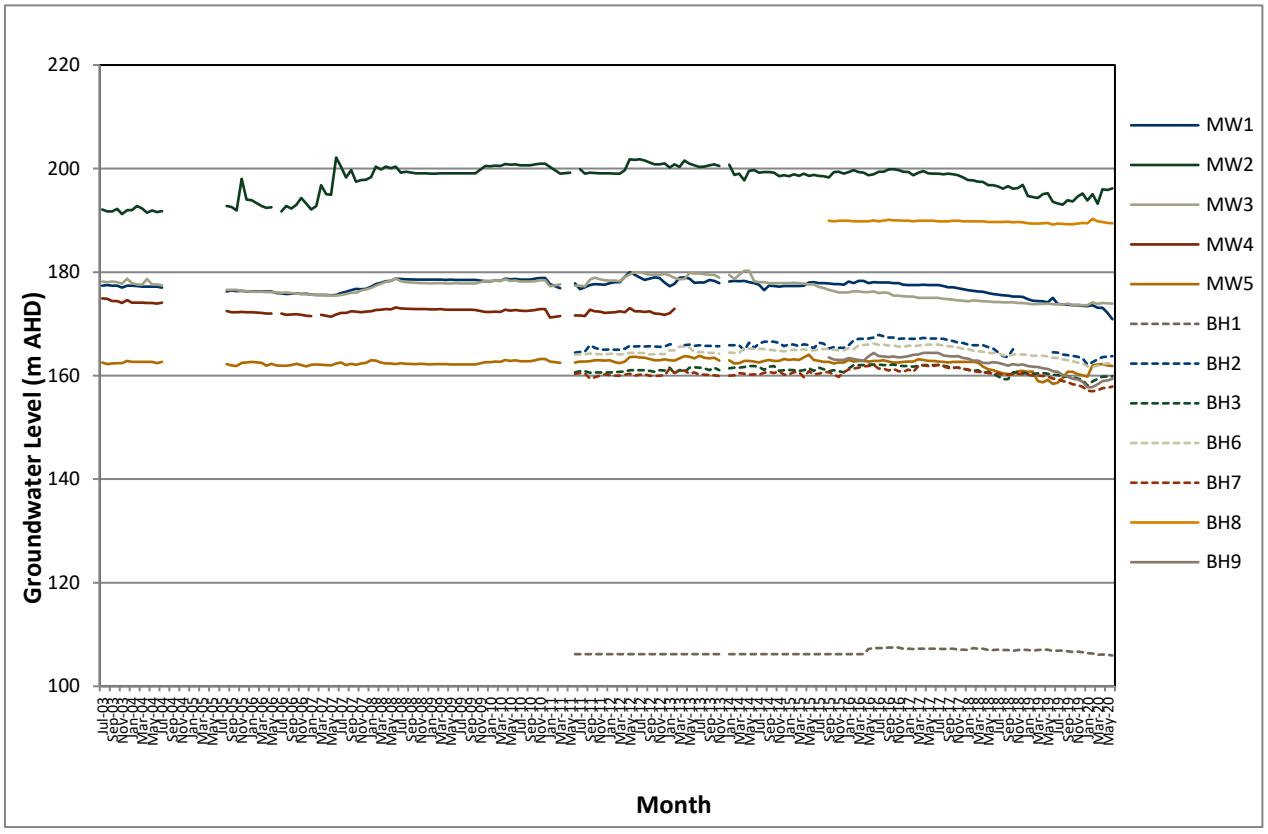


Chart 2.1 Long Term Groundwater Levels, 2003 to 2020

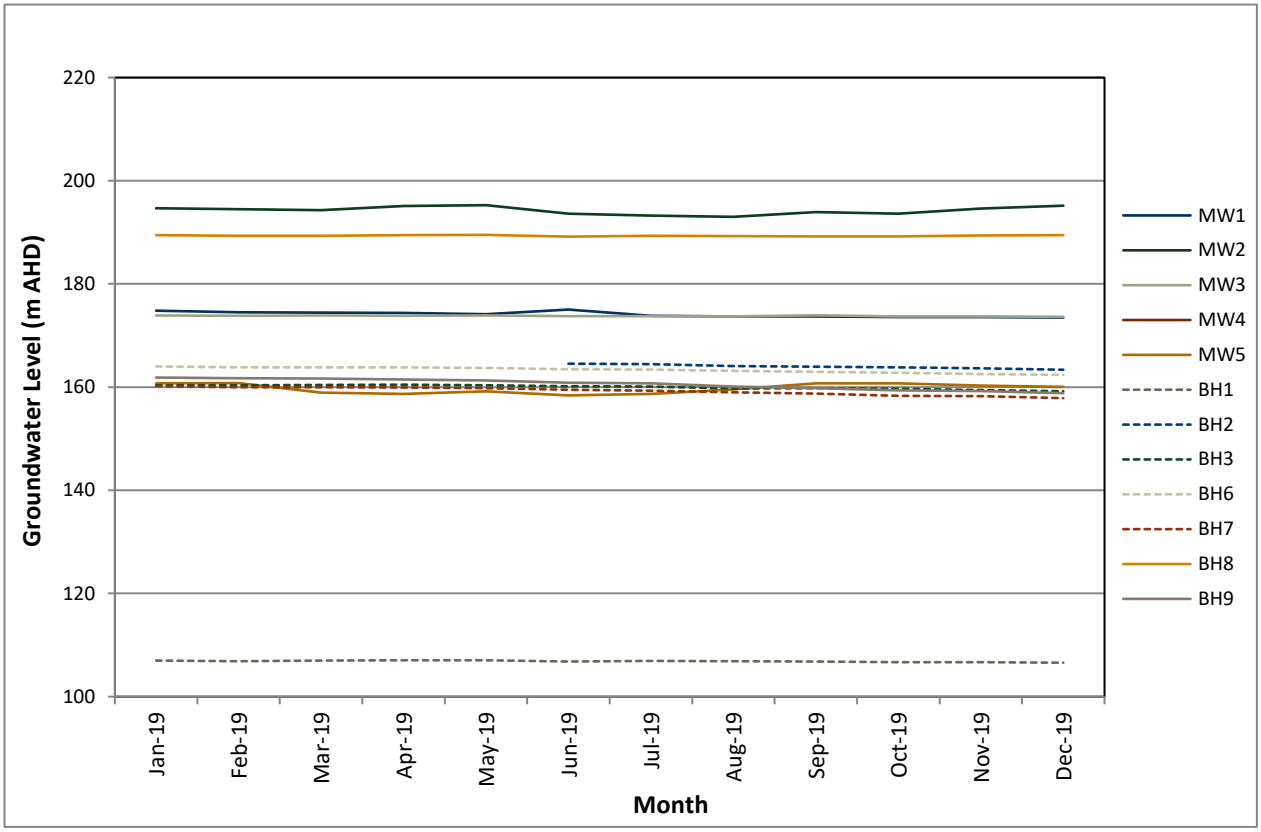


Chart 2.2 Groundwater Levels, 2019

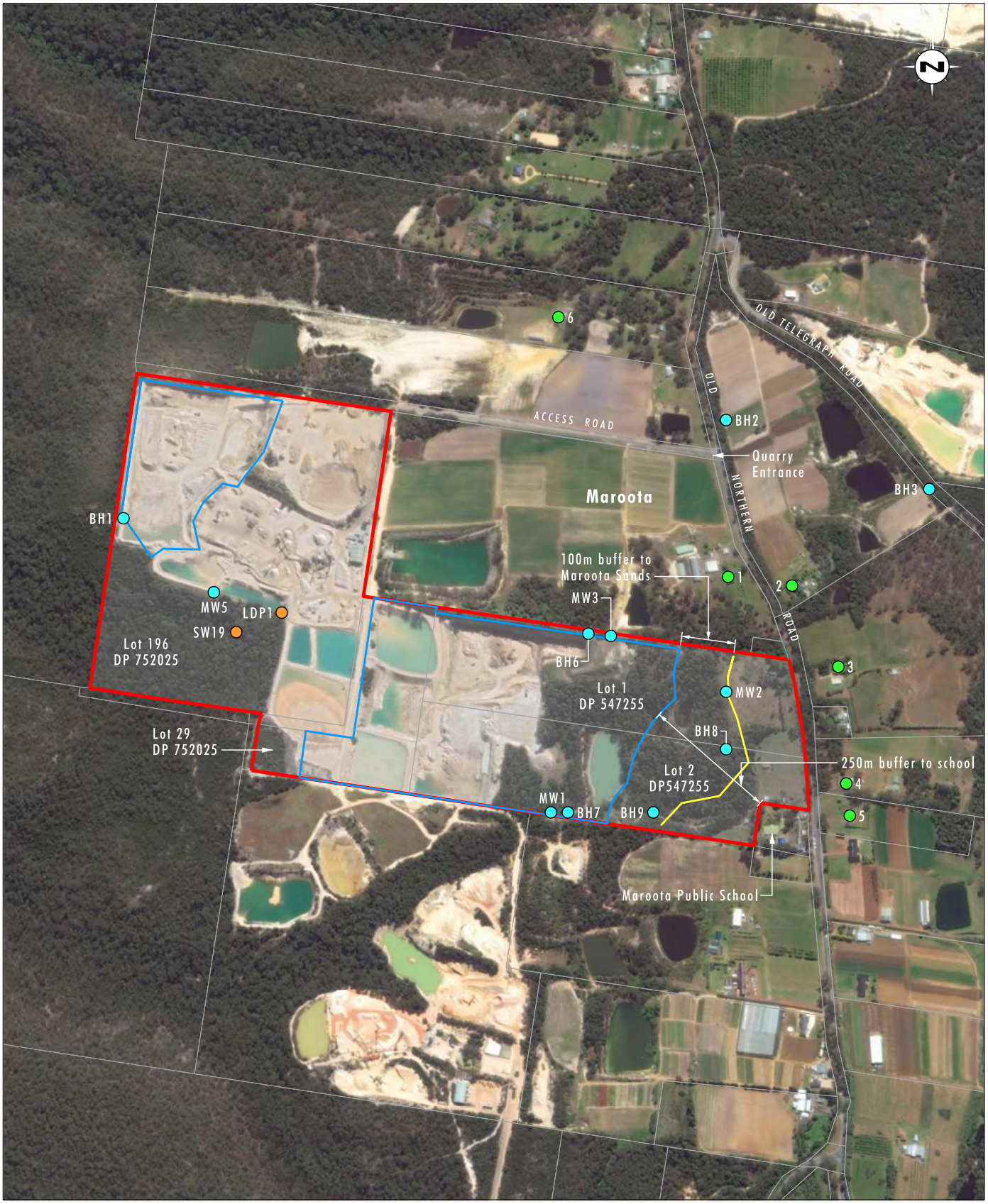


Image Source: Google Earth (2016 - 2017)
Data Source: LPI (2016)

0 100 250 500m
1:10 000

Legend

- Old Northern Road Quarry
- Approved Extraction Limits
- Limit of Maroota Tertiary Sands Groundwater Source
- Residence
- Groundwater Monitoring Bore
- Surface Water Monitoring Location

FIGURE 2.2

Surface Water and Groundwater Monitoring Locations

File Name (A4): R04/4209_008.dgn
20180209 10.26

2.2.2.4 Water Quality

Groundwater is sampled and analysed for pH and electrical conductivity (EC) for the eleven monitoring bores located in and around the quarry. **Table 2.5** presents the baseline groundwater water quality statistics with the 20th percentile and 80th percentile results being the adopted site specific trigger values with respect to groundwater water quality, calculated using long term groundwater quality results commencing 2010 to date. **Charts 2.3** to **2.6** presents the historical groundwater water quality monitoring data.

Table 2.5 Baseline Groundwater Water Quality Statistics and Trigger Values (2010 – 2020)

Monitoring Location	pH			Electrical Conductivity (µS/cm)		
	20th Percentile	50th Percentile	80th Percentile	20th Percentile	50th Percentile	80th Percentile
MW1	4.0	4.1	4.6	206	249	271
MW2	3.7	3.9	4.5	239	560	618
MW3	5.2	5.6	6.1	129	141	160
MW5	4.4	5.1	5.4	135	151	213
BH1	6.0	6.1	6.6	161	185	214
BH2	4.9	5.7	7.1	262	293	325
BH3	5.9	6.0	6.9	176	186	269
BH6	5.2	5.5	5.8	120	127	156
BH7	4.4	4.8	5.8	242	252	258
BH8	3.9	4.0	4.1	267	278	291
BH9	5.4	5.5	5.6	262	269	275

