19.0 Risk Management

19.1 Hazardous Materials

19.1.1 Management System

MRM's Safety Management System and Environmental Management System incorporate the standards, policies and procedures required to meet Xstrata's corporate requirements. One of these standards relates to the management of hazardous materials and requires that there are systems to:

- Maintain a current inventory of all raw materials, intermediates, products, wastes and other materials that have the potential to harm the environment.
- Identify and assess their environmental hazards.
- Maintain appropriate information to enable all these materials used on site, or manufactured for sale, to be properly handled, stored, transported, used and disposed of.
- Establish and disseminate appropriate limits for environmental exposure to relevant materials and physical agents.
- Evaluate the effects of the materials, products and activities on the people environment.

To meet these requirements, MRM:

- Requires evaluation of all chemicals before they come onto site by considering safety, environmental, and supply aspects of each new chemical.
- Requires a Material Safety Data Sheet (MSDS) to be maintained for all site chemicals and maintained on the Chem Alert ll chemical management system.

19.1.2 Hazardous Substances

MSDSs are obtained for all hazardous substances on the mine and port sites. Containers or systems in which hazardous materials are contained are labelled. Disposal of the containers of hazardous substances is carried out in accordance with the MSDS and government legislation.

A chemical request system is in place requiring safety, supply, and environmental approval before hazardous materials come to site. The requirements for storage, handling and disposal are determined before a chemical is purchased.

All personnel handling these substances are trained in the associated procedures, including clean-up procedures. The required safety equipment is available at all times.

An external hazardous substance and dangerous good audit is conducted annually to ensure that all of the required procedures are being followed.

19.1.3 Transportation, Storage and Handling

A variety of hazardous substances and dangerous goods is used in various areas of the operation. The supplier or supplier's contractor undertakes transportation of dangerous goods and hazardous substances to the mine site. All transport companies are required to have the correct licences for transporting dangerous goods and to comply with the requirements of the Dangerous Goods Code.

All hazardous and dangerous goods are handled and stored according to the information provided on the MSDSs. This information is required upon delivery of substances to the mine site, or sent prior to delivery. MRM personnel have access to safety equipment required for the correct handling of hazardous goods and are aware of the spillage clean-up procedures.

19.1.4 Fuel and Oil

Contractors transport fuel and oil to the mine site in appropriate containers. The fuel is stored in bulk containers that are contained within bund walls which meet the requirements of Australian Standard AS1940. Waste oil is stored in bulk containers, each of which is transported from site for recycling as required.

19.1.5 Chemicals

Reagents used in the mineral processing plant are either delivered in bulk and transferred to designated storage tanks or are delivered in bulk bags, mixed and then transferred to designated storage tanks. Before mixing, bulk bags are stored either in shipping containers or in the reagent storage shed.

Hazardous and dangerous goods are stored on-site in either a specific location (such as the reagent shed), or contained within purpose-built, bunded structures.

19.2 Risk Management Process

The risk management process used by MRM has various levels or stages which correspond to the stages of project development with an ongoing process of risk assessment and management which is discussed in this section of the EIS. This process is consistent with Australian Standard AS/NZS 4360:1999 'Risk Management'.

A risk analysis and a risk assessment is undertaken to identify the safety, health, environmental, social and financial risks and potential hazards associated with all significant aspects of the operation. The key requirements of hazard and risk management are as follows:

- Management shall ensure that all personnel have been trained and assessed as competent to manage risks associated with their role.

- The risks associated with all identified hazards shall be assessed. The assessment methodologies and processes shall be selected having due regard for meeting the requirements of legislation and other corporate or statutory due diligence processes.
- Hazard identification processes shall address all life-cycle stages of a project or activity, including design, procurement, construction, commissioning, operation and maintenance, decommissioning and demolition.
- Processes should be established to report and record risk issues, and also be able to conduct trend analysis.
- Control measures are to be implemented and monitoring programs arranged to demonstrate effective control for the reduction or elimination of risk. This process shall be evaluated, documented and modified as appropriate.

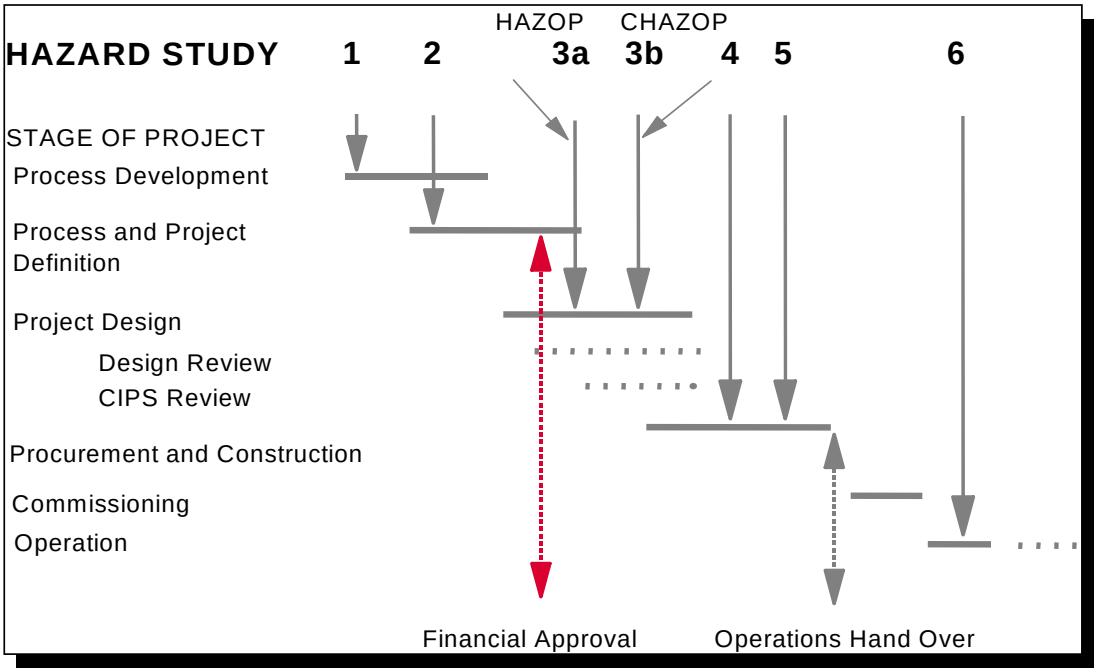
To meet these requirements MRM has:

- Developed a hazard management system that allows for the identification, reporting, risk assessment, recording and follow-up of actions that have been instigated through this process.
- Developed a business risk register and site risk profile through the use of catastrophic risk assessments, and quantitative and qualitative risk assessments.
- Identified the appropriate risk assessment training and instigated the on-site training of employees and contractors who are required to manage risk-related issues.
- Developed a safety risk management procedure that ensures there is adequate closure processes in place and that the emphasis is on elimination of risk if possible or the reduction of the risk profile to an acceptable level.
- Developed a site database to monitor the closure of actions and to ensure the system functions and therefore reduces the site's risk profiles to an acceptable level.

