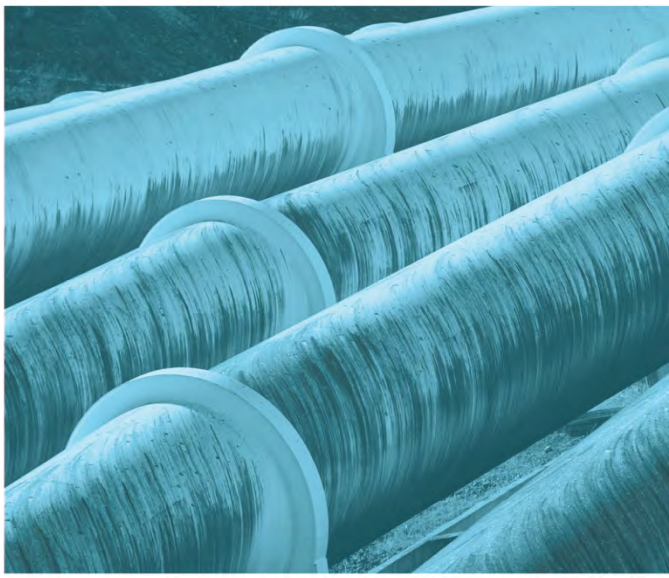



Luddenham Quarry

Soil and Water Management Plan

Prepared for Luddenham Operations Pty Ltd
October 2021

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Luddenham Quarry

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Luddenham Quarry

Soil and Water Management Plan

Report Number

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Client

Luddenham Operations Pty Ltd

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Version

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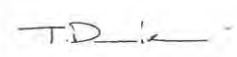
Prepared by



Tess Davies
Senior Water Resources Engineer
19 October 2021

Approved by

Nick Bartho
Associate Water Resources Engineer
19 October 2021

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1 Introduction

1.1 Background

Luddenham Quarry is located at 275 Adams Road, Luddenham NSW (Lot 3 in DP 623799, 'the site') within the Liverpool City Council municipality. The existing shale/clay quarry is approved by State significant development (SSD) consent DA 315-7-2003, issued by the NSW Minister for Planning under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The site is owned by CFT No 13 Pty Ltd, a member of the Coombes Property Group (CPG).

Luddenham Operations Pty Ltd will reactivate and operate the quarry in accordance with Modification 5 (MOD 5) of DA 315-7-2003 which was granted on 24 May 2021.

Figure 1.1 presents the location of the site in the regional context and Figure 1.2 presents the site in its local context.

1.2 Purpose and objectives

This soil and water management plan (SWMP) presents the framework for the management of soil (primarily erosion and sediment control), surface water and groundwater at Luddenham Quarry. This SWMP supersedes the erosion and sediment control plan (Epic Mining 2015a), irrigation management plan (Epic Mining 2015b) and groundwater monitoring plan (NICS 2017) previously prepared for Luddenham Quarry.

The objectives of this soil and water management plan (SWMP) are to:

- address relevant development consent and licence conditions detailed in Section 1.4;
- describe the water management system;
- describe a water monitoring program; and
- provide proposed actions, operating protocols and response measures.

1.3 Consultation

Schedule 4, condition 24 of development consent DA 315-7-2003 requires that a SWMP be developed in consultation with the NSW Department of Planning, Industry and Environment – Water division (DPIE Water) and the NSW Environment Protection Authority (EPA). The draft SWMP has been provided to DPIE Water and EPA for comment in June 2021.

Recommendations on the SWMP were provided by the NSW Natural Resources Access Regulator (NRAR), which are provided in Appendix A, along with how these recommendations have been addressed in the WMP.

1.4 Report preparation

This SWMP has been prepared by Tess Davies, Patrick Carolan and Nick Bartho of EMM Consulting Pty Ltd (EMM).

Tess holds a Bachelor of Engineering (Environmental) (Hons) and a Bachelor of Science and has over eight years of experience as a water resources engineer. Patrick holds a Bachelor of Engineering (Civil) (Hons) and has over nine years of experience as a water resources engineer. Nick holds a Bachelor of Engineering (Civil and Environmental) (Hons) and is EMM's Surface Water Team Leader, with over 20 years of experience as a water resources engineer.

1.5 Approval and licence requirements

1.5.1 Development consent

This SWMP addresses specific soil and water management components of the conditions of development consent DA 315-7-2003 including MOD 5. The relevant requirements of the consent and where these have been addressed in this SWMP are outlined in Table 1.1.

Table 1.1 Development consent DA 315-7-2003 conditions

Condition		SWMP reference
Evidence of Consultation		
Schedule 3, condition 15	Where conditions of this consent require consultation with an identified party, the Applicant must: (a) consult with the relevant party prior to submitting the subject document; and (b) provide details of the consultation undertaken including: (i) the outcome of that consultation, matters resolved and unresolved; and (ii) details of any disagreement remaining between the party consulted and the Applicant and how the Applicant has addressed the matters not resolved.	Section 1.3 Appendix A
Water Supply		
Schedule 4, condition 21A	The Applicant must ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of the development to match its available water supply.	Section 3.6.2
Schedule 4, condition 21A	The Applicant must report on water extracted from the site each year (direct and indirect) in the Annual Review, including water taken under any water licence.	Section 7.2.1
Pollution of Waters		
Schedule 4, condition 22	Except as may be expressly provided by an EPL, the Applicant must comply with section 120 of the *Protection of the Environment Operations Act 1997* during the carrying out of the development.	Section 6
Schedule 4, condition 23	The Applicant must not discharge any water from the development to Oaky Creek, except as otherwise approved under an EPL, and following approval of a Discharge Characterisation and Water Pollution Impact Assessment in accordance with condition 25 below.	Section 3.7
Soil and Water Management Plan		
Schedule 4, condition 24	Prior to recommencing quarrying operations under Modification 5, the Applicant must prepare a Soil and Water Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:	
	(a) be prepared by suitably qualified and experienced person/s;	Section 1.4
	(b) be prepared in consultation with EPA and DPIE Water; and	Section 1.3
	(c) include a:	
	(i) Site Water Balance that includes details of:	
	a. predicted annual inflows to and outflows from the site;	Section 3.6.1
	b. sources and security of water supply for the life of the development (including authorised entitlements and licences);	Section 3.6.2 Section 1.5.3
	c. water storage capacity;	Section 3.3
	d. water use and management on the site, including any water transfers or sharing with neighbouring land users;	Section 3

Table 1.1 Development consent DA 315-7-2003 conditions

Condition				SWMP reference
		e.	licensed discharge points and limits; and	Section 3.7
		f.	reporting procedures, including the annual preparation of an updated site water balance;	Section 3.6.3
	(ii)		Erosion and Sediment Control Plan that:	
		a.	is consistent with the requirements of Managing Urban Stormwater: Soils and Construction – Volume 1: Blue Book (Landcom, 2004) and Volume 2E: Mines and Quarries (DECC, 2008);	Section 3.1 Section 3.4
		b.	identifies activities that could cause soil erosion, generate sediment or affect flooding;	Section 3.4.1 Section 3.9
		c.	describes measures to minimise soil erosion and the potential for the transport of sediment to downstream waters, and manage flood risk;	Section 3.4.2 Section 3.9
		d.	describes the location, function and capacity of erosion and sediment control structures and flood management structures; and	Section 3.3 Section 3.4 Section 3.9
		e.	describes what measures would be implemented to maintain (and if necessary decommission) the structures over time;	Section 4.2
	(iii)		Surface Water Management Plan, that includes:	
		a.	detailed baseline data on surface water flows and quality in water bodies within the site and in Oaky Creek;	Section 5.1
		b.	surface water impact assessment criteria, including trigger levels for investigating any potentially adverse impacts, and surface water management performance measures;	Section 6.2.1
		c.	a detailed description of the surface water management system on the site, including the: • clean water diversion system; • erosion and sediment controls; • dirty water management system; • water storages; and • measures to minimise the need for surface water discharges to Oaky Creek;	Chapter 3
		d.	a program to monitor and evaluate: • any approved surface water discharges; • the effectiveness of the water management system; • impacts on water supply for other water users; • surface water flows and quality in watercourses and/or waterbodies that could potentially be impacted by the development; and	Section 4.1.1
		e.	a protocol for identifying and investigating any exceedances of the surface water impact assessment criteria and for notifying the Department and relevant stakeholders of these events; and	Section 6.2.2 Appendix B
	(iv)		Groundwater Management Plan, that includes:	
		a.	detailed baseline data on groundwater levels and quality across the site;	Section 5.2

Table 1.1 Development consent DA 315-7-2003 conditions

Condition		SWMP reference
	b. a program to monitor and report on: • groundwater levels and quality across the site and identify any unauthorised groundwater interference; and • impacts of the development on alluvium and associated surface water sources and groundwater dependent ecosystems;	Section 4.1.2
	c. a protocol for identifying and investigating any exceedances of the groundwater performance criteria and for notifying the Department and relevant stakeholders of these events; and	Section 6.3.2 Appendix B
	d. a protocol to obtain appropriate water licence(s) to cover the volume of any unforeseen groundwater inflows into the extraction areas.	Section 1.5.3 Section 3.6.3 Section 6.3.2 Appendix B
Discharge Characterisation and Water Pollution Impact Assessment		
Schedule 4, condition 25	Prior to any discharges from the quarry water management system to Oaky Creek, the Applicant must prepare a Discharge Characterisation and Water Pollution Impact Assessment for the development to the satisfaction of the Planning Secretary. This plan must: (a) be prepared by suitably qualified and experienced person/s; (b) be prepared in consultation with EPA and DPIE Water; and (c) include: (i) measures to avoid the need for discharges as far as reasonable and feasible; (ii) analysis of the frequency and volume of discharges during a range of weather conditions; (iii) characterisation of the expected quality of proposed discharges; (iv) assessment of the impacts of discharges to receiving waters; and (v) measures to minimise pollution and potential impacts on receiving waters.	Section 3.7
Irrigation Management Plan		
Schedule 4, condition 26	Prior to the use of water from the quarry water management system for irrigation purposes, the Applicant must prepare an Irrigation Management Plan for the development to the satisfaction of the Planning Secretary. This plan must: (a) identify the specific areas of land to be irrigated; (b) include baseline data on soil and water quality in the irrigation areas; (c) determine sustainable water application rates and management requirements; (d) describe measures to prevent any tailwater drainage from entering Oaky Creek; (e) describe measures to ensure that soils subject to irrigation are not adversely affected by the concentration of salts; and (f) include a monitoring program for the irrigation management system.	Section 3.8

Table 1.1 Development consent DA 315-7-2003 conditions

Condition		SWMP reference
Management Plan Requirements		
Schedule 6, condition 4	Management plans required under this consent must be prepared in accordance with relevant guidelines, and include:	
	(a) a summary of relevant background or baseline data;	Chapter 5
	(b) details of	
	(i) the relevant statutory requirements (including any relevant approval, licence or lease conditions);	Section 1.5
	(ii) any relevant limits or performance measures and criteria; and	Section 6.2.1
	(iii) the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	Section 6.3.1
	(c) any relevant commitments or recommendations identified in the document/s listed in condition 2 of Schedule 3;	
	(d) a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	Chapter 6
	(e) a program to monitor and report on the:	Chapter 4
	(i) impacts and environmental performance of the development; and	
	(ii) effectiveness of the management measures set out pursuant to sub-condition (d) above;	
	(f) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as soon as possible;	Chapter 6
	(g) a program to investigate and implement ways to improve the environmental performance of the development over time;	
	(h) a protocol for managing and reporting any:	Chapter
	(i) incident, non-compliance or exceedance of the impact assessment criteria or performance criteria;	
	(ii) complaint; or	
	(iii) failure to comply with statutory requirements;	
	(i) public sources of information and data to assist stakeholders in understanding environmental impacts of the development; and	
	(j) a protocol for periodic review of the plan.	

