TECHNICAL MEMORANDUM

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PROJECT TITLE	Wirralie Gold Mine – PRCP		
SUBJECT	Response to RFI		
DATE	26 August 2024	OUR REF	2020.10003 - Version 1.0

1. Introduction

The Wirralie Gold Mine (the Project) is located ~30 km north Mount Coolon, ~200 km west of Mackay, North Queensland. The region is administered by the Whitsunday Regional Council and is in a primarily rural area. The main access route to the Project is via Rutherford Road and the Bowen or Suttor Developmental Roads.

The Project was discovered in 1986 while exploring to identify the source to a regional stream sediment sampling anomaly. Mining began at the Project in 1987 and continued until 1993, when the processing plant was relocated to the Yandan mine site, 30 km west. An upgraded 1.5 million tonne per annum treatment plant was reinstated at the Project in 1999. The plant treated low-grade oxide and Deep Lead mineralisation until early 2002, when the site was placed in care and maintenance.

Solomons Gold acquired the Project in December 2013 and since recommenced mining and processing operations.

1.1. Purpose

The purpose of this technical memorandum is to detail the methods and findings from erosion modelling of the proposed final landforms, including:

- Waste rock dumps (WRD 1, 2, 3 and rehabilitated former WRDs);
- Tailings storage facility (TSF);
- Former ROM.

2. Environmental context

2.1. Climate

The nearest Bureau of Meteorology weather station is ~85 km northeast of the Project at the Collinsville Post Office (Station ID: 033013) (BoM, 2024). The mean maximum temperature for the summer period (December to February) is 34 ^oC, and the mean minimum monthly temperature for winter is 10 ^oC. Mean annual rainfall for Collinsville is 700 mm with 52 days of rainfall ≤ 1 mm. Overall the areas' climate provides for a greater risk of rain acting as an erosive force during the distinct wet season.

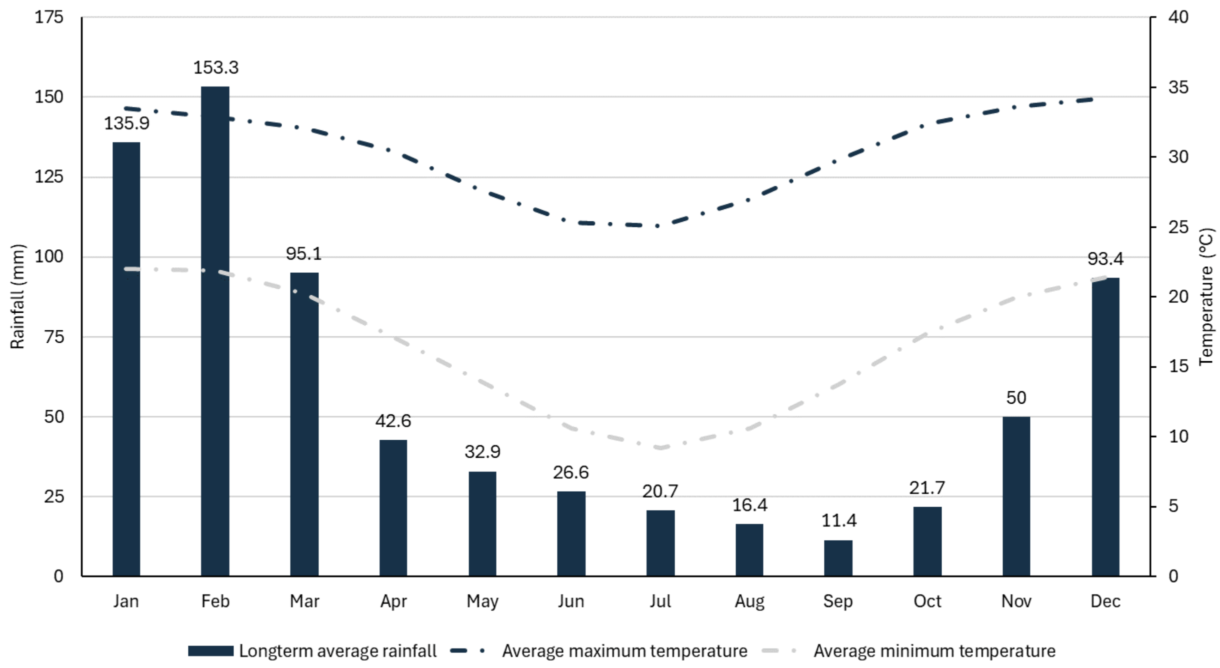

Figure 1. Climate statistics for the Collinsville Post Office (station ID: 033013)

2.2. Topography

The Project is located east of the Great Dividing Range, surrounded by low hills and mountains with elevations between 296 mAHD and 552 mAHD. The mine lease (ML) area is on a jump up and features variably undulating terrain, transitioning to flats and plains 40 meters below at the edge of the ML. The proposed final landforms will generally have low relief, consistent with the natural topography.

2.3. Soils

WTS (2021) undertook a soil and land suitability assessment across the ML. The study identified five soil mapping units (Table 1). Erosion risk across the mine lease was assessed using RUSLE calculations and WTS (2021) concluded that the site has a naturally moderate to high erosion risk (10 - 38 tn/ha/yr) predominately due to sparse surface protection (<2 - 20 % cover).

