16.1 Risk Evaluation Methodology

In order to determine requirements of environmental management plans at Princess Louise and North Point, a qualitative evaluation of potential impacts of the proposed gold mining operations has been carried out, based on Australian Standard AS/NZS 4360:2004 Risk Management, and the information contained in this PER.

AS/NZS 4360:2004 addresses environmental risks based on both the likelihood and the consequence of a particular impact occurring and compares the results to a pre-defined qualitative matrix to ascertain significance. BOPL has adopted this standard to assess the environmental risks and corresponding environmental management requirements for the proposed operations.

Likelihood and consequence ratings applied in the risk assessment process were measured on five-point scales. Consequences were assessed on a scale of 1 to 5 and likelihood was assessed on a scale from A to E. Likelihood and consequence categories were specifically tailored to relate to the activities proposed. The types of risks considered are described in Tables 16.1 and 16.2. Environmental, health and safety, cultural, and socio-economic impacts and consequences were considered.

Assessments were undertaken in a workshop comprising URS and BOPL personnel with broad experience in mining, environmental management, engineering, hydrology and hydrogeology. Assessors undertook an initial literature review, analysed baseline survey data, reviewed the existing BOPL Environmental Management System (EMS), design layouts and the PER Guidelines, and analysed the impacts of the proposed operations based on information provided by BOPL and past experience. As required under the PER Guidelines, potential health and safety implications were also incorporated into the risk assessment process.

In order to assess the significance of impacts the team was posed the following questions:

- What impacts can occur?
- What is the likelihood of these events?
- What are the consequences of the event?
- What are the overall risks (likelihood x consequence)?

Table 16-1 Risk assessment criteria for consequence

Level	Descriptor	Example Detail Description				
		Safety	Cultural	Socio-economic	Business	Environment
1	Insignificant	Minor injury, requiring first aid only	None to minimal impact on Indigenous or historical heritage sites or values.	None to minimal reported complaints about Project. No socio-economic impacts.	<$10,000	No impact, minor breach in procedure, minor non-conformance
2	Minor	Medical attention required	Minor impact on Indigenous or historical heritage sites or values (e.g. restricted access to recreation areas).	Some inconvenience to stakeholders, minimal adverse impact on socio-economic environment, and some intervention required.	$10,000 to < $100,000	Minimal impact outside the local area.
3	Moderate	Disability/Lost Time Incident (LTI)	Moderate impact on Indigenous or historical heritage sites, which can be managed under normal procedures. Some negative media coverage could be expected.	Moderate disruption or inconvenience to stakeholders. Require careful management to restore trust.	$100,000 to < $500,000	Moderate impact external to local area but generally contained on site.
4	Major	Permanent Disability / Fatality	Major disturbances to 1 or 2 significant Indigenous or historical heritage sites or values. Major breach of statutory obligation, access to resource denied in the medium to long-term.	Significant adverse impacts to sectors of the community and stakeholders. Long-term social disruption, diminished quality of life of large or specific sectors of the community.	$500,000 to < $1M	Major environmental harm or breach of license conditions or obligations, discharges off site.
5	Catastrophic	Multiple Fatalities	Major disturbances to a number (3 or more) of significant Indigenous or historical heritage sites or values. Major breach of statutory obligation, access to resource permanently denied.	Irreversible damage to the socio-economic environment. Potential for civil commotion or riot and major damage to BOPL property.	$1M or more	Long term, significant ecological changes, with legal implications and potential to affect community health.

Table 16-2 Criteria for likelihood of events

Level	Measure	Description	Guide
A	Almost certain	Issue will or almost certainly will occur, is currently a problem or is expected to occur in most circumstances.	Weekly
B	Likely to occur	Issue has been a common problem in the past and there is a high probability it will occur in most circumstances.	Once per month
C	Moderate	Issue may have arisen in the past and there is a high probability that it should occur at some time.	Once per year
D	Unlikely	Issue may have occurred in the past, and there is a moderate probability that it could occur at some time.	Once per 10 years
E	Rare	Issue has not occurred in the past, and there is a low probability that it may occur in exceptional circumstances.	Once per 100 years

The combination of the likelihood and consequence ratings was then compared to the qualitative risk analysis matrix, providing an indication of the magnitude or significance of the impact (ranging from low to high risk). The adopted risk level matrix and associated risk definitions is presented in Table 16.3.