19.3 Risk Methodology

The methodology used for risk management on this project is based upon the staged hazard study process developed in the chemical industry. The following diagram outlines the process and identifies when the various risk management stages of the process align with the project stages.

Hazard Studies 1 and 2 are carried out at the Feasibility, Development and Project specification stages and prior to capital approval of the project. Hazard Study 3 (Hazard and Operability (HAZOP) Study and Control Hazard and Operability (CHAZOP) Study) is carried out as soon as suitable design information is available, usually when the process and instrumentation diagrams are reasonably firm. Hazard Studies 4 and 5 are pre-commissioning studies and must be completed before process materials are introduced. Hazard Study 6 is a study of initial operation and is to be completed not earlier than 3 and not later than 6 months after beneficial production.



The objective is to develop a comprehensive understanding of the hazards and risks associated with the operation of the open cut mine and the adequacy of the safeguards. The risk management process encompasses qualitative and quantitative methods typically following the stages below:

- formal risk identification
- risk reduction (via analysis)
- residual risk control to acceptable levels

The relative order in which risk is managed is:

Step 1. Protect the health and safety of the general public (typically off-site risk).

Step 2. Protect the health and safety of the personnel in the facility (on-site risk).

Step 3. Protect the natural environment from contamination (on and off-site risk).

Step 4. Protect plant equipment and property (on-site risk).

Step 5. Protect the business (financial and reputation risk).

Risk management is a dynamic (iterative) process. It is as much about identifying opportunities as avoiding or minimising losses.

19.4 Risk Assessment

19.4.1 Existing Operations

As part of its risk management procedures, MRM maintains a site hazard and risk register to ensure that any potential risk to the safety, health, environmental and business aspects of the operation are minimised. In 2004, the site hazard and risk register was reviewed using a Hazard Identification, Risk Assessment and Risk Control (HIRARC) methodology.

The HIRARC methodology consists of a formal, systematic, critical examination to identify the potential hazards during normal, abnormal, start-up/shutdown and maintenance operations. The aim of the study was to identify hazards, assess the risks and document how they are to be controlled. This study was undertaken in the following five steps:

Step 1. **Hazard Identification** – identify all of the hazardous scenarios/events.

Step 2. **Risk Assessment** – consider the causes and consequences of the hazard actually occurring and posing a risk to the people, environment, plant and business.

Step 3. **Assess the Risk** – based on the likelihood and consequence of the hazardous event.

Step 4. **Control Measures** – consider the various control measures that may be in place under the headings of preventative, mitigating and human factor controls.

Step 5. **Risk Reduction** – on completion of the assessment determine whether further risk reduction is needed and identify any actions required to further mitigate the risks.

The assessment was undertaken in a workshop attended by senior site managers familiar with all relevant aspects of the operations. Initially all potential hazards were identified. This process generated a site hazard category table listing 83 potential hazards sorted into the following categories. The number in brackets indicates the number of separate hazards identified for each category.

- Fire (12)
- Explosion (8)
- Gas release (1)
- Geotechnical (1)
- Injury (25)
- Health (5)
- Environmental effects (12)
- Natural disasters (6)
- Equipment failure (3)
- Major financial (5)
- Other (5)

For each of the hazard scenarios assessed, MRM has developed controls and actions to be implemented to minimise the risks. The prioritised risk management procedures undertaken by MRM are as follows:

- Continue with more detailed risk assessments at a departmental level to gain improved understanding of the risks relevant to each area and provide documented improvement and contingency plans.
- Continue with the development of the site risk management procedure linking the various levels and techniques for risk reviews and their associated frequencies.
- Document and detail the risk management plans for the extreme and high risk scenarios at a site level.
- Continue and report on action (identified) progress.
- Internal auditing program to confirm existence and effectiveness of the identified controls starting with the highest risk scenarios first.
- Continue risk reduction/existing control improvement activities using the hierarchy of controls linked to the budget planning cycle prioritising highest risk scenarios first.
- Develop a site safety, health, environment and business improvement (risk reduction) plan on a timetable agreed by stakeholders.
- Review the common procedural controls, e.g. Permit system, Modification control, Contractor Management, SH&R Training/Education, Incident Management/Reporting/Analysis, Emergency Planning, and include in the improvement plan.

19.4.2 Open Cut Project

A preliminary hazard study has been undertaken by MRM during the open cut feasibility study is to identify safety, health, environmental and business risks associated with the project. The study considered both the development of the Test Pit and the subsequent open cut project.

For each of the identified hazards, the consequence and likelihood of the hazard occurring was determined and categorised according to the classifications in the following tables.

Table 19.1

Consequence Categories

Level	Descriptor	Example Detail Description		
		People	Business Impact	Environment
5	Catastrophe	Multiple Fatalities	>$10M	Catastrophe – long term, significant legal implications and potential to effect community
4	Major	Permanent Disability / Fatality	$1M to $10M	Major Impact – harm or breach of license conditions or obligations, discharges off site
3	Moderate	Disability/Lost Time Incident (LTI)	$100,000 to $1M	Moderate Impact – external to local area, generally contained on site

Level	Descriptor	Example Detail Description		
		People	Business Impact	Environment
2	Minor	Medical	$10,000 to $100,000	Minor Impact – minimal impact outside the local area
1	Insignificant	Minor	<$10,000	Minor Non-Conformance – no impact, minor breach in procedure

Table 19.2

Likelihood Categories

Level	Measure	Description	Guide
A	Almost Certain	The event is expected to occur in most circumstances	Once per week
B	Likely	The event will probably occur in most circumstances	Once per month
C	Possible	The event might occur at some time	Once per year
D	Unlikely	The event could occur at some time	Once per 10 years
E	Rare	The event may occur only in exceptional circumstances	Once per life of facility (30 to 100 years)

By considering both the likelihood of the hazard occurring and its consequence, it is possible to categorise the risk of each scenario. For example, a hazard which is almost certain to occur and with catastrophic consequences would be rated as an extreme risk, while one that would occur rarely and have insignificant consequences would be rated as low risk. The risks have been categorised as shown in Table 19.3.