Table 1. Soils within the ML and their natural erosion estimates (WTS, 2021)

Australian soil classification	Clay %	Sand %	Rock %	Organics %	CEC (meq/100g)	ESP (%)	Est. soil loss (tn/ha/yr)
Deep eutrophic brown dermosol	15	43	4	0.83	3.3	<0.1	15.5
Shallow leptic brown rudosol	27	30	6	1.8	3.6	16.2	15.0
Shallow leptic brown-orthic tenosol	12	42	2	0.46	1.5	<0.1	31.8
Deep sodic brown dermosol	6	57	2	0.4	6	2.9	38.1
Self-Mulching Brown Vertosol	29	27	1	0.83	4.9	8.8	10.4
Average for modelling	18	40	3	0.86	3.9	9.3	22.2

Lu *et al*. (2001), which estimates natural hillslope erosion across Australia, provides for a lower rate of soil loss at 8 – 10 tn/ha/yr (Figure 2). Given the proposed landforms will be constructed from unconsolidated rocky growth media and consideration of Howard & Loch (2019) recommended acceptable erosion rate for the Pilbara (6 tn/ha/yr), a conservative target erosion rate of 5 – 6 tn/ha/yr is applied.

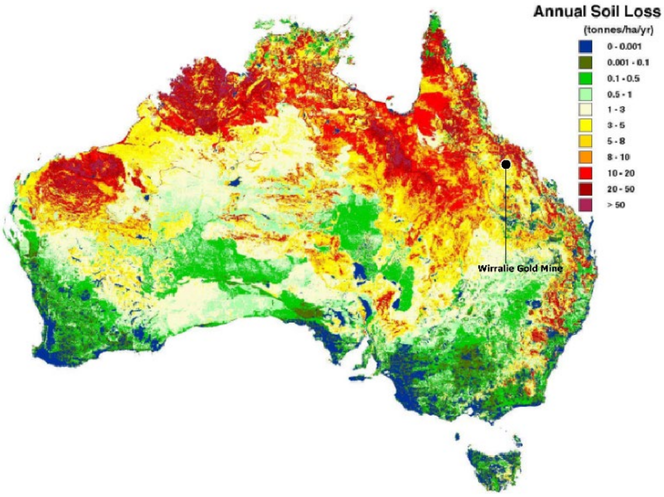

Figure 2. Estimates of hillslope erosion across Australia (Lu *et al*. 2001)

3. Erosion modelling

Erosive forces acting upon the proposed final landforms have been assessed using the Water Erosion Prediction Project model WEPP (USDA, 1995). WEPP requires data on four inputs when modelling hillslope erosion: climate, slope, soil and surface treatment.

3.1. Climate

100 years of SILO drill data was extracted for the Project (-21.10; 147.25) including daily rainfall and minimum and maximum temperature (DESI, 2024). USDA CLIGEN was used to generate a stochastic weather data file suitable for modelling (Figure 3).

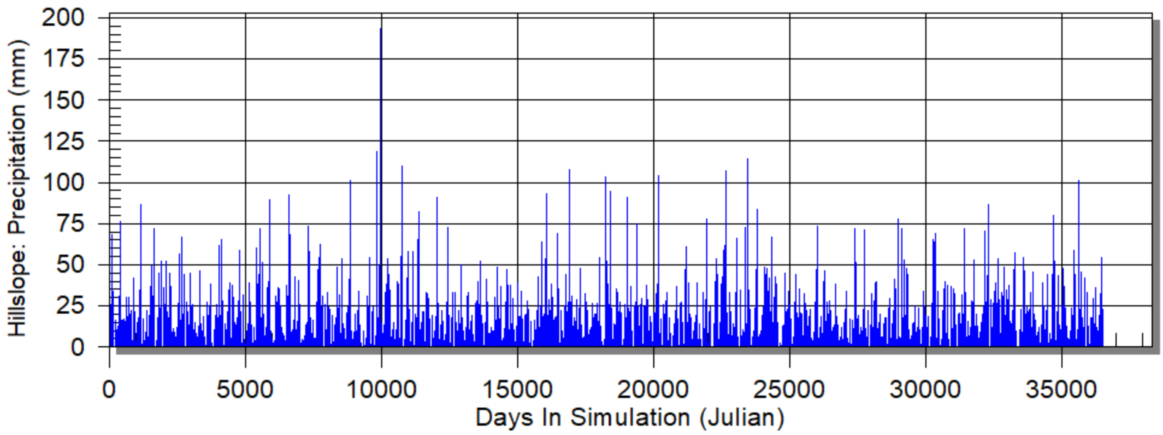

Figure 3. CLIGEN stochastic rainfall data over the 100 year model period

3.2. Slope

Geometries for the modelled features were extracted from a LiDAR derived 1 m digital elevation model (QGIS.org, 2024) and proposed conceptual designs (ATCW, 2022). Visualisation of the modelled features and transects are provided in Figure 4 and Figure 5. Graphs of transects from Figure 5 are in Appendix A.

The proposed final landforms for WRD1, WRD2 and WRD3 depicted in Figure 4 consist of two 10 m high benches battered to a 67 % slope with 10 m wide bench at 3 % outward facing slope. WRD3 is situated on the western rehabilitated WRD. This feature has been modelled as a single unit for the west and northwest slopes of the western rehabilitated WRD. The former ROM is proposed to be reshaped to a low hill to achieve stability. The TSF shall maintain existing slopes for drainage purposes following the placement of 1 m waste rock and 0.15 m growth media.

