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31 January 2023

SENT BY EMAIL

Mr Stephen Barry
Planning Director
Independent Planning Commission
Suite 15.02, 135 King Street
SYDNEY NSW 2000

Re: McPhillamys Gold Project (SSD 9505) – Questions on notice

This letter provides responses to the questions posed by the Independent Planning Commission (the Commission) in relation to the McPhillamys Gold Project (the project), during its meeting with Regis Resources Ltd (Regis) on 6 December 2022 and confirmed in writing on 15 December 2022.

1. Water supply

a) The documentation shows two dimensions for the pipeline diameter – would it be correct to assume that the larger diameter would allow for the most efficient pumping of water?

The pipe diameters vary over the length of the pipeline to manage pressures and velocities within each section. The varying diameters and their associated pressure classes have been specified by the third-party specialist [design] engineers, as part of the detailed design of the pipeline to prevent the pipes failing under the range of modelled events. This design has also been further verified through a third-party expert review process.

2. Salt balance

b) The decant water or water on top of the Tailing Storage Facility will become highly saline and – for example, at year 8 of operations – there would likely be some flow on impacts, such as limits to the rate of evaporation and operational impacts. Have these implications been taken into account?

A salt balance has been undertaken for the Tailings Storage Facility (TSF) by EMM to predict the levels of salinity in the water on top of the TSF over time. A memo describing the outcomes of this salt balance is attached to this letter, with the results summarised below in the answer to Question 2(c). As described below, the salt balance demonstrates that salinity in the TSF is anticipated to increase over time; however, it will remain brackish (ie at approximately 4,500 milligrams per litre (mg/L) total dissolved solids (TDS)) rather than becoming highly saline (greater than 10,000 mg/L TDS). The potential implications of this on evaporation and operational impacts are discussed below.

Evaporation

Evaporation from storage surfaces, and how this was accounted for in the water balance for the project, is described in Section 3.2.2.3 of the *Mine Development Revised Surface Water Assessment* (HEC 2020), prepared as part of the First Amendment Report. As described, daily pan evaporation (taken from McMahon et al. (2013) data for Canberra Airport (located 200 km south of the mine development)) was multiplied by a pan factor in the calculation of storage evaporation losses from water storage areas. A pan factor of 1.2 was used in the estimation of evaporation from wet tailings surfaces (due to the darker tailings surface).

In relation to the effect of salinity on evaporation, research in the Dead Sea has shown that at daily evaporation rates of around 10 mm/day (typical in Australia) water saturated with salt (357 g/L) will evaporate at around 65% of the rate of fresh water (Mor et al, 2018, https://doi.org/10.1002/2017WR021995). This recent finding aligns with the empirical curve published by Bonython, C. W. (1966) (see Figure 1). At moderate salinity (less than seawater salinity), evaporation may be reduced by between 1-3%.

Figure 1: Effect of salinity on evaporation rate (Bonython, 1966)

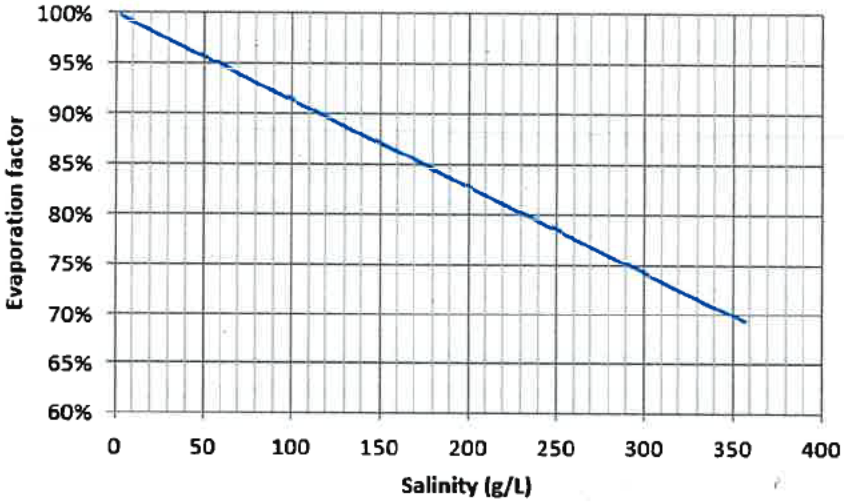

Table 1: Effect of salinity on evaporation rate (Bonython, 1966)

	g/L	Factor
Fresh	3	0.99742
Brackish	**5**	**0.9957**
Seawater	35	0.9699
2x seawater	70	0.9398
4x seawater	140	0.8796
Saturation	357	0.69298

As described in more detail in the answer to question 2(b) below, water quality in the TSF is predicted to remain brackish at < 4,500 mg/L TDS which, as shown by the factors in Table 1, would not materially affect the evaporation rate.