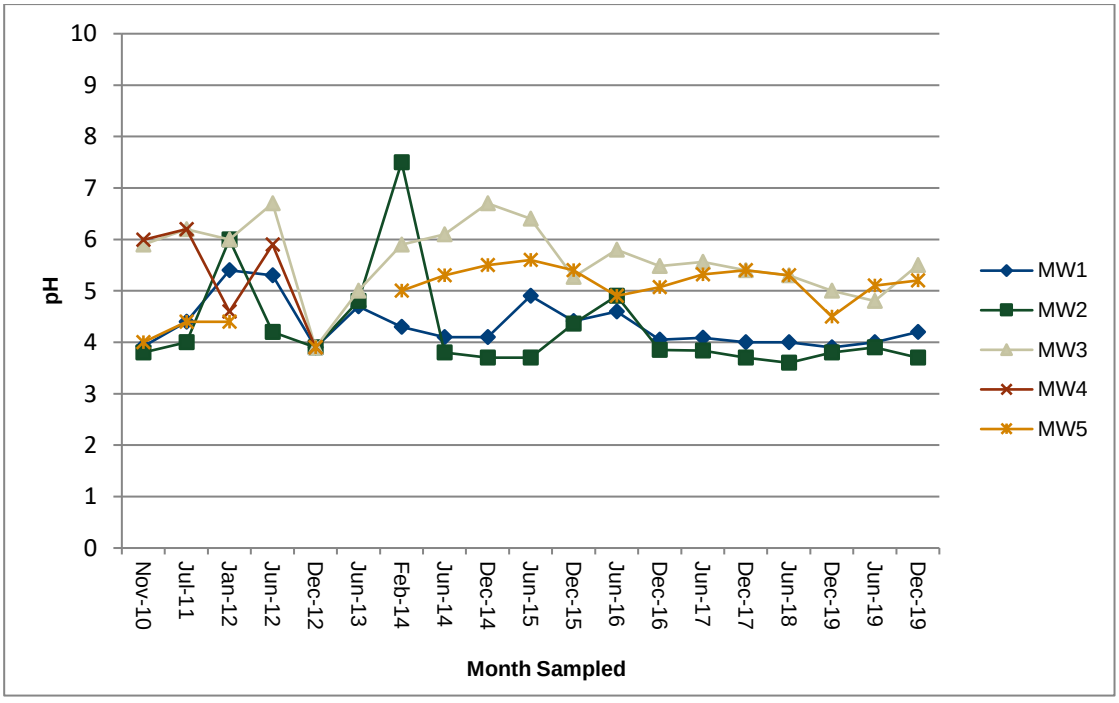


Chart 2.3 Groundwater pH, Bores MW1 to MW5

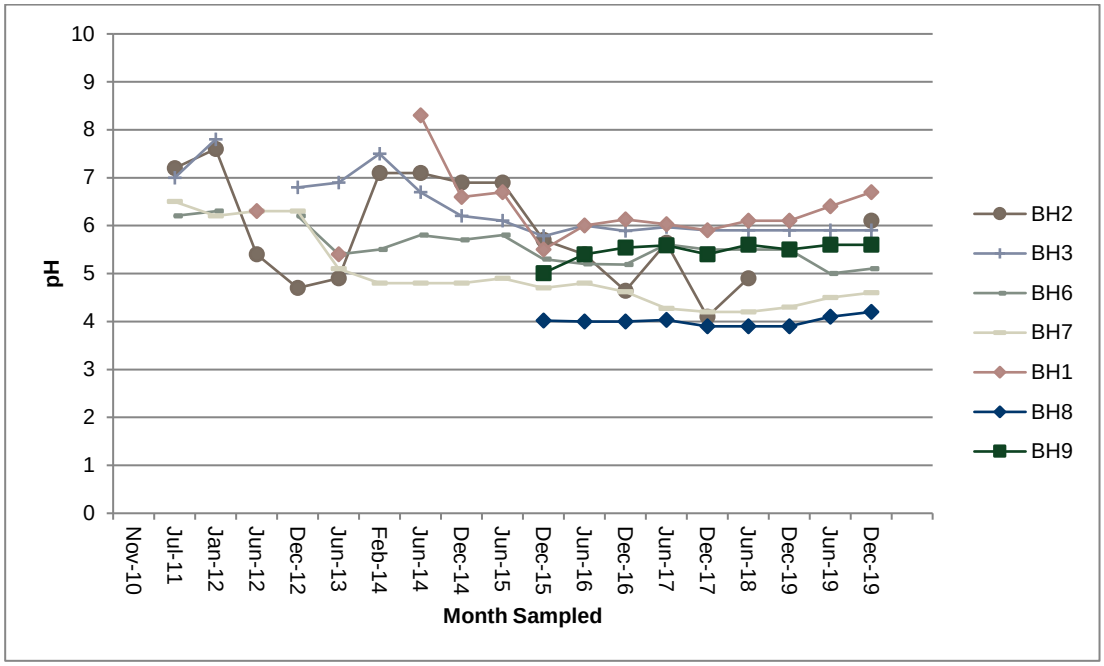


Chart 2.4 Groundwater pH, Bores BH1 to BH9

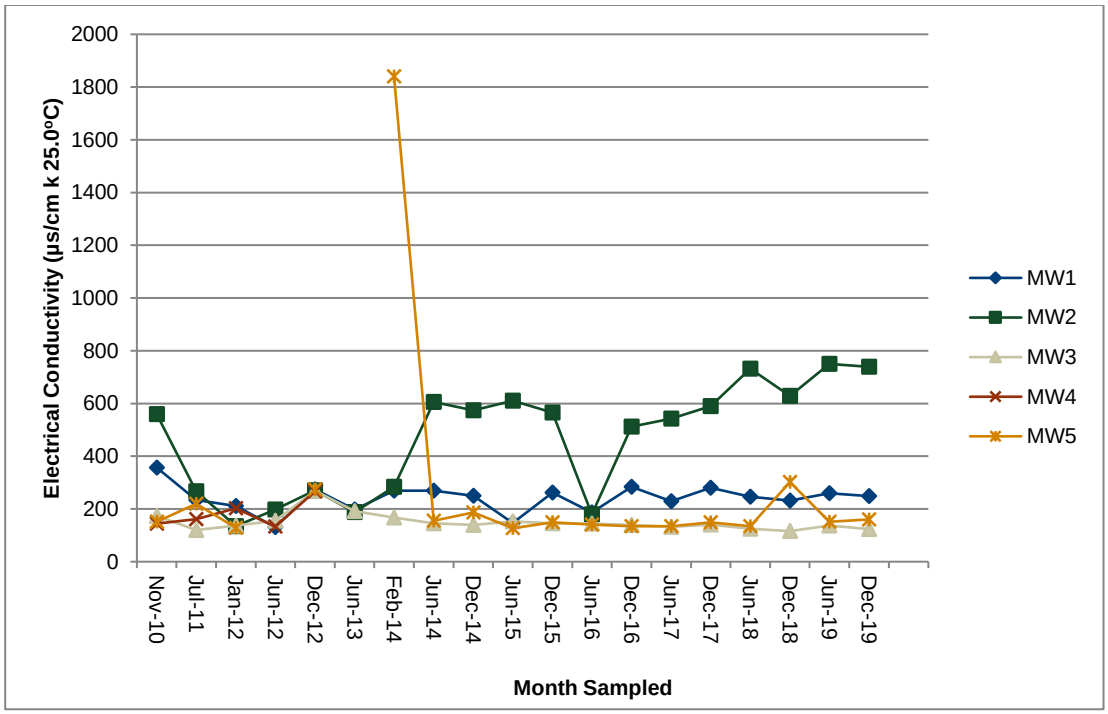


Chart 2.5 Groundwater EC, MW1 to MW5

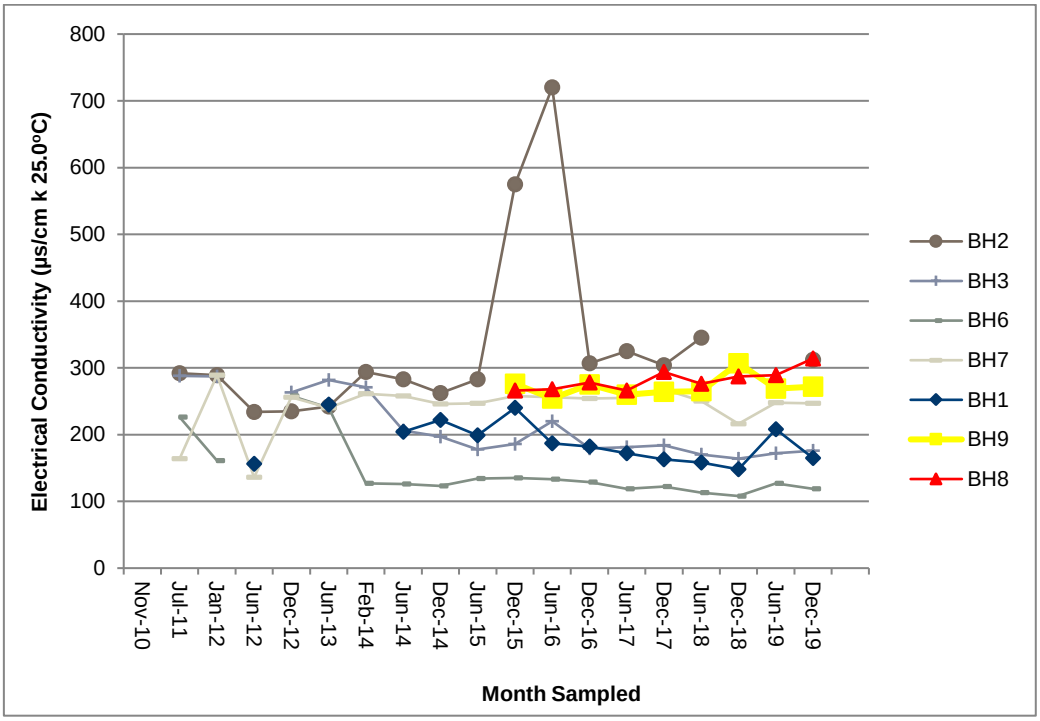


Chart 2.6 Groundwater EC, BH1 to BH9

3.0 Water Management System

3.1 Surface Water Strategy

Figure 3.1 and **Figure 3.2** present a plan and schematic of the quarry WMS respectively. **Table 3.1** presents the approximate areas of the surface water catchments (as of January 2018) that report to the quarry WMS and **Table 3.2** presents WMS water storage volumes. The overall strategy for management of runoff is to contain the runoff from the larger catchments within the extraction pits before transfer to Main Dam and Catch Ponds for reuse. Runoff in the Cons Hill catchment is retained in the Cons Hill Extraction Pit Sump while runoff from the Lots 1 and 2 Extraction Pit and the Upslope Farm is collected in the Lots 1 and 2 Extraction Pit Sump (refer to **Figures 3.1** and **3.2**). Water contained in the extractions pit sumps is transferred to the Main Dam and Catch Ponds as storage capacity becomes available. This water management strategy, combined with EPL conditions relating to discharge water quality (refer to **Section 5.1.1**) from the quarry WMS, are designed to protect the downstream receiving environment including Jacksons Swamp and the Hawkesbury River.

Seepage from intercepted perched aquifers in the Lots 1 and 2 extraction area is also transferred to the Lots 1 and 2 Extraction Pit Sump.

After high or prolonged rainfall events resulting in water levels within the extraction pits that impede sand extraction, excess water may be discharged via the quarry's LDP located on the southern side of the Channel provided water quality meets EPL discharge criteria (refer to **Section 5.0**).

This strategy minimises the requirement to discharge water from the WMS via the quarry's LDP and maximises reuse of water for sand processing, dust suppression and truck washout. Where possible, clean water runoff from upslope undisturbed catchments is directed around the quarry WMS using diversion bunds or drains.

Water for sand processing is pumped from the Channel (refer to **Figure 3.2**) to the processing plant with the majority of the pumped water (less losses to product sand moisture) returning to one of three tailings ponds located within the Lots 1 and 2 Extraction Pit. There are no chemicals added to water used for sand processing and historically there has never been a requirement to add flocculants/coagulants or pH correction chemicals (acids/alkalis) to achieve discharge water quality TSS and pH criteria. Although unlikely, any overflow from the Catch Ponds or Tailings Ponds will report to the Lots 1 and 2 Extraction Pit Sump.

Table 3.1 Quarry Catchments

Catchment	Primary Catchment Type(s)	Approximate Area as at January 2018 (ha)
Cons Hill (extraction pit, workshop, offices, processing plant and stockpiles)	Disturbed and Hardstand	17.6
Lots 1 and 2 Extraction Pit	Disturbed and Upslope Natural	9.5
Upslope Farm	Vegetated	25.7
Catch Ponds and Old Tailings Pond	Disturbed	4.1
Tailings Ponds	Disturbed	5.0
Main Dam and Channel	Disturbed	2.4

Table 3.2 Water Storage Volumes

Storage	Storage Capacity (ML)
Main Dam and Channel	7
Primary Catch Pond	26[1]
Secondary Catch Pond	13[1]
Cons Hill Extraction Pit	>300[2]
Lots 1 and 2 Extraction Pit	>500[2]

1. Volume estimated based on top of dam dimensions, 45° dam wall batters and an average depth of 5 m
2. Conservative estimate of volume based on approximate pit area and depth.

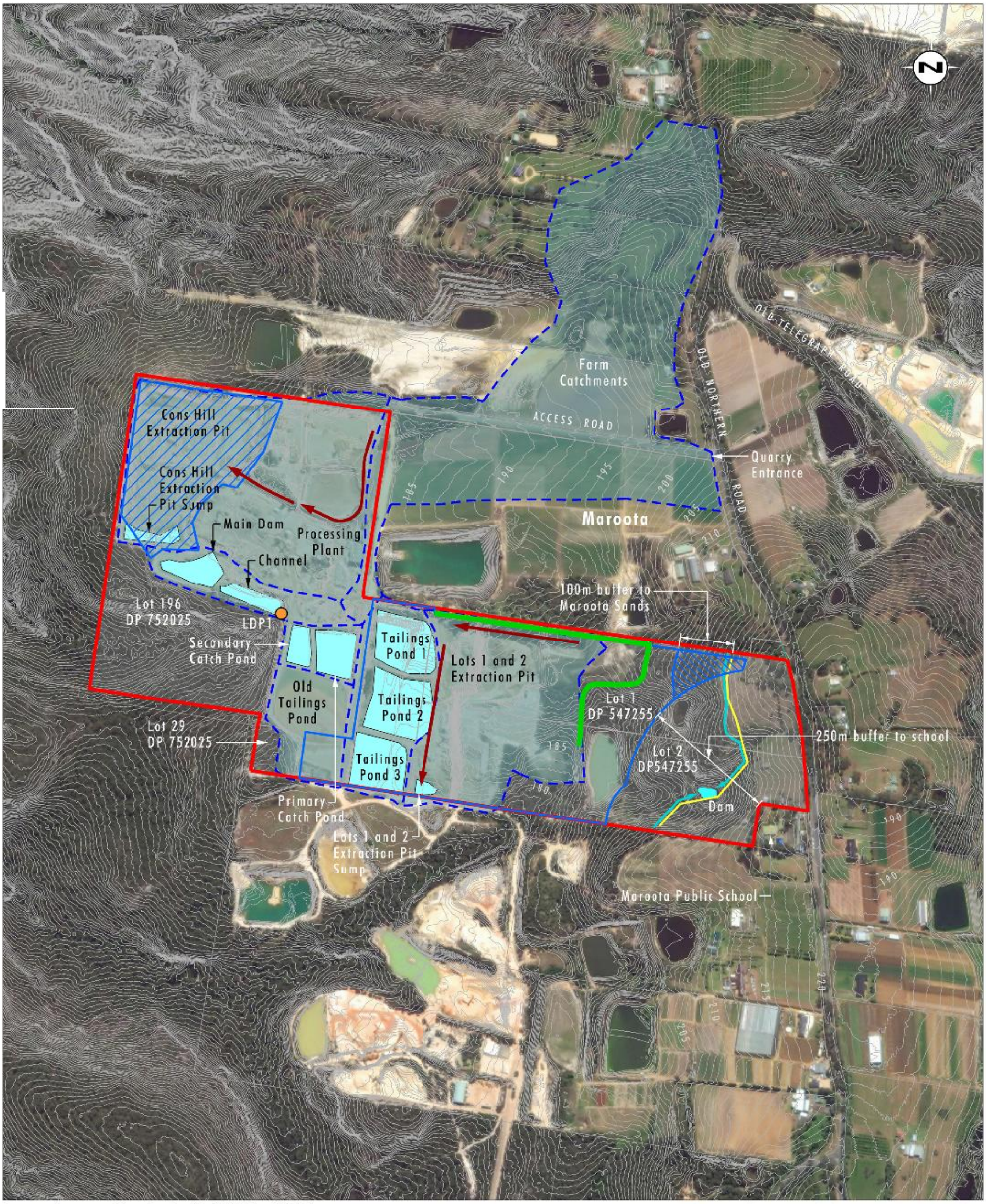


Image Source: Google Earth (2016 - 2017)
Data Sour
Note; Con

0 100 250 500m
1:10 000

Legend

- Old N
- Approv
- Extraction
- Extraction
- Limit of
- Surface
- Dirt
- Catch
- Water
- Diversion

FIGURE 3.1

File Name (A4):
20180405

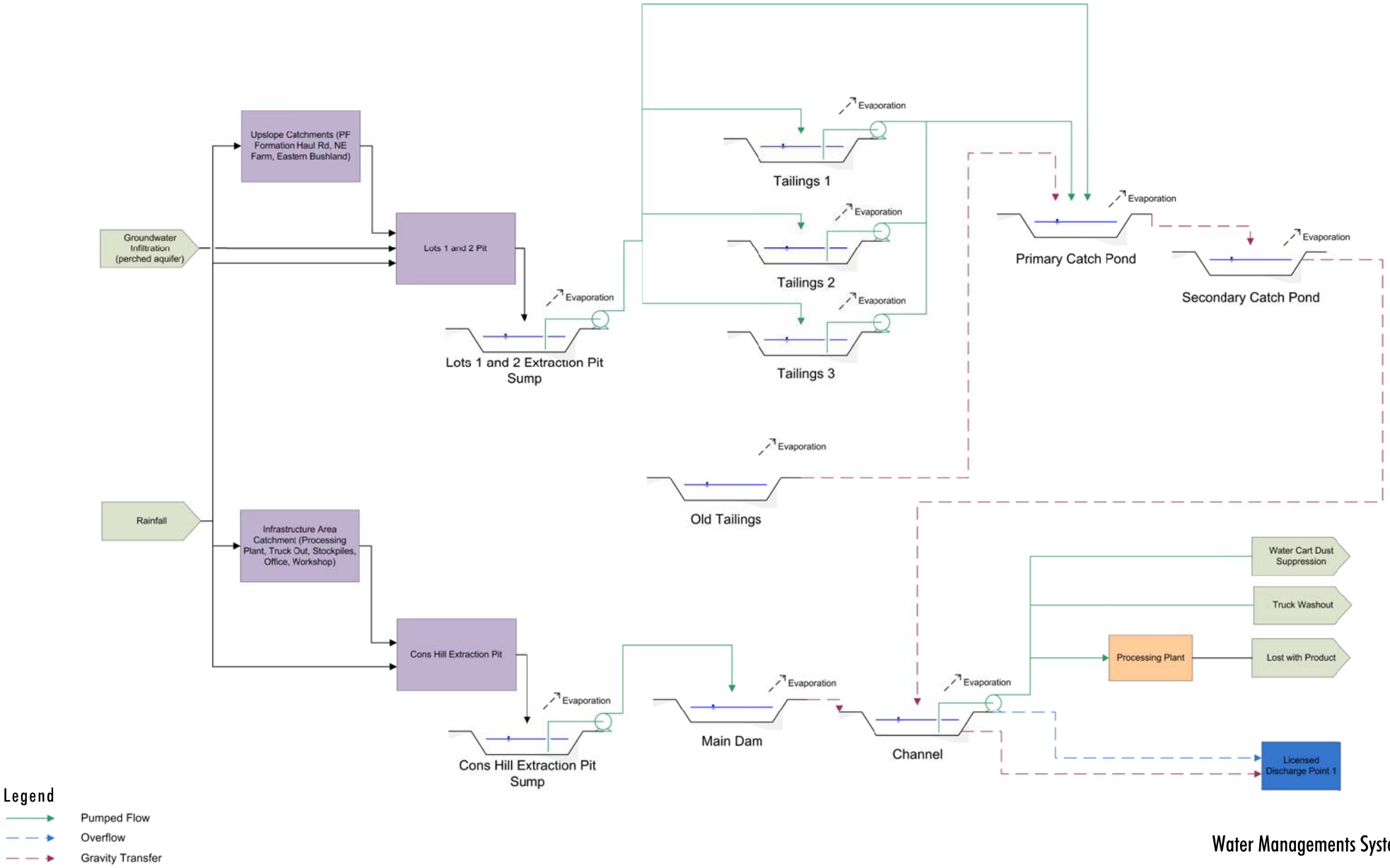


FIGURE 3.2

Water Managements System Schematic

3.2 Erosion and Sediment Control

Activities which have the potential to cause erosion and generate sediment on site include:

- Clearing and topsoil stripping ahead of quarrying operations;
- Quarrying operations, noting that the majority of quarrying areas are internally draining;
- Construction of site haul roads;
- Construction of overburden emplacement areas (i.e. placement of overburden);
- Rainfall/runoff on active work areas and overburden areas;
- Runoff flowing across the disturbed area into drains;
- Irrigation of on-site grassland areas whilst dewatering dams to achieve freeboard.

Practical erosion and sediment controls will be implemented to minimise the generation of sediment on site and transport of sediment around and off-site, as described in the following sections.

3.2.1 Soils

As indicated in the ONR 2001 EIS (ERM, 2001) the soils on site are classified as Type C soils in accordance with Chapter 6 of *Managing Urban Stormwater Volume 1* (Landcom, 2004) with 12 per cent of particles finer than 0.02 mm. As detailed in **Section 2.1.2** the soils on Lots 1 and 2 are considered highly erodible under concentrated flows. In order to minimise enhanced erosion and sedimentation erosion and sediment controls will be employed across the site in accordance with the Blue Book (Landcom, 2004) and *Volume 2E* (DECCW, 2008).

3.2.2 Sediment Basins

The Primary Catch Pond (as well as several other redundant sediment basins) was originally sized as Type C sediment control basins in accordance with the Blue Book (Landcom, 2004) for a catchment much larger than it presently services. As the present water management strategy involves containing the majority of runoff to the WMS within the extraction pits and the Catch Ponds overflow to the Lots 1 and 2 Extraction Pit Sump, the Main Dam/Channel is the only water storage that is at risk of discharge to the environment. As such, the Main Dam water level is managed to ensure suitable storage capacity is available to accommodate the runoff from the Main Dam/Channel local catchment based on the volume of runoff required to be captured for a Type C sediment basin with the following parameters:

- Particle size of 0.02 mm
- Settling zone depth of 0.6 m; and
- Length to width ratio of 3:1 or more.

The volume of runoff required to be contained, and therefore the storage capacity required in the Main Dam, is 1 ML.

3.2.3 General Erosion and Sediment Control Measures.

Water quality measures will be implemented for the quarry to minimise impact on the surrounding environment. These controls are designed and constructed to a standard consistent with:

- *Managing Urban Stormwater – Soils and Construction, Volume 1* (the Blue Book) (Landcom, 2004); and
- *Managing Urban Stormwater – Soils and Construction, Volume 2E: Mines and Quarries* (DECC, 2008).

The measures are designed to minimise erosion and transport of sediment around and off-site and include:

- Clearly identifying and delineating areas required to be disturbed and ensuring that disturbance is limited to those areas;
- clearing as little vegetation as required and minimising machinery disturbance outside of these areas;
- installing appropriate erosion and sediment controls prior to stripping topsoil or disturbing areas;
- limiting the number of roads and tracks established;
- stabilising site entry/exit points to ensure sediment is not tracked onto sealed roadways;
- construction of drains upslope of areas to be disturbed to convey clean runoff away from most disturbed areas where required;
- reshaping, topsoiling and vegetating road and cut and fill batters as soon as practical;
- construction of sediment dams where required to capture and treat runoff from disturbed catchment areas. Further details regarding construction and management of sediment dams can be found in **Section 3.2.2;**
- Diversion of surface and road runoff away from disturbed areas;
- Regular maintenance of all erosion control works and rehabilitated areas;
- Revegetation of areas as soon as practical following the completion of earthworks or operations.