Table 16-3 Risk matrix

	CONSEQUENCE				
LIKELIHOOD	**1 Insignificant**	**2 Minor**	**3 Moderate**	**4 Major**	**5 Critical**
A. Almost certain	M	S	H	H	H
B. Likely to Occur	M	M	S	H	H
C. Moderate	L	M	S	S	H
D. Unlikely	L	L	M	S	S
E. Rare	L	L	M	M	S

Risk Definitions (AS/NZS 4360:1999):

High	Detailed research and management planning required at senior levels. Immediate action required
Significant	Senior management attention needed
Moderate	Management responsibility and integration into management plans required
Low	Manage by routine procedures

16.2 Preliminary Risk Assessment

A summary of high risk events and proposed management controls are shown in Table 16.4. This table identifies key potential impacts for major activities, assesses their risk ranking, and makes suggestions about recommended actions based on the risk definitions included in Table 16.3 and the commitments made in the PER. Risk assessment determined the inherent risk associated with key issues.

Table 16-4 Summary of high risk events

Key Issues	Key Potential Impacts	Consequence Ranking	Likelihood Ranking	Risk Ranking	Management Controls Recommended
Pit development					
Clearing area for pit development	• Vegetation loss, loss of species diversity. • Increased weed species.	2	A	S	Flora EMP – Section 18.3 Weeds and Pests EMP – Section 18.5 Rehabilitation and Mine Closure Planning – Section 3
	• Loss of habitat, shelter and food for listed fauna. • Loss of threatened and/or endangered species.	4	D	S	Fauna EMP – Section 18.4 Weeds and Pests EMP – Section 18.5
	• Interference/ damage or destruction of Aboriginal or European heritage.	3	A	H	Heritage Site Protection EMP – Section 18.11
	• Alter natural drainage flows and divert surface water causing erosion.	3	A	H	Surface Water EMP – Section 18.2 Rehabilitation and Mine Closure Planning – Section 3
	• Dust generation from exposed areas and machinery.	3	D	M	Dust and Noise EMP – Section 18.6

Key Issues	Key Potential Impacts	Consequence Ranking	Likelihood Ranking	Risk Ranking	Management Controls Recommended
Generation of acid drainage from pit walls both during development and after pit closure	• Increase acidity of groundwater, surface water and soil contamination.	3	D	M	Ground Water EMP – Section 18.1 Surface Water EMP – Section 18.2 Waste Rock and Ore Stockpile EMP – Section 18.11 Rehabilitation and Mine Closure Planning – Section 3
Dewatering impacts on regional aquifer during pit development	• Decrease in regional groundwater level which may impact on vegetation in the area. • Change in regional water quality.	2	D	L	Ground Water EMP – Section 18.1 Surface Water EMP – Section 18.2
Surface Mining					
Dust	• Dust nuisance.	2	A	S	Dust and Noise EMP – Section 18.6
Hydrocarbon spillage (other than fuel transport and storage)	• Contamination of soil, groundwater and surface water.	2	D	L	Domestic and Industrial Waste EMP – Section 19.8
Noise and vibration	• Noise and vibration.	1	B	M	Dust and Noise EMP – Section 18.6
Greenhouse gas emissions	• Contribution to Australia's overall greenhouse gas emissions • Contribution to human-induced climate change.	1	A	M	Greenhouse gas emission management – Section 9.3.4
Failure of the dewatering pipelines	• Erosion of soil. • Release of contaminated water into the environment impacting on groundwater quality and vegetation.	2	D	L	Groundwater EMP – Section 18.1 Surface Water EMP – Section 18.2

Key Issues	Key Potential Impacts	Consequence Ranking	Likelihood Ranking	Risk Ranking	Management Controls Recommended
Explosives accident	Injury to employees Damage to mine infrastructure	5	E	S	BOPL Emergency Management Plan – to be developed, see Section 16.4.2
Heavy equipment accident	Injury to truck driver/ other employees	4	D	S	BOPL Emergency Management Plan – to be developed, see Section 16.4.2
Open pit wall/ ramp failure	Injury to employees	4	D	S	BOPL Emergency Management Plan – to be developed, see Section 16.4.2
	Disruption to production	4	D	S	BOPL Emergency Management Plan – to be developed, see Section 16.4.2
Flooding of open pit	Injury to employees	1	D	L	BOPL Emergency Management Plan – to be developed, see Section 16.4.2
	Disruption to production	4	D	S	BOPL Emergency Management Plan – to be developed, see Section 16.4.2
Waste Rock Dumps					
Placement and visual impact of waste rock dumps on the surrounding landscape	Aesthetics	3	B	S	Surface Water EMP – Section 18.2 Waste Rock and Ore Stockpile EMP – Section 18.10 Rehabilitation and Mine Closure Planning – Section 3
Generation of acid rock drainage from waste rock dumps	Increased acidity of soil, ground water and surface water Soil contamination	3	D	M	Surface Water EMP – Section 18.2 Waste Rock and Ore Stockpile EMP – Section 18.10 Rehabilitation and Mine Closure Planning – Section 3