Further, as is the case for the project, mine site water balances use pan evaporation measurement or estimates produced by meteorological organisations such as the Bureau of Meteorology or SILO, multiplied by a factor (X in equation below) which is calibrated to account for sources of uncertainty in estimating evaporation from a TSF (such as, the water body surface area and the area of wet beach and evaporation from beach).

$E_{TSF} = X \, . \, E_{ClassAPan}$ *where X may be between 0.7-1.3*

Even if the input evaporation rate was adjusted down by say 2% to account for lake salinity, it would result in the calibration parameter increasing by a commensurate amount so that the observed water volume in and water volume out remain balanced.

Therefore, for the reasons described above, the salinity in the TSF is not expected to materially affect evaporation rates or the water balance.

Operational Impacts

In relation to operational impacts associated with saline water in the TSF, water salinity is not a restrictor for gold recovery. Hyper saline water, which is five or six times as saline as sea water, is used successfully in gold extraction circuits similar to the project in Western Australia. Given this, and that the salinity in the decant water from the TSF is predicted to remain well below 10,000 mg/L, there will be no operational impacts in the use of this water in processing operations.

c) Has a salt balance calculation been undertaken?

A salt balance has been undertaken for the TSF, with the results described in the memo attached and summarised below.

Water quality modelling, based on the site conceptual model and TSF water balance, was conducted on a range of scenarios to assess the effect of input salinity on the resultant TSF water quality. Scenarios looked at the effect of deposition of oxidised (weathered), transitional, and fresh tailings on the salinity of the TSF (represented by TDS), as well as the input of salt via the water from the pipeline development, which will be used in processing operations. As reported in the Submissions Report (EMM 2020a), the quality of water to be sourced and pumped to the mine site via the pipeline from Centennial's Angus Place, Springvale Coal Services and Mount Piper Power Station currently ranges from around 600 mg/L TDS to 7,000 mg/L, with a likely average of approximately 3,500 mg/L. Salt balance scenarios were therefore run using both the expected average and maximum TDS.

Further model scenarios were also conducted to 'stress' the model and account for the 'worst case' scenario, including the presence of fresh potentially acid forming (PAF) tailings and the maximum TDS of the pipeline water (7,000 mg/L).

The maximum value of TDS modelled in the TSF was similar across the scenarios, including the worst case, at approximately 4,500 mg/L. As described in Section 1.2.3 of the attached memo, this 'upper limit' of TDS is caused by two effects:

- total solid loads are moderated by dilution from direct rainfall events; and/or
- the total solid load in the TSF is solubility limited, with precipitation moderating the concentrations in the TSF water.

The model results show that a number of minerals are at or close to saturation in the TSF in the higher salinity scenarios. These include sulfates such as gypsum ($CaSO_4{:}2H_2O$), anhydrite ($CaSO_4$), and jarosite ($KFe_3(SO_4)2(OH)_6$), salt / halite ($NaCl$), and a number of iron oxides and oxy-hydroxides (eg goethite, $FeOOH$). As such, TDS may be moderated in the TSF by mineral precipitation.

The model scenarios therefore indicate that the water quality in the TSF is predicted to remain brackish (< 10,000 mg/L TDS) at < 4,500 mg/L TDS. This is noted to be greater than most baseline groundwater monitoring data (< 2,000 mg/L), although it is within the range of groundwater reported from the Anson Formation, which was noted at < 5,200 mg/L TDS[1].

3. Tailing Storage Facility design

d) Was a combination of TSF design methods considered?

Four alternative tailings disposal methods were considered by Regis for the Project, as described in Appendix G of the Submissions Report (EMM 2020a). Regis is of the view that combining different disposal methods (which would then determine TSF storage design):

- adds complexity to operations;
- would require different areas for disposal for different disposal methods;
- would have different outcomes on closure; and
- would require different (larger) footprints with potential increased impacts on other land uses (such as State Forests, agriculture and residences).

