Our reference: SF17/45272; DOC19/29180-04
Contact: Ms Alex McGuirk; (02) 6333 3807

The General Manager
Lithgow City Council
PO Box 19
LITHGOW NSW 2790

Attention: Ms Lauren Stevens

20 March 2019

Dear Ms Stevens,

BELL QUARRY REHABILITATION DA294/18
INTEGRATED DEVELOPMENT APPLICATION – RECOMMENDED REFUSAL

I refer to the designated development application, DA294/18, including the environmental impact statement (the EIS; GHD, August 2018), for the proposed rehabilitation project at the former Bell sand quarry (the Premises) referred to the NSW Environment Protection Authority (the EPA) by Lithgow City Council (the Council) on 9 January 2019 (the Project).

The Project proposes to receive 2.2 million tonnes of waste at the Premises at up to 140,000 tonnes per year from earthworks projects across Sydney and the local regional area and apply that waste to existing quarry voids. The waste proposed to be applied to land is a combination of virgin excavated natural material (VENM), excavated natural material (ENM) and other "clean fill" material.

The Premises is located adjacent to the Blue Mountains National Park / Greater Blue Mountains Area, which is included on the UNESCO World Heritage List and the National Heritage List. The Premises intersects an unnamed ephemeral tributary to the Wollongambe River, which is within the catchment of the declared wild river known as the Colo River, Greater Blue Mountains World Heritage Area.

The EPA provided input to the Secretary's Environmental Assessment Requirements (the SEARs) for the Project on 8 November 2016 (see Appendix A to the EIS). The EPA noted that it would:

- Require clarification on "clean fill" and any relevant exemptions,
- Review the EIS to determine if the Project requires an environment protection licence, and
- Review the EIS to determine if environmental impacts have been identified and adequately addressed.

The EPA has reviewed the EIS and has identified that:

- No clarification has been provided on "clean fill" and any relevant exemptions,
- An environment protection licence would be required, therefore the EPA considers the Project to be "integrated development",
- The environmental impacts of the Project have not been fully identified, however sufficient information has been provided for the EPA to consider that the Project poses an unacceptable water pollution risk to the Greater Blue Mountains World Heritage Area, including the Wollangambe River / Colo River.

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Further details of the EPA's review are included in Attachment 1 and Attachment 2. The EPA acknowledges the assistance of the Office of Environment and Heritage (OEH) in its review of the proposal.

Since the EPA considers that the Project poses an unacceptable risk of water pollution to a World Heritage Area and a declared wild river catchment, the EPA does not support the Project and recommends that the Project be refused.

Should you have any further enquiries in relation to this matter, please contact Ms Alex McGuirk at the Central West (Bathurst) Office of the EPA by telephoning (02) 6333 3807 or by emailing central.west@epa.nsw.gov.au.

Yours sincerely

DR SANDRA JONES
Manager Regional Operations – Central West
Environment Protection Authority

Attachment 1. General Comments

The EPA has reviewed the proposal and has identified that the proposed disposal of up to 2.2 million tonnes of "waste" at a Premises with surface water and groundwater connectivity to the Greater Blue Mountains World Heritage Area represents an unacceptable water pollution risk as set out below.

"*Integrated development*" is established in Division 4.8 of the *Environmental Planning and Assessment Act* 1979. Development that requires an environment protection licence is integrated development and requires the consent authority to obtain the EPA's general terms of approval (GTA). Rather than issue GTA, the EPA is issuing a recommendation that the consent authority refuse the Project.

Relevant terms used below are taken from the *Protection of the Environment Operations Act* 1997 (the Act), the *Protection of the Environment Operations Waste Regulation* 2014 (the Waste Regulation) and resource recovery orders and exemptions issued under the Waste Regulation. Relevant terms include:

- "*waste*" defined in the Dictionary to the Act and
  - "*virgin excavated natural material*" defined in Clause 50 of Schedule 1 to the Act
  - "*excavated natural material*" as per the "*excavated natural material order 2014*" (the ENM Order) and the "*excavated natural material exemption 2014*" (the ENM Exemption),
  - "*clean fill*" is undefined and is therefore considered by the EPA to be "waste".
- "*waste disposal (application to land)*" requires an environment protection licence as per Clause 39 of Schedule 1 to the Act,
- "*miscellaneous licensed discharge to waters*" requires an environment protection licence as per sections 122 and 43(d) of the Act,
- "*waters*" and "*water pollution*" defined in the Dictionary to the Act
- "*prohibition of pollution of waters*" established by section 120 of the Act.

Integrated development: waste disposal ("clean fill")

Nothing in the EIS identifies what materials constitute "clean fill". As such, the EPA considers, that this material should be defined as waste. The application of waste to land requires an environment protection licence. The EIS has not identified the range or concentrations of contaminants in "clean fill". The EPA considers that contaminants in "clean fill" will potentially pollute the land and the downstream environment.

Integrated development: miscellaneous licensed discharge to waters

Nothing in the EIS identifies any water treatment of the existing water in the quarry voids, or of the leachates associated with filling the quarry voids with waste. The discharge of pollutants to waters is an offence, unless authorised by an environment protection licence.

Unacceptable water pollution risk: ENM leachates

In order to use resource recovery orders and exemptions, the EPA's guidance material states they must be genuine, fit for purpose and cause no harm to the environment and human health.
https://www.epa.nsw.gov.au/publications/wasteregulation/150107-order-exemptions-factsheet

The EPA does not consider that using the ENM Exemption to fill Bell Quarry is consistent with these requirements. The EIS states that ENM can have up to 2% (by weight) of non-natural material potentially sourced from excavated, or quarried from areas contaminated with manufactured chemicals, or with process residues, as a result of industrial commercial, mining or agricultural activities. Such material should not be used as fill adjacent to a World Heritage Area and a declared wild river.

It is important that the consent authority consider the notes included in the ENM Order, as resource recovery orders and exemptions do not guarantee that material is suitable for use in an environmentally sensitive location such as Bell Quarry. Attachment 2 contains further details of the concerns with the use of the product ENM. Additionally, clause 2.1 of the Order states:

"The requirements in this order apply, as relevant, to any person who supplies excavated natural material, that has been generated, processed or recovered by the person."

