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14. Hazard, Safety and Risk

14.1 Overview

This section examines the hazard and risk issues associated with the Hinze Dam Stage 3 project (the project) during the construction and operational phases. The health and safety of project employees and the public are assessed, and mitigation strategies are outlined where appropriate. The hazards are analysed to identify any significant residual risks to human health, safety or natural ecosystems.

The risks to existing environmental values are addressed in detail throughout **Sections 4** to **18**. This section details the specific risks that have a potential to affect the environment and persons within the community and workforce, and have been assessed in consultation with members of the Alliance and GCCC. Specific commitments in relation to the management of risks associated with the project are provided in the Environmental Management Plans (EMPs) presented in **Section 19**.

14.1.1 Legislative Compliance

Table 14-1 identifies the relevant legislation and the regulatory requirements and describes how the project will achieve compliance.

Table 14-1 Legislative Compliance

Relevant Legislation	Legislative Requirements	Compliance
Explosives Act 1999 and AS 2187 'Explosives—Storage, transport and use'.	The Act sets out the requirements for the handling, storage, transport and manufacture of explosives.	The use and handling of explosive materials/ substances will be in compliance with the Explosives Act.
Workplace Health and Safety Act 1995	The objective of this Act is to prevent a person's death, injury or illness being caused by a workplace, by a relevant workplace area, by work activities, or by plant or substances for use at a workplace.	Work practices will be in compliance with this Act.
Building Act 1975	Permit required for the storage of flammable and combustible liquids from Gold Coast City Council.	A Permit to store flammable and combustible liquids will be obtained.
Dangerous Goods Act 1985	Sets standards for the transport and storage of substances and the systems to be adopted based on these substances.	Comply with Australian Standards and implement management systems as defined for the storage and use of substances.

14.1.2 Project Health and Safety Standards

The Proponent will implement the existing Hinze Dam Safety Standards and Occupational Health Standards that are currently in use and provide the basis for effective management of employee and public health and safety. The constructor of the dam will also comply with these Standards via their own safety system.

14.1.3 Inventory of Dangerous Goods

Some of the key hazards for the project are associated with the substances being stored and used for the project. The project will use few hazardous substances which are regulated by the Australian Dangerous Goods Code. **Table 14-2** lists the principal dangerous goods, by name, classification, raw and storage concentration, UN number, and packaging group.

Table 14-2 Indicative List of Dangerous Goods and Hazardous Substances

Chemical Name/ Shipping Name	DG Class	Raw conc. (wt%)	Storage conc. (wt%)	UN Number	Packaging group	Purpose/ Use
Diesel Fuel Oil	3 (Class C1)*	N/A	N/A	1202	III	Fuel for mobile equipment
Unleaded petrol	3	N/A	N/A	1203	II	Fuel for mobile equipment
Solvents (eg. acetone)	3	99.5	99.5	1090	II	Plant maintenance
Bitumen	9	N/A	N/A	3257	III	Road sealing
Liquid Nitrogen	2.2	99.9	99.9	1977	-	Concreting spillway
Lubrication Oils (hydraulic oil)	3 (Class C2)**	N/A	N/A	N/A	N/A	Lubricate plant and equipment
Paints	3	N/A	N/A	1263	III	Paint

* Class C1—a combustible liquid that has a flashpoint of 150°C or less.

** Class C2—a combustible liquid that has a flashpoint exceeding 150°C.

Construction

Table 14-3 provides an indicative list of dangerous goods and hazardous substances and materials, which may be used during construction. The table details the relevant rate of use and maximum amount of the substance/material stored at the site during construction.

The physical properties of these materials are described in **Table 14-2**. Material Safety Data Sheet (MSDS) information will be obtained and communicated to all site personnel involved in the storage, handling, use and disposal of dangerous and hazardous substances and materials.

Table 14-3 Indicative Dangerous Goods and Hazardous Substances – Construction

Chemical Name/ Shipping Name	Rate of Use	Indicative maximum inventory
Diesel Fuel Oil	11,000 litres/day	165,000 litres
Lubrication Oils (hydraulic oil)	20 litres/day	11,000 litres
Unleaded petrol	200 litres/day	1,000 litres
Solvents	As required	<200 litres
Bitumen	As required	N/A Bitumen is brought in from offsite and used immediately
Liquid nitrogen	As required	85,500 m^3

Operational Phase

The key hazards during the operational phase are associated with the substances being stored and used for maintenance activities. However, the use of these is expected to be minimal when compared to the construction phase.

Table 14-4 lists the rate of use and the maximum amount stored on-site during operations. The physical properties of these materials are described in **Table 14-2**. MSDS information will be obtained and communicated to all site personnel involved in the storage, handling use and disposal of hazardous substances and materials, as is the case with the existing project.

Table 14-4 Indicative Dangerous Goods and Hazardous Substances – Operation

Chemical Name/ Shipping Name	Rate of Use	Indicative Maximum Inventory
Diesel Fuel Oil	As required (minor amounts)	2000 litres
Lubrication Oils (hydraulic oil)	As requested (minor amounts)	2000 litres

The major dangerous/hazardous substances shown in **Table 14-4** are diesel or fuel oils. It is vital that approved separation distances are maintained during the storage of these materials/substances as defined in Australian Standard AS 1940-2004: *The storage and handling of flammable and combustible liquids*.

Also, the storage, handling and use of these materials/substances will be in accordance with current Australian Standards (AS), industry codes of practice and best environmental management practices (BEMP). Given the implementation of appropriate controls for these materials there is negligible risk to employees, adjacent land users, general public and the environment.

14.2 Project Risk Assessment Methodology

The major risks and hazards associated with the construction and operation of the project are identified in this Section. The methodology employed in the study, the preliminary identification of hazards, an assessment of the risks and the safe guards to ensure risks are minimal and controlled are also discussed.

Note that this assessment deals with occupational health and safety hazards and those that affect the public or the environment. Occupational hazards at this site are similar to those of any construction or workplace site and need to be managed by sound workplace health and safety procedures.

The preliminary hazard and risk assessment involved in the following:

- the identification of intended operations and the proposed design of the facilities (described in **Section 3**);
- the identification of hazards and potential operational problems using a modified form of a Hazard and Operability (HAZOP) study (referred to as a preliminary hazard analysis (PHA) for the process of constructing the dam raising, in line with Queensland practice;
- a summary of these scenarios in the form of hazard review tables;
- the identification of possible causes and consequences from the hazards and their detection and protection mechanisms;
- a preliminary qualitative assessment of the major risks associated for each hazardous scenario;
- a preliminary qualitative assessment of the major risks from natural hazards and external risks to major infrastructure;
- a series of recommendations on the most appropriate environmental and quality management systems needed, in regard to key scenarios and potential impacts; and
- an outline of key items for an emergency response plan.

