Independent Expert Report on the Proposed McPhillamy's Gold Project

Prepared for the Environmental Defender's Office

Assoc. Prof. Gavin M. Mudd
Environmental Engineering, RMIT University

15 February 2023

1) I have been requested by the Environmental Defender's Office (EDO) to provide an independent expert report on certain aspects of the proposed McPhillamy's gold project in central New South Wales. Specifically, my report should address the following (clause 17, expert brief, given herein as Appendix A):
   a) *In your opinion, is the assessment of environmental impacts from the Project's Tailings Storage Facility, as far as it relates to your areas of expertise, appropriate and sufficient?*
   b) *In your opinion, are the mine rehabilitation measures, as far as it relates to your areas of expertise, appropriate and sufficient?*
   c) *What, if any, concerns do you have about the environmental impacts of the Project, bearing in mind the mitigation measures proposed?*
   d) *Provide any further observations or opinions, as far as it relates to your areas of expertise, which you consider to be relevant.*

2) I have 28 years relevant experience in assessing the environmental impacts of mining, covering aspects such as groundwater, mine water management, acid and metalliferous drainage, mine rehabilitation, tailings management and sustainability aspects. National and global recognition of my expertise is evidenced through:
   a. Top 1.38% global scholar of all time – my research work has achieved a rank of 37,231 of 2,698,859 scholars ranked (i.e., my position is in the top 1.38%)[1];
   b. Publishing – 90 journal papers, 56 reviewed and 110 non-reviewed conference papers and presentations and 40 research and technical reports or scientific book chapters;
   c. University Teaching – 20 years of university teaching, including groundwater, environmental impact assessment, environmental risk management (amongst others);
   d. Contributing author to 4 of the Leading Practice Sustainable Development Handbooks published by the Australian Government between 2006 to 2009, including *Acid and Metalliferous Drainage* (2007), *Tailings Management* (2007), *Risk Assessment and Management* (2008) and *Evaluating Performance: Monitoring and Auditing* (2009).
   e. Extensive knowledge of mining across Australia and globally, as evidenced by my publications and involvement on numerous legal cases and studies for communities across Australia and the world.

   I provide my short-form curriculum vitae (CV) in Appendix B as evidence of my areas of expertise.

[1] Elsevier Citation Metrics, see https://elsevier.digitalcommonsdata.com/datasets/btchxktzyw/4

3) I acknowledge that I have read the Expert Witness Code of Conduct (Uniform Civil Procedure Rules 2005) and agree to be bound by this code. My report outlines my interpretation and relevant opinions, including the relevant sources of information, career experience or other data which informs that opinion.

4) I have reviewed the relevant sections or chapters of the McPhillamy's Gold Project Environmental Impact Statement (EIS) (i.e., the 'Main Report', herein referred to as the EIS; see EMM, 2019a) as well as related technical appendices. Where necessary, I also cite other technical literature of relevance to ensure my opinion is clearly explained and justified. I set out my report in three major sections to address the key areas as requested: tailings dam engineering and management, mine rehabilitation and general environmental impacts.

Tailings Dam Engineering and Management

5) The proposed tailings storage facility (TSF) for the McPhillamy's Gold Project and its risks are described in sections 2.9, 6.7 and 22.4.4 of the EIS (EMM, 2019a) and in-depth technical detail in Appendix D to the EIS (ATCW, 2019).

6) For the purposes of this report, the final design configuration adopted for the TSF is essentially a valley-fill structure based on a primary embankment (dam) wall and additional dam walls in several places to ensure tailings containment, as shown in Figure 1. The TSF will be built in three stages, eventually covering the area shown in Figure 1. Key engineering features of the TSF will include (amongst others, only those relevant for my views are noted):
   a. Monitoring of TSF wall stability;
   b. Decant structure for process water recovery and helping to achieve tailings consolidation;
   c. Seepage monitoring and recovery;
   d. Emergency spillway for allowing discharge of excess accumulated waters during floods;
   e. Lining or conditioning of the TSF to ensure minimal seepage.

   I note that the presentation of the information in the EIS and Appendix D are conventional engineering design studies, but I believe there are various aspects which fail to address key environmental risks from the proposed McPhillamy's TSF.

7) ***Wall Stability*** – Whilst the modelling and assessment of wall stability suggests a stable structural design (i.e., Factor of Safety greater than 1), during operations this will need to be confirmed through detailed geotechnical monitoring. ATCW (2019) propose that a minimum of eight (8) piezometers will be installed to monitor pore pressures within embankment walls (page 100) – yet there will be up to 10 separate embankment walls at the start of the project, declining to 6 as the TSF is expanded and some walls are merged together (see Figures 102 to 106, ATCW, 2019). This appears to be a weakness as all walls should have multiple piezometers installed to facilitate detailed monitoring of pore pressures – this is crucial to understand wall stability. At present, it would appear that some walls are planned not to have any monitoring – which would remain a significant engineering and environmental unknown and therefore risk. Similarly, it would be highly preferable to have a much greater number of settlement monitoring points to ensure that TSF walls are safe and stable.