Therefore, the onus on deciding if the material meets the Order sits with the supplier of the material, not the owner, operator or the proponent. The ENM Order includes on page 9, the following notes:

In gazetting or otherwise issuing this order, the EPA is not in any way endorsing the supply or use of this substance or guaranteeing that the substance will confer benefit.

The conditions set out in this order are designed to minimise the risk of potential harm to the environment, human health or agriculture, although neither this order nor the accompanying exemption guarantee that the environment, human health or agriculture will not be harmed.

Unacceptable environmental impact: groundwater dependent ecosystems

Nothing in the EIS identifies any controls to stop any pollutants present in the fill material from mixing with and polluting the groundwater within the quarry. Once mobilised within groundwater, nothing in the EIS identifies any measures to stop pollutants within groundwater from moving from the quarry and downstream into the Wollangambe River.

The EIS identifies a groundwater dependent ecosystem, being the prickly tea-tree – sedge wet heath swamp which is listed as an endangered ecological community under the *Biodiversity Conservation* Act 2016 (NSW; formerly the *Threatened Species Conservation* Act 1997), as potentially impacted by the Project.

OEH mapping further identifies a groundwater dependent ecosystem, being the temperate highland peat swamp on sandstone which is listed as an endangered ecological community under the *Environment Protection and Biodiversity Conservation* Act 1999 (Commonwealth), as potentially impacted by the Project.

The EPA notes that, despite its potential impacts on a World Heritage Area and endangered ecological communities, the Project does not appear to have been referred to the Commonwealth as a matter of national environmental significance.

The EPA considers it likely that some of the soil leachates will adversely alter the natural characteristics and ionic balance of water draining into the Greater Blue Mountains World Heritage Area and the Colo River, Greater Blue Mountains World Heritage Area. As such, the EPA does not support the Project and recommends that the Project be refused.

Attachment 2. Response from EPA referral to Scientific Division, Office of Environment and Heritage

Environmental Impact Statement (EIS) for the proposed Bell Quarry Rehabilitation (Lithgow DA294/18) - Comments

On 11 February 2019, the NSW EPA wrote to OEH SD requesting a review of the environmental impact statement (EIS) for the proposed Bell quarry rehabilitation (Lithgow DA294/18), especially the Water Resources Assessment (Appendix C).
The EPA identified that:
The proposed Bell quarry rehabilitation involves receiving 2.2 million tonnes of waste (at up to 140,000 tonnes per year) from earthworks projects and applying that waste to existing voids at a former sand quarry (the Quarry). The waste is described as virgin excavated natural material (VENM), excavated natural material (ENM) and other "clean fill" material.
The Quarry is located adjacent to the Blue Mountains National Park which forms part of the Greater Blue Mountains Area listed on both the UNESCO World Heritage List and the National Heritage List. The existing voids are located on an unnamed ephemeral tributary to the Wollangambe River, which forms part of the Colo sub-catchment of a declared wild river known as the Colo River, Greater Blue Mountains World Heritage Area.
The Quarry received development consent in 1994 under the approvals framework for mining and quarrying that predated the Planning Act. The surrender of the environment protection licence for the Quarry (EPL 3218 for extractive activities) was approved by the EPA on 24 October 2014 on the basis that the site had been rehabilitated consistent with the development consent (DA 108/94; consent issued 21 November 1994) which provided that the existing voids would be retained as a permanent water source for native fauna and a supplementary water source during bushfires.
The EPA had reviewed the EIS and was concerned that the Water Resources Assessment (Volume 2, Appendix C) did not adequately assess the environmental impacts.
These comments have been prepared to assist the EPA in their consideration of the proposed Bell Quarry Rehabilitation project.

Summary

The proposed Bell quarry rehabilitation involves receiving 2.2 million tonnes of waste (at up to 140,000 tonnes per year) from earthworks projects and applying that waste to existing voids at a former sand quarry (Bell Quarry). The major issues identified in the EIS for the Project are:

- The emplacement material may consist primarily of ENM with up to 2% (by weight) of *non-natural* material potentially sourced from *excavated or quarried from areas from contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial, mining or agricultural activities.*

- It is unclear how the 2% (by weight) of *non-natural material* could either be measured, assessed or enforced in terms of the excavated material to be placed at the site.

- ADE (2017) identified that the study was limited by the lack of knowledge of the proposed materials to be imported into the quarry and conservative assumptions into the input of the model.

- The soil/rock sampling undertaken was stated to be limited in nature and was not considered to constitute detailed site investigation of each source site, or each soil/rock landscape/formation (ADE 2017).

- There is no mention in the EIS of installing an impervious membrane (liner) to prevent leachate moving into groundwater. It is therefore likely that leachate will migrate off-site and into the World Heritage Area.

- There was wide variability in the soil leachates tested, depending largely on where they were sourced. Some of these soil leachates could potentially alter the natural characteristics and ionic balance of water draining into the World Heritage Area and Wollangambe River.

- The EIS identified proposed discharges into a tributary of the Wollangambe. It identified a swamp located on the tributary approximately 200m downstream of where the discharge is proposed. The tributary (and its connected swamp) is proposed to receive pumped out water from the quarry pits, any leachate from the material that is emplaced in the pits[1] and overland flow once the area is rehabilitated. The tributary and swamp are in the GBMWHA. There is currently no licensed discharge location for the site.

- The Biodiversity Impact Assessment identified the *Prickly Tea-tree - sedge wet heath* swamp below the quarry discharge location as a Newnes Plateau Shrub Swamp (EEC under the TSC Act) and Temperate Highland Peat Swamps on Sandstone (EEC under the EPBC Act). As the project potentially impacts on the WHA and EPBC listed THPSS, the proposal should have been forwarded to the Commonwealth for assessment.

- The existence of the swamp in the headwaters of the drainage line downstream of Bell Quarry strongly suggests that there is a groundwater source which helps support/maintain the swamp in this location.

- The Water Resources Assessment Section of the EIS has not clearly defined the downstream swamp as a GDE; it has not assessed the level of groundwater dependence for the swamp and the likely pathways (e.g. disruption of groundwater connections, reduction in groundwater quality) by which the project might impact on the swamp; and it does not consider issues surrounding water discharge rates or their effect on geomorphic stability for the swamp. It has therefore not appropriately assessed the risk the project will have on the THPS swamp. Further investigations into the hydrological characteristics of the swamp are needed.

