Bringelly Brickworks Water Management Plan

GLOSSARY AND ABBREVIATIONS

BoM	Australian Bureau of Meteorology
CoA	Conditions of Approval for SSD_5684,
CSR	CSR Limited
DPI&E	Department of Planning Industry & Environment
DPI Water	Department of Industry Water
EIS	Bringelly Brickworks Quarry Extension Environmental Impact Statement (Hyder Consulting, 5 September 2013)
EMS	Environmental Management Strategy
EP&A Act	Environmental Planning and Assessment Act 1979
EPA	NSW Environment Protection Authority
OEH	NSW Office of Environment & Heritage
PIRMP	Pollution Incident Response Management Plan
PGH	PGH Bricks
POEO Act	Protection of the Environment Operations Act 1997
RTS	Bringelly Brickworks Quarry Extension Response to Submissions
Secretary, the	The Secretary of the DP&E
SSD	State Significant Development
TSP	Total Suspended Particulate Matter
VGT	VGT – Environmental Compliance Solutions Pty Ltd – Approved Consultant
WMS	Work method statements
WMP	Water Management Plan

Document Control

Version	Date	Description of Change
3	Dec 2019	Original approval after consultation
4	Dec 2020	Minor Changes only, format, layout and history update.

Contents

1. INTRODUCTION

1.1 Context

This Water Management Plan (WMP or Plan) forms part of the Environmental Management Strategy (EMS) for the Bringelly Brickworks (the facility) owned and operated by PGH Bricks and Pavers Pty Ltd (PGH). The Plan has been prepared following the approval of the Bringelly Brickworks Extension Project (SSD_5684) on 3 March 2015 and a Section 96(1A) modification application (MOD1), which was determined on 31 October 2016.

This WMP has been prepared to address the requirements of the Conditions of Approval (CoA) as updated following the determination of MOD1, the mitigation measures listed in the Bringelly Brickworks Quarry Extension Environmental Impact Statement (EIS) and all applicable legislation, licenses and permits.

All relevant environmental plans were prepared and submitted to the Department of Planning, Infrastructure and Environment (DPIE) in 2017 & 2019, this plan represents an updated version to reflect minor amendments in the Dec 2020 review.

1.2 Background

Bringelly Brickworks (the facility) is a clay/shale quarry and brick making facility located at 60 Greendale Road, Bringelly, on Lot 100 in DP 1203966 and comprises an area of approximately 385.55 hectares (refer Figure 1) in the Camden Local Government Area. The facility has been in operation since 1968, and in its original form it had the capacity to process approximately 51,500 tonnes of bricks per annum.

In 1991, Boral Bricks (NSW) Pty Limited undertook to upgrade the facility with new technology and increase production to ensure the continued economic viability of the site due to the age of the manufacturing plant and machinery. The Council of the Municipality of Camden, as the approving authority at the time, approved the Development Application on 13 September 1991 (Council ref. DA 91/1194). From 1991 until 2013, the Bringelly Brickworks facility operated under this approval, which permitted (among other things) quarry extraction up to 200,000 tonnes per annum, the receipt of up to 96,000 tonnes of supplementary materials and brick production up to 160,000 tonnes per annum.

In 2013, Boral Bricks Pty Limited (Boral) prepared an Environmental Impact Statement (EIS) to assess the environmental impacts of an increase in production at the facility and continued extraction of the quarry to meet the anticipated demand for its brick products ('Bringelly Brickworks Extension Project', Application No. SSD_5684). The project was determined to be State Significant Development (SSD) under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and Clause 8 *State Environmental Planning Policy (State and Regional Development) 2011* (State and Regional Development SEPP).

The EIS was publicly exhibited from 6 November 2013 to 9 December 2013. The then Department of Planning & Environment (DPI&E) received 12 submissions during this period, including 11 from public authorities and 1 submission from the general public who objected to the project due to its potential impacts. While none of the government authorities objected to the project, most raised concerns about its potential impacts and/or made recommendations for managing these impacts.

Boral prepared and submitted an initial Response to Submissions (RTS) to the DPI&E in February 2014. However, following receipt of the RTS, DPI&E received further correspondence from 7 public authorities which necessitated further consultation between Boral, DPI&E and the relevant government

authorities.

The additional consultation was resolved and in February 2015 DPI&E finalised their Environmental Assessment Report and the Bringelly Brickworks Extension Project was approved with conditions on 3 March 2015.

On 1 May 2015, CSR Limited (CSR) and Boral Limited (Boral) formally completed the establishment of a joint venture for operations located in New South Wales, Victoria, Queensland, South Australia, Tasmania and the ACT. Ownership of Bringelly Brickworks (including quarrying activities) was transferred to the joint venture Boral CSR Bricks Pty Ltd (BCB), trading as PGH Bricks & Pavers. PGH Bricks & Pavers (PGH) was the controlling entity of the facility and responsible for implementing the Environmental Management Strategy of the

site. On 31 October 2016 CSR agreed to acquire Boral's interest in BCB, therefore resulting in CSR owning 100% of PGH. BCB no longer exists

Since Project Approval, the type of bricks demanded by the market have changed and Boral Bricks withdrew from the site. These two critical factors necessitated PGH to review its manufacturing requirements to ensure the most efficient use of all the resources available. To manufacture the bricks demanded by the market, the type, composition and quantity of the raw materials to be imported to Bringelly Brickworks was reconsidered because the type of raw materials required could not be solely extracted from the Bringelly quarry. PGH therefore applied to DPI&E to modify SSD_5684 under Section 96(1A) of the *Environmental Planning and Assessment Act 1979* (EP&A Act), to provide for an increased raw material import limit to 321,000 tonnes per annum (referred to as MOD1). MOD1 was approved by DPI&E on 31 October 2016.

Bringelly Brick Works continued to operate under DA 91/1194, however approval for State Significant Development (SSD 5684) was issued in March 2015 for the extension of the quarry and to upgrade ancillary infrastructure.

Schedule 2, Condition 9 of SSD 5684 required PGH to surrender DA 91/1194 following commencement of development, as approved in SSD 5684. The SSD was triggered on 24 Feb 2020, and DA 91/1194 was surrendered to Camden Council.

In anticipation of the surrender of DA 91/1194, draft management plans were prepared in accordance with SSD 5684 and submitted to the Department of Planning and Environment (DPI&E) on 21 February 2017 for comment. Consultation regarding these plans continues as required and modified plans were submitted for approval by DPI&E in Dec 2019. They were subsequently approved in Dec 2019.

A water quality assessment was completed as part of the EIS for the project by specialist water quality consultants, Hyder (2013). This assessment provided a quantitative assessment of potential water quality impacts associated with the project, including:

- Construction and operational impacts, with a focus on processing and water discharge;
- Reasonable and feasible mitigation measures to minimise water quality impacts; and
- Monitoring and management measures, in particular real-time water quality monitoring.

This plan has been drafted by VGT and PGH and prepared to comply with the requirements of the modified SSD_5684.

1.3 WMP Approval

The Conditions of Approval relevant to this WMP and how they are met by this plan are outlined in *Table 1*.

This WMP must have also been endorsed by the Plant Manager and National Environmental Manager prior to submission to the Secretary of the Department of Planning, Infrastructure and Environment (DPIE).

The WMP is required to be submitted to the Secretary of the DPIE for approval prior to commencing the development approved in SSD_5684, unless the Secretary agrees otherwise. (submitted and approved Dec 2019)

1.4 Consultation

As outlined in the CoA (refer *Table 1*), this Plan has been prepared in consultation with the EPA and DPIE- Water previously (refer to *Annexure to this report- Water Management Consultation and Correspondence*). A version of this Plan was provided to the EPA and NRAR on Tuesday, 17 September 2019 for comment. The EPA responded acknowledging receipt of this Plan. The NRAR also responded acknowledging receipt of this Plan.

The EPA stated in their correspondence that they do not approve or endorse the Plan as their role is to set environmental objectives for environmental management, not to be directly involved in the development of strategies to achieve those objectives. NRAR had no comment on the Water Management Plan

A previous draft plan has been submitted the DPIE post approval and comments were provided (see Annexure to this report- *Water Management Consultation and Correspondence*). An amended draft plan was submitted in August 2019 and further comments were in turn received from DPIE. The table below summarises these comments relevant to water management of the Site that require actions and where addressed in this report.

Table 1. DPIE Post Approval Environmental Management Plan Comments

Relevant Consent Condition	Comment (from Attachment A)	Where Addressed in this Report
a) Be prepared by a suitably qualified and experienced person/s approved by the Secretary;	Append evidence of approval	Appendix B
b) Be prepared in consultation with the EPA and DPIE Water	Further consultation required	Annexure to this report- Water Management Consultation and Correspondence
A Site Water Balance that: includes details of: • Quantity of water required to support operations; • sources and security of water supply; • water use and management on site;	See Section 4.9 and 4.10 – Please include specific section references to the Managing Urban Stormwater, Soils and Construction, Volume 2E Mines and Quarries guidelines. Not satisfied	Section 4.9 & 4.10
• Reporting procedures; and • Measures to be implemented to minimise potable water use on site.	See Section 12.6 – Please include further details from conditions 4, 7 and 8 of Schedule 5. Not Satisfied.	Section 11.6
(ii) Surface Water Management Plan, that includes: • baseline data on surface water flows and quality in watercourses that could be affected by the development;	See Section 4.5 and 4.6 – Please include empirical baseline data within the report. Not Satisfied.	Section 4.5 & 4.6

Relevant Consent Condition	Comment (from Attachment A)	Where Addressed in this Report
• a description of the surface water management system on site including:		
○ clean water diversion system;	See Figure 4 – Please clearly indicate clean water diversions on the figure. Not Satisfied.	Figure 3, Figure 4 & Figure 7
○ erosion and sediment controls;	See Section 6 – Please provide further details of erosion and sediment controls including specific section references to the "Blue Book". Not Satisfied.	Section 6
○ dirty water management system; and	See Figure 4 – Please clearly indicate dirty water flow directions on the figure. Not Satisfied.	Figure 3, Figure 4 & Figure 7
○ water storages (addressing maximum harvestable rights if applicable);		
• A program to monitor and report on:		
○ Any surface water discharges	See Section 8.1 and 8.2 – Please include water quality limits from the EPL in the WMP. Not Satisfied.	Section 8.1 & 8.2
○ the effectiveness of the water management system;	See Section 12.6 – Please include specific requirements of consent condition. Not Satisfied.	Section 11.6
○ surface water flows and quality in local watercourses; and	See Section 8.2 – Please include Appendix F and further details on how water quality in local watercourses will be monitored Not Satisfied.	Section 8.2 Appendix D

Other Comments	
Please update all references of "NOW" to "DPIE-Water"	Whole document
The Department requires clear statements i.e. replace "should" references with "will" etc.	Whole document
Several tables are mislabelled or omitted from the document.	Whole document
Table 13 has been cut off. Please amend.	Table 13

2 PURPOSE AND OBJECTIVES

2.1 Purpose

The purpose of this Plan is to describe how PGH proposes to manage potential water impacts generated by the facility. This document has been prepared to satisfy the SSD_5684 MOD1 conditions of consent requiring a Water Management Plan for Surface Water.

2.2 Objectives

The key objective of the WMP is to ensure that impacts to the downstream environment are minimised.

To achieve this objective, PGH will undertake the following:

- Ensure appropriate environmental controls and procedures are implemented to minimise the potential for adverse surface water quality impacts to identified sensitive receivers and the local community;
- Manage Water quality impacts, if they occur, through a systematic analysis of mitigation strategies;
- Ensure environmental management measures identified in *Table 14* are implemented to address the relevant CoA outlined in *Table 1*; and
- Ensure appropriate measures are implemented to comply with all relevant legislation and other requirements as described in *Section 3* of this WMP.

The principle objectives of this Water Management Plan are set out below;

- To minimise erosion and sedimentation from all active and rehabilitated areas, thereby minimising sediment ingress into surrounding surface waters
- To ensure the segregation of 'dirty' water from 'clean' water and manage 'dirty' water appropriately such that any discharge from the project site meets the relevant water-quality limits, including limits contained in the relevant guidelines and any limits imposed by specific project approvals. 'Dirty' water is defined as surface runoff from disturbed catchments. 'Clean' water is defined as surface runoff from catchments that are undisturbed or rehabilitated catchments.
- To minimise the volume of water discharged from the project site but, should the discharge of water prove necessary, ensure sufficient settlement time is provided prior to discharge or employ other means such as flocculants to ensure the water meets the objectives identified in the point above.
- To ensure any water used in the processing of materials is contained within the closed system on the site.
- To monitor the effectiveness of surface water and sediment controls and to ensure all relevant surface water quality criteria are met.
- To determine a water balance for the site based on current and projected usage.
- Develop a set of performance criteria and appropriate environmental management measures for the site.

3 ENVIRONMENTAL REQUIREMENTS

3.1 Relevant Legislation and Guidelines

3.1.1 Legislation

Legislation relevant to Water quality management includes:

- Environmental Planning and Assessment Act 1979 (EP&A Act);
- Protection of the Environment Operations Act 1997 (POEO Act);
- Water Act 1912;
- Water Management Act 2000;
- Sydney Water Act 1994;
- Protection of the Environment Operations Regulation 2000; and
- The Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011.

3.1.2 Guidelines and Standards

The main guidelines, specifications and policy documents relevant to this WMP include:

- Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales (Gazette no 54 of 12 March 2004 p 1150);
- Managing Urban Stormwater, Volume 2E, Mine and Quarries (Department of Environment and Climate Change, New South Wales, June 2008);
- DECC Managing Urban Stormwater - Soils and Construction V1 (2004); and
- The Australian and New Zealand Environment Conservation Council Guidelines (ANZECC guidelines).

3.2 Minister's Consent Conditions

This document has been prepared to satisfy the SSD_5684 MOD1 conditions of consent requiring a Surface Water Management Plan. The Conditions of Approval relevant to this WMP are listed in *Table 1*. A cross reference is also included to indicate where the condition is addressed in this WMP or other environmental management documents.

Table 2. Conditions of Approval relevant to the WMP

Condition	Requirement	Where Addressed in this plan
Schedule 3- **SOIL AND WATER** (General Note)	Under the Water Act 1912 and/or the Water Management Act 2000, the Applicant is required to obtain the necessary water licenses for the development, including in respect of the extraction and/or interception of groundwater.	Section 3.4
Schedule 3- **Water Supply** Condition 16	The Applicant shall ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of operations under the consent to match its available water supply to the satisfaction of the Secretary.	Section 4.8

Condition	Requirement	Where Addressed in this plan
Schedule 3- **Water Discharges** Condition 16 (EPL 1808)	The Applicant shall comply with the discharge limits in any EPL or with Section 120 of the POEO Act.	Section 3.3, 4.6 and 8
Water Management Plan Condition 18	The Applicant shall prepare and implement a Water Management Plan for the development to the satisfaction of the Secretary. This plan must: (a) be prepared by suitably qualified person/s approved by the Secretary;	Letter of Approval *Appendix B*
	(b) be prepared in consultation with the EPA and DPI Water;	Annexure to this report- Water Management Consultation and Correspondence
	(c) be submitted to the Secretary for approval within 6 months of the date of this consent, unless the Secretary agrees otherwise;	Submission and approval for this plan will be obtained prior to commencing operations.
	(d) include a Site Water Balance that: • Includes details of: ○ quantity of water required to support operations; ○ sources and security of water supply; ○ water use and management on site; ○ reporting procedures; and ○ measures to be implemented to minimise potable water use on site;	Section 5
	(e) include a Surface Water Management Plan, that includes: • baseline data on surface water flows and quality in the watercourses that could be affected by the development;	Section 4.5 and 4.6
	• a description of the surface water management system on site, including: ○ clean water diversions; ○ erosion and sediment controls; ○ the dirty water management system; and ○ water storages (addressing maximum harvestable rights if applicable);	 Section 9/10 Section 6 Section 4, 54.9 Section 3.4, 5.3
	• performance criteria, including trigger levels for investigating any potentially adverse surface water quality impacts;	Section 9

Condition	Requirement	Where Addressed in this plan
	• a program to monitor and report on: ○ any surface water discharges; ○ the effectiveness of the water management system; and ○ surface water flows and quality in local watercourses;	Section 8
	• A plan to respond to any exceedances of the performance criteria.	Section 9
	(f) a Groundwater Management Plan, which includes: • baseline data on groundwater levels, yield and quality in surrounding aquifers; • groundwater assessment and performance criteria, including trigger levels for investigating potentially adverse groundwater impacts; • a program to monitor: ○ groundwater inflows to the quarry pit; and ○ impacts of the development on surrounding aquifers; • an analysis of the monitoring results to determine long-term water levels within the quarry • void; and • A plan to respond to any exceedances of the performance criteria.	Refer to GWMP – Separate Plan

3.3 Licences and Permits

The Environment Protection Authority (EPA) issued the Brickworks with licence number 1808. All Surface Water monitoring points, monitoring frequency and analytes required are outlined in the *Table 2* below (source EPL1808). Note EPL Point 1 is the discharge point from Dam 1 and EPL Point 5 is the discharge Point from Dam 5. EPL No. 1808 is currently in force for the scheduled activities undertaken by the facility and prescribes the permitted water quality loads and concentration limits. Prior to the commencement of construction or the extension of the quarry, a variation to EPL No. 1808 would be sought by PGH to reflect the changed and extended operations of the quarry, water quality criteria stipulated within the CoA.