A preliminary hazard analysis (PHA) was undertaken for the EIS. A quantitative and failure impact (risk) assessment will be conducted during the detailed design following Australian National Committee on Large Dams (ANCOLD) guidelines. The PHA identified the key events that might have an impact on surrounding land uses from the associated construction and transport activities. The study considered all relevant hazards, both minor and major, for all activities related to the proposed development.

14.2.1 ANCOLD – Risk Assessment Methodology

The *Water Act 2000* provides the regulatory framework for dam safety of water dams in Queensland and requires that the owners of referable dams must operate and maintain dams in accordance with the Guidelines on Acceptable Flood Capacity for Dams (DNRW 2007c).

These guidelines state that, except for where specified otherwise, the dam safety risk assessment procedure should be carried out in accordance with the following guidelines:

- ANCOLD Guidelines on Selection of Acceptable Flood Capacity for Dams (ANCOLD, 2000a);
- ANCOLD Guidelines on Assessment of the Consequences of Dam Failure (ANCOLD, 2000b);

- NRW Guidelines for Failure Impact Assessment of Water Dams (DNRW, 2002) (for the dam breach sizes and timings and the estimation of Population at Risk);
- ANCOLD Guidelines on Dam Safety Management (ANCOLD, 2003a); and
- ANCOLD Guidelines on Risk Assessment (ANCOLD, 2003b)

ANCOLD determines Dam Hazard Categories on the basis of the consequences of failure of a particular dam and are given in **Table 14-5.**

These will be applied to the dam raising. Categories of environmental effects have been included in this table.

Table 14-5 ANCOLD Dam Hazard Impacts (Consequences)

High	Medium	Low
Loss of life expected because of community or other significant developments downstream	No loss of life expected, but the possibility recognised. No urban development and no more than a small number of habitable structures downstream	No loss of life expected.
Excessive economic loss such as serious damage to communities, industrial or commercial or agricultural land or facilities, important utilities, the dam itself or other storages downstream	Appreciable economic loss, such as damage to limited land areas, secondary roads, minor railways, relatively important public utilities, the dam itself or other storages downstream	Minimal economic loss, such as farm buildings, limited damage to agricultural land, minor roads. Etc
Repairs to dam not practicable. Dam essential for services	Repairs to dam practicable or alternative sources of water/power supply available.	Repairs to dam practicable. Indirect losses not significant
Substantial to irreversible reduction of a species/habitat or National or State significance with little prospect of recovery to pre-impact conditions.	Reduction of a species/habitat with regional significance	Impacts to abundance of flora and fauna in the affected environment limited to a localised effect as species and habitat abundant in the region.

Source: Adaptation from ANCOLD 2003(a)

The risk criteria guidelines available were utilised as a guide only.

Each part of the operations was assessed to identify the hazards, their causes and consequences (or impact). The potential impact was assessed with regard to the public and the environment.

The hazard detection and protection measures for each construction and operation activity are also described in the review tables. These measures are taken into account when the risk assessment is undertaken to determine the residual risk.

The assessment involves rating each hazard for the level of impact, exposure and frequency expressed as L for low, M for medium and H for high. The residual risk rating was determined using a risk calculator which combines the impact, exposure and frequency rating of the hazard.

The Impact category relates to the severity of the possible consequence (as shown in **Table 14-5**). The level of exposure relates to how often the receptor is exposed to the hazardous element.

The frequency category is determined as follows:

- low if the hazard is expected to occur once every 100 years;
- medium if it could occur once every 10 years; and
- high if it could occur once every year.

Historical data were assessed, where available, to indicate the possible frequency of the hazardous events. Where the data were not available, the frequency was based on the experience of experts closely involved in the industry.

Outlines of emergency planning and safety management systems as part of the overall risk management strategy were also addressed.

Definitions

The following definitions were used in this assessment:

- **Risk**: The probability of an adverse event occurring. The likelihood of a failure occurring with adverse consequences, chance of failure to perform, or chance of harm are alternative definitions; and
- **Hazard:** The potential loss of life, property or services.

Currently, the risks posed by the existing Hinze Dam do not satisfy the ANCOLD guidelines for societal risk and individual risk for existing dams.

The main contributing failure modes are piping through the right abutment foundation and flood overtopping. Upgrade works would be required to reduce the risks to an acceptable level even if the dam was not being raised.

14.2.2 Australian Standard AS/NZS 4360 – Risk Assessment Methodology

This section presents the assessment method and results for the hazards and risks associated with the proposed project identified through the use of a hazard identification and risk analysis technique.

The risk assessment was carried out in accordance with the appropriate 'Guidelines for Hazard Analysis' and Australian Standard AS/NZS 4360:2004 Risk Management. This risk assessment was carried out by the Alliance, based on their experience with construction and operational projects.

The assessment outlines the implications for, and the impact on, the surrounding land uses. The preliminary hazard analysis incorporates:

- relevant hazards (minor and major);
- the possible frequency of the potential hazards, accidents, spillages and abnormal events occurring;
- indication of cumulative risk levels to surrounding land uses;
- life of any identified hazards;
- the effects and rate of usage of the hazardous substances to be used, stored, processed or produced contained in **Table 14-2** to **Table 14-4**; and
- the type of machinery and equipment used.

Potential incident scenarios from the operations at the dam were identified through consideration of:

- the range of activities carried out and facilities present during the construction and operation phase. These included construction activities, energy supply, excavation, and handling; and
- the range of potentially hazardous incidents that might be associated with each of the activities/ facilities identified at the site.

The identification of hazards is aided through the application of a prompt list. The list is based upon the possibility of a damaging energy occurring as a result of a loss of control of that energy. Not all energies are relevant to this project as can be seen from the list of identified potential hazards below:

- Animal
- Biological
- Chemical
- Electrical
- Falling objects
- Falls, slips and trips
- Fire & explosion
- Kinetic
- Manual handling
- Mechanical
- Noise
- Proximity
- Pressure
- Radiation
- Temperature
- Vibration
- UV
- Interface
- Sharp
- Vacuum
- Dust, fume, vapour
- Stressors
- Confined spaces

Having identified the range of hazards likely to occur at the site, the following matters were considered for each hazard:

- appropriate controls and mitigation factors expected to be put in place for the management of each hazard. These may include prevention and response measures;
- the consequences of each of the hazardous incidents if they were to occur. Consequences might include direct impacts of incidents and the potential for propagation and secondary incident. Assessment of the severity of the consequences takes into consideration the proposed mitigation measures listed;
- possible causes and the probability of these causes occurring and leading to the hazardous incident identified. The probability of each hazardous incident occurring takes into consideration the proposed control measures;
- this information was then tabled to prioritise the risks and evaluate these risk levels against acceptable risk criteria; and
- where an extreme or high risk was identified, appropriate, controls and mitigation measures were identified to reduce the risk further and/or provide monitoring to identify changes to the risk.