- The Water Resources Assessment Section has primarily used modelling to assess flow characteristics and impacts for the proposal. It is noted that very little empirical data have been collected to either calibrate or validate the model. It is also noted that no 'natural' flow data has been collected in the Wollangambe Tributary likely to receive pumped water, leachate into groundwater and run-off from the final landform for the project. The model therefore appears not to have been appropriately calibrated or validated for local conditions.

- The surface headwaters of the Newnes Plateau and surrounding areas of the GBMWHA generally have excellent water quality with very low concentrations of dissolved and total salts and very low concentrations of most metals, metalloids and non-metallic inorganics (excepting iron and aluminium). It is likely that leachate from the emplacement area, water pumped out from the pits over the life of the project and runoff from the final landform will affect the water quality within the WHA.

Waterways that mainly flow through relatively undisturbed national parks, World Heritage Areas or wetlands of outstanding ecological significance are designated as being of 'high conservation value' (DEC 2006). Strict licence conditions would be needed to ensure discharges from the site are consistent with ANZECC recommendations for the protection of high conservation/ ecological value systems. If the project is considered for approval it is recommended that an impervious membrane (liner) is installed in the quarry pits to prevent any leachate moving into groundwater in the area and then into the GBMWHA.

[1] Which subsequently moves into groundwater aquifers that subsequently drain to the tributary and swamp.

Background

Bell Quarry is located on Sandham Road in Newnes Junction approximately 10 kilometres east of Lithgow, NSW. It is immediately adjacent to the Greater Blue Mountains World Heritage Area (GBMWHA) and within the upper reaches of the Wollangambe River catchment (Figure 1). The EIS states:

- Extraction operations commenced in 1967 and operated under existing use rights until 1994, when a Development Application (DA) was lodged with Lithgow City Council to provide for the continued operation of the quarry.
- Extraction operations continued at the site in accordance with DA 108/94 issued by Lithgow City Council and an Environment Protection Licence (EPL) for extractive operations issued by the NSW Environment Protection Authority (EPA). Active quarry operations at the site have now ceased and the EPL No. 3218 for the operation of the quarry was surrendered to the EPA on the 24th October, 2014.
- The former Bell Quarry has been purchased and Bell Quarry Rehabilitation Project Pty Ltd (BQRP) are seeking to rehabilitate the site through the importation of virgin excavated natural material (VENM), excavated natural material (ENM) and other clean fill material (subject to specific resource recovery exemptions) sourced from earthworks projects across Sydney and the local regional area (the Project).
- Rehabilitation of the site will involve emplacement of clean fill within the existing footprint to enable the site to be returned to a condition closely representing the original landform and that of the adjoining Blue Mountains National Park.
- It is estimated that approximately 1.2 million cubic metres of fill material would be required to fill the site and return it to be representative of the original landform characteristics.

The EIS also states:

> *An ephemeral tributary of the Wollangambe River runs in a north-easterly direction through the project site, with its headwaters in the vicinity of the rail line upstream of the site. The quarry now contains three large voids which are partially filled with water through a combination of surface water run-off and groundwater seepage. Water is discharged from the site through an established sediment basin on the eastern edge of the site and discharges into an unnamed tributary within the Blue Mountains National Park.*
>
> *The tributary passes through a swamp where flows are predominantly subsurface under baseflow conditions and continues for approximately 1.5 kilometres before the confluence with the Wollangambe River. The Wollangambe River winds eastwards through narrow canyons and is one of four major tributaries of the Colo River.*

It appears that this tributary (and its connected swamp within the GBMWHA) is proposed to receive pumped out water from the quarry pits, any leachate from the material that is emplaced in the pits[2] and overland flow once the area is rehabilitated. The operation of the proposed land fill site has the potential to have an adverse impact on the values of the adjacent World Heritage Area.

[2] Which subsequently moves into groundwater aquifers that subsequently drain to the tributary and swamp. See the discussion on groundwater connectivity with Newnes Plateau Swamps later in the comments.

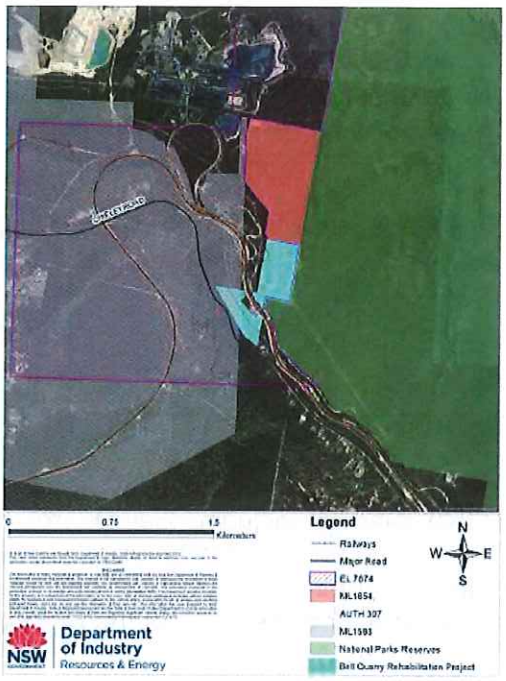

Figure 1. Bell Quarry Rehabilitation Project Area relative to GBMWHA.

Emplacement Material

According to the EIS, the PoEO Act defines virgin excavated natural material (VENM) as 'natural' material (such as clay, gravel, sand, soil or rock fines):

a. that has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial, mining or agricultural activities, and
b. that does not contain any sulfidic ores or soils or any other waste.

According to the EIS, excavated natural material (ENM) refers to naturally occurring rock and soil (including but not limited to materials such as sandstone, shale, clay and soil) that has:

a. been excavated from the ground, and
b. contains at least 98% (by weight) natural material, and
c. does not meet the definition of Virgin Excavated Natural Material in the Act.

Excavated natural material (ENM) does not include material located in a hotspot; that has been processed; or that contains asbestos, Acid Sulfate Soils (ASS), Potential Acid Sulfate soils (PASS) or sulfidic ores.

It is unclear what other "clean fill" material is defined to be.

The fact that the proposal is primarily aiming to emplace ENM as opposed to higher quality VENM is a major concern given the location of Bell Quarry immediately adjacent to a World Heritage Area. The emplacement of up to 2% of *non-natural* material potentially sourced from *excavated or quarried from areas from contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial, mining or agricultural activities* is a serious issue that may impact on the values of the World Heritage Area.

