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FURTHER INFORMATION REQUEST FROM THE EPA

PRINCESS LOUISE AND NORTH POINT

OPEN PIT MINES

PUBLIC ENVIRONMENTAL REVIEW

MARCH 2008

Vr2

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Contents

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PRINCESS LOUISE AND NORTH POINT OPEN PIT MINES

PUBLIC ENVIRONMENTAL REVIEW

1 INTRODUCTION

Burnside Operations Pty Ltd (BOPL) have submitted a Public Environmental Review (PER) document to the NT EPA which details the intention to proceed with mining of open pits at Princess Louise and North Point mining sites. The document was reviewed by a variety of interested parties and a number of comments relating to the document have been returned to BOPL for provision of further detail. The Further Information Request (FIR) from the EPA is provided in Appendix A.

The document presented here is a response to these queries.

2 WATER MANAGEMENT

(F.I.R. points 1 to 5)

2.1 Climate Data for Douglas River

The climate data used for the PER was mistakenly taken from the Daly Waters monitoring station and not the Douglas River station (014901) which is the closest climatic monitoring station to the project sites.

This has now been remedied and data from Douglas River monitoring station has been used to redesign any infrastructure which is required for the development of the mines. This data is presented in this section of the response to the NT EPA's queries.

2.1.1 Rainfall Data

The rainfall data from Douglas River rain monitoring station is summarised in the table below.

Rainfall pattern data, and in particular data on extreme rainfall events, provides an indication of surface water storage space requirements. The data sourced from BOM indicates that the highest daily rainfall event is 206.4 mm.

Runoff waters from operational areas would be captured in the sediment dam constructed at each pit, and if necessary pumped or directed by gravity into the pits during high rainfall events. Upon the end of the rain period, water quality tests will be conducted within the sediment dam and the pits, and discharge will occur once results fall within allowable discharge criteria.

Douglas River Rainfall Data

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Highest Recorded Daily Rain (mm)	194.6	206.4	155	101	52.8	40.1	41.8	8.4	37.2	93.5	98	113
Mean Rainfall (mm/month)	275.4	286.4	230.4	49.8	8.8	2.7	3.1	0.8	4.1	38.8	117.3	196.4
Mean Rain days (days)	24.4	24.2	20.2	4.7	1.2	0.4	0.4	0.2	0.8	4.6	12.6	18.2
90^{th} Percentile Rainfall (mm)	435.3	472.4	455.4	119.3	24.6	0.7	0	1.8	12.2	88.2	188.2	413.3

2.1.2 Surface water management

Design Basis

The surface water management system for both mines has been designed on the basis of a one in two year rainfall event for the wettest month of the year. Based on 39 years of data recorded by the Bureau of Meteorology (BOM) for Douglas River (refer Table above), the wettest month of the year is February; the February mean rainfall is 286.4 mm per month.

At both Princess Louise and North Point, sediment dams will be constructed to accommodate runoff from operational areas. In the event of a rainfall event in excess of the design, surface waters will be pumped from the sediment dam into the pit itself.

The Rational method in conjunction with the Bransby-Williams method[1] has been adopted for the sizing of the sediment dams (Table below). As presented in the Table, the sediment dam at Princess Louise will be of 5,200 m^3 capacities and the North Point sedimentation dam will be of 7,750 m^3 capacity based on the 1 in 2 year return period, of 1 hr duration.