Table 19.3

Risk Categories

Likelihood of the Consequence		Consequence				
		Insignificant	Minor	Moderate	Major	Catastrophic
		1	2	3	4	5
Almost certain	**A**	H11	H16	E20	E23	E25
Likely	**B**	M7	H12	H17	E21	E24
Possible	**C**	L4	M8	H13	E18	E22
Unlikely	**D**	L2	L5	M9	H14	E19
Rare	**E**	L1	L3	M6	H10	H15

A risk assessment was then undertaken by combining the consequence and likelihood of each of the identified hazards and categorising them as shown in Table 19.3. The extreme risk scenarios and the high risk scenarios (H10 and above) identified by this risk assessment are shown in Table 19.4. Note that this table is provided only to illustrate the results of the risk assessment and a similar risk ranking was developed for all of the hazards analysed.

Table 19.4

Summary of Extreme and High Risks

No.	HAZARD SCENARIO	CONSEQUENCE RANKING	LIKELYHOOD RANKING	RISK RANKING	ACTIONS RECOMMENDED
1.0	**Project Definition**				
1.1	Project description not clearly defined	4	E	H10	Identify project description (1.8Mtpa O/C project) in Project Management Plan.
1.2	Demolition/Rehabilitation methodology not defined	4	E	H10	To be included as a section of the EIS.
1.3	Inadequate definition of Timetable for Project Activities	3	C	H13	To be referred to from main project plan
1.8	Inadequate Project Capital Expenditure Cost Control	4	E	H10	Defined Responsibilities and Accountabilities in Project Implementation Plan. Plan to define cost control methodology based upon forward estimate to completion principles.
2.0	**Process Description**				
					No extreme or high risk identified
3.0	**Control Philosophy**				
3.1	Surface Water – Inadequate Management of on-site water	4	D	H14	Undertake detailed water management strategy analysis, including identification of additional water storage opportunities including underground.
3.2	Cultural Heritage- Adverse Impact on Sacred Sites	4	C	E18	Obtain AAPA certificate for the areas covered by the project prior to seeking board approval.
3.2	Cultural Heritage – Adverse Impact on Archaeological Sites	4	C	E18	Develop methodology and include in EIS for archaeological study prior to project commencement.
3.7	Social & Community – Impact on current U/G Workers	2	B	H12	Develop Employee Package for workers affected by the change in mining operations
4.0	**Safety and Health (S&H) Incident**				

No.	HAZARD SCENARIO	CONSEQUENCE RANKING	LIKELYHOOD RANKING	RISK RANKING	ACTIONS RECOMMENDED
	Review				
4.1	Inadequate safety systems implemented for the change to Open cut Mining Operations	3	B	H17	Review of Xstrata Internal database of open cut incidents/issues. Employ key operational staff with substantial Xstrata/Industry experience.
5.0	**Inherent Safety**				
5.1	Groundwater – Affect on mining operations	3	C	H13	Undertake a drilling and modelling program to assess the impact of groundwater and include in the EIS.
5.2	Surface Water- Inadequate flood mitigation design for the bund wall	5	E	H15	Undertake business risk and insurance analysis to determine the flood risk mitigation design
5.3	Surface Water - Inadequate civil design for the bund wall	5	E	H15	Employ specialist in wall design for detailed design.
5.4	Surface Water - Inadequate system for pit evacuation in flood event	5	E	H15	Principal Hazard Management Plan to be developed for flood events.
5.5	Adverse geotechnical condition in the open cut.	2	B	H12	Undertake detailed geotechnical assessment of the open cut.
6.0	**Material Hazards**				
					No extreme or high risk identified
7.0	**Safety Risk Criteria**				
					No extreme or high risk identified
8.0	**Health**				
					No extreme or high risk identified
9.0	**Environment**				
9.1	McArthur River Realignment – Impact of Downstream Water Quality - Sediment	3	C	H13	Undertake sediment analysis assessment
9.2	McArthur River Realignment – Impact of Downstream Water Quality – Increased Metals Concentration	4	E	H10	Employ specialist in wall design for detailed design.

No.	HAZARD SCENARIO	CONSEQUENCE RANKING	LIKELYHOOD RANKING	RISK RANKING	ACTIONS RECOMMENDED
9.4	McArthur River Realignment – Modified River Geomorphology	4	E	H10	Undertake geomorphological assessment of McArthur River on upstream and downstream reaches.
9.6	McArthur River Realignment – Modified Fish Habitat	4	C	E18	Maintain river flow characteristics consistent with current in rechannel.
9.9	MRM Tailings Dam – Tailings Spill	5	E	H15	Undertake review of tailings dam design with emphasis on shifting away from Surprise Creek.
9.15	Groundwater – Adverse impact of Open cut on Palaeochannel	4	D	H14	Undertake drilling program to ascertain location and extent of palaeochannel and to determine the interaction with the proposed open cut. Develop groundwater model.
9.16	Groundwater – Adverse Impact of Open cut on permanent waterholes	4	D	H14	Undertake drilling program to ascertain location and extent of palaeochannel and to determine the interaction with the proposed open cut. Develop groundwater model.
9.17	Groundwater- Adverse Impact on water storage in underground voids on surrounding water system	3	C	H13	Undertake geochemical evaluation of water quality in underground void.
9.18	Surface Water – LTA Understanding of Flood Impact	4	D	H14	Undertake flood modelling post construction.
9.19	Surface Water – Structures not designed for flood velocities	5	E	H15	Employ specialist in wall design for detailed design.
9.20	Rehabilitation & Closure – LTA Closure Strategy	4	E	H10	Undertake analysis of options for closure strategy for the open cut void and rechannel. Include in EIS.
9.21	Rehabilitation & Closure – LTA Tailings Dam Closure Plan	4	E	H10	Develop tailings dam closure strategy. Cost into project economic evaluation.
9.22	Rehabilitation & Closure – LTA Open Cut Void Closure Plan	4	E	H10	Undertake analysis of options for closure strategy for the open cut void and rechannel. Include in EIS.

