Queensland's open-cut coal mine void rehabilitation planning practices: challenges and opportunities

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INTRODUCTION

Thermal and metallurgical coal mining in Queensland has resulted in mines which contain voids due to open-cut mining. While there are several proposals for greenfield coal mines or expansions to existing operations, many existing open-cut coal mines are reaching maturity and most will leave one or more residual voids in place.

The rehabilitation of mine voids is challenging. Water held in voids will evaporate over time leaving solutes to concentrate. This is likely to lead to poor water quality with limited practical use. The most basic practices to rehabilitate voids have historically involved stabilising the high and low walls, bunding to provide flood protection, and preventing public access.

Regulatory reforms for mine rehabilitation were introduced in Queensland as part of the *Mineral and Energy Resources (Financial Provisioning) Act 2018*, and aimed to strengthen progressive rehabilitation planning, limit risks to the environment and improve outcomes for local and regional communities. Under the reforms, the goal for rehabilitation of voids is to achieve a safe, stable, and non-polluting landform, which can sustain a post-mining land use (PMLU). The reforms also introduced a requirement to describe rehabilitation of mined land in Progressive Rehabilitation and Closure (PRC) plans, replacing the description of such plans in Environmental Authorities (EAs). The reforms are not retrospective and recognise historic approvals for voids, meaning established voids will remain in the landscape as non-use management areas (NUMAs). The objectives of this study were to outline historic void rehabilitation planning practices, describe water quality limitations of Queensland mine voids and identify possible opportunities for improved planning.

PLANNING AND WATER QUALITY OF ESTABLISHED RESIDUAL VOIDS

To understand rehabilitation planning for open-cut coal mine voids in Queensland, proposed PMLUs for voids in EAs were examined. Briefly, a dataset which collated EAs (Coffey Services Australia Pty Ltd, 2021) was reanalysed, exploring counts and surface areas of open-cut coal voids of the Fitzroy Basin and their PMLUs. Both analyses of counts and surface area found that uses for most voids were either not specified in approvals or to be specified in future plans (Figure 1). Broad descriptions for a use such as ‘water storage’ and ‘water filled’ were often listed but do not represent a clear future use.