Table 3. EPA Monitoring Requirements - Water Concentration Limits

POINT 1

Pollutant	Units of Measure	50 percentile concentration limit	90 percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
Oil and Grease	milligrams per litre				10
pH	pH				6.5-8.5
Turbidity	nephelometric turbidity units				150

POINT 5

Pollutant	Units of Measure	50 percentile concentration limit	90 percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
Conductivity	microsiemens per centimetre				1450
Oil and Grease	milligrams per litre				10
pH	pH				6.5-8.5
Turbidity	nephelometric turbidity units				150

M2.3 Water and/ or Land Monitoring Requirements

POINT 1

Pollutant	Units of measure	Frequency	Sampling Method
Oil and Grease	milligrams per litre	Weekly during any discharge	Grab sample
pH	pH	Weekly during any discharge	Grab sample
Turbidity	nephelometric turbidity units	Weekly during any discharge	Grab sample

POINT 5

Pollutant	Units of measure	Frequency	Sampling Method
Conductivity	microsiemens per centimetre	<24hrs prior to discharge	Grab sample
Oil and Grease	milligrams per litre	<24hrs prior to discharge	Grab sample
pH	pH	<24hrs prior to discharge	Grab sample
Turbidity	nephelometric turbidity units	<24hrs prior to discharge	Grab sample

3.4 Water Access Licence

The Water Management Act 2000 (WMA) identifies basic landholder rights and when access licenses are required. The harvestable water right is defined in terms of and equivalent dam capacity, the Maximum Harvestable Right Dam Capacity (MHRDC). Schedule 1 of the Water Management Regulation exempts certain classes of dam including those dams solely for the capture, containment and recirculation of drainage and/or effluent, consistent with best management practice or required by a public authority to prevent the contamination of a water source. Therefore, as the on-site dams are used solely for the capture, containment and reticulation of drainage, consistent with best management practice to prevent impacts to Thompsons Creek, the dams are exempt from the need to obtain a licence under the WMA.

The site does however surface water licences;

1. WAL 26259 = 150 ML
2. WAL 26257 = 6.5 ML
3. WAL 25987 = 152.5 ML

In addition there are 4 bores (drilled in the EIS) licenced in perpetuity for monitoring under 10BL605770. Only 3 of these are functioning.

4 EXISTING ENVIRONMENT

4.1 Site Location and Overview

The project site is currently used for quarrying, brick production and associated activities. The brickworks and quarry are located on an approximately 385.55 hectare property owned by PGH Limited, which is located at 60 Greendale Road, within the Camden local government area and is approximately 55 km southwest of the Sydney central business district (Refer to *Figure 1*).

The brick making facility along with various administration buildings, a finished brick storage yard, staff car park and internal road network is generally contained within the northern part of the project site (refer to *Figure 2*), and is set back approximately 200 m from Greendale Road.

Existing quarrying activities have substantially altered the natural landform, with various voids and elevated stockpiles present in the active, north-western part of the project site. Other significant landforms on the site include the raw material stockpiles to the south of the brickworks, as well as unusable materials stockpiles along the western boundary of the site. The underlying topography of the operational footprint on the project site is relatively flat, and the land slopes to the south toward Thompsons Creek.

4.2 Geology and Soils

Geology in the region is comprised of a mix of Triassic and Quaternary age deposits. The Project site is underlain by the lower 75 metres to 150 metres of the Bringelly Shale which comprises claystone, siltstone, laminite and sandstone. The base of the sequence in this area is defined by the Cobbity Claystone, a thin (maximum six centimetres) persistent layer of weathered tuff. Alluvial sands and gravels derived from surrounding rocks are present along streams such as Thompsons Creek and Bardwell Gully. *Section 6.1* provides further detail on the soil type in the area. The soils and subsoils of the area is slightly acidic (pH approximately 4-5).

The soil on the project site is classified generally as having moderate salinity potential, apart from the Thompsons Creek zone which is classified as having high salinity potential.

4.3 Topography

The surrounding topography varies from moderately undulated to hilly with a high density of low order streams to the southwest, to gently undulate with a lower density of streams to the east. The topography of the site is generally gently sloping to the south and west in the direction of Thompsons Creek.

The quarry area of the site has an elevated topography with the highest point towards the northwest corner at 113m AHD. A constructed bund runs along the western boundary north to south of the site which gently slopes downwards towards the east-south-east. The lowest point runs along the eastern side of the site and is characterised by Thompsons Creek.

The north-eastern area of the site is dominated by the brickworks, product stockyard, storage facilities and administration buildings. South of the brickmaking plant is a raw materials stockpile yard, adjacent to which lie settlement ponds Dams 4 and 5. The south–eastern area of the site next to Thompsons Creek is currently leased as farmland for livestock grazing.

Thompsons Creek with a catchment area of approximately 1.6 km^2 has its source to the southwest of the project site. The creek flows eastwards past the southern boundary of the mine, after which it turns

northwards flowing along the eastern boundary of the brick making facility and carpark. It then passes under Greendale Road before joining South Creek approximately 4km further downstream. South Creek is a tributary of the Hawkesbury River.

A 6 metres high earth bund has been constructed along the eastern side of the brickmaking facility which has the dual purpose of attenuating production noise as well as providing flood immunity to the brickworks site from Thompsons Creek. The site is also outside the 1%AEP flood extent. The area surrounding the project site is predominately used for agriculture to the west and south of the site with agricultural land with some rural residential development to the north and east.

4.4 Climate

The Badgerys Creek AWS (Site Number 067108) is the closest Bureau of Meteorology (BoM) weather station to the facility. The site commenced operation in 1995, is located approximately 4.5 kilometres due north of the facility (33° 54' S 150° 43' 48" E) and records monthly climatic statistics. A summary of climate statistics from the Badgerys Creek AWS station is presented in *Table 3*.

Table 4. Monthly Climate Statistics Summary – Badgerys Creek AWS (BoM 2018 Averaged Annual since recorded)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean max. temperature (oC)	30.1	28.8	26.9	24.1	20.7	17.8	17.4	19.2	22.6	24.9	26.4	28.5
Mean min. temperature (oC)	17.1	17.1	15.3	11.5	7.7	5.6	4.1	4.7	7.7	10.4	13.5	15.5
Mean rainfall (mm)	79.4	98.5	81.3	49.4	38.3	61.8	23.6	36.8	32.3	51.4	69	57.1
Mean number of days of rain >=1mm	7	7.3	7.4	5.7	4	5.4	3.9	3.5	4.6	5.5	6.9	6.6
Mean number of days of rain >=10mm	2.3	2.6	2.8	1.3	1.1	1.6	0.6	1	1	1.7	2.3	1.6
Mean 9am relative humidity (%)	73	80	83	76	80	84	81	72	66	62	69	69
Mean 9am wind speed (km/h)	9.4	8.7	8.4	9.8	9.6	9.1	9.6	10.6	11.7	11.8	11	9.8
Mean 3pm relative humidity (%)	49	55	55	52	53	56	50	44	44	45	50	48
Mean 3pm wind speed (km/h)	17.9	15.9	14.5	14.4	13.9	13.7	15.4	17.8	19.2	19.9	18.9	18.5

A review of the climatic data presented in *Table 3* indicates the following trends:

- On average, January is the hottest month of the year and July is the coldest month of the year, with mean maximum and minimum temperatures being 23.95 °C and 10.85 °C respectively.
- Rainfall data indicates that February is the wettest month of the year and July is the driest month of the year, with average falls of 56.5mm.
- Mean 9am humidity levels range from 62% in October to 84% in June. Whilst mean 3pm humidity levels range from 44% in August and September to 56% in June.
- Mean 9am wind speeds range from 8.4 km/h in March to 11.8 km/h in October. Mean 3pm wind speeds range from 13.7km/h in June to 19.9km/h in October.

On an annual basis, winds are most dominant from the south-southwest, with a lesser frequency of winds from the southwest. In spring and summer, the wind distribution is similar to the annual distribution with a higher frequency of easterly winds occurring. During autumn and winter, winds from the south- southwest are most predominating. The annual average wind speed is 1.6m/s and the annual percentage of calms is 24.2%.

4.5 Hydrology and Waterbodies

The project site is located within the Hawkesbury-Nepean catchment, which is the largest catchment within the Sydney area, covering an area of approximately 21,400 square kilometres. It falls directly within the upper reaches of the South Creek sub-catchment, which encompasses most of the Cumberland Plain of Western Sydney.

The South Creek sub-catchment covers an area of approximately 620 square kilometres, comprising small rural residential and urban areas. The upper South Creek sub-catchment lies within Camden City Council's Local Government Area and includes (from west to east) Thompsons Creek, Lowes Creek, Rileys Creek, Kemps Creek and Bonds Creek (WMA Water, 2012). The project site rises within the south western portion (146m AHD) and falls toward Bardwell Gully and Thompsons Creek in the north (76m AHD).

4.5.1 South Creek

The project site is located within the upper portion of South Creek catchment. The confluence of South Creek and Thompsons Creek is located 3.5 kilometres to the north east of the project site. South Creek is regarded as one of the most degraded sub-catchments in the Sydney region.

The hydrological regime of the catchment has been greatly altered through vegetation clearance and an increase in impervious areas through the urbanisation of the catchment. This in turn has led to changes in catchment geomorphology and a reduction in water quality. Water quality is impacted by both point and diffuse sources of pollution, including sewage treatment plants, industrial discharges in the lower reaches of the catchment, and runoff from land uses such as market gardens, grazing lands and urban and stormwater runoff.

The Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011, established under the Water Management Act 2000, covers the project site and the South Creek catchment. The plan splits the South Creek Catchment into two management zones, being the Upper South Creek management zone, within which the project site is located, and the Lower South Creek management zone. The Upper South Creek Management Zone supports 88 surface water licences with a peak daily demand of 43.85 mega litres per day. Water is used to support irrigation and stock watering.

4.5.2 Thompsons Creek

Thompsons Creek is a tributary of South Creek and forms the eastern boundary of the project site. It is classified as a second order ephemeral (intermittently flowing) stream using the Strahler stream classification system (Strahler 1952). Thompsons Creek crosses the eastern and southern boundaries of the study area directly south of the existing brickworks quarry [1].

Thompsons Creek flows in a northerly direction adjacent to the eastern boundary of the project site and discharges directly into South Creek. The dam at the south eastern corner of the project site (known as Dam 6), located within the headwaters of Thompsons Creek has a capacity of 50 mega litres.

Thompsons Creek drains rural, rural residential and urban areas and has poor environmental health. Inspections of this watercourse (by VGT and Kleinfelder) found that it has been impacted by erosion, weed outbreaks, channel modification, litter and poor water quality.

PGH holds an EPL (Ref 1808) to discharge from the Outlet of Dam 5 into Thompsons Creek. This is currently achieved by pumping from the Dam 5 Outlet to Dam 6. PGH are proposing to discharge directly from Dam 5 to Thompson's creek following the implementation of a water treatment system (refer to *Figure 10*).

4.5.3 Bardwell Gully

Bardwell Gully is a small drainage channel that flows into Thompsons Creek in a northerly direction from central northern boundary of the project site. The gully drains northwards, under Greendale Road, before diverting eastwards and converging with Thompsons Creek, approximately one kilometre to the north east of the project site. The gully drains Greendale Road, rural and residential areas and has a highly degraded environmental condition.

4.6 Water Quality

Discharges from the project site are subject to an EPL issued under the POEO Act. The EPL sets water concentration limit values for the project site for Dam 1 and Dam 5, the latter being located in the headwaters of Thompsons Creek. Water quality limit values specified in the EPL are shown in *Table 2*.

Surface water quality in and around the site is characterised by high conductivities. High levels of conductivity are likely to be directly influenced by the presence of clays and shales that exhibit a very high salinity potential. Conductivity levels have been observed to increase during dry periods as results of evaporation processes.

All discharges from the site eventually drain to South Creek. A baseline water quality study for South Creek catchment was undertaken by Sydney Water to establish the baseline environmental conditions. The study highlights the following attributes for water quality in the Upper South Creek Catchment (Hassan et al, 2009):

- Nutrient concentrations for all sites, including tributaries of South Creek were found to be higher than the recommended concentrations for protection of aquatic ecosystems.
- Chlorophyll-values higher than the guideline values for most upper South Creek monitoring locations.
- Faecal coliforms and Enterococci exceed the ANZECC primary contact recreational water quality guidelines at almost all sites. Possible sources of pollution include stormwater discharges, agricultural activities and pre-existing bacterial population in the slopes and sediments of the catchment.
- Dissolved oxygen saturation levels were generally low and below the guideline value for the majority of sites.
- Turbidity levels were very high at most of the sites of the South Creek indicating poor land and riparian management.

The above findings indicate that South Creek is a highly degraded system whereby water quality is impacted by a diverse range of land uses including rural, grazing, market gardening, intensive agriculture as well as both urban and industrial uses. The South Creek Catchment has also been identified as a highly saline catchment. Upper South Creek, Lowes Creek and Kemps Creek conductivities are in the order of 500 to 600µS/cm whilst downstream monitoring locations at South Creek average 900µS/cm[1].

Kleinfelder were engaged by PGH to assist in the variation of the EPL in 2015 (see *Appendix E*). The variation included an increase in the limit on the conductivity of water discharged to Thompsons Creek. Monitoring of the creek was undertaken to provide baseline data which is reproduced in the table below.

Table 5. Thompsons Creek Baseline Water Quality Data

Date Sampled / Analyte	28/2/2015	13/2/2015	27/02/2015
pH (on-site measurement)	6.52	6.79	7.19
Conductivity (µS/cm)	2,900	2,700	2,900
Total Dissolved Solids (mg/L)	1,580	1,830	1,800
Total Suspended Solids (mg/L)	17	10	18
Turbidity (NTU)	15.9	18.0	39.2
Hydroxide Alkalinity as CaCO3 (mg/L)	<1	<1	<1
Carbonate Alkalinity as CaCO3 (mg/L)	<1	<1	<1
Bicarbonate Alkalinity as CaCO3 (mg/L)	152	191	206
Total Alkalinity as CaCO3 (mg/L)	152	191	206
Sulphate as SO4 (mg/L)	10	24	<10
Chloride (mg/L)	699	935	940
Calcium (mg/L)	40	46	50
Magnesium (mg/L)	61	81	84
Sodium (mg/L)	408	633	540
Potassium (mg/L)	19	18	13
Oil & Grease (mg/L)	<5	6	<5

From the results above it was concluded that Thompsons Creek is naturally saline and the EPL was amended accordingly.

Background water quality data from Bardwell Gully has not been undertaken to date due to the ephemeral nature of the watercourse. Similarly, background monitoring on the flows of both creeks has not been undertaken to date although it is expected the ephemeral nature of the watercourses may not yield an abundance of data.

Monitoring of the creeks water quality and flows will commence with the approval of this plan.

4.7 Water Quantity

The Bringelly brick making facility utilises approximately **15,000KL per annum** of Potable water. Potable water Consumption is recorded monthly in Envizy. The site also has a capacity of over 400,000m^3 of dam storage onsite in order to utilise harvested Stormwater for processing and dust control. Sections 4 and 5 provide further detail on individual dam quantities, storage and flows.

4.8 Sources of Security and Water Supply

Water is sourced from 6 dams and potable mains water for the project site. Potable water is purchased by the site for use in the brickmaking factory due to water quality issues and suitability for processing from onsite Sections 4 and 5 provide further detail on individual dam quantities, storage and flows. The total volume of water held on the site including Dam 6 is more than sufficient for the dust mitigation and potential watering of rehabilitation.

4.9 Water Management on Site

The project site's drainage systems have been designed to minimise uncontrolled off-site discharges. The local catchments that currently contribute flows over the approved project site are shown in *Figure 3*.

Runoff from the temporary raw material and unusable material stockpiles, western brick product storage area and material storage facility is directed to Dams 1 and 2 at the northern end of the site for removal of coarse and fine solids respectively through settlement and flocculation. Dam 1 is a licensed discharge point, discharging settled water to Bardwell Gully that in turn discharges to Thompsons Creek.

Runoff from the raw material stockpile area located south of the brickworks is directed to Dams 4 and 5.

Runoff from a catchment area of 26.6 hectares to the west of the project site, of which 4.8 hectares is located within the existing quarry footprint currently drains towards and is captured within the existing quarry. Pit (quarry) water collected in the quarry and runoff from raw material stockpiles and operational areas around the brickmaking facility is transferred to Dam 4 and Dam 5 for removal of coarse and fine solids. Flocculent is added to water via a dosing pit during the process of pumping water from the quarry pit to Dam 4. Water from Dam 5 outlet is currently discharged to Thompsons Creek following testing against EPL water quality criteria. Water discharges intermittently from Dam 6 into Thompsons Creek, usually following heavy rainfall events.

