20. Hazard and risk

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20.1 Introduction

20.1.1 Overview

This section describes the hazard and risk assessment undertaken for the Lower Fitzroy River Infrastructure Project (Project). The hazard and risk impacts from the Project are assessed and methods by which these impacts can be reduced are identified. The assessment addresses Section 8 of the terms of reference (ToR) for the environmental impact statement (EIS). A table cross-referencing the ToR requirements is provided in Appendix B. While the vulnerability of the Project to extremes of climate and natural hazards is described in Chapter 4 Climate, natural hazards and climate change, a risk assessment detailing the potential threats of these hazards to the construction and operation of the Project is provided in this chapter.

Legislation and policies addressing Commonwealth and State counter-terrorism and critical infrastructure protection are addressed within confidential documents provided separately to the Coordinator-General in accordance with Section 8.17 of the ToR.

20.1.2 Methodology

20.1.2.1 Hazard and risk assessment methodology

For the purposes of the EIS, hazard identification focuses on events arising from the construction and operation of the Project that may result in impacts on people and property. The assessment involved:

- Identifying sensitive community and environmental receptors
- Reviewing those aspects of the Project that might present a hazard to community health and safety and the environment
- Evaluating risk associated with each hazard
- Proposing risk mitigation measures
- Reviewing residual risk with mitigation measures in place
- Developing a risk management plan including emergency management for identified scenarios such as leak detection and fire prevention/detection.

Potential scenarios for the different phases of Project were identified by considering:

- The proposed activities that will be undertaken during the construction and operations phases
- The range of potential hazardous events associated with each of these activities occurring as a single event or cumulatively.

In accordance with the requirements of the AS/NZS ISO 31000: 2009 Risk management – Principles and guidelines, a preliminary risk assessment has been performed to identify hazards and corresponding risks for the construction and operations phases (Section 20.3 and Section 20.4, respectively). Each potential hazard and its associated cause and consequence was identified. Based on the consequence and likelihood, a risk ranking was determined from the risk matrix. The risk criteria matrix used to rank each of the hazards is shown in Table 20-1. The definitions of likelihood and consequence criteria have been adapted from AS/NZS ISO 31000: 2009 and Proponent Risk Assessment Matrixes and are shown in Table 20-2 and Table 20-3, respectively.

Table 20-1 Risk and significance matrix

		Consequence				
		Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Likelihood	Almost Certain (5)	Medium	High	High	Very high	Very high
	Likely (4)	Medium	Medium	High	High	Very high
	Possible (3)	Low	Medium	High	High	High
	Unlikely (2)	Low	Low	Medium	Medium	High
	Rare (1)	Low	Low	Medium	Medium	Medium

Table 20-2 Likelihood of occurrence

Descriptor	Description	Probability
Almost certain	Is expected to occur in most circumstances	>0.95
Likely	Will probably occur in most circumstances	0.95 to 0.1
Possibly	Might occur at some time	0.1 to 0.01
Unlikely	Could occur at some time	0.01 to 0.001
Rare	May occur in only exceptional circumstances	Less than 0.001

Additional risk reduction measures were identified for high risk incidents while low risk incidents would be subjected to normal operational controls and continual improvement processes. The contribution of preventative and protective measures was considered when assessing the likelihood and consequence for each hazardous incident.

The principle focus of risk assessment studies is off-site impacts which affect people, property and surrounding land uses. While the risk assessment includes certain risks to workers while onsite, workplace health and safety hazards are not included in this risk assessment. Statutory processes exist under the *Work Health and Safety Act 2011* (Qld) to manage workplace hazard and safety risks.

The risk assessment undertaken assumes that there will be an ongoing hazard and risk assessment throughout the life cycle of the Project and that this will focus on minimisation of risks to the environment and community as well as workers on the site. As the Project becomes operational, the proponent will gather more information during the operational phase and conduct a detailed evaluation of risks. Decommissioning risks will be determined based on operational experience and applicable legislations and standards at the time. Relevant authorities will be consulted as a part of the Project decommissioning process.

Table 20-3 Consequence of occurrence

Descriptor	Life/health/safety	Property	Environment	Social	Governance / cost	Programme
Insignificant	No fatalities or injuries possible	No damage to property possible, No financial loss.	No measurable adverse impact	Little disruption to community.	Additional costs of <$50,000. Readily accommodated cost increase. No community impact.	< 1 week of delay
Minor	Possibility of injury but no fatalities. First aid treatment of injuries	Some damage possible but repairable.	Small adverse impact on environment with no long term effects.	Some personal support required, some disruption for short period.	Additional costs of $50,000 to $500,000. Minor impact on proponent. Local community impact.	1 week - 1 month of delay
Moderate	Medical treatment would be required, perhaps hospitalisation. No fatalities	< 4 houses destroyed. Low financial loss	Some adverse impact on environment with no long term effect and is reversible.	Normal community functioning with some inconvenience. Displacement of people for short period (<24 hrs)	Additional costs of $500,000 to $5,000,000. Moderate impact on proponent costs. Wider community and /or media interest.	< 3 months of delay
Major	Extensive injuries; 1 to 2 fatalities; significant hospitalisation	Localised damage which can be rectified. 4 to 50 buildings destroyed. Medium financial loss	Some adverse impact on environment with long term effect. Damage to offsite flora or fauna.	Large numbers displaced, external resources required for community support Possible damage to lifeline infrastructure	Additional costs of $5,000,000 to $50,000,000. Major impact on proponent costs. Potential show stopper. Significant community impact and widespread media coverage.	3 - 6 months of delay
Catastrophic	3 or more fatalities, extensive hospitalisation and severe injury	Wholesale destruction of property expected, >50 buildings	Major adverse impact on environment with long term or irreversible effects. Major damage to or death of offsite flora or fauna.	Widespread displacement for extended duration. Community unable to function without significant support. Loss of lifeline infrastructure	Additional costs of > $50,000,000. Show stopper. Significant community impact and widespread media coverage with potential political implications. May also include major costs incurred by community.	Anything that causes delay to the contingent supply strategy

20.1.2.2 Other relevant assessments

A number of other assessments have been undertaken during Project design to identify risks and improve safety. These include:

- Dam failure impact assessment

  A separate failure impact assessment has been undertaken to determine the number of people whose safety could be at risk (population at risk) should the weirs fail.

- Failure mode analysis

  A failure mode analysis has been completed for both weirs to identify the means by which component failures would have to occur to cause loss of system function. The analysis involved:

  – Identification of failure initiating events for analysis
  – Identification of weir components for evaluation of failure modes
  – Analysis of failure modes for each component
  – Identification of failure modes for input into detailed design.

- Gate fault tree analysis

  A fault tree analysis is a systematic method for examining the reliability of a system. A fault tree analysis has been undertaken for both weirs to assist in the development and understanding of the operations and controls systems for the proposed crest gates. The analysis assessed the following:

  – The probability of failure per use of the gates in a flood where the gates could fail to operate
  – The probability of failure during sunny day conditions where the gates could fail by inadvertent lowering resulting in uncontrolled reservoir release through the lowered gates
  – The probability of failure per use of the gates after a flood where the gates would fail to raise causing loss of storage.

- Flood hydrological investigations

  Flood hydrological investigations were undertaken to estimate peak flow rates along the Fitzroy River at various locations including at the Eden Bann Weir and the proposed Rookwood Weir site, this included undertaking flood frequency analysis and developing a flood hydrology model.

20.1.3 Regulatory framework

Legislation and project approvals are discussed in Chapter 3. The following standards and guidelines and legislation are applicable to the Project:

- Australian Code for Transport of Dangerous Goods by Road and Rails, Seventh edition.
- Australian National Committee on Large Dams, Guidelines on Risk Assessment, 2003
- Australian/ New Zealand AS/NZS 31000:2009 Risk management – Principals and Guidelines
- Australian Standard HB 203 2012: Managing environment related risks
- New South Wales Department of Planning's Hazardous Industry Planning Advisory Paper No 4 Risk Criteria for Land Use Safety Planning, 2011

- New South Wales Department of Planning's Hazardous Industry Planning Advisory Paper No 3 Risk Assessment, 2011
- Queensland Government, Department of Natural Resources and Mines, Queensland Dam Safety Management Guidelines 2002
- Queensland Government State Planning Policy (DSDIP 2013)
- *Water Act 2000* (Qld)
- *Water Supply (Safety and Reliability) Act 2008* (Qld)
- *Work Health and Safety Act 2011* (Qld)
- *Work Health and Safety Regulation 2011* (Qld).

20.2 Existing environment

20.2.1 Human health and safety

Community health and safety values during construction include air quality, noise and vibration levels and traffic and road safety. Values associated with air quality and noise and vibration are discussed in the Chapter 12 Air quality and Chapter 14 Noise and vibration. Traffic and road safety has been assessed in Section 20.3.3.

The Project location is rural in nature and relatively isolated and, as a result, there are few sensitive receptors in proximity. Air quality (Chapter 12) and noise and vibration (Chapter 14) sensitive receptors have been identified in proximity to construction activities and access roads as listed in Table 20-4. The majority of homesteads that occur along existing access roads to the weir sites and river crossings are set back from the road at distances greater than 200 m. Where homesteads exist immediately adjacent to access roads (for example, along Riverslea Road) these sections of the road are sealed. Construction (and operation) traffic for the proposed Rookwood Weir will exit the Capricorn Highway at Gogango. The Gogango community comprises a small number of residences (less than ten) and a school. Existing access through Gogango comprises a bitumen-sealed road.

Table 20-4 Human sensitive receptors

Receptor		Nearest construction area/activity	Distance from construction area/activity
No.	Type		
1	Homestead	Eden Bann Weir and existing access road	• 750 m from the existing Eden Bann Weir • 450 m from the existing (and proposed construction) left bank access road
2	Homestead	Glenroy Crossing	700 m
3	Out buildings	Riverslea Crossing	700 m
4	Gogango town	Rookwood Weir access and Riverslea Crossing access	<50 m
5	Homestead	Rookwood Weir	3.5 km
6	Homestead	Foleyvale Crossing	2.2 km
7	Homestead	Hanrahan Crossing	3.1 km
8	Homestead	Eden Bann Weir access road (right bank)	2.0 km

As a result of construction activities and workplace health and safety requirements, the camping and water reserve area immediately upstream of the proposed Rookwood Weir site will not be accessible during the construction period and is therefore not considered as a sensitive receptor.