There is no mention in the EIS of installing an impervious membrane (liner) to prevent leachate moving into groundwater and then into the GBMWHA. It is unclear how the 2% (by weight) non-natural material could either be measured, assessed or enforced in terms of the excavated material to be placed at the site.

The EIS also states:

> *All emplacement material brought to the site will be clean fill and meet the acceptance criteria for bringing material to the site in line with the ENM Resource Recovery Order. Detailed water quality modelling demonstrates that both surface water discharges and groundwater are expected to have minimal potential to impact upon the immediate receiving waters in the downstream tributary and swamp located approximately 200 metres from the site.*

Whilst the EIS claims to have undertaken *detailed water quality modelling*, it is noted that very little local data has actually been collected to either calibrate or verify the model or its predictions.

Geology of the Bells Quarry area

Extensive deposits of deeply weathered, soft and friable sandstone exist on the Newnes Plateau and adjacent highland areas in the western Blue Mountains of New South Wales. These deposits occur in Narrabeen Group sediments belonging mainly to the Banks Wall sandstone of the upper Grose sub-group (Pecover 1986). It is these deposits that quarries, including Bell Quarry, have typically targeted. Stratigraphically in this area, the Triassic Burralow Formation usually overlies the Banks Wall Sandstones (McHugh 2014), however it is difficult to determine from the EIS whether the upper geological sequences around Bell Quarry also includes sandstones or claystone's of the Burralow formation[3].

The EIS states:

> *The NSW 1:250,000 geological series sheet S1 56-5 (1966) indicates that the soil landscape in the project area is underlain by bedrock of the Banks Wall Formation, a prominent Triassic Sandstone Unit of Early Triassic Age. It is described by Corkery (1994) as comprising friable medium-grained to pebbly quartzose sandstone with extensive thin limonite (hydrated iron oxide) concentrations or bands, with frequent thin lenses and interbeds of claystone and fine grained sandstone. The claystone generally occurs in thin lenses < 0.5 metres thick. The sandstone is highly weathered with the weather extending to depths in excess of 60 metres below ground level in places (Corkery 1994).*
>
> *Clay-rich friable sandstone was the primary resource extracted from the project area during previous quarrying activities. The friable sandstone generally comprised 4.75 mm to 0.0625 mm size fractions containing 99% silica with minor quantities of iron oxide. Clay constituted approximately 17% of the total material excavated (Corkery 1994).*

The Triassic Burralow Formation consists of medium- to coarse-grained sandstones interbedded with frequent sequences of fine-grained, clay-rich sandstones, siltstones, shales and claystones (McHugh 2014). These latter fine-grained units can be several metres in thickness and their presence differentiates the Burralow Formation from the underlying Banks Wall Sandstone. The base of the Burralow Formation was defined by McHugh (2014) as the base of the lowermost significant fine-grained, clay-rich unit above the more sandstone-rich lithology of the Banks Wall Sandstone.

The dominant lithology of the Banks Wall Sandstone is medium- to coarse-grained sandstone, with the formation having an average thickness of just under 100 metres. The steep-sided cliff faces of the surrounding areas usually consist of the massive sandstones of the Banks Wall Sandstone.

Whilst the EIS provides indicative soils that might be emplaced in the abandoned Bell Quarry pits, it does not appear to have made a similar assessment of the soils in the immediate area of Bells Quarry. This makes it very difficult to compare soil types proposed to be placed in the quarry pits and understand how they differ from soils that occur naturally in the vicinity of Bells Quarry.

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[3] Which is considered a serious deficiency in describing the geology of the area in the EIS.

ADE (2017) identified that the study was limited by the lack of knowledge of the proposed materials to be imported into the quarry and conservative assumptions into the input of the model. This was stated to result in conservative (i.e. low) SSLs, which were identified to be ***potentially prohibitive to the project***. As such, further metrics regarding the potentially imported material, for example the chemical reactivity of soils from various landscape groups when interacting with water within the quarry, was considered warranted.

ADE was engaged by Chalouhi to collect and test soil/rock samples representative of natural materials with the greater Sydney region. The objective of works issued to ADE by the Chalouhi was to collect soil samples from various landscape groups within the Sydney region, analysis of background quality and condition of pooled water within the quarry, and assessment of the
leaching characteristics of the collected soils when subject to water derived from within the quarry. The soils tested are described in Table 1 below.

Table 1 - Summary of source sites and samples collected from various soil landscapes or rock formations.

Landscape	Address	Depth (m BGL)	Soil Description	Date
Ashfield Shale	6-14 Walker Street, Rhodes NSW	2.0	Weathered SHALE, dark grey, brittle with ironstone bands, dry.	09.11.2017
Glenorie	2-4 Lodge Street, Hornsby NSW	2.0	Silty CLAY (CL), medium plasticity, light grey / light brown with trace sub-angular shale fragments, moist.	13.11.2017
Blacktown	490 Twelfth Avenue, Rossmore NSW	0.5	Silty CLAY (CH), high plasticity, medium red mottled light grey, moist.	13.11.2017
South Creek	490 Twelfth Avenue, Rossmore NSW	0.5	Silty SAND (SM), fine grained, well sorted, light brown / light orange, moist.	15.11.2017
Lucas Heights	250 Railway Parade, Kogarah NSW	2.0	Clayey SAND (SC), fine grained, well sorted, medium / high plasticity, dark red / light grey with sub angular iron coated gravels, moist.	16.11.2017
Hawkesbury Sandstone	457-459 Pacific Highway, Asquith NSW	7.0	SANDSTONE, medium / coarse grained, well graded, light orange / dark yellow with dark red ironstone bands, dry.	16.11.2017
Disturbed Terrain	Governor Macquarie Drive, Warwick Farm NSW	2.0	Silty SAND (SM), fine grained, well graded, dark brown / medium orange, moist.	16.11.2017
Faulconbridge	12 Tenth Street, Warragamba NSW	0.5	Silty SAND (SM), medium grained, well graded, dark brown, moist.	16.11.2017
Tuggerah	18 Huntley Street, Alexandria NSW	3.5	SAND (SW), fine grained, well sorted, light orange / light brown, moist.	16.11.2017

The soil/rock sampling undertaken was stated to be limited in nature and was not considered to constitute detailed site investigation of each source site, or each soil/rock landscape/formation (ADE 2017). If the soil characteristics provided in the EIS are analysed using Principal Components Analysis, then the South Creek and Blacktown soils are quite different to the majority of other soil types tested, being relatively higher in terms of zinc, nickel and copper. It is possible that localised soils in the vicinity of Bell Quarry might be more similar to Hawkesbury sandstone, but seeing as the local geology is primarily Narrabeen Sandstones and/or Burralow Formation sandstone and shales, there are still likely to be differences. It is considered a deficiency of the EIS that local soils were not also analysed to provide a comparison to the soil types proposed for emplacement in the pits. Leachates from the tested soils are discussed further below (in the Water Quality Section).