Sewerage at the site is collected and treated in an on-site bio-cycle system. Treated effluent is removed from site by a licenced waste removal contractor.

The EPL and consent conditions place no stipulation on the design capacity of the sediments dams. According to best practice however, the Managing Urban Stormwater, Soils and Construction, Volume 2E Mines and Quarries guidelines has been used in the EIS and this document. Sediment basins are designed for a 90th percentile, 5 day rainfall event assuming a non-sensitive receiving environment for a 20 day management period as set out in *Table 6.1* of Managing Urban Stormwater, Soils and Construction, Volume 2E Mines and Quarries guidelines for disturbance greater than 3 years in duration.

The operation of the existing stormwater management system and catchments is summarised below.

5.3.1 Dam 1 Catchment

Runoff of 6.0Ha from the roof of buildings on the site is collected to a dedicated drainage system. Although the catchment is considered clean water and Dam 1 is an EPL discharge point, the water is often not of sufficient quality to release from the dam. Generally water collected in Dam 1 is transferred (Siphoned or pumped) to the Quarry void or Dam 4 for treatment prior to discharge via Dam 5. Any overtopping or non-compliant discharges from Dam 1 need to be reported to the EPA and logged in WHSE Live.

Plate 1.: Dam 1

5.3.2 Dam 2 Catchment

Runoff (2.8Ha) from the production area drains to Dam 2, which when full, overflows into Dam 1. If required, water can be removed for dust suppression via water cart hose. Due to its small catchment size this dam does not require regular management. The dam is currently full of vegetation (Mainly Phragmites australis) as shown in *Plate 2*.

Plate 2.: Dam 2

5.3.3 Dam 3 (Quarry Pit) Catchment

Runoff from 27 Ha (of which 4.8Ha is on neighbouring land to the west) of the catchment area to the west of the site drains towards and is largely captured within the existing quarry void (Dam 3). The overland flows that are captured within the quarry are pumped out before the commencement of each quarrying campaign if required. The clay material required for brick production is excavated in two campaigns per year.

Plate 3.: Dam 3 (Quarry Pit)

5.3.4 Dam 4 Catchment

There are currently three water inflows to Dam 4. Runoff from 11.4 Ha from the stockpile storage area drains towards Dam 4. Overland flows collected in the quarry and Dam 1 are also pumped to the north west of Dam 4, when required, for de-sedimentation. The configuration of the dam ensures that all dirty water from the stockpile area is retained in this dam. The Dam is covered in thick bulrush (Thypha orientalis). Flocculent is added at the north eastern end of dam 4 to assist with further de-sedimentation. The dam 4/5 pump is used to cycle the water from the northern end of dam 4, through the bulrush and back towards the south – where the outlet pipe is. Once suitable, the content of dam 4 is transferred into dam 5.

Plate 4.: Dam 4

5.3.5 Dam 5 Catchment

There is currently one inflow to Dam 5. Flocculent is added (manually) to the water directly to Dam 5 and as it is pumped out from Dam 4. It is expected that this process will soon be automated utilising an in-situ water treatment system. The treated water then flows from the south of Dam 5 to the northern EPL discharge point at Thompsons Creek once it has met EPL water criteria. Any non-compliant discharges from Dam 5 need to be reported to the EPA and logged in WHSE Live.

Plate 5.: Dam 5

5.3.6 Dam 6 Catchment

Runoff from a clean water catchment of 125.8Ha is collected in Dam 6 which then overtops via a spillway into Thompsons Creek. Dam 6 has a capacity of 50ML.

Plate 6.: Dam 6

5.3.7 Former Irrigation Effluent Area

An existing bio-cycle treatment plant is situated on the site, but is no longer used for treatment, only for storage of the sewerage within its holding tanks. Periodically (based on the level in the holding tanks) the sewerage is then pumped out by a tanker and transported to a local sewerage treatment works. Currently no irrigation of effluent or discharge from the site takes place.

4.10 Water Use

Any surface water collected on the site within the sedimentation dams, other than that used for dust suppression, is eventually returned to the downstream environment after meeting water quality requirements. In this sense disruption to downstream flows is minimised.

PGH Bricks & Pavers currently uses water for dust suppression sourced from the Pit or Dam 4, 5 and 6 the water is used to fill a water truck which provides dust suppression throughout the site. It is estimated that this form of re-use equals approximately 4,500kL per year.

PGH Bricks & Pavers does not currently re-use the surface water captured in the pit for process water in the brickmaking facility or use the water for irrigation on the site. To date potable water (approximately 8,000kL per annum) has been used due to concerns that the sediment and high salinity may adversely affect supply lines and brick quality.

4.11 Water Transfer

Water Trucks can be filled from the Quarry Pump diversion, the Dam 5 Discharge Pump or the Dam 6 standing pipe. Once the standing pipe flowmeter has been installed, the Dam 6 pipe will be the primary collection point for water trucks. If water must be collected from another point; the details of the release must be logged in accordance with *Section 4.12* of this document (*Flow Logging*) – with volume estimated by the capacity of the water truck. This information must then be forwarded to the process engineer / site environmental manager by email at the end of the month.

Dam 1 and Treatment Dams 4 and 5 will always be emptied to their lowest level in readiness for future inflows, particularly heavy rain events. If testing confirms the water quality in Dam 1 at the outlet is within the limits specified in *Table 2*, the EPL permits discharge (overflow). In practice, Dam 1 is not permitted to overflow and is syphoned from Dam 1 into the quarry sump or Dam 4. If in extreme circumstances overflow does occur, water must be tested weekly for its overflow duration.

4.12 Flow Logging

All water taken for use or released from site must be recorded in a site based spreadsheet. In order to comply with regulatory requirements, PGH must record the time and date of release commencement and conclusion, as well as volume released and a calculation of flow rate. The two primary release points where flow must be logged are:

- Water release from Dam 5; and
- Water collection by water trucks for dust suppression.

The pump at Dam 4/5 has a totaliser which will be used for this recording. A flowmeter is currently being investigated for the standing pipe at Dam 6, used for filling up water trucks. All flows leaving site must be quantified.

4.13 Water Treatment

The controls implemented in *Section 8* ensure that limits for pH, conductivity and oil & grease can be achieved. Due to loading with sediment during flow into the Quarry, storm water can require treatment for turbidity to ensure compliance prior to discharge. Onsite Water will be treated using the following method (refer to *Figure 10*):

- Storm water is pumped from the Quarry or Dam 1 to Treatment Dam 4. From there, the water is:

- Recycled through Dam 4 before transfer to Dam 5 using the Treatment Dams Pump or
- Pumped directly from Dam 4 to Dam 5

- A flocculent additive, is dosed at a rate of up to 100 mL/min into:
  - Dosing Point 1 – inlet of the Treatment Dams Pump in Dam 4 (primary) or
  - Dosing Point 2 – discharge sump of treatment dam 5
- Operation of the Dosing Pump is described in WI 4743-0000-002 Water Treatment & Flocculent Dosing Pump.
- Dam 4 extends around the back of Dam 5 to protect Dam 5 from contamination from stormwater running off the stockpile area. Some overflow may run across the dividing wall (from Dam 4 into Dam 5) but this would be controlled by effective dam level management.
- After treatment the water at the inlet to the Treatment Dam Pump in Dam 5 is tested for turbidity and other concentration limits. When results are below the concentration limit, the water can be discharged to Dam 6 and logged in accordance *Section 4.12*.

This method has proven effective for achieving suitable turbidity levels. The Dams must be de-silted periodically as depths diminish to less than 1 m, as verified during the monthly inspections.

While it is anticipated that the use of coagulation/flocculation, vegetation, and sediment control to manage water quality is sufficient to satisfy discharge limits, a more advanced in-situ water treatment system is proposed for Licence Discharge point 5.

The feasibility of in-situ water treatment is being investigated to improve existing stormwater treatment facilities.

5 SITE WATER BALANCE

5.1 Overview

A water balance model, reproduced here, was undertaken by Hyder Consulting Pty Ltd for the EIS which was based on a single 'worst case scenario' for both the existing and fully developed condition (prior to any potential backfilling or rehabilitation) for the project site. The objective of the water balance modelling was to assess the ability of the project site to provide on-site water detention and to understand potential changes in surface water drainage.

Under direction from the 'Blue Book' and EPL requirements, the model investigated the following:

- Estimate the required capacity to contain runoff generated at each catchment during a 90th percentile 5 day rainfall event.
- Ensure that the discharge of water flowing from the disturbed part of the site is limited to 1 to 2 times during the year for a critical historical 10 year period.
- Demonstrate that the frequency and quantity of discharges for the developed condition is equal to or less than the existing conditions.

5.2 Modelling Assumptions

The following assumptions and inputs were applied during the development of the water balance model:

- The developed condition scenario is defined when the water storage area within the quarry is limited to cell 'B' (smallest storage) and once the quarry has been fully extracted i.e. at the end of the 30 year quarry life when cells A-I have been fully extracted this also reflects the worst case scenario where the minimum storage and maximum catchment area is reflected.
- A 90th percentile 5 day rainfall design event was applied to the model to ascertain the minimum storage requirements of each stormwater attenuation structure (dam), to capture runoff from the rainfall event, (refer to *Table 5*).
- To ensure a conservative and realistic assessment is being carried out, 20mm of rainfall will be applied prior to the 5 day 90th percentile rainfall event. It is industry standard practice is followed to provide wetting of the catchment and allows the dams retain some water, as in practice the dams generally have carryover of water from previous flood events .i.e. they are rarely dry.
- To understand how the system operates under both wet and dry conditions, both the existing and developed condition scenarios were modelled with application of a daily time step for a 10 year period, 1979 to 1989.
- Rainfall runoff was calculated using the AWBM model.
- For the 5 day rainfall simulation, a 90th percentile daily rainfall of 22.6mm was calculated from the BOM data. The rainfall data was then transformed to runoff using the AWBM for estimation of the required on-site stormwater retention volumes.

5.3 Dam Capacities and the Design Storm Event

5.3.1 Existing Site

As per the 'Blue Book' the onsite stormwater dams aims to contain all of the sites runoff triggered by a 5 day 90th percentile rainfall event with a 20 day management period. The 20 day management period capacity is defined as 170% the volume required for the design storm for a 5 day management period. The calculated capacities for the 5 day management period (from the EIS) and for the 20 day management period (applied to the EIS estimations) for the existing site are shown in the *Table 5* below.

Table 6. Dam Capacities and DSE.

Dam	Catchment Area (Ha)	Dam Capacity (m3)	Dam Volume Required for 5 day management period (m3)	Dam Volume Required for 20 day management period (170%) (m3)	Notes
1	6	3,180	1,701	2,892	Dam 2 overflows to Dam 1
2	2.8	700	700	700	
3	26.6	346,100	6,640	11,237	
4	8.4	3,350	>3,350	>3,350	Dam 4 overflows to Dam 5
5	3	3,020	>3,020	>3,020	
6	125.8	50,000	35,038	59,565	

Note: the design storm event is assumed to be the 90th percentile, 5 day rainfall event.

As can be seen from the table above it was deduced in the EIS that Dam 4 and 5 currently did not have sufficient capacity for the design storm event even for the 5 day management period. All other dams have sufficient capacity. Since then, the configurations of Dam 4 and 5 have been modified and Dam 4 now has sufficient capacity for the design storm as shown in *Table 6* below.

5.3.2 Developed Site

VGT consulting provided updated calculations of dam capacities for the site. The developed site includes a diversion for clean water runoff collected from the western off-site catchment (Catchment 7) through the installation of the New Dam 7 (as shown in *Figure 6*). This dam diverts clean water from the active pit where it will entrain sediment, into Bardwell Gully via controlled discharge without the risk of scouring the stream. As above the calculated capacities for the 5 day management period (from the EIS) and for the 20 day management period for the existing site are shown in the *Table 6* below.

Table 7. Calculated Capacities.

Dam	Catchment Area (Ha)	Dam Capacity (m^3)	Dam Volume Required for 5 day management period (m^3)	Dam Volume Required for 20 day management period (170%) (m^3)	Notes
1	3.1	3,180	950	1,600	Dam 1 is currently pumped into Dam 3 as required but can be diverted to Dam 4 for treatment prior to discharge.
2	Dam 2 will be eliminated during excavation of Cell D				
3	31.2	381,500	13,000	22,000	-
4	11.8	9,375	3,700	6,300	Dam 4 may surcharge to Dam 5.
5		3,020	-	-	Dam 5 will be managed via an automated water treatment system.
6	120.7	50,000	35,038	-	Dam 6 is considered clean water and any overflow is permissible
7	7.4	2,480	2,180	3,700	Dam 7 overflow will divert to Dam 3 (Quarry Pit Sump)

Dam 4 has sufficient capacity for the design event but will have an emergency overflow with riprap stabilisation to accommodate emergency discharge during very heavy rain events to Dam 5. Dam 7 has

sufficient capacity for the design storm event with a 5 day management period. It is estimated that it may take approximately 7 days to discharge this clean water and whilst the dam does not have sufficient capacity for a 20 day management period, it is unlikely that the time taken to manage the dam would be more than 20 days. In any event, any overflow will be directed to the Quarry Pit Sump.

All other dams have sufficient capacity.

5.3.3 10 Year Simulation

Modelling was performed for the EIS and by VGT consulting for a critical 10 year period (1979-1989) was undertaken to determine the frequency of overflows within the nominated period. This ten year period was selected as it contained the wettest and driest years in any consecutive 10 year period on record.

The results was compared to the Managing Urban Stormwater- Soils and Construction, Volume 2E Mines and Quarries indicative average annual sediment basin overflow frequency for the design storm event (*Table 6.2* of volume 2E). Basins designed for the 90th percentile storm event would be envisaged to have an annual average overflow frequency of 2-4 spills per year.

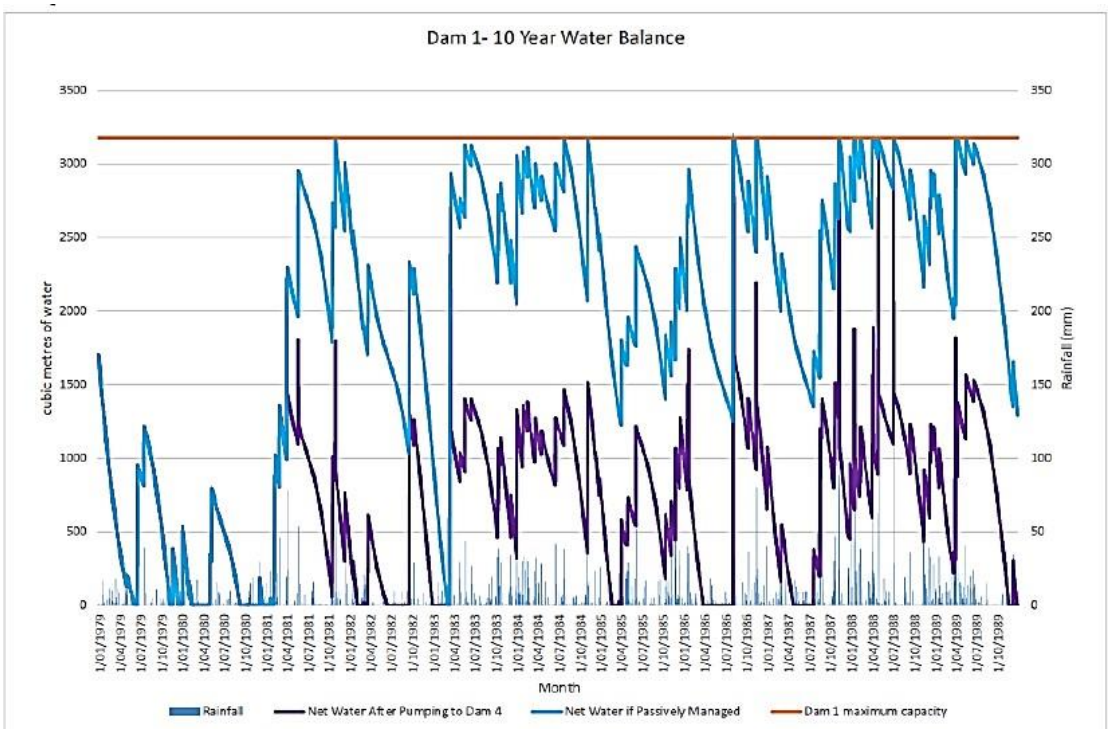
5.3.4 Dam 1

Modelling in the EIS, shows that Dam 1 overflows as soon as the storage volume reaches its maximum capacity of 3,180m3. It also shows that a range of 2-8 overflows per year is expected for all scenarios investigated. It was assumed in the EIS that the catchment for Dam 1 was clean water however, at present the brick storage area catchment for Dam 1 is contributing sediment to the dam through vehicle movements. Therefore the dam is currently managed by pumping excess water to either the Quarry Pit Sump or Dam 4 for treatment and discharge. As the dam will now be managed as a dirty water dam, and Dam 7 will not be constructed as proposed in the EIS, the water balance was reviewed.