No onsite accommodation (for example, temporary worker's camp) is proposed at either Eden Bann Weir or Rookwood Weir during construction. However, the onsite construction workforce is considered to be a sensitive receptor for the assessment of human health risk during construction activities.

As detailed in Chapter 11, water quality in the study area is influenced by interactions between a range of human-induced and environmental drivers, occurring at the local to basin-wide scale. High cyanobacteria cell densities occur at various times throughout waterways of the Fitzroy Basin (Noble et al. 1997). However, no large toxic algal blooms have been recorded in the system (Nobel et al. 1997).

The Fitzroy River is used for recreational activities including fishing and boating (motorised and non-motorised). However recreational use is largely restricted to the downstream reaches, within the Fitzroy Barrage impoundment at Rockhampton and the Fitzroy River estuary.

20.2.2 Emergency services

Rockhampton City is the closet regional centre to the Project. The Rockhampton Base Hospital is the largest hospital in the region. Emergency Management Queensland (EMQ) for the Central Region coordinates Queensland's emergency and disaster management arrangements and disaster mitigation programs and provides the core staffing for the Queensland Disaster Management System. EMQ also manages the State Emergency Service (SES), Emergency Service Unit volunteers, EMQ Helicopter Rescue and Emergency Services Cadets, amongst others. Regional operations are delivered through the Regional Operations Branch.

The Queensland Fire and Emergency Service (QFES) operates its Central Region from Rockhampton and incorporates the Queensland Rural Fire Service. Similarly, the Central Region of the Queensland Ambulance Service (QAS) operates from Rockhampton and the Queensland Police Service (QPS) Police Complex is located in Rockhampton.

20.2.3 Land use

The Project is located in a rural area, with beef cattle grazing the predominant land use. The large rural properties common to Project areas are generally served by unsealed roads, often single lane, branching from the major arteries of the Bruce and Capricorn highways. The main activity occurring on properties affected by the Project is cattle breeding and/or fattening (Chapter 5 Land). There is also some crop cultivation and a small number of properties with irrigation licences. The most common use of the river is for stock watering with cattle generally accessing the water via hardstand areas or via pump/trough systems.

20.2.4 Environmentally sensitive receptors

Potential environmentally sensitive receptors are identified as follows:

- Tributaries and creeks along the route for fuel transport from Rockhampton to Eden Bann Weir along the Bruce Highway, Atkinson Road, Mona Vale Road and Eden Bann Road
- Tributaries and creeks along the route for fuel transport from Rockhampton to Gogango and then to Rookwood Weir along Capricorn Highway and Thirsty Creek Road

- Forested areas along Atkinson Road
- Great Barrier Reef World Heritage Area downstream of the Project
- The Fitzroy River turtle and other threatened species and migratory species as identified and discussed in Chapter 7 Aquatic fauna and Chapter 8 Terrestrial fauna
- Endangered regional ecosystems in proximity to construction areas as identified in Chapter 6 Flora.

There are no national parks or conservation reserves within the Project footprint. Aricia State Forest is located adjacent to the existing Eden Bann Weir impoundment.

20.2.5 Natural or induced hazards

20.2.5.1 Climate related hazards

Climate extremes and natural hazards that affect the Project area are described in Chapter 4 and include:

- Flooding - Major floods can result from the Dawson or the Mackenzie rivers. Significant flooding in the Rockhampton area can also occur from heavy rain in the local area below Riverslea, on the Fitzroy River which is near the proposed Rookwood Weir site
- Tropical cyclones - The Project area is located within the Australia Eastern Region for cyclone activity. For the period 1906 to 2006, 12 cyclones were recorded crossing within 100 km of Rockhampton
- Severe storms - Severe storms in the region are generally confined to the spring and summer months and occur on average at least twice per year
- Extreme temperatures - Using the threshold for temperature within the top five per cent of daily maximum temperatures for a continuous three-day period, Queensland has experienced at least 18 heatwave events since 1899.

20.2.5.2 Bushfires

The Queensland Government's State Planning Policy mapping identifies the areas within and adjacent to the Eden Bann Weir Project footprint as medium to very high risk bushfire hazard areas. The areas along the Fitzroy River within and adjacent to the Rookwood Weir Project footprint are classified as medium to high risk while areas along the Mackenzie and Dawson rivers are generally classified as medium risk with a few areas of high risk.

20.2.5.3 Seismic activity

A seismic hazard assessment undertaken for the Project by the Seismology Research Centre (a division of Environmental Systems and Services) (ESS 2009) informs this section. Due to Australia's position within a major tectonic plate, its relative tectonic activity is low compared with countries situated near plate boundaries, where high activity is attributed to relative plate movement. Australia does however experience intraplate stress (typically horizontal compression) due to the collision and thrusting of the Indo-Australian plate under the Eurasian plate. The rate of accumulation of this stress is low and consequently earthquakes allowing the release of the stresses are less frequent. A low level of activity does not imply that large damaging earthquakes do not occur but rather that a long recurrence interval between such events exists.

The earthquake catalogue shows the Project area to be below average in recorded seismicity in relation to the rest of Australia. Figure 20-1 shows earthquakes recorded in Queensland since the 1960s.

Earthquakes resulting in Modified Mercalli Intensity[1] (MMI) 3 and above (vibrations which are strong enough to be felt) within 200 km of the Eden Bann Weir and proposed Rookwood Weir site are presented in Table 20-5.

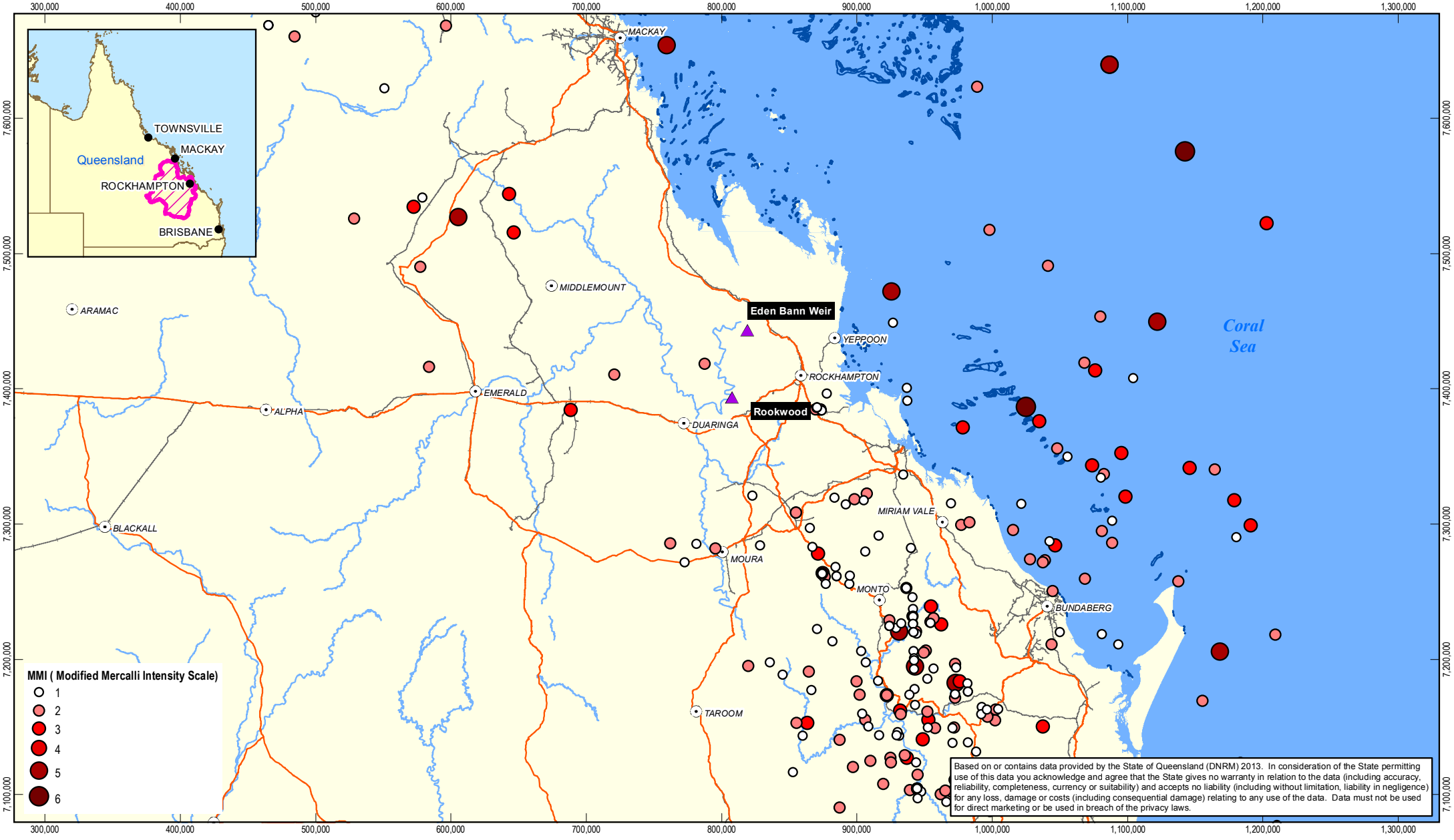
Table 20-5 Earthquakes resulting in MMI 3 and above

Date/time	Place	Distance from the Project (km)	Depth (km)	Richter magnitude (ML)	Intensity (MMI)
06/06/1918, 18H14	Bundaberg	Eden Bann Weir: 248 Rookwood: 253	10	6.0	3
06/12/1989, 22H00	Bowen Basin	Eden Bann Weir: 45 Rookwood: 55	4	4.0	3
02/11/1998, 17H09	Swain Reefs	Eden Bann Weir: 110 Rookwood: n/a	0	4.7	3

The Project area is predicted to experience earthquake intensities of MMI 3 approximately every 18 years. Intensities of MMI 6 (when standard housing experiences damage) are expected to occur approximately once every 871 years for Rookwood Weir and once every 902 years for Eden Bann Weir. Waves are reported to be seen on lakes and ponds at intensities of MMI 7 predicted to occur every 4,000 years and 3,840 years at Eden Bann Weir and Rookwood Weir, respectively. Intensities of MMI 10 and higher will cause damage to dams and embankments. Intensities of MMI 10 are predicted to occur every 270,000 years for Eden Bann Weir and every 290,000 years for Rookwood Weir.