The final landforms were modelled as complex features (batters and benches) or as linear features, where applicable (e.g. TSF), under two scenarios (Table 2):

- Insitu – where averaged slopes and lengths were modelled for the existing structures or proposed WRD designs; and

- Modified – insitu features were reshaped where the target erosion rate (5 – 6 tn/ha/yr) could not be achieved.

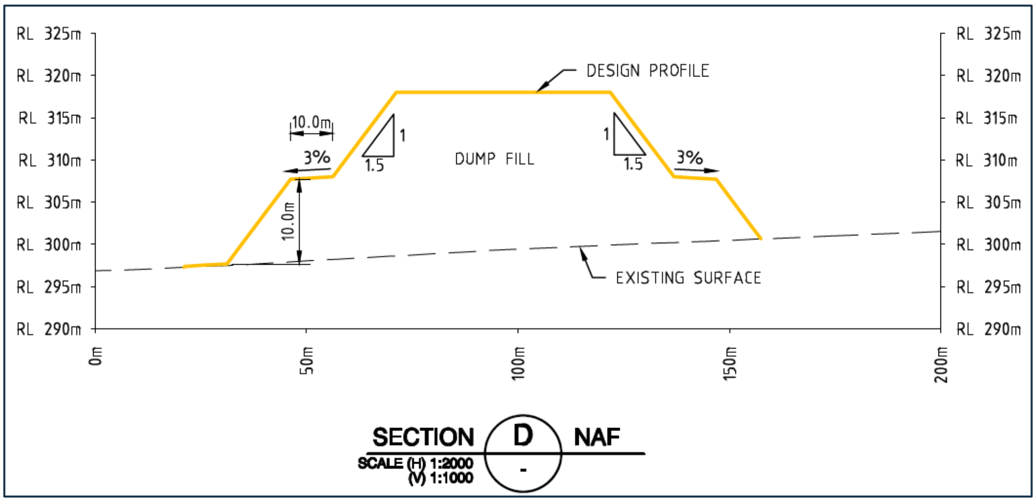

Figure 4. Conceptual final design for WRD1, WRD2 and WRD3 (ATCW, 2022)