3.2.3.1 Progressive erosion and sediment control plans

Progressive erosion and sediment control plans (ESCPs) will be developed in accordance with the Blue Book (Landcom, 2004) for high risk areas detailing the specific erosion and sediment controls, rehabilitation, monitoring and maintenance requirements for these areas. These progressive ESCPs will:

- Be prepared on relevant copies of drainage drawings for:
    - Different construction stages (i.e. initial clearing, grubbing, topsoil stripping and stockpiling with revision for bulk earthworks); and
    - Areas of high erosion hazard.
- Show sizing and design details for all sediment basins and erosion and sediment controls (such as diversion drains).

- Be revised when required by changing circumstances, if the site conditions change or if installed controls are not operating effectively.

- Be integrated with work procedures, construction method statements, activity statements and their scheduling.

- Be site specific and will not generally repeat the information contained in this primary ESCP.

Additional erosion and/or sediment control works will be constructed as might become necessary to ensure the desired protection is given to downslope lands and waterways, i.e. making ongoing changes to the progressive ESCPs where it proves inadequate in practice or is subjected to changes in conditions at the work site or elsewhere in the catchment.

3.2.3.2 Erosion and sediment control measure design criteria

As the duration of the disturbance at the quarry will be greater than 3 years, sediment basins will be designed to the following standard as detailed in **Table 3.3** in accordance with Landcom's *Managing Urban Stormwater Volume 2E Table 6.1* (DECC, 2008):

Table 3.3 Sediment Basin Design Criteria

Design Parameter	Design Criteria
Basin Type	"Type C" basins capable of capturing a "design particle" of 0.02 mm diameter
Design Flow	Equal to the 2 year Average Recurrence Interval (ARI) as per Table 6.1 of Volume 2E of the Blue Book (DECC, 2008).
Minimum Settling Zone Depth	0.6 metres
Length : width Ratio	>3:1
Primary Outlet	Grass or rock protection on both primary and emergency outlets to ensure minimisation of scour.
Emergency Spillway	Designed to be structurally sound in the 100 year ARI storm event.
Internal Batter Gradients	Internal batter gradients to be a maximum of: 2.5(H):1(V) on earth structures 0.5(H):1(V) on rock gibber structures 1(H):4(V) on gabion baskets 1(H):4(V) on stacked (rough squared) rock structures

To ensure the structural stability of sediment basins and sediment basin emergency spillways and to prevent seepage from the sediment basins all sediment basins should be constructed in accordance with *Appendix B – Sediment Basin Design and Operation of Best Practice Erosion and Sediment Control* (International Erosion Control Association – Australasia – Draft document revision, https://www.austieca.com.au/documents/item/697, December 2016). Particular reference should be given to Section B4 of Appendix B – Default Construction Specifications.

Existing sediment basins and dams were constructed in bedrock sandstone (low permeability) and lined with clay to minimise seepage.

Temporary drainage (erosion) (e.g. diversion banks, perimeter banks, catch drains, level spreader, check dams and batter drains and chutes) and sediment controls (e.g. sediment fences, stacked rock sediment traps etc. on small catchments where used as a 'last line of defence' (i.e. without a down slope sediment basin)) will be designed to have a non-erosive hydraulic capacity to convey the 20 year ARI storm event.

3.2.3.3 Soil and stockpile management

Ensure stockpiles of erodible material that have the potential to cause environmental harm if displaced are:

- Constructed in accordance with Standard Drawing SD 4-1 Stockpiles (The Blue Book) (Landcom, 2004)) (included in **Appendix 4**).
- Appropriately protected (for example, seeded or covered) from wind, rain, concentrated surface flow and excessive up-slope stormwater surface flows;
- constructed on the contour at least two (2) (preferably 5 m from hazard areas), particularly likely areas of concentrated water flows, e.g. roads, slopes steeper than 10% etc.;
- constructed greater than 40 m away from the top of bank of drainage lines;
- protected from run-on water by installing water diversion structures upslope; and
- formed with sediment filters placed immediately downslope to protect other lands and waterways from pollution.
- Management of topsoil stockpile with native seed banks to be undertaken in accordance with Section 5.1, Table 5.1 of the Air Quality Management Plan and Section 6.2.6 of the Biodiversity and Rehabilitation Management Plan.

3.2.3.4 Diversion Banks and Channels

A number of existing diversion banks and channels have been previously constructed to control slope lengths and to divert water to required locations. Diversion banks and channels will be implemented and maintained in accordance with the Blue Book (Landcom, 2004) and DECC, 2008 (refer to Blue Book stand drawings SD 5-5 and SD 5-6 included in **Appendix 4**). All diversion banks and channels will be constructed to remain stable whilst conveying peak discharges during a 20 year ARI storm event at less than erosive velocities for the channel construction materials.

3.2.3.5 Contour Banks and Drains

Contour banks will be installed where overland flow lengths exceed 80 m. Diversion drains will be provided at the ends of contour banking to convey stormwater to a sediment basin prior for treatment and management. All internal roads will grade to table drains which will convey flows to diversion drains.

All drains will be constructed to remain stable whilst conveying peak discharges during a 20 year ARI storm event at less than erosive velocities for the channel construction materials.

Drains may either be rehabilitated with grass species or rock armoured if required due to erosivity of flow. Catch drains will be constructed with 1:3 (v:h) side slopes or less and will be grassed or rock armoured channels. Peak velocities will generally be kept below 1.5 m/s. Where peak velocities are likely to exceed 1.5 m/s, rock bars will be placed along the drain at intervals no greater than 30 m to reduce peak velocities, or flumes will be used. In addition, where drains are used in locations where the grade of the drain is in excess of 5%, the drain is to be lined with a suitable material (refer to Table A3 of the Blue Book) to reduce the potential for erosion.

3.2.3.6 Inspections and Maintenance

Regular inspections of all disturbed areas and access tracks/roads will be undertaken to ensure drainage is working effectively and disturbed areas and tracks/roads are stable, particularly after rain. These inspections will be undertaken:

- During construction all temporary controls will be inspected:
  - Daily for high risk controls such as within drainage lines;
  - Weekly for all other controls;
  - Prior to significant forecasted rainfall events; and
  - After significant rainfall events.
- During the operational phase, monthly inspections of long-term erosion and sediment controls will be undertaken as well as inspections prior to and after forecasted rainfall events.

All erosion and sediment control measures, including drainage control measures, will be maintained in proper working order at all times during their operational lives. All erosion and sediment control measures will be maintained in a functioning condition during construction until all construction activities are completed and full stabilisation of the site is achieved (i.e. > 70% ground cover across the whole of the disturbed area within the catchment).

All sediment fences and detention systems (sediment basins) will be kept in good working condition. In particular, attention will be given to:

- Recent works to ensure that they have not resulted in diversion of sediment laden water away from them;
- Degradable products (i.e. sediment fence) to ensure they are replaced as required; and
- Sediment removal as required.

4.0 Water Balance

A daily time step water balance model was developed in GoldSim for the quarry WMS. The water balance model utilises 77 years of historical rainfall records from the Old Telegraph Rd, Maroota BoM station (Station 067014), a runoff model calibrated to the average regional runoff from undisturbed catchments in the Maroota area and average daily evaporation from the UWS Hawkesbury Campus (Station 067021) for years 1973 to 2016.

4.1 Water Sources

Water sources considered in the water balance were:

- Rainfall on water storage surfaces and runoff from catchments reporting to the quarry WMS
- Groundwater inflows from the perched aquifers encountered on Lots 1 and 2.

4.2 Water Demands and Losses

Water demands considered in the water balance are:

- Sand processing plant demands associated with water lost with product and bound with tailings
- Water cart dust suppression
- Truck Washout
- Evaporation from water storages
- Seepage from water storages.

Processing and dust suppression demands are wholly met by water captured within the Quarry WMS. The volume of clean water from undisturbed upslope catchments is minimised as much as practicable through the use of upslope catch drains (refer to **Section 3.1**) to direct clean water runoff around the Quarry WMS.

4.3 Assumptions and Bases

Following are the assumptions and bases used in the model:

- A production rate of 495,000 tonnes/year of product sand
- An extracted sand moisture content of 5% by weight
- A product sand moisture content of 6.5% by weight
- A tailings/silt content in the extracted sand of 12% by weight on a dry basis
- A tailings/silt density of 2.65 tonnes/m^3
- An emplaced tailings density of 2.4 tonnes/m^3
- An average groundwater inflow of 6 ML/year to Lots 1 and 2

- An average water cart dust suppression demand ranging from 40 kL/day in the summer to 20 kL/day in winter

- An average truck washout demand of 10 kL/day.

4.4 Results

The water balance was run for the present quarry WMS catchment. Results for the statistical 10th percentile, 50th percentile and 90th percentile gross water balance are presented in **Table 4.1**. Detailed results for the 50th percentile water balance are presented in **Table 4.2** and provide an indication of the most likely quarry inflows and demands/losses. The predicted minimum, average and maximum off-site discharges are presented in **Table 4.3**.

Table 4.1 Gross Water Balance Results (ML/year)

10th Percentile	50th Percentile	90th Percentile
-29.7	-3.9	102.3

Table 4.2 50th Percentile Year Water Balance Results

	Parameter	Result (ML)
Inflows	Rainfall and Runoff	75.6
	Groundwater	6.0
	Moisture in Extracted Sand	26.4
	Total Inflows	***107.9***
Outflows	Evaporation from Dam Surfaces	-35.8
	Seepage from Dams	-25.3
	Discharges	-0.0
	Moisture in Product	-32.0
	Bound with Tailings	-3.9
	Water Cart Losses	-11.4
	Truck Washout Losses	-3.5
	Total Outflows	***-111.8***
	Change in Storage	-3.9
	Net Water Balance	0.0

Table 4.3 Predicted Off-site Discharge Volumes (ML)

Minimum	Average	Maximum
0	0.03	1.6

Gross water balance results demonstrate that the quarry will typically operate with a neutral water balance. During dry years (e.g. 10th percentile gross water balance result) the quarry will operate with a small water deficit, however, there is adequate water storage on site to ensure water inventories are available for operational demands (sand processing, dust suppression and truck washout) is available. In the event where stored inventories are inadequate to supply operational demands, the quarry also has access to up to 20 ML per year of groundwater sourced from the two licensed bores (refer to **Section 5.2.1**).

Should surface water inflows and existing groundwater licence allocations provide insufficient water for the operations, additional licences will be sought. In the event that operational water demands cannot be met by surface water inflows and available groundwater allocations, site operations will be curtailed to match the available water supply.

During wet years (e.g. 90th percentile gross water balance result) where the quarry will operate with a water surplus, there is adequate buffer storage capacity in the extraction pits to minimise the risk of uncontrolled discharges to the environment. Should stored water from high or prolonged storm events impede sand extraction excess water with water quality meeting EPL discharge criteria (refer to **Section 5.2.1** may be discharged in a controlled manner via LDP 1).

Discharges from LDP 1 are predicted to be relatively small (refer to **Table 4.3**) in volume and infrequent. Only four discharges were predicted for the 77 years of modelled rainfall data. This is to be expected based on the quarry's approach to water management where the bulk of runoff to the WMS is contained in the extraction pits and the relatively small catchment serviced by the Main Dam which was originally constructed to service a much larger catchment. As such, discharges are only predicted to occur during extreme rainfall events provided suitable freeboard is maintained (refer to **Section 3.2**).

The water balance results are supported by site observations in which the quarry has infrequent discharges and has not experienced a shortfall of water for operational demands during 25 years of operation under Dixon Sand management.

5.0 Licensing, Monitoring and Reporting

5.1 Surface Water

5.1.1 Licences and Permits

The quarry operates under EPL 3916 which includes conditions relating to water quality discharge criteria and monitoring of discharge to waters from the quarry's licenced discharge point (LPD 1) (refer to **Figure 2.2**). **Table 5.1** presents the discharge concentration limits and discharge monitoring requirements.

Table 5.1 EPL Discharge Criteria and Monitoring Requirements

Parameter	100 Percentile Limit	Units	Monitoring
pH	4.5 – 6.5	-	Daily during any discharge
Total Suspended Solids	50	mg/L	
Turbidity	-	NTU	
Volume	-	L	Flow meter and continuous logger

Dixon Sand will consult with DoI Water prior to the commencement of operations in strip 4 on Lots 1 and 2 in order to determine whether a permit under the *Fisheries Management Act 1994* is required prior to the commencement of these works.

5.1.2 Monitoring Program

5.1.2.1 Receiving Water

Receiving water quality at monitoring location SW19 (refer to **Section 2.1.4** and **Figure 2.2**) was ceased in 2005 for safety concerns over site access, however, Dixon Sand will establish safe access to SW19 in 2018 and re-commence water quality and visual flow monitoring. Monitoring at SW19 will re-commence in June 2018 and be undertaken on a quarterly basis as follows:

- pH
- Total Suspended Solids
- Turbidity
- Flow condition – no flow, low flow, high flow

Water quality monitoring of discharges from LDP1 (refer to **Section 5.1.2.2**) is also undertaken. No significant impacts in the receiving waters are likely provided discharges are within EPL water quality criteria (refer to **Table 5.1**).

5.1.2.2 Discharges

Water quality in the Main Dam will be tested and compared to the discharge water quality criteria in EPL 3916 (refer to **Table 5.1**) prior to controlled discharges via LDP 1.

Off-site discharges via LDP 1 will be monitored in accordance with the conditions in EPL 3916 (refer to **Table 5.1**). Controlled discharges primarily occur via the weir low flow pipe which incorporates an inline flow meter. The instantaneous flow for discharges via the overflow weir is estimated by measuring the time to fill a large vessel. Total volumes discharged via the weir are estimated by multiplying the measured instantaneous flow by the total duration of overflow.

Monitoring for the concentration of the pollutant discharged to waters will be undertaken in accordance with the Approved Methods Publication - *Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales (DEC, 2004), in accordance with* the *Protection of the Environment Operations (General) Regulation 2009* as specified in Condition M3.1 of EPL 3916.

5.1.2.3 Erosion and Sediment Controls

Monitoring requirements for erosion and sediment controls are detailed **Section 3.2.3.6**.

5.1.3 Reporting

5.1.3.1 EPL

Discharge water quality and volume from LDP 1 are reported to the NSW Environment Protection Agency (EPA) in the Annual Return documents.

In the event that a discharge of water occurs with water quality outside of the 100 percentile limits (refer to **Table 5.1**) the EPA will be notified immediately by telephoning the Environmental Line service on 131 555. Written details of the notification will be provided to the EPA within seven (7) days from the date on which the incident occurred.

5.1.3.2 Annual Review

The following information relating to water management is provided in the quarry's Annual Review:

- Receiving water quality;
- Surface water discharge volumes and water quality;
- A comparison of surface water discharge volumes and water quality with historical discharge data;
- An assessment of receiving water quality monitoring results with respect to baseline water quality and potential quarry impacts; and
- Details of any complaints received in relation to surface water.

5.2 Groundwater

5.2.1 Licences

There are three groundwater access licenced for the quarry land holding (WAL 24341, 24325 and 43270) with a 260 unit share in the Sydney Basin Central Groundwater Source. This allows for the abstraction of up to 260 ML/year from two (2) bores on Lot 196.

The water usage volumes (including NIL extraction) will be reported in accordance with Water NSW's annual reporting requirement utilising the online Water Accounting System (IWAS).

The water usage volumes (including NIL extraction) will be reported in the Annual Review.

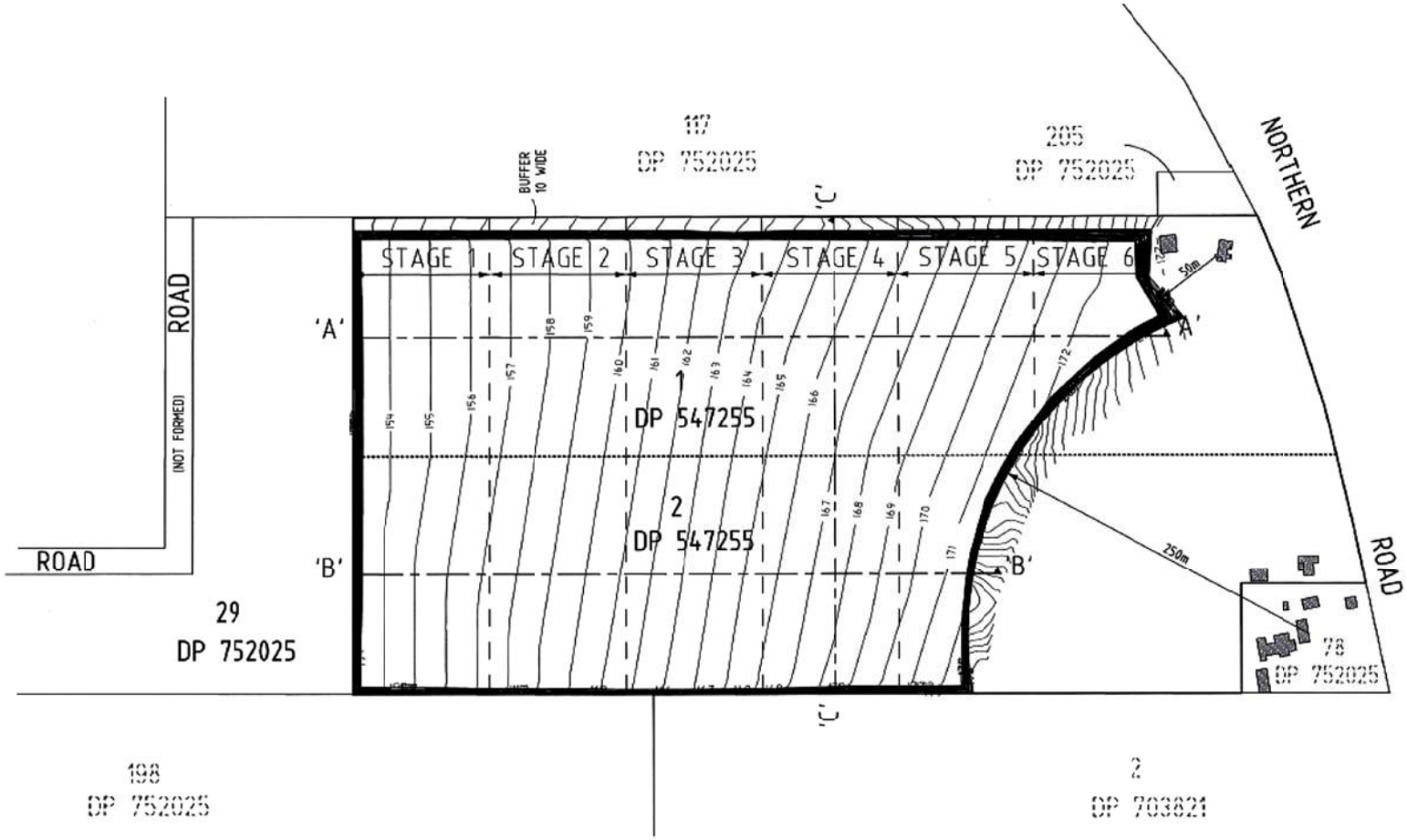
5.2.2 Monitoring Program

5.2.2.1 Extraction Levels and Water Quality

In order to ensure that the depth of extraction does not exceed the extraction limits set out in the Development Consent, a monthly visual survey from survey control points is undertaken by quarry staff during extraction, down to within 5 m of maximum extraction depth. When the extraction depth is found to be within 5 m of maximum extraction depth, professional surveyors are engaged to confirm the depth of extraction at regular intervals until maximum extraction depth is achieved. Extraction limits for Lot 196, Lot 29 and Lots 1 and 2 are summarised in **Table 5.2**.