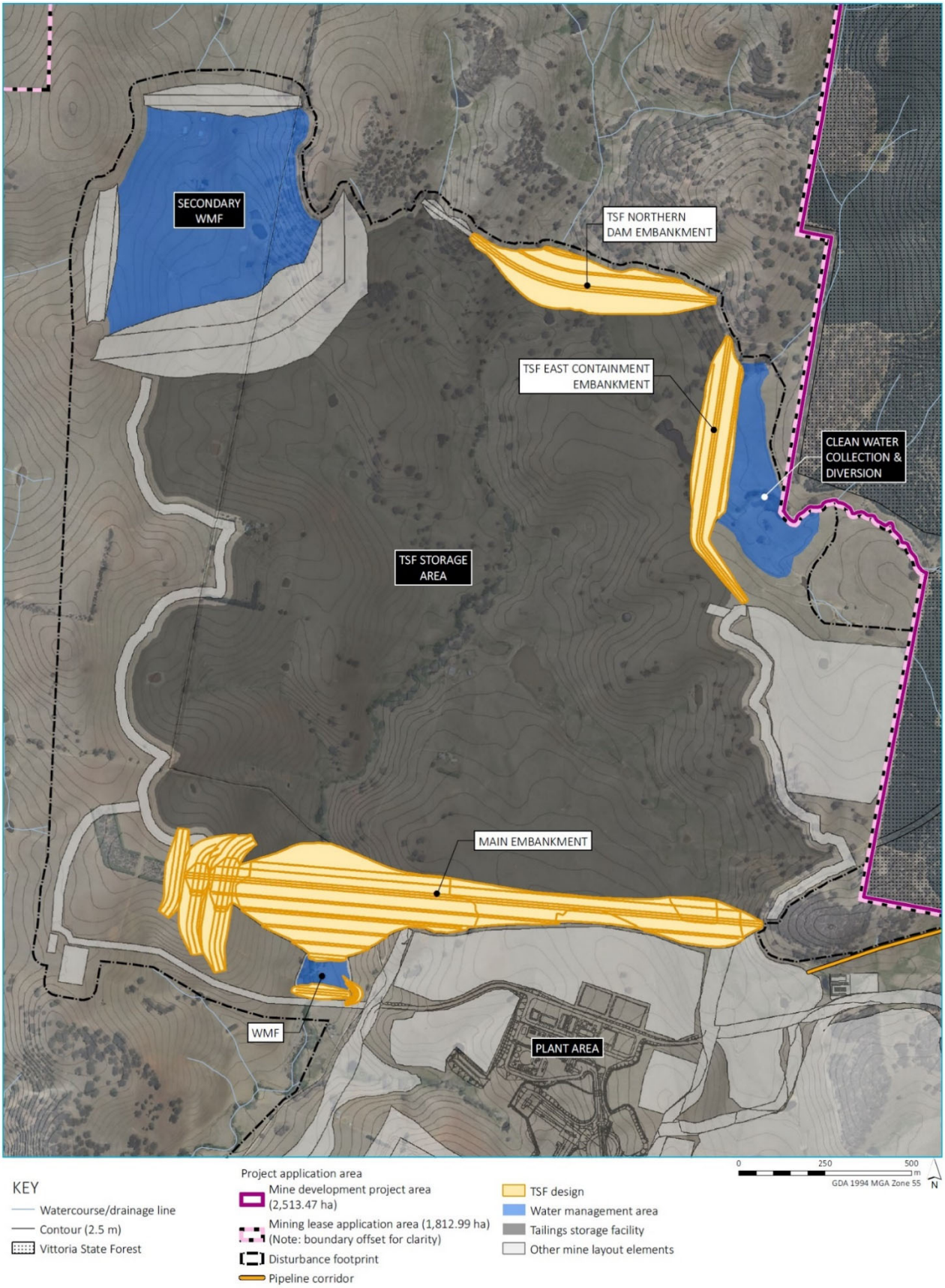

Figure 1: Overall layout of the McPhillamy's Tailings Storage Facility (modified for layout only from Figure 2.10, EMM, 2019a)

8) **Liner or Low Permeability System for the TSF** –

a. the preferred design for the TSF adopts an equivalent liner approach to achieve environmental protection of groundwater and surrounding values. Effectively, the proposal relies on the modest hydraulic conductivity of the underlying soils and rocks to mitigate any seepage impacts rather than building an engineered liner system. Whilst this is argued as optimising the McPhillamy's TSF design, it ensures that the TSF will continue to seep into groundwater for decades after site closure – as acknowledged on page 78 of Appendix D (ATCW, 2019). As the report also notes, if the seepage geochemistry is 'problematic' (page 78) – i.e., contains significant acid and/or metalliferous drainage waters – this could require a seepage interception and treatment system to be in place for many decades into the future to manage potential impacts from such poor quality seepage waters.

b. Furthermore, the results of seepage modelling (Table 19 or Plate 28; ATCW 2019) suggest that the differences in engineering design are negligible. That is, for clay liners of 0.3, 0.6 and 1.0 m the modelled seepage rates are 17.33, 17.28 and 17.22 m^3/day, respectively, or just using a geosynthetic clay liner (GCL) shows a near identical seepage rate of 17.20 m^3/day. This raises questions about the utility of such approaches to modelling seepage – as this effectively suggests that any seepage will be simply controlled by the modest permeability of the underlying Anson Formation and not reduced by any engineering measures at all. In reality, this suggests the potential for mounding of water within the TSF – that is, water will persist within the tailings due to the inability to drain in a reasonable time frame. The implication of this is that the TSF could act as a perched aquifer-like system, acting as a local recharge source to groundwater, effectively in perpetuity.

c. Given that the tailings have been acknowledged in the EIS and Appendix D as potentially acid forming (PAF), in my experience, this gives me significant cause for concern regarding the generation of acid and metalliferous drainage (AMD). Any AMD formation within the TSF pore waters would lead to very poor quality seepage water and a substantial risk to groundwater quality, especially where that groundwater might discharge into surface water such as the Belubula River.

d. The risks of such a scenario for the proposed McPhillamy's TSF would undoubtedly be exacerbated by the risks of climate change – that is, the predicted changes to rainfall, droughts and flood periods. The cyclical change between periods of wetter and drier climates could greatly enhance the potential for AMD generation, yet this major risk remains poorly recognised and assessed, in my view, within the EIS and Appendix D.

9) **In-Pit Tailings Disposal During Closure** –

a. In my review, nowhere in the EIS or Appendix D is the alternative of in-pit tailings considered as part of mine closure and rehabilitation. That is, after the completion of active mining and ore processing, the tailings would be shifted from the TSF to the backfill the final void of the open pit. Based on the authors' extensive knowledge and unpublished mapping of tailings sites across Australia (expected to be released in the near future), there are probably more than one hundred sites where in-pit tailings have been or are being actively used. There are examples for uranium (e.g., Ranger, Nabarlek, Rum Jungle), manganese (e.g., Bootu Creek, Woodie Woodie), iron ore (e.g., Christmas Creek, Yandi, Hope Downs), nickel (e.g., Murrin Murrin, Cawse, Bulong), lead-zinc (e.g., Broken Hill,

Woodcutters, Cadjebut) and extensively across the gold sector (e.g., Cadia Hill, Tanami, Kidston, Mount Pleasant-Paddington Group and now across almost every state in Australia). I show a preliminary map of these sites in Figure 2, demonstrating that the mining industry and regulators now see in-pit tailings as appropriate and viable – yet the EIS and TSF feasibility study (Appendix D), failed to consider it during site closure and rehabilitation.