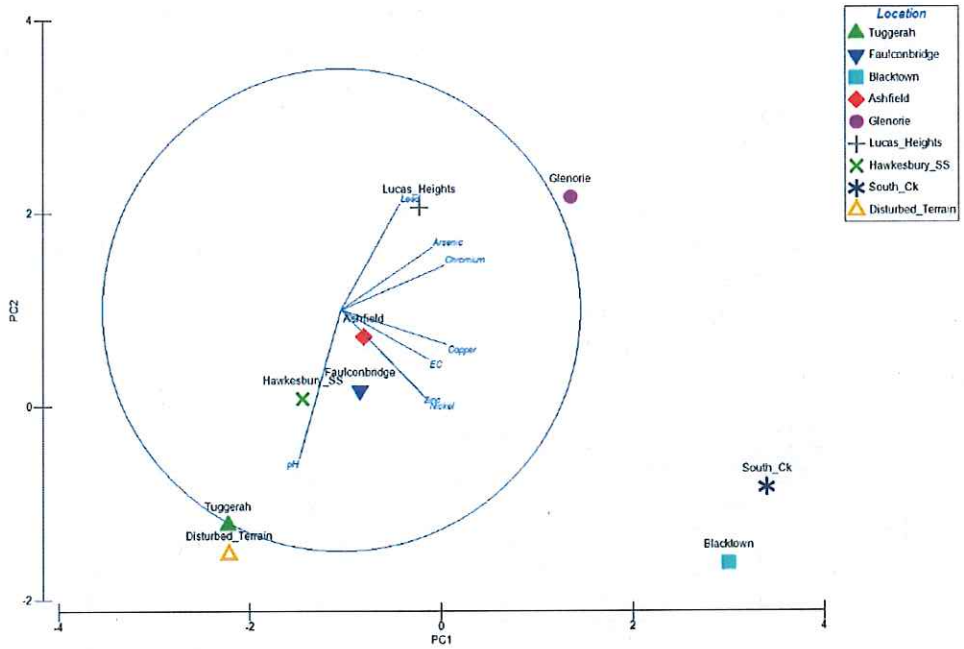

Figure 2. Principal Components Analysis of Selected Soil Types tested in the EIS. Points closer together are more similar in their soil components than points/sites further apart. Vectors indicate increasing values of individual contaminants in the direction of the lines.

Quarry Pit and Surroundings

The existing quarry pit contains a number of water-filled voids (see Figures 3 & 4). The EIS identified that:

Due to the depths of the site voids, seepage of groundwater into the voids results in the surface water and groundwater environments at the site being interrelated. Groundwater from upstream of the site influences the water quality and quantity in the voids, and likewise, any impact on the quality of the surface water at the site is predicted to influence the groundwater quality downstream.

Figure 3. Google Image of Bell Quarry Pits.

Figure 4. Photographs of Bell Quarry Pits. Source: OEH

According to the EIS,

> *An ephemeral tributary of the Wollangambe River runs in a north-easterly direction from the project site. The quarry intersected this tributary's catchment, which has its headwaters in the vicinity of the rail line upstream of the site. Surface flows from this area of the catchment now enter the site at the western edge of the north void, where some erosion from high flow events is evident.*
>
> *Approximately 200 metres downstream of the water-filled voids the drainage line enters a swamp (see Figure 2), where under dry weather conditions, flows are predominantly subsurface. The swamp occupies the majority of the drainage line upstream of the confluence with a similar tributary, which runs to the north of the site. Downstream of this confluence the tributary enters a meandering reach which is somewhat confined by sandstone outcropping, which continues for approximately 1.5 kilometres before the confluence with the Wollangambe River.*

It appears the drainage line to the swamp was previously the site of an EPL discharge under EPL3218 (see details below). The description of the licensed discharge point on EPL3218 was as an '*Overflow from north east corner of sedimentation dam*'. It is, however, unclear how often overflows (if any) have occurred in the past or what the quality of the water was when overflows occurred. Current water quality in the pit appears relatively good (similar to water quality measured in streams on the Newnes Plateau – see Water Quality Section below). Very little if any discussion of the previous operations under EPL3218 have been described in the EIS. For example, it would have been beneficial for information on prior EPL discharges and quality to have been documented in the EIS.

Water and land

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1	Discharge to waters Discharge quality monitoring	Discharge to waters Discharge quality monitoring	Overflow from north east corner of sedimentation dam (known as Cell 2) shown as Discharge Point 1 on drawing titled " Figure 3.1 Proposed Quarry Layout - Year 5" dated 8 October 1992

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				5
pH	pH				6-8.5
Total suspended solids	milligrams per litre				30

Groundwater Dependent Ecosystem Assessment

Figure 4-2 of the Water Resources Assessment Section of the EIS (GHD 2018a) is stated to show the BoM (2017) Groundwater Dependent Ecosystems in the vicinity of Bell Quarry (see Figure 5 below). GHD (2018a) states:

> *The Wollangambe River is mapped as an "Aquatic" GDE downstream of the confluence of the tributary which receives runoff from the site. This is the only mapped GDE which could potentially be affected by the Project, as none of the terrestrial GDEs identified are in the same catchment as the site. While not a mapped GDE, a swamp downstream of the site has been assessed to be representative of a Newnes Plateau Shrub Swamp by the biodiversity assessment undertaken as part of this EIS (GHD 2018). This swamp is considered a sensitive receptor for the purpose of the WRA.*

In contrast, the Biodiversity Impact Assessment, GHD (2018b) states:

> *No groundwater-dependent ecosystems (GDEs) are mapped in the study area on the national atlas. Sydney Peppermint - Silver-top Ash Shrubby Woodland is identified as being a low potential GDE (BOM 2017). Hanging and upland swamps in the Blue Mountains are identified as being high probability groundwater dependent wetland communities (Kuginis et al 2012). As such,* ***the Prickly Tea-tree - sedge wet heath downstream of the Project area is likely to be a GDE***[4]*.*

This swamp (and another close by) have been mapped by OEH (Vegetation of the Western Blue Mountains and Wollemi; see Figure 6). They are also mapped as part of the Temperate Highland Peat Swamp on Sandstone (THPSS) community (Fryirs et al 2019; see Figure 7). The THPSS community is listed as an Endangered Ecological Community (EEC) under the Commonwealth's EPBC Act.