Table 5.2 Maximum Extraction Depth Limits

Lot	Maximum Extraction Depth
196	127.5 m AHD
29	15.24 m below original ground level
1 and 2 (except within MTSGS buffer zone)	170 m AHD in the east, gradually reducing to a depth of 153 m AHD in the west as shown conceptually in **Figure 5.1**
1 and 2 (within MTSGS buffer zone)	2 m above wet weather groundwater table as per maximum extraction depth map prepared by Golder Associates (provided in **Appendix 3**).



Note:
No Survey has been made.
Contours Shown have been digitised from a plan by William Blackhouse P/L
Ref CH421BA1 & plan from Keown & Drummond P\L

0 100 200 300m

FIGURE 5.1

Lots 1 and 2 Extraction Limits

Image Source: McKinlay Morgan and Associates Pty Ltd (March 2012)

Table 5.3 presents borehole details for the quarry groundwater monitoring network (refer to **Figure 2.2**). BH 8 and BH 9 were installed in accordance with Schedule 3, Condition 15 of the development consent. Groundwater levels in these boreholes are monitored monthly. Water quality samples are collected from these boreholes on a 6-monthly basis and analysed for pH and EC. Monitoring of groundwater levels and water quality is undertaken to assist in identifying potential impacts on the groundwater source associated with sand extraction activities and ensure that sand extraction activities are maintained at least 2 m above the regional groundwater table and the MTSGS.

All monitoring equipment and bores must be maintained in satisfactory working condition and repaired or replaced to ensure the groundwater monitoring program can be implemented as detailed in this section.

Section 6.2 contains TARPs detailing the required actions to take in the event that routine groundwater monitoring identifies results outside of the baseline range. Should groundwater results fall outside of the site specific trigger values presented in **Table 2.4** or **Table 2.5** the relevant TARP in **Section 6.2** will be implemented.

Table 5.3 Groundwater Monitoring Boreholes

ID	Easting	Northing	Top of Casing (mAHD)	Ground Surface Level (mAHD)	Borehole Depth (m)	Target Aquifer
MW1	313098.7	6296497	182.98	182.6	15.5	Localised perched
MW2	313422.6	6296724.8	215.8	215.49	25.3	Localised perched
MW3	313162.2	6296833.8	196.45	195.42	33.8	Localised perched
MW5	312470.9	6296899.9	167.44	166.74	unknown[1]	Localised perched
BH1	312290.5	6297040.0	201.88	201.18	74	Sydney Basin Central Groundwater
BH2	313426.5	6297209.2	201.88	201.13	70	Sydney Basin Central Groundwater
BH3	313806.0	6297091.6	193.54	192.84	60	Sydney Basin Central Groundwater
BH6	313151.0	6296826.0	195.41	194.76	60	Sydney Basin Central Groundwater
BH7	313068.0	6296495.0	181.47	180.82	60	Sydney Basin Central Groundwater
BH8	313430.2	6296619.4	215.9	215.18	52	Maroota Tertiary Sands Groundwater
BH9	313292.5	6296502.9	196.4	195.70	80	Sydney Basin Central Groundwater

1. No record of bore hole depth

5.2.2.2 Groundwater Volumes

The volumes of groundwater pumped from the licenced bores on Lot 196 (WAL24341) are measured with inline flow meters.

5.2.3 Reporting

5.2.3.1 Annual Review

The following information relating to water management is provided in the quarry's Annual Review:

- Groundwater levels and water quality;
- A comparison of groundwater levels and water quality data with respect to historical trends;
- An assessment of groundwater levels and water quality with respect to potential quarry impacts; and
- Details of any complaints received in relation to groundwater.

The AEMR will be published on the Dixon Sand website (http://www.dixonsand.com.au/environment).

5.2.3.2 Maximum Extraction Depth Map

Dixon Sand submitted a Maximum Extraction Depth Map (contour map or similar) to DPIE on 16 February 2018 for the development, which demonstrates compliance with the extraction depth limits set out in the Development Consent in accordance with the Condition 21 of the approval requiring submission of the map within 3 months of the approval of Modification 5.

Dixon Sand must review and update the Maximum Extraction Depth Map for the development to the satisfaction of the Secretary within 3-months of the completion of any Independent Environmental Audit.

The Maximum Extraction Depth Map has been subsequently revised and resubmitted. The latest DPIE approved Maximum Extraction Depth Map is provided in **Appendix 3**.

5.2.3.3 DoI Water

Groundwater extraction volumes for WAL24341 are reported annually to DoI Water as per the licence conditions.

5.2.3.4 Incident Reporting

In the event of an incident relating to water management at the Quarry, Dixon Sand will:

- notify the Secretary (using the contact name, email address and phone number provided by the Department from time to time) and any other relevant agencies of the incident; and
- within 7 days of the date of the incident, provide the Secretary and any relevant agencies with a detailed report on the incident, and such further reports as may be requested. This report must include the time and date of the incident, details of the incident, measures implemented to prevent re-occurrence and must identify any non-compliance with this consent.

6.0 Trigger Action Response Plans

Section 6.1 contains the summary of all trigger values and criteria for water management.

Section 6.2 contains TARPs related to surface water monitoring results that are observed to be outside of the normal range. **Section 6.2** contains TARPs related to groundwater and extraction depth monitoring results that are observed to be outside of the normal range.

The procedures to be implemented in response to a water pollution incident are outlined in the Pollution Incident Response Management Plan included as Appendix 4 to the Old Northern Road Quarry Environmental Management Strategy.

6.1 Summary of Trigger Values and Criteria for Water Management

Table 6.1 All Trigger Values and Criteria for Water Management

Baseline Surface Water (SW19) Quality and Trigger Values (June 2018 to June 2020)					
Parameter	**Minimum**	**20th Percentile**	**50th Percentile**	**80th Percentile**	**Maximum**
pH	4.0	4.1	4.2	4.3	4.7
TSS (mg/L)	0.2	2.0	3.0	5.0	9.0
Turbidity (NTU)	0.1	0.2	0.2	1.1	2.2

Baseline Groundwater Level Statistics and Trigger Values (2003 – 2020)					
Monitoring Location	**Minimum**	**20th Percentile**	**50th Percentile**	**80th Percentile**	**Maximum**
MW1	173.1	176.0	177.5	178.3	180.0
MW2	191.2	194.3	199.0	200.3	202.1
MW3	173.6	175.1	177.4	178.4	180.3
MW5	158.4	162.1	162.6	162.9	164.0
BH1	106.1	106.2	106.2	107.1	107.5
BH2	162.1	165.0	165.0	166.7	167.9
BH3	158.1	160.5	161.0	161.7	162.1
BH6	161.7	164.1	164.7	165.5	166.2
BH7	157.0	160.0	160.4	161.2	162.1
BH8	189.2	189.5	189.8	189.9	190.3
BH9	157.8	161.3	163.0	163.8	164.4

Baseline Groundwater Water Quality Statistics and Trigger Values (2010 – 2020)						
Monitoring Location	**pH**			**Electrical Conductivity (µS/cm)**		
	20th Percentile	**50th Percentile**	**80th Percentile**	**20th Percentile**	**50th Percentile**	**80th Percentile**
MW1	4.0	4.1	4.6	206	249	271
MW2	3.7	3.9	4.5	239	560	618
MW3	5.2	5.6	6.1	129	141	160
MW5	4.4	5.1	5.4	135	151	213
BH1	6.0	6.1	6.6	161	185	214
BH2	4.9	5.7	7.1	262	293	325
BH3	5.9	6.0	6.9	176	186	269

BH6	5.2	5.5	5.8	120	127	156
BH7	4.4	4.8	5.8	242	252	258
BH8	3.9	4.0	4.1	267	278	291
BH9	5.4	5.5	5.6	262	269	275

EPL Discharge Criteria and Monitoring Requirements for LDP1

Parameter	100 Percentile Limit	Units	Monitoring
pH	4.5 – 6.5	-	Daily during any discharge
Total Suspended Solids	50	mg/L	
Turbidity	-	NTU	
Volume	-	L	Flow meter and continuous logger

6.2 Surface Water TARPs

Table 6.2 Receiving Water Quality TARP

Observation	Strategy for Mitigation	Monitoring	Monitoring Action	Response
Receiving water quality outside of baseline trigger values range in **Table 2.3**	Site water quality is tested prior to planned discharges. Water management strategy minimises the likelihood of off-site discharges.	SW19	Repeat water quality sampling and analysis as required and if result is confirmed increase monitoring frequency to monthly to establish trend.	• Review monthly water quality monitoring results.

Observation	Strategy for Mitigation	Monitoring	Monitoring Action	Response

Three consecutive water quality results outside of the baseline trigger value range in **Table 2.5**	Site water quality is tested prior to planned discharges.
	
	Water management strategy minimises the likelihood of off-site discharges.
		SW19	Maintain monthly monitoring until:
			• cause is identified; or
			• water quality results are confirmed not to be a result of quarry operations; or
			
			water quality results return to within the trigger value range.
				Investigate potential contributing factors:
				• Climatic conditions
				• Changes in quarry operating practises
				• Sample and analyse water quality from upslope catchments reporting to the quarry WMS (e.g. upslope farm land)
				• Assess Main Dam/Channel for excessive seepage
				• Engage a water quality specialist to undertake a preliminary investigation
				If the deviation of receiving water quality is found to be a result of Quarry operations:
				• Immediately notify the EPA, DPE and DoI Water
				• Take actions agreed in consultation with the EPA, DPE and DoI Water to mitigate the Quarry impacts on receiving water quality. Such actions may include:
				  ○ Transferring water from the Main Dam Channel to the pit
				  ○ Implementing water treatment measures to treat site water
				
				Undertake remediation of the impacted receiving environment to the satisfaction of the EPA, DPE and DoI Water

Table 6.3 Main Dam Water Quality Outside of Discharge Criteria TARP

Observation	Strategy for Mitigation	Monitoring	Monitoring Action	Response
Water in Main Dam requiring discharge is outside of the EPL water quality criteria listed in **Table 5.1**	Main Dam design criteria selected to achieve suitable TSS	Main Dam	Re-test until water quality is within the EPL water quality criteria.	The following actions may be taken to prevent or adjust Main Dam water quality and minimise the risk non-compliant discharges: • Allow additional settling time to achieve TSS criteria • Dose chemical flocculant or coagulant, recirculate stored water to ensure adequate mixing and allow settling of solids. • Dose chemical to correct pH (acid or alkali) as required and recirculate water to ensure adequate mixing. • If there is an imminent risk of an uncontrolled discharge transfer water to either the Cons Hill Pit of Lots 1 and 2 Pit for temporary storage.

Table 6.4 Discharge Water Quality TARP

Observation	Strategy for Mitigation	Monitoring	Monitoring Action	Response
Discharge water quality outside of EPL water quality criteria listed in **Table 5.1**	Water quality is tested prior to planned discharges. Water management strategy minimises the likelihood of off-site discharges.	LDP 1	Continue monitoring as required by EPL.	Stop discharge if possible by closing the valve on the low flow pipe or if discharge is via the overflow weir, transfer water from the Main Dam/Channel to other on site storages. Notify EPA immediately by telephoning the Environmental Line service on 131 555. Written details of the notification will be provided to the EPA within seven days from the date on which the incident occurred. Investigate the cause of the exceedance including: • Contributing climatic conditions • Available water storage prior to discharge • Water storage sediment levels • Contributions of sediment from upslope catchments

6.3 Groundwater TARPS

Table 6.5 Groundwater Quality TARP

Observation	Strategy for Mitigation	Monitoring	Monitoring Action	Response
Water quality result outside of the baseline trigger value range in **Table 2.5**	Sand extraction to be maintained a minimum of 2 m above the wet weather regional groundwater table and MTSGS. Maintenance of machinery to be undertaken in workshop where possible. Any spills of machinery fluids (oils, fuel, coolants) to be immediately contained and all contaminated materials removed.	M1, MW2, MW3, MW5, BH6, BH7, BH8, BH9	Repeat water quality sampling and analysis as required and if result is confirmed increase monitoring frequency to monthly to establish trend.	Review monthly water quality monitoring results.
Three consecutive water quality results outside of the baseline trigger value range in **Table 2.5**	Sand extraction to be maintained a minimum of 2 m above the wet weather regional groundwater table and MTSGS. Maintenance of machinery to be undertaken in workshop where possible. Any spills of machinery fluids (oils, fuel, coolants) to be immediately contained and all contaminated materials removed.	M1, MW2, MW3, MW5, BH 6, BH7, BH8, BH9	Maintain monthly monitoring until: • cause is identified; or • water quality results are confirmed not to be a result of quarry operations; or • water quality results return to within the trigger value range.	Investigate potential contributing factors: • Climatic conditions • Changes in quarry operating practises • Sample and analyse water quality from upslope catchments reporting to the quarry WMS (e.g. upslope farm land) • Engage a groundwater water quality specialist to undertake a preliminary investigation • Where investigations determine that impacts are the result of sand extraction activities, implement the Responsible Impacts Procedure outlined in **Section 6.2.1** below.

Table 6.6 Extraction Depth Exceedance TARP

Observation	Strategy for Mitigation	Monitoring	Monitoring Action	Response
Extraction depths measured to be below extraction limits specified in **Section 2.2.2**	Regular monitoring of extraction depth by site personnel and professional surveyors.	Extraction pit depth measurement	Professional surveyor to confirm extraction depth exceedance.	If exceedance of extraction limit confirmed immediately notify DPE If there is groundwater inflow seepage is associated with the extraction depth exceedance DoI Water should also be notified immediately Undertake remediation works as instructed by DPE and DoI Water Investigate cause of extraction limit exceedance including a review of the adequacy of extraction depth monitoring

Table 6.7 Groundwater Level TARP

Observation	Strategy for Mitigation	Monitoring	Monitoring Action	Response
Water level result outside of the baseline trigger value range in **Table 2.4**	Sand extraction to be maintained a minimum of 2 m above the wet weather regional groundwater table and MTSGS.	M1, MW2, MW3, MW5, BH1, BH 6, BH7, BH8, BH9	Repeat level measurement as required and if result is confirmed increase monitoring frequency to weekly to establish trend.	Review weekly water quality monitoring results.
Three consecutive water level results outside of the baseline trigger value range in **Table 2.4**	Sand extraction to be maintained a minimum of 2 m above the wet weather regional groundwater table and MTSGS.		Maintain weekly monitoring until: • cause is identified; or • water level results are confirmed not to be a result of quarry operations; or • water level results return to within the trigger value range.	Investigate potential contributing factors: • Climatic conditions • Engage a groundwater water quality specialist to undertake a preliminary investigation • Where investigations determine that impacts are the result of sand extraction activities, implement the Responsible Impacts Procedure outlined in **Section 6.2.1** below.

6.3.1 Responsible Impacts Procedure

Where investigations detailed in the TARP determine that groundwater impacts are the result of quarry operations or may potentially impact on adjacent bores, the following procedure is actioned:

- Inform landholders adjacent to streams and/or private bore owners, and DoI Water of preliminary investigation outcomes, as appropriate.
- Undertake a detailed investigation and assess possible mitigation measures in consultation with the landowner and DoI Water, as appropriate.
- If deemed necessary prepare and implement a site mitigation/action plan to the satisfaction of DoI, in consultation with the landowner and DoI Water, as appropriate.
- Conduct a review of results from the follow up investigation.
- Further, the timing of the above includes, but is not limited to:
    - Results of preliminary investigation reported within one week of completion.
    - Commence preparation of detailed investigation including assessment of possible mitigation measures immediately.
    - Commence preparation of mitigation/action within one week of the need being identified.

Table 6.8 Unforeseen Groundwater Inflow TARP

Observation	Strategy for Mitigation	Monitoring	Monitoring Action	Response
Excessive seepage in excess of licence limits	Regular review of monitoring data to ensure extraction is maintained a minimum of 2 m above the wet weather regional groundwater table and MTSGS.	MW1, MW2, MW3, BH6, BH7, BH8, BH9	Increase groundwater level monitoring frequency to weekly.	Review groundwater level and inflow monitoring data to: • confirm regional groundwater table and MTSGS levels (BH6 BH7, BH8 and BH9) are at least two metres below pit depth. If the regional groundwater table or MTSGS has been intercepted, cease extraction activities in the vicinity and immediately notify DoI Water. After consultation with DoI Water and undertake remedial works to the satisfaction of the Secretary • review potential cause of variation in seepage and assess whether the inflow is subject to licensing • submit application for additional groundwater licence units as required

6.4 Incident Response

Pollution incident and non-compliance response and notification are to be undertaken in accordance with Section 7.0 of the Environmental Management Strategy. Table 6.8 contains a summary of potential soil and water related incidents and their relevant approvals and licences.