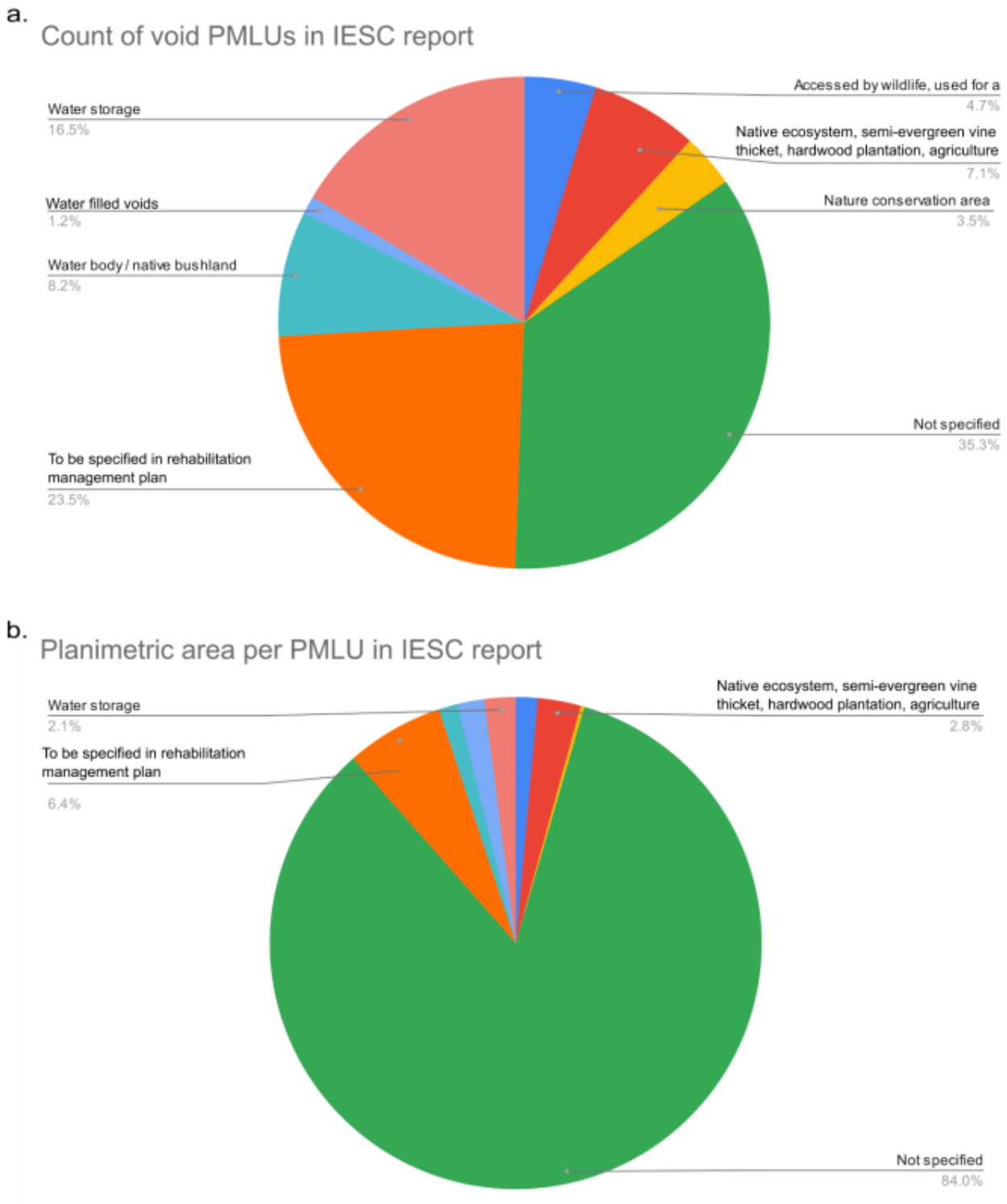

Figure 1. a) Counts and b) surface area of Post Mining Land Uses (PMLUs) assigned to 85 open-cut coal voids of the Fitzroy Basin as reported in Coffey Services Australia Pty Ltd (2021)

To examine whether existing water filled voids could host a use, water quality for a suite of variables was compared to a range of use-related guidelines. Publicly available data was retrieved for 12 voids, and compared their water quality across a suite of variables that were highlighted in the literature (Jones et al., 2019). Elevated salinity is one of the factors likely to limit PMLUs for many voids within the Fitzroy Basin (Figure 2), with six of the 12 voids containing salinity at levels unsuitable for livestock watering. Accordingly, elevated salinity is likely to limit this PMLU for those voids. Copper, aluminium, and sulfate levels in these voids also showed levels likely to prohibit use. The dataset analysed was highly limited by the number of voids and dates of monitoring data (spanning seven years when voids are expected to persist in the environment in perpetuity). Nonetheless, the monitoring data indicates a trend towards increased salinity, likely due to evapo-

concentration, and highlights that it is unlikely that water-filled voids will be able to provide water for agriculture or native aquatic ecosystems without treatment.