These potential incident scenarios, including potential consequences and prevention, protection or mitigation measures are outlined.

14.2.3 Risk Analysis Criteria

The risk assessment matrix, which is shown in

Table 14-8, is a tabular portrayal of risk as the combination of the probability of occurrence and consequence severity. Potentially hazardous incidents are identified for the facility or system under consideration and represent each potential incident having identifiable causes and consequences.

The consequences may vary from a safety or health consideration to an environmental outcome. Where applicable, risk scores for both consequences are recorded in the risk assessment. The consequence and probability are plotted on the risk assessment matrix in order to determine the risk level. The risk assessment matrix presented in

Table 14-8 is based on the model contained in AS/NZS 4360:2004 Risk Management.

The highest risk incidents are judged to have the highest priority for consideration of additional risk reduction options. Low risk incidents are subject to the normal, ongoing improvement process and operational controls.

A likelihood of occurrence was assigned to each identified hazardous incident based on definitions shown in **Table 14-6**. The contribution of the preventative and protective features was taken into account when assessing the likelihood of occurrence and potential consequence from each hazardous incident. The likelihood of occurrence also assumes that any recommendations provided in this document are implemented. The risk levels denote the residual risk for the most likely scenarios.

The consequences assessed include both threats to the natural environment and to health and safety of the public based on definitions shown in **Table 14-7**. Where a hazardous incident may have several outcomes, each potential outcome was assessed in turn.

The risk scales and risk matrix for consequence and likelihood are based on the Australian Standard AS/NZS 4360:2004 Risk Management and HB436: 2004 Risk Management Guidelines. The shading and numerical coding in the risk matrix at

Table 14-8 refers the qualitative bands of risk level. Risk ranks from 1 to 8 are considered to be 'extreme', 9 to 16 are 'high', 17 to 20, 'moderate' and 21 to 25 'low'.

Table 14-6 Likelihood of Occurrence for Hazardous Incidents

Probability rank	Descriptor	Description
A	Almost certain	The event is expected to occur in most circumstances
B	Likely	The event will probably occur in most circumstances
C	Possible	The event could possibly occur at some time
D	Unlikely	The event could possibly occur at some time but is unlikely
E	Rare	The event may occur only in exceptional circumstances

Table 14-7 Consequence Classes for Health and Safety and Environmental Losses

Consequence rank	Descriptor	Health and Safety	Environment
1	Catastrophic	Fatality	Irreversible detrimental effect to off-site natural resource.
2	Major	Permanent disability	Prolonged but reversible detrimental effect to off-site natural resource.
3	Moderate	Hospital treatment	Short term detrimental effect to off-site natural resource with full recovery.
4	Minor	Medical treatment	Minor detrimental effect to on or off-site natural resource and promptly contained/cleaned.
5	Insignificant	First aid	On site release with no damage to natural resource.

Table 14-8 Risk Assessment Matrix

	Consequence				
Likelihood	5	4	3	2	1
A	15	10	6	3	1
B	19	14	9	5	2
C	22	18	13	8	4
D	24	21	17	12	7
E	25	23	20	16	11

The colours in the risk matrix denote the general bands of risk as defined below.

Low	Moderate	High	Extreme

14.3 Construction Hazard Identification

The main hazards during construction of the dam extension (including the decommissioning of temporary works) that have been identified are listed in **Table 14-9**.

Table 14-9 Hinze Dam Raising Construction

Hazard or Event	Possible Causes	Possible Consequences	Detection/Protection Measures
Excavation to expose the Stage 2 earth fill core and the upstream filter zones	Seepage through the remnant embankment under flood surcharge conditions	Unravelling and failure of the main embankment	Construction phase during dry season Flood and wind monitoring/ warning system
Crane is submerged during dam raising.	High water flow High winds	Loss of life, Short term, minor degradation of water quality	Construction phase during dry season Flood and wind monitoring/warning system
Failure of dam embankment	Structural Failure Unpredicted heavy rainfall event Poor maintenance Inadequate design or construction	Delayed release of water followed by a surge downstream with an approximate 20 m wall of water; loss of life	Design according to category of installation determined by Failure Impact assessment according to ANCOLD standards. Use of fail safe devices Develop Emergency Action Plan Remote monitoring by maintenance crew
Major flood during construction causing 'wash out'	Unpredicted heavy rainfall event	Loss of works, increase in litter in river	Construction timed to occur during dry season. Undertake weather monitoring. Construction activities phased to minimise potential 'wash out impacts'
Flood during construction impacts embankment	Unpredicted heavy rainfall event	Consequence related to magnitude of flood	Construction flood risk assessment to be carried out
Spill of hydrocarbons or chemicals, concrete spills, or sedimentation	Spill or leakage of fuel or lubricating oil	Short term, minor degradation of river water quality, Short term, minor land contamination	Construction activities to operate to approved EMP Provide spill clean up kits Provide means and guidelines for containment and responsible disposal

The major hazards resulting in the possible loss of life which ranks as a high impact / consequence has been identified to be:

- high water flow or high winds causing the crane to become submerged during dam construction; and
- high water flow causing unravelling and failure of the main embankment.

Before floods can be directed through the spillway, the dam wall must be at or approaching its final height and the spillway excavation must be almost complete. During the time the dam embankment is being built, there is a risk that a flood will occur that cannot be directed through the spillway and which might therefore overtop and wash away the partially completed dam embankment.

All other hazards associated with the construction of the project raising are minor.

14.4 Operation Hazard Identification

The hazards due to operating the dam have been identified are listed in **Table 14-10** and discussed in this Section.

The hazards involve the following:

- Dam failure, piping or overtopping;
- Electrical Systems;
- Flooding;
- Public Safety; and
- River Water Quality.

A Risk Assessment of the main hazardous elements is provided in the following Section.