Table 1.1 Development consent DA 315-7-2003 conditions

Condition		SWMP reference
Independent environmental audit		
Schedule 6, condition 7	Before 31 December 2010, and every 3 years thereafter, unless the Secretary directs otherwise, the Applicant must commission and pay the full cost of an Independent Environmental Audit of the development. This audit must: (a) be conducted by a suitably qualified, experienced, and independent team of experts whose appointment has been endorsed by the Planning Secretary; (b) include consultation with the relevant agencies; (c) assess the environmental performance of the development, and whether it is complying with the relevant requirements in this consent and any relevant EPL (including any assessment, plan or program required under these approvals); (d) review the adequacy of any approved strategy, plan or program required under these approvals; and (e) recommend measures or actions to improve the environmental performance of the development, and/or any assessment, plan or program required under these approvals; Note: This audit team must be led by a suitably qualified auditor and include experts in rehabilitation and any other field specified by the Planning Secretary.	Section 7.3
Schedule 6, condition 8	Within six weeks of the completion of this audit, or as otherwise agreed by the Planning Secretary, the Applicant must submit a copy of the audit report to the Planning Secretary, together with its response to any recommendations contained in the audit report.	Section 7.3
Revision of Strategies, Plans and Programs		
Schedule 6, condition 9	Within three months of: (a) the submission of an incident report under condition 12 below; (b) the submission of an Annual Review under condition 5 above; (c) the submission of an Independent Environmental Audit under condition 7 above; or (d) the approval of any modification of the conditions of this consent (unless the conditions require otherwise); the suitability of existing strategies, plans and programs required under this consent must be reviewed by the Applicant.	Section 7.4
Schedule 6, condition 10	If necessary, to either improve the environmental performance of the development, cater for a modification or comply with a direction, the strategies, plans and programs required under this consent must be revised, to the satisfaction of the Planning Secretary and submitted to the Planning Secretary for approval within six weeks of the review. Note: This is to ensure that strategies, plans and programs are regularly updated to incorporate any measures recommended to improve the environmental performance of the development.	Section 7.4
Incident Reporting		
Schedule 6, condition 12	The Applicant must immediately notify the Department and any other relevant agencies after it becomes aware of an incident. The notification must be in writing via the Major Projects Website and identify the development (including the development application number and name) and set out the location and nature of the incident.	Section 7.2.4

Table 1.1 Development consent DA 315-7-2003 conditions

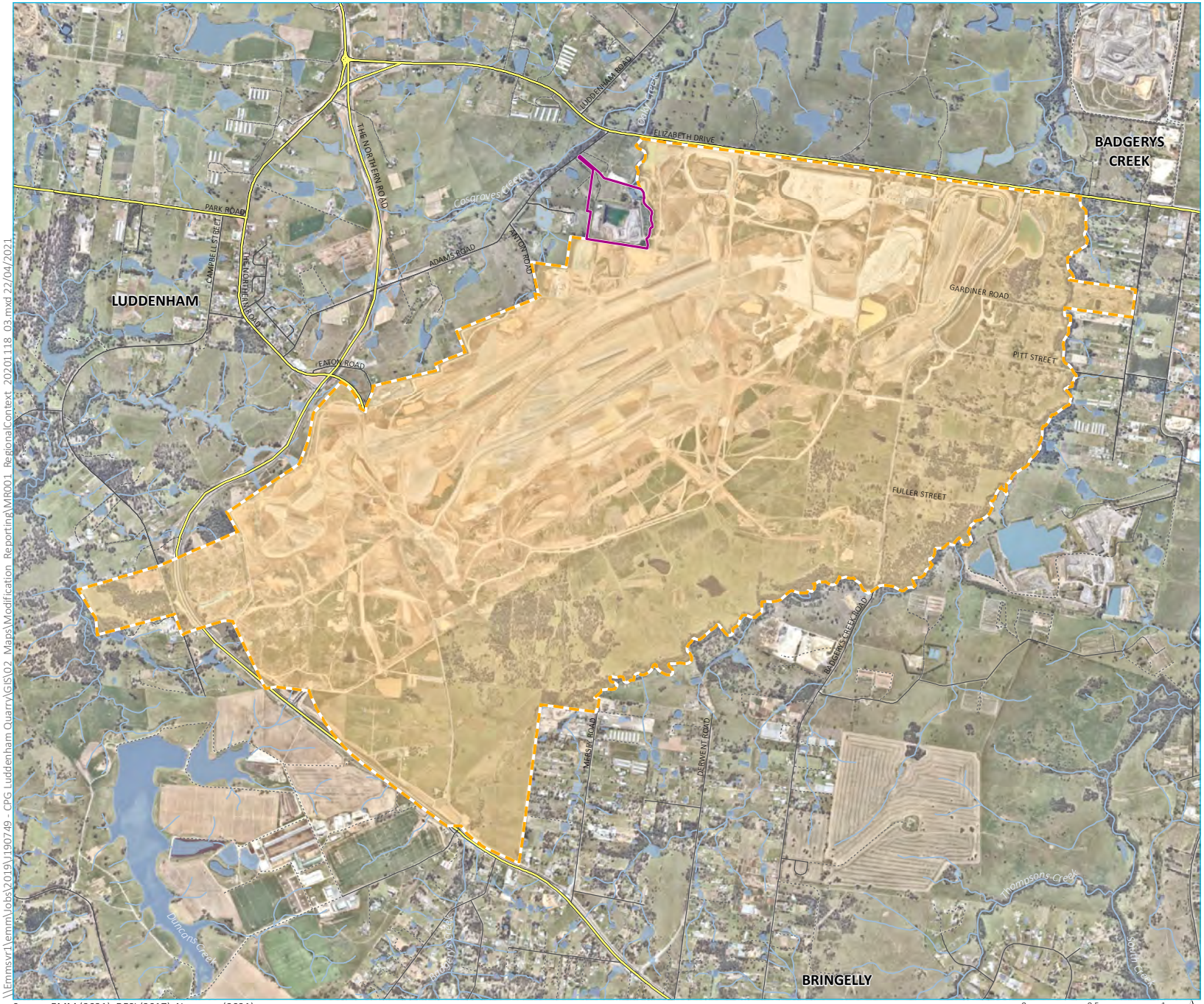
Condition		SWMP reference
Non-Compliance Notification		
Schedule 6, condition 13	Within seven days of becoming aware of a non-compliance, the Applicant must notify the Department of the non-compliance. The notification must be in writing via the Major Projects Website and identify the development (including the development application number and name), set out the condition of this consent that the development is non-compliant with, the way in which it does not comply and the reasons for the non-compliance (if known) and what actions have been, or will be, undertaken to address the noncompliance. Note: A non-compliance which has been notified as an incident does not need to also be notified as a noncompliance.	Section 7.2.4
Regular Reporting		
Schedule 6, condition 14	The Applicant must provide regular reporting on the environmental performance of the development on its website, in accordance with the reporting arrangements in any plans or programs approved under the conditions of this consent.	Section 7.2.3
Access to Information		
Schedule 6, condition 15	From 30 September 2016 and for the duration of the development, the Applicant must: (a) make copies of the following publicly available on its website: • approved strategies, plans and programs required under the conditions of this consent; • a comprehensive summary of the monitoring results of the development, reported in accordance with the specifications in any conditions of this consent, or any approved plans and programs; • a complaints register, which is to be updated monthly; • the Annual Reviews of the development (for the last 5 years); • any Independent Environmental Audit of the development, and the Applicant's response to the recommendations in any audit; (b) keep this information up-to-date, to the satisfaction of the Planning Secretary.	Section 7.2.3 Section 7.2.5 Section 7.2.1 Section 7.3

1.5.2 Environment protection licence

Environment Protection Licence (EPL) 21562 is held for Luddenham Quarry. The EPL does not permit discharge of water collected in the quarry pit or Water Management Dam to waterways, as per Condition O4.3. There are no licensed discharge points or limits specified by EPL 21562.

1.5.3 Water access licence

Water Access Licence (WAL) 43685 and Miscellaneous Work 10MW119330 are held for Luddenham Quarry within the Sydney Basin Central Groundwater Source of the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011*. Luddenham Quarry holds entitlement of 2 unit shares within the water source to account for the estimated maximum groundwater inflow into the quarry pit (EMM 2020a).



KEY

- Study area
- Western Sydney International (Nancy-Bird Walton) Airport
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line

Source: EMM (2021); DFSI (2017); Nearmap (2021)

0 0.5 1 km

GDA 1994 MGA Zone 56

N

Site locality

Luddenham Quarry
Water Management Plan
Figure 1.1

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KEY

- Study area
- Cadastral boundary

Proposed site modifications

- Approved extraction footprint
- Existing noise bunds
- Existing stockpiling area
- Extended stockpiling area
- Internal road
- Site entry infrastructure (incl. offices, amenities, weighbridge)
- Equipment laydown area

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Source: EMM (2021); DFSI (2017); GA (2011); Nearmap (2020)

0 50 100 m

GDA 1994 MGA Zone 56

N

Site features

Luddenham Quarry
Water Management Plan
Figure 1.2

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2 Existing environment

2.1 Land use

The site is adjacent to the future Western Sydney Airport (WSA). Construction of the airport (including road infrastructure upgrades) has commenced. Commonwealth-owned land which will form part of the airport bounds the eastern and southern boundaries of the site.

Other surrounding land uses include:

- agricultural – grazing and intensive agriculture (eg poultry);
- rural residences – the closest occupied residence is approximately 70 m north of the site access road; and
- Hubertus Country Club and pistol range – immediately west of the site.

2.2 Topography

The site elevation is approximately 80 m Australian Height Datum (m AHD) and predominantly flat, with gently sloping relief falling generally from the south-west to the north-east. There is an approximately 10 m fall across the 500 m distance between the western and eastern site boundaries.

2.3 Climate

Patched point climate data was obtained from the Scientific Information for Land Owners (SILO) database hosted by the Science Division of the Queensland Government's Department of Environment and Science. SILO patched point data consist of interpolated estimates based on historically observed data from Bureau of Meteorology (BOM) weather stations. For this assessment, SILO data was obtained for the Badgerys Creek McMasters F.Stn station (BOM station number 67068), which is located 1 km north-east of the site.

Table 2.1 presents key information and statistical data from the historical SILO patched point data between 1889 and 2019. Figure 2.1 presents the average daily rainfall and evaporation rates determined from the SILO data.