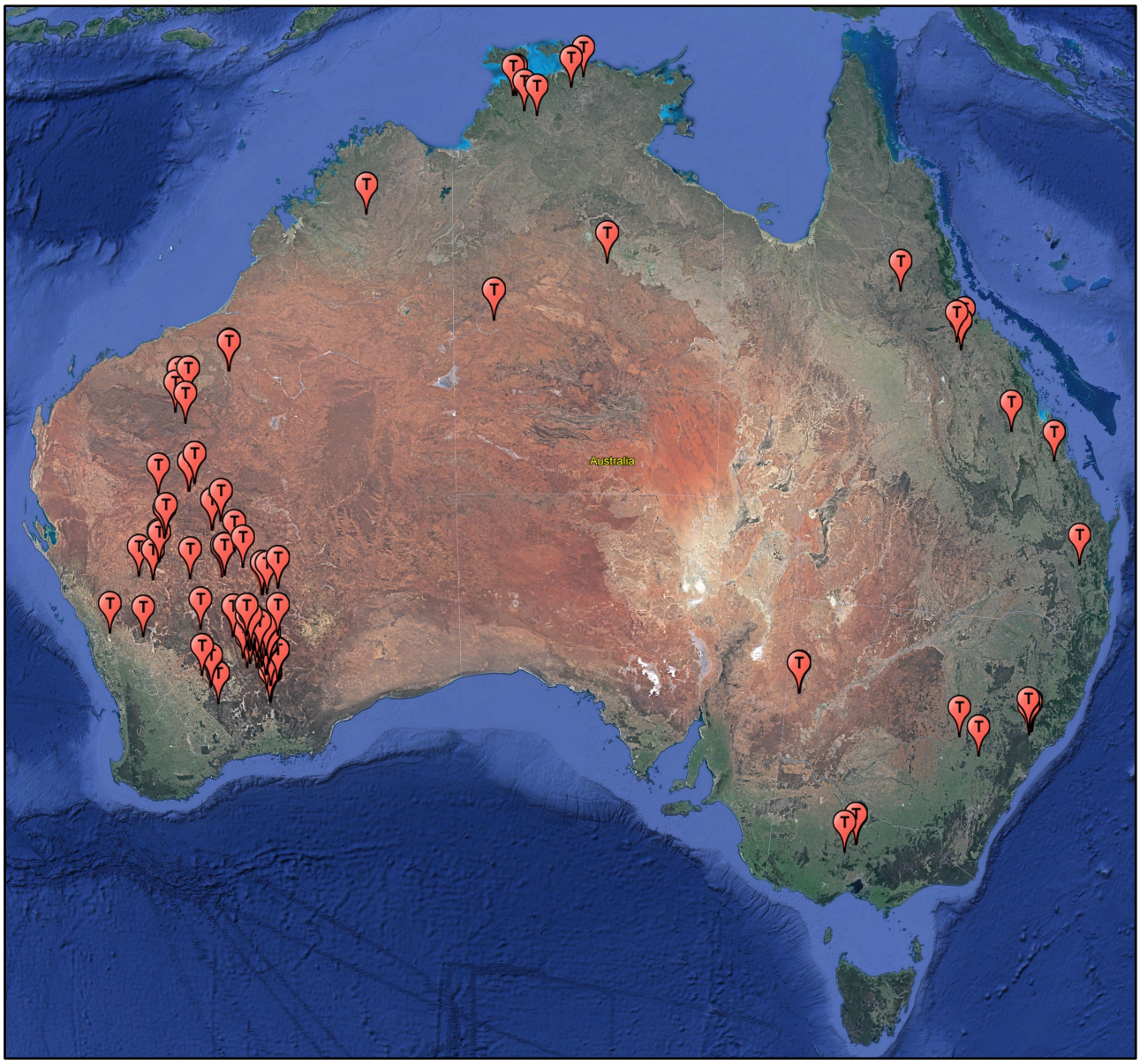

Figure 2: Preliminary map of current or former mines across Australia which have used or are using in-pit tailings (mapped in Google Earth by the author, research in progress and nearing completion, due for publication in the near future)

b. Conceptually, shifting the tailings to the final open pit void would ensure that the tailings remain below the water table, thereby greatly reducing the potential generation of AMD (due to the lack of oxygen ingress below the water table). Indeed, for sites such as Woodcutters, Rum Jungle and others, this has been the principal technical justification for the adoption of in-pit tailings – such a short term cost greatly reduces long-term liabilities and likely substantial future costs. At the former Rum Jungle uranium mine, sulphidic waste rock was rehabilitated above ground using engineered soil covers (1980s) – which failed

within a decade – and the new proposal for another round of rehabilitation will use in-pit backfill to greatly reduce AMD risks (2010s).

c. For McPhillamy's, the proposed open pit is currently designed to excavate about 109 million cubic metres (Mm^3) of rock (gold-containing ore and waste rock), leading to about 60 million tonnes (Mt) of ore processed and subsequent tailings (noting the TSF study allows for up to 70 Mt of tailings). At the assumed dry density of 1.5 t/m^3 (tonnes per cubic metre), this would mean a tailings volume in the pit of about 40 Mm^3 – or less than half of the final void volume.

d. Furthermore, the potentially acid-forming (PAF) waste rock, estimated at 87 Mt in the TSF study (page 12), would occupy a volume of about 43.5 Mm^3 (assuming a dry density of 2 t/m^3, a value typical for waste rock). Combined with the tailings volume, this would leave some 25 Mm^3 for final backfilling of non-acid forming waste rock (or potentially left as a lake, subject to long-term risks such as salinity build-up). Such a final backfilled pit would need more detailed assessment with respect to groundwater pathways, which I believe remain insufficiently investigated and assessed (see next major point).

e. An important aspect of in-pit transfer and final disposal would be whether the remining void is completely backfilled with waste rock, or only partially. This will be influenced by the interactions of groundwater with the final pit – especially the relative water levels. That is, what is the average water table elevation versus the pit water level – if the pit water level is permanently lower, this will make the pit a sink with respect to groundwater (driven effectively by evaporative removal of water from the pit). This could be an important part of minimising risks to adjacent surface water resources but requires considerable more investigation and assessment before final decisions are taken for site closure, rehabilitation and long-term monitoring and maintenance.

f. A conceptual diagram of in-pit tailings for the closure and rehabilitation of the McPhillamy's project is shown in Figure 3, highlighting that potentially acid-forming (PAF) tailings and waste rock would be deep within the former pit void, leaving room for either a lake or complete backfill or even development of a profile close to pre-mine topography.

g. Overall, I believe the adoption of in-pit tailings disposal during site closure and rehabilitation would substantially reduce long-term seepage and related environmental risks from the proposed McPhillamy's TSF.

10) ***Groundwater Around the Proposed TSF***

a. The extent of baseline groundwater data in the immediate area of the proposed TSF is patently inadequate in my view (groundwater is reviewed in Appendix K; EMM, 2019b). For example, the area of the proposed TSF is shown in Figure 4 (an extract from Figure 3.17 of Appendix K) and only contains two bores within the direct TSF footprint (shown by red circles). For such critical infrastructure, significantly more bores should have been installed to help assess the hydrogeology and groundwater in detail (e.g., dozens of bores. In my experience, this is justified due to the especially the complex topography traversed by the proposed TSF, the interactions of groundwater and surface water as well as the need to understand the key processes controlling spring location, flow rates and water quality (see further comments next point).