No.	HAZARD SCENARIO	CONSEQUENCE RANKING	LIKELYHOOD RANKING	RISK RANKING	ACTIONS RECOMMENDED
9.23	Rehabilitation – LTA Underground Void Closure Plan	4	E	H10	Undertake analysis of options for closure strategy for the underground void. Include in EIS.
10.0	**Traffic Management, Transport and Siting**				
10.1	Less than adequate onsite traffic management	2	B	H12	Vehicle and traffic management plan layouts to be developed / finalised
11.0	**External Authorities**				
					No extreme or high risk identified
12.0	**Design Guidelines and Codes**				
					No extreme or high risk identified
13.0	**Organisation**				
13.1	LTA Implementation of Project	2	B	H12	An implementation strategy document to be prepared
14.0	**Emergency Facilities**				
14.1	LTA emergency facilities	2	B	H12	Review current onsite emergency facilities.

19.5 Assessment of Risks from Transport Operations

19.5.1 Haulage and Shipping Operations

Road-Trains

Road-trains with covered, side-tipping trailers are used for the transport of concentrate from the mine site to Bing Bong. The trailer arrangement consists of prime movers with quad-axle trailers in a double AB configuration. The road-trains usually have a payload of approximately 120 t. During maintenance periods a lesser configuration may be used.

Road-Train Loading Operations

The drivers follow a set procedure in the loading of the vehicles. When the road-train arrives at the mine site, the first two trailers are positioned for loading. In this position, the vehicle is refuelled if required.

The driver loads concentrate into the trailers using a front-end loader. The loader has a Roll-Over Protection Structure (ROPS) cabin with fully enclosed, pressurised air conditioning and an absolute filtration system. The loading bay is wide enough to allow one trailer to be positioned for loading at a time. Hence the road-train is re-positioned several times to complete the loading activity.

Road Haulage

A distance of approximately 115 km is travelled from the mine site to Bing Bong. The Northern Territory and Federal Governments have upgraded the road to a two-lane highway, including a new section, which bypasses the town of Borroloola.

Currently there are approximately 4,200 haul truck return trips per year between the mine and Bing Bong. With the open cut operation this will reduce slightly to approximately 4,100 trips.

Concentrate Shipping

The layout of MRM's Bing Bong Port Facility is shown in Figure 3.3. The concentrate storage shed at the Bing Bong port facility has the capacity to hold 60,000 t of concentrate. A central ramp divides the shed in half, with the conveyor tunnel creating four compartments. Depending on which compartments are to receive the load, the road-train either proceeds directly into the shed via the western entrance, or proceeds around the site runoff pond and through the eastern entrance.

Stockpile control and maintenance is carried out using front-end loaders to move concentrate away from the truck discharging area near the ramp to be stacked at the rear of the shed compartments. The moist concentrate reduces dust generation during handling.

Carpentaria Shipping Services is the contractor responsible for delivery of the concentrate to the ocean-going ships anchored in the Offshore Transfer Zone. McArthur River Mining staff are responsible for the management of the shore facility and the loading of concentrate onto the MV 'Aburri' (Aburri).

The bulk carrier used to transport concentrate to sea-going vessels was designed specifically for MRM. The dimensions of the Aburri, are 79.95 m by 18.5 m with a draft of 3.5 m and a capacity to carry 3,200 t. The bulk carrier was built to all applicable Northern Territory Marine and Australian Standards and has an International Lloyd's classification of '100 A1'.

A feature of the Aburri is its ability to self-load (from a single shore mounted loading chute) at an average rate of 900 to 1,000 tph and then discharge at an average rate of 900 to 1,000 tph into an ocean-going vessel. The cargo capacity of each consignment may vary from 6,400 to 45,000 t.

The cargo handling system consists of conveyor belts, a plough station (for even distribution of the load within the hold) and a bucket wheel. The bucket wheel is the primary discharge unit that feeds concentrate onto internal conveyors, then onto a discharge boom that reaches across and into the hold of the sea-going vessel. All the equipment is managed by computer process control systems. An overview of all cargo operations both ashore and at sea is maintained through the use of closed-circuit cameras.

Loading Facility

An "Autodock" system is used to secure the vessel in a set position against the wharf using a hydraulic claw and swing arm. This arrangement guarantees precise location under the loading chute and assists with a rapid turn around time during the loading cycle. Twin bow thrusters and twin rudders augment manoeuvrability of the Aburri.

When the Aburri is ready to be loaded, the gantry is positioned out over the edge of the wharf into position above the hold opening. Once in place and "plugged-in", the conveyor can be started and front-end loaders feed the conveyor hoppers located inside the concentrate shed. If the loading chute is not securely in place, the conveyors cannot start.

The chain of command involves the Master of the vessel assuming final responsibility. Two or more experienced people are at all times involved with the loading process.

There is a preventative maintenance program in place aboard the Aburri and at the Bing Bong plant. As part of the program, the plant is inspected and maintained on a continuous basis. Prior to any loading, the conveyor system is briefly operated to ensure that it is functioning correctly. These tests are carried out after a thorough 30-point safety checklist has been signed off.

An interconnecting system between the Aburri and the concentrate loader instigates a shutdown when a fault is detected. This system assists in the prevention of blocked chutes and overloaded conveyors.

Transit Route

Once the Aburri is loaded it disengages its moorings and shuttles out to the ocean-going vessel waiting in the designated and approved offshore transfer zone (Latitude 15°15' to 15°28'/Longitude 136°25' to 136°35') (Figure 1.3). The transfer zone has an average depth, at low tide, of 14.75 m (range 13-16.5 m).

The risk of collision between the Aburri and sea-going vessels is very low as all approaches are carefully controlled. The two vessels are held apart by heavy-duty inflated rubber fenders. The fenders are capable of absorbing extensive pressure and will cushion any relative differential movement that may be generated by average wind and wave conditions. Collision between the Aburri and other vessels, e.g. fishing trawlers, is a minor risk as the Aburri operations are restricted to a predictable transit route within a low traffic density area. The vessel is well lit during times of poor visibility and two radar sets ensure that all other craft in the area are immediately detected.

Navigation lights lining the channel enable 24-hour operation. Accurate direction is provided by a channel leading beacon which emits a bright white light when centred and red and green for either side of the channel when off-centre. The wharf and bulk carrier have adequate lighting for safe night loading operations.