Table 2.1 Key climate statistics

Key annual statistic	Units	Rainfall	Evaporation
Average	mm/year	759	1,476
Minimum	mm/year	330	1,169
5th percentile	mm/year	424	1,340
10th percentile	mm/year	477	1,400
Median	mm/year	737	1,472
90th percentile	mm/year	1,044	1,522
95th percentile	mm/year	1,164	1,581
Maximum	mm/year	1,695	1,746

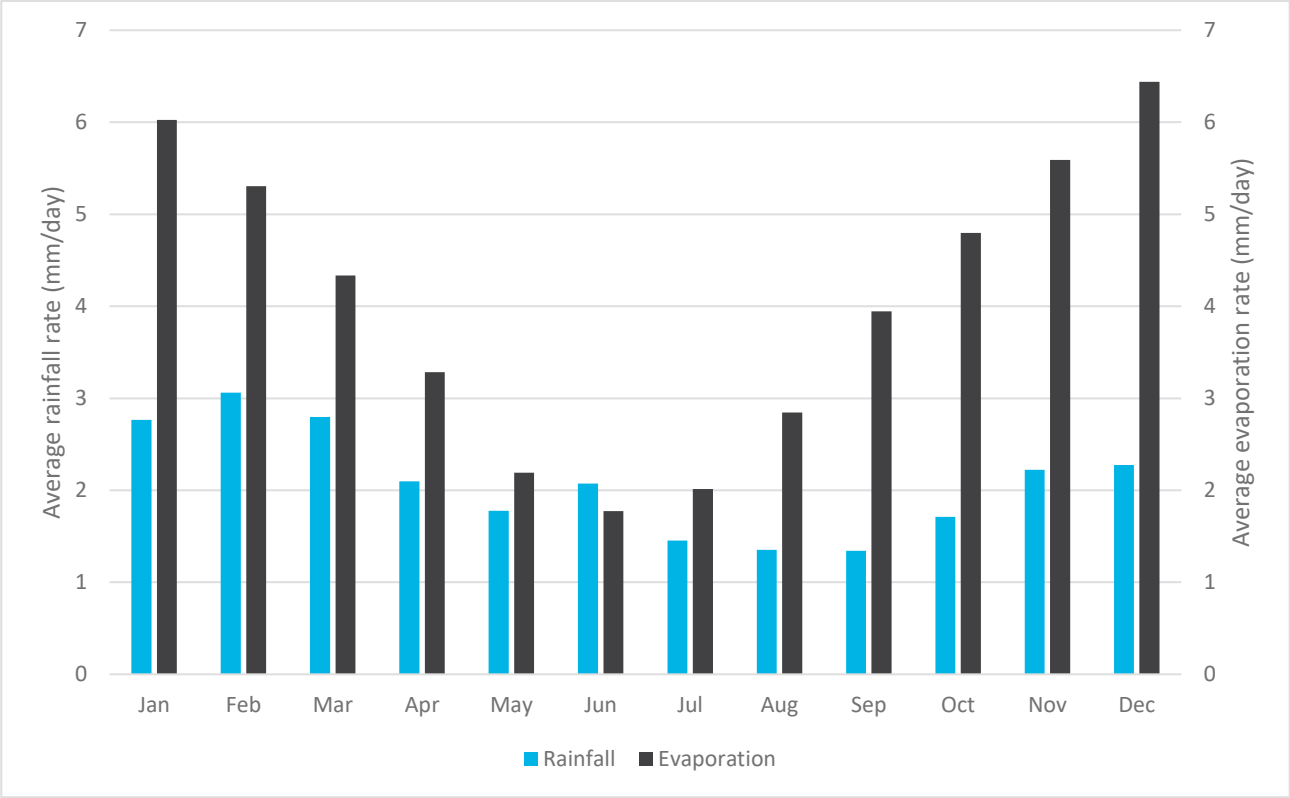

Figure 2.1 Average daily rainfall and evaporation rates

2.4 Geology

The Luddenham area lies within the central part of the Sydney Basin, which is comprised of several sedimentary strata including the thick coal seams in the greater region and extensive and continuous Hawkesbury Sandstone. These sandy sediments and the regional depression of the basin allowed the formation of shaly and silty strata (Wianamatta group) which includes the Ashfield and Bringelly Shales that are several hundred metres thick and form the bulk of the mineral resource of the site.

The *Soil Landscapes of the Penrith 1:100,000 sheet* (Bannerman and Hazelton 1990) geological map indicates that the quarry is underlain by Bringelly Shale of the Wianamatta Group, comprising shale, claystone, laminite and sandstone, with rare coal and tuff. Quaternary alluvium (sand, silt and clay) is identified to the north and west of the site, consistent with the alignment of Cosgroves Creek to the west and the northern reaches of Oaky Creek.

2.5 Hydrology

2.5.1 Regional hydrology

The site is located within the Oaky Creek catchment. The headwaters of Oaky Creek form the eastern boundary of site. Upstream of the site, the Oaky Creek catchment is heavily modified by the construction of the WSA. The creek continues downstream of the site for approximately 0.9 km before joining Cosgroves Creek. Downstream of the confluence with Oaky Creek, Cosgroves Creek flows for approximately 7 km before its confluence with South Creek, which ultimately contributes to the Hawkesbury River and Broken Bay. The total catchment area of Cosgroves Creek at the confluence with South Creek is approximately 2,163 ha.

Watercourses in the vicinity of Luddenham Quarry are presented in Figure 2.2.

KEY

- Study area
- Western Sydney Airport
- Major road
- Minor road
- Vehicular track
- Watercourse

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Source: EMM (2021); DFSI (2017); GA (2011); ASGC (2006); Nearmaps (2020)

0 250 500 m

GDA 1994 MGA Zone 56

N

Watercourses

Luddenham Quarry
Water Management Plan
Figure 2.2

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2.5.2 Local hydrology

The site and immediate surrounds are comprised of four main sub-catchments:

- A well vegetated grassed paddock of approximately 2.8 ha is situated to the north of the quarry, shown shaded in pink in Figure 3.1. This clean water catchment area drains to a depression in the north-east of the site adjacent to the internal road, where it is diverted via an open drain and piped drainage system to the northern boundary of the site at Oaky Creek, downstream of the Water Management Dam. Photograph 2.1 shows the grassed paddock and downstream depression.

- A portion of the unsealed internal road along the northern boundary and adjacent to the Water Management Dam drains to the dam, shown shaded in orange in Figure 3.1. Including the Water Management Dam surrounds, this totals an area of 0.8 ha. Photograph 2.2 shows the Water Management Dam and adjacent internal road.

- Oaky Creek is an ephemeral watercourse bordering the eastern boundary of the site. The creek is characterised by a meandering shallow channel surrounded by dense vegetation, debris and scoured pools. At the north-eastern corner of the site, Oaky Creek drains to an online dammed storage, assumed to be built 50 to 70 years ago. Although partially within the site boundary, this online storage is not part of the site's water management system. Photograph 2.3 and Photograph 2.4 show the Oaky Creek headwaters adjacent the site and the downstream storage, respectively.

- The remaining site areas including the existing and proposed stockpiling areas, proposed equipment laydown area, site entry infrastructure and remaining internal roads, extraction footprint and a minor portion of a neighbouring properties grassed area all drain to the quarry pit. These areas are predominantly disturbed catchment, totalling 12.9 ha, shown shaded in yellow in Figure 3.1. Photograph 2.5 shows the quarry pit and disturbed area surrounds.

Photograph 2.1 Diverted clean water catchment north of the quarry pit

Photograph 2.2 Water Management Dam and adjacent haul road

Photograph 2.3 Oaky Creek adjacent to the quarry pit

Photograph 2.4 **Oaky Creek looking downstream at online storage**

Photograph 2.5 **Quarry pit and surrounding disturbed areas**

3 Water management

3.1 Water management strategy

Table 3.1 summarises the water management objectives and approach that have been applied to establish the water management system.

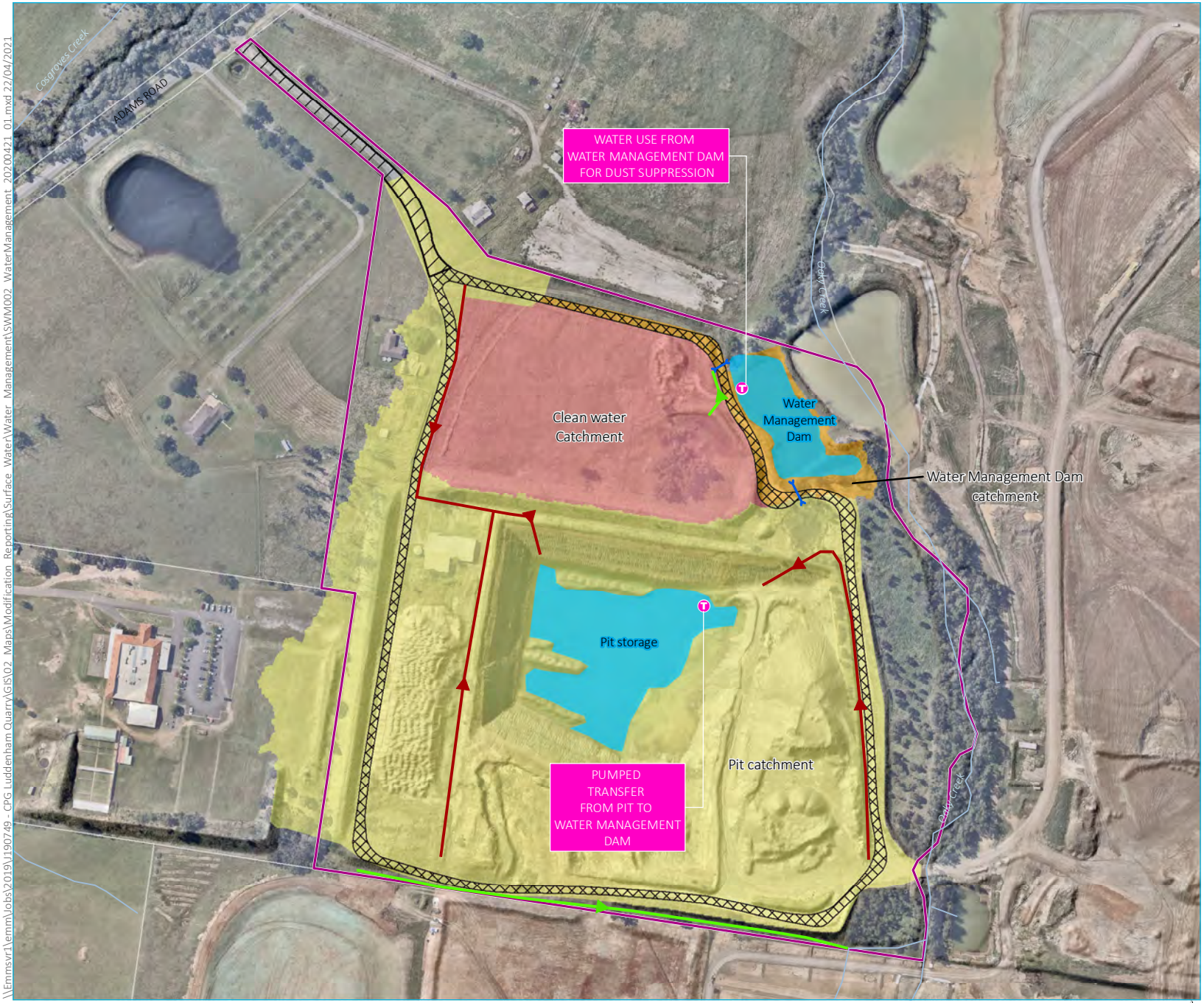
Table 3.1 Water management objectives and approach

Water management objective		Approach
1	Minimise the use of potable water from the public supply for purposes where non-potable water is acceptable and available.	• Water stored in the quarry pit and Water Management Dam is used preferentially for dust suppression over potable water.
2	Maximise the separation of clean and dirty water.	• Diversion channels and drains divert clean water around disturbed areas on site as far as reasonable and feasible. • All sediment-laden runoff is directed into the internal water management system.
3	Minimise the risk of discharges from the site.	• Erosion and sediment control structures sized and maintained generally in accordance with Landcom (2004) and DECC (2008). • Water stored in the quarry pit and Water Management Dam is used for dust suppression on site. • The Water Management Dam is to be always operated with an available capacity of at least 1.5 ML. The Water Management Dam is to be dewatered to the quarry pit following storm events.
4	Minimise the potential for water quality impacts associated with chemical and hydrocarbon spills.	• Chemical and hydrocarbon products will be stored in bunded areas in accordance with relevant Australian Standard AS1940:2004.