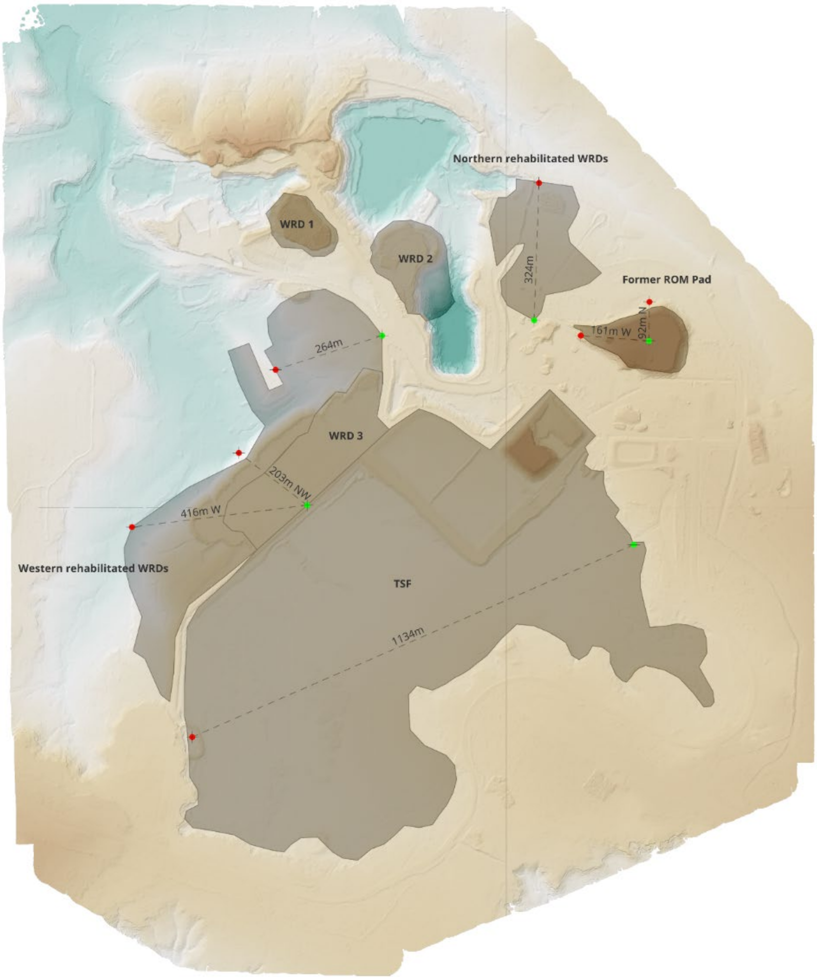

Figure 5. Transects derived from 1m DEM to establish insitu conditions

Table 2. Final landform modelled parameters for insitu/ proposed WRD design

Feature	Modelled Slope %	Slope Class	Modelled Slope length (m)	Slope break or bench
WRD1	67 (2 x batter 18 m) 3 (bench 10 m) 0.5 (flat)	Complex	130	Yes
WRD2	67 (2 x batter 18 m) 3 (bench 10 m) 0.5 (flat)	Complex	80	Yes
North Rehabilitated WRD	3 (batter)	Linear	324	No
West Rehabilitated WRD – west face	5.5 (batter)	Linear	225	No
West Rehabilitated WRD and WRD3 – northwest face	**WRD3** 67 (2 x batter 18 m) 3 (bench 10 m) 0.5 (flat) **West RWRD** 56 (batter)	Complex	160 (WRD3) 40 (West RWRD)	Yes
West Rehabilitated WRD and WRD3 – west face	**WRD3** 67 (2 x batter 18 m) 3 (bench 10 m) 0.5 (flat) **West RWRD** 44 (batter)	Complex	270 (WRD3) 50 (West RWRD)	Yes
Former ROM – north face	39 (batter) 0.5 (flat)	Complex	40 57	No
Former ROM – west face	8 (batter)	Linear	161	No
TSF	0.4 (linear)	Linear	1136 m (including stage 2 rehabilitation area)	No

3.3. Soil

Soil parameters were developed from an average of soils identified by WTS (2021). The rocky mulch growth media depth is 0.15 m across all features (Table 3). Below this depth, benign rock is modelled to 1 m.

Table 3. WEPP soil parameters

Depth m	Sand %	Clay %	Rock %	Organics %	CEC (meq/100g)
0.15	40	18	20	0.86	3.9
1.0	0	0	100	0.01	0

3.4. Management

WEPP management inputs describe the vegetation type and coverage and soil disturbances. Default management parameters were edited based upon the planting of perennial vegetation (70 % cover) and local growing conditions e.g. growing temperatures and expected growing days etc. Initial conditions were set to fallow and an average surface roughness of 7 cm to emulate rocky mulch growth media.

4. Results

Modelled insitu conditions or the proposed WRD landforms identified that only the TSF and northern rehabilitated WRD could achieving the target erosion rate of 5 – 6 tn/ha/yr (Table 4). Modifications were required for the remaining features (Table 5), including:

- The establishment of a rill at the top of the features to prevent runoff overtopping the crests and contributing to erosive forces acting upon the batters;
- The reshaping of the proposed batters for WRD1, WRD2 down to 15 %;
- Reshaping the western and northwestern faces of the western rehabilitated WRD and collocated WRD3 down to 15 % batters;
- Benching of the former ROM to achieve final batters of 15 %.

Recommended conceptual final landform designs are provided in Figure 6 to Figure 9.

Table 4. Modelled erosion rates using insitu/ proposed slopes and 70% cover

Feature	Erosion rate tn/ha/yr
WRD1	78.32
WRD2	91.003
North Rehabilitated WRD	2.483
West Rehabilitated WRD – west face	8.03
West Rehabilitated WRD and WRD3 – northwest face	104.23
West Rehabilitated WRD and WRD3 –west face	212.11
Former ROM – north face	50.875
Former ROM – west face	12.532
TSF	0.000

Table 5. Assessment of erosion rates following modification of the final landform

Feature	Modification	Erosion rate tn/ha/yr
WRD1 and WRD2	Rill at crest to prevent downslope flow Batters modified to 15 % Flat benches	5.374
North Rehabilitated WRD	No change	
West Rehabilitated WRD – west face	10 m bench every 50m	4.213
West Rehabilitated WRD and WRD3 – northwest and west face	Rill at crest to prevent downslope flow 10 m flat bench every 18 m at 15 % batter	4.127
Former ROM	Rill at crest to prevent downslope flow 10 m flat bench every 15 m at 15 % batter	5.345
TSF	No change	