Calculation of sediment dam capacities

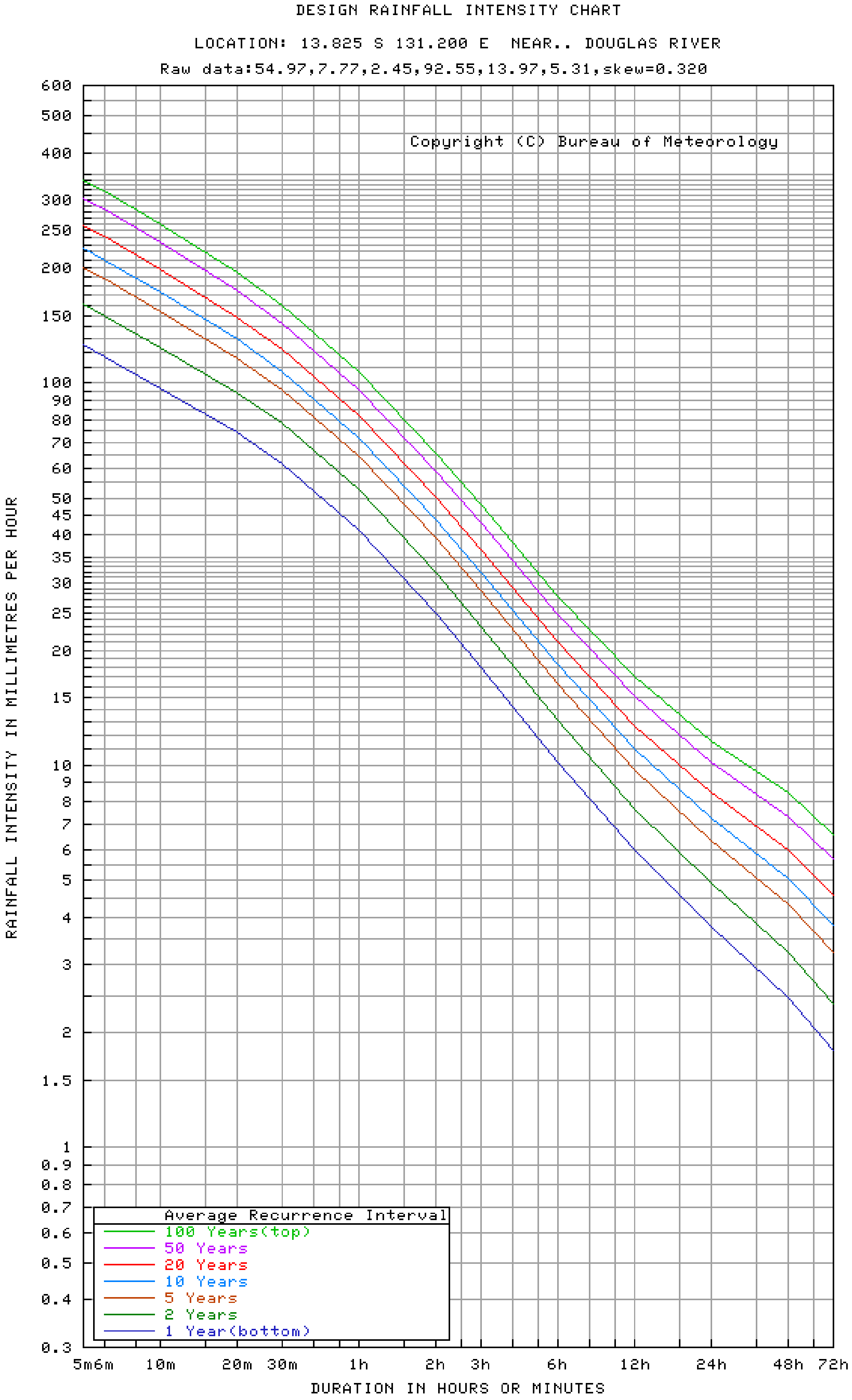
	Princess Louise	North Point
Operational catchment size, where sediment may be generated, ha	6.8	24.8
Runoff coefficient	0.7	0.4
Intensity, mm/hr [1]	109	78
Storage capacity, m^3 1 in 2 yr event	5200	7750
Storage capacity, m^3 1 in 5 yr event	6400	9500

Note 1: Based on 1 in 2 year event, using the Bransby-Williams method (stream length 380 m at Princess Louise and 785 m at North Point, and time of concentration of 14.5 minutes at Princess Louise and 31.9 minutes at North Point).

Data sourced from the Bureau of Metrology has been modelled on the intensity duration and frequency (IDF) model and the results are presented in the design rainfall intensity chart and the following table which presents the data for rainfall intensity and return periods.