The water management system for the site is presented in Figure 3.1. The key water management strategy adopted across the site is containment and management of potentially sediment-laden runoff from disturbed areas and reuse where feasible. The key features of the water management system include:

- diversion of runoff from undisturbed catchments away from disturbed areas and off site;
- collection of all potentially sediment-laden runoff from disturbed areas of the site within the quarry pit and the Water Management Dam; and
- use of stored water within the quarry pit and Water Management Dam for dust suppression of unsealed roads and disturbed areas; and

no water transfers or sharing with neighbouring land users occurs.



KEY

- Study area
- Cadastral boundary
- Watercourse
- Proposed transfer point

Proposed road alignment

- Sealed
- Unsealed

On-site drainage lines

- Clean water diversion
- Piped drainage
- Water management
- Water storages

Sub-catchments

- Clean water catchment
- Pit catchment
- Water Management Dam catchment

Source: EMM (2021); DFSI (2017); GA (2011); ASGC (2006); Nearmap (2020)

0 50 100 m

GDA 1994 MGA Zone 56

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Water management system layout

Luddenham Quarry
Water Management Plan
Figure 3.1

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3.2 Drainage network

The following diversion structures are in place at the site to divert clean runoff around disturbed areas and direct sediment-laden runoff to the Water Management Dam and quarry pit:

- bunds placed around the southern and western quarry boundaries which incorporate a diversion drain to divert clean water around the site;
- quarry walls which act as diversion drains to direct runoff into the quarry pit;
- bund placed on the eastern side of the quarry which incorporates a drain to divert runoff from this area into the quarry pit; and
- drains have also been constructed on the northern and eastern sides of the quarry extraction area to prevent runoff from the quarry leaving the extraction area.

3.3 Water management storages

The Water Management Dam captures runoff from a portion of the unsealed road along the northern boundary and adjacent to the dam. The majority of catchment runoff is directed to the quarry pit, including runoff from stockpiles, equipment laydown area, site entry infrastructure and remaining internal roads, extraction footprint and a minor portion of a neighbouring property's grassed area.

Water stored in the quarry pit is transferred to the Water Management Dam on an as-needs basis to supply dust suppression activities. The dam is operated at a low level, with at least 1.5 ML maintained within the dam to provide sufficient capacity to capture runoff at all times.

Table 3.2 presents a summary of the key water management storage details.

Table 3.2 Water management storage details

Storage	Contributing catchment	Estimated volume	Required volume[1]
Quarry pit	0.4 ha	120 ML[2]	6.4 ML
Water Management Dam	12.9 ha	7 ML[3]	0.2 ML

1. Minimum design volume calculated for a Type D/F storage using the methods recommended by Landcom (2004), as detailed in the surface water assessment (EMM 2020b).
2. Estimated from LiDAR data sourced from ELVIS spatial data (ICSM 2020) based on a nominal minimum volume considered practical within the quarry pit area. The actual volume will vary with the location of stockpiles and operation of the open pit areas, however far exceeds requirements (refer Note 1).
3. The maximum capacity of the Water Management Dam is currently estimated to be 4 ML. The dam will be increased in depth to provide a minimum capacity of 7 ML prior to the reactivation of quarry operations to minimise the risk of off-site discharges from the dam.

3.4 Erosion and sediment control

3.4.1 Disturbance activities

Key aspects of operations at Luddenham Quarry that have the potential to cause soil erosion include:

- site preparatory works including vegetation clearing, topsoil stripping and minor earthworks;
- stockpiling of materials;

- open cut quarrying operations; and
- movement of plant/equipment and transportation of materials within the site.

These activities have the potential to result in soil loss, sedimentation of downstream receiving watercourses and a degradation of water quality. The key areas for activity within the site include:

- the site entry – including entrance road, weighbridge and site office/amenities;
- the quarry extraction area; and
- the quarry haul road and other site access roads.

3.4.2 Erosion and sediment control measures

A range of erosion and sediment control measures will be applied to each area and will be managed in accordance with Landcom (2004) and DECC (2008) guidelines. The site manager will apply a combination of one or more of the erosion and sediment controls provided in Table 3.3 to Table 3.5 based on an assessment of the specific location within each of the quarry areas.

Table 3.3 Drainage, erosion and sediment control options – site entry/office area

Control measure	Purpose
Drainage control	
Lined drains	To convey run-off in a non-erosive manner.
Guttering and down pipes	To convey clean roof runoff from office roof areas.
Erosion control	
Temporary	
Check dams	To reduce flow velocity in drains until permanent drain linings can be installed.
Cover crops	Rapid vegetation establishment until permanent vegetation germinates and grows.
Polymer soil stabiliser	To protect exposed soil from erosion and to control dust.
Permanent	
Slope reduction	To reduce flow velocities below the maximum permissible velocity for the soil.
Revegetation	To protect exposed embankments from erosion from surface flows.
Sediment control	
Temporary	
Check dams	Capture small quantities of coarse sediment in drains.
Sediment fence	To capture coarse sediment in sheet flow environments.
Permanent	
Wheel wash	To remove sediment from light vehicles and trucks to prevent mud tracking to public roads

Table 3.4 Drainage, erosion and sediment control options – quarry extraction area

Control measure	Purpose
Drainage control	
Trafficable cross banks	To divert quarry runoff from the access track to sediment controls.
Lined drains	To convey run-off in a non-erosive manner.
Mitre drains	To divert run-off to reduce the volume and velocity of drainage.
Earth bunds	To contain sediment and turbid run-off to the active quarrying area.
Erosion control	
Temporary	
Check dams	To reduce flow velocity in drains until permanent drain linings can be installed.
Cover crops	Rapid vegetation establishment until permanent vegetation germinates and grows.
Polymer soil stabiliser	To protect exposed soil from erosion and to control dust.
Permanent	
Slope reduction	To reduce flow velocities below the maximum permissible velocity for the soil.
Timber debris	To provide soil surface cover, habitat, rill interruption and to discourage vehicle damage
Revegetation	To cover and stabilise exposed soil, including the completed extraction area and embankments from raindrop splash erosion and surface flows.
Straw based hydromulch/ Hydraulically applied growth medium	To protect newly seeded areas from erosion and allow rapid vegetation establishment.
Rock mulching	To protect steep cut and fill batters from erosion.
Rock energy (stilling pond type)	To reduce flow velocities from drains and culvert outlets to below the maximum permissible velocity for the downstream soil.
Sediment control	
Temporary	
Check dams	Capture small quantities of coarse sediment in drains.
Sediment Fence	To capture coarse sediment in sheet flow environments.
Mulch bunds	To capture medium and coarse sediment in sheet flow environments.
Permanent	
Type D/F sediment basin (quarry pit)	To capture and treat sediment and turbid runoff. Transfers to the Water Management Dam to be completed following settlement of pit water after a storm event.

Table 3.5 Drainage, erosion and sediment control options – access tracks and haul road

Control measure	Purpose
Drainage control	
Lined table drains	To convey track runoff in a non-erosive manner.
Mitre drains	To divert track runoff away from the track to reduce the volume and velocity of drainage.
Trafficable cross banks	To minimise track erosion, disperse water to reduce slope lengths and velocity.
Pipe culvert	To allow clean upstream water to pass through the construction zone without contamination. Maintain natural drainage paths.
Erosion control	
Temporary	
Check dams	To reduce flow velocity in the access track table drains and mitre drains until permanent drain linings can be installed.
Cover crops	Rapid vegetation establishment along track/haul road edges until permanent vegetation germinates and grows.
Trafficable polymer soil stabiliser	To protect exposed soil from erosion and to control dust.
Permanent	
Revegetation	To protect along track/haul road edges from raindrop splash erosion and surface flows.
Straw based hydromulch	To protect newly seeded areas from erosion.
Vegetation mulching	To protect exposed embankments from raindrop splash erosion and surface flows no steeper than 1(v):3(h).
Sediment control	
Temporary	
Check dams	Capture small quantities of coarse sediment in the table drains and mitre drains.
Sediment fence	To capture coarse sediment in sheet flow environments.
Permanent	
Type D/F sediment basin (Water Management Dam)	To capture and treat sediment and turbid runoff. Water Management Dam to be dewatered to provide at least 1.5 ML capacity within five days of a storm event.

3.5 Potable water and wastewater

Potable water for the offices, equipment laydown area and amenities will be sourced from the Sydney Water potable water supply network. Prior to the site being connected to mains water, potable water will be supplied by tanker if required.

Temporary demountable amenities are proposed due to the short remaining life of the quarry (with extraction ceasing in December 2024) and because there will be a low number of site personnel (around 12 employees during normal operating conditions with a maximum of 15 employees during peak operations). Wastewater from these amenities will either be contained in a temporary chemical closet (ie a port-a-loo) or be discharged to a septic holding tank, which will be pumped out by an approved licensed contractor when required.

3.6 Site water balance

3.6.1 Overview

A site water balance has been developed for the quarry to quantify water use and transfers during operations (EMM 2020b). The water balance model applies a continuous simulation methodology that models the response of the water management system under a range of climatic conditions (ie rainfall and evaporation). The model has been developed by representing each process of the water management system with pre-determined responses that reflect how the water management system operates. A schematic of the overall water management system modelled is shown in Figure 3.2.

The water balance model simulated the water management system using 131 years of historical climate data and a daily time step. Daily rainfall and evaporation data for the period 1889 to 2019 was obtained as SILO patched point data (refer Section 2.3) and applied to the model. A summary of annual inputs and outputs of the water management system for the typical dry (10th percentile), median (50th percentile) and wet (90th percentile) rainfall years is provided in Table 3.6.

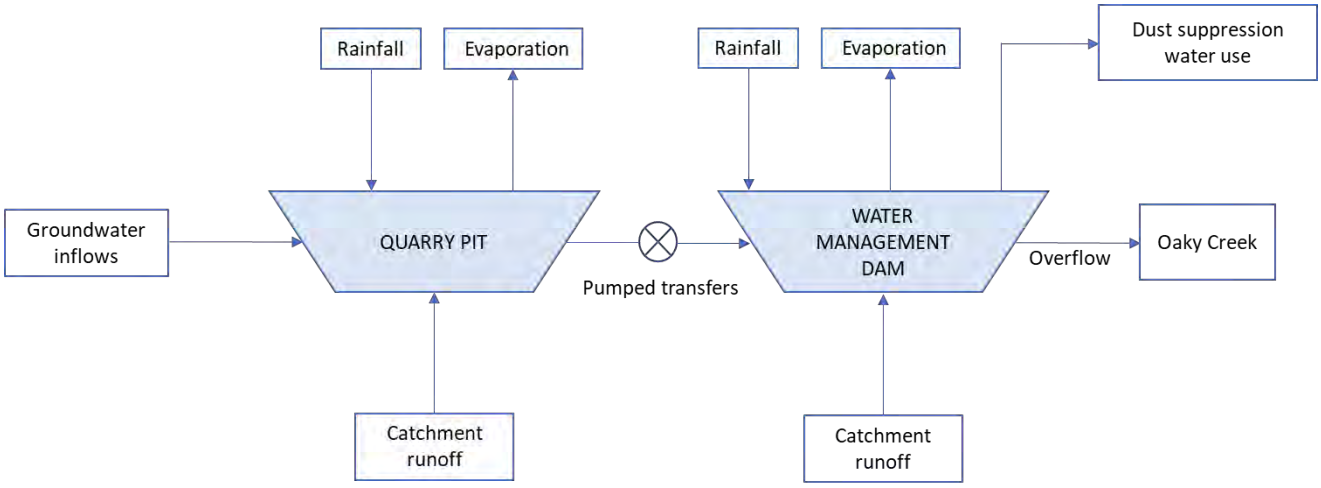

Figure 3.2 Water management system schematic

Table 3.6 Summary of annual water balance results

	Typical dry rainfall year	Typical median rainfall year	Typical wet rainfall year
	ML/year	ML/year	ML/year
INPUTS			
Rainfall and runoff	10.7	21.6	45.6
Groundwater inflows into quarry pit	1.8	1.8	1.8
Potable water supply	0.0	0.0	0.0
Total inputs	12.5	23.4	47.4
OUTPUTS			
Evaporation	6.9	21.7	16.5
Dust suppression	24.1	19.8	16.7
Discharge to Oaky Creek	0.0	0.0	0.0
Total outputs	31.0	41.5	33.2
CHANGE IN STORAGE			
Quarry pit	-18.5	-18.1	14.2
Water Management Dam	0.0	0.0	0.0
Total change in storage	-18.5	-18.1	14.2
BALANCE	0.0	0.0	0.0

3.6.2 Water supply security

Water to meet the site operational demand associated with dust suppression of unsealed roads and disturbed areas is sourced from water stored within the quarry pit, including harvested runoff and groundwater inflows. The water balance results presented in Table 3.6 indicate that in a typical dry (10th percentile) rainfall year, the demand for dust suppression activities was modelled to be met through the use of water stored in the quarry pit. Therefore, there is sufficient water for the development to meet operational water demands. The scale of the development will be adjusted if necessary to match available water supply.