Under the developed site, with the preferred option of diverting clean water from Dam 7 offsite and not into Dam 1, it will have more than enough capacity for the 5 day 90th percentile design storm event. The 10 year critical period water balance indicates that on average the dam would be expected to overflow twice per year if passively managed.

These periods when the dam is expected to overflow correspond to storm events greater than the design criteria i.e. rainfall greater than 42.6mm over 5 days (from the Blue Book). If the dam is pumped to the Quarry Pit Sump or to Dam 4 the number of overflows per year would be reduced even further. As stated in the Blue Book above the overflow frequency when passively managed is in line with that expected for a dam designed to the 90th percentile, 5 day storm event of between 2-4 spills peryear.

Graph 1: Dam 1 Ten Year Water Balance



5.3.5 Dam 2

Runoff (2.8Ha) from the production area drains to Dam 2, which when full, overflows into Dam 1.

Dam 2 will be eliminated during excavation of Cell D.

5.3.6 Dam 3 (Quarry Pit)

With a capacity of 381,500 m^3, modelling from the EIS indicates that no overflow from the quarry pit would occur during the ten year period.

5.3.7 Dam 4

Modelling for Dam 4 has been undertaken by VGT Consulting including recent modification and deepening.

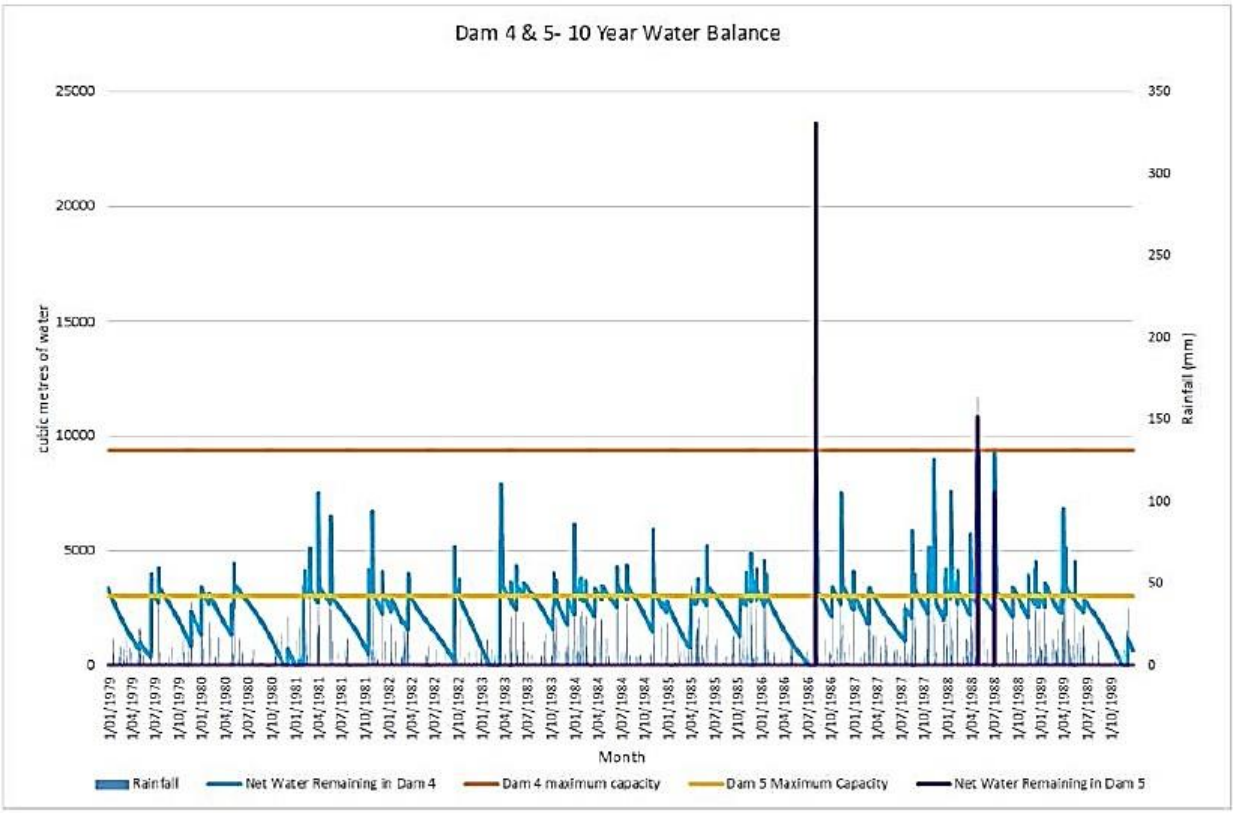
5.3.8 Dam 5

Modelling for Dam 4 has been undertaken by VGT.

The discharge rate is assumed to be 1,800L per minute using the current pump. This may change once the proposed automatic flocculation system is installed and the discharge rate of the new system is known. The EPL discharge point will not change. Water is assumed to be drawn from these dams for dust suppression at a rate of 10 cubic metres per day on average. In reality, water may be drawn from any of the site dams, including the clean water Dam 6 in the south, as required. If insufficient water is held on site for dust suppression, it may also be sourced from potable water.

The model also assumes that water from Dam 1 is pumped into Dam 4 when the volume if Dam 1 exceeds the capacity required to hold the design storm event. Dam 5 was also assumed to be maintained as an empty dam. Over the ten year critical period the model suggests that Dam 4 will overtop into Dam 5 on average 3 times. Of those times Dam 5 also would have overflowed into Thompsons Creek. These were periods of intense rainfall and flooding outside of the design storm criteria and the impact on the downstream environment would have been negligible. It is concluded that the proposed changes to the water management system will reduce the risk of the onsite dams overtopping resulting in uncontrolled discharge.

Graph 2: Dam 4 & 5, 10-year Water Balance



6 EROSION CONTROL

Generally the site is prone to moderate erosion but these are limited to the exposed worked areas of the quarry. Eroded soils and sediment are captured within the pit sump and do not leave the site. Slopes are kept moderate where possible in the pit to reduce the erosion hazard.

6.1 Soil Types

The soil landscapes of the Penrith 1:100 000 sheet were mapped by Bannerman and Hazelton (1990). There are three different soil landscapes mapped within the area of the project site: the residual soil landscape Blacktown, the alluvial soil landscape South Creek, and the erosional soil landscape Luddenham.

Soils generally consist of Red, Brown and Yellow Podzolic on the undulating shale hills and rises, with mainly Red and Brown Podzolic Soils on the Upper Slopes, and Yellow Podzolic soils on lower slopes. The plains include stagnant ponded areas, with mainly Yellow Podzolics on the footslopes, and Soloths on the plains. Structured Plastic Clays or Structured Loams form on the flat to gently sloping alluvial plains in and immediately adjacent to drainage lines. Red and Yellow Podzolic soils are most common on terraces with small areas of Structured Grey Clays, Leached Clay and Yellow Solodic soils (OEH, 2012). Important site physical characteristics (from the EIS) are identified in the table below used to calculate soil erosion rates and sediment dam capacities.

Table 8. Soil Constraints and Characteristics

Constraint/Opportunity	Value
Rainfall Erosivity	2,400
Soil Erodibility Factor	0.05
Slope length. Gradient factor	3.1
Calculated Soil Loss	242 tonnes/ha/yr
Disturbed Site Area	28 ha approximately

Sediment retention basins are designed using the Type D Soils calculations (*Blue Book Section 6.3*). This includes the sediment storage zone calculation using the estimated soil loss for the site over two months. The likely soil loss is calculated with the Revised Universal Soil Loss Equation (RUSLE- *Appendix A1 of the Blue Book*). The values of the other RUSLE factors are: P of 1.3 and the C are assumed to be 0.5.

6.2 General Instructions

The control of erosion and sedimentation at Bringelly will focus on source reduction measures. In general these measures will include:

- Reading the Water Management Plan with any engineering plans and any other plans or written instructions issued in relation to development at the subject site.
- Ensuring contractors undertake all soil and water management works as instructed in this specification and constructed following the guidelines stated in the "Blue Book" (see *Appendix F* for standard drawings).
- Inform all subcontractors of their responsibilities in minimising the potential for soil erosion and pollution to downslope areas.

6.3 Works Sequence

All works are to be undertaken following the Mine Operations Plan (MOP) in the following sequence.

- Topsoil in new cells will be surveyed, mapped and the texture, thickness and quality described prior to stripping. Topsoil and overburden not for immediate use will be stockpiled in appropriate disturbed areas and limited to 2 metres in height and revegetated with temporary ground cover species, mulching or chemical stabilisers or binders if they are to remain in place for more than 30 days. A minimum of 70 percent cover is required for both mulch and vegetative covers.
- Construct earth banks (Stormwater Collection Drains) to divert as much clean water as possible and capture the dirty water in new cells (see *Appendix F* for standard drawings).
- Undertake extraction activities in the new cell.
- Rehabilitate lands in exhausted cells with topsoil and overburden and revegetate.
- Install barrier fencing to limit access to rehabilitated areas.
- Ensure management practices are carried out to minimise areas being affected by wind and water erosion.

6.4 Erosion Control Instructions

The soil erosion hazard on the site will be kept as low as practicable by minimising disturbance. Some ways of doing this are outlined in *Table 8*. Extraction will take place within a defined work area and materials will be transported only within the site for processing. Entry to land not involved directly in the extraction process will be prohibited and will be managed as natural grassland or woodland as appropriate. Vehicular access to the site will be limited to that essential for extraction or rehabilitation.

Table 9. Limitations to Access

Landuse	Access Limitations	Comments
Extraction	Land disturbances (pre-strip) will not occur more than 1-2 month prior to an active extraction campaign.	All site workers will clearly recognise these areas and they will be clearly marked — suitable materials include barrier mesh, sediment fencing, etc. The project manager will determine their actual location on site. They can vary in position to conserve existing vegetation best while being considerate of the needs of efficient works activities.
Access Roads	Roads and tracks are limited to a width that are the minimum necessary to allow safe operation of heavy equipment	
Remaining Lands	Land disturbances are prohibited except for essential management works.	

Rehabilitation means:

Achieving a C-factor (Revised Universal Soil Loss Equation) of less than 0.1 should ensure water quality is protected by reducing the risk of erosion and through vegetation, paving, armouring, etc. as soon as practicable after extraction activities cease. It should be noted that the cover factor, C, is the ratio of soil loss from land under specified crop or mulch conditions to the corresponding loss from continuously tilled, bare soil. A C-factor of 1.0 corresponds to that of bare soil. While C-factors are likely to rise to 1.0 during the work's program, they should not exceed those given in *Table 9* within the specified times.

Table 10. Maximum acceptable C-factors at nominated times during works

Lands	Maximum C-Factor	Remarks
Waterways and other areas subjected to concentrated flows, post construction.	0.05	Applies after ten working days from completion of formation and before they are allowed to carry any concentrated flows. Flows are limited to those indicated in "Blue Book". Foot and vehicular traffic are prohibited in these areas.
Stockpiles, post clearance	0.1	Applies after ten working days from completion of formation.
All lands, including waterways and stockpiles during construction	0.15	Applies after 20 working days of inactivity, even though works might continue later.

The required C factors can be achieved in the short term (temporary protection for up to six months) with either:

- a suitable soil binder in areas of sheet flow, e.g. topsoil stockpiles
- jute mesh or Geo fabric covering;
- a temporary vegetative cover.
- Any soil binders applied will be employed following the manufacturer's instructions.

A suggested listing of suitable plant species is shown in *Table 10*. Before sowing, additional tests will be undertaken to assess the requirements of ameliorants such as lime to help plant growth.

Table 11. Plant Species for Temporary Cover

Sowing Season	Seed Mix
Autumn/Winter	Oats @ 40kg/Ha Japanese Millet @ 10kg/Ha
Spring/Summer	Oats @ 20kg/Ha Japanese Millet @ 20kg/Ha

While ever the C-factor is higher than 0.1, maintain the lands in a condition that resists removal by wind. This can be achieved by keeping the soil moist (not wet) by sprinkling with water and where practicable, leaving the surface in a cloddy state. Notwithstanding the above, schedule works so that the duration from the conclusion of land shaping to completion of final stabilisation is less than 10 days on slopes steeper than 30 per cent and 20 days on slopes less steep than 30 per cent.

Lands planted recently with grass species will be watered regularly until an effective cover has properly established and plants are growing vigorously. Follow-up seed and fertiliser will be applied as necessary in areas of minor soil erosion and/or inadequate vegetative protection. Where practicable, foot and vehicular traffic will be kept away from all recently stabilised areas.

Topsoil is to be stripped in a moist condition to avoid pulverisation and dust and topsoil stockpiles are not to exceed 2m in height with a minimum crest width of 2m. They will be seeded with a temporary vegetation cover if stockpiles are to remain longer than 30 days. Stockpiles are to be located at least five metres from areas of likely concentrated or high velocity flows, especially drainage lines and access roads. If necessary, earth banks or drains will be constructed to divert localised run-on. Soil materials are to be replaced in the same order they are removed from the ground. It is particularly important that all subsoils are buried and topsoils remain on the surface at the completion of works. Earth batters can have maximum gradients of 2(H):1(V) during the works program but will be laid back to lower grades

before the rehabilitation program starts. Final batter gradients will not exceed 3:1. All waterways, drains, spillways and outlets will be constructed to be stable in accordance with the "Blue Book" for soils with high erodibilities (see *Appendix F* for standard drawings).

6.5 Post Closure

The impact of the proposed final landform on surface water is not expected to be significant. The flatter profile of the area post closure compared to the existing site will potentially reduce erosion from runoff from the area. The extent to which the area is woodland or grassland could also impact on the runoff volumes. The Surface Water Management Plan will remain in place until the water quality from the site meets the target objectives for the area. With the use of vegetation and reduced slopes it is expected that there will be limited risk of impacts on surface water post closure.

7 SURFACE WATER IMPACTS

7.1 Catchment Surface Flow Volumes

The development has the potential to impact on annual flow volumes (i.e. yield) due to the need to control runoff from disturbed areas, including quarry extraction areas and processing areas.

Table 11 indicates the approximate catchment areas for South Creek and Thompsons Creek upstream of their confluence prior to the project, existing and with the maximum operational disturbance.

Table 12. Predicted Impacts on Catchments

Catchment	Total Catchment Area (Ha)*	Modified Catchment as percentage of Existing Catchment
Bardwell Gully prior to development	275	114%
Bardwell Gully Existing	240	100%
Bardwell Gully with maximum disturbance	233	97%
Thompsons Creek prior to development	178	106%
Thompsons Creek Existing	167	100%
Thompsons Creek with maximum Disturbance	167	100%
Total South Creek Catchment	62,000	99.989%

The total South Creek Sub-catchment into which Bardwell Gully and Thompsons Creek flow covers some 620 square kilometres (approx. 62,000Ha). The total loss of flow to the South Creek catchment in the fully developed state compared to the existing state is negligible.

The loss of base flow will be offset in the medium to long term through the release of surplus water that complies with the target release criteria for the quarry in terms of the EPL.

Discharge rates to Thompsons Creek via the Dam 5 (EPL Point 5) and Dam 1 (EPL Point 1) are regulated by the pump capacity which is currently 1,800L/min (1.8 m^3/sec). This rate is much less than the 1-year, time of concentration (tc) flow rate for the estimated total catchment of 407Ha (above the confluence of both streams) of approximately 21m^3/sec (calculated using the 'Blue Book') and would have negligible impact on the stability of downstream watercourses. It should be noted that it is best practice to design drains to contain the 10-year tc flow rate.

Using the existing pump system to discharge Dam 5 with a volume of 3,020 m^3 (3,020,000L) it would take approximately 28 hours. Dam 1 with a volume of 3,180 m^3 would take approximately 29 hours to discharge into Thompsons Creek.

7.2 Downstream Water Users

The Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011, established under the Water Management Act 2000, covers the project site and the South Creek Catchment. The plan splits the South Creek Catchment into two management zones, being the Upper South Creek management zone, within which the site is located and the Lower South Creek

management zone. The Upper South Creek Management Zone supports 88 surface water licences with a peak daily demand of 43.85 mega litres per day. Water is used to support irrigation and stock watering. As stated above the base flow loss to the Upper South Creek Management Zone will be offset in the medium to long term through the release of surplus water from the site[1].

7.3 Riparian and Ecological Vales of the Watercourses

The riparian woodland that occurs along Thompsons Creek to the east of the existing quarry is in poor condition and loosely meets the criteria for the EEC River flat Eucalypt Forest. It is also unlikely that aquatic habitats would contain any threatened fish species listed in the FM Act or EPBC Act. Thompsons Creek, mapped as Key Fish Habitat by DPI, was assessed to be in a degraded condition. The proposal would not result in any direct impacts to the creek according to the EIS[1].

From the EIS:

> *'The project will not have any significant impacts on the existing condition of nearby watercourses, including Thompsons Creek, Bardwell Gully and South Creek. These systems are characterised by degraded environmental conditions as previously outlined in this section.'*

There will be no increase in the frequency of discharges over and above current levels and therefore no additional impacts on riparian environments, including geomorphology and environmental flows.'

