6.1 Regional Surface Water Systems

North Point

North Point's surface waters drain into two creek systems, Yam Creek to the west and Ban Ban Creek to the east, however the vast majority of the surface water drains to the Yam Creek catchment (see Figures 2.2 and 2.3 for site location). These creek systems are ephemeral, and as such do not flow until the wet season starts. Based upon climatic data presented in Section 9, it is expected that there will be little rain during the early operational period (late 2007).

Princess Louise

The surface water drainage of Princess Louise is significantly harder to evaluate, as the area of excavation is undulating, with significant terrain differences. However, ultimately all operational surface waters drain into Ban Ban Creek, which is a collector for the Margaret River. As noted above, the upper creeks of the Margaret River are ephemeral, and as such will not be flowing until the wet season starts.

6.2 Operational Area

6.2.1 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 87 years of data recorded by the Bureau of Meteorology (BOM) for Daly Waters (refer Table 6.2), the wettest month of the year is February; the February mean rainfall is 168.5 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 6.1). As presented in Table 6.1, the sediment dam at Princess Louise will be of 5,200 m^3 capacity and the North Point sedimentation dam will be of 7,400 m^3 capacity.

[1] The Rational method is used to determine the volume collected by a catchment over a certain time period. The Bransby-Williams method estimates the intensity of a rainfall event, based upon the longest length of the catchment, area of catchment and slope.

Table 6-1 Calculation of sediment dam capacities

	Princess Louise	North Point
Operational catchment size, where sediment may be generated, ha	6.8	24.8
Run-off coefficient	0.7	0.4
Intensity, mm/hr [1]	109	75
Storage capacity, m^3	5200	7400

[1] Based on 1 in 2 year event, for mean monthly rainfall of 168.5 mm, 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).

6.2.2 Groundwater management

The mine groundwater model is discussed in detail in Section 5. The water from the dewatering operation will be used mainly for dust suppression, as discussed below.

North Point

The North Point pit has a water extraction rate of approximately 24 L/sec (2074 kL/day). The water will be pumped to a tank where water trucks can be filled as part of the dust suppression program. The overflow from this tank will flow into the old Yam Creek mine pit approximately 250 m south of the proposed mine; this pit will be used as a sediment dam for excess groundwater, and water samples will be collected and tested in accordance with the discharge licence, if required.

Princess Louise

Princess Louise pit has a water extraction rate of approximately 5 L/sec (425 kL/day). The water will be pumped to a tank where water trucks can be filled as part of the dust suppression program. Based on the requirement to manage the dust around the site and on Grove Hill Road, all the Princess Louise mine water will be utilised.

6.2.3 Waste rock dump runoff

The waste rock dumps will be constructed according to the method described in Section 4, in order to limit the potential for acid drainage and minimise the risk of potential impacts on the immediate and downstream environment.

During construction and operations, stormwater from the catchment area upstream of the waste rock dumps will be diverted to avoid contact with waste rock. Surface run off and seepage from the waste rock dumps will be directed to the sediment dams and monitored for quality prior to release. If water treatment is required, this will occur at the sediment dams.

Following rehabilitation, waste rock dump surface runoff and seepage monitoring will continue until it can be demonstrated that water quality release criteria can consistently be met and that there is no significant residual risk to the immediate or downstream environment.

A draft environmental management plan for waste rock generated at the proposed Princess Louise and North Point mines is provided at Section 18.10.

6.2.4 General issues

There are no wetland systems located within the North Point and Princess Louise mine footprint, and therefore there will be no impact on wetland ecosystems.

All fuel drums will be placed on bunded pallets, thus limiting any surface water flow of hydrocarbons. Common areas, such as offices, workshops, toilets, etc will have all surface waters directed into the sediment dam.

6.2.5 Flood risk from extreme rainfall events

As noted above, the closest BOM long term rain gauging station is Daly Waters, which has 87 years of recorded rainfall data. This data is summarised in Table 6.2.

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 180.1 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.

Table 6-2 Daly Waters Rainfall Data

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Highest Recorded Daily Rain (mm)	123.2	146.0	127.8	137.2	47.5	113.3	24.2	34.3	64.5	61.5	180.1	118.4
Mean Rainfall (mm/month)	160.5	168.5	117.3	22.2	5.2	5.8	1.6	1.8	5.1	21.9	57.9	109.1
Mean Raindays (days)	12.1	11.9	8.3	2.5	0.7	0.5	0.3	0.2	0.8	2.8	6.2	9.8
90^{th} Percentile Rainfall (mm)	296.8	324.1	287.6	64.8	17.3	16.7	3.3	1.5	16.8	63.4	117.1	211.0

Source: BOM, 2006

6.3 Monitoring and Management

BOPL will minimise the disturbance to the tenement area, and in particular the operational area. At each mine site open channels will be constructed, directing any sediment-laden water from operational areas to a sediment dam. Surface waters will be treated prior to being allowed to flow to surrounding waterways. Discharge will only occur within discharge licence limits.

The sediment dam size will be sufficient to cope with a one in two year event for a monthly rainfall of 168.5mm (the maximum monthly mean). In the event of rainfall in excess of the design capacity of the sediment dam, surface waters will be directed to the mine pits. After settling has occurred, discharge can occur.

Groundwater from mine dewatering will be pumped to tanks at each mine site, where water trucks can be filled as part of the dust suppression program. At North Point, excess groundwater will flow into the old Yam Creek mine pit approximately 250 m south of the proposed mine. At Princess Louise, all groundwater will be utilised for dust suppression.

BOPL will instigate a baseline surface water quality monitoring programme. The proposed monitoring points include a base source upstream of the disturbance, points in water holding/releasing structures (sediment dams, and pits after closure), and points downstream of the disturbance in Yam Creek, Ban Ban Creek and the Margaret River. The program will comprise the tests set out in Table 6.3.

The monitoring will continue for a period of at least one year following pit closure, and continue until the monitoring demonstrates that water quality release criteria can be consistently met and that there is no significant residual risk to the immediate or downstream environment.

Table 6-3 Frequency of Testing

	pH	EC	Total Suspended Solids	Alkalinity	Total Sulphate	Anions: Sulphate (filtered)	Aluminium	Arsenic	Cobalt	Manganese	Nickel	Zinc	Copper	Flow and level
Sediment Dam	D	D	D	W	W	W	W	W	W	W	W	W	W	D
Upstream (control)	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Downstream	W	W	W	M	M	M	M	M	M	M	M	M	M	W

M = Monthly (when flowing) W = Weekly (when flowing) D = Daily (when flowing)

6.4 Post-Mining Surface Water Issues

Following mine closure, the surface water issues will include runoff into the pits, and runoff from the other closed operational areas and waste dumps into the sediment dams. Monitoring will be undertaken for a period of at least one year following pit closure, and continue until the monitoring demonstrates that water quality release criteria can consistently be met and that there is no significant residual risk to the immediate or downstream environment.

6.5 Commitments

At commencement of mining, BOPL commits to providing sediment dams to capture runoff water, at each mine site.

BOPL commits to pumping runoff water from the sediment dams to the mine pits, if required during high rainfall events while the mines are operational.

During and after mining, BOPL commits to monitoring runoff water prior to release. If water treatment is required, this will occur at the sediment dams.

BOPL commits to applying for water discharge licences if necessary.

During and after mining, BOPL commits to complete the proposed water monitoring schedule and to maintain the records in easily read Excel files, to be provided to DPIFM.

BOPL commits to monitoring for a period of at least one year following pit closure, and to continue until the monitoring demonstrates that water quality release criteria can consistently be met and that there is no significant residual risk to the immediate or downstream environment.