3.6.3 Annual site water balance

An update of the site water balance will be prepared annually to document site water use and compliance with water licensing requirements. Measured rainfall, evaporation, quarry pit water levels and pumped transfers (eg from the quarry pit to the Water Management Dam and for dust suppression) will be used as inputs to the water balance to estimate groundwater take. The results of the annual site water balance will be reported in the annual review for the site (refer Section 7.2).

The annual site water balance will be used to verify groundwater inflows to the quarry pit in wet and dry years. In the event that groundwater inflows are estimated to exceed the entitlement held for Luddenham Quarry, entitlement will be obtained to account for the additional groundwater take. DPIE and DPIE Water will be notified as soon as practicable of the exceedance.

3.7 Discharges to Oaky Creek

There is currently no approval under EPL 21562 to discharge water collected in the quarry pit or Water Management Dam to waterways (refer Section 1.5.2). There are no licensed discharge points or limits specified by EPL 21562.

The Water Management Dam will be operated at a low level, with sufficient capacity to capture catchment runoff at all times. Discharges to Oaky Creek via overflow of the Water Management Dam were predicted by the water balance model to occur once over the 131 year historical rainfall record simulated. No overflows from the quarry pit were modelled to occur.

Prior to any discharge activities from the water management system to Oaky Creek are planned to occur, a discharge characterisation and water pollution impact assessment will be prepared as required by the development consent and approval to discharge will be sought from the EPA.

3.8 Irrigation

No irrigation is currently undertaken at Luddenham Quarry. If irrigation activities are planned to occur, the irrigation management plan (Epic Mining 2015b) will be revised as required by the development consent.

3.9 Flooding

Flood modelling undertaken as part of the environmental impact statement for the WSA (GHD 2016) predicted that the disturbed areas of the quarry site would remain above the limit of flooding along Oaky Creek for all events up to and including the probable maximum flood. As a result, there is no potential for adverse flood impacts associated with quarrying operations and no flood management structures are required.

3.10 Chemical and hydrocarbon control and spill management

Fuel and any hazardous chemicals will be stored in bunded facilities in accordance with NSW government guidelines and Australian Standard AS1940:2004. Maintenance on mobile plant and equipment will be undertaken within a bunded area, unless within the quarry excavation. Hydrocarbon spills (eg a burst hydraulic hose or spill during refuelling) may occur during quarry operations. Spills will be immediately cleaned following the identification of an incident. The clean-up and treatment of spills will be managed under the quarry's *Pollution Incident Response Management Plan* (PIRMP) and internal standards and procedures.

4 Monitoring, inspection and maintenance program

4.1 Monitoring program

4.1.1 Surface water

The objective of the surface water monitoring plan is to collect data to:

- assess the effectiveness of the water management system;
- identify and quantify water quality impacts to receiving waters; and
- assess compliance with any relevant development consent and licence conditions.

Surface water quality monitoring is undertaken at the following locations, as shown in Figure 4.1:

- Oaky Creek upstream of the site;
- Oaky Creek downstream of the site;
- water stored within the quarry pit; and
- water stored within Water Management Dam.

Table 4.1 presents an indicative analytical suite for the site. Samples are analysed annually and once during or after any discharge events. Physical and chemical stressors (with the exception of total suspended solids) are monitored in the field with a calibrated hand-held water quality meter. All other parameters are analysed at a laboratory accredited by the National Association of Testing Authorities (NATA).

Table 4.1 Surface water quality monitoring program

Category	Parameters	Analysis method
Physical and chemical stressors	Dissolved oxygen, electrical conductivity, pH, total dissolved solids, turbidity	In the field with a calibrated hand-held water quality meter
	Total suspended solids	Analysis undertaken at NATA accredited laboratory
Nutrients	Ammonia, nitrate, nitrite, total Kjeldahl nitrogen, total nitrogen, reactive phosphorus, total phosphorus	Analysis undertaken at NATA accredited laboratory
Dissolved metals	Aluminium, arsenic, boron, cadmium, chromium, copper, iron, lead, manganese, nickel, zinc	Analysis undertaken at NATA accredited laboratory
Other	Total hardness, oil and grease	Analysis undertaken at NATA accredited laboratory

All monitoring is undertaken in accordance with Approved Methods for Sampling and Analysis of Water Pollutants in New South Wales (DEC 2004).

KEY

- Study area
- Cadastral boundary
- Watercourse
- Water quality monitoring location
- Groundwater monitoring bore

Water quality monitoring locations

Luddenham Quarry
Water Management Plan
Figure 4.1

Source: EMM (2021); DFSI (2017); GA (2011); ASGC (2006); Nearmap (2020)

0 100 200 m

GDA 1994 MGA Zone 56

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EMM creating opportunities

4.1.2 Groundwater

A groundwater monitoring bore network was installed prior to quarrying to understand the hydrogeology at the site and to monitor for potential impacts. Three monitoring bores (refer Figure 4.1) were drilled and installed to a depth of approximately 30 m into the Bringelly Shale with the overlying unconsolidated material cased off. The monitoring bores were sited with one bore up-hydraulic gradient (BSM1) as a background bore (to the quarry footprint) and two bores down-hydraulic gradient of the pit (BSM2 and BSM3). The two down-hydraulic gradient bores are located along the eastern downslope perimeter of the quarry, outside the 40 m vegetated riparian zone associated with the western banks of Oaky Creek. The BSM2 monitoring bore was reportedly damaged and is receiving rainfall and runoff, resulting in unrepresentative groundwater quality results (refer Section 5.2.2). Prior to the commencement of the monitoring, BSM2 will be rehabilitated or replaced with an equivalent monitoring bore.

Table 4.2 summarises the groundwater monitoring program. Groundwater quality monitoring is undertaken quarterly, with groundwater levels monitored at the same time. Physical and chemical stressors (with the exception of total suspended solids) are monitored in the field with a calibrated hand-held water quality meter. All other parameters are analysed at a laboratory accredited by NATA.

Table 4.2 Groundwater quality monitoring program

Category	Parameters	Analysis method
Physical and chemical stressors	Dissolved oxygen, electrical conductivity, pH, total dissolved solids, turbidity	In the field with a calibrated hand-held water quality meter
	Total suspended solids	Analysis undertaken at NATA accredited laboratory
Nutrients	Ammonia, nitrate, nitrite, total Kjeldahl nitrogen, total nitrogen, reactive phosphorus, total phosphorus	Analysis undertaken at NATA accredited laboratory
Dissolved metals	Aluminium, arsenic, boron, cadmium, chromium, copper, iron, lead, manganese, nickel, zinc	Analysis undertaken at NATA accredited laboratory
Other	Total hardness, oil and grease	Analysis undertaken at NATA accredited laboratory

All monitoring is undertaken in accordance with Approved Methods for Sampling and Analysis of Water Pollutants in New South Wales (DEC 2004).

4.2 Inspection and maintenance program

Inspections of water management structures and erosion and sediment control measures will be undertaken:

- periodically during active operations; and
- as soon as practicable following rainfall events that exceed 40 mm in 24 hours.

The water management structures will be visually inspected for capacity, structural integrity and effectiveness. Maintenance, such as the removal of excessive sediment accumulation or macrophyte growth from the Water Management Dam and drainage lines, will be implemented as required.

5 Baseline data

5.1 Surface water

5.1.1 Surface water flow

There are no available records of streamflow within Oaky Creek. The nearest gauged data is situated in the neighbouring catchment on South Creek. Streamflow regimes in Oaky Creek have been recently modified by the construction of the WSA. Modified flow regimes are a function of:

- consistent low flows from the low flow outlet of the WSA water management system;
- occasional active discharge from the WSA site during construction; and
- infrequent high flows from overflows of the WSA water management system during high rainfall events (estimated to be approximately two to three times a year on average).

The Oaky Creek online storage, downstream of the quarry site, is known to have a consistent water level due to low flow inflows and WSA discharge. Flood conditions near the quarry are described in the surface water assessment (EMM 2020b).

5.1.2 Surface water quality

Two rounds of water quality sampling were undertaken at three locations on Oaky Creek during the preparation of the surface water assessment (EMM 2020b). Monitoring sites are shown on Figure 5.1. Results from these rounds are provided in Table 5.1.

A surface water monitoring program was also undertaken during previous quarry operations. Summary results from previous monitoring is provided in Table 5.2.

Key results for Oaky Creek are summarised as follows:

- Salinity (as indicated by electrical conductivity) has a recent range of 748 µS/cm to 929 µS/cm. Previous monitoring indicated the salinity of Oaky Creek to be above 1,870 µS/cm.
- pH within Oaky Creek, both upstream and downstream of the quarry, was within the default guideline value (DGV) range (refer Section 6.2.1).
- Total suspended solids are generally reported to be low (typically below 50 mg/L); however, elevated concentrations are known to occur following significant rainfall events.
- Nutrient levels are generally low, however phosphorus concentrations at the Oaky Creek upstream site have exceeded the DGVs in the past.
- Metals are generally below standard detection levels, with slight exceedances of the relevant DGVs for dissolved iron at the Oaky Creek upstream site.