Loading of Ships

The transfer of concentrate cannot commence until the masters of Aburri and the ocean-going vessel are satisfied that all necessary preparations are completed and that the prevailing weather conditions are acceptable. In the nine years of operations there has been only one incident involving contact between the Aburri and mother ship. Environmental conditions in which loading is permitted have subsequently been reviewed and the master's standards amended accordingly.

Once the vessels are secure, the discharge point of the loading boom is positioned in the centre of the nominated open hatch, with the chute below the hatch coaming. The exact location of the discharge point is controlled in both horizontal and vertical planes to ensure an even distribution in the hold of the vessel being loaded. The chute at the end of the discharge boom can be adjusted as required (from a vertical position) to facilitate an even loading profile. The concentrate is progressively fed onto the conveyor belts by the bucket wheel and into the discharge chute with the rate averaging 900 to 1,000 tph.

Fuel Loading

The Aburri is normally bunkered on a monthly basis prior to each loading cycle. Fuel is supplied from a tanker truck that parks adjacent to the bulk fuel store. An underground fuel line has been constructed from the truck discharging point to the northern edge of the shed ramp, from where the line runs above ground to the vessel.

19.5.2 Risk Identification

The following risks to people, the environment or nearby facilities from potential accidents associated with haulage and shipping operations have been identified:

- Injury or death to people from road accidents during haulage operations.
- Spillage of concentrate as a result of road accidents during haulage operations.
- Spillage of concentrate from accidents during barge loading operations.
- Spillage of concentrate from accidents during ship loading operations.
- Spillage of concentrate or fuel from accidents during barge transit.

19.5.3 Risk Analysis

The approach to risk analysis for haulage and shipping activities was to review the change in the level of risk that the open cut operations posed in comparison to the risk posed by the current operations. In order to achieve a comparison, the methodology adopted for the original EIS (Hollingsworth Dames & Moore, 1992) was utilised.

The following changes have occurred since the time the original risk assessment was undertaken:

- The route for concentrate haulage no longer passes through Boroloola.
- The entire route for concentrate haulage is now sealed.
- Traffic flows along the haul route have changed.

Traffic Accidents

Utilising updated information obtained from the Australian Bureau of Statistics and the NT Department of Infrastructure Planning and Environment, the frequency of accidents associated with the open cut operations is presented in Table 19.5.

Table 19.5

Frequency of Accidents on Haul Route (per year)

Route	1992 EIS	Open Cut Operations
Mine to Carpentaria Highway	0.01	0.01
Carpentaria Highway to Borroloola	0.1	0.23
Borroloola to Bing Bong	0.3	0.21

Table 19.5 shows little change in the overall risk profile. This is essentially because of the slight reduction in haul truck movements from the future operations (Section 19.5.1). The majority of the increase in risk along the Carpentaria Highway to Borroloola is associated with the updated accident rate data (non-urban

articulated truck accident rate data changed from 0.4 to 1.0 accidents per million kilometres between 1992 and 2004). The fatal accident rate per year marginally reduced from 0.06 to 0.05 predominantly due to the sealing of the entire haul route.

Spillage of Concentrate from Traffic Accidents

The frequency of accidents resulting in overturning and spilling concentrate during heavy rainfall or into a waterway has been determine and presented in Table 19.6. This shows little change from the existing situation.

Table 19.6

Frequency of Accidents and Spills (per year)

Spill Type	1992 EIS	Open cut Operations
Spill into watercourse	0.00054	0.0007
Spill during rainfall	0.03	0.03

During the history of operations there have been no overturning incidents that have resulted in spillage of concentrate into waterways or during heavy rainfall. A summary of the overturning incidents that have occurred is provided in Table 19.7.

Table 19.7

History of Road Transport Concentrate Spills

Date	Incident
10 May 1999	Inadequately cleaned road-train spilt approx. 0.05 t concentrate onto Carpentaria Highway.
27 October 1999	Rear trailer overturned and spilled approx. 24 t of concentrate on road and adjacent roadside area.
15 November 2000	Loaded concentrate trailer rollover 17 km south of Bing Bong Port.
24 January 2001	Two trailer roll-over spilling concentrate into table drain on the Carpentaria Highway approx. 2 km South of Ryan's Bend turn off.
5 September 2004	The rear trailer of a 3-configuration road-train carrying concentrate along the Carpentaria Highway to Bing Bong detached itself from the 2nd trailer and tipped on its left hand side, spilling a thin layer (approx. 0.04 t) of concentrate across the bitumen. The majority of the concentrate load was contained within the trailer.

Spillage from Barge and Ship Loading

Spills of concentrate associated with barge and ship loading could occur from the following sources:

- truck unloading;
- conveyors; or
- spout to the barge or ship.

A review of the frequencies and consequences identified in the original EIS identified that the risk analysis was still valid for the open cut operation. Hence the risk level for the open cut operations will not appreciably change in comparison to the current activities. This is a result of the conservative assumptions made in the original EIS, particularly in regard to the absence of limit switches (which are present in the current and future operations).

Barge Transit

Spills of concentrate or oil may occur from the following situations:

- grounding of the vessel;
- collision with trawler or jetty; or
- collision with ship or ship's anchor.

A review of the frequencies and consequences identified in the original EIS identified that the risk analysis was still valid for the open cut operation.

19.5.4 Risk Management and Control

Spillage of Concentrate from Traffic Accidents

For the road haulage operation, the two transfer points have been identified as the higher-risk areas for potential spillage. The transfer areas are the loading facility at the mine site and the unloading ramp at the Bing Bong facilities.

The safeguards for loading of the concentrate at the mine site include:

- the loading operation taking place under cover except as specified;
- roads are cleaned using a road-sweeper; and
- a wheel wash for all vehicles leaving the compound.

Safeguards at the unloading ramp at Bing Bong include:

- unloading operation taking place undercover;
- alignment of the road-train in pre-determined, marked positions for tipping;
- tipping position where the side of the trailer extends over the edge of the ramp preventing spills onto the ramp;
- inspection of the road train to ensure that no concentrate is caught up in the system;
- provision of written tipping procedures and sequences; and
- wheel wash for all vehicles leaving the compound.

In the event of an accident that results in the spillage of concentrate, MRM's Major Concentrate Spill – Trucking Incident environmental procedure will be followed. This procedure is available to all personnel and is also located on the MRM intranet website. This procedure requires the road-train driver to undertake or organise the initial communication, notification, traffic control and spill containment. MRM and the haulage contractor will be contacted to clean up the spill as specified in the procedure. The protective cover over each trailer of the road-train assists in minimising the volume of concentrate spilt from the trailer in the vent of a roll-over.