Table 6.1 Summary of Potential Soil and Water related incidents

Condition	Requirement
DA 250-9-01, Schedule 3 – Specific Environmental Conditions	
Water Supply	
12.	The Applicant must 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. *Note: Under the Water Act 1912 and/or the Water Management Act 2000, the Applicant is required to obtain all necessary water licences for the development.*
Water Discharges	
13.	The Applicant must comply with the discharge limits in any EPL, or with section 120 of the POEO Act.
Groundwater Management	
17.	The Applicant must ensure that groundwater in the regional groundwater source managed under the *Water Sharing Plan for the Greater Metropolitan Groundwater Sources 2011* is not intercepted or contaminated by its operations. In the event of this groundwater being intercepted or contaminated, operations are to cease within the vicinity of the affected area and the Applicant must consult with the Secretary and DPI Water to determine the basis upon which extraction may recommence. *Note: Perched groundwater lenses that are above the regional groundwater source and are outside the MTSGS buffer zone may be intercepted however Water Access Licences must be held to account for all groundwater taken.*
18.	In the event that the regional groundwater table is intercepted by any on-site dams, the Applicant must carry out remedial works, such as backfilling to the depth of the water table, to the satisfaction of the Secretary.
EPL 3916	
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.
Notification of environmental harm	
R2.1	Notifications must be made by telephoning the Environment Line service on 131 555.
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.
	Note: The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.
Water Access Licence 24325	
Reporting	

Condition	Requirement
MW0051-00002	Once the licence holder becomes aware of a breach of any condition on this access licence, the licence holder must notify the Minister as soon as practicable. The Minister must be notified by: A. email: water.enquiries@dpi.nsw.gov.au, or B. telephone: 1800 353 104. Any notification by telephone must also be confirmed in writing within seven (7) business days of the telephone call.
Water Access Licence 24341	
Reporting	
MW0051-00001	Once the approval holder becomes aware of a breach of any condition on this approval, the approval holder must notify the Minister as soon as practicable. The Minister must be notified by: A. email: water.enquiries@dpi.nsw.gov.au, or B. telephone: 1800 353 104. Any notification by telephone must also be confirmed in writing within seven (7) business days of the telephone call.

7.0 Review and Improvement

Ongoing monitoring and review on the performance and implementation of this SWMP will be undertaken in accordance with the quarry EMS and Development Consent, which require review of the plan within 3 months of the submission of:

- An incident report under Condition 10 of the Development Consent;
- An annual review under Condition 12 of the Development Consent;
- An Independent Environmental Audit report under Condition 14 of the Development Consent; and
- Any modifications to the consent.

The quarry will notify DPE in writing of any review of this SWMP. Should a review lead to any revisions to this SWMP, the revised document will be submitted to DPE within 6 weeks of the review. Updated versions of this SWMP will be made publically available on the Dixon Sand website in accordance with Condition 15 Schedule 5 of the Development Consent.

7.1 Adaptive Management

In accordance with Schedule 5, Condition 7 of the Development Consent, Dixon Sand will assess and manage soil and water related risks to ensure compliance with the water quality objectives outlined in this plan.

Where a non-compliance or monitoring result outside the normal range relating to soil or water impact has occurred, Dixon Sand will implement the mitigation, monitoring and contingency response strategies outlined in **Section 6.0** and at the earliest opportunity:

- take all reasonable and feasible steps to ensure the exceedance ceases and does not reoccur
- consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Secretary describing those options and any preferred remediation measures or other course of action
- implement remediation measures as directed by the Secretary, to the satisfaction of the Secretary.

Following such an incident, the management and monitoring measures outlined in this plan will be reviewed to determine whether any changes are required to avoid recurrence of such an incident.

8.0 References

Australian Groundwater Technologies, 2013. *Groundwater Assessment for Dixon Sands Operation on Lot 1 and 2 – Groundwater Monitoring and Management*.

Environment Protection Authority, 2015. *NSW Environment Protection Licence 3916*.

Environmental Resources Management Australia (ERM), 2001. *Proposed Extension of Sand Extraction Operations Lots 1 and 2 DP 547255 Old Northern Road Maroota Environmental Impact Statement*.

ERM, 2004. *Dixon Sand Maroota Quarry Annual Environmental Management Plan 7 July 2003 to 6 July 2004*.

ERM, 2005. *Sand Quarry Old Northern Road, Maroota Annual Environmental Management Report 7 July 2004 to 6 July 2005*.

ERM, 2006. *Dixon Sand Quarry on Lots 29, 296, 1&2 Old Northern Road, Maroota Annual Environmental Management Report*.

International Erosion Control Association – Australasia, 2016. *Appendix B – Sediment Basin Design and Operation of Best Practice Erosion and Sediment Control* (International Erosion Control Association – Australasia – Draft document revision, https://www.austieca.com.au/documents/item/697, December 2016)

Landcom, 2004. *Managing Urban Stormwater*.

Nexus Environmental Planning Pty Ltd, 2011. *Environmental Assessment Section 75W Modification DA 250-09-01 Dixon Sand (Penrith) Pty Ltd, Old Northern Road, Maroota.*

Nexus Environmental Planning Pty Ltd, 2013. *Environmental Assessment Section 75W Modification (4) DA 250-09-01 Dixon Sand (Penrith) Pty Ltd, Old Northern Road, Maroota.*

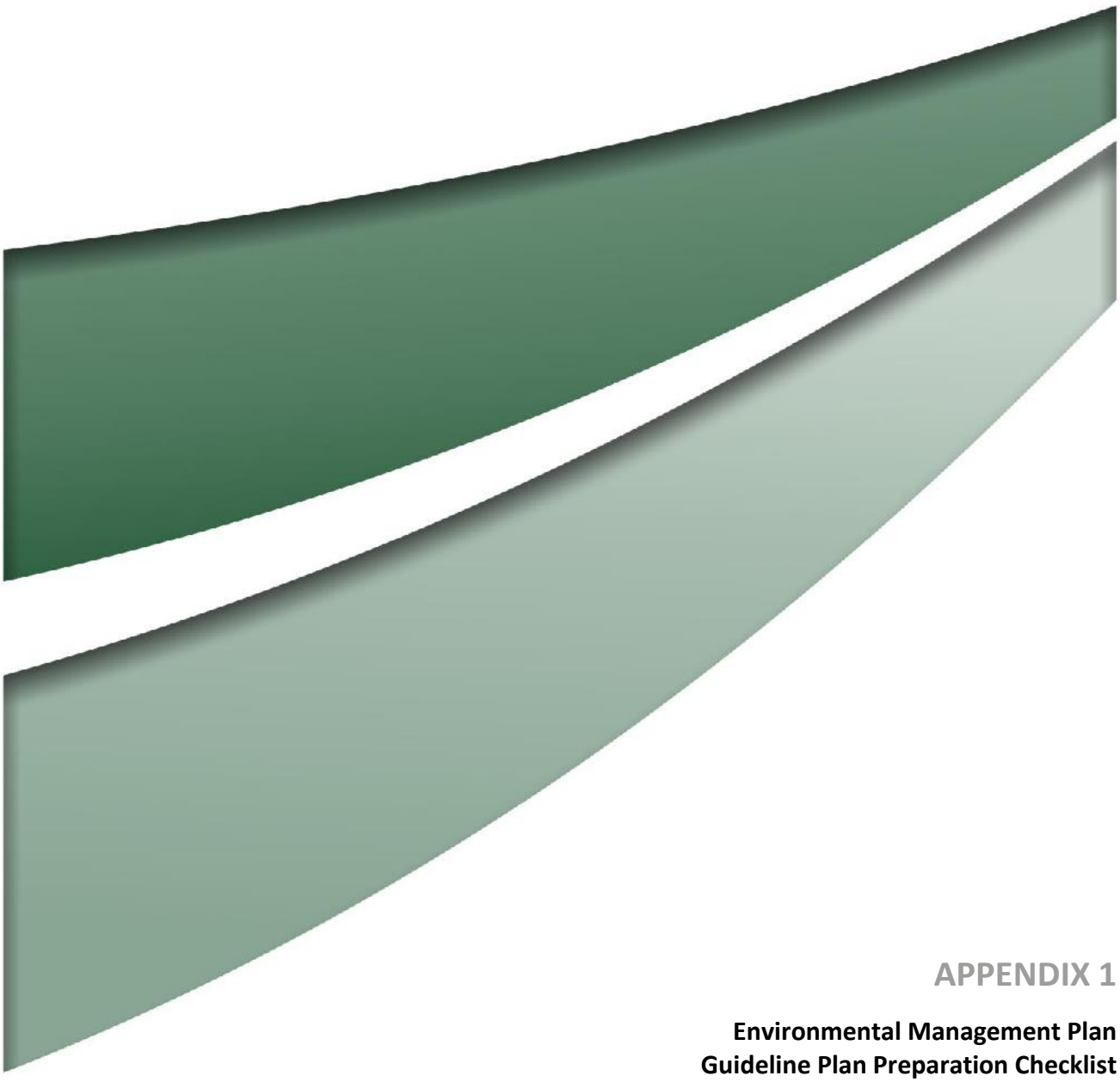
NSW Department of Planning and Environment, 2017. *Draft Environmental Management Plan Post Approval Requirements*.

Project Environmental Services, 2016. *Old Northern Road and Haerses Road Quarries, Maroota, Annual Review 2015 – 2016*.

Project Environmental Services, 2017. *Old Northern Road and Haerses Road Quarries, Maroota, Annual Review 2016 – 2017*.

Department of Environment and Conservation (NSW), 2004. *Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales.*

RPS Aquaterra, 2012. *Groundwater Assessment for Dixon Sand Operations, Lot 1 and 2 DP547255, Maroota NSW*.



APPENDIX 1

Environmental Management Plan
Guideline Plan Preparation Checklist

Appendix 1 – Plan Preparation Checklist & Certification

The Environmental Management Plan Requirements guidelines state that the following checklist must be completed and supplied to the Department with an Environmental Management Plan (EMP) and Sub-plans.

Requirement	Plan Reference	Yes/No/NA
Document preparation and endorsement		
Has the Plan been prepared in consultation with all relevant stakeholders? (Section 3.1)	Section 1.4.5 and Appendix 2	Yes
Have the views of the relevant stakeholders been taken into consideration, have appropriate amendments been made to the Plan and does the Plan clearly identify the location of any changes? (Section 3.1)	Section 1.4.5 and Appendix 2	Yes
Has the Plan been certified on behalf of the proponent? (Section 3.2)	Appendix 1	Yes
Version content		
Does the Plan include the required version control information? (Section 2.3)	Doc Status	Yes
Does the Plan reference the project description as required in Section 2.4?	Section 1.1	Yes
Does the Plan identify the components of the project to which it applies (i.e. scope)? (Section 2.5).	Section 1.2	Yes
Does the Plan describe the proponent's Environmental Management System (EMS), and identify how the Plan relates to other documents required by the conditions of consent? (Section 2.6)		NA
Does the Plan identify continuous improvements processes from the EMS that will be adopted? (Section 2.6)	Section 7.0	Yes
Does the Plan include (unaltered) all the conditions of consent to the addressed by the Plan and identify where in the Plan each requirement has been addressed? (Section 2.7.1)	Section 1.4.1	Yes
Have all other additional approvals been identified? Has appropriate information been provided regarding how each additional approval is relevant? (Section 2.7.2)	Section 1.4.3 and 1.4.4	Yes
Have all relevant guidelines, policies and standards been identified, including details of how they are relevant? (Section 2.7.3)	Section 1.5	Yes
Has the project's organisational structure been included? (Section 2.8)		NA
Are the roles and responsibilities of key positions or personnel (including any specialists required by the conditions of consent) outlined? (Section 2.8)	Section 1.3.1	Yes
Is the process that will be adopted to identify and analyses the environmental risks included? (Section 2.9)		NA
Does the Sub-plan identify the relevant sections of the EIA documents that contain the assessment of the matter/s addressed by the Plan? (Section 2.10)	Section 1.4.2 and 2.0	Yes
Have all further studies required to support mitigating measures been identified and included? (Section 2.11)	Section 1.3.2	Yes

Requirement	Plan Reference	Yes/No/NA
Have project hold points been identified and included? (Sections 2.7.2 and 2.12)	Section 1.3.3	Yes
Have all mitigation measures from conditions of consent been included unaltered? (Section 2.13)	Sections 1.4.1, 2.2.2 and 5.2.2	Yes
Have any new mitigation measures been written in committed language and all relevant information included? (Section 2.13)	Section 3.2	Yes
Have the tools that will be used to communicate Plan requirements to project personnel been included? (Section 2.14)		NA
Is an environmental inspection program described as required? (Section 2.15.1)		NA
Are relevant details of environmental monitoring that will be carried out included? (Section 2.15.2)	Section 5.1.2 and 5.2.2	Yes
Is a compliance monitoring and reporting program (or similar) referenced? (Section 2.15.3)		NA
Is an independent auditing program referenced? (Section 2.16)		NA
Are project status notification protocols that comply with conditions included? (Section 2.17.1)		NA
Does the Plan reference a Community and Stakeholder Engagement Plan (or similar) or include community and stakeholder engagement actions (if required)? (Section 2.17.2)		NA
Does the document include the incident notification and reporting protocols that comply with the relevant conditions of consent? (Section 2.17.3)		NA
Does the document identify the project person or position that is responsible for deciding whether an occurrence is an incident? (Section 2.17.3)		NA
Does the document describe corrective and preventative action protocols that address the requirements? (Section 2.18)		NA
Does the document identify training and awareness programs as required? (Section 2.19)		NA
Does the document include details of a document review and revision process that complies with the requirements? (Section 2.20)		NA
Does the document include details of public availability requirements? (Section 2.21)		NA

Plan Preparation Certification

Document Certification Form	
Project Name	Old Northern Road Quarry
Project Application Number	DA 250-09-01
Proponent	Dixon Sand Pty Ltd
Document Title	Old Northern Road Quarry Soil and Water Management Plan
Document Version	V5
Date of Issue	**5 November 2020**

Old Northern Road Quarry Soil and Water Management Plan has been prepared by Umwelt (Australia) Pty Ltd in response to conditions of consent Schedule 3 Condition 20 DA 250-09-01 for the Old Northern Road Quarry. I am authorised to and have reviewed the document on behalf of Dixon Sand (Penrith) Pty Ltd.

I certify that the Old Northern Road Quarry Soil and Water Management Plan:

- has been prepared in accordance with the relevant condition/s and the Department's Environmental Management Plan
- adequately identifies and addresses all relevant conditions of consent
- has been prepared in accordance with relevant requirements of the conditions of consent regarding
- stakeholder consultation.

Name of Certifier	**Hunny Churcher**
Position	**Environmental Officer**
Company	**Dixon Sand Pty Ltd**
Date	5 November 2020

APPENDIX 2

Agency Correspondence

Planning Services
Resource Assessments
Contact: Philip Nevill
Phone: 8275 1036
Email: philip.nevill@planning.nsw.gov.au

Ms Aleashia Kelly
Environmental Scientist
Umwelt (Australia) Pty Limited
75 York Street
Teralba NSW 2284

SENT BY EMAIL

Dear Ms Kelly,

Dixon Sand (DA 250-09-01)
Soil and Water Management Plan

I refer to your email dated 30 January 2018 requesting the Secretary's endorsement of two suitably qualified and experienced persons to prepare the updated Soil and Water Management Plan for Dixon Sand's Old Northern Road Quarry (DA 250-09-01) following its recent modification (MOD 5).

The Department has reviewed the credentials of Mr Chris Bonomini and Ms Melissa Swan of Umwelt (Australia) Pty Limited and agrees that they are suitably qualified. In accordance with condition 20(a) of Schedule 3 of the above consent, the Secretary endorses Mr Chris Bonomini and Ms Melissa Swan to prepare the updated plan.

If you wish to discuss this matter further, please contact Philip Nevill at the details listed above.

Yours sincerely

Howard Reed 31.1.18
Director Resource Assessments
as the Secretary's nominee

NSW GOVERNMENT | Planning & Environment

Planning Services
Resource Assessments
Name: Tertius Greyling
Phone: 9274 6402
Email: tertius.greyling@planning.nsw.gov.au

Ms Hunny Churcher
Environmental Officer
Dixon Sand (Penrith) Pty Ltd
4610 Old Northern Road
Maroota NSW 2756

Dear Ms Churcher

Old Northern Road Quarry (DA 250-09-01 MOD 5)
Submission of amended EMS and management plans

I refer to your correspondence dated 11 December 2017 requesting an extension for the submission of the following amended management plans as required by modification 5 of DA 250-09-01:

- Environmental Management Strategy (EMS);
- Noise Management Plan;
- Air Quality Management Plan;
- Soil and Water Management Plan;
- Traffic Management Plan; and
- Biodiversity and Rehabilitation Management Plan

The EMS and management plans have to be submitted within three months of the date of determination of the modification, ie 17 November 2017. Therefore, the due date is currently 17 February 2018. I note that your consultant is currently undertaking the work. However, due to the number of documents and the work falling over the year end period, an extension of one month has been requested.

The Department is not able to grant your request for an extension for submission of the EMS, as there is no power in condition 1 of Schedule 5 to do so. On the other hand, the conditions that govern submission of the management plans do permit extensions. Accordingly, an extension for the submission of the management plans is granted until 17 March 2017. You are advised to finalise preparation of the EMS and submit it for the Secretary's approval as soon as possible, and in any case no later than 17 March 2018.

Should you have any questions about this letter, please contact Tertius Greyling at the details above.

Yours sincerely

JEvans 10/01/2018

Jessie Evans
A/Director
Resource Assessments
As nominee of the Secretary

DOC18/140884-02
Your Ref.

Ms Gabrielle Allan
Principal Environmental Consultant
Umwelt Australia Pty Ltd
75 York Street
TERALBA NSW 2284

Dear Ms Allan

Consultation of Quarry Soil & Water Draft Management Plan for Old Northern Road Quarry for Dixon Sand Pty Ltd

I refer to your request for consultation of the draft Soil and Water Management Plan (SWMP) for Old Northern Road Quarry located at Old Northern Road, Maroota NSW, which was received via email by the Environment Protection Authority (EPA) on 1 March 2018.

Based on the information provided in the draft SWMP, the EPA identifies the following information be included in the SWMP:

- With regard to the sediment basin design criteria specified in Table 3.3 of the draft SWMP, please give details of material specifications to ensure the stability of bund walls and that sediment water contained will not infiltrate the ground in sediment basins;
- also with regard to Table 3.3, which states that the emergency spillway will be designed to be structurally sound for the 100- year ARI storm event, please give details of the material specification and construction to achieve this;
- specify the measures proposed in the event of dirty construction/operational water (e.g. water in the main dam) and/or water to be discharge offsite exceeded the water quality criteria specified in the environmental protection licence EPL 3916; and
- As runoff and discharges from the quarry site flow to Jackson Swamp, a freshwater floodplain at the Hawksbury River approximately 2 km north west of the quarry, please specify measures to ensure that any discharges that flows from the quarry will not affect the wetland species of significance in the Hawkesbury area.

The draft SWMP stated that there were development consent conditions that were set under development approval DA250-09-01 and EPL 3916 relating to buffer zones, maximum extraction depths, water supply, water discharges, ground water management and soil and water management.

This leads the EPA to conclude that substantial soil and water conditions have been put in place under the licences. The EPA encourages the proponent to implement the draft SWMP. In the future, the EPA may call upon the proponent at any time to produce relevant documentation demonstrating that all management plans in place are being applied.