Source: EMM (2021); DFSI (2017); GA (2011); ASGC (2006); Nearmap (2020)

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Baseline data water quality locations

Luddenham Quarry
Water Management Plan
Figure 5.1

EMM
creating opportunities

Table 5.1 EIS water quality monitoring

			Sample date	13/10/2020	12/02/2021	13/10/2020	12/02/2021	13/10/2020	12/02/2021
Parameter	**Units**	**LOR**		**Oaky Creek Upstream**		**Online Storage**		**Oaky Creek Downstream**	
Physical and chemical stressors									
pH	-	-		7.9	7.9	7.8	8.4	7.8	8.4
Electrical conductivity	µS/cm	1		851	929	764	748	782	773
Total dissolved solids	mg/L	10		463	472	388	385	398	412
Total suspended solids	mg/L	5		<5	22	50	11	16	40
Major ions									
Total hardness	mg/L	1		148	78	98	50	119	49
Nutrients									
Ammonia	mg/L	0.01		0.03	0.01	<0.01	<0.01	<0.01	0.1
Nitrite	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate	mg/L	0.01		<0.01	0.42	0.07	0.29	0.04	0.22
Oxidised nitrogen	mg/L	0.01		<0.01	0.42	0.07	0.29	0.04	0.22
Total Kjeldahl nitrogen	mg/L	0.1		0.4	0.2	0.2	<0.1	0.2	0.2
Total nitrogen	mg/L	0.1		0.4	0.6	0.3	0.3	0.2	0.4
Total phosphorus	mg/L	0.01		0.01	0.04	0.01	0.01	0.01	0.04
Reactive phosphorus	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dissolved metals									
Aluminium	mg/L	0.01		<0.01	0.04	<0.01	<0.01	<0.01	0.02
Arsenic	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Cadmium	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001		0.001	0.014	<0.001	0.001	<0.001	<0.001
Lead	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001		0.027	0.059	0.144	0.047	0.026	0.038
Nickel	mg/L	0.001		<0.001	0.004	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.005		0.026	0.012	<0.005	<0.005	<0.005	<0.005
Boron	mg/L	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Iron	mg/L	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Table 5.2 Summary of historical surface water quality monitoring results

Parameter	Units	Oaky Creek Upstream		Oaky Creek Downstream	
		Count	Median	Count	Median
Physical and chemical stressors					
Dissolved oxygen	mg/L	1	3.9	1	6.8
Electrical conductivity	µS/cm	1	**11,000**	2	1,870
pH	pH units	26	7.0	26	6.9
Total dissolved solids	mg/L	1	6,720	1	1,420
Total suspended solids	mg/L	26	37	26	14
Nutrients					
Nitrate	mg/L	1	<0.005	1	<0.005
Nitrite	mg/L	1	<0.005	1	<0.005
Total Kjeldahl nitrogen	mg/L	1	3.7	1	0.6
Reactive phosphorus	mg/L	1	**0.174**	1	0.02
Total phosphorus	mg/L	1	**0.4**	1	<0.05
Dissolved metals					
Arsenic	mg/L	1	0.002	1	<0.001
Cadmium	mg/L	1	<0.0001	1	<0.0001
Chromium	mg/L	1	0.001	1	<0.001
Copper	mg/L	1	<0.001	1	<0.001
Iron	mg/L	1	**2.2**	1	0.2
Lead	mg/L	1	<0.001	1	<0.001
Mercury	mg/L	1	<0.00005	1	<0.00005
Nickel	mg/L	1	0.002	1	0.002
Zinc	mg/L	1	0.002	1	0.002
Total metals					
Iron	mg/L	1	5	1	0.6
Other parameters					
Oil and grease	mg/L	25	2.5	25	2.5

5.2 Groundwater

Three monitoring bores exist at the site (refer Figure 4.1), which were drilled to a depth of approximately 30 m into the Bringelly Shale, with the overlying unconsolidated material cased off. The monitoring bores were sited with one bore up-hydraulic gradient (BSM1) as a background bore (to the quarry footprint) and two bores down-hydraulic gradient of the pit (BSM2 and BSM3).

5.2.1 Groundwater levels

The most recent groundwater standing water levels (SWLs) measured in all bores were in November 2017, ranging from 60.37 m AHD (bore BSM1) in the south-west to 46.72 m AHD to the north-east (bore BSM3), with the inferred groundwater flow direction to the north-east mirroring the prevailing topography. However, it is noted that quarrying activities have disrupted natural groundwater flow, with some local groundwater flows likely to be towards the pit. The historic groundwater standing water levels are presented in Figure 5.2.

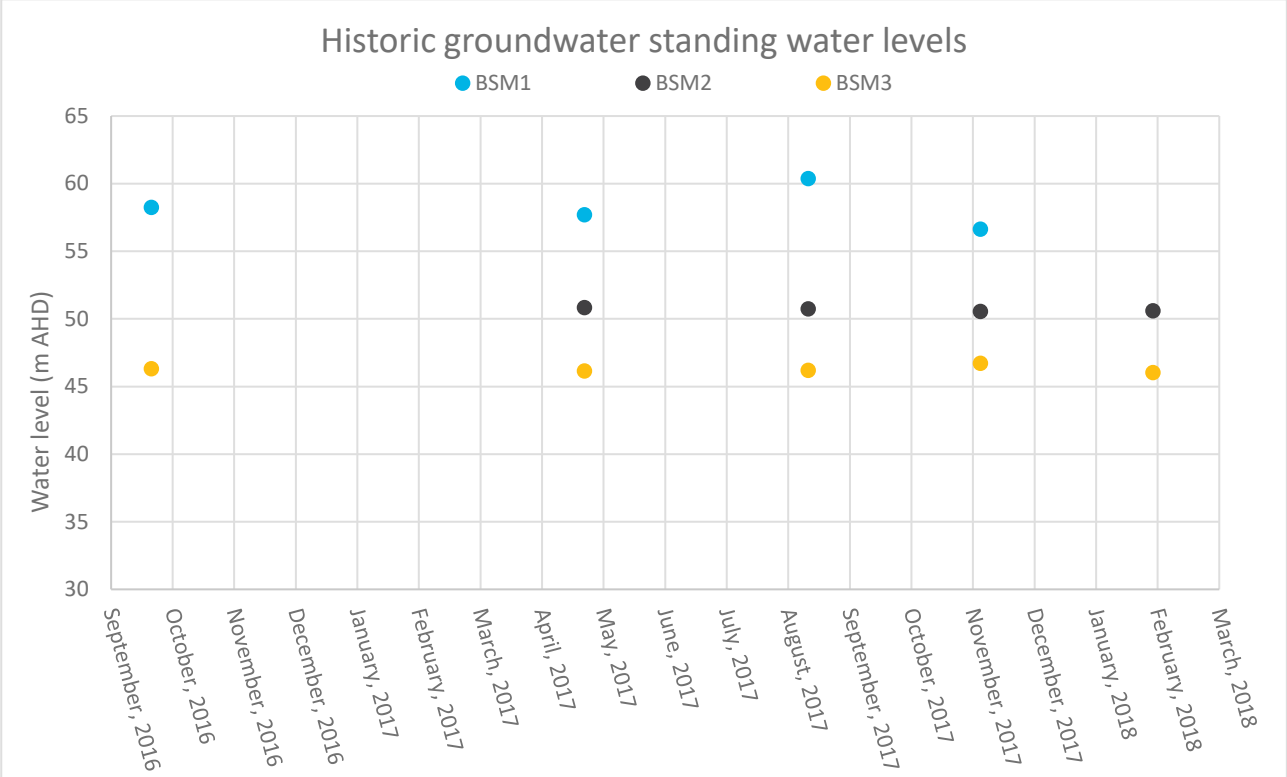

Figure 5.2 Historic groundwater standing levels

5.2.2 Groundwater quality

A summary of groundwater quality monitoring results from October 2016 to February 2018 are presented in Table 5.3. Groundwater monitoring indicates that groundwater is near neutral, saline (total dissolved solids of approximately 18,000 mg/L), and with elevated total nitrogen concentrations (NICS 2017). Relatively low concentrations of metals were also reported for the bores sampled, less than the relevant guideline values. Note that, although bore BSM2 has been sampled, it was considered that rainfall runoff had impacted this previously damaged bore, thus resulting in un-representative groundwater quality results. BSM2 will be rehabilitated or replaced ahead of recommencement of the monitoring program (refer Section 4.1.2).

Table 5.3 Summary of historical groundwater quality monitoring results

Parameter	Units	BSM1		BSM2		BSM3	
		Count	Median	Count	Median	Count	Median
Physical and chemical stressors							
Dissolved oxygen	mg/L	5	1.3	4	1.35	5	1.5
Electrical conductivity	µS/cm	5	23,300	4	1,500	5	23,100
pH	pH units	5	6.7	4	7.2	5	6.7
Total dissolved solids	mg/L	5	18,500	4	1,049	5	17,200
Total suspended solids	mg/L	2	38.5	2	216	2	57
Nutrients							
Nitrate	mg/L	5	0.137	4	21	5	0.010
Nitrite	mg/L	5	0.007	4	0.295	5	<0.005
Total Kjeldahl nitrogen	mg/L	5	5.3	4	4.2	5	9.3
Reactive phosphorus	mg/L	5	0.09	4	0.395	5	0.4
Total phosphorus	mg/L	5	0.016	4	0.7	5	0.050
Dissolved metals							
Arsenic	mg/L	5	<0.001	4	0.007	5	<0.001
Cadmium	mg/L	5	<0.001	4	<0.001	5	<0.001
Chromium	mg/L	5	0.004	4	0.004	5	0.001
Copper	mg/L	5	0.003	4	0.052	5	<0.001
Iron	mg/L	5	2.3	4	0.135	5	8.5
Lead	mg/L	5	<0.001	4	<0.001	5	<0.001
Mercury	mg/L	5	<0.00005	4	<0.00005	5	<0.00005
Nickel	mg/L	5	0.009	4	0.011	5	0.006
Zinc	mg/L	5	0.028	4	0.069	5	0.060
Total metals							
Iron	mg/L	5	4.1	4	5.8	5	11
Other parameters							
Oil and grease	mg/L	2	<5.0	2	<5.0	2	<5.0

6 Action plan

6.1 Unforeseen impacts

In the event of an unforeseen impact associated with surface water or groundwater at Luddenham Quarry, the following procedure will be implemented:

- alert the environmental coordinator and site manager;
- conduct an investigation to identify and assess the contributing factors, including a review of historical monitoring data and relevant operational data;
- develop an appropriate course of action in consultation with specialists and relevant regulatory agencies;
- increase monitoring as required to measure the effectiveness of remediation measures; and
- review the SWMP and related procedures to prevent a reoccurrence of potential future impacts.

6.2 Surface water

6.2.1 Surface water assessment criteria and trigger values

There are no prescribed surface water monitoring criteria in EPL 21562. Notwithstanding, the quarry must comply with Section 120 of the *Protection of the Environment Operations Act 1997* (POEO Act). The surface water monitoring would be undertaken to provide baseline Oaky Creek water quality and determine whether there are any contaminants in the water management system that could infiltrate to the underlying groundwater or Oaky Creek.

The baseline monitoring data (see Section 5.1.2) indicates that Oaky Creek is fresh to brackish with electrical conductivity and turbidity ranges which generally meet the ANZG (2018) DGVs shown in Table 6.1. Water pH levels near the quarry were observed to be slightly acidic with some samples being lower than the DGV range.

Surface water assessment criteria have been developed using the DGVs presented by ANZG (2018). The DGVs provided by ANZECC (2000) are used where a parameter DGV is not yet defined by ANZG (2018). The surface water assessment criteria are provided in Table 6.1.

Table 6.1 Surface water assessment criteria and trigger values

Parameter	Units	Trigger value
General[1]		
pH	-	6.5–8.5
Electrical conductivity[3]	µS/cm	125–2,200
Turbidity	NTU	6–50
Oil and grease	mg/L	Above detection
Nutrients[1]		
Ammonia	µg N/L	20

Table 6.1 Surface water assessment criteria and trigger values

Parameter	Units	Trigger value
Oxidised nitrogen	µg N/L	40
Total nitrogen	µg N/L	500
Reactive phosphorus	µg P/L	20
Total phosphorus	µg P/L	50
Dissolved metals[2]		
Aluminium	µg/L	55
Arsenic[4]	µg/L	13
Boron	µg/L	370
Cadmium	µg/L	0.2
Chromium[5]	µg/L	1.0
Copper	µg/L	1.4
Iron	µg/L	-
Manganese	µg/L	1,900
Nickel	µg/L	11
Lead	µg/L	3.4
Zinc	µg/L	8.0

1. The trigger values for general parameters and nutrients refer to the DGVs for physical and chemical stressors in south-east Australia (lowland river) that are reported in Tables 3.3.2 and 3.3.3 of ANZECC (2000) as DGV is not yet defined by ANZG (2018).
2. Dissolved metal trigger values are for slightly to moderately disturbed ecosystems (ANZG 2018).
3. Table 3.3.3 of ANZECC (2000) specifies NSW coastal rivers typically have salinity values in the range of 200–300 µS/cm. The DGV for salinity in lowland rivers is 125–2,200 µS/cm as a DGV is not yet defined by ANZG (2018).
4. For AS (V).
5. For Cr (VI).