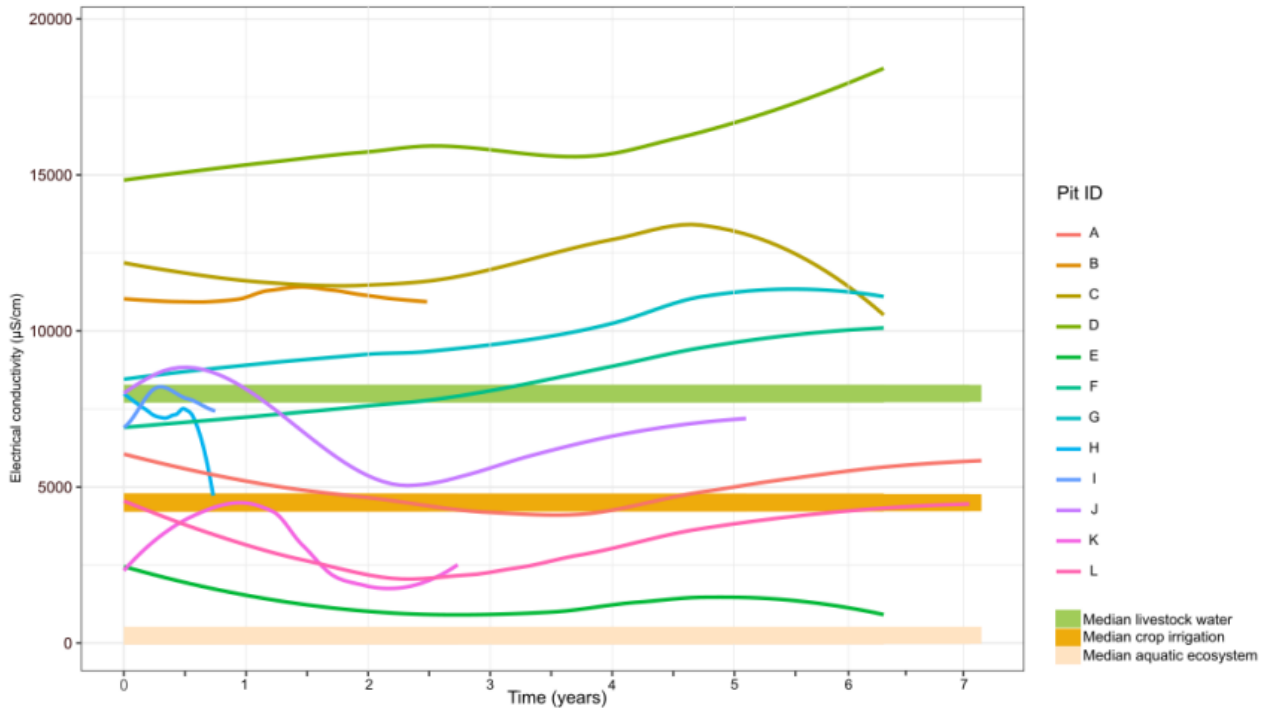

Figure 2. Electrical conductivity (µS/cm) for 12 open-cut coal voids in the Fitzroy Basin compared with use related water quality guidelines (ANZECC & ARMCANZ, 2000; DEHP, 2011; DES, 2017)

CURRENT VOID PLANNING IN PRC PLANS

To understand how mine voids in the Fitzroy Basin are currently being planned for, the counts and surface area of proposed PMLUs for voids in PRC plans were examined. Analysis of PRC plans of nine mines showed that 29 voids are expected to be created during life of mine. Twelve of these are planned to be backfilled (to grazing, 11; to native habitat, one), 16 will be NUMAs, and one is proposed to have a PMLU of "water management". Although PRC plans have only been completed for a limited number of sites, more are being submitted and approved over time, and will subsequently be analysed for this project.

LOOKING FORWARD: CHALLENGES AND OPPORTUNITIES FOR GREENFIELD OPEN-CUT COAL MINES

Considering the evidence that water-filled voids in the Fitzroy Basin will likely accumulate water of poor quality, appropriate planning for PMLUs for voids in greenfield sites should clearly show how a use will be achieved. This may include a robust demonstration of water quality, through baseline surveys and modelling, and use viability planning. This may be additional to the *"evidence based comparison and justification for each proposed PMLU against alternative options"* (Queensland Government, 2021, p.21). Alternatives to water-filled void uses involve backfilling a void, which provides flexibility to achieve a range of PMLUs such as grazing or native ecosystems. Backfilling can also help to minimise risks associated with an open water body and avoid leaving an undesirable landform to the local community and future generations.

CONCLUSION

This study outlines a body of evidence which shows that many open-cut coal mines in Queensland have approved residual voids. These voids are likely to remain in the landscape and accumulate increasingly poor-quality water. The data analysed here shows that it will be difficult or costly to retrofit these voids for uses that are compliant in terms of water quality and would potentially involve ongoing water treatment. Our analysis of PRC plans shows increased clarity in planning for voids, although NUMAs have been proposed within those documents. Water-filled voids at greenfield sites

and new expansions require careful consideration given water quality limitations of extant residual voids. Resultingly, there is an opportunity for good planning that will not compromise regional water quality, will strive for leading practice rehabilitation and will benefit the local environment and communities.

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