[4] Bold emphasis added.

Figure 5. EIS depiction of Groundwater Dependent Ecosystems in the vicinity of Bell Quarry.

Figure 6. Swamps mapped by OEH in the vicinity of Bell Quarry (Vegetation layers for the Western Blue Mountains & Wollemi)

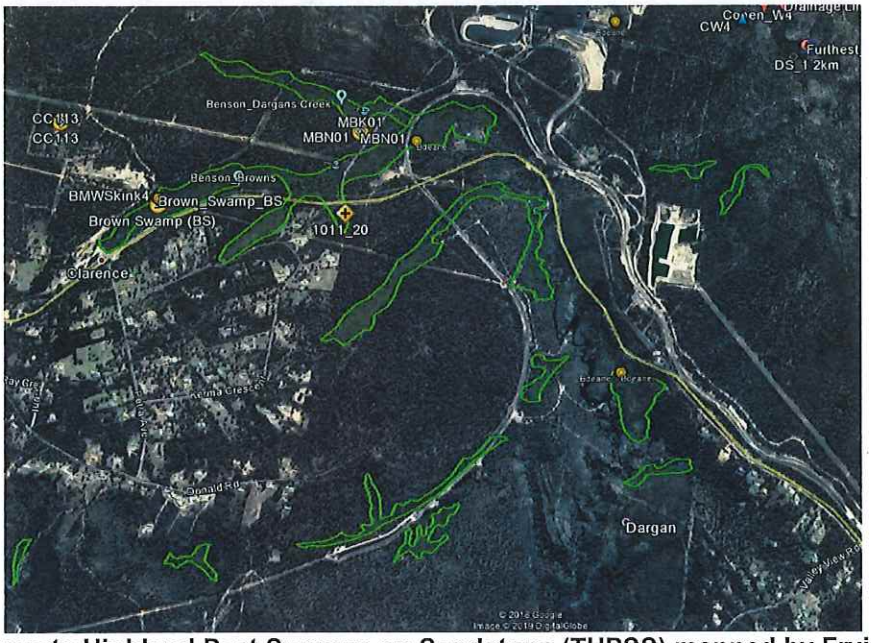

Figure 7. EPBC Temperate Highland Peat Swamps on Sandstone (THPSS) mapped by Fryirs et al 2019 near Bell Quarry.

As identified in GHD (2018b):

> *An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Australian Minister for the Environment.*

The EPBC Act identifies MNES[5] as:

- *World heritage properties*
- *National heritage places*
- *Wetlands of international importance (Ramsar wetlands)*
- *Threatened species and ecological communities*
- *Migratory species*

[5] Matter of national environmental significance.

- *Commonwealth marine areas*
- *The Great Barrier Reef Marine Park*
- *Nuclear actions (including uranium mining)*
- *A water resource, in relation to coal seam gas development and large coal mining development.*

GHD (2018b) identified the *Prickly Tea-tree - sedge wet heath* swamp as a Newnes Plateau Shrub Swamp (EEC under the TSC Act) and Temperate Highland Peat Swamps on Sandstone (EEC under the EPBC Act). As the project potentially impacts on the WHA and EPBC listed THPSS, the proposal should have been forwarded to the Commonwealth for assessment. This does not appear to have occurred.

The Commonwealth's Independent Expert Scientific Committee have recently released an Information Guidelines explanatory note for Assessing groundwater-dependent ecosystems (Doody et al 2019). http://www.iesc.environment.gov.au/system/files/resources/422b5f66-dfba-4e89-adda-b169fe408fe1/files/information-guidelines-explanatory-note-assessing-groundwater-dependent-ecosystems.pdf

The IESC defined a logical sequence of steps to prepare an appropriate environmental impact assessment for GDEs. These steps were:
1. Define the likely area of impact of the proposed project (including the disturbance footprint of surface infrastructure and the extent of groundwater depressurisation).
2. Use a desktop assessment of reports, maps, databases and other resources to list potential GDEs in the project impact area, and make a preliminary assessment of possible risks to these GDEs from each stage of the proposed project.
3. Apply conceptual models and other tools described in the explanatory note to assess the level of groundwater dependence for each GDE and the likely pathways (e.g. disruption of groundwater connections, reduction in groundwater quality) by which the project might impact on GDEs.
4. Determine baseline ecological condition and ecosystem value of each GDE, including GDEs to be used as control or reference sites to assess changes over time that are not associated with the project. Field surveys will be needed to obtain site-specific data that can be supplemented with information from remote sensing and other techniques.
5. Conduct a systematic risk assessment to estimate the likelihood and consequences of potential impacts on GDEs arising from the proposed project, including cumulative impacts. Tools such as the GDE Risk Matrix and the associated matrix of management options are useful here.
6. Using the risk assessment and other information from the preceding steps, specify options to avoid or mitigate impacts on GDEs and establish a monitoring plan to assess the effectiveness of mitigation.

The Water Resources Assessment Section of the EIS (GHD 2018a) has not clearly defined the downstream swamp as a GDE[6] (Figure 5) and has not appropriately assessed the risk the project will have on the THPS swamp. It has not assessed the level of groundwater dependence for the swamp and the likely pathways (e.g. disruption of groundwater connections, reduction in groundwater quality) by which the project might impact on the GDE. This is considered a significant deficiency in the EIS and one that should be corrected before any development is approved.