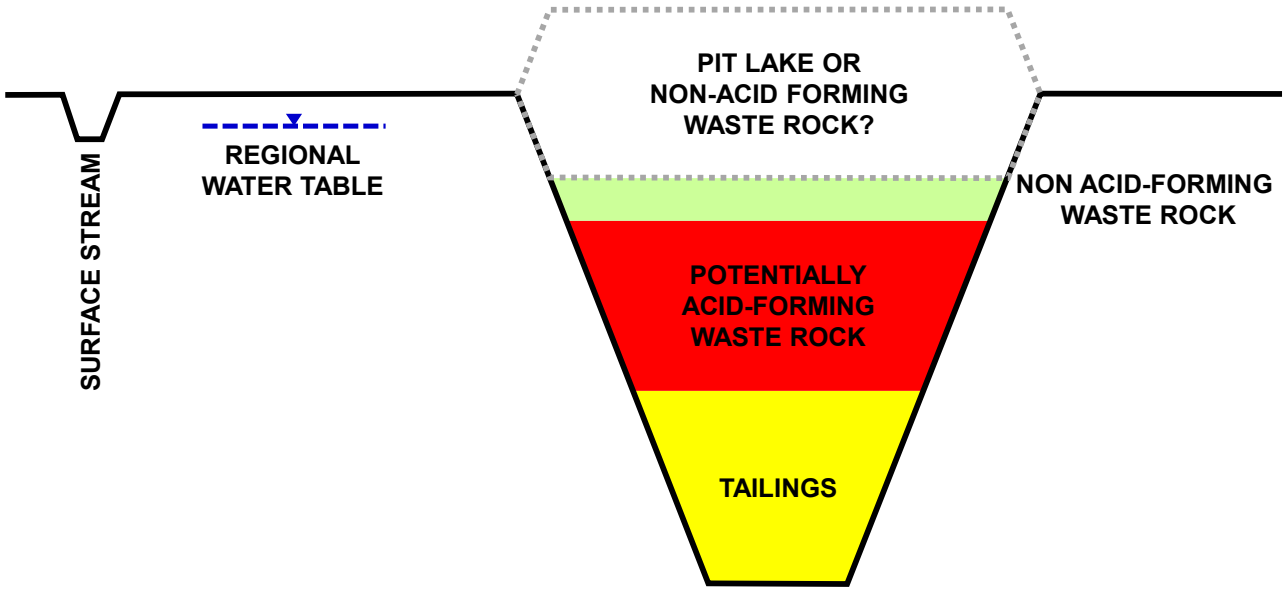

Figure 3: Conceptual view of the profile of in-pit tailings and PAF waste rock following closure and rehabilitation of the McPhillamy's project – note the relative position of the regional water table, which would facilitate discharge to surface waters (going to the left) and the final stage of the backfill of the former pit to be left as a lake or completely backfilled (author's concept only based on extensive experience in reviewing such issues across Australia)

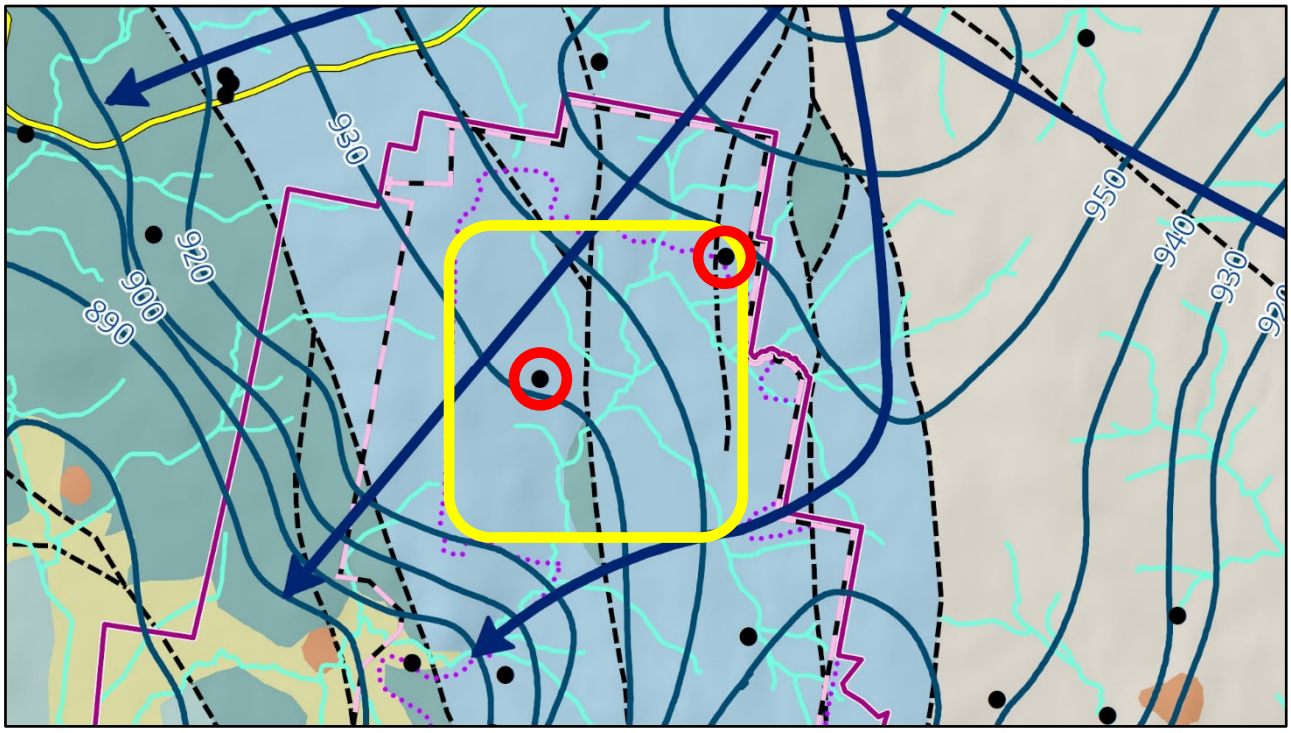

Figure 4: Extract of known groundwater bores assessed for the McPhillamy's Project (extracted from Figure 3.17, Appendix K to the EIS; EMM, 2019b) in the immediate TSF area (approximated by the yellow outline) with the only two groundwater bores highlighted in red circles (author's emphasis) (a similar view of groundwater bores can also be seen in Figure 4.1)

b. The lack of detailed location-specific groundwater data also leaves uncertainty with respect to the proposed TSF, especially local permeability and lithology variations, geotechnical characteristics, seepage risks, etc. Such detailed investigations should be completed before any final assessment and potential approval of the TSF (especially the 'liner').

c. The minimal baseline groundwater information and data around the TSF is acknowledged by EMM (2019b) on section 7.3, Appendix K (page 214) – to quote the section itself (authors' emphasis):

"Additional baseline monitoring and assessments are proposed to provide additional understanding of baseline surface water-groundwater interactions (groundwater interaction with springs and Belubula River) and additional baseline data in the TSF and waste emplacement areas." *(page 214)*

Springs and Seeps

11) It is good to see acknowledgement of springs and seeps as important ecological, cultural and groundwater-dependent features (section 4.7.2, Appendix K, EMM, 2019b). The assessment represents a reasonably detailed effort to understand risks to springs and seeps from the McPhillamy's project, but my concerns remain:
    a. Time dependency remains poorly understood – that is, how variable are spring flows or seep areas over time? to what extent are they influenced by variations in climate (i.e., droughts / floods)?
    b. Further to (i), there are no assessments of areal extent of springs and seeps over time. It has been known for many decades that the area of wetlands created by springs in the Great Artesian Basin are closely correlated to spring flow rates (e.g., Williams & Holmes, 1978; White & Lewis, 2011; Mudd & Currell, 2022). Why then was this not completed for the McPhillamy's EIS and associated studies?
    c. From Figure 4.28 (EMM, 2019b), the TSF would completely cover – and therefore make extinct – some 22 springs or seeps (i.e., only one appears to be completely outside the TSF footprint whilst another is right at the base of the northern embankment). It is difficult to conceive of ways in which the springs or seeps could be remediated after being smothered by 60 Mt of tailings. The only precedent I am aware of is in the Witwatersrand Basin around Johannesburg, South Africa, where they are reprocessing gold mine tailings formerly dumped in low-lying wetland features – the objective is to remove the tailings, remediate acid and metalliferous drainage and restore the wetlands. The work (to my knowledge) is still underway and many years away from being completed, so no conclusions can be drawn regarding efficacy as yet.
    d. Overall, based on my experience, I believe that such direct impacts on recognised springs would be incompatible with the Australian and global mining industry's modern approach to incorporating sustainable development considerations to new mining projects (e.g., see the Minerals Council of Australia's 'Water Accounting Framework 2.0', MCA, 2022; also the International Council on Mining and Metals' approach, ICMM, 2023).

