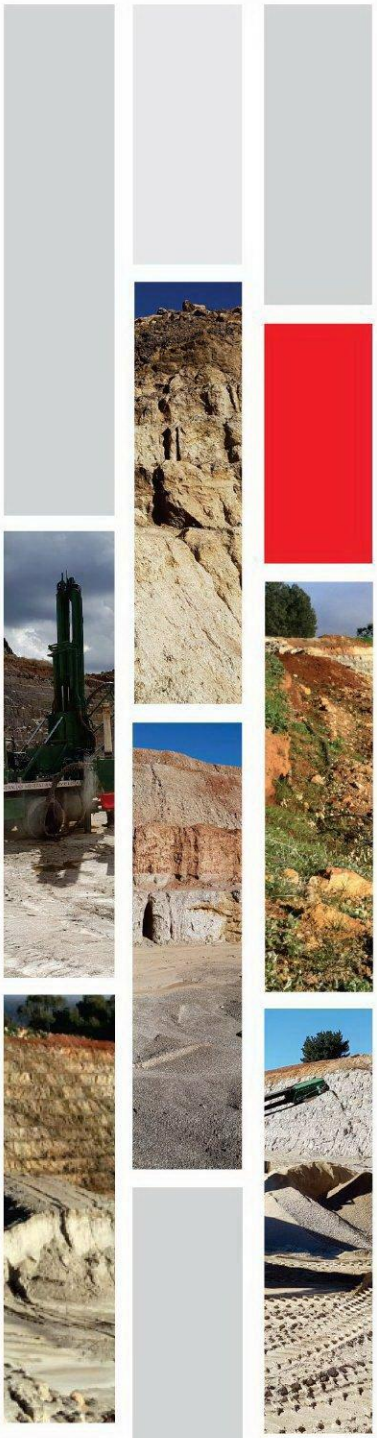

APPENDIX G

Land Resources Assessment

DOC18/188649

Environmental
Compliance
Solutions Pty Ltd

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PGH Bricks & Pavers Ltd

Land Resources Assessment for: Andersons Clay Mine Environmental Impact Statement

November 2018

Prepared by:

VGT Environmental
Compliance Solutions Pty Ltd

PGH Bricks & Pavers Ltd

Land Resources Assessment for: Andersons Clay Mine Environmental Impact Statement

November 2018

Prepared by:	
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Greenhills NSW 2323	

Report Date:	27/11/2018	
Report Number:	3618_AN_EIS_SL_F0	
Report Authorised by:	Tara O'Brien	27/11/2018
	Joe Gauci	27/11/2018
Checked by:	Rich Mason	27/11/2018

Revision Table

Date	
2/08/2018	3618_AN_EIS_SL_D0
3/10/2018	3618_AN_EIS_SL_D1
27/11/2018	3618_AN_EIS_SL_F0

Disclaimer

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Table of Contents

Figures

List of Tables

Appendices

Section 1. Introduction

1.1. Background

The subject land is described as Lot 2, DP 856969, 253 Shaw Road, Springdale Heights, located in the suburb of Springdale Heights, approximately 7km north east of Albury, see *Figure One.*

The land contains a functioning mine known as Anderson's Clay Mine.

The property is owned by PGH Bricks and Pavers Pty Ltd under freehold title.

A development application is being sought for the proposed expansion of an existing clay mine located at 253 Shaw Street, Springdale Heights. The proposed development is deemed to be a Designated Development in Schedule 3 of the Environmental Planning and Assessment Regulation 2000 and a request for the Secretary's Environmental Assessment Requirements (SEARs) was made in April 2017. The SEARs were issued by the Secretary on the 18th of May 2017.

The aim of this report is to provide additional information, as guided by the SEARs to assist the Department and relevant authorities in determining the development application.

1.2. Secretary's Requirements

1.2.1. SEARs

The SEARs require that the EIS, which will include this report, shall address the following issues relating to water.

Table 1. SEARs Land Resources Issues to be Addressed

Key Issue	Where Addressed in this Document
An assessment of potential impacts on soils and land capability (including potential erosion and land contamination) and the proposed mitigation, management and remedial measures (as appropriate).	Section 5.2, Section 5.3, Section 5.5
An assessment of potential impacts on landforms (topography), paying particular attention to the long term geotechnical stability of any new landforms (such as overburden dumps, bunds etc.).	Section 5.1
An assessment of the compatibility of the development with other land uses in the vicinity of the development in accordance with Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries*) 2007.	Section 3.5 & Section 5.6

1.2.2. Council Requirements

Table 2. Albury City Council Land Resources Issues to be Addressed

Key Issue	Where Addressed in this Document
The EIS should include an assessment of all potential impacts of the proposed development on the existing environment (including cumulative impacts where relevant and appropriate).	Section 5
Particular areas/issues of focus: • Stockpile management	Section 5.3

1.2.3. DPE Royalties and Advisory Services Requirements

Table 3. DPE Land Resources Issues to be Addressed

Key Issue	Where Addressed in this Document
Post Mining Landuse a) Identification and assessment of post-mining land use options;	Section 4.2
b) Identification and justification of the preferred post-mining land use outcome(s), including a discussion of how the final land use(s) are aligned with relevant local and regional strategic land use objectives;	Section 3.5 & Section 4.2
c) Identification of how the rehabilitation of the project will relate to the rehabilitation strategies of neighbouring mines within the region, with a particular emphasis on the coordination of rehabilitation activities along common boundaries areas.	Section 4.2
Conceptual Final landform Design g) Inclusion of a drawing at an appropriate scale identifying key attributes of the final landform, including final landform contours and the location of the proposed final land use(s).	Section 4.1
Barriers or Limitation to Effective Rehabilitation l) Identification and description of those aspects of the site or operations that may present barriers or limitation to effective rehabilitation, including: ii. an assessment and life of mine management strategy of the potential for geochemical constraints to rehabilitation (e.g. acid rock drainage, spontaneous combustion etc.), particularly associated with the management of overburden/interburden and reject material;	Section 4.3.1

Key Issue	Where Addressed in this Document
iii. the processes that will be implemented throughout the mine life to identify and appropriately mange geochemical risks that may affect the ability to achieve sustainable rehabilitation outcomes;	Section 4.3.1
iv. a life of mine tailings management strategy, which details measures to be implemented to avoid the exposure of tailings material that may cause environmental risk, as well as promote geotechnical stability of the rehabilitated landform: and	Section 4.3.2
v. Existing and surrounding landforms (showing contours and slopes) and how similar characteristics can be incorporated into the post-mining final landform design. This should include an evaluation of how key geomorphological characteristics evident in stable landforms within the natural landscape can be adapted to the materials and other constraints associated with the site.	Section 4.3.3
m) Where a void is proposed to remain as part of the final landform, include: i. A constraints and opportunity analysis of final void options, including backfilling, to justify that the proposed design is the most feasible and environmentally sustainable option to minimise the sterilisation of land post-mining;	Section 4.4
ii. A preliminary geotechnical assessment to identify the likely long-term stability risks associated with the proposed remaining high wall(s) and low wall(s) along with associated measures that will be required to minimise potential risks to public safety; and	Section 4.3.4 & Section 5.1

Section 2. Statutory Requirements and Guidelines

2.1. Environmental Planning and Assessment Act 1979

The clay extraction activities will continue to be subject to the provisions of the AEAP&A Act for any subsequent changes or modifications to the operations. Additionally the operations will need to be able to demonstrate compliance against the current Conditions of Approval issued under the provisions of the EP&A Act.

2.1.1. Current Council Consent Conditions

In August 1983, the Albury -Wodonga Development Corporation granted a permit (number N72), which approved the mining of clay brick within the north-eastern portion of the subject land. The activity involved an area of 7.975 hectares. The permit did not include an end date to the approval.

Council consent conditions that pertain to the management of Land Resources are reproduced below.

'14. i) The permit holder shall ensure that all working faces are maintained on a slope of not steeper than 1 vertical in 2 horizontal. Existing faces are to be reclaimed by battering or back filling to form a slope not steeper than 1 vertical in 2 horizontal.

ii) When extraction has ceased, and not later than one month before the expiry of the permit, terminal faces are to be battered from natural ground level into the pit a slope not steeper than 1 vertical in 5 horizontal for a minimum horizontal distance of 10 metres. For this purpose battering may commence at a point 10 metres inside the permit boundary, i.e. 5 metres outside the excavation limit, or in accordance with a landscape restoration plan. In carrying out this work no vegetation is to be effected within the remaining 10 metres of the buffer-zone. The terminal faces are to be covered with a minimum of 30cm of topsoil and planted with suitable vegetation. All reclamation works shall be carried out to the satisfaction of the Corporation who may specify at that time that additional works are to be undertaken.

17. ii) all residues, including topsoil is to be returned to the excavation and topsoil is to be retained at all times on the quarried sites.'