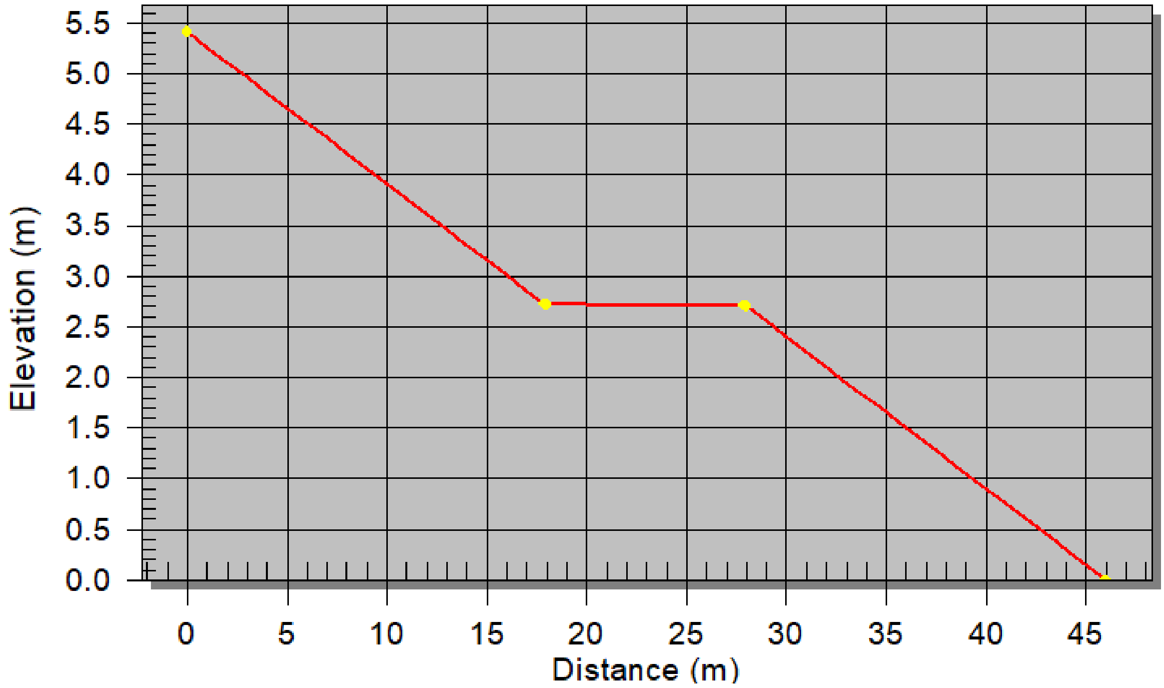

Figure 6. WRD1 and WRD2 recommended conceptual final landform slopes

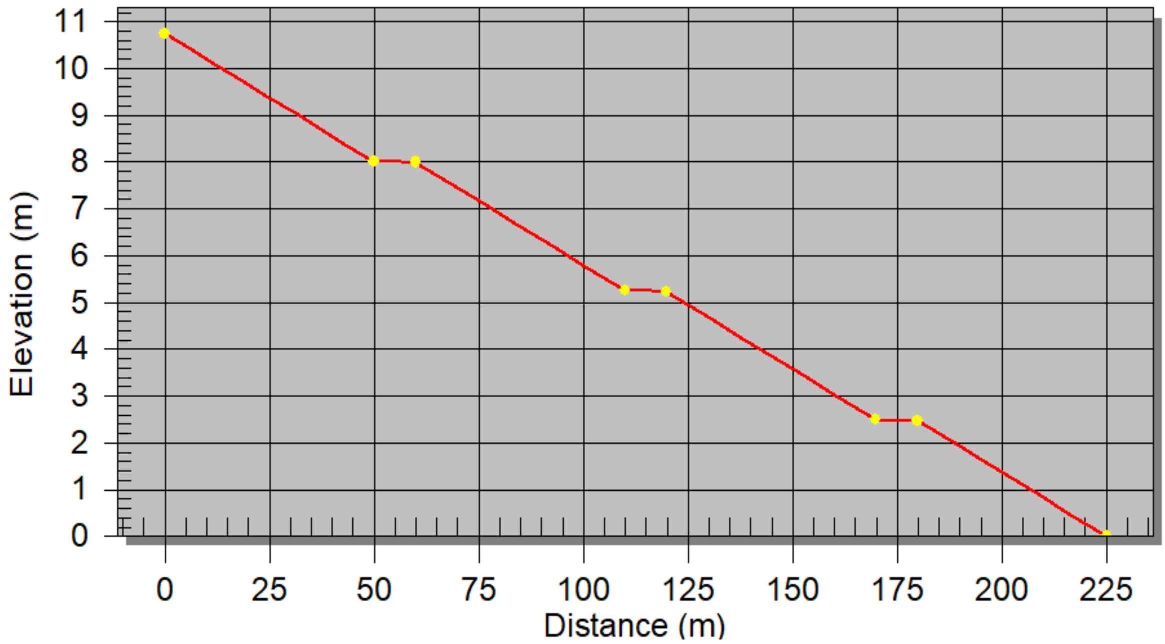

Figure 7. Western rehabilitated WRD (west face) recommended conceptual final landform slopes