Groundwater Monitoring

12) At present the proposed approach to groundwater monitoring is objective and risk driven only with no specific locations or sampling regime presented or discussed in Sections 7.1 to 7.4. This lack of detailed monitoring seems to me to be a major oversight – how will seepage impacts from the TSF be monitored? how many bores and where? how does the monitoring allow processes to be identified, such as climate variability, flow paths, water quality impacts and mining-induced changes, to be discerned?

Mine Closure and Rehabilitation

13) Similarly to groundwater monitoring, the proposed approach to mine closure and rehabilitation is objective and risk driven only – in other words, almost entirely qualitative. Despite the plethora of criteria, objectives, aspects and regulatory requirements, virtually no quantitative criteria are provided – effectively leaving such matters to be determined in the distant future as the mine approaches this stage. My concerns remain:
    a. Quantitative criteria need to be set now for a variety of aspects, such as springs, the Belubula River, revegetation, ecological productivity, water quality, erosion, and the like.
    b. No consideration at all has been given to removing the tailings from the TSF and emplacing them deep within the former void – as I outlined in points 9 and 10 above. I fundamentally believe that such an approach would vastly reduce the long-term risks and liabilities associated with tailings from the (proposed) McPhillamy's gold project. As explained above, there are strong industry precedents for such an approach:
        i. Woodcutters lead-zinc-silver mine, NT – after closure in 1999, site rehabilitation involved removing the tailings from the TSF and emplacing them in the former pit. Perhaps most importantly, this was proposed by the site despite no legal requirement to do so – principally to reduce long-term acid drainage risks.
        ii. McArthur River lead-zinc-silver mine, NT – despite fundamental, severe mistakes in assessing acid drainage risks at the site (based on the authors' detailed knowledge of the mine, its environmental assessment and operating history), current plans call for tailings to be reprocessed after site closure in the 2030s and emplaced in the former pit – again to reduce long-term acid drainage risks.
        iii. Cadia Valley gold-copper-silver-molybdenum mine, NSW – after the TSF failure of March 2018, tailings are now discharged to the former Cadia Hill pit, demonstrating industry and regulator acceptance of in-pit tailings.
        iv. Fosterville gold mine, VIC – as mining has moved underground, most of the former pits have been used for tailings disposal and management.
        v. Overall, I firmly believe that final in-pit management of tailings would vastly reduce the perpetual risks from McPhillamy's tailings.
    c. There appears to be no recognition of the need to fund long-term site monitoring, assessment and maintenance for decades beyond closure and rehabilitation. Whilst a rehabilitation bond is required in modern mining, this almost always only covers the immediate works required to complete site rehabilitation and rarely involves anything but minimal budgets for short-term environmental monitoring. In my experience, I am yet to see a mining rehabilitation project which has provided funds for decades of environmental monitoring, assessment and maintenance. Given the long-term risks of leaving potentially acid-forming tailings above ground within a TSF in a changing climate within the headwaters of the Belubula River, the funding requirements for such monitoring, assessment and maintenance would be very substantial – and they should not be borne by the local environment, farmers and local community. The lack of long-term funding for environmental monitoring of mine rehabilitation is a systemic challenge for the industry and governments – yet it remains crucial to address for improved social licence (noting it is crucial but does not guarantee social acceptance of mining in and of itself) as well as ensuring long-term mine rehabilitation success.

d. Climate Change – the assessment of climate change risks are very minimal and lack substantial quantitative details. For example, what do the various scenarios for future climate suggest with respect to groundwater recharge? how will declining rainfall but increasing potential evapotranspiration affect water balance and infiltration into and through the TSF? how will climate change affect the potential generation of acidic drainages from the TSF or waste rock dump? how will climate change affect surface water-groundwater interaction after the project – especially the flows expected in the Belubula River or springs and seeps? how is uncertainty accounted for with respect to sequences of extreme droughts and floods – which are arguably already a reality in the region given recent climatic behaviour?

Key Summary Points

14) Tailings –

a. More extensive monitoring points are required for wall stability as well as seepage impacts to groundwater.

b. whilst seepage is likely to be modest, the lack of groundwater data and studies in the TSF footprint and nearby remains a stark gap which must be addressed before final designs and potential approvals are given on the proposed TSF.

c. Final rehabilitation must adopt in-pit tailings placement as the end goal, thereby removing the TSF as an effectively perpetual risk to monitor and manage for the future.

d. Climate change risks to the TSF during operations need to be better quantified and assessed, with the level of rigour at present insufficient to address legitimate community concern.

15) **Springs –** the proposed TSF would permanently destroy the known springs and seeps in the TSF footprint, with deep concerns remaining about those just outside this area.

16) **Mine Closure & Rehabilitation –** considerably more details are required to inform and quantify the closure of the proposed McPhillamy's gold project. **The use of final in-pit tailings placement must be mandatory** given the long-term seepage and acidic and/or metalliferous drainage (AMD) risks from the TSF if left above ground after site closure and rehabilitation. Proposed rehabilitation will need to assess the risks fo climate change in much greater detail than has been done at present, especially with respect to hydrology and changes in rainfall, evapotranspiration and groundwater-surface water interactions.

Signed
(electronically)

15 February 2023

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Appendix A

Expert Brief

Environmental Defenders Office

18 January 2022

Dr Gavin Mudd
Associate Professor
Environmental Engineering
RMIT University

By email only: [redacted]

CONFIDENTIAL AND PRIVILEGED

Dear Associate Professor Mudd

Brief to expert – McPhillamys Gold Project (SSD 9505): Independent Planning Commission (IPC) public hearing

1. We act for the Belubula Headwater Protection Group (**BHPG**) in relation to the McPhillamys Gold Project (**Project**). The BHPG is a large community organisation, representing members who reside in the area of the proposed Project, including local farmers and Aboriginal people. Our client and its constituent members strongly oppose the Project due to the impacts on the environment, Aboriginal cultural heritage and the broader social and economic fabric of the local community.

2. The Project has previously been on public exhibition through an Environmental Impact Statement Review process between 12 September 2019 and 24 October 2019. As a consequence of the assessment undertaken to date, the proponent has amended the Project three times. On 17 November 2022 the Department of Planning and Environment (**Department**) published its assessment of the Project and recommended that the Project be approved. The Project has now been referred to the Independent Planning Commission (**IPC**) for determination.

3. Our client wishes to engage you to review the environmental assessment of the Project, conducted by the proponent Regis Resources Limited (**Regis**), and prepare an expert opinion on the appropriateness and adequacy of the assessment within your area of expertise.

Duty to act as an impartial expert

4. We note as a preliminary matter that our primary purpose in briefing you to prepare your report is to provide independent expert advice in your area of expertise. We do not ask you to be an advocate for our client. You are requested to prepare an independent report that is clear and well-written.