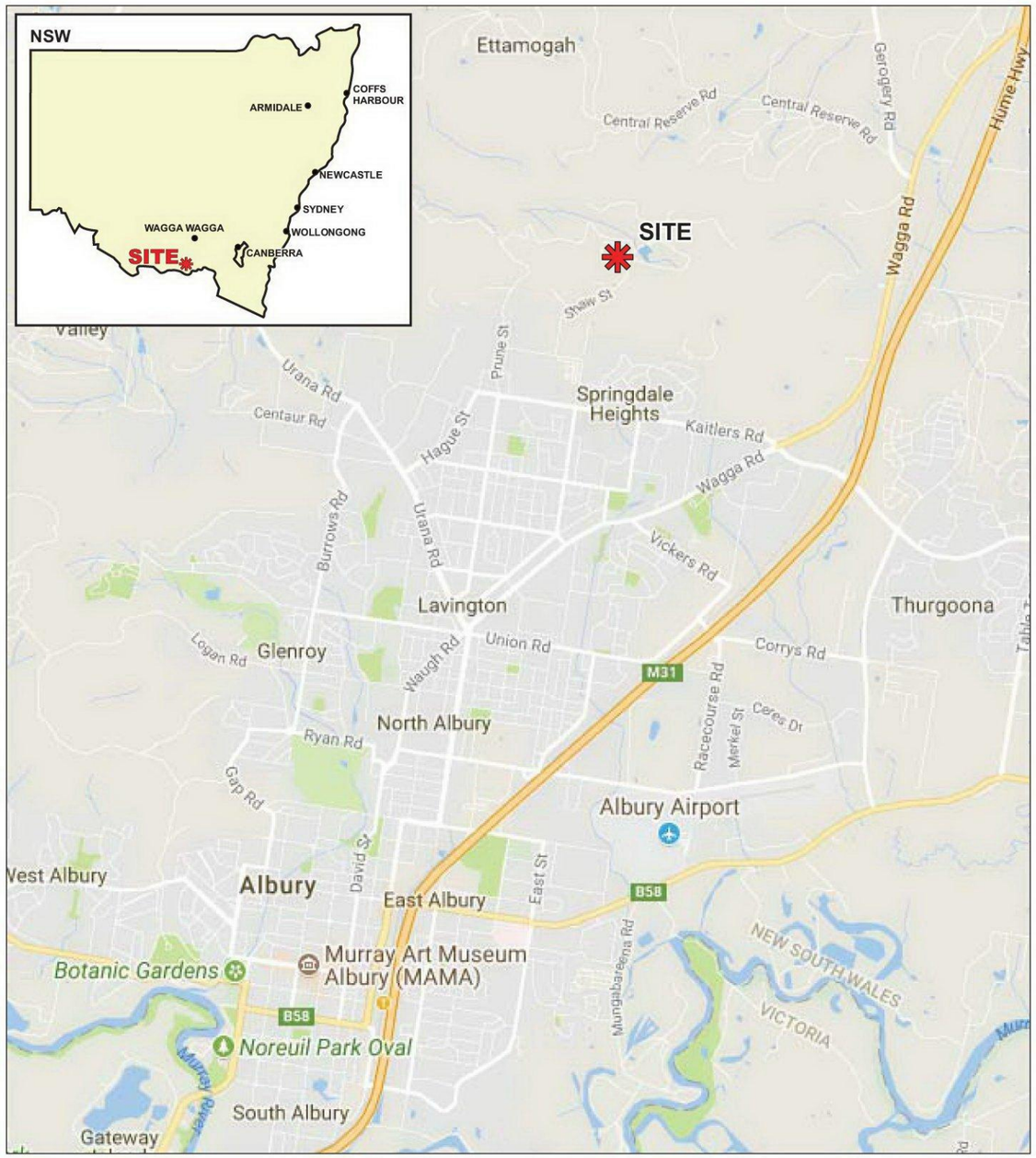
18. The permit holder shall ensure that topsoil is only stripped in stages sufficient for one year's extraction or 2Ha in area whichever is the lesser. Topsoil which is disturbed, shall be removed separately and placed in dumps. Soil required to comply with the requirements if condition 14 ii) is to be stored within the excavation area and excess topsoil should be place as far as possible along the southern boundary of the current and proposed mining operations. This is to be sown down with grasses to prevent erosion and so as to provide and aesthetic and effective screen on approach from Albury. All topsoil storage t be located and designed to the satisfaction of the Corporation.

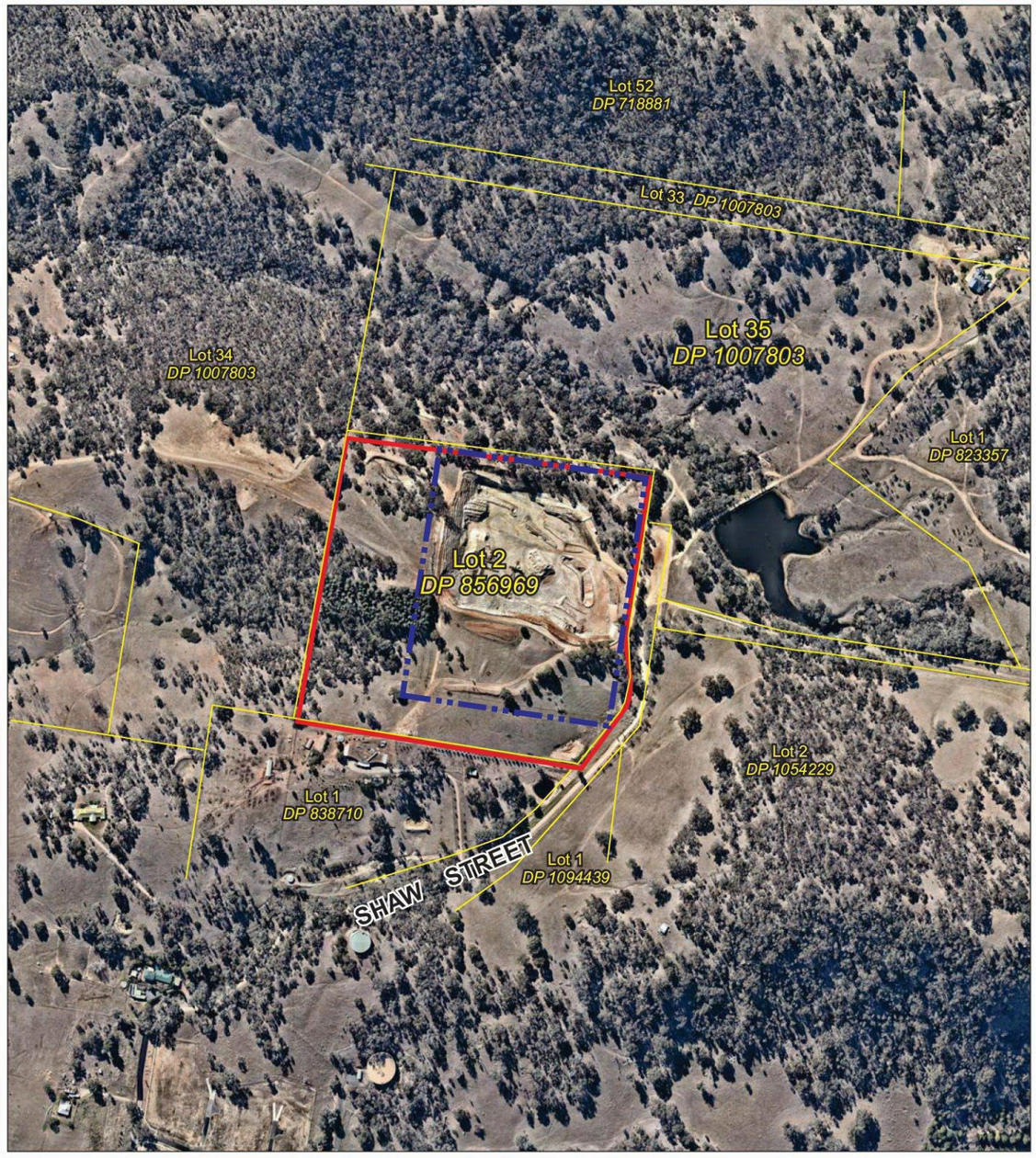
19. No stockpiling of clay is to be allowed on site except for two weeks normal production.

Plan of:	Land Resources Assessment for Andersons Clay Mine Environmental Impact Statement 2018 - Site Location	***Location:***	253 Shaw Street, Springdale Heights, NSW	***Source:***	nearmap - Image Date 01/05/2018 & Google Maps 2018	***Our Ref:***	3618_BAN_LR_DA17_C001_V1_F1.cdr
Figure:	ONE	***Council:***	Albury Wodonga Shire Council	***Survey:***	N/A	***Plan By:***	JD
Sheet:	1 of 1	***Tenure:***	Permit Number N72	***Projection:***	N/A	***Project Manager:***	TO
Version/Date:	V1 03/10/2018	***Client:***	PGH Bricks & Pavers Pty Ltd	***Contour Interval:***	N/A	***Office:***	Thornton

N

vgt Environmental Compliance Solutions Pty Ltd





Approx Scale: 0 1 2km

Approx Scale: 0 150m

Legend

- Site *(Lot 2 DP 856969)*
- N72 Consent Boundary
- Lot Boundary

Manager/Authorisation Holder PGH Bricks & Pavers Pty Ltd: Joe Gauci
Signed:
Date: 27/11/2018

Project Manager VGT: Tara O'Brien
Signed:
Date: 27/11/2018

Plan of:	Land Resources Assessment for Andersons Clay Mine Environmental Impact Statement 2018 - Site Layout	***Location:***	253 Shaw Street, Springdale Heights, NSW	***Source:***	nearmap - Image Date 01/05/2018 & Landair Surveys	***Our Ref:***	3618_BAN_LR_DA17_C002_V1_F2.cdr
Figure:	TWO	***Council:***	Albury - Wodonga Shire Council	***Survey:***	Landair Surveys - Image Flown 08/02/2017	***Plan By:***	SK/JD
Sheet:	1 of 1	***Tenure:***	Permit Number N72	***Projection:***	MGA	***Project Manager:***	TO
Version/Date:	V1 03/10/2018	***Client:***	PGH Bricks & Pavers Pty Ltd	***Contour Interval:***	1m	***Office:***	Thornton

N

0 50m

vgt Environmental Compliance Solutions Pty Ltd

6014000 N

495000 E

Humbug Gully

Dam 2

In-pit Sedimentation Dam

Stockpile

Haul Road

Humbug Gully Catchment

Site Access

Stockpile

6013750 N

Manager/Authorisation Holder PGH Bricks & Pavers Pty Ltd: Joe Gauci

Signed:

Date: 27/11/2018

Project Manager VGT: Tara O'Brien

Signed:

Date: 27/11/2018

Dam

Nearest Residence

SHAW STREET

495250 E

495500 E

LEGEND

Feature/Domain	
	Property Boundary
	Consent Boundary *(N72)*
	Water Management Area
	River/Major Drainage Line
	Road
290	Contour
	Area of Disturbance