6.2.2 Surface water Trigger Action Response Plan

Surface water monitoring will be undertaken from within the water management system and Oaky Creek (see Section 4.1.1). In accordance with Condition 24 (iii) e, a protocol for identifying and investigating any exceedances of the surface water impact assessment criteria and for notifying DPIE and other relevant stakeholders is provided in the Trigger Action Response Plan (TARP) provided in Appendix B. Table B.1 establishes methods to identify the source of water quality exceedances and if necessary, establish actions to either improve water management or further investigate the exceedance, as well as notifications required.

The surface water TARP and trigger values may be refined in future years as more site-specific surface water data are obtained.

6.3 Groundwater

6.3.1 Groundwater assessment criteria and trigger values

There are no prescribed groundwater water monitoring criteria in EPL 21562. Notwithstanding, this, the quarry must comply with Section 120 of the POEO Act.

Impacts of the development on alluvium and associated surface water sources and groundwater dependent ecosystems will be determined through monitoring of groundwater levels and quality, as described below.

i Groundwater levels

In the absence of prescribed criteria, a deviation of two metres from the long-term median groundwater level in the quarry monitoring bores would be considered a trigger for further action. Two metres was chosen as the deviation value as it aligns with the minimal impact considerations of the aquifer interference activities stated in the NSW Aquifer Interference Policy (DPI 2012).

ii Groundwater quality

Groundwater quality trigger levels can only be satisfactorily developed after sufficient data is collected in the medium term and a natural range of variations is established and assessed. As a preliminary approach, pending the acquisition of longer term data, the DGVs for surface water will be applied as Stage 1 trigger values (refer Section 6.3.2 and Table B.2), except where baseline groundwater conditions are known to exceed the DGVs, including:

- electrical conductivity;
- turbidity; and
- nutrients.

For the interim until longer term data is available, these parameters are to be compared to the upgradient bore (BSM1) to determine if concentrations are increasing over time downgradient of the quarry activities (BSM2 and BSM3). The interim groundwater assessment criteria are provided in Table 6.2.

Table 6.2 Groundwater assessment criteria and trigger values

Parameter	Units	Trigger value
General[1]		
pH	-	6.5–8.5
Electrical conductivity[3]	µS/cm	Comparison with upgradient bore[6]
Turbidity	NTU	Comparison with upgradient bore[6]
Oil and grease	mg/L	Above detection
Nutrients[1]		
Ammonia	µg N/L	Comparison with upgradient bore[6]
Oxidised nitrogen	µg N/L	Comparison with upgradient bore[6]
Total nitrogen	µg N/L	Comparison with upgradient bore[6]
Reactive phosphorus	µg P/L	Comparison with upgradient bore[6]
Total phosphorus	µg P/L	Comparison with upgradient bore[6]
Dissolved metals[2]		
Aluminium	µg/L	55
Arsenic[4]	µg/L	13
Boron	µg/L	370

Table 6.2 Groundwater assessment criteria and trigger values

Parameter	Units	Trigger value
Cadmium	µg/L	0.2
Chromium[5]	µg/L	1.0
Copper	µg/L	1.4
Iron	µg/L	-
Manganese	µg/L	1,900
Nickel	µg/L	11
Lead	µg/L	3.4
Zinc	µg/L	8.0

1. The trigger values for general parameters and nutrients refer to the DGVs for physical and chemical stressors in south-east Australia (lowland river) that are reported in Tables 3.3.2 and 3.3.3 of ANZECC (2000) as DGV is not yet defined by ANZG (2018).
2. Dissolved metal trigger values are for slightly to moderately disturbed ecosystems (ANZG 2018).
3. Table 3.3.3 of ANZECC (2000) specifies NSW coastal rivers typically have salinity values in the range of 200–300 µS/cm. The DGV for salinity in lowland rivers is 125–2,200 µS/cm as a DGV is not yet defined by ANZG (2018).
4. For AS (V).
5. For Cr (VI).
6. Parameter known to frequently exceed the DVG. Long term trend comparison to upgradient bore (BSM1) is most appropriate means of assessment.

6.3.2 Groundwater Trigger Action Response Plan

Groundwater monitoring will be undertaken from the three site monitoring bores (see Section 4.1.2). In accordance with Condition 24 (iv) c, a protocol for identifying and investigating any exceedances of the groundwater impact assessment criteria and for notifying DPIE and other relevant stakeholders is provided in the TARP provided in Appendix B. Table B.2 establishes methods to identify the source of groundwater quality exceedances and if necessary, establish actions to further investigate the exceedance.

The groundwater TARP and trigger values may be refined in future years as more site-specific groundwater data are obtained.

7 Compliance management

7.1 Training

All employees and contractors will be provided with training to ensure the necessary skills and knowledge to competently complete required tasks, with awareness of the potential environmental hazards and risks. Site induction training will address elements including:

- erosion and sediment control implementation;
- minimisation of water quality impacts;
- reuse and discharge of water;
- incident response; and
- spill management and reporting.

7.2 Reporting

7.2.1 Annual review

Luddenham Quarry prepares an annual environmental management report (known as an annual review) that reviews the performance of operations against the requirements of the SWMP, provides an overview of environmental management actions taken and summarises the monitoring results over the 12 month reporting period. The annual review typically includes the following elements specific to soil and water management:

- any amendments to licensing or statutory approvals;
- a summary of complaints or incidents relating to the performance of the water management system over the reporting period;
- a summary of the monitoring results collected over the reporting period and assessment against any relevant criteria;
- an evaluation of any trends in the monitoring results occurring over the life of the operation;
- annual update of site water balance (refer Section 3.6.3);
- a summary of water extracted from the site (direct and indirect), including water taken under any WAL;
- any non-compliance recorded during the reporting period and the actions taken to ensure compliance;
- identification of any discrepancies between the predicted and actual impacts of operations and an analysis of the potential cause of any significant discrepancies; and
- a summary of management actions to be implemented over the next year to improve the environmental performance of the site.

The annual reviews for the previous five years will be made publicly available on the Luddenham Quarry website.

7.2.2 Annual return

EPL 21562 requires an annual report (known as an annual return) on compliance with the requirements of the licence, including a summary of environmental monitoring. This report is on a prescribed form provided to the licence holder by the EPA.

7.2.3 Environmental monitoring

In accordance with Section 66(6) of the POEO Act and requirements issued by the EPA, all monitoring data that has been collected as a result of EPL requirements must be made publicly available.

Regular reporting on the environmental performance of the Luddenham Quarry will be made publicly available on its website.

7.2.4 Incident and non-compliance reporting

Any incident that occurs within the site boundary or is associated with Luddenham Quarry's operations must be reported by the employee or contractor who has been associated with or witnessed the incident. An incident is defined by development consent DA 315-7-2003 as a set of circumstances that:

- causes, or threatens to cause, material harm to the environment; and/or
- breaches or exceeds the limits or performance measures/criteria in the development consent.

The Department of Planning, Industry and Environment (DPIE) is required to be notified immediately following an incident via the NSW Planning Portal. Where an incident results in a non-compliance with development consent DA 315-7-2003, DPIE and any relevant agencies are required to be notified with the following information within seven days:

- the non-compliance;
- the reasons for the non-compliance (if known); and
- what actions have been taken, or will be taken, to address the non-compliance.

In accordance with the requirements of EPL 21562 and POEO Act, any employee or contractor must notify EPA and any relevant agencies of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident. Notifications must be made by telephoning the Environmental Line service on 131 555. Written details of the notification to the EPA must be provided within seven days of the incident.

7.2.5 Complaints

In accordance with the requirements of EPL 21562, a record of any complaints made to any employee or contractor in relation to activities conducted at the site. The record of complaint must be kept for at least four years and must include the following details:

- date and time of the complaint;
- method by which the complaint was made;
- any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to the that effect;
- nature of the complaint;
- action taken in relation to the complaint, including any follow-up contact with the complainant; and
- if no action was undertaken in relation to the complaint, the reasons why no action was taken.

A complaints register will be made publicly available on the Luddenham Quarry website and will be updated monthly.

7.3 Independent environmental audit

Every three years, an independent environmental audit of the quarry is undertaken by a suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Planning Secretary. The audit includes:

- consultation with relevant authorities;
- assessment of the environmental performance of the quarry, including compliance with the approval and licence requirements detailed in Section 1.5;
- review the adequacy of this SWMP; and
- recommend measures or actions to improve the environmental performance of the quarry and/or this SWMP.

Within six weeks of the completion, the audit report is submitted to the Planning Secretary, along with a response to any recommendations. The audit will also be made publicly available on the Luddenham Quarry website.

7.4 SWMP review

This SWMP will be reviewed and revised as necessary within three months of:

- the submission of an incident report, as detailed in Section 7.2.4;
- the submission of an annual review, as detailed in Section 7.2.1;
- the submission of an independent environmental audit, as detailed in Section 7.3; or
- the approval of any modification of the development consent DA 315-7-2003 conditions.

This SWMP will also be reviewed and revised as necessary to incorporate any measures recommended to improve the environmental performance of the quarry. The plan will be submitted to the Planning Secretary within six weeks of any revision.

7.5 Access to information

The approved WMP, monitoring results, complaints register and independent environmental audits will be made available publicly on the Luddenham Quarry website. This information will be kept up-to-date to the satisfaction of the Planning Secretary.

8 References

ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, National Water Quality Management Strategy, Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand.

ANZG (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australian and New Zealand Governments and Australian state and territory governments, http://www.waterquality.gov.au/anz-guidelines/.

Bannerman, S.M. and Hazelton, P.A. (1990). *Soil Landscapes of the Penrith 1:100,000 Sheet.* Soil Conservation Service of NSW, Sydney.

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

DECC (2008) *Managing Urban Stormwater: Soils and Construction – Volume 2E Mines and Quarries*, NSW Department of Environment and Climate Change.

Douglas Nicholaisen & Associates Pty Ltd (2003) *Environmental Impact Statement: Proposed Clay/Shale Extraction Operation*, prepared for Badger Mining Company Pty Limited.

DPI (2012) *NSW Aquifer Interference Policy: NSW Government policy for the licensing and assessment of aquifer interference activities*, NSW Department of Primary Industries, Office of Water.

EMM (2020a) *Luddenham Quarry Modification 5: Groundwater Assessment*, prepared by EMM Consulting Pty Ltd.

EMM (2020b) *Luddenham Quarry Modification 5: Surface Water Assessment*, prepared by EMM Consulting Pty Ltd.

Epic Mining (2015a) *275 Adams Road, Luddenham NSW: Erosion and sediment control plan*. Epic Mining Pty Ltd.

Epic Mining (2015b) *275 Adams Road, Luddenham NSW: Irrigation management plan*. Epic Mining Pty Ltd.

GHD (2016) *Western Sydney Airport: Surface Water Hydrology and Geomorphology*, prepared by GHD Pty Ltd for Commonwealth Department of Infrastructure and Regional Development.

ICSM (2020) *ELVIS – Elevation and Depth – Foundation Spatial Data*, Intergovernmental Committee on Surveying and Mapping, https://elevation.fsdf.org.au/.

Landcom (2004) *Managing Urban Stormwater: Soils and Construction – Volume 1*, 4th edition.

NICS (2017) *Groundwater Monitoring Program: Epic Mining Pty Limited*, prepared by National Integrated Creative Solutions.