Concentrate Spillage from Bulk Carrier Operations

The preventative measures put in place to address the risks of a spill from the bulk carrier operations are detailed in Table 19.8 below.

Table 19.8

Spill Control Measures for Bulk Carrier Operations

Risk	Control
Spillage from shore loading facilities	• The equipment for concentrate loading onto the Aburri operates on a closed circuit system, ensuring that the shore based system cannot operate unless the Aburri's system is operating, and/or ready to receive concentrate. This 'hand shake' system also ensures that the shore-based loading chute is adequately connected to the Aburri's receipt and distribution system. A failure in any component immediately shuts-down the entire system. Restarting cannot commence until the problem has been rectified. • Prior to any bulk carrier loading, the conveyor system is briefly operated to ensure that it is functioning correctly. These tests are carried out after a thorough 30-point safety checklist has been signed off. • Drainage pipes have been installed through the conveyor tunnel walls to assist with dust clean-up measures. Small amounts of concentrate underneath, or caught up in the conveyor system, can be hosed out through pipes into the wharf sump. Excess water is pumped from the sump into the Site Runoff Pond. • There is a preventative maintenance program in place aboard the Aburri and at the Bing Bong plant. As part of the program, the plant is inspected and maintained on a continuous basis.
Spillage from spout to bulk carrier	• An overview of all cargo operations both ashore and at sea is maintained through the use of closed-circuit cameras. • If the loading chute from the shore to the Aburri is not securely in place, the conveyors cannot start. • Two or more experienced people are always involved with the loading.
Bulk carrier collision with wharf	• An "Autodock" system is used to secure the vessel in a set position against the wharf using a hydraulic claw and swing arm. This arrangement guarantees precise location under the loading chute and assists with a rapid turn-around time during the loading cycle. • The wharf and bulk carrier have adequate lighting for safe night loading operations.
Spillage from transfer of concentrate from the bulk carrier to sea going vessel	• The transfer of concentrate from the bulk carrier to the sea-going vessel will not occur until both masters are satisfied that the conditions are suitable and safeguards are in place.

Risk	Control
Spillage from deck of bulk carrier	• The construction of gutters along each side of the Aburri has allowed efficient clean-up measures to be employed. The decks can be hosed off, with the water collected in a sump near the stern ramp. The water is pumped ashore into the site runoff pond via the wharf sump.
Collision between bulk carrier and sea-going vessels.	• The two vessels are held apart by heavy-duty inflated rubber fenders. The fenders are capable of absorbing extensive pressure and will cushion any relative differential movement that may be generated by average wind and wave conditions.
Collision between bulk carrier and all other craft	• The vessel is well lit during times of poor visibility and two radar sets ensure that all other craft in the area are immediately detected.
Grounding of the bulk carrier	• Navigation lights lining the channel enable 24-hour operation. Accurate direction is provided by a channel leading beacon which emits a bright white light when centred and red and green for either side of the channel when off-centre.

In a worst case scenario, whereby both the control and safety systems fail and concentrate is spilt, cleanup procedures will be implemented immediately. A wharf cleanup will be undertaken with a loader, or similar equipment. Spilt material will be loaded into a vehicle returning the concentrate to the storage shed. Should concentrate spills occur at the offshore transfer area, they will be evaluated on a case by case basis.

In the case of a minor spill, no recovery is planned unless routine monitoring detects a significant and adverse impact on the environment. For a significant spill:

- Visible spillage will be recovered using a suction dredge with the assistance of divers.
- A survey will be undertaken to determine the extent of the spill. The methodology will be consistent with that used in the monitoring program.
- If required, a recovery program would be developed in conjunction with the DBIRD.

Fuel Spillage from Bulk Carrier Operations

The following measures are taken to prevent or minimise an oil spill from operation of the bulk carrier:

- Although capable of carrying 256 t of fuel, the bulk carrier only carries approximately 35 t during loading operations with an average daily consumption of 5 t when operating.
- Carpentaria Shipping Services operate to a ‘No Spills’ Policy and will ensure that all relevant personnel are familiar with the Aburri’s bunkering system.
- The above ground line allows immediate recognition of any leaks or damage to the pipe. The line is regularly inspected during bunkering operations.
- ‘Cam-lok’ hose connections are used to secure the hose to both the truck and the bulk carrier. The hoses are drained of all fuel prior to any couplings being separated after fuel has been transferred. A collection bucket is available to contain small quantities that may remain in hose pockets and separated couplings. Absorbent material is available for minor accidental leaks.

- The Aburri has been designed so that any accidental overfilling of a fuel tank will drain into an overflow catchment tank. The overflow tank located on the Aburri feeds into the day service tank, recirculating the fuel.
- Oily waste is disposed of in a suitable container as part of the general routine clean up and containment procedure.

In the event of a fuel spill, the design of the swing basin results in the containment of the majority of material. In the situation of a spillage, the fuel would be broken up through agitation created by Aburri's engines. A smaller outboard-fitted boat will also assist in this process.

A quantity of "seaclean" or similar product will be available for a general clean up in the event of a fuel spill onto the wharf, or the Aburri's deck. As detergents used to disperse fuel may exacerbate harm to the natural environment, they will not be used.

Lubricating and hydraulic oil is transferred from drums into the bulk carrier's tanks. Any minor spills from the small diameter transfer hose is soaked up with absorbent materials.

As no fuel transfer will take place between the bulk carrier and the sea-going vessel during the concentrate loading, no fuel should be spilt whilst the bulk carrier is at sea. As part of the Aburri receiving classification and registration as a Class 2B coastal cargo vessel, a Shipboard Oil Pollution - Emergency Plan was developed. The Australian Maritime Safety Authority (AMSA) reviewed the plan and approved copies were distributed to the relevant regulatory authorities.

19.6 Incident Management

In the event of an incident on-site, MRM has committed to the following:

- Systems shall be established and maintained for personnel to identify and report hazards and incidents.
- Systems shall be established and maintained for the investigation of all incidents. The investigation shall include steps to ensure essential factors and root causes are identified and that corrective action is taken. The investigation and recording of environmental incidents and complaints occurs.
- A management level appropriate to the potential consequence of the incident shall manage investigations.
- Only persons competent in the incident investigation process shall investigate incidents.
- Corrective and preventive actions shall be prioritised.
- Systems shall be established and maintained to ensure completion of corrective actions. These shall include a process for follow up, close out, and feedback of information to relevant personnel.
- Systems shall be established and maintained to ensure all corporate and legislative recording and reporting requirements are met.