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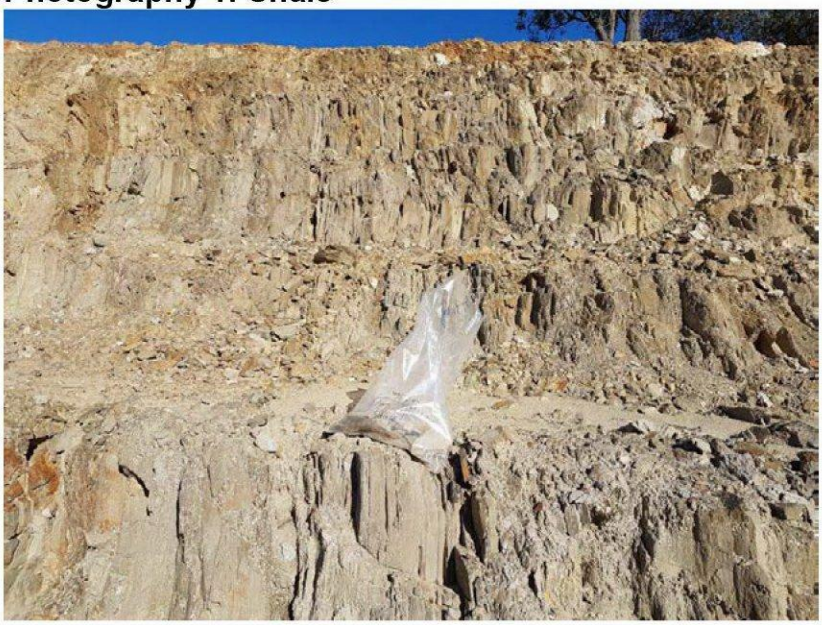
Section 3. Existing Environment

3.1. Geology and Soils

The resource in Andersons Clay Mine consists of two types of raw material, a weathered granite from the Silurian period (known as 'Clay' by PGH) and a weathered Shale from the upper Ordovician (known as 'Shale'). The contact between these two rock types runs approximately diagonally through the north-west corner of the property boundary. The Shale (in the north west) has a high percentage of mica, which provides PGH with a very unique type of brick product.

The site borders two different soil landscapes, the Livingstone Soil Landscape to the north and the Dora Dora Soil Landscape to the south.

Photography 1: Shale



Photography 2: Clay

3.1.1. Livingstone Soil Landscape

According to the Environment NSW eSpade online data the Livingstone Soil Landscape is characterised by rolling to steep low hills to hills on Ordovician metasedimentary rocks. It also contains narrow crests, ridges and upper slopes, moderately long, straight to waning mid to lower slopes and narrow drainage lines. Slopes are in the order of 20-33% with local relief from 50-150m. Elevations range from 260m to 480m with the project site averaging approximately 300m.

The soils are described as shallow (<50cm) Mesotrophic Paralithic Leptic Rudodols (Lithosols) on crests, ridges and upper slopes, moderately deep (50-100cm) mesotrophic Red Chomosols and Eutrophic brown Kurosols (Red and Brown Podzolic Soils) on mid – lower slopes and moderately deep (50-100cm) Mesotrophic Brown Kandosols (Brown Earths) on lower slopes and in drainage lines.

The soil is considered as erosional with greater than 15cm of soil has been lost through sheet erosion on most cleared pasture land and burnt areas. Minor to moderate gully erosion is common along drainage lines. Gullies are up to 1.5m deep, most to bedrock.

3.1.2. Dora Dora Soil Landscape

According to the Environment NSW eSpade online data the Dora Dora Soil Landscape is characterised by rolling hills on granite with slopes from 10-30%, occasionally up to 40%. Local relief ranges from 30-90m with elevations from 200-480m. It includes broad crests and ridges, steep straight slopes and narrow drainage lines.

The crests and flatter slopes are composed of deep (1.0-1.5m), moderately well-drained Brown and Red Kandosols and Dermosols (Red Earths). Other slopes are made up of moderately deep (0.5-1.0m), very well-drained bleached (sporadically) Leptic Tenosols and Rudosols (Lithosols).

There are localised moderately discontinuous, shallow gully erosion in some drainage depressions and localised mass movement of steeper slopes.

3.1.3. Soil Characteristics

A soil profile sample was taken from the extension area and each horizon was analysed for pH and Conductivity as shown in the table below.

Table 4. Soil Analysis

Soil Horizon		pH	Conductivity (dS/m)
'A' Topsoil 0-0.1m		4.6	0.8
'B' Topsoil 0.1-0.2m		4.5	0.3
'C' Horizon		5.2	<0.1

The topsoil in the extension area is quite thin (approximately 10 to 20cm in depth) overlaying the very hard weathered Shale shown as the 'C' Horizon in the table above and Photography 4 below. The soils are slightly acidic and are have low to moderate conductivities.

Photography 3: Soil Sampling Site

Photography 4: Typical Topsoil and Subsoil Profile

Photography 5: Typical A, B and C Soil Horizon In-Pit

3.1.4. Potential Soil Loss

The NSW Managing Urban Stormwater handbook, also known as the Blue Book, was used to assist in making the following determinations regarding the potential soil loss at the site for a design storm event.

The Soil Hydrological Group for the soil materials is assumed to be D, very high run-off potential. Water moves into and through these soils very slowly when thoroughly wetted. They regularly shed run-off from most rainfall events.

The likely soil loss is calculated with the Revised Universal Soil Loss Equation (RUSLE). The values of the other RUSLE factors are: P of 1.3 and the C is assumed to be 1.0 for bare soil. Calculations can be found in *Appendix C.*

The potential soil loss of the site has been calculated using *Managing Urban Stormwater, Soil and Construction, Volume 2E Mines and* Quarries for a 90th percentile, 5 day rainfall event assuming a non-sensitive receiving environment. Important site physical characteristics are identified in the table below.

Table 5. Constraints and Characteristics

Constraint/Opportunity	Value
IFD:2 year, 6 hour storm	6.02 (from the BOM IFD data)
Slope Gradients	Low to Moderate to high (Average 6-10%)
Potential Erosion Hazard	Very Low
Soil Erodiblity	K= 0.050 High (assumed)
Calculated Soil Loss	From 14 to 572 tonnes/ha/yr depending on particular internal mine slopes.
Soil Loss Class	1 on the pit floor to 5 on the pit high walls
Soil Texture Group	Type D
Soil Hydrological Group	D
Runoff Coefficient	0.64 (Soil Hydrological Group D)
Current Disturbed Site Area	4.7 ha approximately
Developed Disturbed Site Area	11 ha approximately

The site is located in rainfall zone 10 according to *Figure 4.9* of the Blue Book. Works are appropriate to be undertaken at all times during the year within this rainfall zone for Soil Loss Classes 1 to 4. Works on Soil Loss Class 5 soils (on the highwalls) are recommended to be only undertaken from the end of March to December. However these restrictions are not appropriate for the mine due to the supply demands from the brickworks. In addition, the resource lost from the highwalls through erosion is still captured in the pit and will eventually be re-extracted.

3.2. Topography

The site is located in a ridge on the northern outskirts of Albury with the highest elevations at approximately 320m RL in the south sloping to 300mRL to the north.

Slopes on the site range from 5 to 45 % with the steeper slopes within the excavation itself.

Photography 6: Typical natural drainage line

Photography 7: Slopes to the north of the site

Photography 8: Slopes to the south of the site

Photography 9: Ridgeline to the west of the site

3.3. Land Capability

According to Land Capability mapping for NSW on the SEED portal, maintained by the NSW Government, the site is classified as having a land capability of 7. That is, land generally incapable of agricultural land use (selective forestry and nature conservation), very low capability land; Under this classification it is described as land has severe limitations that restrict most land uses that generally cannot be overcome. In addition it is said that on-site and off-site impacts of land management practices can be extremely severe if limitations not managed and there should be minimal disturbance of native vegetation.

Plan of:	Land Resources Assessment for Andersons Clay Mine Environmental Impact Statement 2018 - Land Capability	***Location:***	253 Shaw Street, Springdale Heights, NSW	***Source:***	SEED, Dept of Finance, Services & Innovation 2017 & Water NSW	***Our Ref:***	3618_BAN_LR_DA17_C005_V1_F3.cdr
Figure:	THREE	***Council:***	Albury - Wodonga Shire Council	***Survey:***	N/A	***Plan By:***	SK/JD
Sheet:	1 of 1	***Tenure:***	Permit Number N72	***Projection:***	N/A	***Project Manager:***	TO
Version/Date:	V1 03/10/2018	***Client:***	PGH Bricks & Pavers Pty Ltd	***Contour Interval:***	N/A	***Office:***	Thornton

N

0 1km

vgt Environmental Compliance Solutions Pty Ltd

JINDERA

ETTAMOGAH

SPRINGDALE HEIGHTS

HAMILTON VALLEY

LAVINGTON

SPLITTERS CREEK

GLENROY

THURGOONA

NORTH ALBURY

WEST ALBURY

ALBURY

EASTH ALBURY

LEGEND
Land & Soil Capability

- Approximate Location of Site
- Very Slight to Negotiable Limitations
- Slight But Significant Limitations
- Moderate Limitations
- Moderatet to Severe Limitations
- Severe Limitations
- Very Severe Limitations
- Extremely Severe Limitations
- Extreme Limitations
- Water
- Disturbed Terrain

Manager/Authorisation Holder PGH Bricks & Pavers Pty Ltd: Joe Gauci
Signed:
Date: 27/11/2018

Project Manager VGT: Tara O'Brien
Signed:
Date: 27/11/2018

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3.4. Land Contamination

A search of the NSW EPA Contaminated Land Register shows that the site has not been notified to the EPA. The proponent advises that there are no dangerous goods held on site.

3.4.1. Contaminants of Potential Concern

Table 6. Site Use Summary and Associate Potential Contaminants

Site Use/ Contaminant Source	Potential Contaminants	Volumes Held/ Control Methods
Weed and pest spraying	Herbicides and Pesticides (OCP's and OPP's)	Weed and Pest control is undertaken by licenced contractors. Chemicals are not stored on site and only minor amounts are used.
Fuel Storage	Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl benzene, Xylene (BTEX), Polycyclic Aromatic Hydrocarbons (PAHs)	No Fuel is stored permanently on site. Refuelling is conducted off site or within the pit floor by transportable fuel tanks. Contractors carry spill kits at all times.
Oils/Solvents/Lubricants in production and maintenance	Hydrocarbons	No oils/solvents or lubricants are stored in site. All vehicle and machine maintenance is conducted in off site. Contractors carry spill kits at all times.