The main impacts associated with seismic activity in relation to the weirs would be: cracking with loss of section strength; embankment settlement; sliding of foundations and slope failure; overtopping due to waves created by landslides; cracking or collapse of ancillary structures.

[1] MMI provides a physical description of the effects of shaking that can be expected at a specific locality and indicates the severity of an earthquake (ESS 2009).



1:3,735,000 (at A4)

0 25 50 75 100

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA94)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Populated places
- Weir Location
- Highways (National)
- Railway
- Waterway (Major)
- Fitzroy Catchment
- Reef

Gladstone Area Water Board

GHD CLIENTS|PEOPLE|PERFORMANCE

SunWater Making Water Work

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
Revision C
Date 10 Feb 2014

Earthquakes recorded in Queensland from 1960 to 2013 Figure 20-1

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Level 9, 145 Ann Street Brisbane QLD 4000 Australia T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: © Copyright Commonwealth of Australia (Geoscience Australia): Places, Waterways (2007), Earthquakes (2013); Sunwater: Weir Locations - 2008; DNRM: Railways, Roads, Reef (2010).
Created by: MS *See Appendix for disclaimers and copyrights.

20.2.5.4 Landslides

The greatest potential landslide risks in the Rockhampton region are as follows:

- Activities associated with domestic building construction for example cutting and filling sites for building pads. During significant rainfall events, small landslides may occur in road and rail batters and in cuts and fills associated with building development
- Steep natural slopes with a gradient of more than 15 per cent are known to be of higher risk of landslide activity Aurecon Australia Pty Ltd (2012).

Geotechnical investigations have identified the site selections as being the optimal locations for the water infrastructure. Based on geotechnical investigations the potential risk of a landslide hazard is considered negligible.

20.2.6 Wildlife hazards

Estuarine crocodiles are present in low numbers at the existing Eden Bann Weir impoundment. The provision of expanded habitat upstream of the existing Eden Bann Weir impoundment and similar new habitat upstream of Rookwood Weir may allow for a higher carrying capacity for the species in the area.

Other wildlife hazards include increased exposure to snakes, spiders, and disease carrying animals and insects, including but not limited to, mosquitoes, rats and flies. Habitat for venomous snakes and spiders may be present in the Project area, including rocky outcrops, long grass, and fallen trees. Mosquito breeding may be exacerbated due to the increase in breeding habitat within the impoundment. Mosquitoes are able to transmit viruses such as dengue fever and Ross River fever.

20.2.7 Unexploded ordinance

The Department of Defence provides information regarding potential for unexploded ordinance. The Department's website shows no potential areas of unexploded ordinance within the Project footprint.

20.3 Construction phase hazards and risks

20.3.1 Overview

Table 20-6 provides an analysis of potential hazards that may occur during the construction phase of the Project. It describes and quantifies potential hazard events using the methodology provided in Section 20.1.2.1. The assessment has been undertaken in accordance with the AS/NZS ISO 31000: 2009 Risk management – Principles and guidelines.

The hazard and risk assessment identified 19 hazards during construction which resulted in six high risks, nine medium risks and four low risks in the absence of management and mitigation. After mitigation measures are implemented, the residual risks comprise four medium risks and 15 low risks. Potential hazards, associated impacts and relevant mitigation and management measures are discussed in the following sections.

Construction phase hazards will be further considered and managed through the implementation of an environmental management plan (EMP), specifically a construction EMP (CEMP) (Chapter 23 Environmental management plan).

Table 20-6 Construction phase hazard and risk assessment

Item	Hazard event	Potential impacts (consequence)	C	Likelihood of occurrence	L	Overall risk	Preventative measures	Responsive measures	Residual risk		
									C	L	Risk
Risk to human health and safety											
1	Excessive dust, noise and vibration	Risk of health impacts/injury and damage to property.	2	Excessive dust and noise incidents are possible, particularly in the dry season.	3	Medium	Construction contractor to: • Implement and maintain environmental controls and procedures during all phases of construction. • Compliance with statutory requirements via monitoring and auditing	Construction contractor to implement dust and noise and vibration control procedures within CEMP and respond to all incident reports.	1	2	Low
2	Persons accessing the construction site without authorisation	Accidental death or injury. Unauthorised persons causes environmental incident, for example deliberately breaches fuel storage tanks.	4	Construction site facilities and storages will be fenced; remoteness of location and dense vegetation will discourage unintentional access.	2	Medium	Security at construction site. Legitimate persons on construction site to wear clear identification. Install warning signs along roads and tracks that approach construction site stating that access to the site is prohibited without authorisation. Remove any unauthorised persons from site immediately.	Clean up activities. Evacuation of injured persons to hospital.	2	2	Low
Road and traffic hazards											
3	Traffic accident	Death or injury to occupants of the vehicle.	4	During construction phase, traffic volumes may	3	High	Project related traffic limited to daylight hours only as far as practicable (particularly	Incorporate vehicle accident response in	4	2	Medium

Item	Hazard event	Potential impacts (consequence)	C	Likelihood of occurrence	L	Overall risk	Preventative measures	Responsive measures	Residual risk		
									C	L	Risk
		Remoteness from medical facilities may mean that serious injuries are exacerbated by delay in receiving treatment. Damage to personal property (vehicle).		increase by addition of heavy vehicles. Light vehicle trips are expected to be ten per day during construction. Accident statistics for roads within study area are not available.			deliveries) and reduce vehicle numbers by provision of bussed transport for workers. Drivers trained in safe driving of the vehicle. First aid kits in all project related vehicles. Reduced speed limits. Develop and implement site specific traffic management plans (TMPs), including provision for hazardous loads, wide or oversize loads and emergency response.	incident response plan. Depending on location, provide response from construction site incident response team or coordinate response from Rockhampton. Notify emergency services of any accidents immediately.			
4	Community member (pedestrian) accident with trucks transporting material through Gogango.	Injury or death to member of the community.	4	Low likelihood of interactions between members of community and Project related truck/bus activities. Truck/ bus movements during daytime hours only.	3	High	Speed limits on roads. Daytime movements only. Trained drivers. Supervised and escorted wide or oversized loads. Community engagement plans and notifications.	Include in incident response plans. Evacuation of injured persons through Queensland Ambulance Service.	4	2	Medium
5	Vehicle carrying oversized load crashes	Death or injury to occupants of the vehicle. Remoteness from medical facilities may mean that serious injuries	4	During construction phase, traffic volumes will increase by addition of heavy	3	High	Project related traffic limited to daylight hours only as far as practicable (particularly deliveries).	Incorporate vehicle accident response in TMP. Depending on location, provide response from	4	2	Medium

Item	Hazard event	Potential impacts (consequence)	C	Likelihood of occurrence	L	Overall risk	Preventative measures	Responsive measures	Residual risk		
									C	L	Risk
	or overturns.	are exacerbated by delay in receiving treatment. Damage to personal property. Localised and short term impact. Damage to plants and animals unlikely.		vehicles. Accident statistics for roads within study area are not available.			Drivers trained in safe driving of the vehicle and securing of heavy loads. First aid kits in all project related vehicles. Develop and implement site specific TMPs, including provision for hazardous loads, wide or oversize loads and emergency response.	construction site incident response team or coordinate response from Rockhampton. Notify emergency services (QPS, QFES and QAS) of any accidents immediately.			
Environmentally hazardous substances											
6	Fuel tanker crash (with rupture of one or more tanks)	Release of diesel to soils if tank ruptures, resulting in contamination of soil, vegetation or waterways. Release of diesel to creeks, resulting in sediment and water contamination downstream. Aquatic organisms may be killed or harmed. In case of spillages on the access road, the impact will be on the land along the road.	2	Number of trips is relatively low – two trips/month during construction phase. Road is unsealed and contains some hazards, particularly in wet weather.	3	Medium	All vehicles conform to the Australian Dangerous Goods Code (ADG Code). Drivers trained in safe driving of the vehicle, including any speed limit restrictions dictated by road conditions. First aid, spill response and firefighting equipment will be available with each fuel truck. Spill response equipment available at construction site for deployment. Check road conditions ahead of trips.	Spill response procedures in place and implemented in the event of spills. Containment and immediate clean-up of spills. Removal of contaminated soils and sediments and rehabilitation of damaged vegetation. Drivers trained in spill response. Immediately notify emergency services (QPS, QFES and QAS) of any accidents. Notification to the	2	2	Low

Item	Hazard event	Potential impacts (consequence)	C	Likelihood of occurrence	L	Overall risk	Preventative measures	Responsive measures	Residual risk		
									C	L	Risk
								Department of Environment and Heritage Protection (DEHP) if spill occurs to a waterway and cannot be contained.			
7	Vehicle carrying lubricating oils crashes and ruptures oil container.	Release of oil to soils if tank ruptures, resulting in soil contamination and vegetation health. Impacts as per item 1, but more localised due to lower volumes likely to be released and more viscous nature of material.	2	Number of truck trips is low – one trip/quarter during construction phase. Road is unsealed and contains some hazards, particularly in wet weather.	2	Low	As per item 6.	As per item 6.	1	2	Low
8	Vehicle carrying waste oil crashes and ruptures waste oil container.	Release of oil to soils if tank ruptures, resulting in soil contamination and vegetation health. Impacts as per item 8, but more localised due to lower volumes likely to be released and more viscous nature of material.	2	Number of truck trips is low.	2	Low	As per item 6.	As per item 6.	1	2	Low
9	Vehicle carrying acetylene or oxygen gas cylinders crashes and results in gas	Localised and short term impact only. Release volumes will be negligible. Damage to plants and animals unlikely. Release of acetylene/ oxygen may result in fire and	1	Number of truck trips is very low. Cylinder design minimises risk of rupture, even in accident situations.	2	Low	All vehicles conform to ADG Code. Drivers trained in safe driving of the vehicle. First aid and firefighting equipment will be available	Immediately notify emergency services (QPS, QFES and QAS) of any accidents.	1	1	Low