- Systems shall be established and maintained for the injury management and rehabilitation of employees following a work-related injury, illness or other adverse health effect.
- Internal and external complaints related to safety, health and environmental aspects of the operations shall be recorded, acknowledged in writing, and investigated as incidents.
- Incidents and non-conformance investigations shall be viewed as learning opportunities. Lessons learnt and trends arising from incident investigations shall be reported.

To meet these requirements, MRM:

- Established safety and environmental procedures that detail the system for reporting incidents and hazards.
- Developed a system of environmental incident Categories from 1 to 5, whereby Category 1 and 2 incidents are minor, whilst Category 3, 4, and 5 are those with considered reportable to DBIRD and potentially serious environment risk. Generally, only those with potential for serious environmental risk are fully investigated. Complaints are registered as incidents and registered.
- Implemented a system for the follow up of actions and outcomes from incident investigations.
- Trains employees and contractors in the use of the incident reporting procedures and use of the environmental and safety report forms.
- Introduces all new employees and contractors to the incident reporting system and reporting form during the induction process.
- Developed an electronic database for the recording of incidents.
- Developed procedures and systems designed to ensure ongoing treatment and rehabilitation of injured employees.
- Provides ongoing incident investigation training for those personnel required to participate in incident investigations.
- Communicates the outcomes and learning experiences of incident investigations with employees and contractors through the MRM web page, safety meetings, toolbox meetings and notice boards where applicable.

All of these measures will continue to be applied during the open cut operations.

19.7 Emergency Management

19.7.1 Emergency Preparedness

MRM's key requirements of emergency preparedness are:

- The nature and scale of reasonably foreseeable emergencies, related to the MRM site and activities, shall be identified and documented.
- Each site shall develop and maintain the competencies, plans, processes and equipment needed to ensure effective response.
- Emergency preparedness shall be maintained at all times. The system to ensure preparedness shall include:
  - Personnel trained in emergency response.
  - Documented plans and procedures.
  - Procedures to provide support to relatives of personnel who may be involved or affected.
  - Procedures to manage interface with media, authorities and other external agencies.
  - Mutual cooperation arrangements with external emergency services.
  - A process for regular testing and response exercises.
- Relevant emergency response procedures shall be clearly explained to all MRM personnel, contractors and visitors.
- Emergency equipment shall be available in sufficient quantities and shall be maintained in good working order.

To meet these requirements MRM has:

- Developed emergency procedures to ensure appropriate response to any foreseeable emergency situation.
- Provided all required resources to respond to any foreseeable emergency situation, this includes but is not limited to:
  - Emergency first aid centre with state of the art life support equipment.
  - Modern 4WD ambulance.
  - Emergency rescue truck equipped to respond to foreseeable emergency situations.
  - Mine rescue facilities to house the emergency rescue equipment.
  - Four volunteer mine rescue teams of which two are always on site.
  - Regular training sessions for all emergency response personnel with an emphasis on external specialist providers such as: Mine Rescue Service of NSW; NT Fire & Rescue St John Ambulance NT Service; and Australasian Training Services.
- Conduct biennial airport disaster exercises.
- MRM rescue teams compete in NT mine rescue competitions annually to test their capabilities and to benchmark against other teams.

- Conduct regular evacuation drills for all areas of the operation.
- Provide fire training for all new employees and permanent contractors.
- Regularly review emergency procedures.

19.7.2 Emergency Response

Emergency Response Manual

MRM has implemented a comprehensive emergency response system which is documented in its Emergency Procedures Manual. This manual establishes procedures to be implemented in the event of an unplanned event of incident that may include, but is not limited to, the following:

- Fire;
- Flood;
- Chemical spills or product leaks;
- Fume, vapour or gas leaks;
- Explosions;
- Transport accidents;
- Radiation leaks;
- Electric shocks;
- Serious injury/fatality;
- Bomb threat; and,
- Unauthorised entry.

The emergency procedures are reviewed annually for relevance and effectiveness. Any changes arising at any time are communicated to all employees and contractors through the regular safety meetings. All areas of the operation are required to undertake regular evacuation drills.

The emergency procedures will be modified as necessary to incorporate all relevant aspects of the open cut project.

Emergency Response Procedures

When an emergency occurs, the first person at the scene either:

- Dials the emergency number which will put them through to the mill control. The control room operator will obtain from them all the relevant information required in the emergency procedure. The appropriate on-duty personnel will then take control of the emergency situation; or

- Announces the emergency on the appropriate emergency channel for their area of the operation. The appropriate person in that area who will take charge of the emergency will answer this call.

Once the emergency has been reported the Duty Mine Manager takes over as the Incident Controller. All hazardous sites are evacuated and the relevant mine-site personnel and external authorities are notified so that accountabilities can be assigned.

The site's Emergency Response Flowchart is shown in Figure 19.1.

Emergency Response Facilities

MRM has four emergency response teams, one on each crew. There are always two teams available on site at any given time. Each team consists of a maximum of eight members who are drawn from all areas of the operation.

Emergency response equipment on site includes the following:

- Fully equipped 4x4 rescue truck;
- Mine rescue hut at mine portal;
- Mine rescue station;
- 4x4 troopcarrier equipped with first aid equipment;
- 4x4 troopcarrier ambulance; and
- First aid centre.

All emergency rescue teams train for one 12-hour day every four weeks plus undertake specialised training in Darwin. Specialist external trainers are used extensively by MRM to ensure team members are trained in the latest rescue techniques. Some of the external providers include NSW Mine Rescue Service, Fallright International, Air & Gas Systems, NT Fire Brigade, and St Johns Ambulance Service.