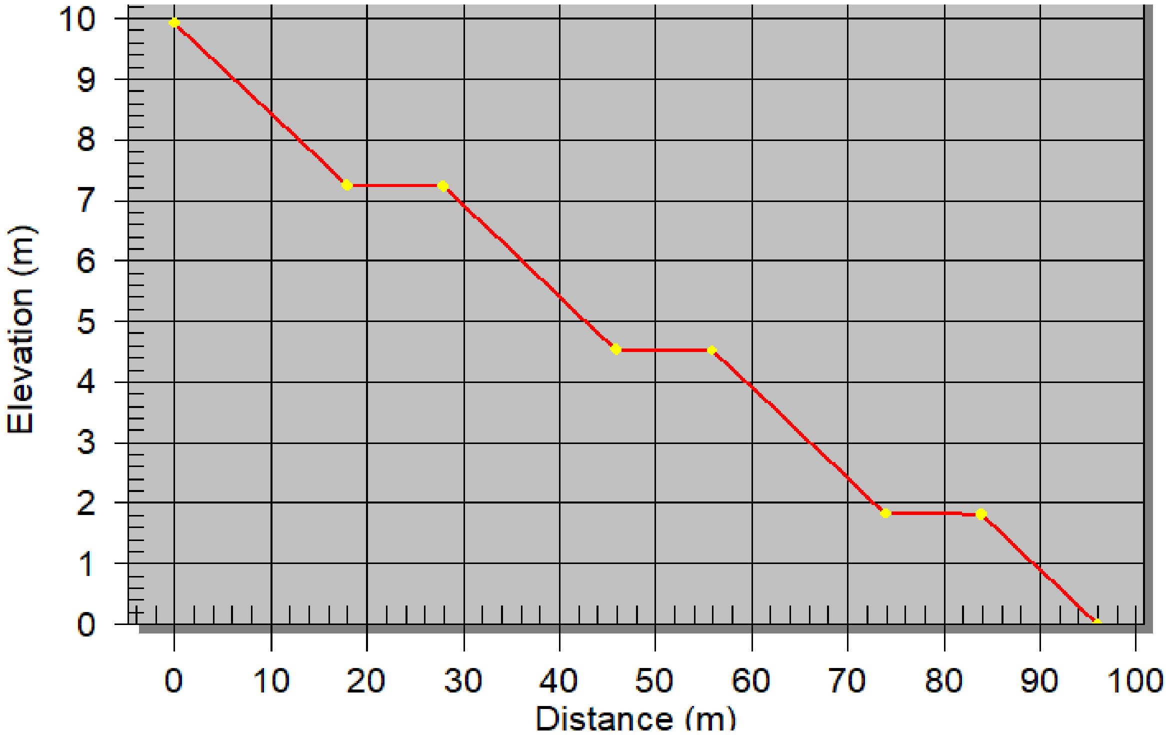

Figure 8. Western rehabilitated WRD and WRD3 (west and northwest face) recommended conceptual final landform slopes

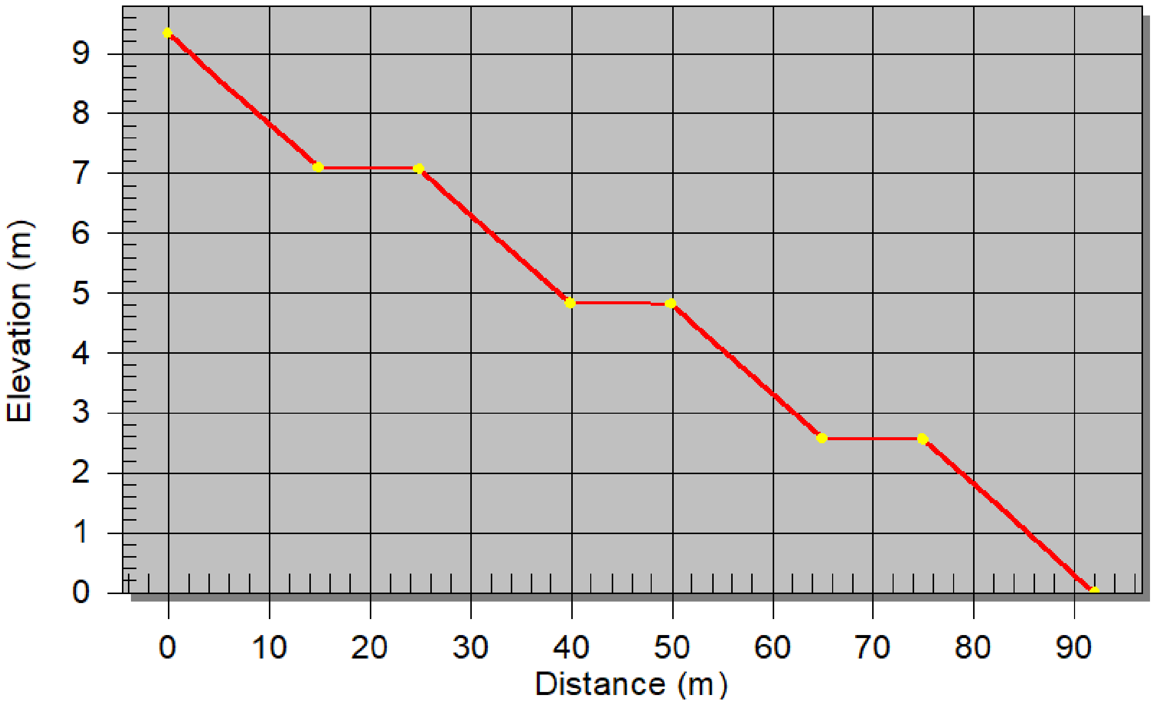

Figure 9. Former ROM recommended conceptual final landform slopes

4.1.1.Conclusion

The Project is in an area that has calculated rates of natural erosion between 10 – 40 tn/ha/yr using site specific data. However, conservatively, 5 – 6 tn/ha/yr has been identified as being an acceptable erosion rate for the Project. This rate is consistent with recommendations from Howard & Loch (2019).

Erosion modelling using WEPP was conducted on insitu landforms and the proposed final landform for WRD1, WRD2 and WRD3 over a 100-year period. The modelling identified that some features had slopes resulting in rates of erosion above the target. The northern rehabilitated WRD and TSF contained slopes that provided for acceptable erosion rates i.e. <5 - 6 tn/ha/yr.

Modifications to the benching and slope gradients were required for WRD1, WRD2, western rehabilitated WRD and collocated WRD3 and the former ROM. Recommended modifications include:

- Prevention of runoff overtopping the crests;
- Reducing the proposed batter angle for WRD1 and WRD2
- Reshaping the western and northwestern faces of the western rehabilitated WRD and collocated WRD3 down to 15 % with benches at regular intervals acting as slope breaks;
- Benching of the former ROM to achieve final batters of 15 % at regular intervals with slope breaks.

WEPP modelling indicates that the final landforms, reshaped as per recommendations and rehabilitated using 0.15 m of rocky growth media will achieve the target erosion rate of 5 – 6 tn/ha/yr.