Phone 131 555
Phone +61 2 9995 5555 (from outside NSW)
Fax +61 2 9995 5999
TTY 133 677
ABN 43 692 285 758
PO Box 668 Parramatta NSW 2124 Australia
L13, 10 Valentine Ave Parramatta NSW 2150 Australia
info@epa.nsw.gov.au
www.epa.nsw.gov.au

If you have any questions relating to this matter, please contact Lilian De Torres on (02) 9995 5059 or Lilian.DeTorres@environment.nsw.gov.au.

Yours sincerely

Mark Carey
Acting Unit Head – Sydney Industry
Environment Protection Authority

15 March 2018

From: Gabrielle Allan
To: "water.referrals@dpi.nsw.gov.au"
Subject: FW: 4209: Old Northern Road Quarry Maroota - Draft Soil and Water Management Plan
Date: Monday, 16 April 2018 10:00:00 AM

Good morning,

I refer to the draft Soil and Water Management Plan for Old Northern Road Quarry provided to DoI Water for review on 1 March 2018.

We are in the process of finalising this report for submission to the Department of Planning and Environment by Monday 23 April 2018. Could you please confirm whether DoI Water will be providing any comment on the draft plan prior to its finalisation? If so, it would be appreciated if any comments could be received by Wednesday 18 April to enable these comments to be integrated into the plan prior to submission.

Kind regards

Gabrielle Allan
Principal Environmental Consultant

Umwelt (Australia) Pty Limited
75 York Street
Teralba, NSW 2284

Phone: (02) 4950 5322
Mobile: 0448 936 029

My regular working days are Monday, Wednesday and Friday. In my absence, please contact John Merrell on jmerrell@umwelt.com.au or 02 4950 5322, otherwise I will respond on my return.

www.umwelt.com.au

Inspired People | Dedicated Team | Quality Outcomes

Newcastle ph. 02 4950 5322 | **Perth** ph. 08 6260 0700 | **Canberra** ph. 02 6262 9484 | **Sydney** ph. 1300 793 267 | **Brisbane** ph. 1300 793 267

From: landuse.enquiries@dpi.nsw.gov.au [mailto:landuse.enquiries@dpi.nsw.gov.au]
Sent: Monday, 5 March 2018 2:52 PM
To: Gabrielle Allan
Subject: RE: 4209: Old Northern Road Quarry Maroota - Draft Soil and Water Management Plan

Thanks Gabrielle,

Your correspondence has been forwarded to the Water Regulation team for their dealing. You can contact them for any further enquiries at water.referrals@dpi.nsw.gov.au

Kind Regards,

Adam Oehlman | Project Support Officer
Cabinet and Legislation Services
NSW Department of Industry | Lands & Water | Strategy and Policy
Level 49 | 19 Martin Place | Sydney NSW 2000
T: +61 2 9934 0805
E: adam.oehlman@dpi.nsw.gov.au
W: www.industry.nsw.gov.au

From: Gabrielle Allan [mailto:gallan@umwelt.com.au]
Sent: Thursday, 1 March 2018 5:14 PM
To: adam.oehlman@dpi.nsw.gov.au
Cc: Environment
Subject: 4209: Old Northern Road Quarry Maroota - Draft Soil and Water Management Plan

Hi Adam,

Your contact details have been provided by Tertius Greyling at the Department of Planning and Environment in relation to consultation on draft management plans for the Old Northern Road Quarry at Maroota.

Dixon Sand (Penrith) Pty Ltd operates the Old Northern Road Quarry, a sand extraction and processing operation, located on Old Northern Road, Maroota in New South Wales. A recent modification to the quarry's development consent (DA 250-09-01 MOD 5) requires a Soil and Water Management Plan to be prepared for the quarry in consultation with DPI Water. We forward the following draft plan on behalf of Dixon Sand and request your review and any comments on the plan by **Wednesday 14 March**. The plan can be downloaded via the following link:

https://umwelt.sharefile.com/d-s35b6297e83041b5a

A copy of the development consent and associated environmental impact assessment documentation can be found on the Department of Planning website at http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=8309

If you require any further information, please contact myself or Hunny Churcher of Dixon Sand on 0405 844 207.

Kind regards

Gabrielle Allan
Principal Environmental Consultant

Umwelt (Australia) Pty Limited
75 York Street
Teralba, NSW 2284

Phone: (02) 4950 5322
Mobile: 0448 936 029

My regular working days are Monday, Wednesday and Friday. In my absence, please contact John Merrell on jmerrell@umwelt.com.au or 02 4950 5322, otherwise I will respond on my return.

www.umwelt.com.au

Gabrielle Allan

From: Gabrielle Allan
Sent: Wednesday, 2 May 2018 6:39 PM
To: marie.schildt@dpi.nsw.gov.au
Subject: FW: FW: 4209: Old Northern Road Quarry Maroota - Draft Soil and Water Management Plan

Hi Marie,

I'm following up on the Old Northern Road Quarry draft Soil and Water Management Plan, which I understand from the email below has been forwarded to you for review.

Are you able to confirm whether DoI Water will be providing any comment on the plan, and if so, the likely timing of comments? The Department of Planning and Environment is keen to understand whether DoI Water will be making any comment prior to approving the plan.

Kind regards
Gabby

Gabrielle Allan
Principal Environmental Consultant

Umwelt (Australia) Pty Limited
75 York Street
Teralba, NSW 2284

Phone: (02) 4950 5322
Mobile: 0448 936 029

My regular working days are Monday, Wednesday and Friday. In my absence, please contact John Merrell on jmerrell@umwelt.com.au or 02 4950 5322, otherwise I will respond on my return.

www.umwelt.com.au

Inspired People | Dedicated Team | Quality Outcomes

Newcastle ph. 02 4950 5322 | **Perth** ph. 08 6260 0700 | **Canberra** ph. 02 6262 9484 | **Sydney** ph. 1300 793 267 | **Brisbane** ph. 1300 793 267

From: joanna.pajkowska@dpi.nsw.gov.au [mailto:joanna.pajkowska@dpi.nsw.gov.au] **On Behalf Of** Water Referrals
Sent: Wednesday, 18 April 2018 4:48 PM
To: Gabrielle Allan
Cc: Marie Schildt; Irene Zinger
Subject: Re: FW: 4209: Old Northern Road Quarry Maroota - Draft Soil and Water Management Plan

Hello Gabrielle

Unfortunately DoI-Water has not been able to prepare advice on the draft Soil and Water Management Plan for Old Northern Road Quarry due to severe staff shortages.

This matter has been now re-assigned to Marie Schildt, Water Regulation Officer who will be in touch shortly to advise of the expected delivery date of DoI-Water's comments. Marie can be also contacted on 02 9842 8640.

Apologies for delay in our advice on this matter.

Best regards
Joanna Pajkowska

Water Referrals

Lands & Water Division | Department of Industry
10 Valentine Avenue | Parramatta NSW 2150 | Locked Bag 5123 | Parramatta NSW 2124
P: 1800 353 104 E: water.referrals@dpi.nsw.gov.au
W: www.water.nsw gov.au | www.industry.nsw.gov.au

Requests for review or comment on reports or specific projects can be sent directly to water.referrals@dpi.nsw.gov.au for action.

On 16 April 2018 at 10:00, Gabrielle Allan <gallan@umwelt.com.au> wrote:

Good morning,

I refer to the draft Soil and Water Management Plan for Old Northern Road Quarry provided to DoI Water for review on 1 March 2018.

We are in the process of finalising this report for submission to the Department of Planning and Environment by Monday 23 April 2018. Could you please confirm whether DoI Water will be providing any comment on the draft plan prior to its finalisation? If so, it would be appreciated if any comments could be received by Wednesday 18 April to enable these comments to be integrated into the plan prior to submission.

Kind regards

Gabrielle Allan
Principal Environmental Consultant

Umwelt (Australia) Pty Limited
75 York Street
Teralba, NSW 2284

Phone: (02) 4950 5322
Mobile: 0448 936 029

My regular working days are Monday, Wednesday and Friday. In my absence, please contact John Merrell on jmerrell@umwelt.com.au or 02 4950 5322, otherwise I will respond on my return.

www.umwelt.com.au

Inspired People | Dedicated Team | Quality Outcomes

Newcastle ph. 02 4950 5322 | **Perth** ph. 08 6260 0700 | **Canberra** ph. 02 6262 9484 | **Sydney** ph. 1300 793 267 | **Brisbane** ph. 1300 793 267

From: landuse.enquiries@dpi.nsw.gov.au [mailto:landuse.enquiries@dpi.nsw.gov.au]
Sent: Monday, 5 March 2018 2:52 PM
To: Gabrielle Allan
Subject: RE: 4209: Old Northern Road Quarry Maroota - Draft Soil and Water Management Plan

Thanks Gabrielle,

Your correspondence has been forwarded to the Water Regulation team for their dealing. You can contact them for any further enquiries at water.referrals@dpi.nsw.gov.au

Kind Regards,

Adam Oehlman | Project Support Officer

Cabinet and Legislation Services
NSW Department of Industry | Lands & Water | Strategy and Policy
Level 49 | 19 Martin Place | Sydney NSW 2000
T: +61 2 9934 0805
E: adam.oehlman@dpi.nsw.gov.au

W: www.industry.nsw.gov.au

From: Gabrielle Allan [mailto:gallan@umwelt.com.au]
Sent: Thursday, 1 March 2018 5:14 PM
To: adam.oehlman@dpi.nsw.gov.au
Cc: Environment
Subject: 4209: Old Northern Road Quarry Maroota - Draft Soil and Water Management Plan

Hi Adam,

Your contact details have been provided by Tertius Greyling at the Department of Planning and Environment in relation to consultation on draft management plans for the Old Northern Road Quarry at Maroota.

Dixon Sand (Penrith) Pty Ltd operates the Old Northern Road Quarry, a sand extraction and processing operation, located on Old Northern Road, Maroota in New South Wales. A recent modification to the quarry's development consent (DA 250-09-01 MOD 5) requires a Soil and Water Management Plan to be prepared for the quarry in consultation with DPI Water. We forward the following draft plan on behalf of Dixon Sand and request your review and any comments on the plan by **Wednesday 14 March**. The plan can be downloaded via the following link:

https://umwelt.sharefile.com/d-s35b6297e83041b5a

A copy of the development consent and associated environmental impact assessment documentation can be found on the Department of Planning website at http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=8309

If you require any further information, please contact myself or Hunny Churcher of Dixon Sand on 0405 844 207.

Kind regards

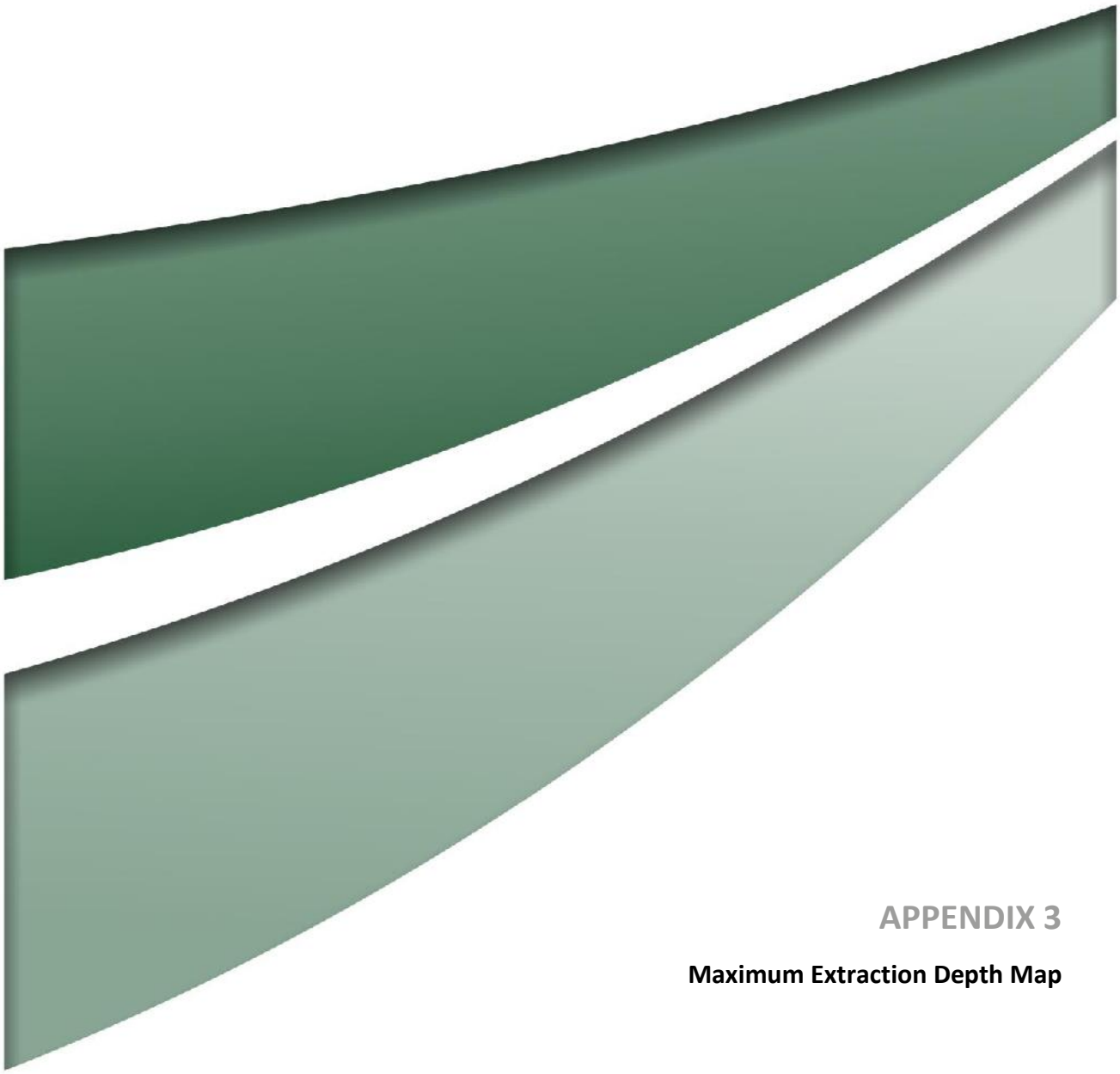
Gabrielle Allan
Principal Environmental Consultant

Umwelt (Australia) Pty Limited
75 York Street
Teralba, NSW 2284

Phone: (02) 4950 5322
Mobile: 0448 936 029

My regular working days are Monday, Wednesday and Friday. In my absence, please contact John Merrell on jmerrell@umwelt.com.au or 02 4950 5322, otherwise I will respond on my return.

This message is intended for the addressee named and may contain confidential information. If you are not the intended recipient, please delete it and notify the sender. Views expressed in this message are those of the individual sender, and are not necessarily the views of their organisation.



APPENDIX 3

Maximum Extraction Depth Map

30 March 2020 Project No. 1780381-L006-Rev0

Hunny Churcher
Dixon Sand Pty Ltd

EXTRACTION DEPTH FOR DA 250-09-01 MOD 5

Introduction

Dixon Sand Pty Ltd (Dixon Sand) operates the Old Northern Road Quarry, Maroota. The site covers 58.4 ha and includes extraction on Lot 29 DP752025, Lot 196 DP752025, Lot 1 and Lot 2 DP547255 (Figure 1).

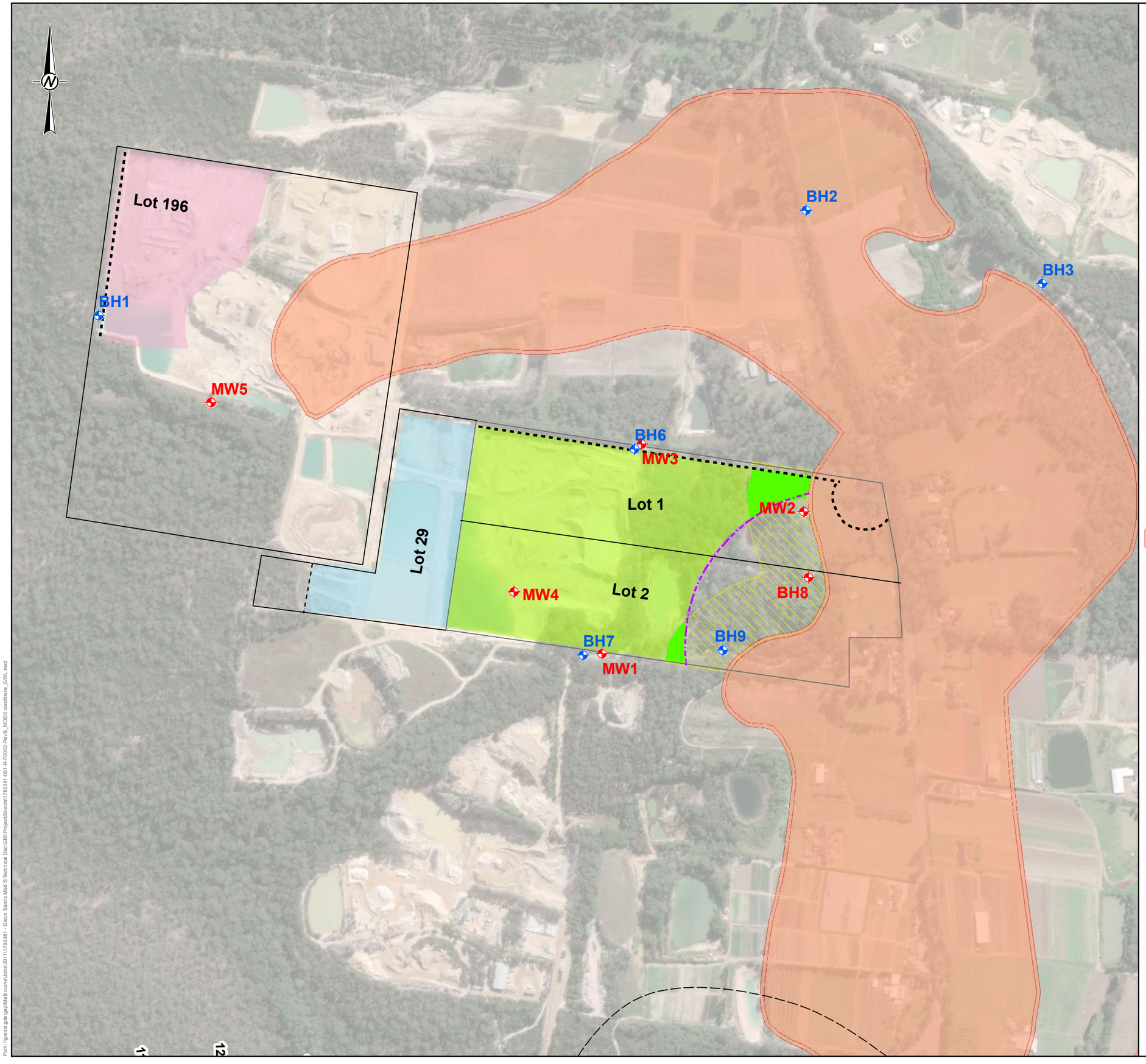
The Old Northern Road DA250-09-01 Mod 5 was approved on 17th November 2017, Dixon Sand is required to submit a revised Maximum Extraction Depth Map which is based on the *wet weather groundwater elevation* and is determined by the quarry groundwater monitoring network. The Maximum Extraction Depth Map was approved on 3rd July 2018.