RAINFALL INTENSITY IN mm/h FOR VARIOUS DURATIONS AND RETURN PERIODS

	RETURN PERIOD (YEARS)						
DURATION	1	2	5	10	20	50	100
5 mins	126.	161.	200.	224.	258.	304.	340.
6 mins	117.	150.	187.	210.	242.	285.	319.
10 mins	97.1	124.	154.	173.	199.	234.	261.
20 mins	74.0	94.5	116.	130.	148.	174.	194.
30 mins	61.3	78.2	96.0	107.	122.	143.	159.
1 hour	41.2	52.5	64.4	71.6	81.9	95.7	107.
2 hours	25.1	32.0	39.3	43.8	50.2	58.8	65.5
3 hours	18.1	23.1	28.6	31.9	36.6	42.9	47.9
6 hours	10.2	13.1	16.3	18.3	21.0	24.8	27.7
12 hours	5.99	7.71	9.73	11.0	12.7	15.1	17.0
24 hours	3.79	4.92	6.35	7.27	8.51	10.2	11.6
48 hours	2.46	3.23	4.32	5.04	5.99	7.34	8.45
72 hours	1.79	2.38	3.25	3.82	4.59	5.68	6.59


DESIGN RAINFALL INTENSITY CHART
LOCATION: 13.825 S 131.200 E NEAR.. DOUGLAS RIVER
Raw data:54.97,7.77,2.45,92.55,13.97,5.31,skew=0.320
Copyright (C) Bureau of Meteorology
RAINFALL INTENSITY IN MILLIMETRES PER HOUR
600
500
400
300
250
200
150
100
90
80
70
60
50
45
40
35
30
25
20
15
10
9
8
7
6
5
4
3
2
1.5
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
Average Recurrence Interval
100 Years(top)
50 Years
20 Years
10 Years
5 Years
2 Years
1 Year(bottom)
5m6m
10m
20m
30m
1h
2h
3h
6h
12h
24h
48h
72h
DURATION IN HOURS OR MINUTES

2.2 Water Quality Impacts

Water quality impacts can be anticipated from two sources after the closure of the mine. The first is potential for some acid mine drainage (AMD) to remain in the open void after mining has ceased and thus seep towards the ground water affecting the local aquifer. Firstly, it is noted in the PER that ground water in the area is already high in arsenic (the water quality determinant of concern) top levels of 0.05 to 0.4 mg/l. This is dealt in section 4 of this document.

The second potential impact is to surface water quality run off. This is dealt with in greater detail in section 3, 4, 5 and 6 of this document.

Oxide rock at the mine is not expected to offer any potential for further reaction with oxygen or water to generate contaminant (metalliferous) products as these reactions have already occurred in the geological past and any soluble contaminants would have been leached out.

2.3 Water Balance

2.3.1 Princess Louise Open Pit Mine

Figure 1 illustrates schematically the annual water balance at the site.

The water balance was calculated by taking the two primary sources of water, rainfall and pit dewatering and allocating this water to the various sinks and losses at the site.

The rainfall input was calculated from the influence of the operational area and the run-off coefficient, while the water input from the mining operation was calculated as a simple function of rate of pumping per day over a period of one year. This may be an over-estimate, as the rate of pumping will decrease over time, as a function of water level drop in the local aquifer.

Seepage to ground water for both the sediment dam and the waste rock dump were estimated as comparable, because the sediment dam has a hydrostatic head while the rock dump will only have infrequent water ponding at base of dump. Also, the rock dump will eventually have a store and release cover, which will minimise any water infiltration to the base of the dump.

2.3.2 North Point Open Pit Mine

Figure 2 illustrates schematically the annual water balance at the site.

The water balance was calculated by taking the two primary sources of water, rainfall and pit dewatering and allocating this water to the various sinks and losses at the site.