Table 14-10 Hinze Dam Raising Operation Risks

Hazard or Event	Possible Causes	Possible Consequences	Detection/Protection Measures
Sudden failure of dam	Vandalism Structural Failure Poor maintenance Inadequate design/ construction	Delayed release of water followed by a surge downstream with an approximate 20m wall of water; loss of life	Design according to category of installation determined by Failure Impact assessment according to ANCOLD standards. Use of fail safe devices Regular maintenance Develop Emergency Action Plan Remote monitoring by maintenance crew
Flooding	Presence of dam	Different lands/habitats being inundated	Ensure potential flooding zone does not affect significant habitats or residents where possible.
Drowning in Dam	Public access	Injury/Loss of life	Provide adequate signage to warn public of any dangers Restrict primary contact recreation if possible
Water quality of dam reduced	Inundation of vegetation Recreational activities	Gold Coast potable water supply reduced	Remove vegetation before inundation Develop an Algae bloom action plan. Inspection of algae levels in dam
Changes to current downstream river ecology	Water release flows and schedules do not mimic current environmental conditions Barrier to passage of aquatic life	Reduction of current populations due to: reproductive and life cycle ecology altering from changes in spawning and migration queues; barrier impacts on migratory species so do not complete life cycle.	Ensure fish lock is adequate Mimic environmental flows with release patterns Maintain downstream riffle areas Survey for relevant indicator species' population Log water release flows and schedules Review schedules after survey
Increase in Inundation area	Reservoir changes water depth, flows, temperatures, plant and bed habitat	Displacement of species, change to/reduction of shallow habitat including riffles resulting in reduction in numbers of species].	Maintain upstream and downstream riffle areas Determine status of vulnerable species Determine if possible to relocate vulnerable species Continue to monitor numbers of these species

14.4.1 Dam Failure, Piping or Overtopping

The consequence of sudden dam failure would be the sudden release of a 20m wall of water downstream. It is expected that this wall would cause great damage due to the close proximity of urban areas further downstream. If anyone was in the path of this wall due to recreational activities, then loss of life could result which is a high hazard. This failure is further assessed in the Risk Assessment Section.

The process of a piping failure can be divided into the four phases: 1) erosion initiation of the embankment, 2) erosion continuation 3) progression to form a pipe, and 4) formation of a breach. These phases were incorporated in the analysis along with the likelihood that the development of a piping hole is detected and if intervention is attempted, if it is successful in preventing the breach of the embankment.

Overtopping could occur either by wave action for reservoir levels at or below the dam crest or by sheet flow over the embankment for reservoir levels above the dam crest.

14.4.2 Electrical Systems

The electrical and control systems that may be used on the site were reviewed. The control system does not in itself constitute a significant risk and so is not discussed here. It is primarily used to control risks and help mitigate effects.

The major hazards are restricted to the site and involve the potential for fire from short circuiting and electrical leakages. Uncontrolled water release or containment would also be possible from power grid supply failures. The consequence of this event could be upstream flooding or a sudden release of water downstream. However, these hazards are minor.

14.4.3 Flooding

Flooding within the impoundment area of the dam may result in adjacent properties being inundated. The probability of this happening is not changed by the increase in capacity of the dam. However, the consequence changes because different lands will be subject to flooding. Flood levels will however rise more slowly thus providing more warning.

Risk of minor flooding downstream of the dam will be reduced. For major floods, there will be more warning of floods and delay to flood peaks. Hence, the impact of the raising of the dam upon flooding is not significant.

14.4.4 Public Safety

It is planned to continue to allow primary contact recreation or kayaking, boating or other similar recreational activities within the dam impoundment.

Fishing and passive enjoyment from the banks of the impoundment will be allowed at a number of designated access points. Access is restricted to the nominated vehicle access points, generally associated with the provision of recreation facilities. These are all located within the CID boundary.

However, in the event of public access to the reservoir, drowning is a possibility, which is hazardous and therefore, subject to assessing the level of risk.

14.4.5 Water Quality

The schedule of the downstream flows, if significantly different to current environmental flows, can impact on ecology. The consequence could be a reduction in current aquatic populations that are significant to the area.

Therefore, the impact of this consequence on the downstream river ecology was rated as medium. The impact will be reduced to low as the majority of downstream flow releases will not be altered from existing conditions.

The extra length and depth of inundation due to the raising of Hinze Dam is minimal compared with that which already exists in the Nerang River and due to the extent to which river modification has already been undertaken. Therefore, it is expected that any hazardous impact on habitat quality will be minor.

14.5 ANCOLD Requirements

14.5.1 Risk Assessment

The existing Hinze Dam and proposed upgrade as described in **Section 3** meets the definition for a large dam under the Australian National Committee on Large Dams (ANCOLD) Inc. Glossary of Definitions, Term and Abbreviations as noted below.

A large dam is defined as one which is:

a) More than 15 metres in height measured from the lowest point of the general foundations to the 'crest' of the dam (meets this criteria);

b) More than 10 metres in height measured as in (a) provided they comply with at least one of the following conditions (meets this criteria):

   i. The crest is not less than 500 metres in length (meets this criteria).

   ii. The capacity of the reservoir formed by the dam is not less than 1 million cubic metres (meets this criteria).

   iii. The maximum flood discharge dealt with by the dam is not less than 2000 cubic metres per second. (meets this criteria).

   iv. The dam is of unusual design (Does not meet this criteria).

Hence an initial assessment of the consequences was undertaken in line with the ANCOLD Guidelines on Assessment of the Consequences of Dam Failure.

The EIS addresses the required inputs for an initial consequence assessment as defined in the Guideline. This information includes:

- dam and reservoir data (refer **Section 3**);
- topographical data (refer **Section 4**);
- flood characteristics (refer **Section 3** and **Section 7**);
- downstream community information (refer **Section 16**); and
- natural environment (refer **Section 9** and **Section 10**).

Examination of this information justifies the following conclusions set out in **Table 14-11**:

Table 14-11 Hinze Dam – ANCOLD Consequence Assessment

Consequence	Assessment
Flood affected zone	The zone downstream of the Hinze Dam is mainly northward from the site in populated locations.
Potential damages and losses	The affected areas are limited to the following: the land required to upgrade the dam, including quarry sites; value of the water in storage and localised environmental impact to the nearby environment.
Population at risk	Populations downstream of the dam have an exposure.
Other considerations	The project will be an extension to the existing dam and the ANCOLD Guidelines on Design and Safety Management are required to be complied with to mitigate this risk. The remainder of the issues in this section are addressed in the above conclusions.

To assess the risks posed by the construction and operation of the dam, the major credible hazards (as identified above) were individually examined and each was assigned a value for frequency, exposure and impact. The major hazards have an impact of 'High' as they resulted in possible fatalities.

In determining the resultant risk levels, mitigation and control measures were taken into account, even if these were only identified as being applied at the time of design, construction or operation. It is expected that the approval to construct and operate the project would be dependent on these conditions being met.

Table 14-12 below lists the credible hazards and the assessed values for the various inputs and the resultant individual risk level.

The standard approach has been taken in relation to acceptability of risks, as follows:

- HIGH: This level of risk is not tolerable. Additional or alternative mitigation strategies to be implemented to reduce risk to lower level;
- MEDIUM: This level of risk is acceptable provided all possible efforts have been made to reduce risk where those efforts have a positive cost benefit ratio (apply the principles of ALARP – As Low As Reasonably Practical); and
- LOW: This level of risk acceptable with normal management procedures.