An Independent Environmental Audit was completed and the report submitted in January 2020. Condition 23 of Schedule 2 of DA 250-09-01 MOD 5 states that the a review and update of the Maximum Extraction Depth Map for the development is to be undertaken within 3 months of the completion of the Independent Environmental Audit, to the satisfaction of the Secretary. This review and revision of the Maximum Extraction Depth Map is undertaken to fulfil the above requirement.

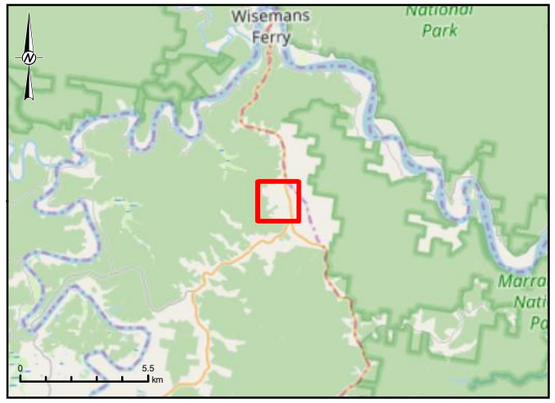
The extraction areas are within Lot 196, Lots 1 and 2 and Lot 29 (Figure 1). Extraction depths outside of the MTSGS buffer zone are restricted to 2 m above the *wet weather elevation* of the Sydney Basin Central Groundwater Source (SBCGS), whilst extraction within the MTSGS buffer zone is restricted to 2 m above the *wet water level of the perched zone* in the upper weathered portion of the SBCGS. There are buffer zones that prohibit extraction but these a related to land uses rather than for hydrogeological purposes.

Golder
118 Franklin Street Adelaide, South Australia 5000 Australia T: +61 8 8213 2100 | F: +61 8 8213 2101

A.B.N. 64 006 107 857



LOCATION MAP



Legend

- SBCGS Monitoring Bore
- Perched GW Monitoring Bore
- Boundary buffers
- Maroota public school buffer
- Property boundary
- Lot 29 Extraction area
- Lot 1 and 2 Extraction area within MTSGS buffer
- Lot 1 and 2 Extraction area outside MTSGS buffer
- NW Pit extaction area
- MTSGS (Etheridge 1980)
- MTSGS Buffer Zone (100m)

COPYRIGHT

1. Aerial image and basemaps sourced from ArcGIS Online.
2. Roads data sourced from MapInfo Street Pro.

0 100 200 300 400
METRES

REFERENCE SCALE: 1:6,000 (at A3)

PROJECTION: GDA 1994 MGA Zone 56

CLIENT
DIXON SAND (PENRITH) PTY LTD

PROJECT
GROUNDWATER ASSESSMENT:

TITLE
SITE PLAN

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-30
PREPARED	GB
DESIGN	-
REVIEW	JA
APPROVED	JA

PROJECT No.	CONTROL	Rev.	FIGURE
1780381	001-R	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A3 25mm 0

Path: \\golder.gds\gaa\Melbourne\Jobs\2017\1780381 - Dixon Sands Mod 5\Technical Doc\GIS\Project\Sketch\1780381-001-R-F0002-RevB_MOD5 conditions_GWL.mxd

The following consent conditions apply to the extraction areas on Lot 196, 29, 1 and 2 (Figure 1).

- Condition 17 of Schedule 2: Extraction below a depth of 15.24 m below original ground level is restricted to Lot 196 DP 752025 within the shaded area shown in Appendix 2 of DA 250-09-01 (see Figure 1 of this document) and to a depth not greater than 127.5 m AHD.
- Condition 18 of Schedule 2: Extraction on Lot 29 DP 752025 is limited to a depth not greater than 15.24 m below original ground level.
- Condition 19 of Schedule 2: Extraction on Lots 1 and 2 DP 547255, with the exception of the MTSGS buffer zone, is limited to a depth not greater than 170 m AHD in the east, gradually reducing to 153 m AHD in the west, and as shown conceptually in the figure in Appendix 4 of DA 250-09-01.
- Condition 20 of Schedule 2: The Applicant must ensure that no extraction occurs with 2 m of the highest recorded wet weather groundwater level within the MTSGS buffer zone.

Groundwater Elevation and Extraction Depth

The wet weather groundwater level of the SCBGS was calculated based on the maximum water level reached following a 50 mm rainfall event in a 24 hour period.

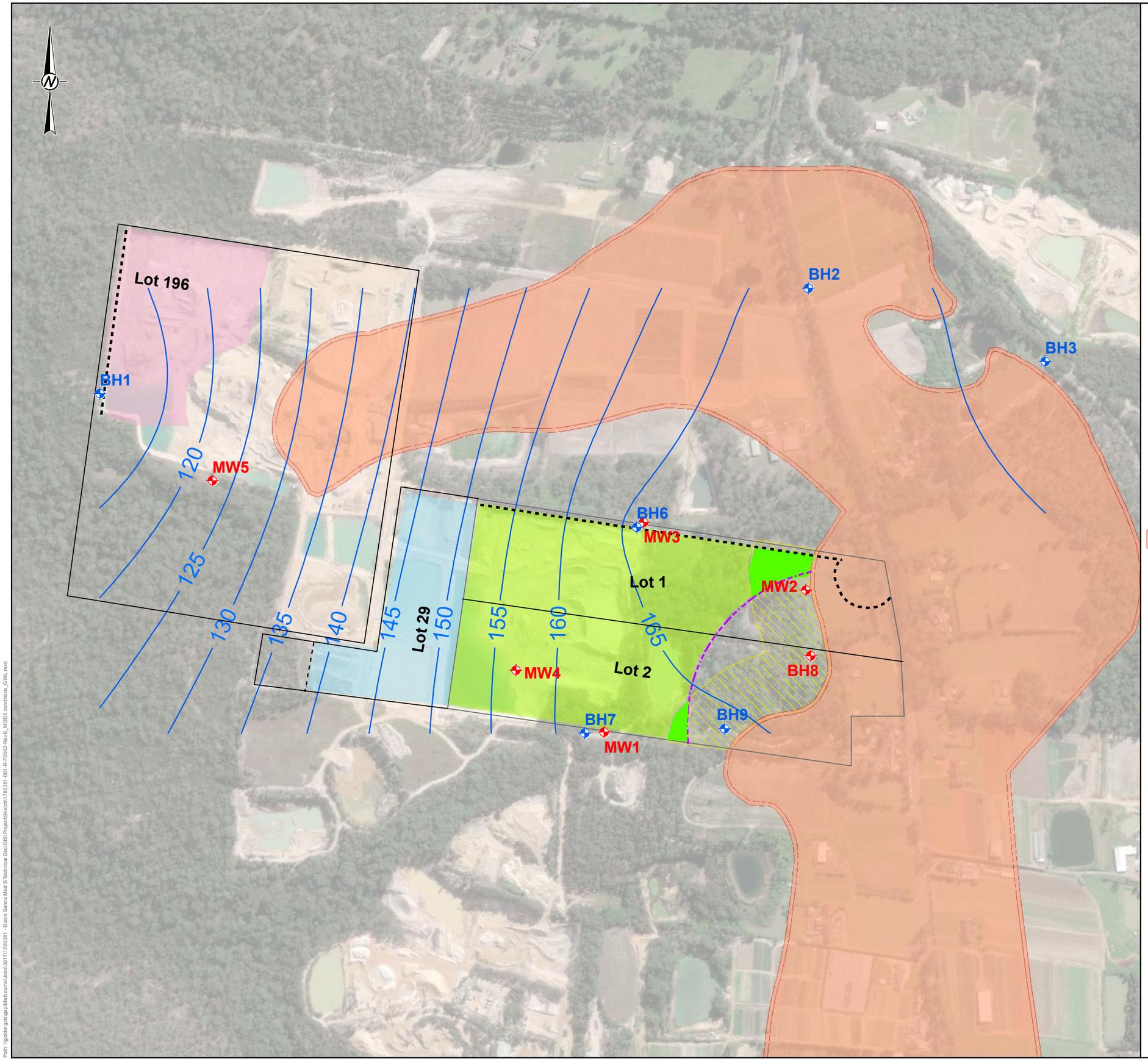
The historical daily rainfall records for the nearest BoM rainfall recording station have been analysed to determine the relevant groundwater level at each of the sites that have been monitored over the quarry life. Since 2005, the recorded rainfall at the nearest BoM station 67014 (Maroota Old telegraph Road) have included approximately 32 days when the total daily rainfall exceeded 50 mm, as listed in Appendix A.

Table 1 shows the peak water level measured at each of the bores completed in the SBCGS (based on BH series wells) and in the MTSGS buffer zone (based on BH8 and MW2) after each daily rainfall of 50 mm or more. Both current and past monitoring bores are included in the table. Contours of the wet weather groundwater levation based on the values in Table 1 are shown on Fgure 2 Note: Groundwater levels for shallow monitoring bores that target perched groundwater (MW1, MW3, MW4 and MW5) has been excluded from this assessment as they do not represent the wet weather elevation of the regional SBCGS.

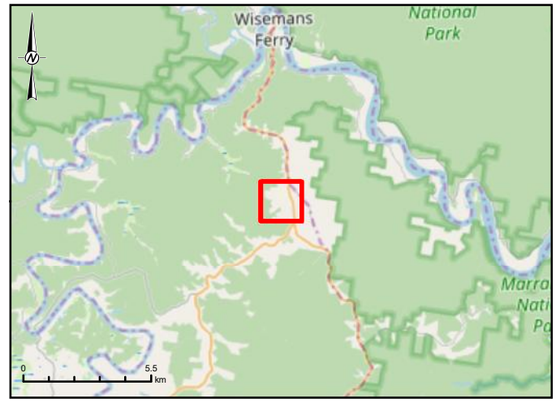
Contours of maximum extraction depth have been created by adding 2 m to each wet weather groundwater level and these are presented on Figure 3.

Table 1: Wet Weather Groundwater Elevation (Maximum).

Monitoring Bore	Aquifer	Wet Weather Groundwater eEevation (mAHD)	Monitoring Since
BH1	SBCGS	107.4	Jun-11
BH2	SBCGS	167.9	Jun-11
BH3	SBCGS	162.1	Jun-11
BH6	SBCGS	166.2	Jun-11
BH7	SBCGS	162.07	Jun-11
BH9	SBCGS	164.4	Sep-15
BH8	Weathered SBCGS (perched water table)	190.0	Sep-15
MW2	Weathered SBCGS (perched water table)	202.14	Jul-03



LOCATION MAP



Legend

- SBCGS Monitoring Bore
- Perched GW Monitoring Bore
- Boundary buffers
- Wet weather groundwater elevation mAHD
- Maroota public school buffer
- Property boundary
- Lot 29 Extraction area
- Lot 1 and 2 Extraction area within MTSGS buffer
- Lot 1 and 2 Extraction area outside MTSGS buffer
- NW Pit extaction area
- MTSGS (Etheridge 1980)
- MTSGS Buffer Zone (100m)

0 100 200 300 400 METRES

REFERENCE SCALE: 1:6,000 (at A3)

PROJECTION: GDA 1994 MGA Zone 56

CLIENT
DIXON SAND (PENRITH) PTY LTD

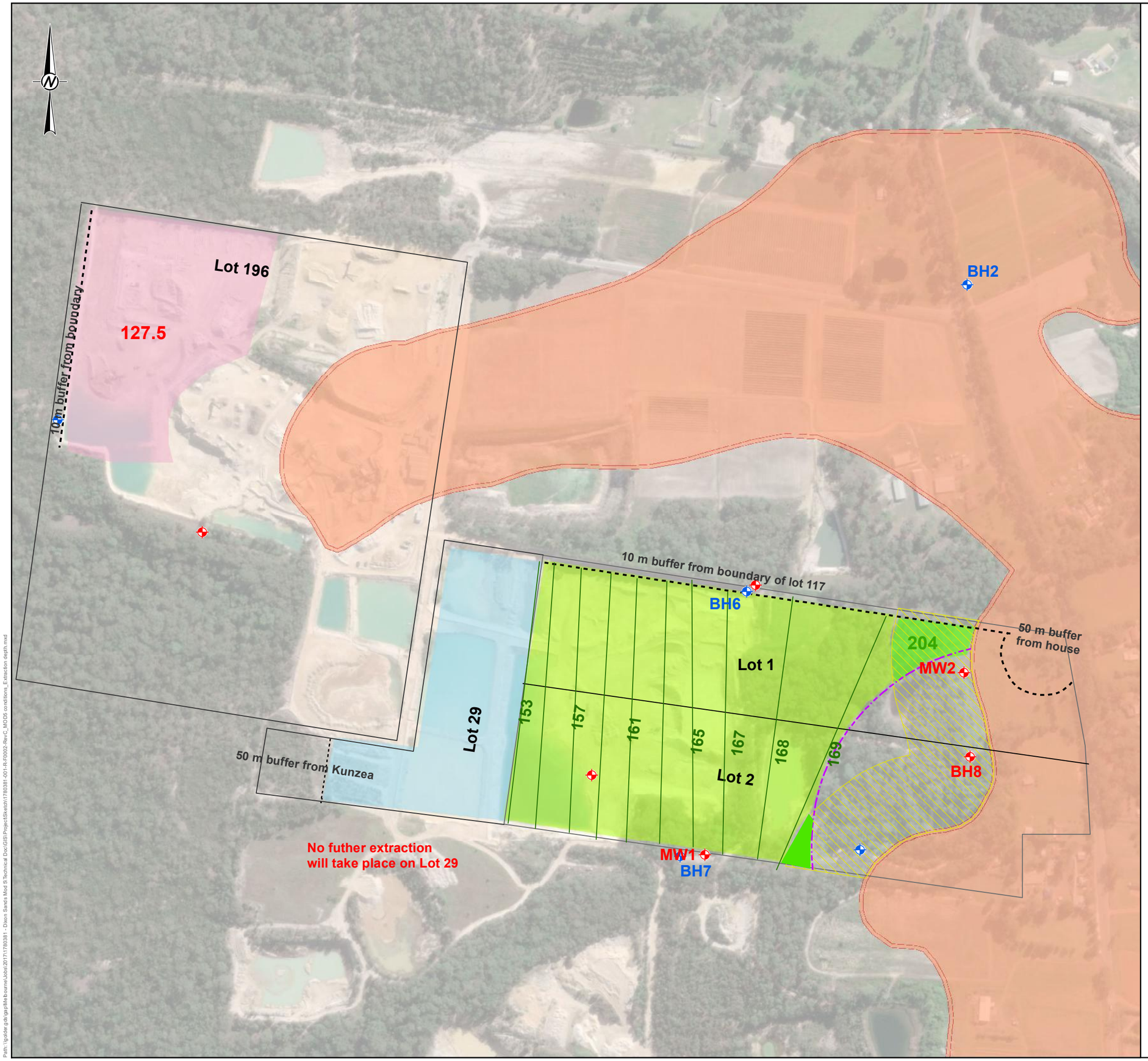
PROJECT
GROUNDWATER ASSESSMENT:

TITLE
SITE PLAN

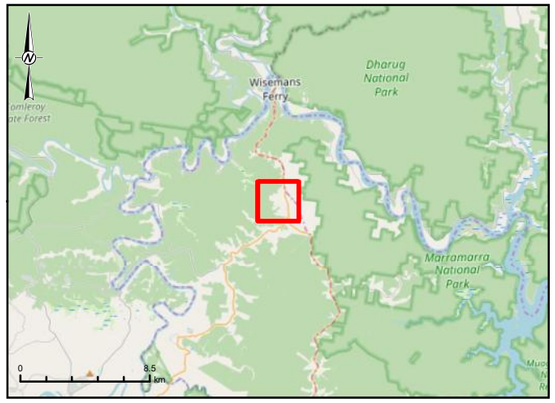
CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-30
PREPARED	GB
DESIGN	-
REVIEW	JA
APPROVED	JA

PROJECT No.	CONTROL	Rev.	FIGURE
1780381	001-R	0	**2**



LOCATION MAP



Legend

- SBCGS Monitoring Bore
- Perched GW Monitoring Bore
- Boundary buffers
- Maroota public school buffer
- MTSGS Buffer Zone (100m)
- Property boundary
- Lot 1 and 2 Extraction area within MTSGS buffer
- Lot 1 and 2 Extraction area outside MTSGS buffer
- Lot 29 Extraction area
- NW Pit extaction area
- MTSGS (Etheridge 1980)

0 80 160 240 320 METRES

REFERENCE SCALE: 1:4,675 (at A3)

PROJECTION: GDA 1994 MGA Zone 56

CLIENT
DIXON SAND (PENRITH) PTY LTD

PROJECT
GROUNDWATER ASSESSMENT:

TITLE
MAXIMUM EXTRACTION DEPTH (MAHD)

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-30
PREPARED	GB
DESIGN	-
REVIEW	JA
APPROVED	JA

PROJECT No.	CONTROL	Rev.	FIGURE
1780381	001-R	0	3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A3 0 25mm

Path: \\golder.gds.golder.com\Melbourne\Jobs\2017\1780381 - Dixon Sands Mod 5\Technical Docs\GIS\Project\Sketch\1780381-001-R-Fig002-Rev-C_MOD5 conditions_Extraction depth.mxd

The maximum extraction depth map on Figure 3 shows:

- Maximum extraction depth on Lot 1 and 2 outside of MTSGS buffer zone based on revised groundwater level contours should be limited to a depth not greater than 170 m AHD in the east, gradually reducing to 153 m AHD in the west.
- Maximum extraction depth on Lot 1 and 2 within MTSGS buffer zone is 204 mAHD, which was based on the *wet weather groundwater elevation* measured at MW2 (202 m). (Note. BH8 is also positioned within the MTSGS buffer area, but has revealed a deeper perched groundwater level of 190 mAHD. However, extraction within this area of the MTSGS is not permitted due to the presence of the 250 m buffer zone for the Maroota Public School).
- Maximum extraction depth on Lot 196 is 127.5 mAHD, which was previously set based on the inferred groundwater elevation for the eastern margin of the extraction area (125.5 mAHD).
- Maximum extraction depth on Lot 29 is limited to a depth not greater than 15.24 m below original ground level, a condition not related to groundwater levels. It should be noted, no futher extraction will take place on Lot 29.