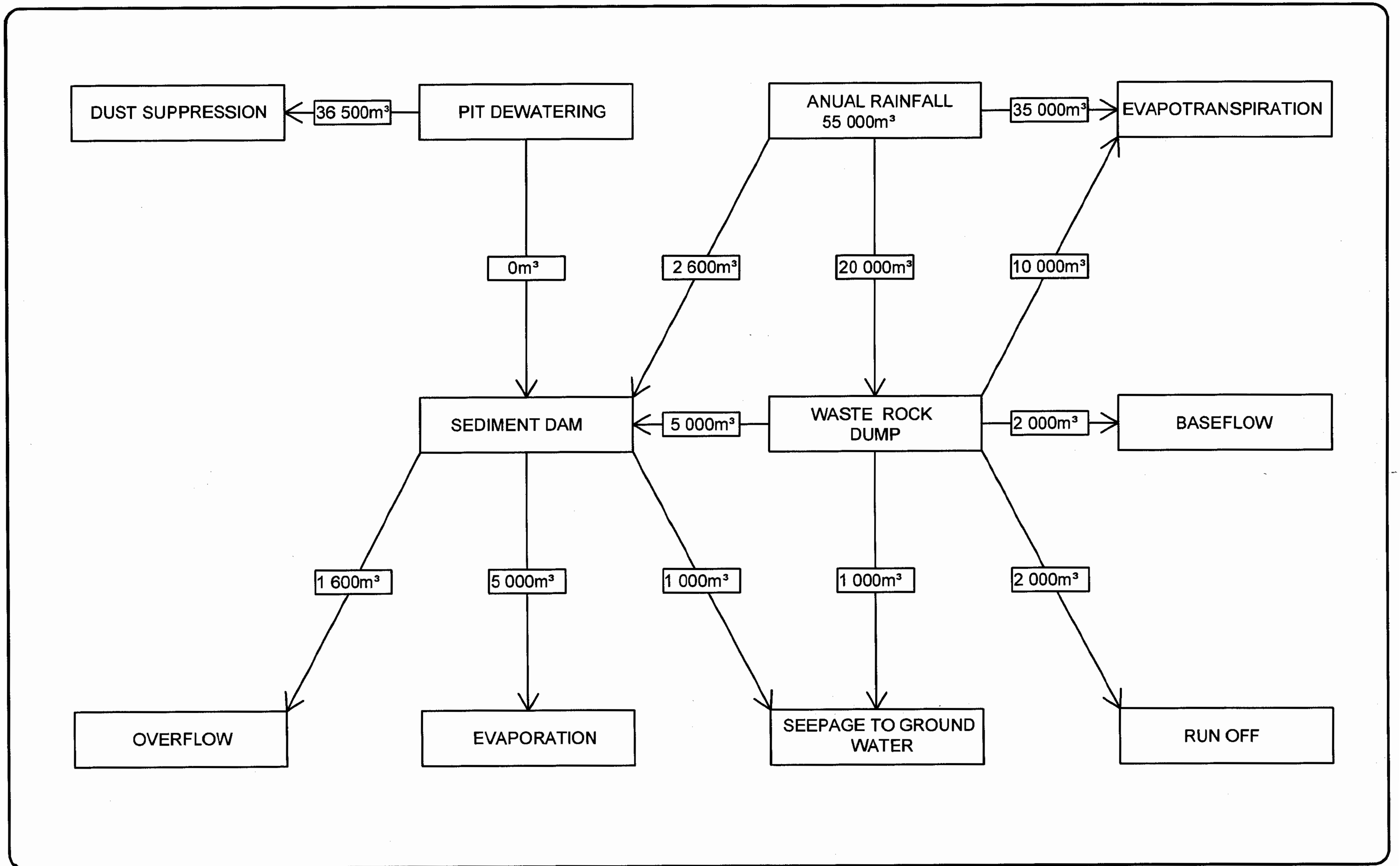


FIG1 - ESTIMATED SITE WATER BALANCE BASED ON AVERAGE ANNUAL RAINFALL - PRINCESS LOUISE MINE

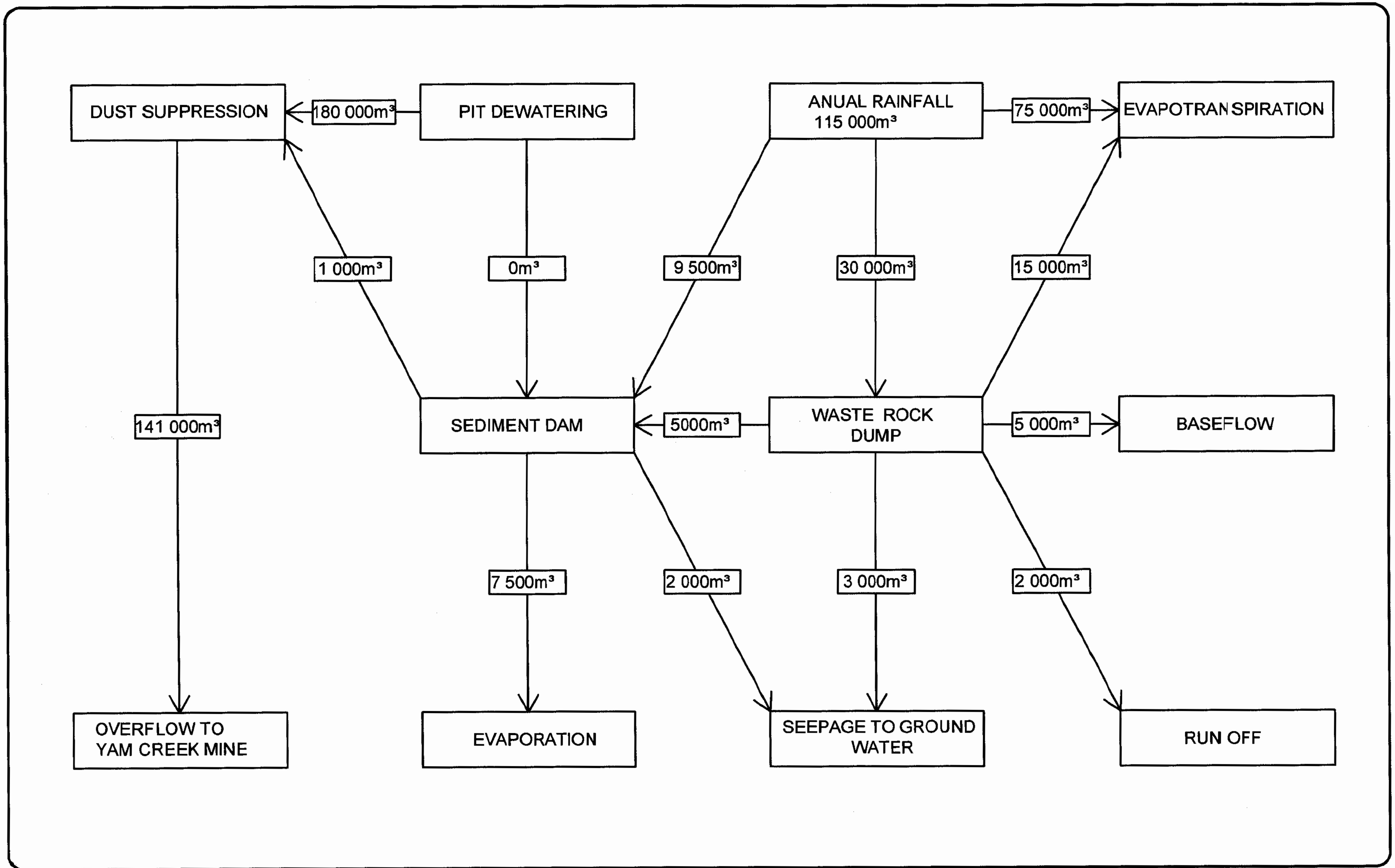


FIG2 - ESTIMATED SITE WATER BALANCE BASED ON AVERAGE ANNUAL RAINFALL - NORTH POINT MINE

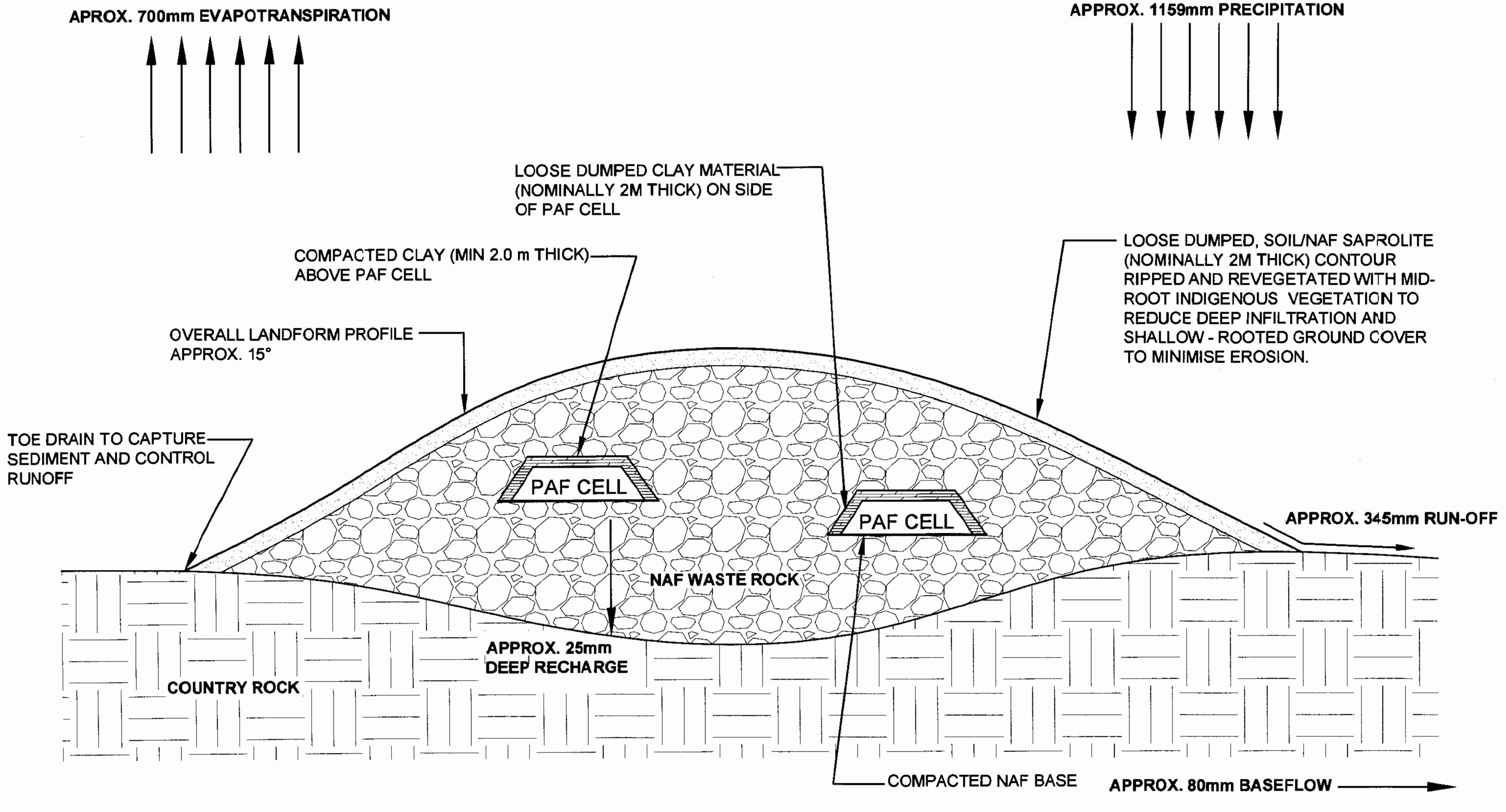


FIG 3 - CONCEPTUAL CROSS-SECTION OF THE WASTE ROCK LANDFORM INDICATING CONTAINMENT OF POTENTIALLY ACID FORMING MATERIAL (PAF) WITHIN A NAF

The rainfall input was calculated from the influence of the operational area and the run-off coefficient, while the water input from the mining operation was calculated as a simple function of rate of pumping per day over a period of one year. This may be an over-estimate, as the rate of pumping will decrease over time, as a function of water level drop in the local aquifer.

3 WASTE ROCK DUMPS

(F.I.R. points 6 to 12)

The majority of the mined waste material from both Princess Louise and North Point open pits will be Non Acid Forming (NAF) waste rock. A total of 352 samples were tested for acid generating potential and the results showed that only 0.5% of the analytical results from at Princess Louise and 0.7% of the analytical results from North Point mines indicated high capacity Potentially Acid Forming (PAF) materials. The depth of weathering at the mine sites is in excess of 20 m depth, which has skewed the geochemical test programme (in terms of material representation) in favour of fresh, potentially sulphidic material. This further illustrates that PAF waste from these mining operations is expected to be relatively minimal when compared to the total of the waste rock mined from these operations.