Appendix A

Consultation

Contact: Natural Resources Access Regulator
Phone: 1800 633 362
Email: nrar.enquiries@nrar.nsw.gov.au

Our ref: DOC21/241167, V20/23504#1

20 September 2021

Janet Krick
Level 3, 175 Scott Street
Newcastle NSW 2300

Uploaded to the Major Projects Portal

Dear Janet Krick,

Re: Luddenham Quarry (DA 315-7-2003) Soil and Water Management Plan

Thank you for giving the Department of Planning, Industry and Environment – Water (DPIE-Water) the opportunity to review Luddenham Quarry (DA 315-7-2003) Soil and Water Management Plan.

Department of Planning, Industry and Environment - Groundwater Management & Science Team (DPIE-Water) recommends the following:

Required prior to approval:

1. Update the WMP to include a revised water balance which clearly demonstrates evidence of water available for operations demands, and verifies groundwater inflow to the quarry in wet and dry years and on average.
2. Demonstrate they hold sufficient WAL units to account for the groundwater inflows into the quarry pit and which will then be used on site.
3. Include details of the EPL requirements (when and if granted) for any discharges from site to Oakey Creek in the WMP.

Not required prior to approval:

4. Update the WMP's monitoring provisions to include:
    a) Details of the baseline groundwater data and descriptions in the existing conditions section (propose a referenced appendix of monitoring bore hydrographs).
    b) Quarterly monitoring of groundwater levels and quality at a minimum.
    c) Rehabilitation or replacement of the non-functioning monitoring bore BSM2 prior to commencement of activities.
    d) Specific timeframes in the TARP.

Should you have any further queries in relation to this submission please do not hesitate to contact the Natural Resources Access Regulator's Service Support Team at nrar.servicedesk@dpie.nsw.gov.au.

Yours Sincerely

Jane Curran
A/Manager Licensing & Approvals
Water Regulatory Operations
Natural Resources Access Regulator

Janet Krick

From: Kieran Henry <Kieran.Henry@epa.nsw.gov.au>
Sent: Wednesday, 28 July 2021 2:33 PM
To: Janet Krick
Cc: Phil Towler
Subject: RE: Luddenham Quarry - DA 315-7-2003 - Management Plans

Hi Janet,

The EPA's position on post approval management plans (including the NMP, AQMP and SWMP) is to encourage the development of such plans to ensure that proponents have determined how they will meet their statutory obligations and designated environmental objectives.

However, we do not approve or endorse these documents as our role is to set environmental objectives for environmental management and not to be directly involved in the development of strategies to achieve those objectives. Therefore we will not be providing comments on the NMP, AQMP and SWMP.

These documents are important for our decision making, such as with the licence application, and ensure compliance with s45 of the POEO Act and to support those decisions.

I expect to send a draft EPL to Luddenham Operations Pty Ltd by the end of the week.

Regards,

Kieran

From: Janet Krick <jkrick@emmconsulting.com.au>
Sent: Wednesday, 28 July 2021 7:58 AM
To: Kieran Henry <Kieran.Henry@epa.nsw.gov.au>
Cc: Phil Towler <ptowler@emmconsulting.com.au>
Subject: RE: Luddenham Quarry - DA 315-7-2003 - Management Plans

Good morning Kieran,

Following up on my email below – are you able to provide an update on when we may expect EPA's comments on the draft management plans and status of the EPL application?

Many thanks

Janet Krick
Associate Environmental Planner

T 02 4907 4811
M 0456 664 212
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From: Janet Krick
Sent: Wednesday, 14 July 2021 2:39 PM
To: Kieran Henry <Kieran.Henry@epa.nsw.gov.au>

Recommendation	Response
Required prior to approval	
1 Update the WMP to include a revised water balance which clearly demonstrates evidence of water available for operations demands, and verifies groundwater inflow to the quarry in wet and dry years and on average.	Section 3.6 provides the current annual water balance for the site. Water to meet the site operational demand associated with dust suppression of unsealed roads and disturbed areas is sourced from water stored within the quarry pit, including harvested runoff and groundwater inflows. The water balance results presented in Table 3.6 indicate that for all climatic conditions assessed, the demand for dust suppression activities was modelled to be met through the use of water stored in the quarry pit. The predicted quantity of groundwater to be intercepted by the quarry pit was modelled to be a constant 5 m^3/day, based on the original groundwater assessment undertaken for the quarry (Douglas Nicolaisen & Associates 2003). Therefore, groundwater inflows simulated in the water balance model were average values and not predicted to vary with rainfall.
2 Demonstrate they hold sufficient WAL units to account for the groundwater inflows into the quarry pit and which will then be used on site.	Section 1.5.3 has been updated to include details of water entitlement held to account for groundwater inflows into the quarry pit.
3 Include details of the EPL requirements (when and if granted) for any discharges from site to Oakey Creek in the WMP.	Section 1.5.2 has been updated to include details of EPL 21562.
Not require prior to approval	
4 Update the WMP's monitoring provisions to include:	
a) Details of the baseline groundwater data and descriptions in the existing conditions section (propose a referenced appendix of monitoring bore hydrographs).	Section 5.2.1 has been updated to include all available historic groundwater standing levels.
b) Quarterly monitoring of groundwater levels and quality at a minimum.	Section 4.1.2 has been updated to include quarterly monitoring of groundwater levels and quality.
c) Rehabilitation or replacement of the non-functioning monitoring bore BSM2 prior to commencement of activities.	As noted in Section 4.1.2, groundwater monitoring bore BSM2 will be rehabilitated or replaced with an equivalent monitoring bore prior to the commencement of monitoring.
d) Specific timeframes in the TARP.	Appendix B has been updated to include timeframes.

Appendix B

Trigger Action Response Plans

Table B.1 Surface water Trigger Action Response Plan

Water management aspect	Normal conditions	Stage 1 – Low hazard	Stage 2 – Non-compliance	Notifications
Water Management Dam storage volume	Storage captures events up to and including the design event (ie five-day rainfall total of 48.8 mm (refer to the surface water assessment EMM 2020b). At least 1.5 ML available capacity within Water Management Dam.	**Trigger:** Less than 1.5 ML available capacity with Water Management Dam. **Action:** Investigate storage operation and dewatering operations. Undertake dewatering of Water Management Dam to the Quarry Pit. Increase inspection frequency as required. Undertake education for all staff.	**Trigger:** Storage is discharging as a result of a storm event less than the design criteria. **Action:** Implement immediate actions to stop, or if not immediately possible, control the discharge. Undertake dewatering of Water Management Dam to Quarry Pit. Increase inspection frequency as required. Undertake water quality sampling of Water Management Dam and Oaky Creek locations.	**Stage 1:** Notify environmental coordinator and site manager as soon as practicable. **Stage 2:** Notify relevant agencies in accordance with Section 7.2.4. Immediate notification to DPIE via the NSW Planning Portal. Written incident notification within seven days to DPIE and EPA. As well as the information required for all incidents (refer Section 7.2.4), the report will include the following information: • location of overflow event; • time at which overflow event commenced and ceased; • duration of overflow event; and • estimated volume of overflow.

Table B.1 Surface water Trigger Action Response Plan

Water management aspect	Normal conditions	Stage 1 – Low hazard	Stage 2 – Non-compliance	Notifications
Erosion and sediment control	All controls are appropriately in place and well maintained. No unstable disturbance areas of migration of sediment away from disturbance areas.	**Trigger:** One or more areas of notable surface erosion or other movement of sediment from an area of disturbance. Controls are not maintained or are inappropriately installed. **Action:** Seek to stabilise the area to stop the erosion process. This can include the use of groundcover or other temporary measures. Investigate works undertaken prior to the disturbance activities.	**Trigger:** Controls are not in place. Rainfall event has led to sediment migrating off site. **Action:** Isolate the area through diverting contributing surface flows to another appropriate control structure. Increase inspection frequency as required. Undertake water quality sampling of Water Management Dam and Oaky Creek locations. Undertake education for all staff.	**Stage 1:** Notify environmental coordinator and site manager as soon as practicable. **Stage 2:** Notify relevant agencies in accordance with Section 7.2.4. Immediate notification to DPIE via the NSW Planning Portal. Written incident notification within seven days to DPIE and EPA.
Clean water diversions	Clean water diverted around disturbed areas.	**Trigger:** Clean water catchment is draining to water management system. **Action:** Review catchment plan. Review design capacity of clean water system.	N/A	**Stage 1:** Notify environmental coordinator and site manager as soon as practicable.

Table B.1 Surface water Trigger Action Response Plan

Water management aspect	Normal conditions	Stage 1 – Low hazard	Stage 2 – Non-compliance	Notifications
Receiving water quality	Water quality at monitoring locations is within or below the values specified in Table 6.1.	**Trigger:** Water quality is outside or above the values presented in Table 6.1. **Action:** Investigate the source of the exceedance and develop corrective/preventative actions based on outcomes.	**Trigger:** Investigation into Stage 1 trigger identifies that trigger exceedance is due to an operational activity. **Action:** Implement corrective/preventative actions in consultation with relevant agencies based on the outcomes of the investigation. Review the SWMP and related procedures to prevent reoccurrence.	**Stage 1:** Notify environmental coordinator and site manager as soon as practicable. **Stage 2:** Notify relevant agencies in accordance with Section 7.2.4. Immediate notification to DPIE via the NSW Planning Portal. Written incident notification within seven days to DPIE and EPA.

Table B.2 Groundwater Trigger Action Response Plan

Water management aspect	Normal conditions	Stage 1 – Low hazard	Stage 2 – Non-compliance	Notifications
Quarterly groundwater level	Groundwater levels are within two metres from the long-term median groundwater levels.	**Trigger:** Groundwater levels are outside of two metres from the long-term median groundwater levels. **Action:** Continue to monitor and assess water level data, establish trends and correlate with quarry activities and climatic data. Determine whether any decrease in water level may be due to impacts from the quarry. Calculate and assess any distance drawdown effects with respect to any neighbouring water users (bores).	**Trigger:** Results of Stage 1 investigations indicate that decrease in water levels may be due to impacts from the quarry operations. **Action:** Increase monitoring and engage hydrogeological specialist to assess and confirm groundwater level impacts are associated with the quarry operations. Work with regulators to determine necessary remediation actions.	**Stage 1:** Notify environmental coordinator and site manager as soon as practicable. **Stage 2:** Notify relevant agencies in accordance with Section 7.2.4. Immediate notification to DPIE via the NSW Planning Portal. Written incident notification within seven days to DPIE and EPA.
Annual groundwater inflows into the active extractive area	Groundwater inflow lower than the licenced volume (2 ML/year).	**Trigger:** Groundwater inflow into the pit estimated to be greater than the licensed volume (2 ML/year). **Action:** Review groundwater level data and determine cause of unexpected inflows. Obtain additional entitlement for the Sydney Basin Central Groundwater Source to account for additional groundwater take.	N/A	**Stage 1:** Notify DPIE and DPIE Water as soon as practicable of licence exceedance.

Table B.2 Groundwater Trigger Action Response Plan

Water management aspect	Normal conditions	Stage 1 – Low hazard	Stage 2 – Non-compliance	Notifications
Quarterly groundwater quality	Groundwater quality is within or below the values specified in Table 6.1.	**Trigger:** Groundwater quality is outside or above the values presented in Table 6.1. **Action:** Undertake investigate to determine if the change in groundwater quality is related to quarry operations.	**Trigger:** Investigation into Stage 1 trigger identifies that trigger exceedance is due to an operational activity. **Action:** Implement corrective/preventative actions in consultation with relevant agencies based on the outcomes of the investigation. Review the SWMP and related procedures to prevent reoccurrence.	**Stage 1:** Notify environmental coordinator and site manager as soon as practicable. **Stage 2:** Notify relevant agencies in accordance with Section 7.2.4. Immediate notification to DPIE via the NSW Planning Portal. Written incident notification within seven days to DPIE and EPA.