5. References

ATCW. (2022). *Wirralie Gold Mine Concept Closure Methodology and Water Balance Model.* Maroochydore: ATC Williams Pty Ltd on behalf of Solomons Gold Pty Ltd.

BoM. (2024). *Climate data online for the Collinsville Post Office (#33013) accessed 18/08/2024.* Canberra: Bureau of Meteorology, Australian Government.

DESI. (2024). *The Long Paddock SILO data portal https://longpaddock.qld.gov.au/silo/ accessed 22/08/2024. .* Department of Environment Science and Innovation, Queensland Government.

Howard, E., & Loch, R. (2019). *Acceptable erosion rates for mine waste landform rehabilitation modelling in the Pilbara, Western Australia.* Perth: 13th International Conference on Mine Closure.

QGIS.org. (2024). *QGIS Geographic Information System.* Open Source Geospatial Foundation Project. http://qgis.org.

USDA. (1995). *USDA-Water Erosion Prediction Project Hillslope Profile and Watershed Model (WEPP Model Version 2012.8).* National Soil Erosion Research Laboratory, U.S. Department of Agriculture.

WTS. (2021). *Soil and Land Suitability Assessment, Wirralia Gold Mine.* Townsille: Wulguru Technical Services Pty Ltd on behalf of Solomons Gold Pty Ltd.

Appendix A – Insitu slopes

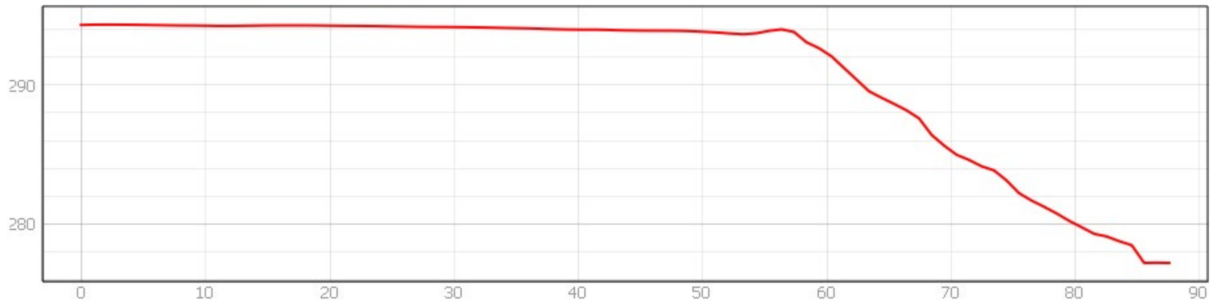

Figure 10. North facing slope of the former ROM

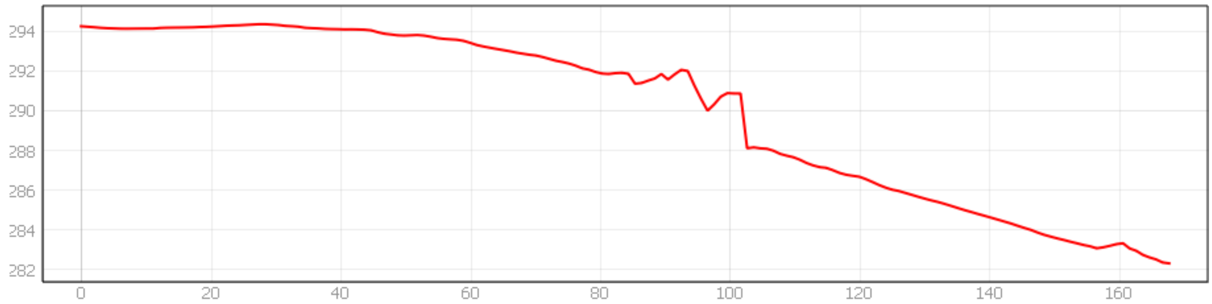

Figure 11. West facing slope of the former ROM

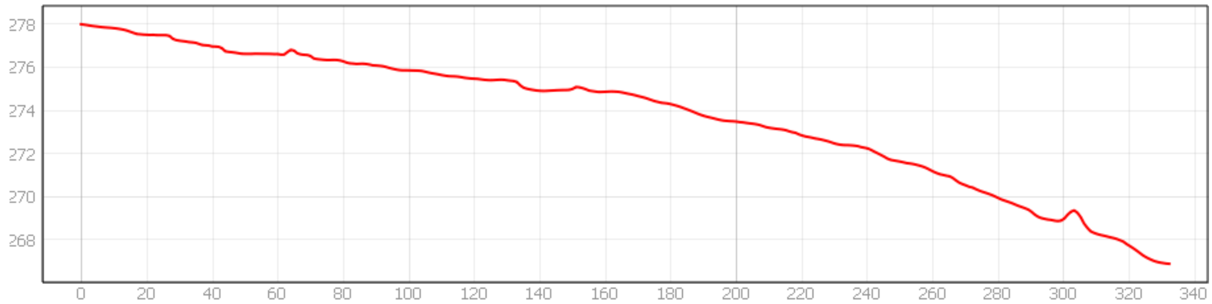

Figure 12. Slope of the northern rehabilitated WRDs (m)