7.4 Flooding

A small portion of the site, to the east adjacent to Thompsons Creek is potentially impacted by Probable Maximum Flood Levels and the five per cent Annual Exceedance Probability (AEP) event. A bundwall with a maximum height of six metres has been constructed for visual and noise mitigation along this eastern boundary, extending from the brickmaking facility to the raw material storage area and finishing adjacent to Dam 6.

This bund also serves to prevent flood waters entering the site from Thompsons Creek. The brickmaking facility, material storage facility and quarry cells are largely located outside Council identified flood prone areas and are not considered being at risk from flooding. The project is also unlikely to impact on the natural functioning of the floodplain.

8 MONITORING AND MAINTENANCE

8.1 Surface Water Quality

Surface water must be sampled at Licenced Discharge Points 1 and 5 according to the following condition in line with the Environment Protection Licence 1808:

- Point 1 – Weekly during any discharge
- Point 5 – <24 hrs prior to discharge.

Samples must be analysed for pH, conductivity, turbidity and oil & grease using the following methods.

- pH and Conductivity

  pH and Conductivity are measured using the TPS WP81 pH and Conductivity Meter. The TPS WP81 pH and Conductivity Meter will be calibrated weekly prior to measurement. Refer to WI 4743-0000-003 pH and Conductivity Meter for instructions on calibration and testing. Sampling data is recorded in the Dam Test Spreadsheet and reported on the PGH website.

- Turbidity

  Turbidity is measured using the TPS WP88 Turbidity Meter. The TPS WP88 Turbidity Meter will be calibrated when a " * " replaces the decimal point on the digital display of the meter. Refer to WI 4743-0000-004 Turbidity Meter for instructions on calibration and testing. Sampling data is recorded in the Dam Test Spreadsheet and reported on the PGH website.

- Oil & Grease

  The routine test for Oil & Grease is a visual check. No evidence of Oil & Grease is considered to be <10 mg/L. If Oil & Grease is detected at the sampling point, water from the point is to be sampled and tested.

All Sampling data is recorded in the Dam Test Spreadsheet and reported on the PGH website and in the EPL Annual return.

Monitoring of Thompsons Creek upstream and downstream and Bardwell Gully will be undertaken monthly for the same analytes or prior to discharge to that watercourse.

PGH will undertake sampling within 24 hours prior to discharge for Point 5 and samples weekly from Point 1 as required by the EPA licence. There will be no changes to this procedure. Monitoring of the surface water outside the EPL Licence Points and the watercourses may be undertaken from time to time such as the other sediment dams in and out of the pit. The results of all monitoring are recorded and assist in the compilation of the Annual Rehabilitation Report to the DPIE-RG, The Annual Review to the DPIE and to the EPA in the Annual Return.

Water quality limits from the EPL are reproduced in *Section 3.3, Table 2*.

8.2 Surface Water Flows

The following management checks on the surface water flows will be undertaken monthly and recorded on the Monthly Stormwater Management System Inspection checklist, see *Appendix D*.

- Visual check of stability and operation of all banks, ponds, channels and spillways to be undertaken monthly. Affecting any necessary repairs.
- Visually check the discharge points into Thompsons Creek and Bardwell Gully to ensure that the discharge does not cause erosion or scouring of the creeks. Effecting any necessary repairs

- Drains and culverts for both clean water and dirty water will be examined for vegetation cover and blockages and maintenance will be performed to ensure they are working as designed.
- Diversion bund walls will be inspected regularly to assess the integrity and effectiveness. Maintenance will be performed when required.
- Removal of spilled materials from hazard areas, including lands closer than five metres from areas of likely concentrated or high velocity flows, especially waterways and access roads.
- Ensuring that rehabilitated lands have effectively reduced the erosion hazard and initiate upgrading or repair as appropriate.
- Constructing additional erosion and /or sediment control works as might become necessary to ensure the desired water quality control is achieved

There are no requirements in the EPL to record flows, however discharge volumes and estimated flow rates from the site will be recorded and reproduced in the Annual Review. Flows in Thompsons Creek and Bardwell Gully will be noted during the monthly checks.

8.3 Dam Management and Maintenance

Sediment dams will be managed using the following:

- Level indicators will be installed in dams with relevant marks located on the peg to indicate the amount of sediment load in the dam (see *Table 12* for volumes).
- All sediment basins will be maintained by de-silting when the capacity is diminished.
- Sediment dams and clean water dams will be visually assessed for water quality and volumes on a regular basis or as required after high rainfall events.
- If discharge is required, the visual assessment will be followed by sampling and testing of the water quality prior to discharge to ensure water quality criteria are met. In the case of the modified Dam 5 treatment system, the water quality parameters will be automatically monitored via in line monitors. The dams will also be periodically manually sampled tested as well as regular calibration of the monitoring equipment.
- The EPA limits of pH 6.5 – 8.5, oil and grease less than 10 mg/L, Conductivity less than 1,450µS/cm and turbidity of less than 150 NTU in the discharged water will be adopted (unless modified by the EPA).
- Ensuring that rehabilitated lands have effectively reduced the erosion hazard and initiate upgrading or repair as appropriate.
- Constructing additional erosion and /or sediment control works as might become necessary to ensure the desired water quality control is achieved

8.4 Sediment Load Calculations

Trigger levels for the de-silting of sediment dams have been developed by VGT and are provided in *Table 12* below. Desilting is required when the remaining dam capacity cannot hold the design storm event volume.

The equivalent depth of silt in the dam this equates to have been estimated below in order to allow marking posts to be installed in the dams. Dam 6 and 7 are not included as they are assumed to be a clean water dams that no longer influence the water management system of the site. Dam 2 is also not included as it will be incorporated into the new extraction areas in Cell D. Dam 3, the quarry pit sump,

is also not included due to the very large capacity and the requirement to mine within the pit. Dam 5 has not been estimated as it is not used as a primary catchment dam.

Table 13. Trigger Levels for De-silting Dams[1]

Dam #	Dam(M^2)*	Dam Volume Required for 20 day management period (170%) (m3)	Sediment Dam Maximum Capacity (m3)	Maximum volume of silt that may be contained before design Capacity exceeded (m3)	Depth of Silt(m)
Dam 1	4,100	1,431	3,180	1,749	0.4
Dam 4	3750	6,101	9,375	3,274	0.9

Note: the design storm event is assumed to be the 90th percentile, 5 day rainfall event.

In accordance with the results in the table above, Dam 1 will be installed with a marked post indicating that when the depth of silt has reached 0.4m above the base of the dam. Similarly a post will be installed in Dam 4 indicating when the depth of silt has reached 0.9m from the base of the dam. Dam 5 will have a similar post installed as the depth of silt before the capacity is compromised is assumed to be similar to Dam 4.

9 PERFORMANCE CRITERIA

Table 14. Performance Criteria and Trigger Action Response Plan

Objective	Performance Indicator	Potential Adverse Outcome	Trigger Level	Actions to be Implemented	Evidence/ Reference
Water discharged from the site is consistent with the baseline hydrological conditions of the surrounding environment	Total volume of water discharged from the site to be as close as possible to the natural volumes expected.	Significant changes to volume of water discharged harms ecological communities downstream.	Sediment dams are not emptied to return to design storm capacity within the 20 day management period.	Review water management procedures to ensure that the dams can be emptied to the design storm capacity within the 20 day management period.	Annual review report/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP
	Flow rate of the discharged water to not exceed that expected by natural flow rates expected predevelopment.	Significant changes to flow rates of water discharged erode creeks or otherwise harm ecological communities downstream.	Flow rates for controlled discharge exceed those in Section 5 for a 1 in 10 year ARI storm for the catchments pre-development.	Review discharge procedures and capacity of pipes and pumps used to discharge water to ensure flow rates are not exceeded.	Annual review report/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP

Objective	Performance Indicator	Potential Adverse Outcome	Trigger Level	Actions to be Implemented	Evidence/ Reference
Sediment to be contained on site	Sediment Dams are sized according to the 'Blue Book' Criteria for a 5 day 90th percentile storm event with 20 day management period (see Table 5)	Sediment is not contained within the sediment dams and is observed as uncontrolled discharge exiting the site due to incorrect dam sizing.	Sediment dams reach capacity and are at risk of overtopping after a 5 day rainfall event of 42.6mm. Uncontrolled discharge is observed leaving the site from the sediment dams after a 5 day rainfall event of 42.6mm.	Emergency pumping from sediment dams at risk of overtopping to Dam 3 to be undertaken. Dam sizes are to be verified against current catchments. Dams are to be enlarged if required to meet the required capacity. Review of the SWMP to be undertaken.	Annual review report/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP
	Sediment Dam capacity is maintained at a level sufficient for the design 5 day 90th percentile storm event with 20 day management period (see Table 5)	Sediment is not contained within the sediment dams and is observed exiting the site as uncontrolled discharge due to dams having diminished capacity as requiring desilting or dam not emptied from previous storm event.	Sediment retained in sediment dams exceeds that calculated (and pegged with markers onsite) as the maximum volume before desilting is required as Listed in Table 12.	Once this level has been reached the dams will be desilted.	Annual review report & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP

Objective	Performance Indicator	Potential Adverse Outcome	Trigger Level	Actions to be Implemented	Evidence/ Reference
	All surface water received over exposed surfaces prone to sediment entrainment is flows to the dirty water management system.	Surface water received over exposed surfaces prone to sediment entrainment that egresses off site as no sediment dam or drains provided for disturbed catchments.	Expansion of the quarry or changes to the mining sequence that may impact the current water management system.	Review of site and SWMP to determine water management requirements. No work will commence in new areas or changes to the mining sequence until the SWMP is reviewed and appropriate water management structures are constructed.	Environmental Management Report/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP
	Constructed drains/pipes direct sediment laden water to the sediment dams and clean water around the site.	Sediment leaves the site due to the failure to construct suitable drains/pipes to contain the design storm event to direct dirty water to the sediment dams. Excessive clean water is diverted onto the site and sediment dam capacity for dirty water is impacted causing overtopping of dams	Clean or dirty water drains/pipes observed to be blocked or damaged. Inspection during rainfall events shows dirty water egressing the site via drain overflow. Inspection during rainfall events shows additional drains/pipes required to redirect dirty water to sediment dams. Inspection during rainfall events shows additional drains required to redirect clean water around the site.	Blocked or damaged drains/pipes are to be repaired. Drains sizes are to be checked by onsite measurements to ensure compliance with Blue Book calculations i.e. All drains will be designed for the 1 in 10 year design storm event. Install additional drains/pipes as required.	Annual review report photographic evidence Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP

Objective	Performance Indicator	Potential Adverse Outcome	Trigger Level	Actions to be Implemented	Evidence/ Reference
	Sediment Dam spillways and earth embankments are vegetated and stable for the design storm event.	Sediment leaves the site due to the failure of the dam wall or spillway due to not being designed for the design storm flows. Sediment leaves the site due to the erosion of the dam wall or spillway.	Inspection during a 5 day rainfall event of <42.6mm shows overtopping of the sediment dams. Erosion or tunnelling on the dam walls observed. Dam wall failure. Inspections shows dam walls (earth embankments) are not adequately vegetated and spillways protected from erosion adequately.	Spillways to be measured to check if complies with Blue Book calculations i.e All spillways to be designed for the 1 in 100 year design storm event. Dam walls and batters to be measured to ensure they are not too steep i.e.>3H:1V Replace vegetation on eroded surfaces if required. Repair dams as required.	Annual review report & photographic evidence/Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP

Objective	Performance Indicator	Potential Adverse Outcome	Trigger Level	Actions to be Implemented	Evidence/ Reference
Erosion is minimised	Rehabilitation slopes are designed to minimise the effects of erosion according to the Blue Book	Excessive sediment builds up in sediment dams. Re-vegetation unable to establish. Loss of topsoil for rehabilitation.	Slopes in rehabilitated areas observed to be greater than 3 horizontal to 1 vertical. Slope lengths exceed 20m before a catch drain is installed for a 3H:1V batter. Slope lengths exceed 35m before a catch drain is installed for a 4H:1V batter. Slope lengths exceed 60m before a catch drain is installed for batters >4H:1V. Visual inspection shows evidence of excessive rilling or gullying on rehabilitation slopes. Visual inspection shows established rehabilitated areas lose vegetation coverage or are unable to establish adequate vegetation coverage i.e. <60% coverage. Visual inspection shows spread topsoil on areas awaiting revegetation is eroding.	Install catch drains or earth banks on slopes where slope lengths exceed recommendations. Review rehabilitation areas to determine where slopes and catch drains need maintenance or repair or reworking. Reseeding/replant areas that require increased vegetation cover. Replace/ rework topsoil as required.	Annual review report & photographic evidence/Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP

Objective	Performance Indicator	Potential Adverse Outcome	Trigger Level	Actions to be Implemented	Evidence/ Reference
	Revegetation whether temporary or permanent is undertaken as soon as practicable to reduce the exposed surface area.	Excessive sediment builds up in sediment dams. Re-vegetation unable to establish. Loss of topsoil.	A C-factor (Revised Universal Soil Loss Equation) of less than 0.1 is not achieved on rehabilitated surfaces i.e. equivalent of 60% coverage by vegetation.	Review rehabilitation areas to determine where revegetation requires maintenance or repair.	Annual review report & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP
	Long term topsoil stockpiles and overburden stockpiles are protected from erosion within 10 days of formation.	Excessive sediment builds up in sediment dams. Loss of topsoil for rehabilitation.	A C-factor (Revised Universal Soil Loss Equation) of less than 0.1 is not achieved on rehabilitated surfaces i.e. equivalent of 60% coverage by vegetation	Review topsoil and overburden stockpiles to determine where maintenance or repair is required.	Annual review report & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP
	Access to rehabilitated areas and works areas are limited to necessary vehicles and personnel	Erosion of rehabilitation areas due to tracks by vehicles or feet. Disturbance and erosion of areas outside the quarry extraction footprint.	Monthly visual inspections show evidence of vehicle tracks or earthworks outside of approved works areas or within rehabilitation areas.	Repair damage to rehabilitation areas or areas outside the quarry extraction footprint. Ensure adequate signage and/or barrier fencing is erected to limit traffic access to sensitive areas Review staff training to ensure personnel are aware of 'no go' areas.	Monthly inspection reports & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP

Objective	Performance Indicator	Potential Adverse Outcome	Trigger Level	Actions to be Implemented	Evidence/ Reference
	Tracks suitable for access or pedestrian usage will not be subject to excessive use or erosion.	Excessive sediment builds up in sediment dams.	Visual inspection indicates excessive road / track erosion and deterioration.	Slopes of major tracks <10° or have cross drains/banks installed. Where unsuitable soils are present, tracks to be stabilised with crushed bricks, concrete, gravel or similar.	Monthly inspection reports & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP
Water discharged from the site is consistent with the baseline ecological and geomorphic conditions of the surrounding environment	Water quality monitoring results show that the discharge is non-polluting.	Significant changes to quality of water discharged harms ecological communities downstream.	Water Quality does not meet the objective of Section 120 of the Protection of the Environment Operations Act 1997. In particular Monitoring Point 1 and 2 shows water quality parameters outside the EPL criteria of pH between 6.5 and 8.5, turbidity <150mg/L and O&G <10mg/L(none visible). Conductivity <1450µS/cm for Point 5.	Discharge is to cease immediately. Sediment dams are to be treated as appropriate to ensure the water to be discharged meets the EPL criteria Discharge will not recommence until the quality of the water is sufficient.	PIRMP Annual review report & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP

Objective	Performance Indicator	Potential Adverse Outcome	Trigger Level	Actions to be Implemented	Evidence/ Reference
	Fuel and oil storage is bunded and spill kits are accessible. No spills of hydrocarbons occur.	Releases of hydrocarbons changes quality of water discharged and harms ecological communities downstream.	Hydrocarbon spill occurs that has not been contained and contaminants observed to enter the water management system. Water Quality does not meet the objective of Section 120 of the Protection of the Environment Operations Act 1997. In particular Monitoring Point 1 and 2 shows water quality parameters outside the EPL criteria of O&G <10mg/L (none visible).	Discharge is to cease immediately. Sediment dams are to be treated as appropriate to ensure the water to be discharged meets the EPL criteria Discharge will not recommence until the quality of the water is sufficient. All hydrocarbon spills are to be cleaned up. Procedures for handling hydrocarbons to be revised and updated if required. Staff and contractors to be re-trained in the handling of hydrocarbons.	PIRMP Spill Response Training Annual review report & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP

10 ENVIRONMENTAL MANAGEMENT MEASURES

Specific surface water management measures identified in the EIS, CoA and EPL have been interpreted and generally reproduced in *Table 14*. The management measures identified in this table are to be implemented to mitigate or manage impacts identified. Relevant responsibility and references for each have been identified in the corresponding columns below.