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5. In this respect, we draw your attention to Division 2 of Part 31 of the *Uniform Civil Procedure Rules 2005* (**UCPR**), and the Expert Witness Code of Conduct (**Code of Conduct**) contained in Schedule 7 of the UCPR, both of which govern the use of expert evidence in NSW Courts. We understand that the IPC public hearing is not a Court proceeding, however, we are of the view that the Code of Conduct should be adhered to in this instance.

6. In particular, we note that clause 2 of the Code of Conduct states that:

> *An expert witness is not an advocate for a party and has a paramount duty, overriding any duty to the party to the proceedings or other person retaining the expert witness, to assist the Court impartially on matters relevant to the area of expertise of the witness.*

7. Please read these documents carefully before you commence the work requested. Please include in your expert report an acknowledgment that you have read the Code of Conduct and that you agree to be bound by it.

Scope of your expert report

8. We request that you undertake the following work:

   a. review the documents listed below at [13]-[15];
   b. prepare a written expert report that addresses the issues identified below ('Expert Opinion Sought' at [17]-[18]) and ensure that the work is prepared in accordance with Division 2 of Part 31 of the UCPR and the Expert Evidence Practice Note; and
   c. appear as an expert witness at the IPC public hearing for the purpose of giving evidence. Appearing at the IPC public hearing may be done via video link.

9. You will be required to register to speak at the IPC hearing, for a 15-minute timeslot. The online speaker registration form can be accessed here - IPC Hearing Registration to Speak. Please let us know once you have registered.

10. Our client intends to attach a copy of your expert advice to their own submission to the IPC.

11. Your expert report will be used as evidence in chief of your professional opinion. In providing your opinion you must set out all the assumptions upon which the opinion is based.

12. Your expert report must also set out the process of reasoning which you have undertaken in order to arrive at your conclusions. It is insufficient for an expert report to simply state an opinion or conclusion reached without an explanation as to how this was arrived at. The purpose of providing such assumptions and reasoning is to enable decision makers to make an assessment as to the soundness of your opinion.

Documents

13. Division 2 of Part 31 of the UCPR is available via the following link: https://legislation.nsw.gov.au/view/html/inforce/current/sl-2005-0418#pt.31-div.2. The Expert Code of Conduct contained at schedule 7 of the UCPR is available via the following link: https://legislation.nsw.gov.au/view/html/inforce/current/sl-2005-0418#sch.7.

14. Full Project documentation is available at the following website: NSW Government Planning Portal: https://pp.planningportal.nsw.gov.au/major-projects/projects/mcphillamys-gold-project

15. The following documents relating to the Project are provided for your consideration.

Environmental Impact Statement

a. Executive Summary
b. McPhillamys EIS Main Report
c. Appendix D - TSF Definitive Feasibility Study
d. Appendix F - TSF Risk Assessment
e. Appendix H - Soils (Mine site)
f. Appendix R - Mine Preliminary Hazard Analysis
g. Appendix U - Rehabilitation
h. Appendix X - Pipeline Water
i. Appendix CC - Cyanide Utilisation

Response to Submissions

a. Submissions Report
b. Appendix C – SW and GW Interaction
c. Appendix F – Response to DPIE Hazards
d. Appendix G – Tailings Disposal Options
e. Appendix H – Gold Processing Options

Amendments

a. 1st Amendment Report
b. 1st Amendment – Appendix D – Tailings Storage Facility (Sep 2020)
c. 1st Amendment – Appendix E – Soils (Sep 2020)
d. 1st Amendment – Appendix T – Rehabilitation and Closure (Sep 2020)
e. 2nd Amendment Report

f. 3rd Amendment Report

Agency Advice

a. Dams Safety – Advice on EIS
b. Dams Safety – Advice on RTS & 1st Amendment
c. DPE Hazards – Advice on EIS
d. EPA – Advice on EIS
e. EPA – Advice on RTS & 1st Amendment
f. EPA – Advice on Response to Advice on 1st Amendment

Additional Information from the proponent

a. Regis Response – Pipeline Land Contamination Assessment

Department's Assessment

b. Assessment Report
c. Appendix E – Recommended Conditions of Consent

16. In 2019, our client engaged an environmental engineer Emmet O'Loughlin to review the EIS while it was on public exhibition. Mr O'Loughlin provided the **enclosed** report, for your information. Unfortunately, Mr O'Loughlin, is no longer able to review the material. The concerns outlined in Mr O'Loughlin's report do not appear to have been addressed by the proponent.

Expert opinion sought

17. Please prepare an expert report that addresses the following:

    a. In your opinion, is the assessment of environmental impacts from the Project's Tailings Storage Facility, as far as it relates to your areas of expertise, appropriate and sufficient?
    b. In your opinion, are the mine rehabilitation measures, as far as it relates to your areas of expertise, appropriate and sufficient?
    c. What, if any, concerns do you have about the environmental impacts of the Project, bearing in mind the mitigation measures proposed?
    d. Provide any further observations or opinions, as far as it relates to your areas of expertise, which you consider to be relevant.

18. We request that you provide us with a draft of your report for review before finalising it. The purpose of this is not to influence the conclusions or recommendations you make but to ensure that the report is clear and addresses the issues adequately to inform the IPC.

Key dates

19. As you know, the public hearing for the Project was scheduled to be held in December 2022. However, due to tragic circumstances that hearing was cancelled. The new IPC hearing for the Project will now be held on **Monday to Wednesday 6-8 February 2023**. The IPC has indicated that it will except new registrations for speakers. It has not set a deadline for new speaker requests. However, we would be grateful if you could please let us know at your earliest convenience if you are available to appear at the public hearing.

20. The deadline for making a written submission to the IPC is **5pm AEDT on 15 February 2023**. To allow our client sufficient time to complete their own submission, we would appreciate receiving your advice by **31 January 2023**.

Duty of confidentiality

21. Please treat your work as strictly confidential until your expert report is provided to the IPC, unless authorised by us.

Fees and terms

22. Thank you for agreeing to provide your advice at a rate of $500 per day and capped at $2,500 (inclusive of GST). As a not-for-profit environmental legal centre, EDO relies on the support of experts such as yourself in ensuring that the community is able to obtain independent scientific advice on environmental issues.

23. We note that you are yet to confirm whether this fee includes your appearance at the IPC hearing. Please let us know in writing as soon as practicable whether you will require an additional fee for your appearance as we will need to seek our client's instructions before committing to any additional fees.

24. Please note the following terms:

    a. Your work will only be used by EDO in relation to the above matter, unless your consent is obtained first;

    b. Our client may choose to make your expert report publicly available. Your report will also be publicly released by the IPC on the IPC's website;

    c. EDO will take all reasonable steps to prevent your work from being used for purposes other than that mentioned above, but we accept no responsibility for the actions of third parties and note that your report may be disclosed by the *Government Information (Public Access) Act 2009* (NSW) (akin to a "freedom of information" request);

    d. Regardless of the above points, EDO may choose not to use your work; and

e. You will not be covered by the EDO's insurance while undertaking the above tasks.

25. If you require any further assistance, please call or email either myself [redacted], or Sharyn Goldstien, Scientific Officer [redacted] or [redacted]).