The landform analyses in the PER confirmed that the local soils, which will be pre-stripped prior to mining, contain high proportion of clays, e.g. alkaline columnar clays and clays derived from weathered alkaline shales. From this, the availability of low permeability materials for encapsulation of PAF waste cells within the WRD is considered sufficient. The thickness of lining materials on the PAF encapsulation cells will be in the order of 2 m thick. The encapsulation material is expected to have a minimum hydraulic conductivity of at least 1×10^{-7} metres per second and an optimal hydraulic conductivity of 1×10^{-8} metres per second, providing an average potential infiltration of 1.71 metres per year.

These calculations show that the minimum capping thickness of 2 meters will be sufficient to exclude water infiltration to the underlying PAF cells in the waste rock dump (see Figure 3). The hydraulic conductivities of the capping material assume a constant hydraulic head on the top of the PAF cap. This in fact will not occur in reality, as the waste dump has a water store and release design and standing water on top of the PAF cell will occur rarely, if at all. The two meters of capping is considered a very conservative cover depth for the PAF cells. Water mounding within a WRD can create a saturated portion of the dump at its base to about 10% of its height, relative to permeability of the WRD material. As the WRD is made up from loose rock and gravels, the permeability is expected to be very high, thus preventing the formation of excessive saturated water mounds within the dump. The PAF cells will be constructed at a level in the WRD to be at least 5 m above the potential phreatic surface resulting from any water mounding within the dump.

The oxide material mined from the top 20 m of the open pits is relatively high in secondary clay minerals and of low permeability. The depth of top soil pre stripping will be in the order of 100 mm to 200 mm. The high clay content soils and clayey oxide material will be used in the construction of low permeability capping to the PAF cells in the WRD.

The total tonnage of PAF materials has been quantitatively assessed as:

Princess Louise – 361,000 x 2% = 7,220 tonnes

North Point - 1,030,000 x 3.5% = 36,050 tonnes

The tonnages of PAF waste rock provided above indicate the worst case conditions, as both, Low Capacity and High capacity PAF material has been included in the calculations.

Due to the design of the PAF containment cells and the thickness of the low permeability capping layer over the cells, it is not expected to have any acidic drainage emanating from the waste rock dump.

The arsenic in the waste rock is contained within the arsenopyrite, or the PAF waste material. The arsenic release into the environment is by the oxidation of the sulphides in waste rock and formation of acidic waters which leach the arsenic into solution. This allows for the migration of metals and arsenic. Arsenic which is inert (non-soluble and non-leachable – in its natural mineral sulphidic form) cannot migrate from the WRD and is not considered as a hazardous material within the WRD. As all sulphidic material will be considered PAF, the arsenic content of the waste will automatically be deposited in the lined PAF cells within the WRD, preventing oxidation and thus solubilisation and migration of this material.

A further method of containing the potential for AMD which is being considered is for the inundation of PAF material in the pit voids after mining has been completed. As only small amounts of PAF material are expected to be excavated (see tonnages above) during mining and only towards the end of the mining campaign, it may prove to be more efficient to return these materials to the open pit and allow for natural inundation. Inundation of the PAF materials in the open pit would occur in less than one year (see figures 1 and 2 for predicted pit water inflow)

4 PIT VOIDS

(F.I.R. points 13 and 14)

Limited information is available to permit a good evaluation of the final void geochemistry. The first 20 m depth of the pit will consist largely of leached oxide rock and the base of the pit will contain some fresh sulphidic material. This however, will remain under water following the cessation of mining, preventing any oxidisation and formation of acidic drainage from the base of the pit. Based on experience from other open pits in the area, it is estimated that the pit water depth will be equivalent to the ground water depth below the surface which is 14 meters below ground level (mbgl) for North Point and 25 mbgl for Princess Louise open pit.