Item	Hazard event	Potential impacts (consequence)	C	Likelihood of occurrence	L	Overall risk	Preventative measures	Responsive measures	Residual risk		
									C	L	Risk
	leakage.	explosion in presence of an ignition source. However, this is unlikely as the trucks will comply with the requirements for transporting dangerous materials, including compatibility requirements.					with each truck.				
10	Spill or leak from on-site diesel storage tanks	Contamination of soil. Contamination of surface waters either by direct release or leaching through soil. Contamination of groundwater. Contamination of surface waters may result in damage to aquatic ecosystems. Extent of damage will depend on the quantity released. Maximum volume stored in main diesel storage tanks is 50 kL. All other tanks contain smaller quantities, mostly less than 1000 L.	3	All storages will comply with AS 1940 requirements, thus minimising the likelihood of rupture or leak that results in release to the environment.	3	High	Design, construction and operation comply with AS1940 requirements. Procedures developed for all hazardous material storage, transport and handling. Personnel trained in procedures. Personal protective equipment and spill response equipment available on site and personnel trained in appropriate use.	Include in incident response plans. Immediately notify emergency services (QPS, QFES and QAS) of any significant accidents. Spill kits will be available for placement on spillages to contain spill and assist with clean-up. All contaminated material to be collected and placed in secure containers for later disposal. Employ external operator to undertake clean up and remediation of spill area.	2	3	Medium
11	Spill or leak from oil or waste oil storage	Contamination of soil and groundwater. Contamination of surface waters either by direct release or leaching	2	Low likelihood of spills entering environment as oils and waste oils will be handled and stored in	3	Medium	As per item 10. Store oil and waste oil in secure containers in enclosed locations.	As per item 10.	2	2	Low

Item	Hazard event	Potential impacts (consequence)	C	Likelihood of occurrence	L	Overall risk	Preventative measures	Responsive measures	Residual risk		
									C	L	Risk
		through soil. Quantities are likely to be small (less than 100L) and material is viscous, reducing likelihood of flows to creeks.		contained areas.							
12	Fire or explosion from stored chemicals /explosives	Localised and short term impact only. Release volumes will be negligible. Damage to plants and animals unlikely. May result in fire and explosion. However, this is unlikely as the site will comply with the requirements for storing dangerous chemicals and explosives, including compatibility requirements.	1	Number of chemicals and explosives stored is very low. Storage areas will be designed to minimise risk of incident.	2	Low	All storage areas will comply with the relevant approvals for the storage of chemicals and explosives. Construction workers will be trained in the handling of chemicals and explosives. First aid and firefighting equipment will be available near each storage area.	Implement incident response and management procedures within CEMP and emergency response plan. Immediately notify emergency services (QPS, QFES and QAS).Establish and maintain contact with local police (QPS) and ambulance services (QAS).	1	1	Low
Natural or induced hazards											
13	Flooding at Project site	Damage to partially completed structures. Risk of death, injury or loss of property.	4	Unlikely during dry season. Flooding could occur in the wet season due to severe rainfall events. Weir design and construction schedule based on assessment of	2	Medium	Incorporate flood response in emergency response plan and maintain flood management and response capability at site. Educate staff in relation to flood management and response procedures.	Implement flood response procedures and provide appropriate warnings. Establish and maintain contact with QPS, EMQ, QFES and QAS. Communicate with police in in relation to need for road closure.	2	2	Low

Item	Hazard event	Potential impacts (consequence)	C	Likelihood of occurrence	L	Overall risk	Preventative measures	Responsive measures	Residual risk		
									C	L	Risk
				climatic characteristics, historic river flows and flood levels.							
14	Tropical cyclone or severe storm	Damage to partially completed structures. Risk of death, injury or loss of property.	4	Unlikely during dry season. Severe storms are likely in summer months. Weir design and construction schedule based on assessment of climatic characteristics, historic river flows and flood levels.	3	High	Incorporate severe storm and cyclone response procedures in emergency response plan and maintain management and response capability at site. Educate staff in relation to storm management and response procedures.	Construction staff to monitor BoM warnings and take required precautions and site evacuation as necessary. Implement storm and cyclone response procedures and provide appropriate warnings. Establish and maintain contact with emergency services (EMQ, QPS and QFES). Communicate with police in in relation to need for road closure.	2	2	Low
15	Heat wave	Risk of death or injury from heat stroke. Bushfire.	4	Could occur during summer months.	2	Medium	Incorporate extreme heat management procedures in CEMP and maintain management and response capability at site. Educate staff in relation to extreme temperature management and response	Implement extreme temperature response procedures as outlined in the CEMP. Establish and maintain contact with emergency services (EMQ and QAS). Refer to item 16 for	2	2	Low

Item	Hazard event	Potential impacts (consequence)	C	Likelihood of occurrence	L	Overall risk	Preventative measures	Responsive measures	Residual risk		
									C	L	Risk
							procedures. Refer to item 16 for bushfire measures.	bushfire measures.			
16	Bushfire at Project site	Loss of vegetation. Risk of death, injury or loss of property.	3	Unlikely during wet season. Bushfires could occur in the dry season due to both anthropogenic and natural causes.	2	Medium	Clear vegetation in all working areas. Maintain fire breaks around areas identified as being potential sources of ignition. Incorporate bushfire response emergency response plan and maintain fire fighting capability at site. Educate staff in relation to bushfire prevention, including management of cigarettes. Develop and train staff in procedures for welding, and other activities with high risk of starting fires.	Implement bushfire response procedures and provide appropriate warnings. Establish and maintain contact with local fire and ambulance services (QFES and QAS). Communicate with police in in relation to need for road closure. Burnt areas should naturally regenerate.	2	2	Low
17	Landslide	Damage to partially completed structures. Risk of death, injury or loss of property. Weir design and construction methodologies consider slope and stability for cut and fill operations.	4	Based on geotechnical investigations the potential risk of a landslide hazard is considered negligible.	1	Medium	Incorporate landslide response in emergency response plan. Educate staff in relation to landslide management and response procedures.	Implement landslide response and management procedures within emergency response plan. Establish and maintain contact with local police (QPS) and ambulance services (QAS).	2	1	Low

Item	Hazard event	Potential impacts (consequence)	C	Likelihood of occurrence	L	Overall risk	Preventative measures	Responsive measures	Residual risk		
									C	L	Risk
Wildlife hazards											
18	Bites and stings (for example snakes and spiders)	Risk of death or injury.	4	During construction phase disruption of wildlife may increase the likelihood of bites or stings.	3	High	Construction areas would be inspected by a suitably qualified professional prior to the commencement of construction activities to identify wildlife hazards. Educate staff on the risks associated with wildlife including first aid training.	Construction contractor to implement wildlife and first aid response procedures.	2	1	Low
19	Estuarine crocodile attack	Risk of death or injury.	4	During construction phase disruption of estuarine crocodiles may increase the likelihood of attack.	1	Medium	As per item 19. Construction staff are to avoid entering areas known to be used by crocodiles and where possible, avoid walking along the banks of the river/creeks. Signage will be strategically placed to warn of the presence of estuarine crocodiles, the dangers they pose and actions to avoid contact.	Construction contractor to implement wildlife and first aid response procedures.	2	1	Low

20.3.2 Risks to human health and safety

Community health and safety values during construction include air quality, noise and vibration levels and traffic and road safety. Risks to human health and safety associated with changes to air quality and noise and vibration levels are assessed in the Chapter 12 and Chapter 14 respectively. Traffic and road safety is informed by Chapter 16 Transport and has been assessed separately in Section 20.3.3.

As identified in Chapter 18 Social impact residents near the construction areas and along the construction access roads may experience nuisances as a result of increased noise, vibration and dust. Construction is planned to be intermittent, occurring primarily during the dry season and relatively short term. Air quality and noise and vibration levels will be monitored and managed in accordance with an approved CEMP (Chapter 23 Environmental management plan) for the Project. Management measures include:

- Time restrictions on activities
- Maintaining and operating construction equipment, plant and machinery in accordance with manufacturer's guidelines
- Dust suppression through water application
- Notification to residents and stakeholders (as applicable) of noise generating activities.

Persons accessing the construction site without authorisation could result in accidental death or injury or an environmental incident should the unauthorised persons deliberately breach fuel storage tanks. During construction the weir sites will be fenced and visitor access to the weirs would be restricted. Security will be present onsite and clear identification is to be worn by all personnel. Warning signs will be installed along access roads and tracks approaching the constructions sites notifying of restricted access.

20.3.3 Roads and traffic hazards

The Project will require a workforce of approximately 150 persons across the two year construction period. All workers will be transported daily by bus to the construction site and back to their accommodation or to a meeting point close to their accommodation. The number of additional heavy vehicles using access roads would be approximately 30 heavy vehicles per day. Increased traffic volumes may increase the risk of accidents involving single vehicles, other road users or stock.

Accident statistics for the stretch of these roads under consideration were not available. Although an assessment of traffic volumes generated by the Project indicates that volumes are within the capacity of the roads, increased traffic volumes associated with the Project may potentially increase the likelihood of traffic accidents occurring. This in turn may result in death or injury to individuals, and damage to private property (vehicles). For vehicles carrying diesel or other environmentally hazardous substances from Rockhampton, there is an additional hazard associated with traffic accidents, being the release of hazardous substances to the environment.

A separate assessment of traffic and transportation issues has been undertaken to examine impacts of Project related traffic on both road safety and road operability (Chapter 16 Transport). The outcomes of this study have been incorporated into a suite of road use management plan commitments for to construction to address traffic related impacts on public roads.