Table 14-12 Major Credible Hazards – Construction and Operation

Hazard or Event	Frequency	Exposure	Impact	Residual Risk
Sudden dam failure	H	L	H	M
Public safety	L	L	H	L

The main hazardous events involved with constructing and operating the project are a sudden dam failure and public safety.

The essential cause of a sudden dam failure is due to poor design and construction leading to a breach. The frequency of this kind of failure is not expected to occur often and so, has a low rating. The impact has the potential to be high. These ratings result in a residual risk of medium.

The proposed Stage 3 design addresses the issue of piping above the top of the Stage 2 core by connecting the new clay core into the existing core and extending the new core to crest level.

For the proposed Stage 3 design, the estimated annual probability of failure by flood overtopping is extremely low (in the order of 3.5E-10 per annum) due to the increase in flood capacity to handle the Probable Maximum Flood event. The estimated Annual Exceedance Probability (AEP) of the PMF is in the order of 1 in 20 million.

Concrete structures will be checked for earthquake behaviour according to USACE Guidelines Response Spectra and Seismic Analysis for Concrete Hydraulic Structures EM 1110-2-6050 June 1999. A Probabilistic Seismic Hazard Assessment is being prepared to improve the level of confidence in the seismic design criteria, given the critical nature of Hinze Dam in terms of primary water supply for the Gold Coast and hazard in terms of the population at risk downstream of the dam.

The proposed Stage 3 design reduces the dam safety risks to an acceptable level.

To ensure the frequency is kept to a minimum the following measures will be implemented:

- design according to category of installation determined by Failure Impact assessment according to ANCOLD standards;
- use of fail safe devices;
- regular maintenance;
- develop Emergency Action Plan; and
- remote monitoring by maintenance crew.

The other hazard involving public safety will have a low frequency and a low exposure due to public access being restricted. Therefore, the residual risk is low.

14.5.2 Risk Summary

The analysis of the hazards indicates that off-site risks to the public and to the environment are moderate. In terms of this preliminary risk assessment, it is considered that the risk levels are tolerable, but every effort will be made to both reduce and confirm the risk levels.

The major risks are summarised as follows:

Dam Construction/Operation - Sudden dam failure

Medium risk - all features of design and construction to follow ANCOLD guidelines which dictates that a Failure Risk Assessment must be performed.

Dam Operation – public safety

Low risk - provide adequate signage to ensure the public are aware of the dangers of recreation in and around reservoirs.

14.5.3 Commitments

The major potential hazards from the dam operations were identified to be due to sudden dam failure.

The project is deemed to be a referable dam and as such will require a Failure Impact Assessment Study prior to undertaking detailed design.

The following commitments are made, based on the preliminary hazard review:

- completion of a Failure Impact Assessment Study according to ANCOLD guidelines;
- development of safety management systems for all of the operations will be done in line with current guidelines as published by ANCOLD(b);
- emergency planning will be implemented in line with Queensland and Australian Emergency Planning Guidelines Codes of Practice; and
- an Emergency Plan detailing each potential hazardous scenario on the site, including evacuation plans and emergency response will be documented prior to dam commissioning.

14.5.4 Dam Safety

The commitments specific to ensuring that the project is constructed and operated safely, are summarised in this Section.

Design

The following commitments are made with respect to design of the proposed dam upgrade:

- suitable materials for dam raising will be identified;
- design will take into consideration the load and strengths of construction materials to ensure that the dam wall integrity is maintained in the long term;
- instrumentation will be included to allow adequate monitoring during construction and operation; and
- a quantitative Risk Assessment will be carried out according to ANCOLD (b); including HAZOP analysis of the operating elements associated with the release mechanisms.

Construction

The following commitments are made with respect to construction of the proposed dam extension:

- actual conditions will be checked against design assumptions and specifications and amendment of the design made as appropriate;
- detailed records including as built drawings of all stages of construction will be maintained;
- detailed records will be kept during the initial filling stage; and
- design report with associated data will be prepared.

Operations and Maintenance

An updated Operations and Maintenance manual will be prepared for the dam. This should include procedures for the following:

- operating the dam under normal conditions;
- coordination with other flow regulating structures within the catchment;
- maintaining environmental flows;
- coordinating with emergency response and counter disaster agencies;
- flood warning;
- maintaining the dam, associated structures and associated equipment in accordance with the designer's operating criteria;
- a program for surveillance and monitoring of the dam and all associated structures and equipment to allow for early detection of faults and deficiencies;
- recording and reporting of routine and non-routine surveillance;
- remedial action in the event of faults or deficiencies being identified by surveillance; and
- periodic review, at five yearly intervals or when changes or other circumstances dictate.

The manual will be written such that persons unfamiliar with the dam can operate it properly. This is particularly important in an emergency situation.

14.6 AS 4360 Risk Assessment

14.6.1 Construction Risks

Using the risk scales and risk matrix detailed in **Section 14.2.3** a hazard and risk assessment during construction has been undertaken. This is shown in **Table 14-13**.

The assessment takes into account the various aspects of the project, such as spillway construction, intake tower construction, rockfill dam construction, rock quarry, borrow pit, saddle dam construction and other infrastructure construction. The risk rating includes appropriate mitigation and management measures and as such represents the reduced or residual risk.

- **Table 14-13 Risk Assessment Table – Construction Phase**

Hazards	Proposed controls	Environment			Health and Safety		
		C	L	R	C	L	R
1. Dust from road and earthworks.	1. Water trucks.	5	C	22	5	C	22
	2. Speed limits.						
2. Traffic incidents on site	1. Traffic management plan.	4	D	21	3	D	17
	2. Safety inductions for workers.						
	3. Speed controls.						
	4. Radio communications in vehicles.						
	5. Dust Management						