3.5. Compatibility with Other Land Users

Albury City includes the main urban centre of Albury, as well as substantial industrial, commercial, recreational and parkland areas and significant rural hinterland. Albury's population generally lives in the outer suburbs including the Springdale Heights locality where the mine is located. Closer to the mine the urban environment gives way to rural and semi-rural dwellings where land is used for mixed agricultural purposes.

The operation of the mine is compatible with the surrounding rural land uses. Similar developments within the locality include a Waste Management Facility 5 kilometres to the west, and the Burgess Earth Moving Pty Ltd quarry on Central Reserve Road located 3 kilometres north of the site and the AP & Delany and Co Pty Ltd's Rockwood quarry on Winchester Lane some 4 kilometres north of the site. Defences forces holds land some 2 kilometres north east of the site which was used as an RAAF ammunition depot storage during World War II and is still held by the government due to remediation works.

The site has sympathetically operated alongside its neighbours for many decades with very few complaints received.

Plan of:	Land Resources Assessment for Andersons Clay Mine Environmental Impact Statement 2018 - Surrounding Landuse	***Location:***	253 Shaw Street, Springdale Heights, NSW	***Source:***	nearmap - Image 01/05/2018	***Our Ref:***	3618_BAN_LR_DA17_C003_V1_F4.cdr
Figure:	FOUR	***Council:***	Albury - Wodonga Shire Council	***Survey:***	N/A	***Plan By:***	JD
Sheet:	1 of 1	***Tenure:***	Permit Number N72	***Projection:***	N/A	***Project Manager:***	TO
Version/Date:	V1 03/10/2018	***Client:***	PGH Bricks & Pavers Pty Ltd	***Contour Interval:***	N/A	***Office:***	Thornton

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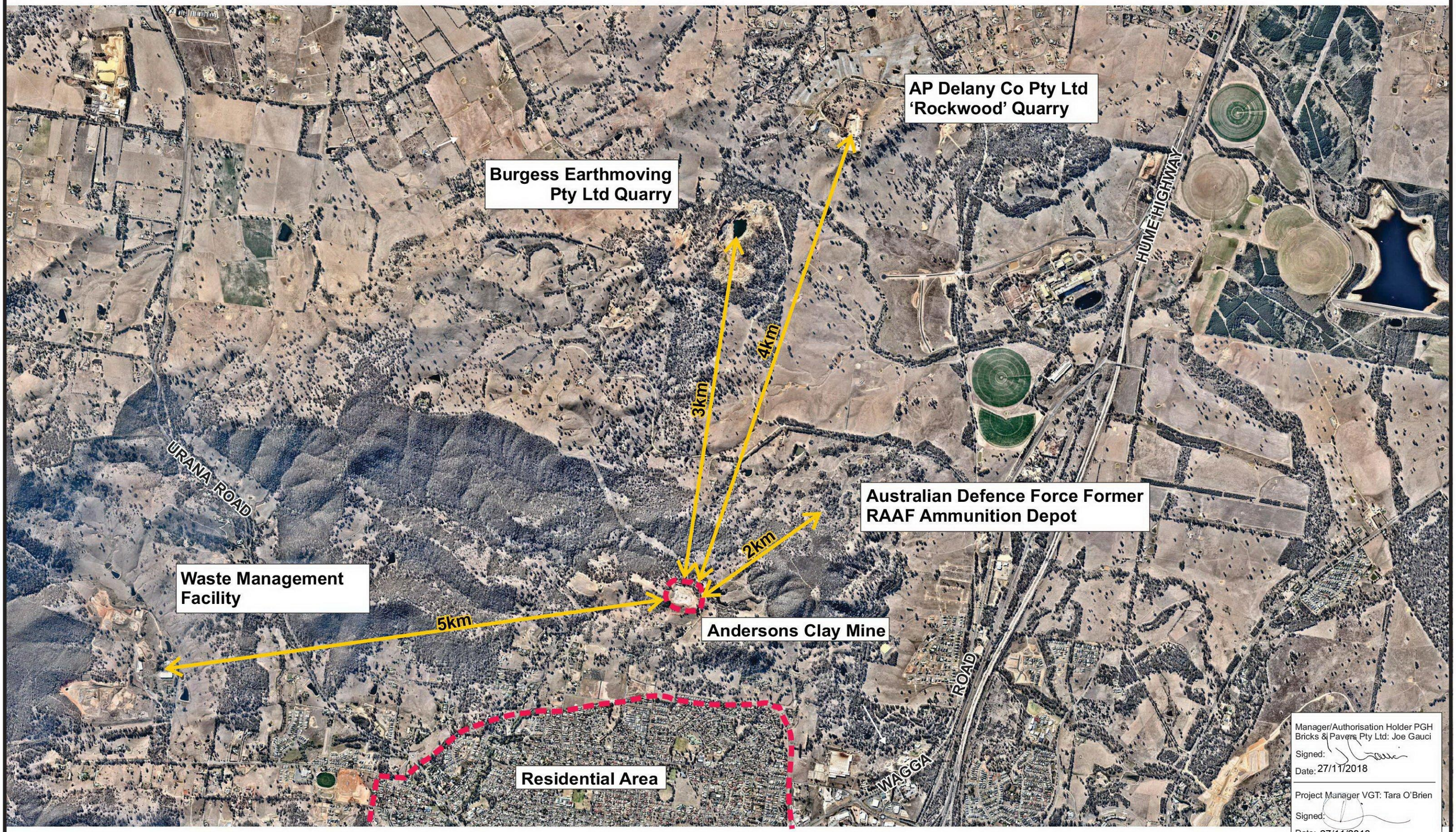
0 1000m

vgt Environmental Compliance Solutions Pty Ltd



Manager/Authorisation Holder PGH Bricks & Pavers Pty Ltd: Joe Gauci
Signed:
Date: 27/11/2018

Project Manager VGT: Tara O'Brien
Signed:
Date: 27/11/2018

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The site is located with land zoned E3- Environmental Management. The objectives of the zone are reproduced below from the Albury City Council LEP.

Objectives of zone

- *'To protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values.*
- *To provide for a limited range of development that does not have an adverse effect on those values.*
- *To ensure the long term viability of populations of threatened species, populations and ecological communities by protecting and improving the condition of wildlife habitats and wildlife corridors.*
- *To allow appropriate land uses in close proximity to the Landfill Buffer Area.'*

Developments permitted with consent include;

Aquaculture; Boat launching ramps; Boat sheds; Community facilities; Dual occupancies (attached); Dwelling houses; Environmental facilities; Extensive agriculture; Farm buildings; Group homes; Home-based child care; Information and education facilities; Jetties; Recreation areas; Recreation facilities (indoor); Roads; Signage; Water recreation structures.

In the making of the Albury Local Environmental Plan 2010, the subject land (Lot 2 DP 856969, was included as an additional permitted use under Schedule 1.

Schedule 1 states:

> *6 Use of certain land at 253 Shaw Street, Lavington*
> *(1) This clause applies to land at 253 Shaw Street, Lavington, being Lot 2, DP 856969.*
> *(2) Development for the purpose of open cut mining or extractive industries is permitted with consent.*

Thus Albury City Council has acknowledged the operation of the mine as a legitimate landuse suitable for the locality.

At this stage there are no other regional plans or strategies with the Albury City Council that apply to the site.

Section 4. Proposed Land Resource Management

4.1. Conceptual Final Landform

The conceptual final landform will include a void with battering of all slopes back to between 3 horizontal to 1 vertical and 4 horizontal to 1 vertical. It will include a sediment dam most likely to the west of the current location, this may remain permanently depending on rainfall intensities and duration of dry weather. Native pasture and grasses will be established on the final void slopes surrounding the sediment dam on pit floor. The landform will also be conducive to low level grazing consistent with neighbouring properties.

The final landuse may change course throughout the lifetime of the mine depending economic or community factors. Thus proposed final landform will aim to not preclude any suitable future landuse not currently anticipated. Apart from grazing, the land might become useful for recreation, as per original council consent.

4.2. Post Mining Land Use Options

The post mining landuse will be consistent with the land zoning objectives stated in *Section 3.5* above. That is, the proposed final landuse of agricultural activities including grazing or recreation area are permitted with consent within the Albury LEP.

No listed threatened flora or fauna species were observed during site field surveys conducted in 2016 or spring 2018 or are known from the proposal site. Several potential threatened species habitats were identified however the threatened species were not identified on the site at the time of the survey. The Box Gum Woodland on the property was found to conform with both the NSW and the Federal definitions under both the Threatened Species Conservation (TSC) Act and Environmental Protection Biodiversity Conservation (EPBC) Act although some areas were in better condition than others. The survey also found 2.6ha of moderate to good quality box gum is located outside the proposed area which would not be impacted by the expansion of the mine.

Rehabilitation of the final landform would be sympathetic to the Box Gum Woodland with selection of species within the grassland. This would enhance wildlife corridors and improve the condition of wildlife habitats in the area.

There are no common boundaries with existing mines at the site therefore the project does not need to accommodate the rehabilitation strategies of other mines.

Any other future land uses will be within the scope of the permitted uses within the Environmental Management land zoning. The potential uses are fairly limited in order to protect the environmental values of the land. Other feasible future land use options other than those currently proposed would most likely include residential dwellings.