Swamp Downstream of Bells Quarry

As identified in the previous Section, GHD (2018b) identified the swamp as a *Prickly Tea-tree - sedge wet heath* swamp part of the Newnes Plateau Shrub Swamp (EEC under the TSC Act) and Temperate Highland Peat Swamps on Sandstone (EEC under the EPBC Act) community. The swamp was stated to be in moderate/good condition (GHD 2018b). A site visit by OEH SD (10/03/2019) also identified the swamp as being in relatively good condition dominated by tea-tree (*Leptospermum* sp) shrubs growing to

[6] Simply calling it a *sensitive receptor.* It is unclear in the EIS how a *sensitive receptor* is defined or how it has been treated in the GDE assessment. Alteration of groundwater flows and quality to GDEs could have a significant impact on the GDE.

approximately 2.5m in height (see Figure 8). This swamp is somewhat different to the nearby Newnes Plateau and Dargan Creek swamps. Given the potential for the project to impact on this swamp, further baseline ecological condition and ecosystem value data for the swamp should have been collected and presented in the EIS, especially if the operation of the Project could potentially cause an impact to this swamp in the future.

Figure 8 Swamp in d[illegible]

McHugh (2011, 2013) studied the upper stratigraphy of the Angus Place/Springvale leases, in particular the Burralow Formation, and identified both a lithological and topographic link between the presence of the Burralow Formation and the occurrence of the Newnes Plateau Hanging Swamps (NPHS) and Newnes Plateau Shrub Swamps (NPSS). Several of the claystone horizons, together with clay-rich, fine-to-medium grained sandstones and shales were found to be acting as aquitards, or semi-permeable layers within the stratigraphic sequence of the Burralow Formation. These aquitards decrease the hydraulic gradient of rainwater and groundwater movement percolating through the weathered and semi-weathered strata of the Burralow Formation and form a permanent water source for the formation and maintenance of the hanging swamps. In total, McHugh identified seven units, designated YS1 to YS6, which were capable of sustaining the hanging swamps in the area, provided the topographic conditions were amenable to the formation of a hanging swamp.

The above discussion of the linkage between well-drained sandstone, clay layers and swamps is of importance to the swamp immediately downstream of Bell Quarry since it is likely to receive:

- Pumped water from the pits
- Leachate infiltrating into groundwater aquifers from the pits
- Runoff from the final landform

The EIS states:

> *A detailed assessment of the potential impacts of the project on water resources has been undertaken as part of this EIS. The project will restore the flow regime to be representative of*

natural run-off conditions from before the commencement of extractive operations. During the rehabilitation activities there will be a temporarily reduction to the frequency of low flows and more frequent moderate flows for stages requiring dewatering. The changes to the flow regime are relatively minor and are not anticipated to significantly impact upon downstream geomorphological processes due to the natural stream profile and thick and well established vegetation in the immediate receiving waters.

Given the low level of sampling and empirical data on flows and water quality[7] provided for the area, the claim that a *detailed assessment* has been undertaken is highly questionable. As identified above, the EIS also claims to have undertaken *detailed water quality modelling*, but it is noted that very little data has actually been used to either calibrate or verify the model or its predictions. As a result, the model outputs are likely to largely reflect the architecture and underlying assumptions used in the model. Since a number of important assumptions (eg groundwater connectivity) have not been explored or detailed, the veracity of the model, its assumptions and its conclusions need further explanation and justification.

The existence of the swamp in the headwaters of the drainage line downstream of Bell Quarry strongly suggests that there is a groundwater source which helps support/maintain the swamp in this location. Further investigations into the hydrological characteristics of the swamp are obviously needed. Since the swamp has also been identified as being part of the EPBC listed THPSS EEC, the proposal should also have been forwarded to the Commonwealth Government for assessment.

Discharge, Flow and Water Quality

GHD (2018a) used a water balance model (GoldSIM software package) using a daily timestep and historical meteorological data to assess flow characteristics for the proposal. It is noted that very little empirical data have been collected to either calibrate or validate the model. It is also noted that no 'natural' flow data has been collected in the Wollangambe Tributary likely to receive pumped water, leachate into groundwater and run-off from the final landform for the project. The model therefore appears not to have been calibrated or validated for local conditions.

GHD (2018a) stated that the discharge from the site only occurs when the balance of rainwater, groundwater flow and evaporation are such that the voids are full and overflowing. However, it is proposed that water in the quarry pits is to be de-watered, with water directed to the downstream tributary at the location of a previous licensed discharge. ADE (2017) identified that the licence was surrendered on 1 October 2014[8], so there is currently no licensed discharge location for the site. GHD (2018a) did not discuss the pump out rates in the EIS, however if flow rates to the tributary are too high, then there is significant potential to destabilise sediments in the downstream swamp. If an erosional nick-point is established in the swamp, it could lead to the loss of the swamp in its entirety through erosion and gullying. The EIS does not consider issues surrounding discharge rates or their effect on geomorphic stability for the swamp.

ADE (2017) also identified that:

- *The modelling completed thus far has indicated that emplacement of Excavated Natural Material (ENM), as defined under the NSW Environmental Protection Agency's (NSW EPA's) 'Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014 – The excavated natural material order 2014', could result in the discharge of water from the Quarry to Wollangambe River with Contaminants of Potential Concern (CoPC) above adopted guideline values (GVs) for protection of aquatic species.*

[7] Largely one-off sampling.

[8] Elsewhere in the EIS it was stated as 24th October 2014

- *The study was limited by the lack of knowledge of the proposed materials proposed to be imported into the quarry and conservative assumptions into the input of the model. This resulted in conservative (i.e. low) SSLs, which were identified to be potentially prohibitive to the project.*

- *Further metrics regarding the potentially imported material, for example the chemical reactivity of soils from various landscape groups when interacting with water within the quarry, was considered warranted.*

To assess the leaching potential of the collected soil samples when subject to water within Bell Quarry, Australian Standard Leaching Potential (ASLP) tests were undertaken on soil/rock samples using water sampled from within the quarry as the solvent/reagent. It was noted that using water derived from the quarry as the reagent/solvent was not a NATA accredited test, under ALS Global's NATA accreditation. Nevertheless, the leachate tests provide an opportunity to assess what leachate quality might be generated from the soil types tested[9].

If the leachate characteristics provided in the EIS are analysed using Principal Components Analysis then the South Creek and Blacktown leachates are quite different to the majority of other soil leachates, quarry pit water samples and stream water samples from the Bell Quarry location (see Figure 9). The Blacktown soil leachate was relatively high in terms of zinc, nickel, copper and Total Nitrogen. The South Creek soil leachate was relatively high in terms of Sodium, Chloride, Arsenic and EC. Groundwater (locations MB02 & MB03) was relatively higher in total alkalinity, total phosphorus, reactive phosphorus and pH.