Hazards	Proposed controls	Environment			Health and Safety		
		C	L	R	C	L	R
3. Construction activity hazards	1. Fall from heights controls.				3	D	17
	2. Experienced supervision.						
	3. Safety management systems.						
	4. Equipment inspection and selection.						
3. Construction activity hazards	5. Formal design safety practices.						
	6. Welding safety practices.						
	7. Contractor and supplier selection.						
	8. Personal Protective Equipment (PPE).						
4. Slump of sloped ground	1. Rollover Protective Structures (ROPS) fitted to equipment.	5	D	24	3	D	17
	2. Geotechnical investigation and design.						
	3. Drainage Controls.						
5. Leaks of oil, fuel, chemicals or concrete from vehicles onto construction earthworks, or within impoundment	1. Refuelling in designated areas fitted with spill containment.	4	C	18			
	2. Storage and handling in accordance with AS1940.						
	3. Material used in construction will be stored and used in an appropriate fashion to ensure containment.						
6. Pests (weeds) brought to site by earthmoving equipment	1. All vehicles must be washed down and inspected prior to arrival on site.	4	D	21			
7. Blasting	1. Explosive materials handled and used incompliance with current Australian Standards (AS2187)/best environmental management practice.	4	D	21	1	E	11
	2. Explosive materials will only be made by licensed contract personnel as and when required.						
	3. Explosives will only be handled and used by competent Contractor personnel.				3	D	17
	4. Sources of ignition will be strictly controlled.						
	5. Blasting procedures including separation from the blast zone.						
	6. Storage of detonators shall be in accordance with the *Explosives Act 1999*, Part 4 Division 6.						
8. Bushfire	1. Facilities and equipment will be inspected and tested for fire safety on a regular basis.	3	D	17	4	D	21
	2. Relevant site staff will complete fire safety training during induction.						
	3. Access maintained for fire fighting						
	4. Develop response plan in accordance with Gold Coast Water procedures						
9. Contact with high voltage electricity	1. Secured access				1	E	11
	2. Qualified electricians.						
	3. Control of Energy (isolations) procedure						
10. Excessive noise	1. Design and operate all equipment to comply with the *Environmental Protection (Noise) Policy 1997*.	5	C	22	5	C	22
	2. Noise emission requirements included in vendor information for the evaluation process.						
	3. Personal Protective Equipment provided.						

C – Consequence
L – Likelihood
R – Risk

Note that the health and safety risks in the above table generally refer to worker exposure on-site.

14.6.2 Operations Risks

Using the risk scales and risk matrix detailed in **Section 14.2.3** a hazard and risk assessment during operation has been undertaken. This is shown in **Table 14-114**.

- **Table 14-14 Risk Assessment Table – Operations Phase**

Hazards	Proposed Controls	Environment			Health and Safety		
		C	L	R	C	L	R
1. Traffic incidents on site	1. Traffic management plan.	4	D	21	3	D	17
	2. Safety inductions for workers.						
	3. Speed controls.						
	4. Radio communications in vehicles.						
2. Leaks of oil, fuel or chemicals from vehicles during site operations	1. Major equipment maintenance to be conducted in dedicated facilities.	4	C	18			
	2. Refuelling in designated areas fitted with spill containment.						
	3. Storage and handling in accordance with AS1940.						
	4. Material used in operation will be stored and used in an appropriate fashion to ensure containment.						
3. Bush Fire	1. Facilities and equipment will be inspected and tested for fire safety on a regular basis.	3	D	17	4	D	21
	2. Relevant site staff will complete fire safety training during induction and thereafter on an annual basis.						
	3. Facilities on site will have an approved fire alarm, detection, suppression and fighting system designed and installed in consultation with the relevant fire control authorities.						
	4. The existing GCW bushfire response plan will be upgraded to include the upgraded dam facilities.						

14.6.3 Risk Assessment - Conclusion

The information contained in **Table 14-13** and **Table 14-4** shows that the risk profile for the proposed facility is generally 'Low' or 'Moderate' with the exception of safety risks from blasting, and contact with electricity which have been assessed as 'High' risk.

It should be noted that these are assessed as high since there is significant energy involved and the controls can only address the probability of the event. These risks are common to most construction projects. Blasting is covered specifically in **Section 14.7**.

There are no 'Extreme' risk scenarios identified. There are no identified extreme or high risks to off site facilities, persons or the environment.

An overview of the management of the risks identified through this assessment is detailed in the following sections. Further details are provided in the EMPs contained in **Section 19.**

14.7 Construction and Operations Risks Controls

14.7.1 Emergency Response

Designated first aid and emergency rescue facilities and equipment will be available during the construction and operation phases, as is the case with the existing operation. Appropriately trained personnel will be available

throughout the life of the project to provide first aid and emergency response to on site emergencies. First aid response and provision will be included in site induction training that will be provided to all staff members.

Stores, workshops and offices will be fitted with approved and certified fire detection (smoke detectors) and sprinkler systems. First aid and fire fighting equipment (hand held extinguishers and fire hoses) will be installed at strategic points within each building. Fire fighting equipment and exit locations will be suitably signed. All work areas will be within the required distance to reach emergency exits.

Induction training will include fire response techniques. The site will have a fire truck or suitably equipped water truck or trailer that can support fire response requirements. Site fire fighting capabilities also will be addressed in the Emergency Response Plan.

Fire drills will continue to be undertaken on a regular basis. Permanent facilities, such as fuel storage areas, will have a dedicated fire alarm, suppression and fire fighting systems.

The dam constructor and operator will liaise with local State Emergency Services and local ambulance and hospital services with respect to planning for Emergency Response.

14.7.2 Risk Control Measures

Dust

The project will implement particulate and gas/vapour exposure standards and procedures that will apply to dust, fibres, mist and fume (i.e. particulates), and gas and vapour exposures in the workplace, (with emphasis on inhalation as the primary route of exposure).

The standards and procedures cover, amongst other things, evaluation of particulate and gas/vapour hazards, and development of a control program to ensure that employees and contractors will not suffer adverse health effects from particulates or gas/vapours, either used or generated by the project. Where required, the dust control program will include engineering controls and use of respiratory protection devices.

The health risks are expected to be low. Dust will increase risk of vehicle accident during construction. Dust from earthmoving machinery will be controlled by water trucks and adequate haul road maintenance. The nearest residences are within a kilometre from the site but are not expected to be adversely affected by dust during construction or operation (see **Section 11**).

Noise

All equipment (both fixed and mobile) will comply with the relevant Australian Standard in regard to design and operating noise levels.

The project will continue to implement hearing conservation standards and procedures during construction and operation to ensure that employees and contractors will not suffer adverse health effects from noise generated in the workplace.

These standards and procedures cover, amongst other things, the identification and evaluation of occupational noise hazards and development of noise control programs to minimise noise levels and protect employees and contractors from adverse exposure. Where required the noise control programs will include use of hearing protection devices.

Pests

The project is not expected to lead to an increase in the number of pests during construction or as a result of expanded site operations.

Waste

Waste will be managed to avoid adverse impacts on the health of the construction workforce and minimise risk of impact on land, air and water.

There will be small amounts of wastes generated during construction. This waste will consist of scrap steel, timber, concrete, general waste, recyclable waste and some hazardous waste from the operation and service of equipment.

During the construction phase, food wastes, paper and recyclables will be generated in communal areas. Colour-coded, signed bins will be used to segregate and collect these wastes. The bins will be located throughout offices and canteen areas to achieve maximum economic waste recovery.

Waste materials that are known to attract vermin will be stored and handled in a hygienic manner. General wastes will be transported for disposal to the nearest landfill.

Standard procedures will be in place during construction to contain and limit damage from accidental release of waste materials, such as oil spillages. Standard procedures for the storage, containment, disposal and spill response for potentially hazardous waste materials will minimise potential impacts associated with these materials/substances.