Table 15. Environmental Management Measures

#	Management Measure	Responsibility	Frequency	Reference
General				
G1	An environmental consultant with appropriate qualifications for the task will be engaged to help review and implement surface and ground water management plan and measures for the Project.	Environmental Consultant Environmental Manager Operations Manager	As required	VGT Consultant Correspondence
G2	All relevant individuals will read the WMP with any engineering plans and any other plans or written instructions issued in relation to development at the project site.	Operations Manager Site Engineers Contractors	As required	WMP (This Plan)
G3	Implement Water Management Procedures and regularly review to ensure relevance and compliance with internal and external requirements.	Operations Manager Site Engineers Contractors	At least annually	Water Management Procedures
G3	Ensuring contractors undertake all soil and water management works as instructed in this specification and constructed following the guidelines stated in the "Blue Book" and internal procedures.	Operations Manager Site Engineers Contractors	As required	Water Management Procedures
G4	Inform all subcontractors of their responsibilities in minimising the potential for surface and ground water quality impacts, spills etc. through site induction and toolbox talks.	Environmental Manager Operations Manager	At least annually	Induction
G5	Annual Review of this plan and relevant procedures	Operations Manager Environmental Manager	At least annually	WMP (This Plan)

#	Management Measure	Responsibility	Frequency	Reference
Surface water Management				
SW1	Undertake Water quality, flow and consumption monitoring as per the requirements of the EPL and this Plan	Environmental Manager Site Engineer Site Staff & Contractors	Monthly	EPL, WMP (This Plan) ENVIZY CSR environmental database.
SW2	Investigation of options for the reuse of water stored on-site for beneficial use in order to increase the on-site water extraction regime, improve on-site storage capacity and reduce discharges to Thompsons Creek. Key potential uses will include using water from the Quarry Pit, Dams 4, 5 and 6 for dust suppression activities associated with routine operations and extraction campaigns	Environmental Consultant Environmental Manager Operations Manager	As required	WMP (This Plan)
SW3	Investigation and implementation of a mechanical /automatic dosing and testing point at Discharge point 5.	Environmental Consultant Environmental Manager	As required	WMP (This Plan)
SW4	Stabilisation and controls for temporary stockpiles in accordance with Section 9 controls to minimise the risk of erosion.	Operations Manager Site Engineers Contractors	As required	WMP (This Plan)
SW5	Use of flocculants in sediment basins to increase sediment removal rates as per procedure 4743-0000-001.	Operations Manager Site Engineer Site Staff	As required	Water Management Procedures
SW6	Routine maintenance and inspection of dams, drains, sediment basins and bunds. Including sediment level checks, once levels have been reached dams will be desilted. Blocked or damaged drains/pipes/dams are to be repaired where required.	Operations Manager Site Engineer Site Staff & Contractors	As required	WMP (This Plan)
SW7	Activities with the potential to reduce or contaminate local water quality (including refuelling, vehicle servicing, concrete washout, storage of fuels and hazardous materials,) will be undertaken within appropriately bunded or surfaced areas.	Operations Manager Site Engineer Site Staff & Contractors	As required	Water Management Procedures / PIRMP

#	Management Measure	Responsibility	Frequency	Reference
SW8	PGH will undertake water quality sampling as per the requirements of EPL 1808.	Environmental Consultant Environmental Manager Operations Manager	As required	WMP (This Plan)
SW9	All Fuel and oil storage will be appropriately bunded with spill kits are accessible. All hydrocarbon spills are to be cleaned up and reported as per PIRMP. Procedures for handling hydrocarbons and spills to be revised and updated if required	Environmental Manager Operations Manager Site Engineer Site Staff & Contractors	As required	WMP (This Plan)
SW10	Staff and contractors to be trained in the handling of hydrocarbons, spills and PIRMP annually.	Environmental Manager Operations Manager Site Engineer Site Staff & Contractors	Annually	WMP (This Plan)/Induction/ Spill Training
Soil Erosion, Sediment and Drainage Control Measures				
SE1	Construct earth banks or Stormwater Catch to divert as much clean water as possible and capture the dirty water in new cells, cleared ground or on slopes where slope lengths exceed recommendations.	Operations Manager Site Engineer	As required	Section 6
SE2	Review rehabilitation areas to determine where revegetation requires maintenance or repair.	Environmental Manager Operations Manager Site Engineer Site Staff & Contractors	Annually	Section 6
SE3	Review topsoil and overburden stockpiles to determine where maintenance or repair is required.	Environmental Manager Operations Manager Site Engineer Site Staff & Contractors	Annually	Section 6

#	Management Measure	Responsibility	Frequency	Reference
SE4	Install erosion and sediment controls where required, ensure maintenance and include in regular inspections of the site.	Operations Manager Site Engineer Site Staff Contractors	As required	Section 6
SE5	Staff and contractors to be trained in the Erosion and Sediment controls annually.	Environmental Manager Operations Manager Site Engineer Site Staff & Contractors	Annually	WMP (This Plan)/Induction/ ERSED Training

11 COMPLIANCE MANAGEMENT

11.1 Inspections

Weekly inspections and daily visual observations by the Plant Manager (or delegate) of surface water quality conditions and controls will occur throughout the operational lifetime of the facility.

11.2 Training

All employees and contractors working on site will undergo site induction training, which will cover issues relating to water quality management, including:

- Existence and requirements of this Plan;
- Relevant legislation;
- Bringelly Brickworks operational hours;
- Location of Spill kits;
- All other water quality management measures that need to be implemented to minimise impact to surface and ground water;
- Location of sensitive receivers; and
- Incident and Complaints reporting.

11.3 Complaints and Enquires Procedure

All community inquiries and complaints related to the facility's activities will be referred to a community information line (02 4774 8751). A postal address, PGH Bricks, Locked Bag 1345, North Ryde BC NSW 1670) and email address has been provided for receipt of complaints and enquiries. Information to be recorded will include location of complainant, time of occurrence of alleged complaint, perceived source, prevailing weather conditions and similar details that could be utilised to assist in the investigation of the complaint.

An initial response acknowledging a complaint will be provided within 24 hours of a complaint being received. A further detailed response, including steps taken to resolve the issue(s) that led to the complaint, will be provided within 10 days. All reasonable endeavours will be made to resolve and close off complaints. The complainants will be kept informed of when they will receive a response.

Information on all complaints received, including how they were addressed, whether resolution was reached and whether mediation was required or used will be included in a complaint register.

Complaints and the subsequent action(s) taken by PGH will be reported at each subsequent Community Consultative Committee meeting.

11.4 Incident Management

PGH will immediately notify the Secretary and any relevant agencies when an incident has occurred. More specifically, where the following conditions are not met a water incident shall be raised and reported accordingly:

1. On review of Water quality monitoring data, an exceedance is recorded above the criteria stipulated in *Section 9*; and

2. Within seven days of the declaration of an incident, a report documenting the facts of the incident must be submitted to the Secretary. This report is to document the findings of the incident investigation, attempt to identify the cause and nature of the exceedance.

11.5 Audit

Audits (both internal and external) and reporting will be undertaken to assess the effectiveness of environmental controls, compliance with this WMP, CoA and other relevant approvals, licenses and guidelines.

11.5 Reporting

The effectiveness of the water management system will be assessed in an annual review and audits as required by consent conditions. Additional reviews will be undertaken in the form of an Annual Rehabilitation Report (ARR) as required by the Mine Lease conditions. In addition Water usage and quality data will be provided in the EPL annual Return and internally through ENVIZY.

These reviews will report on the progress towards performance criteria as outlined in *Table 13*. Where an action response has been implemented, details of the action and any results obtained will be included in the ARR. The ARR's will be submitted to the DPIE- Resources and Geoscience until the Mining Lease has been relinquished.

In Addition to the ARR's, and Annual Review of the environmental performance will be undertaken and submitted to DPIE by the end of September each year to the satisfaction of the Secretary in accordance with Schedule 5-Condition 4 of the CoA.

The Secretary will be notified immediately of any incidents and a report will be provided to the Secretary as discussed in *Section 11.4.*

Audits (routinely conducted every 3 years after the initial 12 monthly audit) will also be submitted to the Secretary.

PGH will provide regular reporting on the environmental performance of the development on its website.

As part of the measurement of the effectiveness of the water management system, PGH will assess the following:

- Water imported, water use, volumes stored and any discharges from the site and report results or changes to the balance;
- Water quality results for compliance and trends;
- Water flows within Thompsons Creek and Bardwell Gully as well as surface water flows on the site;
- Identifying non-compliances and actions taken to ensure compliance;
- Discrepancies between the predicted and actual impacts of the development; and
- Measures that may be undertaken to improve the environmental performance of the development.

12 REVIEW AND IMPROVEMENT

Continuous improvement of this WMP will be achieved through the ongoing evaluation of environmental management performance against environmental policies, objectives and targets.

The continuous improvement process is designed to:

- Identify areas of opportunity for improvement of environmental management and performance;
- Determine the cause or causes of non-conformances and deficiencies;
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies;
- Verify the effectiveness of the corrective and preventative actions;
- Document any changes in procedures resulting from process improvement; and
- Make comparisons with objectives and targets.

Inspections, monitoring, auditing and management reviews may result in the need to update or revise this WMP.

13 REFERENCES

1. VGT: Surface Water Management Plan for Bringelly Quarry(ML1731 (Act 1992) - February 2018
2. Golder and Associates – Groundwater Impact Assessment (2013)
3. Hyder Consulting - Bringelly Brickworks and Quarry Expansion ENVIRONMENTAL IMPACT STATEMENT Volumes 1 & 2 -5 September 2013
4. Kleinfelder Water Management Plan PGH Bricks & Pavers Bringelly - 28 October 2016
5. DECC, 2008, the Blue Book – Volume 2D.
6. Landcom, 2004, Managing Urban Stormwater: Soils and Construction – Volume 1 and 2 (4th edition).
7. Western Sydney Regional Organisation of Councils, 2004, Draft Salinity Code of Practice.
8. NOW Guidelines for Controlled Activities.
9. ANZECC Guidelines for Fresh and Marine Water Quality.
10. ANZECC Guidelines for Water Quality Monitoring and Reporting.
11. Water Management Act 2000.

Figure 1 Site Location

Plan of:	Bringelly Clay Mine Surface Water Management Plan - Site Location	**Location:**	Bringelly Clay Mine Off Greendale Road, Bringelly, NSW	**Source:**	nearmap - Image Date 12/01/2019 & Google Maps 2019	**Our Ref:**	8006_BR_SWMP_C001_V0_F1.cdr
Figure:	ONE	**Council:**	Camden Council	**Survey:**	N/A	**Plan By:**	JD
Sheet:	1 of 1	**Tenure:**	ML 1731	**Projection:**	N/A	**Project Manager:**	TO
Version/Date:	V0 10/09/2019	**Client:**	PGH Bricks & Pavers Pty Ltd	**Contour Interval:**	N/A	**Office:**	Thornton

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Legend

- Cadastral Boundary
- Project Approval Boundary
- Authority Boundary (ML 1731)

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Figure 2 Site Layout

Plan of:	Bringelly Clay Mine Surface Water Management Plan - Site Layout	**Location:**	Bringelly Clay Mine Off Greendale Road, Bringelly, NSW	**Source:**	Photomapping 2015 & nearmap - Image Date 12/01/2019	**Our Ref:**	8006_BR_SWMP_C002_V0_F2.cdr
Figure:	TWO	**Council:**	Camden Council	**Survey:**	Photomapping 2015	**Plan By:**	TO/JD
Sheet:	1 of 1	**Tenure:**	ML 1731	**Projection:**	MGA	**Project Manager:**	TO
Version/Date:	V0 5/09/2019	**Client:**	PGH Bricks & Pavers Pty Ltd	**Contour Interval:**	1m	**Office:**	Thornton

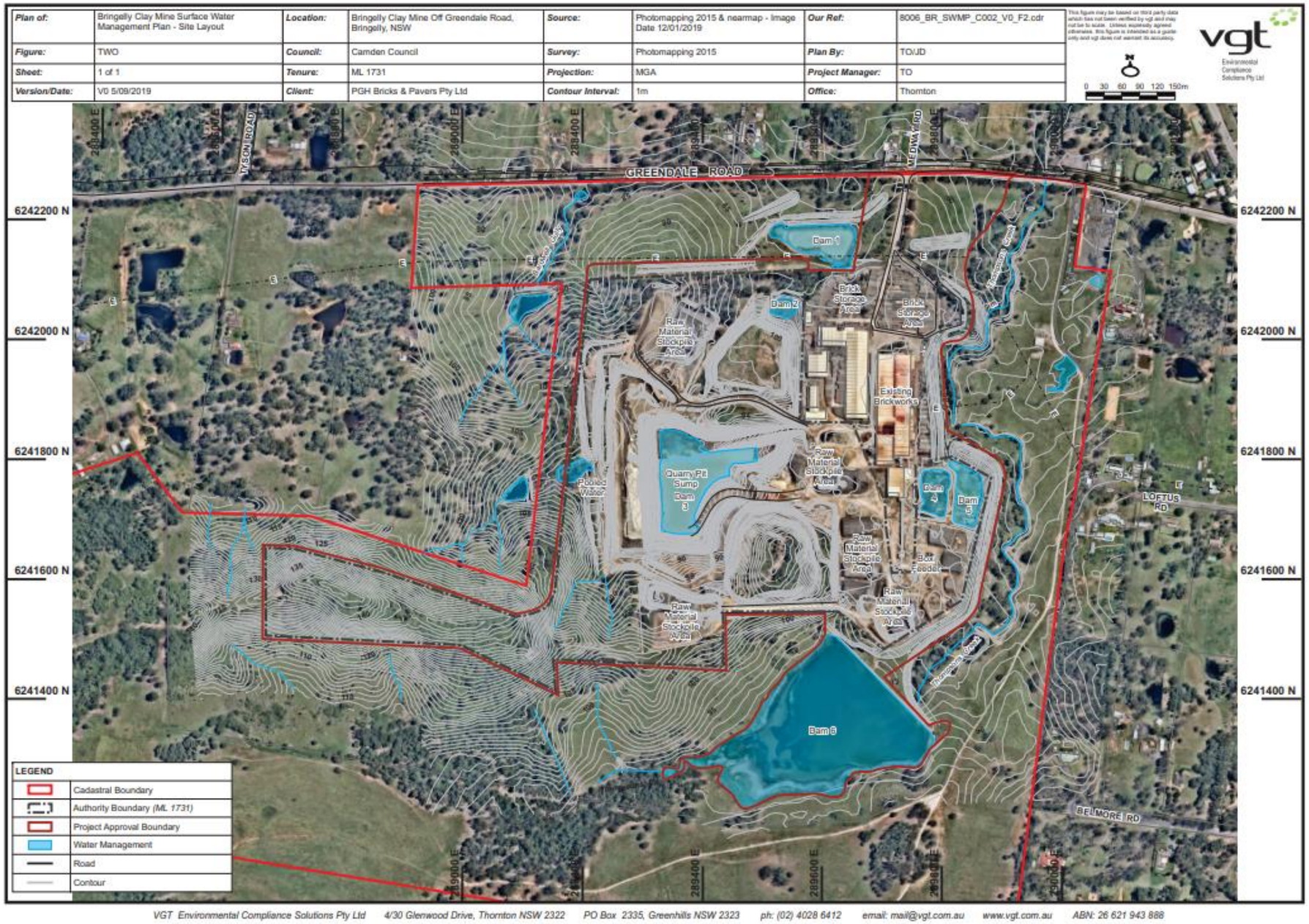

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Figure 3 Existing Water Management

Plan of:	Bringelly Clay Mine Surface Water Management Plan - Existing Water Management	*Location:*	Bringelly Clay Mine Off Greendale Road, Bringelly, NSW	*Source:*	Photomapping 2015 & nearmap - Image Date 12/01/2019	*Our Ref:*	8006_BR_SWMP_C003_V0_F3.cdr
Figure:	THREE	*Council:*	Camden Council	*Survey:*	Photomapping 2015	*Plan By:*	TO/JD
Sheet:	1 of 1	*Tenure:*	ML 1731	*Projection:*	MGA	*Project Manager:*	TO
Version/Date:	V0 5/09/2019	*Client:*	PGH Bricks & Pavers Pty Ltd	*Contour Interval:*	1m	*Office:*	Thornton