As identified in OEH (2015), the surface headwaters of the Newnes Plateau generally have excellent water quality with very low concentrations of dissolved and total salts and very low concentrations of most metals, metalloids and non-metallic inorganics (excepting iron and aluminium). This high quality is also evident in measurements for water quality from samples taken in the quarry pits and streams of the area; and presented[10] in the EIS. There is quite wide variability in the soil leachates, depending on where they were sourced. Some of these soil leachates could potentially alter the natural characteristics and ionic balance of water draining to the World Heritage Area and Wollangambe River.

In relation to water quality GHD (2018a) states:

- *Table 5-10 indicates that no exceedances of the ANZECC (2000) GVs are predicted at the site discharge assuming the average leachate water quality, with the exceptions of pH and zinc;* and
- *It is also noted that the minor exceedances were at or below the zinc concentration observed by OEH (2015) in the Wollangambe River at a point upstream of the Clarence Colliery (refer Table 4-1). As such, the predicted zinc concentrations presented in Table 5-10 are expected to not have any adverse impact in the receiving environment if they were to result from run-off from the site.*

[9] It remains possible that the soils tested in the EIS could be much better/cleaner than the full range of other soils which may find their way into the quarry pit voids.

[10] But not statistically compared. Note too this was largely based on a single grab sample on one occasion at each site.

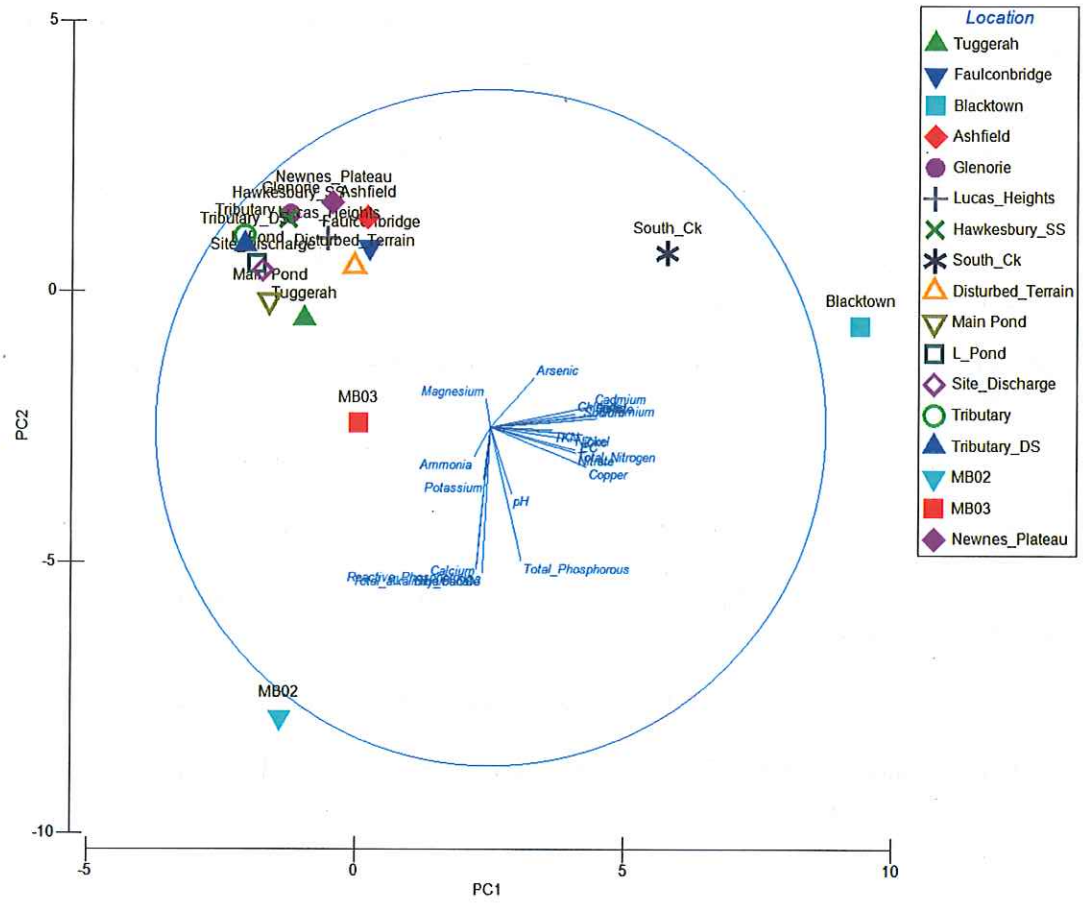

Figure 9. Principal Components Analysis of Selected Soil Leachates, quarry pit water samples and stream water samples[11]. Points closer together are more similar in their soil components than points/sites further apart. Vectors indicate increasing values of individual contaminants in the direction of the lines.

What GHD (2018a) fail to discuss in this context is that:

- the zinc measurement for W1 (0.0056 mg/L) was in between ANZECC levels to protect 95% and 99% of species
- the zinc measurement for W3 (0.019 mg/L) was influenced by the Clarence Colliery discharge[12]
- the zinc measurements for soil leachates ranged from a minimum of 0.03 mg/L (Tuggerah Soil Type) to a maximum of 0.484 mg/L (Blacktown Soil Type)[13]
- Table 5-9 identifies a range of other leachate results with exceedances of the ANZECC (2000) GVs.
- Only one leachate sample has been measured for each soil type (ie no replication)
- The soils tested may not be representative of the 'worst' soils likely to be emplaced in the quarry pits.

If the project is considered for approval it is recommended that an impervious membrane (liner) is installed in the quarry pits to prevent leachate moving into groundwater in the area and then into the GBMWHA.

References

ADE (2017) Letter to Chalouhi Pty Ltd (Chalouhi) RE: Soil and water sampling - Bell Quarry Rehabilitation Project, Blue Mountains NSW. ADE Consulting Group Pty Ltd. 6th December 2017

[11] Newnes Plateau sample based on 80th percentiles for streams on the Newnes Plateau (see OEH 2015).

[12] There are recent plans to remove this discharge from the Wollangambe River.

[13] All much higher than (5 to 86 times) the W1 zinc level.

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