26. We are grateful for your assistance in this matter.

Yours sincerely
Environmental Defenders Office

[redacted]

Nadja Zimmerman
Solicitor
Our ref: S493

Appendix B

Short Form CV

Assoc. Prof. Gavin M. Mudd

Curriculum Vitae (short form): June 2022

Current Position

Associate Professor – Environmental Engineering
School of Engineering, *RMIT University*, Melbourne, VIC, Australia
Ph +61-3-9925-3209 Mobile +61-419-117-494 Email: Gavin.Mudd@rmit.edu.au

Qualifications

Doctorate (PhD) *Victoria University*, Melbourne, Australia (awarded Oct. 2001)
B. Env. Eng. (Hons) *RMIT University*, Melbourne, Australia (awarded May 1995)

Current and Previous Appointments

- January 2017 to present – **Associate Professor in Environmental Engineering**, *School of Engineering*, *RMIT University*, including teaching, research and administration.
- May 2003 to January 2017 – **Assistant Lecturer / Lecturer / Senior Lecturer / Course Director in Environmental Engineering**, *Dept. of Civil Eng*, *Monash University*, including teaching, research and administration.
- Nov. 2009 to Feb. 2010 – **Visiting Fellow**, Institute of Environmental Studies, Uni. of New South Wales, Sydney
- July to Oct. 2009 – **Visiting Fellow**, Dept of Civil & Environmental Eng, University of Auckland, New Zealand
- Approximately 20 months **consulting experience** - contaminated sites, environmental assessment, groundwater, solute transport and unsaturated flow modelling, laboratory testing of mine wastes, liaison with government and industry organisations, working with and for Aboriginal people.
- July 2000 to April 2002 - **Research Fellow in Mine Waste Hydrology**, *Dept. of Civil Eng*, *University of Queensland*.
- March to July 1998 (Semester One) - **Lecturer in Earth Sciences/Geomechanics**, Victoria Uni.
- March 1995 to June 2000 - **PhD Research** - groundwater impacts and management of coal ash disposal.

Research Interests & Performance (as of 21 June 2022)

- **Global Top 2% of Scientists:** Ranked in top 2% of scientists globally according to Elsevier Citation Metrics (v3[1]).
- **H-index: Scopus** – **41**; 4,974 total citations (109 doc's); **Google Scholar** – **52**; 9,203 total citations (276 doc's).
- **Edited Books** – **1** edited conference proceedings (SSEE 2009 Conf., Melbourne, Australia, Nov. 2009).
- **Book & Encyclopaedia Chapters** – **34** edited book and encyclopaedia chapters.
- **Journals** – **90** journal papers (~95% ISI listed journals).
- **Major Research Reports and Handbooks** – **40** research and technical reports and contributions to industry, government and academic institutions and community handbooks.
- **Conference Papers – 56** peer-reviewed and **110** non-peer reviewed papers and/or presentations.
- **Sustainable Mining** – environmental impacts, geochemistry, leachability & management of mine wastes, acid mine drainage, sustainable resource management; commodities include uranium, gold, nickel, copper, lead-zinc-silver, platinum group elements, iron ore, cobalt, rare earth elements, critical and specialty metals (such as indium, rhenium, molybdenum), lithium, coal, oil and gas.
- **Industrial Ecology** – life cycle assessments, environmental impact assessment, material flow analyses.
- **Hydrogeology & Groundwater Resources** – groundwater management & sustainability, groundwater impacts from mining, geochemistry, flow and solute transport modelling, vadose (unsaturated) zone issues.

Selected Recent Publications

1. **Mudd, G M**, 2021, *Assessing the Availability of Global Metals and Minerals for the Sustainable Century: From Aluminium to Zirconium*. **Sustainability**, 13, DOI: 10.3390/su131910855, 20 p.
2. **Mudd, G M**, 2020, *The Resources Cycle: Key Sustainability Issues for the Mining of Metals and Minerals*. In "Encyclopedia of Geology", Editor L A Robb, Elsevier, Netherlands, Vol. 5, pp 607-620.
3. **Mudd, G M**, 2020, *Sustainable/Responsible Mining and Ethical Issues Related to the Sustainable Development Goals (SDGs)*. In "Geoethics: Status and Future Perspectives", Editors G Di Capua, P T Bobrowsky, S W Kieffer, C Palinkas, Geological Society of London, UK, In Press.
4. **Mudd, G M**, Roche, C, Northey, S A, Jowitt, S M & Gamato, G, 2020, *Mining in Papua New Guinea: A Complex Story of Trends, Impacts and Governance*. **Science of the Total Environment**, 741, 140375, 19 p.
5. **Mudd, G M**, 2018, *Material Criticality Assessment and Resource Nexus Analysis*. In "Routledge Handbook of the Resource Nexus", Editors R Bleischwitz, Hoff, H, Spataru, C, van der Voet, E and van Deveer, S, Routledge, Oxon, UK, pp 129-148.

[1]Elsevier BV, August 2021 Data-Update for "Updated Science-Wide Author Databases of Standardized Citation Indicators". https://elsevier.digitalcommonsdata.com/datasets/btchxktzyw/3 (Accessed 31 Dec. 2021).

6. **Mudd, G M**, Jowitt, S M & Werner, T T, 2018, *Global Platinum Group Element Resources – A Critical Assessment*. **Science of the Total Environment**, 622-623, pp 614-625.
7. **Mudd, G M** & Jowitt, S M, 2018, *Growing Global Copper Resources, Reserves and Production: Discovery is Not the Only Control on Supply*. **Economic Geology**, 113 (6), pp 1235-1267.
8. Werner, T T, Ciacci, L, **Mudd, G M**, Reck, B K & Northey, S A, 2018, *Looking Down Under for a Circular Economy of Indium*. **Environmental Science & Technology**, 52 (4), pp 2055-2062.
9. Northey, S A, **Mudd, G M**, Werner, T T, Haque, N, Jowitt, S M, Weng, Z & Yellishetty, M, 2017, *The Exposure of Global Base Metal Resources to Water Criticality, Scarcity and Climate Change*. **Global Environmental Change**, 44, pp 109-124.
10. Werner, T T, Jowitt, S M & **Mudd, G M**, 2017, *The World's By-Product and Critical Metal Resources Part III: A Global Assessment of Indium*. **Ore Geology Reviews**, 86, pp 939-956.
11. **Mudd, G M**, Jowitt, S M & Werner, T T, 2017, *The World's By-Product and Critical Metal Resources Part I: Uncertainties, Current Reporting Practices, Implications and Grounds for Optimism*. **Ore Geology Reviews**, 86, pp 924-938.
12. Weng, Z, Haque, N, **Mudd, G M** & Jowitt, S M, 2016, *Assessing the Energy Requirements and Global Warming Potential of the Production of Rare Earth Elements*. **Journal of Cleaner Production**, 139, pp 1282-1297.
13. Weng, Z, Jowitt, S M, **Mudd, G M** & Haque, N, 2015, *A Detailed Assessment of Global Rare Earth Resources: Opportunities and Challenges*. **Economic Geology**, 110 (8), pp 1925-1952.
14. **Mudd, G M**, Weng, Z, Jowitt, S M, Turnbull, I D & Graedel, T E, 2013, *Quantifying the Recoverable Resources of By-Product Metals: The Case of Cobalt*. **Ore Geology Reviews**, 55, pp 87-98.
15. Prior, T, Giurco, D, **Mudd, G M** & Behrisch, J, 2012, *Resource Depletion, Peak Minerals and the Implications for Sustainable Resource Management*. **Global Environmental Change**, 22 (3), pp 577-587.
16. van der Voet, E, Salminen, R, Eckelman, M, Norgate, T, **Mudd, G M**, Hischier, R, Spijker, J, Vijver, M, Selinus, O, Posthuma, L, de Zwart, D, van de Meent, D, Reuter, M, Tikana, L, Valdivia, S, Wäger, P, Hauschild, M & de Koning, A, 2013, *Environmental Challenges of Anthropogenic Metals Flows and Cycles*. Working Group Metals, **UNEP International Resources Panel**, April 2013, 234 p.