The objectives of the road use management plan would be two-fold:

- To prevent any incidents and harm to individuals
- To minimise impacts of traffic and transport activities on local residents and road users

Key aspects of the road use management plan would include:

- Protocols for giving way to local traffic and pedestrians
- Imposition of appropriate speed limits on project related traffic
- Any temporary traffic controls and warning signs required to manage road and intersection upgrades and construction traffic
- Training and licencing requirements for truck drivers
- Zero tolerance for drugs and alcohol for all personnel
- Strict controls on fatigue
- Induction training for truck drivers particularly highlighting prescribed access routes and controls required to address hazards along the route
- Signs and other awareness raising and warning requirements to ensure local residents are aware of traffic and transport activities, risk areas and controls in place to protect them (e.g. controlled crossing points on the access road)
- Provision for escorts of wide or oversized loads
- Incident response requirements in the event of a traffic accident outside the site.

The road use management plan would be developed in consultation with Department of Transport and Main Roads, Rockhampton Regional Council, QPS and QFES.

Hazards associated with dust and noise emissions from transportation are assessed in detail in Chapter 12 Air quality and Chapter 14 Noise and vibration. The risk of dust impacts on sensitive receptors due to vehicle movements along access roads are expected to be negligible as homesteads are either located away from the road or adjacent to sealed sections of the road. Measures to mitigate the generation of dust emissions are described in Chapter 12 Air quality and included within the Project EMP (Chapter 23). Traffic related noise impacts are considered to be localised and of short duration.

20.3.4 Environmentally hazardous substances

The Project will potentially use a number of environmentally hazardous substances including those listed in the ADG Code. An indicative list of these substances is provided in Table 20-7. Table 20-8 describes the likely quantities, storage and transport of environmentally hazardous substances.

Table 20-7 Indicative list of environmentally hazardous substances

Chemical name	Concentration (%w t)	Dangerous goods class	Hazchem code	UN number	Packaging group	Purpose/use
Diesel	None allocated	3 (Class C1)*	3[Z]	1202	III	Fuel for heavy vehicle operations
Oils (lubrication/ hydraulic oils)	None allocated	3 (Class C2)**	None allocated	None allocated	None allocated	Lubricate plant and equipment and replenish hydraulic systems
Acetylene (dissolved)	> 98%	2.1	2[S]E	1001	None allocated	Welding
Oxygen	> 98%	2.2	2[S]	1072	None allocated	Welding
Waste oil	None allocated	None allocated	None allocated	None allocated	None allocated	Waste oil from equipment/ machinery
Ammonium nitrate	100%	5.1	1[Y]	1942	III	Blasting on site
Detonators	None allocated	1.1	E	0360	None allocated	Blasting on site

* 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

Table 20-8 Likely quantities, storage and transport of environmentally hazardous substances

Chemical name	Indicative maximum inventory onsite	Indicative storage details	Transport and handling details	Storage location
Diesel	100 kL	2 x 50 kL aboveground storage tanks	Road transport by 57 kL fuel tanker to construction site. Manual transfer to vehicles onsite	Fuel farm
Oils (lubrication/ hydraulic oils)	2 kL	Above ground tanks	Road transport to construction site	Fuel farm and maintenance area
Acetylene (dissolved)	2 kL	Waste oil bins, bunded	Road transport to site in individual cylinders. Manual transfer to licensed contractor vehicles for recycling	Fuel farm, refuelling and maintenance areas
Oxygen	245 m^3	In standard bottles	Road transport to construction site by trucks. Manual transfer to storage	Construction site
Waste oil	245 m^3	In standard bottles	Road transport (trucks). Manual transfer to storage	Construction site
Ammonium nitrate	Minimum quantity	Containers	Road transport (trucks)	Construction site
Detonators	Minimum quantity	Containers	Road transport (trucks)	Construction site

As identified in Table 20-6, leaks and spills of environmentally hazardous substances may results from a number of hazard events during construction as follows:

- Fuel tanker crash with rupture of one or more tanks – single vehicle or involving another vehicle
- Vehicle carrying lubricating oils/waste oils crashes and ruptures oil container – single vehicle or involving another vehicle
- Vehicle carrying acetylene or oxygen gas cylinders crashes and results in gas leakage – single vehicle or involving another vehicle
- Fire or explosion from storage of chemicals and explosives on site.
- Spill or leak from diesel storage tanks or from oil or waste oil storage.

The following mitigation measures would be implemented to reduce risks associated with the use, transport, handling and storage of hazardous substances:

- Trucks used to transport hazardous substances from Rockhampton will comply with all aspects of the ADG Code
- Aboveground storage tanks will be designed as per AS 1940:2004 – The storage and handling of flammable and combustible liquids
- Acetylene bottles will be kept upright, in the secure area within the stores compound on a firm floor to prevent falling. Bottles will not be stored near sources of ignition, oxidising agents, poisons, flammable liquids or combustible materials
- The contractor responsible for transport of ammonium nitrate will comply with the requirements of AS1678.5.1.002-1998 Emergency procedure guide – Transport Ammonium nitrate
- Explosives storage will be approved under the *Explosive Act 1999* (Qld). Explosives storage and use on site will meet the requirements of AS 2187:1998 Explosives – Storage, transport and use and AS 4326-2008 The storage and handling of oxidising agents
- The explosives storage area design will:
  - Consider avoiding provisions for drains, channels or pits. Where the presence of drains, channels or pits is unavoidable, they will be protected so as to prevent molten ammonium nitrate running into them
  - Be located away from possible sources of heat, fire or explosion, such as oil storage, flammable liquids and combustible materials
  - Be established such that it can be secured and will be designed in compliance with the size and volume of explosives on site. Bund containment and earth mounding will be constructed on-site and the explosives area installed with security monitoring.
- All tank transfer operations will be on impervious surfaces. Dedicated fuel tanker delivery and turn around area is provided to minimise risk of vehicle accident. Dedicated filling points for on-site fuel trucks will also be provided with impervious surfaces and containment using rollover bunds
- Activities using oils will generally be conducted on a hard stand area, and drip trays will be provided at appropriate locations including during the transfer operations
- Regular inspection of the storages and piping will be done by the construction staff

- Daily checks of the bunds for stormwater accumulation will be undertaken and procedures developed for management of water in the bunded areas. No contaminated stormwater will be discharged to the river
- Regular inspections and maintenance will be planned for all electrical equipment and fittings
- Adequate security provisions and access control will be provided for the storage areas
- A pest control system will be provided to limit the damage from animals
- Smoking will be prohibited in all storage areas and 'no smoking' notices will be prominently displayed
- Spill kits will be available for placement on spillages to assist with clean up. The material will be collected and placed in a labelled container for disposal off-site through a licensed contractor
- All spillages will be prevented from entering drains or water courses. Absorbent material will be placed on the spillages which will be collected for disposal and any contaminated soil removed to a bioremediation pad
- Suitable fire fighting systems will be provided. In the event of fire, emergency response will include the use of carbon dioxide, dry chemical or foam and personnel who engage in emergency response activities will wear breathing apparatus
- On-site emergency response teams will be trained to undertake the necessary actions to address fire and other incidents that may arise with areas used for storage of hydrocarbon products and other hazardous materials
- Personal protective equipment (PPE) for exposure control will consist of impervious material gloves for hand protection, safety glasses or face shield for eye protection and suitable personal clothing for body protection. All PPE will conform to the relevant Australian Standards
- Other precautions which will be taken include prompt cleaning of spillages, keeping walls, floors and equipment clean, and locating electrical equipment where it cannot come into contact with the stored materials
- Public access to the construction site will be prohibited.

20.3.5 Natural or induced hazards

20.3.5.1 Flooding

A severe rainfall event may result in flooding. Flooding during construction may damage partially completed structures, private properties and public infrastructure. Weir design, construction methods and construction scheduling (Chapter 2 Project description) has considered timing and severity of floods. A flood warning system is in place for the area and is operated by the Bureau of Meteorology (BoM). BoM issues regular flood warnings. The construction site officials will be responsible to monitor such warnings and take actions to minimise damage during construction and if required evacuate site workers. Flood response will be incorporated into the emergency response plan and flood management can response capability will be maintained at site.

20.3.5.2 Tropical cyclones and severe storms

The BoM monitors and issues thunderstorm warnings. The construction staff will be responsible for monitoring these warnings and for taking required precautions and site evacuation if necessary. Power and communications to the site may be disrupted during thunderstorms. Back-up generators will be installed to facilitate backup power during such events. Strong wind conditions during construction will be further considered and managed through the implementation of a CEMP.

20.3.5.3 Extreme temperatures

The construction staff will be responsible for monitoring temperature during construction and for taking required precautions if necessary. Extreme temperature conditions during construction will be further considered and managed through the implementation of a CEMP. Extreme cold temperatures are not considered a hazard in the region with the lowest average minimum temperature being 9.5 °C.

20.3.5.4 Bushfires

The Project is located in medium to very high bushfire hazard areas. Vegetation within all working areas will be cleared and fire breaks will be maintained around areas identified as being potential sources of ignition. Bushfire response will be incorporated into the emergency response plan and firefighting capability will be maintain at site. Staff will be educated in relation to bushfire prevention and trained in procedures for activities with a high risk of starting fires (e.g. welding).

20.3.5.5 Seismic activity

Limited seismic activity occurs in the region as identified in Section 20.2.5. The main risks from seismic activity during construction would be as follows:

- Cracking of soil
- Sliding of foundations of construction buildings
- Damage to construction equipment
- Injury to construction personnel
- Cracking or collapse of ancillary structures to the weir.

Earthquake response procedures during construction will be further considered and managed through the implementation of a CEMP and emergency response plan.

20.3.5.6 Landslides

As detailed in Chapter 4 Climate, natural hazards and climate change geotechnical investigations have identified the site selections as being the optimal locations for the water infrastructure. Weir design and construction methods assess slope and account for risk associated with cut and fill operations. Based on geotechnical investigations the potential risk of a landslide hazard is considered negligible.