Plan of:	Land Resources Assessment for Andersons Clay Mine Environmental Impact Statement 2018 - Conceptual Final Landform	***Location:***	253 Shaw Street, Springdale Heights, NSW	***Source:***	nearmap - Image Date 01/05/2018 & Landair Surveys	***Our Ref:***	3618_BAN_LR_DA17_C006_V0_F5.cdr
Figure:	FIVE	***Council:***	Albury - Wodonga Shire Council	***Survey:***	Landair Surveys - Image Flown 08/02/2017	***Plan By:***	SK/JD
Sheet:	1 of 1	***Tenure:***	Permit Number N72	***Projection:***	MGA	***Project Manager:***	TO
Version/Date:	V0 04/10/2018	***Client:***	PGH Bricks & Pavers Pty Ltd	***Contour Interval:***	1m	***Office:***	Thornton

N

0 50m

vgt Environmental Compliance Solutions Pty Ltd

6014000 N

495000 E

495250 E

495500 E

6013750 N

Humbug Gully

In-Pit Sump

Maximum Batter 3H:1V to 298mRL Floor

2H:1V Batters

Haul Road

Site Access

Humbug Gully Catchment

Maximum Batter 3H:1V to 298mRL Floor

Dam

Nearest Residence

SHAW STREET

Manager/Authorisation Holder PGH Bricks & Pavers Pty Ltd: Joe Gauci
Signed:
Date: 27/11/2018

Project Manager VGT: Tara O'Brien
Signed:
Date: 27/11/2018

LEGEND

Feature/Domain	
	Property Boundary
	Consent Boundary *(N72)*
	Water Management Area
	River/Major Drainage Line
	Road
1m 5m	Contour

4.3. Barriers or Limitation to Effective Rehabilitation

4.3.1. Geochemical Constraints

The site geochemistry provides a minor risk of pH levels below optimum levels for rehabilitation. Analysis of water from within the pit sump indicates that the water at the contact of the Clay and Shale is neutral with very low conductivities (see *Appendix A*). The risk of acid mine drainage is therefore considered to be negligible. There is almost negligible risk of spontaneous combustion due to the absence of carbonaceous material at the site.

The geochemistry is not expected to present any particular difficulties with regard to overburden and topsoil management. The soils are somewhat dispersive and will be stored appropriately to minimise erosion if they cannot be immediately utilised.

The site is located on the boundary between the Table Top Hydrogeological Landscape (HGL) and the Nail Can-Bungowannah Hydrogeological Landscape. These landscapes are described as having a moderate to high risk that salinity issues will occur. The Table Top landscape water quality is characterised as having moderate salinity levels whilst the Nail Can-Bungowannah landscape is also moderate with observations of conductivities of greater than 600µS/cm within streams.

Conductivities of the water bodies on the site are very low as are the conductivities of the nearby streams (see *Appendix B*). It is concluded that it is unlikely that the soils will experience salinity issues that present limitations to rehabilitation.

Soil chemistry will be investigated prior to revegetation to determine if ameliorants are required. It should be noted that the endemic species selected for revegetation are suitable and adapt to these soils.

4.3.2. Tailings

There will be no tailings generated from the extraction process. Any Clay or Shale material exposed in the active faces of the mine are considered stable and do not constitute a risk to the environment during extraction or rehabilitation. Topsoil and overburden will be managed appropriately as described in *Section 5.3.*

4.3.3. Incorporation of Existing and Surrounding Landforms

The surrounding landform to the south is characterised as moderately to deeply weathered with undulating low hills and rises having rounded crests and long gently inclined foot-slopes. Undulating plains and fans are also present. Slopes are gentle and waxing. Drainage lines are widely spaced and poorly defined. The landform to the north is characterised by narrow ridge crests and upper slopes; long, straight to waning middle and lower slopes; and narrow drainage lines.

The final faces of the extraction area will be battered back 4 horizontal to 1 vertical and blended with the existing landform. These slopes (10 to 20%) are typical of the location leading into Humbug Gully in the north. To the south the immediate slopes are generally less steep but transition to gradients that replicate these slopes, moving down the ridgeline.

The final water body will not be out of character for the area given the dam located in Humbug Gully, less than 100m to the east of the site and other farm dams located in the area.

Photography 10: Neighbouring water body

4.3.4. Geotechnical Constraints

Geotechnical risks related from ground movement include such hazards as subsidence, landslips, toppling, settlement, heave, slumping and fracturing. As no underground activities are undertaken on the site and there is no history of underground working the risk of subsidence is considered negligible.

The Clay and Shale material remaining the final landform is geotechnical and chemically stable and is unlikely to fail at these batter angles. Current faces at much steeper slopes have proved resistant to failure over the life of the operation and the risk of failure of the final landform is considered to be minimal. Additionally, previously rehabilitated slopes have proven to be stable as shown in *Photography 12* below.

Photography 11: Stable batters and benching in current pit

Photography 12: Previously rehabilitated slopes

The risk of dewatering or heave is also considered negligible given the site does not intersect groundwater nor are there any underground workings on the site. Clay and Shale material is not prone to swelling when wet, the prime cause of heaving. The strata does not contribute chemical leachates harmful to rehabilitation or environment.

The final water body will be created from the mine void and does not require construction of dam walls. The water balance undertaken for this EIS suggests that the final void is unlikely to overtop as losses due to evaporation and dissipation will balance the rainfall received. A spillway will be constructed nonetheless that complies with Blue Book requirements.

4.4. Constraints and Opportunities Analysis of Final Void

Table 7. Constraints and Opportunities Analysis of Void in Final Landform

Constraint	Opportunity	Issues/ Mitigation Measures	Feasibility	Environmental Sustainability Rating
The final water body sterilises land covered for grazing purposes.	The final void will contain a water body that will provide stock water should grazing be undertaken as the final landuse. The depression would also provide stock shelter from wind.	Land surrounding the water body would be rehabilitated with species suitable for grazing. The area of land lost to grazing would be minimal.	High	High
	The final void could be completely backfilled to provide a free draining landform and additional grazing land.	Imported fill would need to be imported to the site to backfill and compact the void. This would require substantial volumes of fill material to create a free draining landform. Obtaining material suitable for filling i.e. VENM is likely to be difficult due to low availability in the local area. The rehabilitation of the site may therefore be prolonged for many years or decades leaving the site unusable for grazing or other purposes.	Low	High
The water body may exceed that of the Harvestable Rights for farm dams.	A water body would improve the appeal of the site for future land purchases, for purpose of agriculture, with the provision of water security (via a Water Access Licence if required). The land value could feasibly increase.	If the maximum harvestable rights for the property is exceeded a WAL could be obtained.	High	High
	The void could be partially backfilled to provide a water body whose volume is within the Harvestable Rights for farm dams.	Imported fill would need to be imported to the site to partially backfill and compact the void. This would require substantial volumes of fill material. Obtaining material suitable for filling i.e. VENM is likely to be difficult due to low availability in the local area. The rehabilitation of the site may therefore be prolonged for many years or decades leaving the site unusable for grazing or other purposes.	Low	High

Constraint	Opportunity	Issues/ Mitigation Measures	Feasibility	Environmental Sustainability Rating
The final water body sterilises land covered from use as habitat to native fauna.	The water body would provide water for native fauna (including threatened species consistent with the Box Gum Woodland) that may establish after rehabilitation of the site.	Tree stands could be established with species consistent with the Box Gum Woodland to provide habitat and shelter for native fauna. These could be strategically placed to enhance connectivity with other woodland areas.	High	High
	The final void could be completely backfilled to provide a free draining landform and more habitat for native fauna.	Imported fill would need to be imported to the site to backfill and compact the void. This would require substantial volumes of fill material to create a free draining landform. Obtaining material suitable for filling i.e. VENM is likely to be difficult due to low availability in the local area. The rehabilitation of the site may therefore be prolonged for many years or decades leaving the site unusable for grazing or other purposes.	Low	High
The final water body could constitute a drowning hazard to the public or landowners in the final landform.	The final void would provide a pleasing aesthetic should recreational land use be undertaken.	The final water body will not constitute any greater risk to drowning than any other publically accessible water body such as rivers or lakes. Signage could be erected warning of the danger. The site is already securely fenced and fencing is envisaged to remain at the end of the mine life to discourage trespassing.	High	High
	The final void could be completely backfilled to remove the drowning hazard.	Imported fill would need to be imported to the site to backfill and compact the void. This would require substantial volumes of fill material to create a free draining landform. Obtaining material suitable for filling i.e. VENM is likely to be difficult due to low availability in the local area. The rehabilitation of the site may therefore be prolonged for many years or decades leaving the site unusable for grazing or other purposes.	Low	High

Constraint	Opportunity	Issues/ Mitigation Measures	Feasibility	Environmental Sustainability Rating
Riparian ecosystems downstream are impacted by reduced flows.	Riparian ecosystems adapt to the reduced flows and/or habitate the remaining water body instead.	It is not planned release environmental flows into Humbug Gully at the cessation of mining. It is expected that there have already been some adaptations within the ecosystems within the drainage lines since the commencement of mining, several decades ago resulted in reduced flows. The changes to the riparian corridors is considered to be offset by the establishment of an ecosystem within the permanent water body.	High	High
	The final void could be completely backfilled to provide a free draining landform that restores natural flows to the riparian ecosystems.	Imported fill would need to be imported to the site to backfill and compact the void. This would require substantial volumes of fill material to create a free draining landform. Obtaining material suitable for filling i.e. VENM is likely to be difficult due to low availability in the local area. The rehabilitation of the site may therefore be prolonged for many years or decades leaving the site unusable for grazing or other purposes.	Low	High

From the analysis above it can be seen that leaving a water body in the final landform is the most feasible and environmentally sustainable option.

Section 5. Impacts and Mitigation

5.1. Topography and Geotechnical Stability

5.1.1. Mitigation

Walls within the active void are currently at angles of approximately between 1.5 horizontal to 1 vertical and 2 horizontal to 1 vertical with benches cut into the walls in order to maximise resource recovery whilst decreasing the length of slope. As mining progresses and final faces are achieved, walls will be battered to make safer angles of approximately 4 horizontal to 1 vertical. As stated previously, to date the walls have proven resistant to failure over the life of the operation at these angles. Mining will continue in a similar manner with regards to working faces.

During mining the change in topography will be largely shielded from view from neighbouring properties as the mine face progresses behind the ridgeline. The final landform will be similarly shielded from view. The final slopes will be similar to those typical for the locality and thus the restored topography will blend into the surrounding land.

The site is well fenced and securely locked when no activities are undertaken on site. The benched extraction plan reduces the risk of harm to personnel and public in case of accidental falls or impact from loose material falling directly down the active face onto personnel or equipment. Signage is also in place to warn of the risk of falls from deep excavations at present and will be maintained on the site until rehabilitation efforts reduce the slopes in the final landform.