Important Information

Your attention is drawn to the document – “Important Information”, which is included in Attachment B of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

We trust the above satisfies your requirements, however please contact us if you would like ot discuss the findings

GOLDER ASSOCIATES PTY LTD

Jason van den Akker
Principal Hydrogeologist

JV/jd

Attachments: A - Wet Weather groundwater level calculations
B – Important Information

\\golder\gap\(other offices)\(other offices)\melbourne\jobs\2017\1780381 - dixon sands mod 5\correspondence out\006\1780381-l006-rev0.docx

APPENDIX A

Wet Weather Groundwater Level Calculations

Maroota Daily Rainfalls Exceeding 50mm – 2005 to 2020				Peak water level after >50mm/day rainfall							
Year	Date	Rainfall	Comment	SCBGS						MTSGS Buffer Zone	
				BH1	BH2	BH3	BH6	BH7	BH8	BH9	MW2
2006	7 Sep	65.0									192.29
2007	13 Feb	52.2									192.8
	9 June	172.0									202.14
	20 July	136.5									200.4
	6 Dec	50.6									197.85
2008	5 June	51.0									200.4
2009	2 April	51.0									199.10
	22 May	78.0									199.09
2010	7 Feb	75.0									200.55
2011	20 Aug	74.5		106.18	164.63	160.84	164.16	160.44			199.05
2012	18 Apr	52.0		106.18	165.18	160.79	164.21	160.17			199.05
2013	29 Jan	118.0		106.18	166.08	161.54	164.89	161.37			200.2
	23 Feb	72.0	154.4 mm over 2 days (23-24 February 2013)	106.18	165.98	160.44	164.91	160.47			200.8
	24 Feb	82.4									
2014	19 Aug	52.6		106.18	166.58	161.14	165.11	160.57			199.3
	7 Dec	55.0		106.18	165.68	161.04	164.71	160.17			198.7
2015	21 Apr	161.0	279 mm over 2 days (21 to 22 April 2015)	106.18	166.08	161.04	165.11	159.67			
	22 Apr	118.0									198.5
	22 Dec	63.6		106.18	165.38	160.64	164.91	160.67	163	189.9	199

Maroota Daily Rainfalls Exceeding 50mm – 2005 to 2020				Peak water level after >50mm/day rainfall							
2016	5 Jan	108.0	221.2 mm over 4 days (4 to 7 January 2016)								
	6 Jan	68.0		106.18	165.88	161.34	163.4	189.9	189.9	163.4	199.3
	5 June	69.0	147.4 mm over 3 days (4 to 6 June 2016)								198.9
	6 June	68.0		107.38	167.88	162.14	164.4	190	190	164.4	
2017	18-Mar	54.8		107.28	167.08	161.94	164.1	189.9	189.9	164.1	199.2
	31-Mar	55.0									
2018	26-Feb	66.0		107.38	165.88	160.94	162.9	189.8	189.8	162.9	197.7
	5-Oct	55.0		106.81	165.08	160.63	162.23	189.6	189.6	162.23	196.1
2019	16-Mar	86.0	86 mm from 16 to 18 March 2019	106.99		160.43	161.65	189.35	189.35	161.65	194.32
2020	17-Jan	51.0	51 mm over 17th to 20th Jan	106.39	162.14	158.06	157.75	189.44	189.44	157.75	193.83
Average peak water level after >50mm/day rainfall event				106.52	165.68	160.86	164.86	160.46	189.74	162.43	189.74
Highest peak water level after >50mm/day rainfall event				107.38	167.88	162.14	166.21	162.07	190.00	164.4	190

APPENDIX B

Important Information

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

This Report is provided for use solely by Golder's Client and persons acting on the Client's behalf, such as its professional advisers. Golder is responsible only to its Client for this Report. Golder has no responsibility to any other person who relies or makes decisions based upon this Report or who makes any other use of this Report. Golder accepts no responsibility for any loss or damage suffered by any person other than its Client as a result of any reliance upon any part of this Report, decisions made based upon this Report or any other use of it.

This Report has been prepared in the context of the circumstances and purposes referred to in, or derived from, the Contract and Golder accepts no responsibility for use of the Report, in whole or in part, in any other context or circumstance or for any other purpose.

The scope of Golder's Services and the period of time they relate to are determined by the Contract and are subject to restrictions and limitations set out in the Contract. If a service or other work is not expressly referred to in this Report, do not assume that it has been provided or performed. If a matter is not addressed in this Report, do not assume that any determination has been made by Golder in regards to it.

At any location relevant to the Services conditions may exist which were not detected by Golder, in particular due to the specific scope of the investigation Golder has been engaged to undertake. Conditions can only be verified at the exact location of any tests undertaken. Variations in conditions may occur between tested locations and there may be conditions which have not been revealed by the investigation and which have not therefore been taken into account in this Report.

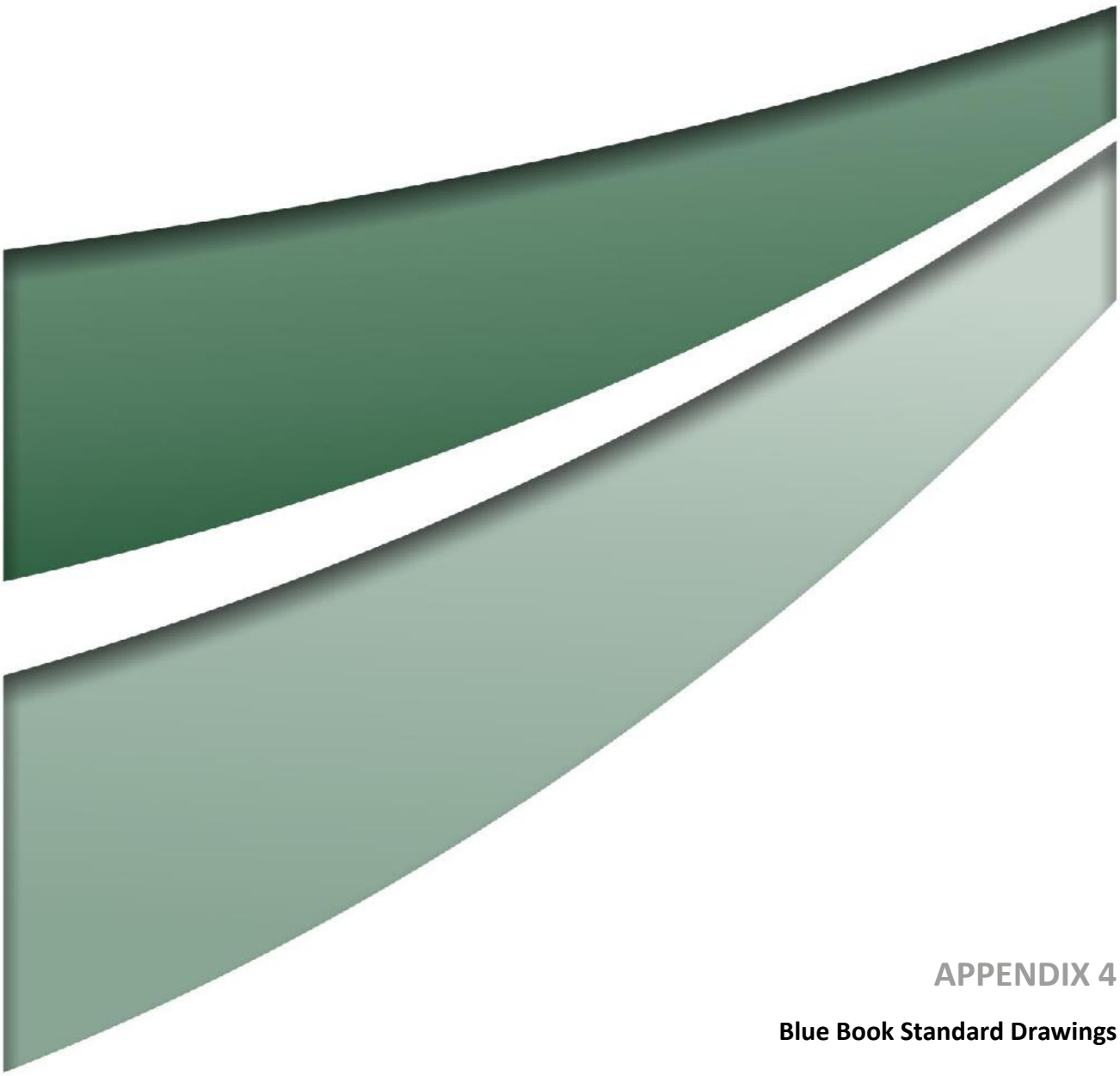
Golder accepts no responsibility for and makes no representation as to the accuracy or completeness of the information provided to it by or on behalf of the Client or sourced from any third party. Golder has assumed that such information is correct unless otherwise stated and no responsibility is accepted by Golder for incomplete or inaccurate data supplied by its Client or any other person for whom Golder is not responsible. Golder has not taken account of matters that may have existed when the Report was prepared but which were only later disclosed to Golder.

Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

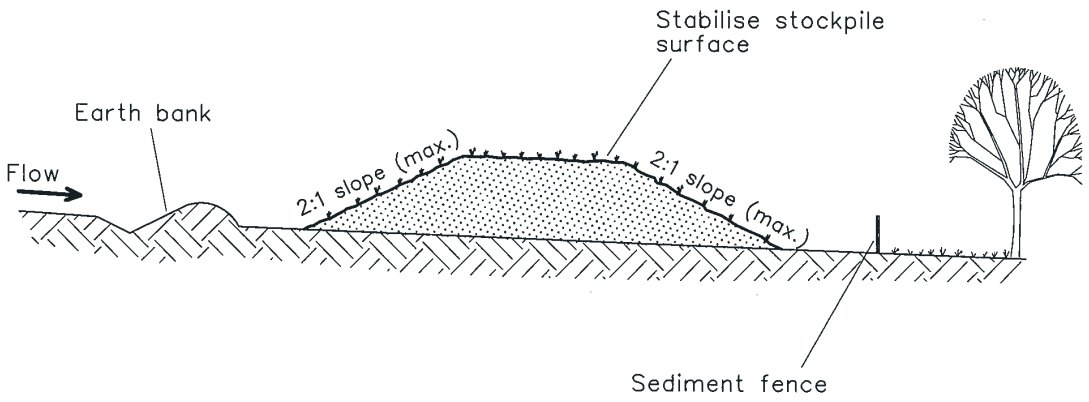
By date, or revision, the Report supersedes any prior report or other document issued by Golder dealing with any matter that is addressed in the Report.

Any uncertainty as to the extent to which this Report can be used or relied upon in any respect should be referred to Golder for clarification



APPENDIX 4

Blue Book Standard Drawings

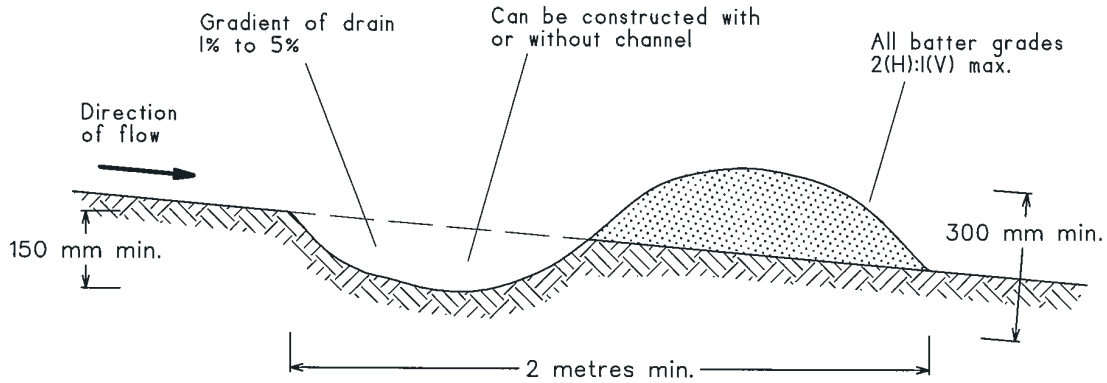


Construction Notes

1. Place stockpiles more than 2 (preferably 5) metres from existing vegetation, concentrated water flow, roads and hazard areas.
2. Construct on the contour as low, flat, elongated mounds.
3. Where there is sufficient area, topsoil stockpiles shall be less than 2 metres in height.
4. Where they are to be in place for more than 10 days, stabilise following the approved ESCP or SWMP to reduce the C-factor to less than 0.10.
5. Construct earth banks (Standard Drawing 5-5) on the upslope side to divert water around stockpiles and sediment fences (Standard Drawing 6-8) 1 to 2 metres downslope.

STOCKPILES

SD 4-1

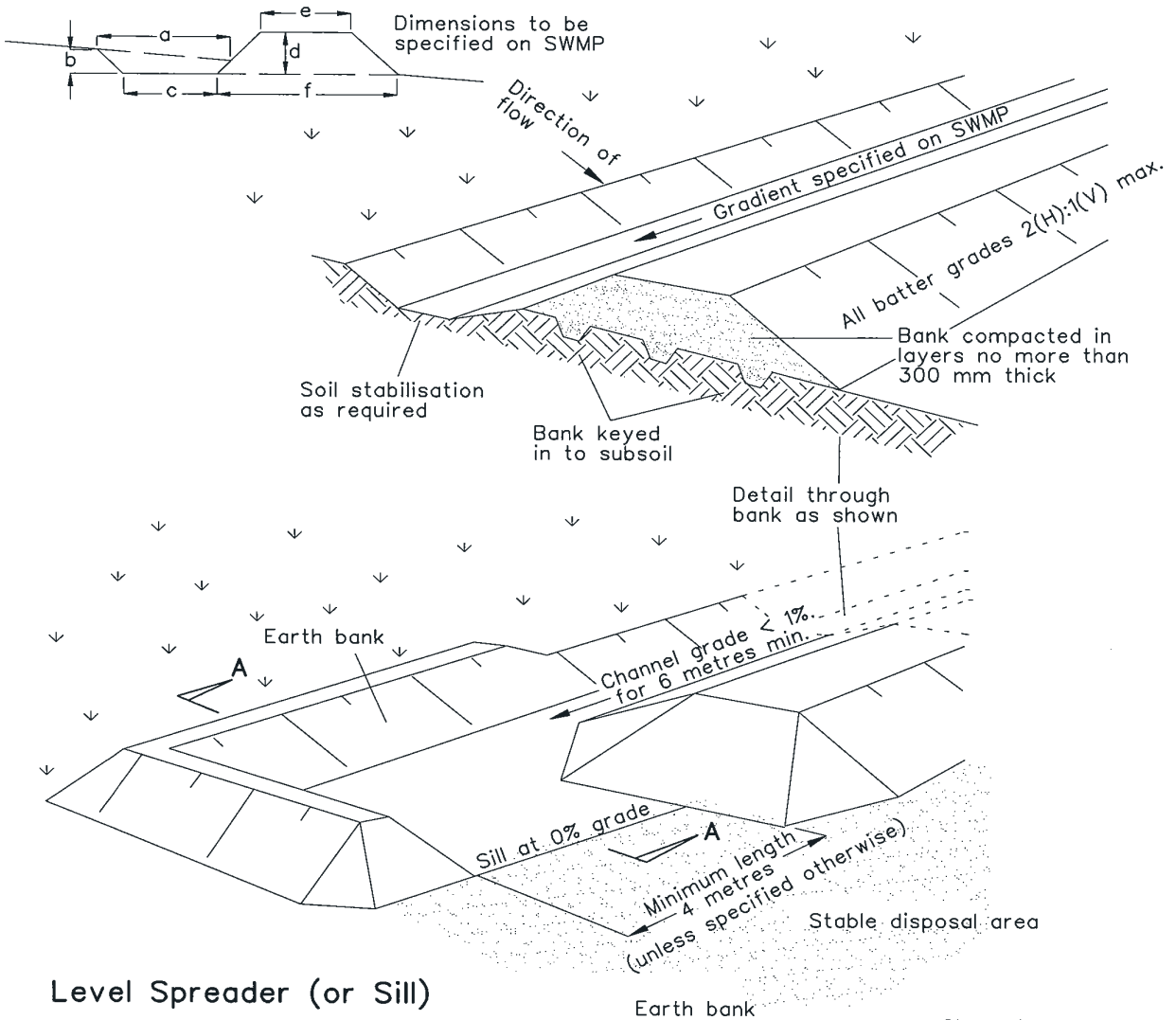


NOTE: Only to be used as temporary bank where maximum upslope length is 80 metres.

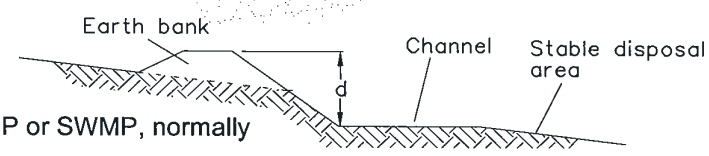
Construction Notes

1. Build with gradients between 1 percent and 5 percent.
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V shaped.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction.

EARTH BANK (LOW FLOW) SD 5-5



Level Spreader (or Sill)



Section AA

Construction Notes

1. Construct at the gradient specified on the ESCP or SWMP, normally between 1 and 5 percent
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V-shaped, at the dimensions shown on the SWMP.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction following Table 5.2 in Landcom (2004).
7. Where discharging to erodible lands, ensure they outlet through a properly constructed level spreader.
8. Construct the level spreader at the gradient specified on the ESCP or SWMP, normally less than 1 percent or level.
9. Where possible, ensure they discharge waters onto either stabilised or undisturbed disposal sites within the same subcatchment area from which the water originated. Approval might be required to discharge into other subcatchments.

EARTH BANK (HIGH FLOWS) SD 5-6

umwelt

Newcastle

75 York Street
Teralba NSW 2284

Ph. 02 4950 5322

Perth

PO Box 783
West Perth WA 6872
7 Havelock Street
West Perth WA 6005

Ph. 1300 793 267

Canberra

PO Box 6135
56 Bluebell Street
O'Connor ACT 2602

Ph. 02 6262 9484

Sydney

50 York Street
Sydney NSW 2000

Ph. 1300 793 267

Brisbane

Level 11
500 Queen Street
Brisbane QLD 4000

Ph. 1300 793 267

www.umwelt.com.au