Numerous alternative locations were also considered, as well as a multiple (two) cell TSF within the same area of the proposed TSF location (a stepped down-valley arrangement was considered). A multiple-cell system was not proposed due to the following negative impacts of such an arrangement:

- Loss of spatial efficiency in a multiple-cell system which would therefore require significant additional disturbance area, construction materials and site imported infrastructure (pipelines, valving etc).
- Additional site-impacted water would need to be managed. This would include a greater stored volume of water and greater surface area for potential seepage (likely to be sited over different geological units and possibly within different catchment areas).
- Greater system complexity to be managed and maintained as a result of increases in pumping distances and heads, operating footprint and surveillance and inspection requirements.
- Additional closure/rehabilitation areas and potential additional disturbance for material borrows.

A single TSF in proximity to the process plant comprising downstream lifts in three stages was determined to be the best approach for the project.

It is noted that Professor David Williams was requested to undertake an independent expert technical review of the tailings design, operation and closure for the project in 2020.

Professor Williams is the author of the 2009 and 2016 *Tailings Management Handbook*, as part of the Commonwealth Leading Practice Sustainable Development program for the mining industry.

Professor Williams is internationally recognised for his expertise and experience in mine waste management and mine closure, particularly related to tailings dams. Professor Williams' expertise in this area is outlined in Appendix D of the Amendment Report (EMM 2020b).

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1 EMM (2020). McPhillamys Gold Project Amendment Report – Groundwater Assessment Addendum (Amendment Report Appendix H).

Professor Williams stated that:

> *Regis and their consultants are commended for having gone beyond leading practice in their very comprehensive Feasibility Study for the Tailings Storage Facility (TSF) of the McPhillamys Gold Project. Their approach has been to select the optimal upper catchment siting for the TSF, and the optimal disposal method for the site of thickened tailings.*

Professor Williams further considered that:

> *At the feasibility stage of the McPhillamys Gold Project, sub-aerial, thickened slurry tailings disposal was found to best meet the assessment criteria, which included water use, liner/seepage complexity, cyanide breakdown rate, acid and metalliferous drainage (AMD) risk, tailings stability, energy use, tailings footprint, location suitability, capital cost, and operating cost. Paste tailings are better suited to underground backfill, and the filtration of tailings is expensive, difficult to scale-up, technically difficult, and hence carries a high risk. Co-disposing filtered tailings and waste rock would require crushing of the waste rock to make it handleable, and would add to haulage, impacting the local community through extra traffic, noise and dust.*

The topography, climate, water availability (external pipeline) and upper catchment location favour the application of thickened tailings which will meet the overarching objective of the Project's rehabilitation strategy, which is to achieve a safe, stable and non-polluting post mining landform (refer to Appendix U of the EIS (EMM 2019), Appendix T of the Amendment Report (EMM 2020c) and section 5.9.1 of the Submissions Report (EMM 2020a)).

Combining alternative (sub-optimal) TSF design methods based on the site characteristics of were not considered for the Project.

If you require any further detail or wish to discuss the information provided, please do not hesitate to contact me via the details below.

Yours sincerely

Andrew Wannan
Approvals Manager
[redacted]

Attach: Memorandum – McPhillamys Gold Project Tailings storage facility salinity modelling

References

EMM Consulting 2019, *McPhillamys Gold Project Environmental Impact Statement*, Prepared for LFB Resources NL.

EMM Consulting 2020a, *McPhillamys Gold Project Submissions Report*, Prepared for LFB Resources NL.

- 2020b, *McPhillamys Gold Project Amendment Report*, Prepared for LFB Resources NL.

- 2020c, *McPhillamys Gold Project Rehabilitation and Landscape Management Strategy Addendum,* Prepared for LFB Resources NL.

Hydro Engineering & Consulting Pty Ltd (HEC) 2020, *McPhillamys Gold Project, Mine Development Revised Surface Water Assessment*, Prepared for EMM Consulting.

McMahon, T.A., Peel, M.C., Lowe, L., Srikanthan, R. & McVicar, T.R. 2013, *Estimating actual, potential, reference crop and pan evaporation using standard meteorological data: a pragmatic synthesis*, Hydrology and Earth System Sciences, vol. 17, pp. 1331-1363.