5.1.2. Cumulative Impacts

There are no mines or quarries adjacent to the site therefore cumulative impacts to the geotechnical stability of the area of these operations are not relevant. The final landform will not result in an unacceptable change in the overall topography or stability. Current surrounding landuses such as grazing are also not likely to impact significantly on the topography or stability of the location.

Photography 13: Warning signage

5.2. Land Capability

5.2.1. Assessment of Land Capability

The current and proposed final landform has been assessed using the OEH *The Land and Soil Capability Assessment Scheme (second approximation) - A General Rural land Evaluation System for NSW* (LSCAS). The scheme defines LSC classes based on the biophysical features of the land. These biophysical features determine the on-site and off-site limitations and hazards of the land and include soil type, slope, landform position, acidity, salinity, drainage, rockiness and climate.

The landform assessment in the extension area prior to disturbance is summarised in the table below. The final LSC class of the land is based on the most limiting factor.

Table 8. Land Capability Assessment of Existing Extension Area

Aspect	Details	Land Capability Classification
Water Erosion Hazard	Slope along the ridge range from 5% to 15%. (The site is assumed to lie in the Eastern and Central Division)	Class 4
Wind Erosion Hazard	Soil texture is considered to most closely resemble a fine sandy loam with 6-13% clay, therefore the Wind erodibility class of surface soil is 'moderate' (Table 5 of LSCAS). Annual average rainfall is around 600mm per annum and the site lies within a High Wind Erosive Power area (Figure 6 of LSCAS). The exposure to wind is high due to the ridgeline topography.	Class 5
Soil Structure Decline Hazard	Soils most closely resemble clay loam soils with no texture modifiers such as sodicity i.e. fragile medium textured soil	Class 3
Soil Acidification Hazard	The soils most closely resemble Red Earth-less fertile (granites and metasediments) (Table 9 of LSCAS). These soils have a low buffering capacity. Note: pH of soils was tested and found to range from 4.5 to 5.5. Annual average rainfall is around 600mm per annum.	Class 5
Salinity Hazard	Recharge potential is considered low due to the ridgeline setting. Discharge potential is considered low as the site is well above the groundwater table. The salt store is considered moderate i.e. soil conductivity less than 0.8dS/m.	Class 3
Water Logging Hazard	The soils rapidly drain and are moderately well drained	Class 2
Shallow Soil and Rockiness Hazard	The extension area has nil rocky outcrops (Table 15 of LSCAS).	Class 1
Mass Movement Hazard	No mass movement of soil has been noted.	Class 1
Final LCS Class		**Class 5**

Table 9. Land Capability Assessment of Final Landform

Aspect	Details	Land Capability Classification
Water Erosion Hazard	Slopes within the rehabilitated landform will approximate 20 to 33%. (The site is assumed to lie in the Eastern and Central Division)	Class 6
Wind Erosion Hazard	Soil texture is considered to most closely resemble a fine sandy loam with 6-13% clay, therefore the Wind erodibility class of surface soil is 'moderate' (Table 5 of LSCAS). Annual average rainfall is around 600mm per annum and the site lies within a High Wind Erosive Power area (Figure 6 of LSCAS). The exposure to wind will be low due to the protection of the depression of the remaining void.	Class 3
Soil Structure Decline Hazard	Topsoils stripped during land clearing will be emplaced on the final landform. There is expected to be an increase in coarseness of the material as subsoils and overburden may have some degree of mixing in the topsoil material.	Class 4
Soil Acidification Hazard	The soils most closely resemble Red Earth-less fertile (granites and metasediments) (Table 9 of LSCAS). These soils have a low buffering capacity. Note: pH of soils was tested and found to range from 4.5 to 5.5. Annual average rainfall is around 600mm per annum. The acidification risk is not expected to change in the final landform.	Class 5
Salinity Hazard	Recharge potential may increase to moderate due to the presence of the final void and the final water body. Discharge potential is considered low as the final landform will still be well above the groundwater table. The salt store is considered moderate i.e. soil conductivity less than 0.8dS/m.	Class 3
Water Logging Hazard	The soils outside the final water body are expected to rapidly drain and will be moderately well drained	Class 2
Shallow Soil and Rockiness Hazard	The rehabilitated landform will not contain any rocky outcrops as the landform will be battered with overburden material and then topsoiled (Table 15 of LSCAS).	Class 1
Mass Movement Hazard	No mass movement of soil will be expected due to the minimum batters of 3H:1V to 4H:1V.	Class 1
Final LCS Class		**Class 6**

The Land and Soil Capability class in the rehabilitated landform is expected to drop from LCS class 5 to Class 6 primarily due to the increase in slopes within the final void. Class 5 land is described as:

'Moderate–low capability land: *Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.'*

Class 6 land is described as:

'Low capability land: *Land has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation.'*

This land capability is suited to the proposed uses of low level grazing and recreational activities.

5.2.2. Cumulative Impacts

As the Land Capability mapping for NSW the site is classified as having a land capability of 7, the assessed proposed final land capability of 6 is considered a slight improvement. The change in landform capability is not expected to have negative cumulative impacts on neighbouring landform capability.

5.3. Soils and Erosion

The control of erosion and sedimentation at the site focusses on source reduction measures. In general these measures include:

- Reading the Land Resources Assessment (this report), the Water Management Plan (WMP) and any other plans or written instructions issued in relation to development at the subject site.
- Ensure contractors undertake all soil and water management works as instructed in this specification and constructed following the guidelines stated in the NSW Managing Urban Stormwater (the "Blue Book") and *Managing Urban Stormwater, Soil and Construction, Volume 2E Mines and* Quarries
- Informing all subcontractors of their responsibilities in minimising the potential for soil erosion and pollution to downslope areas.

5.3.1. Topsoil Stripping and Storage

All works are to be undertaken following the Mine Operation Plan (MOP), this report and the WMP.

Prior to stripping all water management features will be constructed which include earth banks (Stormwater Collection Drains) to divert as much clean water as possible and capture the dirty water within the pit sump. Prior to stripping the vegetation should be sprayed for weeds to assist in reducing the weed content in topsoil that may be transferred to new rehabilitation areas.

When a new area is required to be extracted, topsoil will be stripped and where possible emplaced on previously ripped completed faces.

Stripping should not occur when in either and excessively dry or wet condition. Grading or pushing soil into windrows with graders or dozers for later collection for loading into rear dump trucks by front-end loaders are examples of preferential less aggressive soil handling systems. This minimises compression effects of the heavy equipment that is often necessary for economical transport of soil material.

Where immediate reuse of the topsoil is not possible it will be stored appropriately on the perimeter of the site. That is, stockpiles of topsoil to be located at least five metres from

areas of likely concentrated or high velocity flows, especially drainage lines and access roads. The surface of soil stockpiles should be left in as coarsely structured a condition as possible in order to promote infiltration and minimise erosion until vegetation is established, and to prevent anaerobic zones forming.

Topsoil stockpiles are not to exceed 3m in height with a minimum crest width of 3m and are to be seeded with a temporary vegetation cover if stockpiles are to remain longer than 12 months. If necessary, earth banks or drains will be constructed to divert localised run-on.

Topsoil to a depth of 10 to 15cm will be stripped first with the subsoils, if found, to a depth of a further 20 to 30cm stripped and stored separately. The actual depth of stripping of each layer will be recorded and a total volume of topsoil and subsoils estimated and an inventory kept. Each stockpile location will be logged and the stockpiles signposted clearly stating the nature of the soil. Barrier fencing will be installed to limit access to rehabilitated areas or the stockpiles. Management practices will be carried out to minimise areas being affected by wind and water erosion.

5.3.2. Topsoil Quality

Topsoil will be analysed prior to respreading to determine if amelioration measures are required such as lime, fertilisers or other nutrients to make the soil suitable for the species to be planted.

5.3.3. Topsoil Respreading

Prior to re-spreading stockpiled topsoil onto reshaped overburden, an assessment of weed infestation on stockpiles should be undertaken to determine if individual stockpiles require herbicide application and / or “scalping” of weed species prior to topsoil spreading.

Where topsoil resources allow, topsoil should be spread to a nominal depth of 100 mm on all re-graded subsoils. Subsoils will be emplaced first over the battered overburden material used to create the final landform. The depth of subsoils should aim to replicate that of the original soil profile.

Topsoil should be spread, treated with fertiliser and seeded in one consecutive operation, to reduce the potential for topsoil loss to wind and water erosion.

5.3.4. Seedbed Preparation

Thorough seedbed preparation should be undertaken to ensure optimum establishment and growth of vegetation. All areas to be topsoiled should be lightly contour ripped to create a “key” between the soil and the spoil. Ripping should be undertaken on the contour. Best results will be obtained by ripping when soil is moist and when undertaken immediately prior to sowing. The respread topsoil surface should be scarified prior to, or during seeding, to reduce run-off and increase infiltration. This can be undertaken by contour tilling with a fine-tyned plough or disc harrow.

5.3.5. Topsoil Balance

The topsoil resource has been estimated for the site using site survey to estimate currently stored topsoil stockpiles and the estimated topsoil to be won within full extent of the currently consented extraction area as well as the proposed extension area. The locations of the topsoil stockpiles and areas to be stripped are shown in *Figure Six*.

Table 10. Topsoil and Subsoil Volumes

Soil Description	Estimated Stripping depth (m)	Area (m^2)	Volume Estimates (m^3)
Topsoil Stockpile 1	-	-	1,800
Topsoil Stockpile 2	-	-	1,400
Topsoil from Undisturbed Area in the South	0.15	20,000	3,000
Topsoil from the Extension Area	0.15	24,000	3,600
Total Topsoil Available			**9,800**
Subsoil from Undisturbed Area in the South	0.30	20,000	6,000
Subsoil from the Extension Area	0.30	24,000	7,200
Total Subsoil Available			**13,200**

Table 11. Topsoil and Subsoil Volumes Required in Final Landform

Soil Description	Estimated Emplacement depth (m)	Area to be covered in final landform* (m^2)	Volume Required (m^3)
Topsoil	0.15	70,000	10,500
Subsoil	0.30	70,000	21,000

*Note: The water body in the final landform is assumed to cover an area of approximately 20,000m^2 from the WMP. The total area of disturbance is estimated to be 90,000m^2.