Landslide response procedures during construction will be further considered and managed through the implementation of a CEMP and emergency response plan.

20.3.5.7 Climate change

As detailed in Chapter 4, Queensland has a naturally variable climate and its climate is projected to become more variable and extreme in the future. The construction period will be short term therefore climate change has not been considered further.

20.3.6 Wildlife hazards

As detailed in Section 20.2.6 the potential wildlife hazards in the Project area include estuarine crocodiles snakes, spiders, and disease carrying animals and insects, including but not limited to, mosquitoes, rats and flies.

Habitat modification during construction may result in the disruption of wildlife including the estuarine crocodile and snakes.

The following mitigation measures would be implemented to reduce the risk of crocodile attacks, snake and spider bites and mosquito breeding during construction:

- Construction areas would be inspected by a suitably qualified professional prior to the commencement of construction activities to identify wildlife hazards including estuarine crocodiles, snakes and spiders within the construction area
- All construction staff would receive appropriate education and training to address the risks associated with wildlife
- Construction staff are to avoid entering areas known to be used by crocodiles and where possible, avoid walking along the banks of the river or creeks
- Signage will be strategically placed to warn of the presence of estuarine crocodiles, the dangers they pose and actions to avoid contact
- Queensland Health alerts for mosquito borne diseases such as dengue fever and Ross River fever will be monitored and all construction staff will be educated on the risk of mosquito borne diseases including personal protective measures through onsite inductions
- Any areas on site with the potential to hold water will be monitored and drained to prevent stagnant water accumulation.

20.4 Operational phase hazard and risk

20.4.1 Overview

Table 20-9 provides an analysis of potential hazards that may occur during the operations phase. It describes the hazard events, and then quantifies them using the tables provided in Section 20.1.2.1. The assessment has been undertaken in accordance with the AS/NZS ISO 31000: 2009 Risk management – Principles and guidelines. Potential hazards, associated impacts and relevant mitigation and management measures are discussed.

The assessment identified 14 hazards during operation which resulted in five high risks and nine medium risks in the absence of management and mitigation. After mitigation measures are implemented, the residual risks comprise three medium risks and 11 low risks.

Operations phase hazards will be further considered and managed through the implementation of an operations EMP (OEMP) (Chapter 23 Environmental management plan)

Table 20-9 Operation phase hazard and risk assessment

Item	Hazard event	Potential impacts (consequence)	C	Likelihood of occurrence	L	Overall risk	Preventative measures	Responsive measures	Residual risk		
									C	L	Risk
Risk to human health and safety											
1	Recreational use of the impoundment	Accidental death or injury.	4	Weir access restricted to authorised personnel. Weir sites and impoundments are remote and bordered by private landholdings restricting access to the river. The Project will not facilitate recreational use.	2	Medium	Access to weirs restricted by fencing and locked gates Weir sites monitored by CCTV. All visitors to weir site accompanied by authorised personnel. Adequate signage provided to warn against use of the area for recreational purpose. Routine inspections of fencing will be conducted.	Implement recommendations of incident reporting.	4	1	Medium
2	Algal blooms	Poor water quality and toxicity, disruption to water supplies. Risk to livestock, wildlife and human health.	3	Storages within the Fitzroy Basin are reported to be unstratified most of the year, or slightly stratified during the warmer months. The potential for and presence of blue-green alga is considered to be low.	2	Medium	Monitor blue green algae and manage the potential risks through the implementation of established protocols and action plans. Develop monitoring programs and emergency plans as appropriate.	Publish blue green algae levels as warnings to the public, landholders and water users. Implement monitoring programs and emergency plans as appropriate.	2	2	Low

Item	Hazard event	Potential impacts (consequence)	C	Likelihood of occurrence	L	Overall risk	Preventative measures	Responsive measures	Residual risk		
									C	L	Risk
Road and traffic hazards											
3	Traffic accident	Death or injury to occupants of the vehicle. Remoteness from medical facilities may mean that serious injuries are exacerbated by delay in receiving treatment. Damage to personal property (vehicle).	4	During the operation phase light vehicle trips will be made by the Project staff responsible for operations / inspection. These are expected to be 2-3 trips per week. Accident statistics for roads within study area are not available.	2	Medium	Drivers trained in safe driving of the vehicle. First aid kits in all project related vehicles.	Incorporate in incident response plan. Notify emergency services (QPS, QFES and QAS) of any accidents immediately.	3	2	Medium
4	Community member (pedestrian) accident with Project vehicle	Injury or death to member of the community.	4	Low likelihood of interactions between members of community and Project related vehicles.	2	Medium	Speed limits on roads. Daytime movements only. Trained drivers.	Include in incident response plans. Evacuation of injured persons through QAS.	3	2	Medium
Natural or induced hazards											
5	Flooding at Project site	Damage to structures. Disruption of operations.	2	Unlikely during dry season. Flooding could occur in the wet season due to severe rainfall events.	4	Medium	Educate operational staff in relation to flood management and response procedures. The weir structures will be designed to safely pass the flood. Associated and ancillary infrastructure designed to	Monitor floods, access flood warning information and respond accordingly. Implement flood response procedures and provide appropriate warnings. Establish and maintain contact with local police (QPS), EMQ, QFES and	2	2	Low

Item	Hazard event	Potential impacts (consequence)	C	Likelihood of occurrence	L	Overall risk	Preventative measures	Responsive measures	Residual risk		
									C	L	Risk
							appropriate flood levels.	QAS. Communicate with police in in relation to need for road closure.			
6	Tropical cyclone or severe storm	Damage to structures.	4	Unlikely during dry season. Severe storms are likely in summer months.	3	High	Incorporate severe storm and cyclone response procedures in site emergency response plan and maintain management and response capability at site. Educate staff in relation to storm management and response procedures.	Monitor BoM warnings and take required precautions and site evacuation as necessary. Implement emergency response procedures and provide appropriate warnings. Establish and maintain contact with QPS and EMQ. Communicate with police in in relation to need for road closure.	2	2	Low
7	Heat wave	Risk of death or injury from heat stroke. Bushfire.	4	Could occur during summer months.	2	Medium	Incorporate extreme heat and management procedures in emergency response plan and maintain management and response capability at site. Educate staff in relation to extreme temperature management and response procedures. Refer to item 8 for bushfire measures.	Implement extreme temperature response procedures as outlined in the OEMP. Establish and maintain contact with QFES and QAS. Refer to item 8 for bushfire measures.	2	2	Low

Item	Hazard event	Potential impacts (consequence)	C	Likelihood of occurrence	L	Overall risk	Preventative measures	Responsive measures	Residual risk		
									C	L	Risk
8	Bushfire at Project site	Loss of vegetation. Risk of death, injury or loss of property.	3	Unlikely during wet season. Bushfires could occur in the dry season due to both anthropogenic and natural causes.	2	Medium	Clear vegetation in all working areas. Maintain fire breaks around areas identified as being potential sources of ignition. Incorporate bushfire response in site incident management plan and maintain fire fighting capability at site. Educate staff in relation to bushfire prevention, including management of cigarettes.	Implement bushfire response procedures and provide appropriate warnings. Establish and maintain contact with QFES and QAS. Communicate with police in in relation to need for road closure. Burnt areas should naturally regenerate.	2	2	Low
9	Weir failure due to seismic event.	Population at risk downstream of proposed weir. Environmental harm could arise from rapid release of impounded water. Loss of weir storage capacity. Destruction of assets.	3	Very unlikely that there would be cracking and loss of strength to the weir. Likelihood of sliding of dam foundation is rare.	1	Medium	Design of weir in accordance with seismic assessment for the site. Design of weir as per ANCOLD and Queensland Dam Guidelines. Expert peer review of design and construction of the weir.	Develop weir failure response plan. Establish and maintain contact with local emergency services (EMQ, QPS, QFES, QAS).	2	1	Low
10	Landslide	Damage to structures.	4	Based on geotechnical investigations the potential risk of a landslide hazard is considered negligible.	1	Medium	Incorporate landslide response in Emergency Response Plan. Educate operational staff in relation to landslide	Proponent to implement landslide response and management procedures within an OEMP. Establish and maintain	2	1	Low

Item	Hazard event	Potential impacts (consequence)	C	Likelihood of occurrence	L	Overall risk	Preventative measures	Responsive measures	Residual risk		
									C	L	Risk
							management and response procedures.	contact with local emergency services (EMQ, QPS, QFES, QAS).			
Wildlife hazards											
11	Bites and stings (for example snakes and spiders)	Risk of death or injury .	4	Operational activities may cause disruption of snakes/spiders may increase the likelihood of bites or stings.	2	Medium	Inspection of work areas by a suitably qualified professional prior to the commencement of any maintenance activities to identify wildlife hazards. Educate staff on the risks associated with wildlife including first aid training.	Operational staff to implement wildlife and first aid response procedures.	2	1	Low
12	Estuarine crocodile attack	Risk of death or injury .	4	Operation phase may result in the provision of additional suitable habitat for the estuarine crocodile within the impoundment areas. Increase in habitat may increase the likelihood of attack.	2	Medium	As per item 11. Operational staff are to avoid entering areas known to be used by crocodiles and where possible, avoid walking along the banks of the river or creeks Signage will be strategically placed to warn of the presence of estuarine crocodiles.	Operational staff to implement wildlife and first aid response procedures.	2	1	Low
Weir failure											
13	Failure of weir gates during operation	Population at risk downstream of proposed weir. Environmental harm could arise	3	Failure of the weir gates is unlikely but could occur as a result of power grid supply failure.	2	Medium	Backup diesel generators for electricity supply will be available onsite.	As per item 9. Surveys and clean-up of downstream areas as required.	1	2	Low

Item	Hazard event	Potential impacts (consequence)	C	Likelihood of occurrence	L	Overall risk	Preventative measures	Responsive measures	Residual risk		
									C	L	Risk
		from rapid release of impounded water. Loss of weir storage capacity.									
14	Static weir failure	As per item 9.	3	Very unlikely that the design will be poor leading to build-up of pressure and instability.	2	Medium	Design by experienced personnel in accordance with ANCOLD and Queensland Dam Guidelines. Expert peer review of design and construction of the weir.	As per item 9.	2	1	Low

20.4.2 Risks to human health and safety

During operations potential impacts on air quality are largely limited to vehicles travelling to and from the site and minor operational machinery. The resultant minor emissions are considered negligible. Similarly the potential noise operational impacts associated with the Project are considered negligible and restricted to maintenance activities and the operation of the fishways, gates and intermittent us of an emergency generator. Therefore no noise or air quality impacts are predicted on workers or the community.