Operational activities are not expected to generate significant amounts of waste. The health risks presented by operational wastes are low.

Chemicals

The chemicals used during the construction and operation phases will be relatively benign. Fuel (predominantly diesel), lubricants, oils, minor quantities of solvents, degreasers and domestic cleaning agents will form the majority of chemicals on site (refer **Table 14-3**).

All hydrocarbons will be stored and handled in accordance with Australian Standard 1940:2004 The storage and handling of combustible and flammable liquids. In the event of leaks or spills, chemical storage areas will be suitably bunded and constructed to minimise the potential for leaks to cause environmental harm. Spill kits will be kept at storage locations and in plant. All chemicals will be stored, handled and used according to provisions in their MSDS. The health risk presented by these chemicals is relatively low.

14.7.3 Workforce Construction and Operation Safety Issues

The key hazards to the workforce identified with the construction and operation phase are discussed below, along with appropriate prevention, detection and protection measures.

Equipment

Construction vehicles and equipment will be operated within the manufacture's specifications. All vehicles and equipment will be maintained and serviced on a regular basis. Machinery and equipment operators will be trained and carry the current licenses, where necessary. The health risk presented by equipment/machinery operation is considered low. The key hazards identified with the operations are also shown below, along with appropriate prevention, detection and protection measures.

Vehicle Collision and Driving Conditions

Vehicles on the construction site are likely to include front-end loaders, graders, rollers, water trucks, dump trucks and light vehicles (four-wheel drives) that operate on roads and access roads around the project. Collisions between these have the potential to cause serious injury to operators and passengers.

Construction workers operating vehicles on-site will be trained and licensed, so that these vehicles are driven in a safe and appropriate manner. Speed control (signage), driving to conditions, and prescribed driving etiquette on the site will be used to control the risk. All vehicles will be fitted with radios for two-way communication.

Maintenance of haul roads and access areas will be undertaken regularly to suppress dust and improve visibility. The risk of injury is confined to construction personnel, and the hazard is considered moderate.

Watering of roads and access areas will be undertaken regularly to suppress dust and improve visibility.

The potential for injury from vehicles on the construction site is confined to construction personnel and animals, and the risk is considered moderate.

Personnel Interaction with Machinery

Personnel may be at risk of interacting with construction machinery, parts from vehicles and earth moving equipment, resulting in the potential for serious injury. The hazards from interaction with machinery may occur during construction and the movement of heavy equipment.

Although the potential for injury is moderate, strict adherence to the project's work place health and safety rules and established safety systems will reduce the likelihood of occurrence.

Fuel Storage (Mobile and Static)

Fuel storage on-site will be predominantly diesel, which presents a relatively low combustion risk and a moderate environmental risk. Ignition sources will be controlled to avoid fire involving bulk fuel oil. Fire fighting facilities will be provided at fuel storage facilities.

All hydrocarbons will be stored and handled in accordance with Australian Standard 1940:2004 The Storage and handling of combustible and flammable liquids. Chemical storage areas will be suitably bunded and constructed to minimise the potential for leaks to cause environmental harm.

Standard operating procedures for the storage, containment, disposal and spill response for potentially hazardous materials will be developed. The use of Australian Standards (AS 1940) for the management of fuel storage (bunding and containment) and inspections will reduce this risk to a low level.

The hazard associated with the storage of fuel oil arises from leaks/ failures in the system. To minimise the hazards associated with fuel oil leaking during tanker unloading, the following measures will be in place:

- a program of regular equipment inspection and testing will be continued to ensure reliable performance;
- operators will continue be trained in the safe operation of the system and emergency procedures in the event of fuel oil leakage;
- spill containment equipment will be available at the unloading pad for use in the event of spillage;
- a sump will be provided to collect any spillage and allow recovery;
- ignition sources will be strictly controlled and limited to avoid a fire;
- appropriate fire fighting materials and equipment will be available to suppress fires; and
- an approved fire protection system will be installed around new hydrocarbon storage areas.

The following measures will be taken to minimise the potential for the leakage of fuel oil from storage tanks:

- adequate bunding will be constructed to contain spills, in accordance with AS 1940;
- tank level indicators will be installed on fuel oil tanks for monitoring of fuel oil levels;
- maintenance of fuel oil tanks will be undertaken, to ensure safe and effective operation of all components; and
- tanks will be designed in accordance with AS 1692: 2006 Steel tanks for flammable and combustible liquids to minimise the potential for failure of the diesel storage vessel.

Blasting and Misfires

Blasting creates a number of potential risks such as dust, noise, vibration and fly-rock and air-blast effects. Fly-rock and air-blast effects can cause serious personal injury if not properly controlled and therefore create a high risk to the workers. Mitigation measures include the use of blasting experts to undertake safe blast design, control of access (including temporary mine site road closure) and evacuation warnings before blasting. Personnel in the vicinity of a blast will continue to wear Personal Protective Equipment (PPE) and all personnel will observe safe distances during blasting activities.

Proper stemming will be used in the preparation of charges and appropriate charge ratios will be used to limit the amount of fly rock produced by a blast. Blasting operations will continue to be carried out by an explosive contractor, which has an established record of operation in the mining industry and adherence to the Australian Explosives Manufacturer Safety Committee (AEMSC) Code of Practice.

Blasting misfires include incomplete detonation of the blast. This may reduce or confine the blast impact, and may pose safety issues to personnel re-entering the area of blast misfires. The training and management of the blast crew will be required to ensure appropriate knowledge and skill by personnel involved in blasting activities. Safety procedures will be strictly adhered to on site to limit the probability of the hazard occurring.

High Voltage Exposure

Powerlines will be affected by the project and will require relocation. Specialist electrical engineers will undertake this using approved codes of practice and procedures.

Relocating electricity infrastructure, and electricity use from lighting and the electrical operation of infrastructure will require the use of potentially lethal levels of voltage and amperage. There will be specific and detailed standard operating procedures implemented that deal with high voltage. The residual high risk can be managed by ensuring the preventative controls are well implemented and monitored.

Working at Height and Falling Objects

There will be instances where workers are required to work at height during the construction phase (e.g. buildings/ infrastructure). The Proponent will plan activities to eliminate the requirement to work at heights where practical. However, where working at heights is unavoidable, Safe Operating Procedures for working at height will be used to control this risk. Mandatory PPE on a construction site that protects against objects falling from height includes steel capped boots and hard hats (both are worn at all times). Fall of persons will be controlled through appropriate elevated work platforms and the proper use of harnesses.

The residual risk is moderate with these controls, as safety statistics during construction activities indicate that injuries caused from falls do contribute significantly to work related injuries.

During operations, there will also be instances where operators are required to work at height during maintenance or repair duties. Safe Operating Procedures for working at height will continue to be used to control this risk.