Therefore it is estimated that there will be shortfall of topsoil and subsoil of approximately 700m^3 and 7,800m^3 respectively. Overburden or VENM material may be suitable to assist in making up the shortfall of subsoils. Other options to improve the quality and quantity of topsoil is the addition of mulch or composted organics to 'create' topsoil. These options will be investigated further as required during the life of the mine.

5.3.6. Overburden

Very little overburden is expected to be generated on the site due to the target materials lying very close to the surface in the extension area. Overburden is variable in the south.

The 3-4 Horizontal to 1 Vertical mine final face batters will provide gentler slopes and the requirement for overburden to batter final slopes will be reduced. Further exploration activities will identify the volumes, if any, of overburden material expected.

Photography 14: Subsoils and Overburden in the South

Plan of:	Land Resources Assessment for Andersons Clay Mine Environmental Impact Statement 2018 - Soil Resources	***Location:***	253 Shaw Street, Springdale Heights, NSW	***Source:***	nearmap - Image Date 01/05/2018 & Landair Surveys	***Our Ref:***	3618_BAN_LR_DA17_C004_V1_F6.cdr
Figure:	SIX	***Council:***	Albury - Wodonga Shire Council	***Survey:***	Landair Surveys - Image Flown 08/02/2017	***Plan By:***	SK/JD
Sheet:	1 of 1	***Tenure:***	Permit Number N72	***Projection:***	MGA	***Project Manager:***	TO
Version/Date:	V1 03/10/2018	***Client:***	PGH Bricks & Pavers Pty Ltd	***Contour Interval:***	1m	***Office:***	Thornton

N

0 50m

vgt Environmental Compliance Solutions Pty Ltd

6014000 N

495000 E

Humbug Gully

Dam 2

In-pit Sedimentation Dam

Stockpile

Haul Road

Humbug Gully Catchment

Site Access

Stockpile

6013750 N

Dam

Nearest Residence

SHAW STREET

495500 E

Manager/Authorisation Holder PGH Bricks & Pavers Pty Ltd: Joe Gauci

Signed:

Date: 27/11/2018

Project Manager VGT: Tara O'Brien

Signed:

Date:27/11/2018

LEGEND

Feature/Domain	
	Property Boundary
	Consent Boundary *(N72)*
	Water Management Area
	River/Major Drainage Line
	Road
290	Contour
	Area of Disturbance
Primary Domains *(Operational)*	
	Topsoil Stockpile Area
	Overburden Emplacement Area
	Topsoil Stripping Area *(South)*
	Topsoil Stripping Area *(Extension Area)*

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5.3.7. Access Limitations

The soil erosion hazard on the site will be kept as low as practicable by minimising disturbance. Limiting access to certain areas of the operation during various stages is one way of reducing the erosion hazard and are outlined in *Table 12*.

Table 12. Limitations to Access

Landuse	Access Limitations	Comments
Extraction	• Land disturbances beyond five (preferably two) metres from the edge of the operations are prohibited. • Extraction will take place within a defined work area and materials will be transported only within the site for stockpiling or rehabilitation. • Entry to land not involved directly in the extraction process will be prohibited and will be managed as natural grassland.	All site workers should clearly recognise these areas and they should 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. • Limit vehicular access to the site to that essential for extraction or rehabilitation work.	
Remaining Lands	Land disturbances are prohibited except for essential management works.	

5.3.8. Soil Stabilisation

Soil stabilisation is primarily achieved through the rehabilitation of exposed areas. Here, rehabilitation means achieving a C-factor (Revised Universal Soil Loss Equation) of less than 0.1 (equivalent of 60% groundcover) and the program that ensures it will drop permanently, by reducing the risk of erosion by vegetation, paving, armouring, etc. as soon as practicable after activities cease.

NOTE: 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 life of the mine, they should not exceed those given in *Table 12* within the specified times.

Table 13. Maximum acceptable C-factors at nominated times during life of mine

Lands	Maximum C-Factor	Remarks
Waterways and other areas subjected to concentrated flows, post construction.	0.05 (70% groundcover)	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.
Topsoil/ Subsoil/Overburden Stockpiles stored out of the pit	0.1 (60% groundcover)	Applies after ten working days from completion of formation.
All other lands outside of the extraction area	0.15 (50% groundcover)	Applies after 20 working days of inactivity, even though works might continue later.

Note: *working days* does not include public holidays, weekends or days when work is not possible due to wet weather.

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; or
- anionic bitumen emulsion sprayed over hessian cloth (at 0.5 L/m2) in areas of concentrated flow, e.g. diversion banks and waterways; or
- a temporary vegetative cover.

Application of any soil binders employed should follow the manufacturer's instructions.

A suggested listing of suitable plant species is shown in *Table 13*. Before sowing, additional tests should be undertaken to assess the requirements of ameliorants such as lime to help plant growth.

Table 14. 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 or 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

- 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.

All waterways, drains, spillways and outlets will be constructed to be stable in accordance with the "Blue Book" for soils with high erodibilities.

5.3.9. Cumulative Impacts

As there is no adjacent extractive industry, nor release of sediment offsite, the cumulative impacts due to erosion of soils resulting in sediment entering the downstream environment are considered negligible. The downstream environment in Humbug Gully is not affected at present by any other extractive industry of land disturbing activity other than agriculture. None of the other existing quarries are within this catchment area.

5.4. Geochemical Constraints

5.4.1. Amelioration Measures

As described in *Section 3.1.3* and *Section 4.3.1* the soils on the site are slightly acidic and low to moderately saline. Appropriate amelioration measures may include liming of the topsoil and any subsoils during rehabilitation activities.

Soil chemistry will in any case, be investigated prior to revegetation to determine if ameliorants are required and the appropriate application rates.

5.4.2. Cumulative Impacts

No cumulative impacts are envisaged regarding the soil pH or salinity. Agricultural activities undertaken on adjacent lands are unlikely to be affected geochemically by the extraction activities given the limited pathways for chemical species to migrate such as groundwater. Surface water will be directed to the pit sump which has been established as having neutral pH and low conductivity.

The stripped soils will be reused on the site and the action of stripping, stockpiling and replacement of the soils is not expected to liberate any untoward chemical species nor change the soil chemistry to a degree that it would render establishment of vegetation overly challenging.

5.5. Land Contamination

5.5.1. Mitigation

There are no known contamination issues at the site. Hydrocarbons are a potential contamination source due to the use of plant and equipment used on the site during extraction and rehabilitation activities. All contractors are inducted by PGH and are required to follow PGH's Spill and Leaks procedures. They are also required to carry spill kits and refuelling is undertaken within the hardstand areas. The volumes of fuel held on site are minimal and it is unlikely that spill would result in contamination of groundwater or surface water. Spills would be cleaned up immediately and contaminated material removed to a licenced waste facility.

5.5.2. Cumulative Impacts

The extraction activities on the site are unlikely to contribute to land contamination on the site. The use of fuels on adjacent lands due to agricultural machinery is also a source of potential contamination however the volumes of fuels used are likely to be much less that that used on the site. It is unlikely that either on-site or off-site activities will result in land contamination.

5.6. Compatibility with Other Land Users

The site activities are compatible with the agricultural activities already undertaken in the adjacent lands and with other extraction industries in the locality. Site activities are limited by operating hours that will reduce the impact to the amenity of adjacent landowners and residents. Other non-land resource related potential impacts and mitigation measures such as dust, traffic and noise are discussed separately.

The impacts to land resources are not expected to be greater than that already experienced due to the extraction activities.

Section 6. Monitoring and Maintenance

Monitoring of land resources will be undertaken monthly. It may include but is not limited to the following.

- Topsoil stripping to be visually monitored to check moisture content of soil and depth of stripping.
- Topsoil/ Subsoil and overburden stockpiles to be visually assessed at time of forming to check they do not exceed three metres high.
- Ensure soil resources are not placed in hazard areas, including lands closer than five metres from areas of likely concentrated or high velocity flows, especially waterways and access roads.
- Ensuring rehabilitated lands and stockpiles soil resources have effectively reduced the erosion hazard and initiate upgrading or repair as appropriate i.e. ensure groundcover is at least 60% coverage.
- Constructing additional erosion and/or sediment control works as might become necessary to ensure the desired sediment and erosion control is achieved.
- Ensure the actual depth of stripping of each soil layer is recorded and a total volume of topsoil and subsoils estimated and an inventory kept.
- Each stockpile location will be logged and the stockpiles signposted clearly stating the nature of the soil.
- Barrier fencing will be installed to limit access to rehabilitated areas or the stockpiles.
- Visual inspection of the mine batters and slopes to determine if areas of instability are apparent and undertake works to stabilise the landform as required.
- During respreading of soils, the depth of soils will be checked visually (by test pits) to assess if the desired thickness has been achieved.
- Continue weed monitoring on the site and soil stockpiles and engage contractors to spray weeds as required. Reseed soil stockpiles with suitable species if coverage is insufficient.

References

Ref. 1. Albury City Council ((2010) *Local Environmental Plan*

Ref. 2. ANZMEC and Minerals Council of Australia (2000) *Strategic Framework for Mine Closure*

Ref. 3. DECC (2004) Managing Urban Stormwater Soils and Construction –Volume 2E Mines and Quarries

Ref. 4. Environment NSW (2010) eSpade online data *Livingstone Soil Landscape*

Ref. 5. Environment NSW (2010) eSpade online data *Dora Dora Soil Landscape*

Ref. 6. EPA (2018) Contaminated Sites Register

Ref. 7. NSW Coal Association (February 1995) – *Mine Rehabilitation*

Ref. 8. NSW Department of Primary Industries – Mineral Resources (January 2006) Guidelines to the Mining, Rehabilitation and Environmental Management Process

Ref. 9. NSW Government (2018) on line Portal SEED- *Land Capability Mapping of NSW*

Ref. 10. NSW Department of Trade & Investment – Resources and Energy (September 2013) *ESG3: Mining Operations Plan (MOP) Guidelines*

Ref. 11. NSW Office of Environment and Heritage (2012) The Land and Soil Capability Assessment Scheme (second approximation) - A General Rural land Evaluation System for NSW (LSCAS).