Public use of the impoundments would create a hazard of drowning. Boating activities also introduce a risk of boat accidents. Recreational use of the Fitzroy River at the existing Eden Bann Weir is not facilitated. The Project area is remote and difficult to access. Access to the weir itself is restricted to authorised personnel and the impoundment is largely bordered by private landholdings restricting access to the river. Opportunities to access the Fitzroy River may exist at river crossings however there are no formal facilities (such as boat ramps and ablutions) to facilitate such access.

The Project will not facilitate recreational use of the impoundments and no public access to the river would be provided as part of the Project. The weir sites will be fenced and visitor access to the weir would be restricted. The Proponent will provide adequate signage to warn the public against use of the area for recreational purpose and will conduct routine inspections of fencing.

Excessive levels of blue-green algae or cyanobacteria, known as algal blooms, can adversely impact on water quality. The potential for and presence of blue-green blooms is considered to be low (Chapter 11 Water quality). However the retention of vegetation within the impoundments has the potential to elevate nutrient levels, particularly during the first year of operation. Blue-green algae will be monitored and managed through the implementation of established protocols and action plans. The inundated areas will not support recreational activities and the risk of adversely impacting human health as a result of algal blooms developing is minimal.

20.4.3 Roads and traffic hazards

Operational activities include maintenance of the infrastructure and private access roads. The impact of traffic generated during the operation phase of the Project is expected to be minimal and largely relates to maintenance personnel accessing the weir sites on a weekly basis using a utility vehicle. Operational traffic volumes associated with the Project are negligible. Traffic impacts are to be managed and monitored in accordance with an approved TMP (Chapter 16 Transport).

20.4.4 Natural or induced hazards

20.4.4.1 Flooding

The proposed raising of Eden Bann Weir would impact on water levels upstream in smaller flood events. The estimated afflux for the 1 in 5 to 1 in 100 Annual Exceedance Probability (AEP) events is less than 0.5 m at the raised Eden Bann Weir while for the 1 in 2 AEP event the estimated afflux is 3.6 m. The afflux reduced to 2.6 m approximately 13 km upstream of the Eden Bann Weir, and to 0.3 m approximately 54 km upstream of the weir for the 1 in 2 AEP event.

The proposed Rookwood Weir impacts water levels upstream in smaller magnitude floods (1 in 2 and 1 in 5 AEP events). The estimated afflux for the 1 in 2 AEP event is 5.0 m which reduces to approximately 0.6 m about 40 km upstream of the Rookwood Weir. The 1 in 5 AEP event has an

estimated afflux of 1.2 m at the weir which reduces to 0.2 m 40 km upstream. The impact of the weir during larger magnitude events such as the 1 in 10 to the 1 in 100 AEP events is less than or equal to 0.6 m at the proposed Rookwood Weir site.

Detailed flood modelling has been undertaken and is described in Chapter 9 Surface water resources.

The operational staff will be responsible for monitoring floods likely to impact on the weirs and on the surrounding land use. The staff will have access to flood warning information and be able to respond accordingly. The weir structures are designed to safely pass the flood. The gates installed over the weir will open in the event of flood waters reaching a predetermined level which will allow the waters to be discharged.

20.4.4.2 Tropical cyclones and severe storms

The BoM monitors and issues thunderstorm warnings. The operational staff will be responsible for monitoring these warnings and for taking required precautions and site evacuation if necessary. Power and communications to the site may be disrupted during thunderstorms. Back-up generators will be installed to facilitate backup power during such events.

20.4.4.3 Extreme temperatures

The operational staff will be responsible for monitoring temperature during the operational phase and for taking required precautions if necessary.

20.4.4.4 Bushfires

During the operational phase, the proposed Project is not expected to exacerbate bushfire hazard to the community or environment. Based on the bushfire classification of the Project area, the possibility of a bushfire initiating and progressing is medium to very high. The operational staff will be responsible for monitoring bushfire warnings issued by the BoM, liaise with local Rural Fire Service personnel and be on the look-out for any fires in the vicinity of the weirs.

20.4.4.5 Seismic activity

Seismic activities occur in the region as identified in Section 20.2.5. The main risks from seismic activity to the weirs would be as follows:

- Cracking with loss of section strength
- Sliding of foundation
- Overtopping due to waves created by landslides
- Cracking or collapse of ancillary structures to the weir.

Ground conditions amplify the shaking during a seismic event. Stability analysis for the weirs will account for seismic loading for both weirs. Seismic activity has been considered further as an initiating event in the failure modes effects criticality analysis for Eden Bann Weir and the proposed Rookwood Weir. An Earthquake Risk Plan will be developed for the Project ACG.

20.4.4.6 Landslides

As described in Section 20.2.5.4, geotechnical investigations have identified the site selections as being the optimal locations for the water infrastructure. Based on geotechnical investigations the potential risk of a landslide hazard is considered negligible.

20.4.4.7 Climate change

As detailed in Chapter 4 Climate, natural hazards and climate change Queensland has a naturally variable climate and its climate is projected to become more variable and extreme in the future.

Predicted increased temperatures, increased evaporation and reduced rainfall as a result of climate change will impact on catchment yields. Staging the development of the Project will allow the Project to respond to actual demand over time taking into account climate variation, economic considerations and Government policy, planning instruments and guidelines based on circumstances at the time. Water storages are likely to become more important for the purpose of water supply, mitigating drought and for maintaining environment flows as climate change impacts are realised.

The impacts of climate change include flooding, increases in temperatures and extreme storm events. These risks have been assessed above.

20.4.5 Wildlife hazards

As detailed in Section 20.2.6 the potential wildlife hazards in the Project area include estuarine crocodiles snakes, spiders, and disease carrying animals and insects, including but not limited to, mosquitoes, rats and flies.

Habitat modification as a result of the Project may result in the provision of additional suitable habitat for the estuarine crocodile and mosquito breeding within the impoundment areas.

An increase in the number of estuarine crocodiles at Eden Bann or Rookwood carries an increased risk of crocodile attacks, particularly if there is increased recreational use of the area.

The following mitigation measures would be implemented to reduce the risk of crocodile attacks and snake and spider bites during operation:

- All staff would receive appropriate education and training to address the risks associated with wildlife
- Operational staff are to avoid entering areas known to be used by crocodiles and where possible, avoid walking along the banks of the river or creeks
- Signage will be strategically placed to warn of the presence of estuarine crocodiles, the dangers they pose and actions to avoid contact
- Recreational use of the impounded areas would not be encouraged and no public access to the river would be provided as part of the Project and the weir sites will be fenced and visitor access to the weir would be restricted
- Management measures to control biting insect populations will be incorporated into the weed and pest management plan. If necessary, application of larvicides may be used to control mosquitos.

20.4.6 Weir failure

20.4.6.1 Overview

Weir failure could result in a population at risk downstream as well as significant damage to downstream watercourses, particularly scouring and vegetation removal. Failure not associated with rainfall events or earthquakes are classified as static failures. These are mainly due to failure

of pipeline or gates and slope instability problems. The primary cause of these failures is inadequate or poor site investigations, design and construction.

20.4.6.2 Failure impact assessment

A failure impact assessment has been undertaken for the Project. The results of the assessment show that estimated incremental population at risk due to a breach of the raised Eden Bann Weir is greater than 2 for all scenarios considered. Therefore, the raised Eden Bann Weir has a minimum Category 1 failure impact rating and is a referable dam as defined under the *Water Act 2000* (Qld).

The results of the failure impact assessment for the proposed Rookwood Weir show that none of the properties identified as being potentially at risk are expected to be flooded by either the no-failure or the breach scenarios considered. As the present estimate of incremental population at risk is less than two, the proposed weir does not have a failure impact rating. As such, the proposed weir is not referable in terms of the *Water Supply (Safety and Reliability) Act 2008* (Qld). However, this assessment will be reviewed at five yearly intervals to determine whether any activities or the establishment of any permanent population takes place that may affect the population at risk should the Rookwood Weir be constructed.

Eden Bann Weir is a referable dam and is therefore subject to the provisions of the *Water Supply (Safety and Reliability) Act 2008* (Qld). Eden Bann Weir will be assessed in accordance with the following dam safety guidelines that apply to referable dams:

- Guidelines for Acceptable Flood Capacity for Water Dams (DEWS 2013)
- Guidelines for Failure Impact Assessment of Water Dams (DERM 2010)
- Queensland Dam Safety Management Guidelines (DNRM 2002).

Although the proposed Rookwood Weir has not been designated as a referrable dam it will be designed to the same safety standards as the Eden Bann Weir.

20.4.6.3 Failure mode analysis

Critical failure modes identified in the analysis include:

- Fire leading to a loss of power / controls and subsequent failure of the spillway gates
- Erosion due to seepage (known as 'piping') within the earth embankment on the left abutment as a result of earthquake leading to a loss of seepage control and possible breach
- Piping through the foundation:
  - Under the embankment at the left abutment leading to a possible breach
  - At/under the concrete embankment at the right abutment (weathered granite) leading to a possible breach at Eden Bann
  - At/under the existing concrete embankment at the right abutment (extremely weathered granite) leading to a possible breach at Eden Bann
  - Around/under the cut off at the left abutment leading to a possible breach at Rookwood
- Instability of the left abutment serpentinite (rock) leading to possible breach (Eden Bann)
- Overturning of the concrete embankment at the right abutment as a result of erosion of the downstream toe at Eden Bann.

Fire leading to a loss of power does not present a failure risk unless the issue coincides with a requirement to lower the gates (for example, flood). The likelihood of bushfire coinciding with an event where the gates need to be lowered to prevent dam failure is very low.