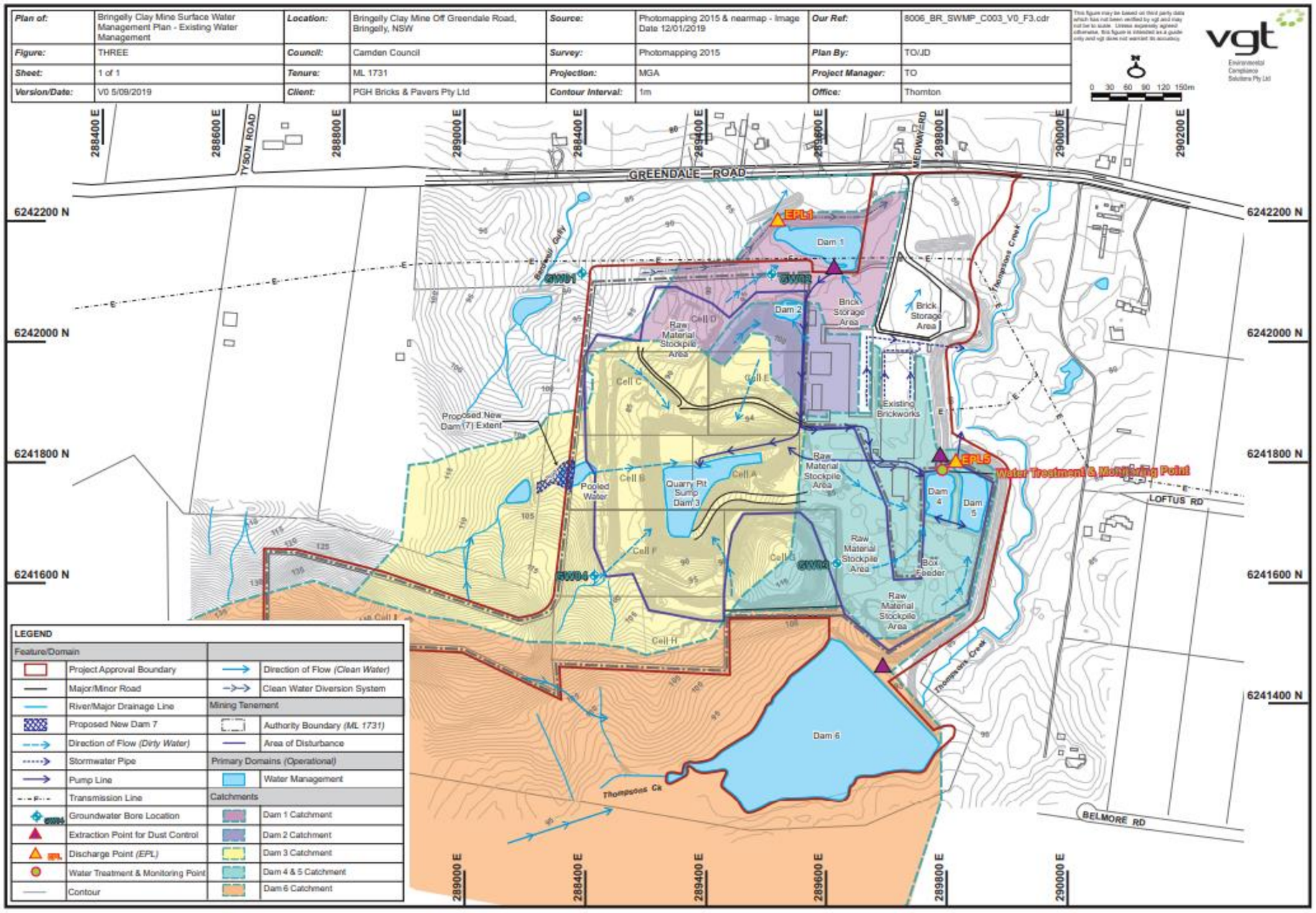

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Figure 4 EIS Preferred Option

Plan of:	Bringelly Clay Mine Surface Water Management Plan - EIS Preferred Option	**Location:**	Bringelly Clay Mine Off Greendale Road, Bringelly, NSW	**Source:**	Photomapping 2015 & nearmap - Image Date 12/01/2019	**Our Ref:**	8006_BR_SWMP_C004_V0_F4.cdr
Figure:	FOUR	**Council:**	Camden Council	**Survey:**	Photomapping 2015	**Plan By:**	TO/JD
Sheet:	1 of 1	**Tenures:**	ML 1731	**Projection:**	MGA	**Project Manager:**	TO
Version/Date:	V0 5/09/2019	**Client:**	Boral CSR Bricks Pty Ltd	**Contour Interval:**	1m	**Office:**	Thornton

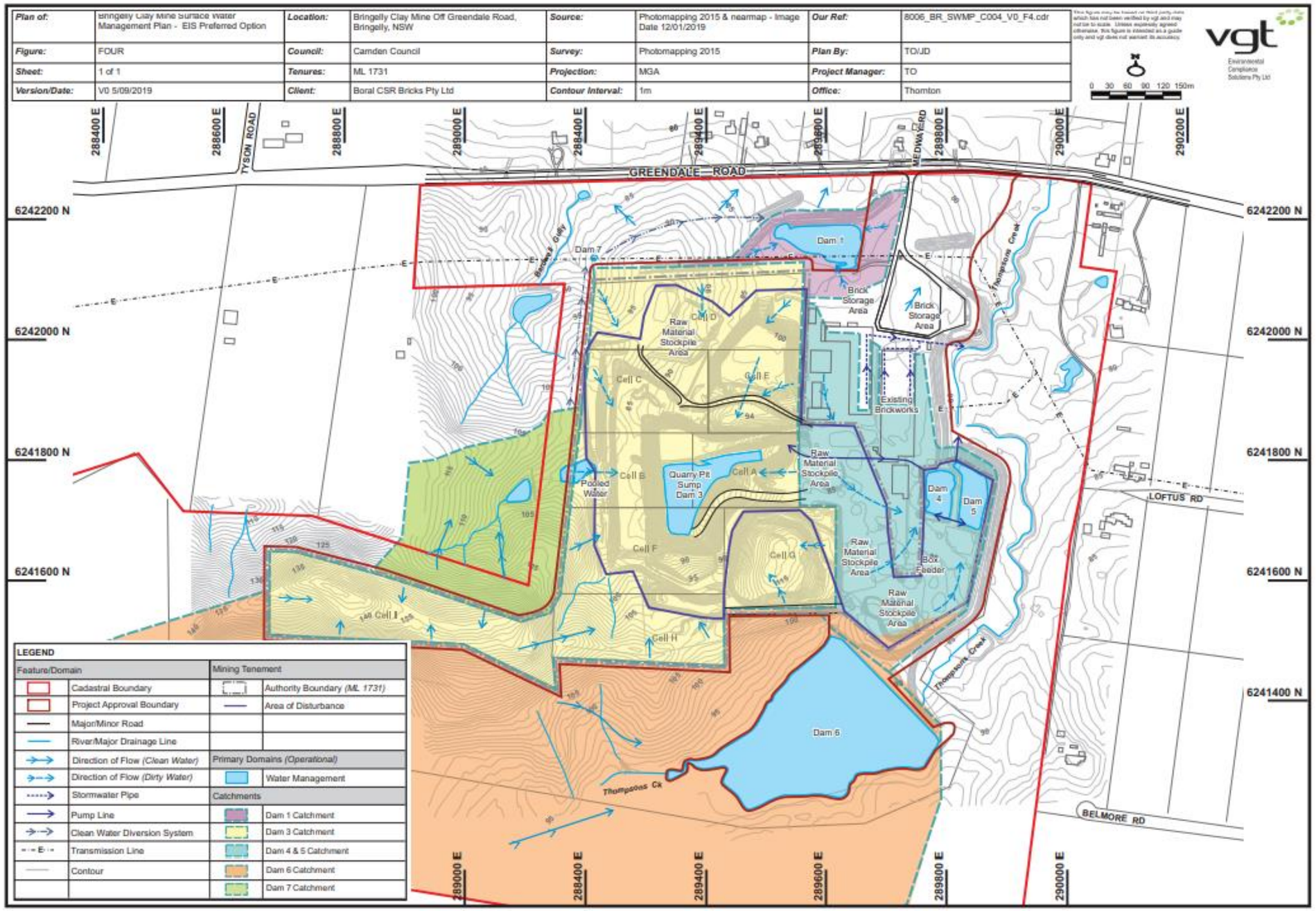

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Figure 5 Existing Western Catchment Management

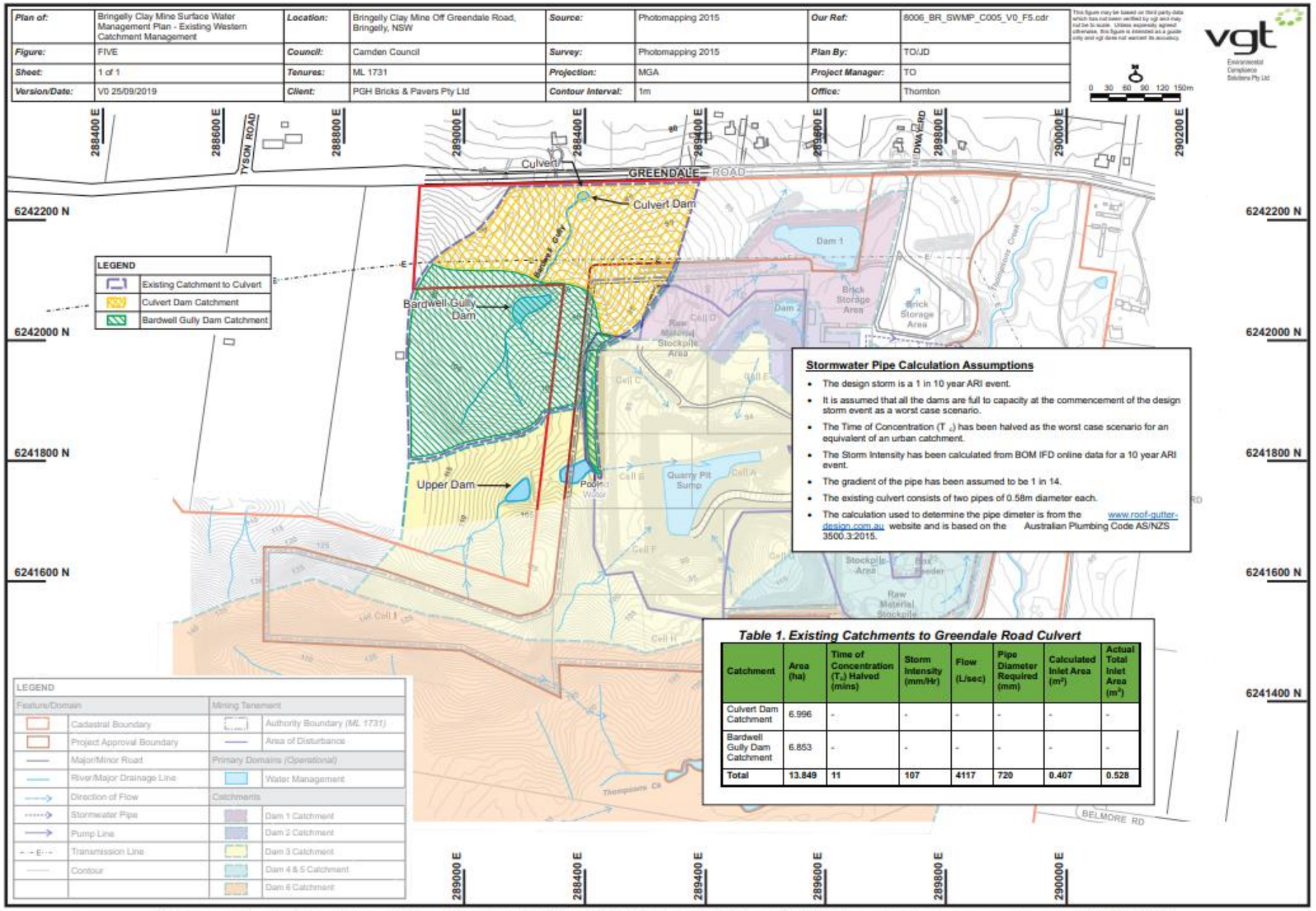

Figure 6 Direct Diversion of Dam 7 to Bardwell Creek

Plan of:	Bringelly Clay Mine Surface Water Management Plan - Direct Diversion of Dam 7 to Bardwell Gully	**Location:**	Bringelly Clay Mine Off Greendale Road, Bringelly, NSW	**Source:**	Photomapping 2015	**Our Ref:**	8006_BR_SWMP_C006_V0_F6.cdr
Figure:	SIX	**Council:**	Camden Council	**Survey:**	Photomapping 2015	**Plan By:**	TO/JD
Sheet:	1 of 1	**Tenures:**	ML 1731	**Projection:**	MGA	**Project Manager:**	TO
Version/Date:	V0 5/09/2019	**Client:**	PGH Bricks & Pavers Pty Ltd	**Contour Interval:**	1m	**Office:**	Thornton

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0 30 60 90 120 150m

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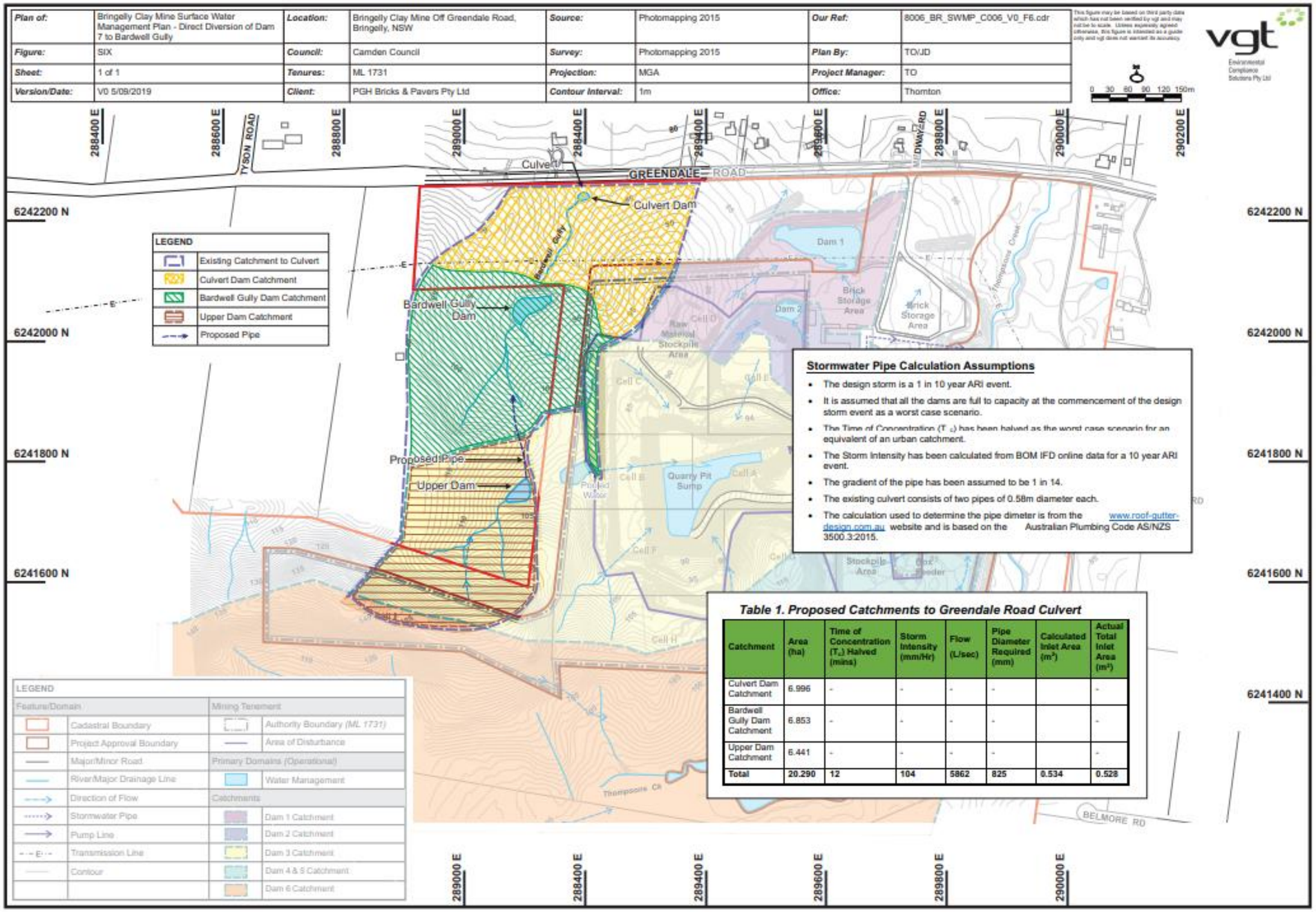

Table 1. Proposed Catchments to Greendale Road Culvert

Catchment	Area (ha)	Time of Concentration (T_c) Halved (mins)	Storm Intensity (mm/Hr)	Flow (L/sec)	Pipe Diameter Required (mm)	Calculated Inlet Area (m^2)	Actual Total Inlet Area (m^2)
Culvert Dam Catchment	6.996	-	-	-	-		-
Bardwell Gully Dam Catchment	6.853	-	-	-	-		-
Upper Dam Catchment	6.441	-	-	-	-		-
Total	**20.290**	**12**	**104**	**5862**	**825**	**0.534**	**0.528**

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Figure 7 Proposed Water Management

Plan of:	Bringelly Clay Mine Surface Water Management Plan - Proposed Water Management	**Location:**	Bringelly Clay Mine Off Greendale Road, Bringelly, NSW	**Source:**	Photomapping 2015 & nearmap - Image Date 12/01/2019	**Our Ref:**	8006_BR_SWMP_C007_V0_F7.cdr
Figure:	SEVEN	**Council:**	Camden Council	**Survey:**	Photomapping 2015	**Plan By:**	TO/JD
Sheet:	1 of 1	**Tenures:**	ML 1731	**Projection:**	MGA	**Project Manager:**	TO
Version/Date:	V0 5/09/2019	**Client:**	Boral CSR Bricks Pty Ltd	**Contour Interval:**	1m	**Office:**	Thornton