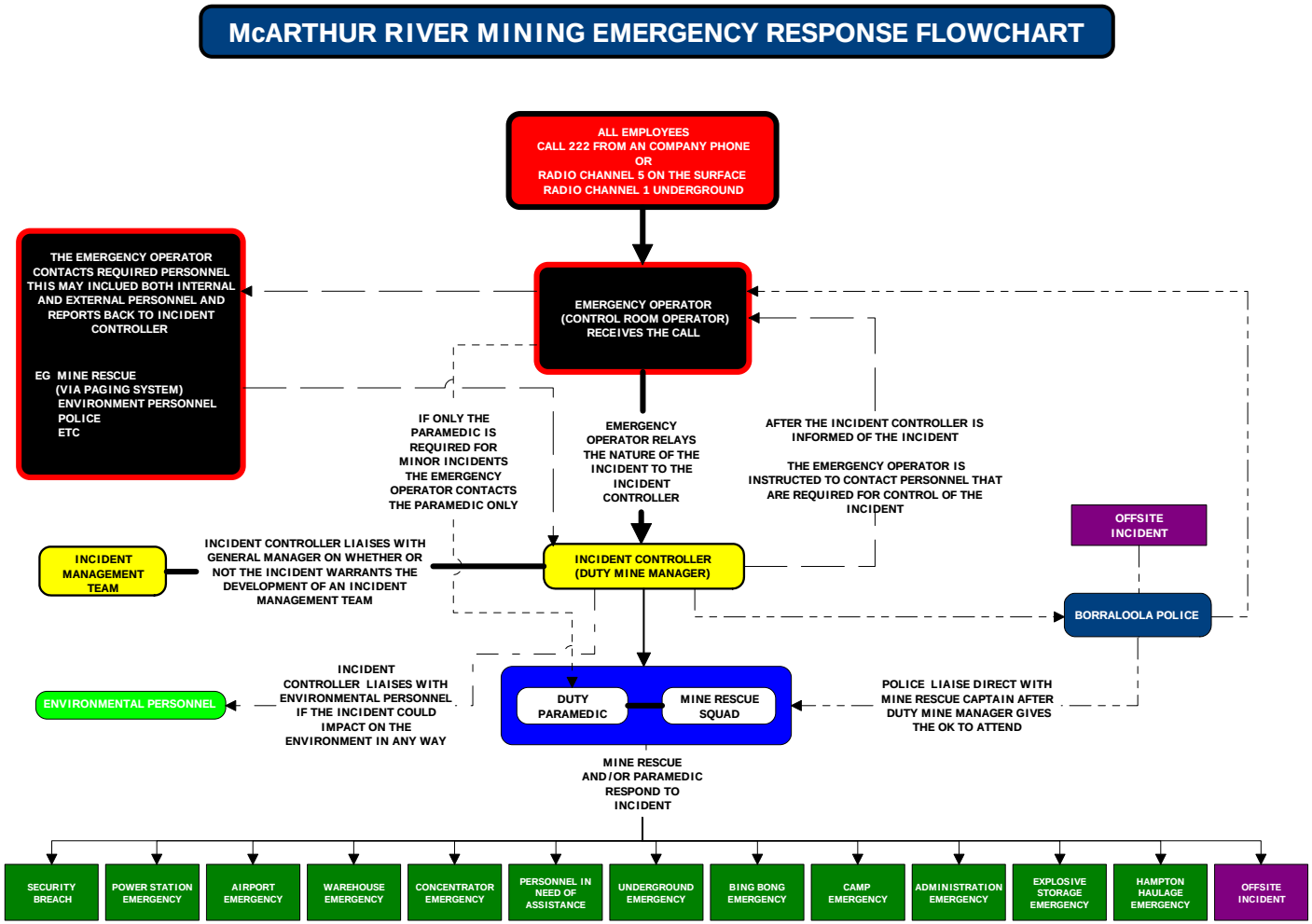

McARTHUR RIVER MINING EMERGENCY RESPONSE FLOWCHART
ALL EMPLOYEES
CALL 222 FROM AN COMPANY PHONE
OR
RADIO CHANNEL 5 ON THE SURFACE
RADIO CHANNEL 1 UNDERGROUND
EMERGENCY OPERATOR
(CONTROL ROOM OPERATOR)
RECEIVES THE CALL
THE EMERGENCY OPERATOR
CONTACTS REQUIRED PERSONNEL
THIS MAY INCLUED BOTH INTERNAL
AND EXTERNAL PERSONNEL AND
REPORTS BACK TO INCIDENT
CONTROLLER
EG MINE RESCUE
(VIA PAGING SYSTEM)
ENVIRONMENT PERSONNEL
POLICE
ETC
IF ONLY THE
PARAMEDIC IS
REQUIRED FOR
MINOR INCIDENTS
THE EMERGENCY
OPERATOR CONTACTS
THE PARAMEDIC ONLY
EMERGENCY
OPERATOR RELAYS
THE NATURE OF THE
INCIDENT TO THE
INCIDENT
CONTROLLER
AFTER THE INCIDENT CONTROLLER IS
INFORMED OF THE INCIDENT
THE EMERGENCY OPERATOR IS
INSTRUCTED TO CONTACT PERSONNEL THAT
ARE REQUIRED FOR CONTROL OF THE
INCIDENT
OFFSITE
INCIDENT
INCIDENT
MANAGEMENT
TEAM
INCIDENT CONTROLLER LIAISES WITH
GENERAL MANAGER ON WHETHER OR
NOT THE INCIDENT WARRANTS THE
DEVELOPMENT OF AN INCIDENT
MANAGEMENT TEAM
INCIDENT CONTROLLER
(DUTY MINE MANAGER)
BORRALOOLA POLICE
ENVIRONMENTAL PERSONNEL
INCIDENT
CONTROLLER LIAISES WITH
ENVIRONMENTAL PERSONNEL
IF THE INCIDENT COULD
IMPACT ON THE
ENVIRONMENT IN ANY WAY
DUTY
PARAMEDIC
MINE RESCUE
SQUAD
POLICE LIAISE DIRECT WITH
MINE RESCUE CAPTAIN AFTER
DUTY MINE MANAGER GIVES
THE OK TO ATTEND
MINE RESCUE
AND/OR PARAMEDIC
RESPOND TO
INCIDENT
SECURITY
BREACH
POWER STATION
EMERGENCY
AIRPORT
EMERGENCY
WAREHOUSE
EMERGENCY
CONCENTRATOR
EMERGENCY
PERSONNEL IN
NEED OF
ASSISTANCE
UNDERGROUND
EMERGENCY
BING BONG
EMERGENCY
CAMP
EMERGENCY
ADMINISTRATION
EMERGENCY
EXPLOSIVE
STORAGE
EMERGENCY
HAMPTON
HAULAGE
EMERGENCY
OFFSITE
INCIDENT

Figure 19.1