Research Awards

- **Mann Redmayne Award for best paper published in Applied Earth Sciences (2015)**, Joint Australasian Institute of Metallurgy (AusIMM) and Institute of Materials, Minerals and Mining (IoM3) journal
- **Most-cited paper in Resources Policy (2009-2013) by Elsevier in 2014 (for my 2010 paper in Res. Pol.)**

Major Research Grants & Involvement (Recent and Current)

- **Geoscience Australia** – major research project sampling tailings around south-east Australia to assess the potential for critical minerals *(March 2022 to June 2023)*
- **Geoscience Australia** – major research project mapping Australia's mine wastes and their potential for reprocessing for critical metals *(October 2021 to June 2024)*
- **International Round Table on Materials Criticality** – Expert Partner, project aims to develop an international research network on critical materials *(July 2017 to June 2024)*
- **Geoscience Australia** – major research project exploring Australia's potential endowment of critical metals and validating cost models for mining *(June 2018 to June 2019)*
- **International Copper / Nickel / Lead-Zinc Study Groups** – research project examining trends in mine wastes, management policies and economic costs and opportunities *(January to July 2018)*
- **Columbia Water Center, Columbia University** – research project to synthesize detailed water use data for mining to link to life cycle assessment and financial performance of mining companies. *(July to December 2017)*
- **Netherlands Environmental Assessment Agency (PBL)** – research project to map global mineral resources and mining against biodiversity. *(July to December 2017)*
- **CSIRO Wealth From Waste Cluster** – joint CSIRO-university initiative, led by Institute for Sustainable Futures at University of Technology Sydney (UTS), the project is exploring the concept of material flows from mineral resources to products through to recycling and related issues. Monash University was a major cluster partner, along with Yale University, University of Queensland and Swinburne University. *(Project completed, 2013-2016)*
- **CSIRO Minerals Futures Cluster** – joint CSIRO-university initiative, led by Institute for Sustainable Futures at UTS, with my involvement through Monash helping to explore the concept of 'peak minerals' and related environmental issues in the mining industry. *(Project completed, 2009-2012)*
- **Others** – Institute for Sustainable Water Resources (2004-2008); Facility for Advancing Water Biofiltration (2007-2009); eWater CRC (2006-2009)

Teaching Awards

- **2019 ROSE Award – Recognition of Outstanding Student Experience**, RMIT University
- **Department of Civil Engineering's Award for Excellence in Teaching (2012)**, Monash University
- **Faculty of Engineering Dean's Award for Excellence in Teaching (2012)**, Monash University
- **Vice Chancellor's Citation for Outstanding Contribution to Student Learning (2011)**, Monash University

Post-Graduate Research Supervision

- **6 PhD students and 2 Masters** completed as principal supervisor, **4 PhD students** completed as co-supervisor
- Presently 1 PhD student as principal supervisor and 1 PhD student as co-supervisor.

Teaching Interests

- Environmental Impact Assessment (EIA), Environmental Risk Management, Groundwater Management.
- Sustainable Engineering and Industrial Ecology (tools such as life cycle assessment, material flow analysis).
- **Environmental Engineering** – Environmental Engineering, Groundwater & Hydrogeology, Environmental Impact Assessment & Management, Environmental Risk Assessment, Environmental Policy, Final Year Research Projects.
- **Guest Lectures** – Geography, Environmental Science, Civil Engineering, Mining Engineering.

University Administration

- **Course Director – Environmental Engineering** (Monash University)
- **University** – Environmental Sustainability Stakeholder Committee
- **Faculty of Engineering – Academic Progress Committee (APC)**

External Committees

- **Present** (September 2009 to present) – **Alligator Rivers Region Technical Committee (ARRTC)**, environment representative, national committee overseeing research on environmental aspects of uranium mining in the Alligator Rivers Region of the Northern Territory. ARRTC is a statutory committee of the Australian Government and membership is government-appointed based on relevant scientific expertise.
- **Prior** (Nov 2006 to Nov 2010) – **Society for Sustainability and Environmental Engineering (SSEE; Victorian Branch)** – Victorian committee of national society, part of Engineers Australia (SSEE is now the Sustainable Engineering Society or SEng).
- **Prior** (May 2004 to Dec 2006) – **Great Artesian Basin Co-ordinating Committee (GABCC)** – national inter-governmental committee for oversight of groundwater management of the GAB. The GABCC is a statutory committee of the Australian Government and membership is government-appointed based on relevant expertise.

External Consulting & Community Engagement

- **General Mining** – as requested, providing technical advice on environmental issues and mining (e.g. gold mining in WA, Indonesia, New Zealand and Papua New Guinea; copper heap leaching; mineral sands mining; existing and proposed coal mining; coal seam gas; mining legacies and lack of mine rehabilitation, etc.).
- **Uranium Mining** – pro-active role in providing detailed technical review and advice on uranium mining issues in the Kakadu National Park world heritage area (Ranger, Jabiluka), and globally (e.g. Malawi, USA, Canada).
- **Mineral Policy Institute (MPi)** – Chair of the Board (2010-present). MPi is the only Australian non-government organisation dedicated to research and advocacy on the environmental and social issues around the mining industry. MPi's work includes projects in Papua New Guinea, Malawi, Australia, New Caledonia and others, covering issues such as deep sea mining, mine waste management, corporate governance and accountability, community empowerment and development, mining legacies, and related aspects of modern mining.
- **Groundwater** – technical advice on groundwater chemistry and impacts from mining or other sites (e.g. coal seam gas), groundwater resources and management.
- **Environmental Impact Assessment** – providing technical advice on EIA processes, critiquing EIS's, links to environmental management systems and environmental regulation.
- **Community Seminars** – I have always maintained a strong community engagement, presenting regularly at community seminars, workshops and conferences, with a major focus in recent years being the groundwater and environmental issues involved with unconventional gas developments (e.g. 2013 I gave ~25 community talks).

Professional Memberships

Current:	• Society of Economic Geologists (**SEG**)	
Former:	• Sustainable Engineering Society (**SEng**) • International Association of Hydrogeologists (**IAH**) • Australian Mining History Association (**AMHA**)	• Australasian Institute of Mining & Metallurgy (**AusIMM**) • International Society for Industrial Ecology (**ISIE**)