Key Issues	Key Potential Impacts	Consequence Ranking	Likelihood Ranking	Risk Ranking	Management Controls Recommended
Erosion of battered faces of waste rock dump	Build up of sediment in stormwater drains and surface water systems	3	D	M	Waste Rock and Ore Stockpile EMP – Section 18.10 Rehabilitation and Mine Closure Planning – Section 3
Fuel Transport and Storage					
Spillage of hydrocarbons during bulk transport to site	Contamination of soil, groundwater and surface water	4	D	S	Hazardous Substances EMP – Section 18.8
Hydrocarbon contamination while onsite	Contamination of soil, groundwater and surface water	4	D	S	Hazardous Substances EMP – Section 18.8
Waste Management					
Putrescible waste	Leachate Odour Landfill greenhouse gas emissions Attraction of vermin/ feral animals	1	C	L	Domestic and Industrial Waste EMP – Section 18.9 Weeds and Pests EMP – Section 18.5
Sewage treatment	Contamination of soil, groundwater and surface water Odour	1	C	L	Domestic and Industrial Waste EMP – Section 18.9
Hydrocarbons waste	Contamination of soil, groundwater and surface water	1	D	L	Surface Water EMP – Section 18.2 Domestic and Industrial Waste EMP – Section 18.9
Disposal of contaminated soil	Leaching of pollutants into soil, groundwater and surface water Vegetation loss	1	D	L	Hazardous Substances EMP – Section 18.8 Domestic and Industrial Waste EMP – Section 18.9

Key Issues	Key Potential Impacts	Consequence Ranking	Likelihood Ranking	Risk Ranking	Management Controls Recommended
General Operational					
Creation of biting insect breeding sites	Increased incidence of bites Spread/ introduction of biting insect borne disease	2	D	L	Mitigation strategies/commitments outlined in Section 13 Surface Water EMP – Section 18.2
Increased large vehicle use on roads	Increased noise and air emissions Wildlife road kill Road safety issues	3	A	H	Dust and Noise EMP – Section 18.6 Fauna EMP – Section 18.4 Road safety actions/commitments outlined in Section 11
Light vehicle accident	Injury to employee/s or members of the public	4	B	H	BOPL Emergency Management Plan – to be developed, see Section 16.4.2
Rehabilitation					
Poor seeding success	Loss of vegetation Slow growth rates Loss of stabilization of soil	3	D	M	Rehabilitation and Mine Closure Plan - Section 3
Impact on soils and degree of erosion	Sediment build up in surface water and other drainage systems; water finding alternative route causing erosion and flooding of areas Inability to rehabilitate Gullying and removal of areas of cap core	3	B	S	Rehabilitation and Mine Closure Plan - Section 3
Impact of animals on rehabilitation	Vegetation overgrazed Trampling of slopes damaging soil structure causing erosion and inability of plants to establish.	3	C	S	Fauna EMP – Section 18.4 Weeds and Pests EMP – Section 18.5 Rehabilitation and Mine Closure Plan - Section 3

Key Issues	Key Potential Impacts	Consequence Ranking	Likelihood Ranking	Risk Ranking	Management Controls Recommended
Generation of acid rock drainage from waste rock dumps	Increased acidity of soil, ground water and surface water Soil contamination	3	D	M	Surface Water EMP – Section 18.2 Waste Rock and Ore Stockpile EMP – Section 18.10 Rehabilitation and Mine Closure Planning – Section 3
Closure					
Impact on environment over time after pit closure	Change in groundwater levels and quality	3	D	M	Ground Water EMP – Section 18.1
	Attraction of feral animals to water source	2	C	M	Weeds and Pests EMP – Section 18.5
	Collapsing of pit walls	2	D	L	Rehabilitation and Mine Closure Planning – Section 3
	Stock access to water	3	E	M	Ground Water EMP – Section 18.1 Surface Water EMP – Section 18.2
	Third party use	3	E	M	Rehabilitation and Mine Closure Planning – Section 3
Natural Disasters					
Flood	Loss of access to open-pit mine (flooded/impassable roads) Loss of essential supplies (fuel, reagents, consumables)	2	C	M	BOPL Emergency Management Plan – to be developed, see Section 16.4.2
	Medical emergency (inability to evacuate ill or injured personnel)	4	D	S	BOPL Emergency Management Plan – to be developed, see Section 16.4.2