On closure, the pit water is unlikely to have any convective overturn and as such will for a stratified water quality scenario, with fresh water at the surface and more contaminated water towards the base of the pit. This is unlikely to affect the quality of ground water in the area, as the porosity and permeability (see ground water report appended to the PER) of the host rock is extremely low. Existing ground water quality data from local bores (pre mining) suggests that ground water is already impacted to above both ecological and drinking water criteria (DWQG 2004) – Arsenic in particular is recorded at concentrations between 0.05 mg/l to 0.4 mg/l.

5 SEDIMENTATION BASINS

(F.I.R. points 15 to 18)

Sediment basins will be constructed to contain runoff from all operational areas where sediment is identified as a potential surface water contaminant. Given all mining activities are scheduled to be undertaken in the dry season, sediment basins will only be required to manage runoff from decommissioned areas until these surfaces have been stabilised with vegetation over time. Sediment basins will be designed in accordance with Water Quality Protection Guideline No 6. *Mining and Mineral Processing: Minesite Stormwater* (2000) produced by the Department of Environment, Water and Rivers Commission and Department of Industry and Resources-WA. The minimum design standard is to retain water from a 1 in 2 year event.

It is considered the appropriate location for the detailed design of the sedimentation basins is in the PER. These details may include a review of the drainage off the waste landform if the design shows that the capacity of the sediment basins needed to cater for the volume off the current catchment (which include the natural hillsides on each side of the waste landform) is excessive. Reducing the catchment to the waste landform only will reduce the required capacity of the sediment basins.

As stated in the PER, BOPL will conduct water quality monitoring after completion of mining activities to ensure downstream water quality is not adversely affected by the project. The duration of monitoring will be dependant on monitoring results and is anticipated to be subject to discussions with DPIFM personnel as the lead agency for management of mining operations.

BOPL will engage suitably qualified personnel to conduct regular inspections during wet seasons following completion of mining to ensure sediment ponds remain in a condition suitable to achieve their design objectives. It is anticipated this will involve removal of accumulated sediment prior to the wet season and periodic inspection during the wet season to ensure the basin is functioning. Removal of accumulated sediment during the wet season may also need to occur if the inspection determines the basin is full.

Where rainfall events exceed the sediment basin design capacity, residence time will be reduced and small particle removal efficiency will decrease. The water courses in the Brocks

Creek area are ephemeral in nature. Limited monitoring data and anecdotal evidence suggests that these ephemeral systems are naturally subject to highly variable suspended sediment loads. The environmental risk associated with sediment loads likely to be added during such events, given the small size of the potential disturbed area, short duration of exposed surfaces and dilution effects in the receiving environmental are considered to be low.

Wetland treatment systems for discharges from the waste dump or sedimentation ponds are not proposed at this time.

6 CLOSURE

(F.I.R. point 19)

On cessation of mining all of the operational areas will be rehabilitated to ensure that environmental impact to water quality in the catchment will not occur. The F.I.R. presupposes that there will be a decreased water quality impact from the mining projects which will in turn affect the water quality in the catchment for the proposed Marrakai Dam to be constructed some time into the future.

The only potential for the generation of decreased water quality run off to the catchment is from the WRDs. These have been designed as rainfall store and release dumps, with internally compartmentalised sectors for construction of PAF cells which will remain moisture free. However negligible, some impact to run off water quality can still be anticipated from seepage from the base and toe of the WRDs. This would occur during the first flush at the onset of the wet season when dilution from rainfall can be expected to be at least 3 to 4 orders of magnitude and possibly more. After the first flush, no further impact to run off can be expected till the wet season in the following year.

The exact impact to water quality in the catchment is impossible to predict at this time, but recent data from a nearby mine (Fountain Head) and monitoring of nearby streams shows that arsenic concentrations in surface water are in the order of 0.35 µg/l (refer to attached data). These concentrations are well below the aquatic freshwater guideline of 24 µg/l for As (III), 12 µg/l for As (V) and 7 µg/l for the drinking water guideline.

The pit waters from Woolwonga (a nearby closed mine) shows concentrations of arsenic of 5.2 µg/l and recent analyses from the Fountain Head open pit show arsenic concentrations of 5.2 to 6.8 µg/l.