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0 30 60 90 120 150m

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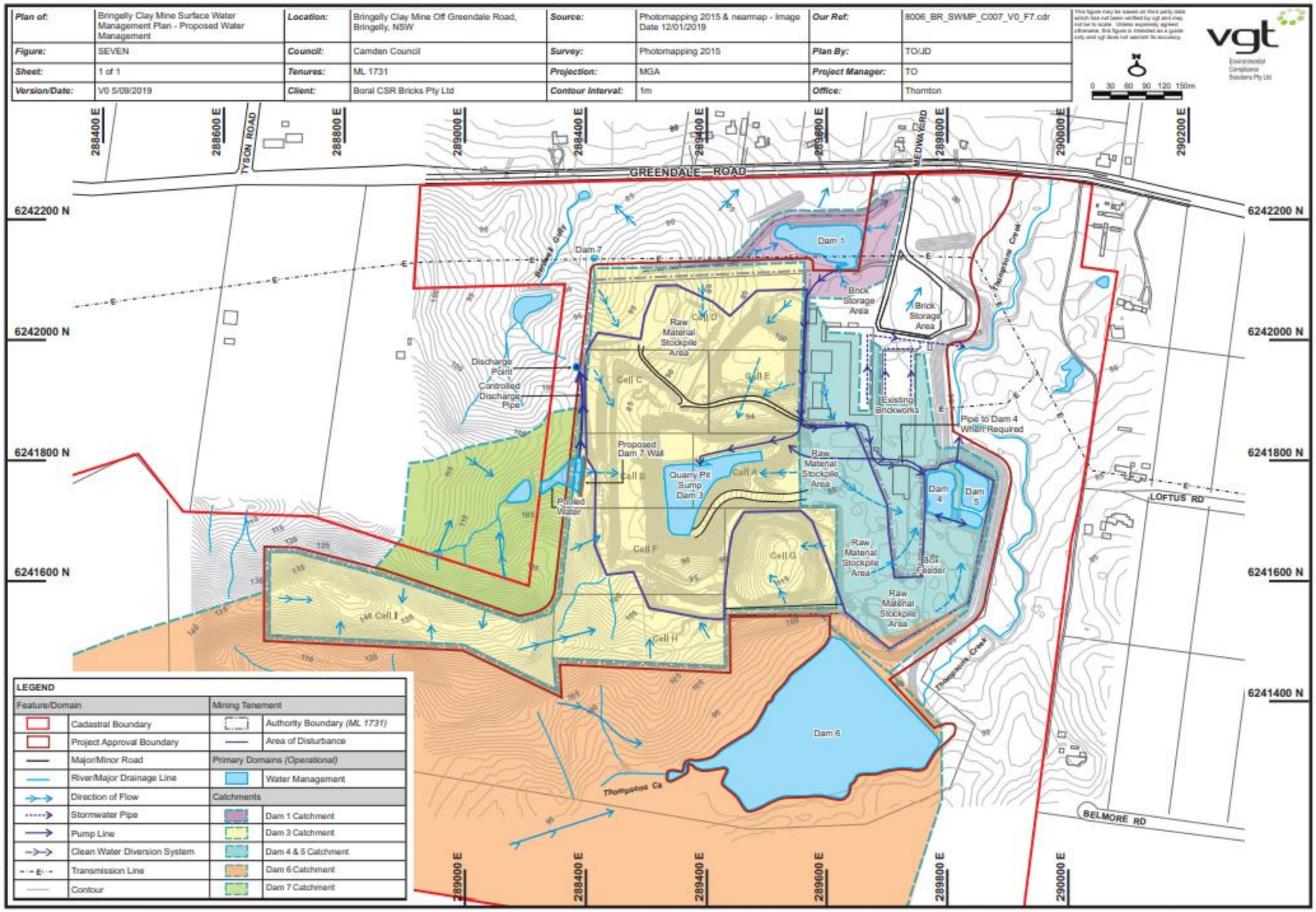

LEGEND			
Feature/Domain		Mining Tenement	
	Cadastral Boundary		Authority Boundary *(ML 1731)*
	Project Approval Boundary		Area of Disturbance
	Major/Minor Road	Primary Domains *(Operational)*	
	River/Major Drainage Line		Water Management
	Direction of Flow	Catchments	
	Stormwater Pipe		Dam 1 Catchment
	Pump Line		Dam 3 Catchment
	Clean Water Diversion System		Dam 4 & 5 Catchment
	Transmission Line		Dam 6 Catchment
	Contour		Dam 7 Catchment

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Figure 8 Detail of Dam 7 Controlled Discharge

Plan of:	Bringelly Clay Mine Surface Water Management Plan - Detail of Dam 7 Controlled Discharge	**Location:**	Bringelly Clay Mine Off Greendale Road, Bringelly, NSW	**Source:**	Photomapping 2015	**Our Ref:**	8006_BR_SWMP_C008_V0_F8.cdr
Figure:	EIGHT	**Council:**	Camden Council	**Survey:**	Photomapping 2015	**Plan By:**	TO/JD
Sheet:	1 of 1	**Tenures:**	ML 1731	**Projection:**	MGA	**Project Manager:**	TO
Version/Date:	V0 5/09/2019	**Client:**	PGH Bricks & Pavers Pty Ltd	**Contour Interval:**	1m	**Office:**	Thornton

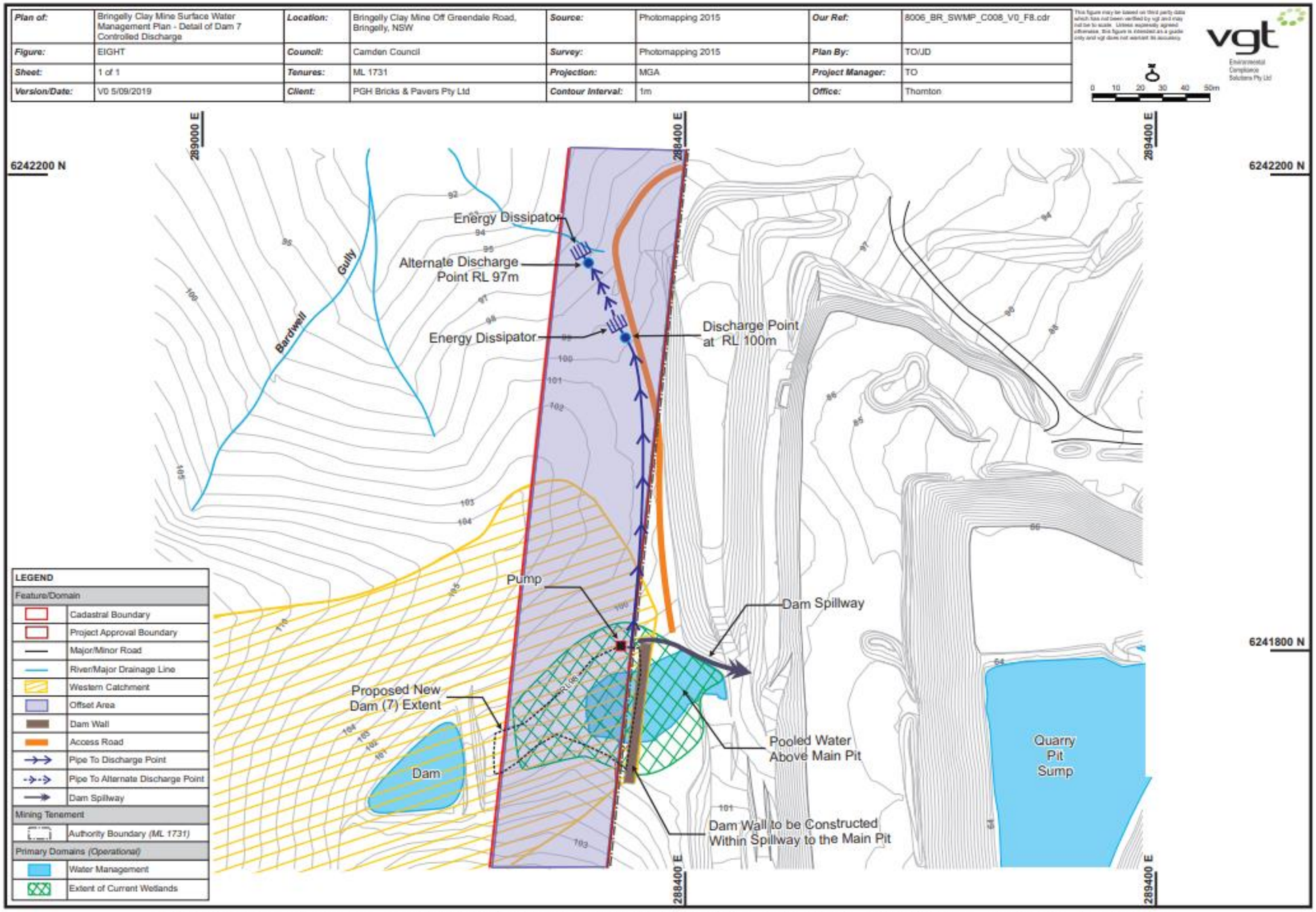

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Figure 9 Existing Dam 4 and 5 Management

Figure 10 Proposed Dam 4 and 5 Management

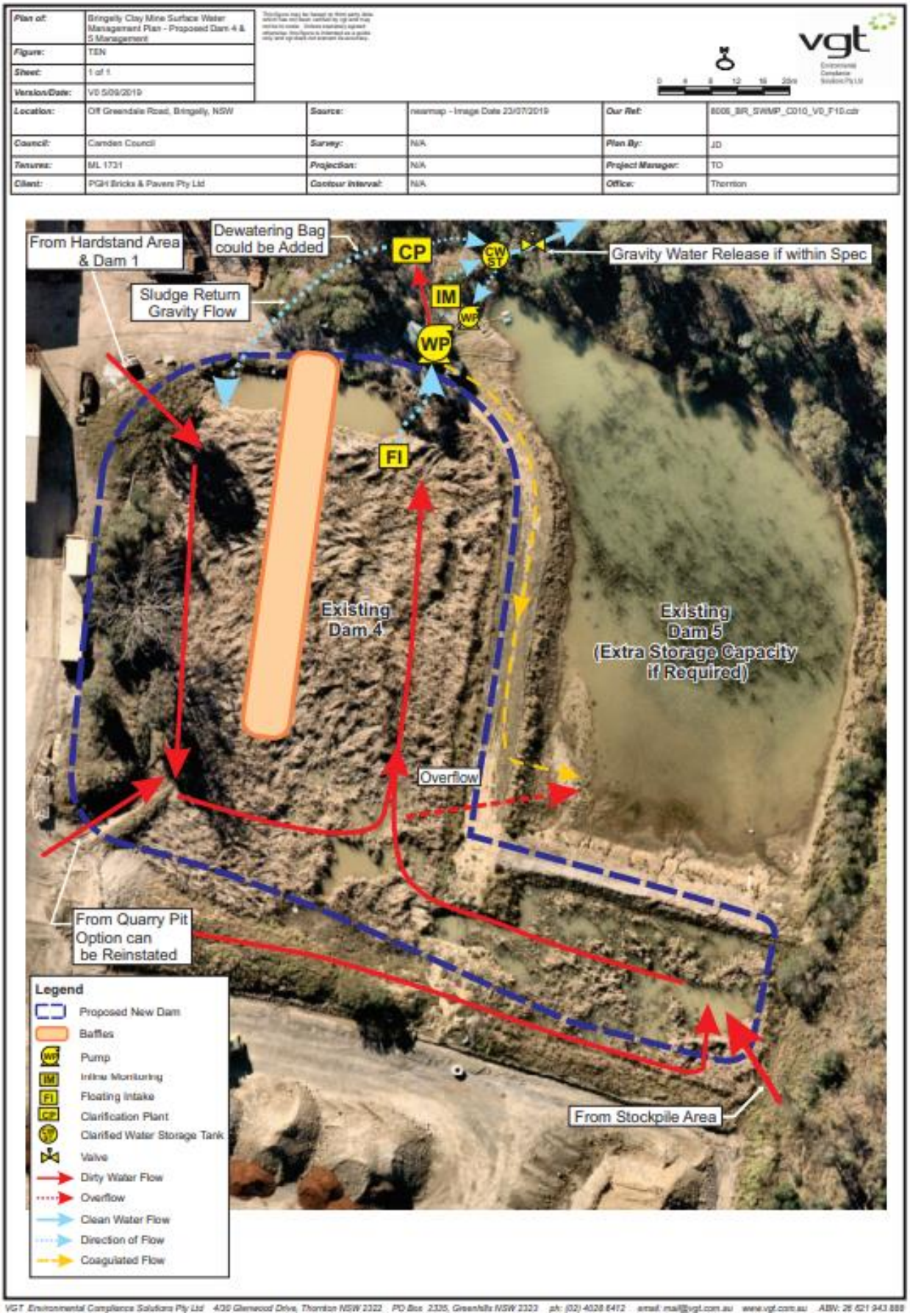
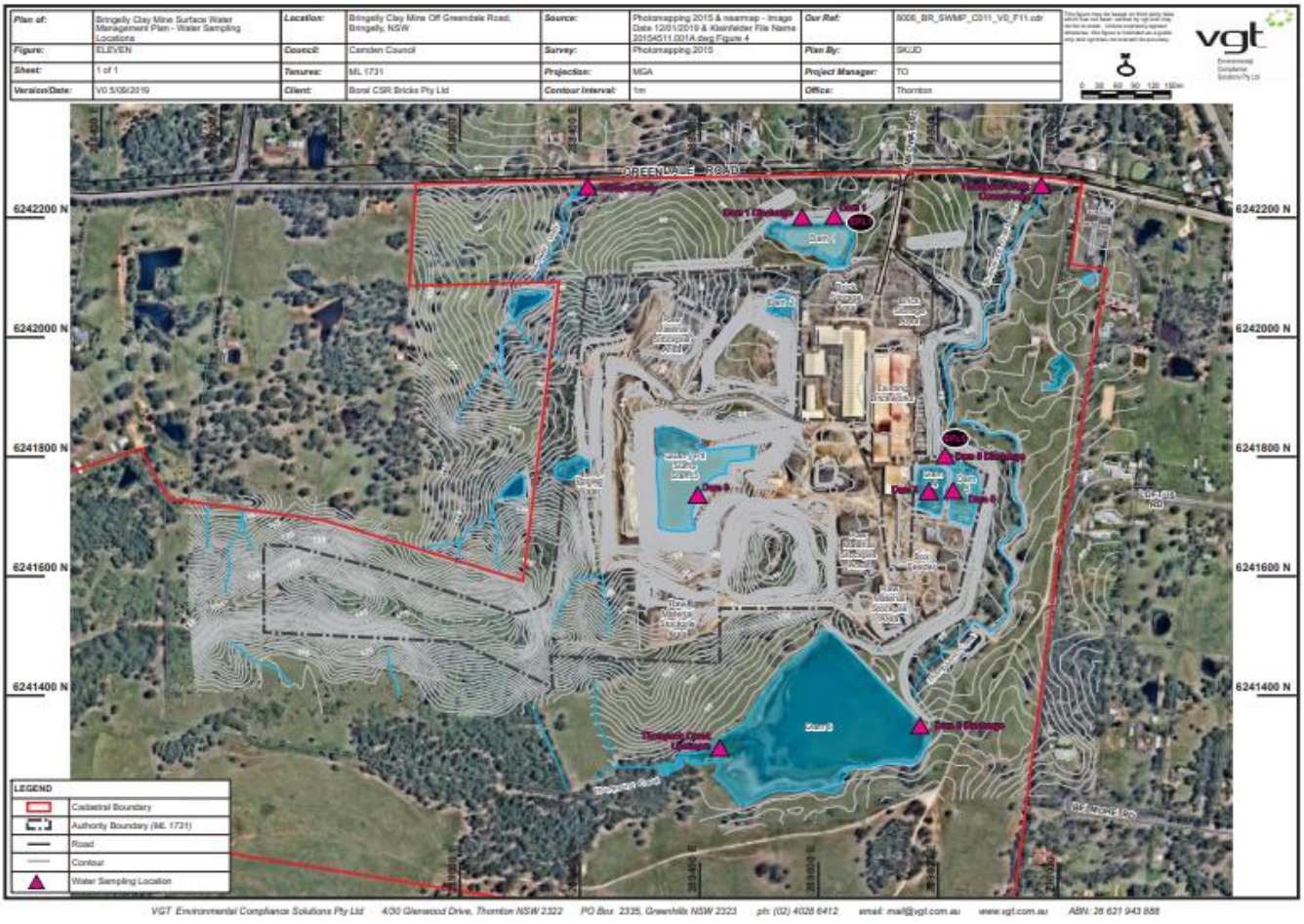


Figure 11 Water Sampling Locations



Appendix A Consultation Approval

Appendix B Environmental Protection Licence

Appendix C Stormwater Management System Inspection Checklist

Appendix D Kleinfelder EPL Letter and Monitoring Results

Appendix E Blue Book Standard Drawings

Appendix F Bluebook Calculations