The residual hazard is still high, as safety statistics at construction sites indicate that injuries caused from falling objects and falls do contribute significantly to work related injuries. Hence the preventative controls must be strictly enforced.

Transportation

Licensed transporters operating in compliance with the Australian Dangerous Goods Code will undertake the transport of dangerous goods to the construction site.

During construction, licensed transporters will continue to undertake the transport of dangerous goods (ammonium nitrate) to the project site. The transport of ammonium nitrate will be undertaken in compliance with the requirements of AS 1678.5.1.002-1998: Emergency procedure guide - Transport - Ammonium nitrate.

14.7.4 Security

The construction area will be enclosed with suitable fencing. Fencing will protect selected areas with high risk of a security breach or unauthorised public access. After hours security patrols will be active through out the construction phase of the project.

Prior to being given access to the project site, visitors will complete mandatory registration and an environmental, health and safety induction. The scope of induction will reflect those areas of the project site that the visitor will be permitted access.

Access to the construction site will be denied to any site staff/visitor not wearing the following mandatory personal protective equipment (PPE):

- safety helmet;
- steel cap boots;
- safety glasses; and
- high visibility clothing.

14.7.5 Explosives

A specialist explosives company will provide the ammonium nitrate, emulsion, detonators and boosters to be used during blasting operations. The Contractor's personnel will be licensed and trained in the transport, handling, mixing and use of explosive materials. ANFO will be mixed on-site by the explosives company in a dedicated area. Blasting operations will comply with the *Explosive Act 1999*.

The location of the explosives and associated activities will be based on the requirements of AS2187.1- 1998 Explosives—Storage, transport and use Part 1: Storage and Section 2 Design Requirements and take into consideration:

- public risk;
- enhancing physical protection to the public by the use of natural ground features;
- vehicular access routes and junctions with public roads;
- security;
- other activities within the proximity of the site; and
- protection from flood, fire, landslide, lightning or other natural incidents.

14.7.6 Future Risk Assessment

A hazard and operability (HAZOP) study will be carried out for construction and operation. Operations risk assessment such as Failure Mode Effect Analysis and Job Safety Analysis shall be carried out on mechanical and task based exposures.

14.7.7 Monitoring

Monitoring will be undertaken to assess whether project health and safety measures are being implemented and effective. Monitoring will involve the compilation and assessment of data relating to health and safety issues, such as reported near misses, accident reports and any health surveillance data (sickness data).

Accident and near miss data will be monitored to identify where:

- common themes occur;
- PPE is being incorrectly used/abused;
- corrective actions have not been strictly implemented

- corrective actions are ineffective;
- procedures/practices need to be reviewed; and
- retraining may be required.

14.8 Community Safeguards

14.8.1 Approach

It is vitally important that the impacts of the proposed dam upgrade have minimal impact on the local communities around the Gold Coast. The community safeguards will be implemented through a, 'safety in depth' or 'defence in depth' approach where there exists a layered approach to public and environmental impacts.

These safeguard layers come in two principal forms:

- the design of processes to, 'best engineering practice' standard; and
- the implementation of safety management systems and emergency planning appropriate for the hazards involved in the operations.

Many of the design issues related to the project have been discussed in the hazard review in the previous Sections which outlined the detection and protection mechanisms that should be in place.

Using the 'defence in depth' approach the 'inner layer' deals with the actual engineering designs and these are usually often dictated by Australian Standards and industry codes of practice as specified by ANCOLD. The outer layers of the approach can include:

- continuous regulation and control;
- alarm systems;
- fire detection and suppression systems;
- local and site emergency procedures; and
- off-site emergency procedures.

Elements of all of these items will be implemented where the hazards dictate.

14.8.2 Safety Management Systems

The safety management system adopts an integrated approach to risk management of the dam raising construction and operations, recognising the hazards at all points in the operations and how these are controlled.

The safety management system will comprise many of the 'defence in depth' layers but should also include the following:

- strict review of modification and design procedures;
- policies for managing change (new technology, new procedures);
- assessment of human factors in the design and operation;
- training programs for operators;
- internal standards and codes of practice;
- process and equipment integrity including preventative maintenance and procedures;
- documentation and propagation of process knowledge to operators and engineers;
- accident investigation procedures;
- enhancement of safety knowledge and its dissemination to staff;

- high quality risk and compliance auditing; and
- clear statements of risk management objectives and goals.

These issues will be addressed by the Alliance as the project progresses using proven systems that have been developed and refined on previous projects.

14.8.3 Emergency Planning

Emergency planning represents the outer layers of the 'defence in depth' approach to community safeguards. The emergency planning that will be undertaken will be based on the following components:

- analysis of the key incidents likely to take place for each operational area;
- assessment of the degree of impact likely to occur;
- assessment of what constitutes 'an emergency' for the particular operation;
- on-site plan to handle incidents;
- off-site plan with reference to emergency services needed;
- communication, emergency responsibilities, control centre establishment;
- post emergency procedures, including recovery, debriefing and review of plan; and
- test the plan under emergency-like conditions.

General guidance for preparing emergency plans can be obtained from the Queensland Government, Department of Emergency Services. In particular, the recent Australian-New Zealand code of practice for emergency planning will form the basis for the detailed development of the plans covering the individual areas.

The final detailed plans will be developed the detailed engineering design progresses. This will involve local emergency services such as police, fire brigade and state emergency services personnel as well as the local emergency response groups.

14.8.4 Emergency Action Plan

An Emergency Action Plan (EAP) or Dam Safety Emergency Plan will be developed and will include the following:

- identification of emergency conditions which could endanger the integrity of the dam;
- dam operation procedures to follow in the event that such emergency conditions are identified;
- warning systems for downstream communities;
- notification listing or flowchart – identifying responsibility for notification, the order of notification and who is to be notified;
- roles and responsibilities – of the dam owner, operator and dam personnel;
- area map – showing the access routes to the storage during fair and adverse weather conditions, including distance and travel times;
- a drawing of the Storage Catchment Area;
- emergency Events and Actions List - detailing typical problems, problem characteristics and when/ what to check for during inspections;
- a dam failure inundation map – this should identify: downstream inhabited areas subject to danger, inundated areas, a narrative description of areas affected by dam break; and
- any other charts, rating tables, considered by the dam owners as necessary.

14.9 Public Liability

For the construction phase public liability and protection of infrastructure will be managed by the Alliance with closure of the area to the public, so there is no public access to the construction site. Protection of infrastructure will be maintained by ensuring the Alliance has identified all assets and undertakes construction in a way that does not damage this infrastructure or cause a reduction in service provided by the dam and associated infrastructure.

During the operational phase the risk to the public will be essentially the same as it is currently. As such public liability will be managed by GCCC based on current arrangements.