Key Issues	Key Potential Impacts	Consequence Ranking	Likelihood Ranking	Risk Ranking	Management Controls Recommended
Seismic event/ earthquake	Collapse of mine infrastructure Loss of access to mine or pit Induces major fire/explosion Disruption to security/communications	4	E	M	BOPL Emergency Management Plan – to be developed, see Section 16.4.2
Severe electrical storm	Employees struck by lightning Lightning initiating fire or explosion	5	C	H	BOPL Emergency Management Plan – to be developed, see Section 16.4.2
	Disruption to power/ security systems	2	B	M	BOPL Emergency Management Plan – to be developed, see Section 16.4.2
Cyclone	Loss of access to pit or mine Loss of essential supplies (fuel, reagents, consumables etc)	3	C	S	BOPL Emergency Management Plan – to be developed, see Section 16.4.2
	Medical emergency (inability to evacuate ill or injured personnel)	5	C	H	BOPL Emergency Management Plan – to be developed, see Section 16.4.2
Major infectious disease outbreak/ biological contamination	Infection to persons providing first aid treatment to others Employee illness Adverse reaction/panic by other employees	4	D	S	BOPL Emergency Management Plan – to be developed, see Section 16.4.2
Major bushfire	Damage to site infrastructure Injury to employees fighting the bushfire	4	C	S	BOPL Emergency Management Plan – to be developed, see Section 16.4.2

16.3 Risk Management and Mitigation

In order to maximise the return of investment of resources into management of risk, it is important that staff and other resources are available and allocated to addressing or managing priority issues. It is normally accepted that the highest risk issues should receive the highest priority.

A draft risk assessment methodology documented above (Section 16.1 and 16.2) has been adopted by BOPL to assist in prioritising impacts. This risk assessment is consistent with the requirements in AS/NZS 4360:2004 and AS/NZS 4360:1999.

As priorities may change over time due to changes in operational conditions and community and stakeholder expectations, the risk assessment and management process is an iterative process that is reviewed on an ongoing basis. Risk assessments will include consideration of biophysical, cultural and socio-economic criteria, as well as external risks including the risks of cyclones and flooding, as illustrated in Table 16.4.

An EMS has been developed that incorporates the management and monitoring strategies identified as a consequence of the risk assessment process. A Safety Management Plan (SMP) has also been implemented by BOPL to ensure a healthy and safe workplace for all staff, employees, contractors and visitors to BOPL sites.

As the mine becomes operational, and in accordance with the EMS and SMP, each department will be required to formally identify any hazards, and assess the risk and initiate control measures on all its activities, products and services (including those of its contractors).

16.4 Emergency Management

It is BOPL's policy to take all reasonable steps to protect the environment and comply with all legal obligations. Occasions may arise when an environmental incident occurs even though all reasonable and necessary precautions have been taken to avoid or minimise the risks.

The procedures to be adopted in the event of an environmental incident have two main objectives, namely to ensure a prompt and effective response, and to minimise the effects of any incident.

16.4.1 Emergency response philosophy

BOPL's emergency response procedure involves the following priorities for action:

- Notification of emergency personnel and authorities;
- Protection of human health and safety;
- Protect and minimise the effects on health and safety, and on the environment;

- Neutralise and render safe any noxious or hazardous materials;
- In the event of a major spill or release, to contain the spread of material;
- Determine an appropriate response strategy;
- Undertake required response and/or clean up activities and site remediation; and
- Identify any necessary changes to operations or procedures to prevent a recurrence of the incident.

16.4.2 Emergency Management Plan

BOPL will develop an Emergency Management Plan for the Princess Louise and North Point mining project, based on similar plans in place at operational mines currently run by its parent company GBS, and taking into account the site-specific risks of the project area.

The Emergency Management Plan will provide management and staff with detailed information on how to identify and respond to specific emergency situations. The Emergency Management Plan forms part of the BOPL emergency and crisis management system, which comprises plans, procedures, responsibilities, forms and checklists necessary for the management of emergency situations.

Incidents requiring an emergency response could occur either on or off site, and may involve BOPL or contractor employees, or possibly members of the public. The impacts could include injury, equipment or environmental damage, legal action, loss of production or damage to company reputation.

16.5 Integration into the EMS

The risk assessment process was used to identify those Environment Management Plans (EMPs) required for the project, in order to implement the EMS at an operational level. This is discussed further in Section 17.

The commitments in relation to risk assessment are also summarised below, as the risk assessment process is integral to EMS implementation.