Ref. 12. NSW Soil Conservation Service (1978) *Albury District Technical Manual*

Ref. 13. VGT (2016) Mine Operations Plan for: Andersons Clay Mine Springdale Heights

Ref. 14. Personal Communication Tim Fuge (Fuge Earthmoving) 06/07/2017

Appendix A: Water Analysis

vgt
Laboratories Pty Ltd
PO Box 2335 Greenhills NSW 2323
P (02)4028 6412 E mail@vgt.com.au
www.vgt.com.au ABN 77 621 943 600

Report Number: 4053

Date Issued: 14/05/2018

Revision Number: 01

Site/Job: Andersons Quarry

Client: .PGH Bricks and Pavers Pty Ltd
Address Lot 1
Hueske Road
Jindera NSW 2642
Contact Joe Gauci

The following 2 samples were received on 31/03/2017

Client Sample Reference	Licence Ref /GPS	Date Sampled	Laboratory ID	Matrix	General Comments
Top of Hill Pond		31/03/2017	4053/1	Water	
Main Pit Pond		31/03/2017	4053/2	Water	

The samples have been tested and the following reports are included:

- Test Report
- Sampling Report
- Chain of Custody (if available)

Anthony Crane
Senior Chemist

NATA Accredited Laboratory – 15230.

Accredited for compliance with ISO/IEC 17025 – Testing. The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

NATA
WORLD RECOGNISED ACCREDITATION

Test Report Number: 4053

Date Issued: 14/05/2018 Revision No: 01

vgt Laboratories Pty Ltd

Results

Physical Components	Units	Method	Limit of Report	4053/1 Top of Hill Pond 31/03/2017	4053/2 Main Pit Pond 31/03/2017
Temperature	°C	Temp	*0.1*	21.0	21.4
pH	pH Units	VGT-WI/01	*0.1*	6.8	7.2
Electrical Conductivity	µS/cm	VGT-WI/02	*50*	112	56
Total Suspended Solids	mg/L	VGT-WI/03A AS3550.4	*2*	25	2,550

COMMENTS:

Location Analysed : 4/30 Glenwood Dr Thornton NSW 2322

Note: # Where present, indicates the performance of this test is not covered under NATA accreditation

Holding times for some or all of the tests listed below are outside the period recommended in the method: pH (0.25 hrs), TSS, Turbidity (24 hrs).
This may be important to the interpretation of the results.

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NATA WORLD RECOGNISED ACCREDITATION

Results have been approved and report finalised on 3/04/2017

Sampling Report Number: 4053

Date Issued: 14/05/2018 Revision No: 01

Sampling Conditions:

Laboratories Pty Ltd

Sample #	Description	Date Sampled	Sampler	Method of Sampling	Pre-treatment / Preservation	Comments
4053/1	Top of Hill Pond	31/03/2017 9:45 AM	GVT	Unknown		
4053/2	Main Pit Pond	31/03/2017 9:45 AM	GVT	Unknown		

Sampling procedures have been approved and report finalised on 3/04/2017
Where method is "unknown" sampling procedures are not endorsed

NATA Accredited Laboratory – 15230.

Accredited for compliance with ISO/IEC 17025 – Testing. The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

NATA
WORLD RECOGNISED ACCREDITATION

vgt
Laboratories Pty Ltd
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www.vgt.com.au ABN 77 621 943 600

Report Number: 4764

Date Issued: 14/05/2018

Revision Number: 01

Site/Job: Andersons Water

Client: .PGH Bricks and Pavers Pty Ltd
Address Lot 1
Hueske Road
Jindera NSW 2642
Contact Joe Gauci

The following 3 sample(s) were received on 11/09/2017

Client Sample Reference	Licence Ref /GPS	Date Sampled	Laboratory ID	Matrix	General Comments
Upper Sediment Pond	495215, 6013919	8/09/2017 12:00 AM	4764/1	Water	
Up Stream	495351, 6014064	8/09/2017 12:00 AM	4764/2	Water	
Down Stream	495180, 6014102	8/09/2017 12:00 AM	4764/3	Water	Fence

The samples have been tested and the following reports are included:

- Test Report: Results relate to sample(s) as received
- Chain of Custody (if available)

Anthony Crane
Senior Chemist

NATA Accredited Laboratory – 15230.

Accredited for compliance with ISO/IEC 17025 – Testing. The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

NATA
WORLD RECOGNISED ACCREDITATION

Report Number: 4764

Date Issued: 14/05/2018 Revision No: 01

vgt Laboratories Pty Ltd

Results

Physical Components	Units	Method	Limit of Report	4764/1 Upper Sediment Pond 8/09/2017	4764/2 Up Stream 8/09/2017	4764/3 Down Stream 8/09/2017
Temperature	°C	Temp	*0.1*	17.3	17.3	17.5
pH	pH Units	VGT-WI/01	*0.1*	6.3	6.3	6.4
Electrical Conductivity	µS/cm	VGT-WI/02	*50*	205	140	73
Total Suspended Solids	mg/L	VGT-WI/03A AS3550.4	*2*	13	7	9

COMMENTS:

Location Analysed : 4/30 Glenwood Dr Thornton NSW 2322

Note: # Where present, indicates the performance of this test is not covered under NATA accreditation

Holding times for some or all of the tests listed below are outside the period recommended in the method: pH (0.25 hrs), TSS, Turbidity (24 hrs).
This may be important to the interpretation of the results.

Results have been approved and report finalised on 11/09/2017

NATA Accredited Laboratory – 15230.

Accredited for compliance with ISO/IEC 17025 – Testing. The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

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Appendix B: Soil Testing

Laboratories Pty Ltd
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Sample Receipt Report Number: 5902

Date Issued: 4/10/2018 Revision Number: 01

Site/Job: **Anderson Soil testing**

Client: .PGH Bricks and Pavers Pty Ltd
Address Lot 1
Hueske Road
Jindera NSW 2642
Contact Joe Gauci

The following 3 samples were received on 15/05/2018

Client Sample Reference	Licence Ref	Date Sampled	Laboratory ID	Matrix	General Comments
AND1 Soil 0-0.1M			5902/1	Soil	
AND2 Soil			5902/2	Soil	
AND3 C Horizon			5902/3	Soil	

The samples have been tested and the following reports are included:

- Test Report: Results relate to sample(s) as received
- Chain of Custody (if available)

Anthony Crane
Senior Chemist

Test Report Number: 5902

Date Issued: 4/10/2018

Laboratories Pty Ltd

Results

Test Description	Units	Method	Limit of Report	5902/1 AND1 Soil 0 -0.1M	5902/2 AND2 Soil	5902/3 AND3 C Horizon
Temperature	°C	Temp	*0.1*	24.8	24.1	24.0
Conductivity (1:5)	dS/m	NEPM B36.2 Soil EC	*0.1*	0.8	0.3	<0.1
pH (1:5)	pH units	NEPM B36.2 Soil pH	*0.1*	4.6	4.5	5.2

Results have been approved and report finalised on 17/05/2018

Appendix C: Blue Book Calculations

1. Erosion Hazard and Sediment Basins

Site Name: Andersons

Site Location:

Precinct/Stage:

Other Details:

Site area	Sub-catchment or Name of Structure						Notes
	Pit	Dam 2	Dev Pit				
Total catchment area (ha)	4.7	1	11				
Disturbed catchment area (ha)	4.7		11				

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	D	D	D				From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	D	D	D				Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5	5	5				See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	90	90	90				
x-day, y-percentile rainfall event (mm)	35.2	35.2	35.2				
Rainfall R-factor (if known)							Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)	6.02	6.02	6.02				

RUSLE Factors

Rainfall erosivity (*R*-factor)	1020	1020	1020				Auto-filled from above
Soil erodibility (*K*-factor)	0.05	0.05	0.05				
Slope length (m)	150	150	250				
Slope gradient (%)	6	6	6				RUSLE LS factor calculated for a high rill/interrill ratio.
Length/gradient (*LS*-factor)	2.15	2.15	2.93				
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2	2	2	2	2	Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.64	0.64	0.64				See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	142	142	194				
Soil Loss Class	1	1	2				See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	110	110	149				Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	86		274				See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	1059	225	2478				See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	1145		2752				

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

1. Erosion Hazard and Sediment Basins

Site Name: Andersons

Site Location: In Pit Soil Loss

Precinct/Stage:

Other Details:

Site area	Sub-catchment or Name of Structure						Notes
	W HW	S HW	N HW	floor			
Total catchment area (ha)	0.33	0.35	0.3	2.1			
Disturbed catchment area (ha)	0.33	0.35	0.3	2.1			

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	D	D	D	D			From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	D	D	D	D			Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5	5	5	5			See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	90	90	90	90			
x-day, y-percentile rainfall event (mm)	35.2	35.2	35.2	35.2			
Rainfall R-factor (if known)							Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)	6.02	6.02	6.02	6.02			

RUSLE Factors

Rainfall erosivity (*R*-factor)	1020	1020	1020	1020			Auto-filled from above
Soil erodibility (*K*-factor)	0.05	0.05	0.05	0.05			
Slope length (m)	30	35	25	100			
Slope gradient (%)	45	45	45	1			RUSLE LS factor calculated for a high rill/interrill ratio.
Length/gradient (*LS*-factor)	7.61	8.63	6.55	0.20			
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2	2	2	2	2	Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.64	0.64	0.64	0.64			See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	504	572	434	14			
Soil Loss Class	5	5	4	1			See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	388	440	334	10			Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	21	26	17	4			See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	74	79	68	473			See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	95	105	85	477			

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

VGT Environmental Compliance Solutions Pty Ltd
- Environmental & Geological Assessments
- Environmental Monitoring & Management
- Quarry/Mine Plans & Rehabilitation Plans
- CPESC Endorsed Sediment & Erosion Plans
- Annual Reports
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