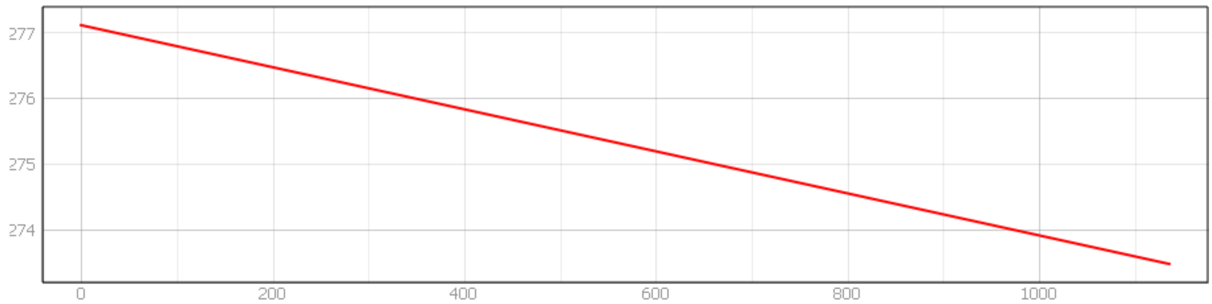

Figure 13. Existing slope of the Tailings storage facility surface (m)

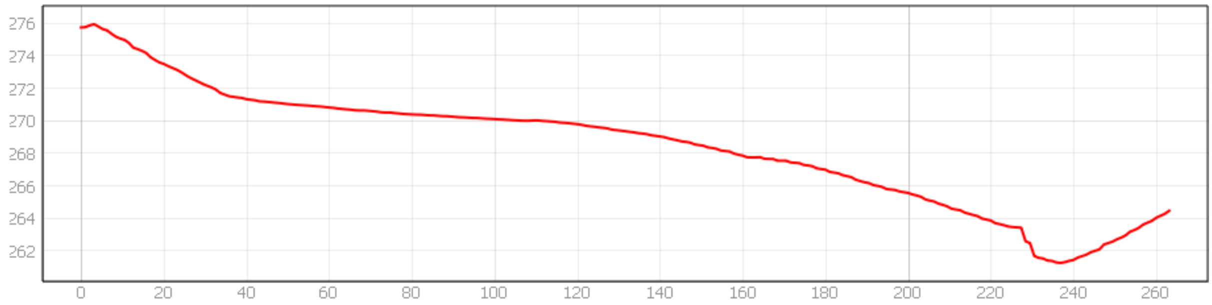

Figure 14. West facing slope of the western rehabilitated WRD

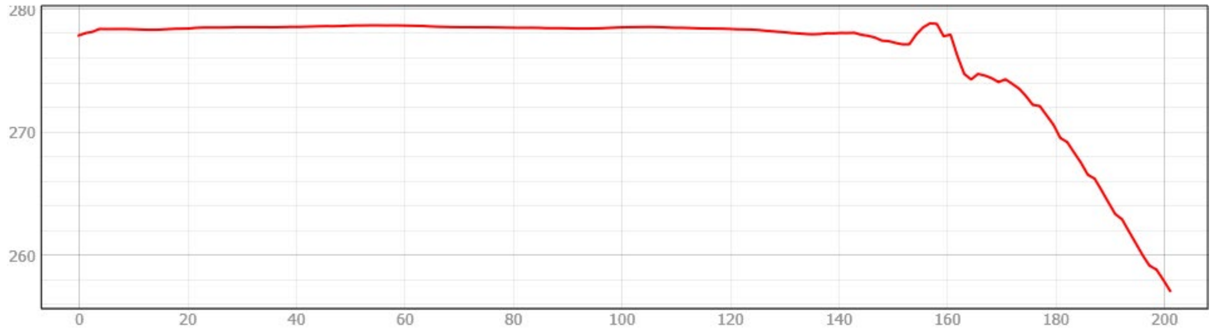

Figure 15. Northwest facing slope of the western rehabilitated WRD and WRD3

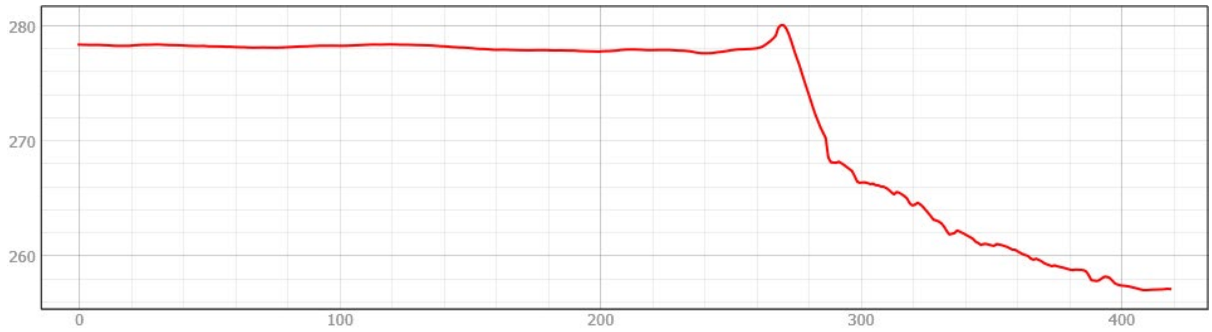

Figure 16. West facing slope of the western rehabilitated WRD and WRD3