At this stage of the design, three seepage cut-off options (at each weir) for the left and right abutments have been provided to mitigate the failure modes associated with piping. Nominal erosion protection has been provided in the design to minimise the risk of erosion at the downstream toe from overtopping flow impinging on erodible granite.

20.4.6.4 Gate fault tree analysis

The probability of failure per use of the crest gates relating to flood events are shown in Table 20-10. The results of the analysis showed that the proposed system provides reliability generally in accordance with good modern practice for gates and that the operation of the gates in a bank of four gates is acceptable. A number of recommendations for the detailed design phase were identified to further enhance the reliability of the system.

Table 20-10Fault tree analysis results for crest gate operation

Top event		Probability of failure
1 gate independently fails to go down in each bank	Any 1 gate	0.0138
1 gate in a bank of 4 fail to go down	1 of 4	0.0479
2 gates in a bank of 4 fail to go down	2 of 4	0.0145
3 gates in a bank of 4 fail to go down	3 of 4	0.0041
4 gates in a bank of 4 fail to go down	4 of 4	0.00224
Any 1 gate out of 12 gates fail to go down	1 of 12	0.137
Any 2 gates out of 12 gates fail to go down	2 of 12	0.0905
Any 2 gates out of one bank fail to go down	2 of 12	0.0428
Any 2 gates out of 12 gates fail to go down with lower human error probability (HEP)	2 of 12	0.0189
Any 2 gates out of 12 gates fail to go down with lower software	2 of 12	0.0676
Any 2 gates out of 12 gates fail to go down with lower HEP and lower software	2 of 12	0.0162
1 bank in 3 fails to go down (sunny day failure)	4 of 12	0.00663

20.4.6.5 Electrical and control system

The electrical and control systems that may be used onsite, mainly to operate the gates, will be installed during the final stage of development at Eden Bann and Rookwood weirs. The major hazards are restricted to the site and involve the potential for fire from short circuiting and electrical faults. Uncontrolled water release would also be possible from power grid supply failure and open gates. However, backup diesel generators for electricity supply will be available. All outlet valves and similar control equipment will have manual as well as automatic actuators. As a result, these hazards have been assessed as insignificant. The Proponent will establish health and safety management systems which will be implemented at this Project.

20.5 Decommissioning

The design life of the Project is 100 years and it is anticipated that the weir infrastructure will be maintained after this period. As such, planning for decommissioning and assessment of hazard and risk impacts during this phase have not been undertaken as part of this assessment. When required, decommissioning of the Project will be undertaken in accordance with legislative requirements and best practice methods current at the time.

20.6 Cumulative risk

Discussion of cumulative impacts from the Project and other proposed projects in the catchment are presented in Chapter 21. The Projects contribution to cumulative risk relating to air quality, noise and vibration, road and traffic hazards are considered insignificant due to the short-term and localised nature of these risks during construction.

20.7 Risk management

20.7.1 Safety in Design

'Safety in Design' (SiD) is a strategy aimed at preventing injuries and disease by considering hazards as early as possible in the planning and design process, enhancing safety through choices in the design process. At each design stage the SiD process can make a significant contribution by identifying and eliminating hazards, and reducing likely risks from hazards where elimination is not possible.

The following hierarchy of controls is a world-wide accepted model and is accepted model of Safe Work Australia for managing health and safety risk:

- Eliminate the hazard
- Change the way the work is done
  - Substitute – replace or change plant, substances or materials to lower the risk
  - Isolate the hazard
  - Engineering control – design and install equipment to counteract the hazard
  - Administrative control – arrange work so less time is spent around the hazard and monitor workforce understanding of the hazard and the controls
- Ensure PPE is worn near hazards

A number of the preventative mitigation measures require particular design measures to minimise the risk of hazards that might impact on the community or environment. These measures include:

- Incorporation of signage, locked gates and fencing in the detailed design to minimise the risk of unauthorised access to the site
- Design of fuel, oil and explosive storage areas in accordance with Australian Standards
- Design of the weir to meet Queensland dam safety requirements and the Australian National Committee on Large Dams (ANCOLD) guidelines.
- Post incident recovery
- Auditing and inspection
- Incident reports and investigations

- Management reporting and responses.

Hazards identified in Table 20-6 will be addressed in the incident response plans. An outline of response plans for oil spill, traffic related incidents and fire and explosion have been provided as these have been identified as a medium residual risk. In case of a bushfire, the Project proponent will have limited onsite firefighting capabilities but will coordinate with State and local government agencies to develop appropriate response strategies.

20.7.2 Spill response plan

The plan for oil spill emergency responses will include reporting of the oil/fuel spill to the Incident Controller. The spill will be assessed to identify the type of material (lube oil or diesel), location of the spill source, the quantity of oil spilled and its environment, community, health and safety impact. The Incident Controller will undertake immediate steps to spill containment/control, recovery of spill material and waste management. Recovery operations are then commenced which includes clean up and replenishment of material stocks.

The objective of the spill response plan will be to minimise contamination due to spilled oils. The following will be adhered to:

- Material Safety Data Sheets will be kept at the storage location and administration office such that they are readily accessible to all in the event of an oil spill
- Petroleum product spillages will be immediately cleaned up with appropriate absorbent materials along with remediation of the area if required with advice from a qualified professional. The soiled absorbent will be kept in an appropriate container marked ‘regulated waste’ for a waste contractor licensed to receive such waste
- Spill kits including containment and treatment equipment and materials will be provided near storage areas of hazardous materials
- Staff will be provided with appropriate PPE and training on how to use them
- Where spills occur offsite and/or cannot be managed onsite QFES will be notified (Table 20-9
- Regular inspection of all petroleum product storage areas will be conducted. Results will be reported to the Site Manager
- In the case of reportable incidents, the Site Manager will report the incident to the DEHP and Rockhampton Regional Council. A report detailing the cause of the spill and corrective actions will be prepared
- Investigations/corrective actions undertaken will be documented. Corrective actions will be closed out by senior management according to an agreed responsibility and timescale.

20.7.3 Fire/explosion emergency response plan

Fire and explosion has the potential to cause bushfires as the area has been identified as a bushfire hazard area. The plan for emergency response to a fire or explosion will include immediate actions of raising alarms and taking lifesaving actions. The Emergency Controller will make an assessment of the situation including the environmental impact and access control to the site. The Emergency Controller will then accordingly plan for containment and for dealing with casualties and a survey for effects on the environment. The emergency will then be responded to for issues including fire management and containment, rescue, casualty management, and environmental impact actions. External agencies such as QFES and QAS will be contacted for

required assistance. Recovery operations will then be initiated which include the restoration of essential services, provision of welfare, clean up, reconstruction and replenishment of stocks consumed during the emergency response. The plan will have all necessary information on responsibilities, emergency contact details, communication procedures, training, fire protection equipment, first aid, post incident follow-up and review.

20.7.4 Traffic management and traffic incident response

A separate assessment of traffic and transportation issues has been undertaken to examine impacts of Project related traffic on both road safety and road operability (Chapter 16 Transport). The outcomes of this study have informed a suit of commitments with regard to road use management planning to address traffic related impacts on public roads. A road use management plan (RUMP) (and site specific traffic management plans (TMPs) will be required for the construction phase of the Project.

The objectives of the RUMP will be twofold:

- To prevent any incidents and harm to individuals
- To minimise impacts of traffic and transport activities on local residents and road users.

Key aspects of the RUMP will include:

- Protocols for giving way to local traffic and pedestrians
- Imposition of appropriate speed limits on Project related traffic
- Any temporary traffic controls and warning signs required to manage road and intersection upgrades and construction traffic
- Training and licencing requirements for truck drivers
- Zero tolerance for drugs and alcohol for truck drivers
- Strict controls on fatigue
- Induction training for truck drivers particularly highlighting prescribed access routes and controls required to address hazards along the route
- Signs and other awareness raising and warning requirements to ensure local residents are aware of traffic and transport activities, risk areas and controls in place to protect them (eg controlled crossing points on the access road)
- Incident response requirements in the event of a traffic accident outside the site.

The RUMP will be developed in consultation with Department of Transport and Main Roads, Rockhampton Regional Council, EMQ and QFES as necessary and applicable.

20.7.5 Emergency response

An incident response strategy will be developed and will nominate an incidence response team, inclusive of emergency and health services personnel, to facilitate that adequately trained and equipped personnel are readily available in the event of an incident. Members of the team will be trained in the following aspects in relation to environmental and community hazards: firefighting; chemical, diesel and oil spill response and clean up; first aid; and responding to vehicular accidents. Trained paramedics or similar would be identified.

20.7.5.1 Emergency response equipment

In relation to environmental and community hazards, the proponent will have the following equipment available at the site to support incident response:

- Oil and chemical spill response equipment suitable for spills to land and creeks
- PPE as required to protect personnel involved in incident response activities
- Suitable communication equipment to communicate during emergencies.

20.7.5.2 External emergency services

Emergency services, including QFES, QAS, QPS and EMQ, will be immediately notified in the event of an accident during construction or operation. The Project proponent will liaise with external emergency services in Rockhampton to facilitate that resources are available to assist in emergency response. Prior to construction of the weirs, the Proponent will liaise with state emergency service providers to finalise the emergency response plan. A copy of the emergency response plan will be provided to each emergency response provider. Desktop and practical exercises will be planned for attendance and participation by the emergency services.

20.8 Summary

A preliminary risk assessment has been carried out for all components of the Project in accordance with the AS/NZS ISO 31000: 2009 Risk management – Principles and guidelines and with a number of legislations, standards and guidelines applicable to the Project, including the *Work Health and Safety Act 2011* (Qld), Australian Standards on risk management, Queensland dam safety guidelines and the New South Wales Department of Planning's Hazardous Industry Planning Advisory Papers. For the purposes of the EIS, hazard identification focuses on non-routine events that may result in impacts on people, property or the environment.

The Project will potentially use a number of environmentally hazardous substances which will be stored and handled in accordance with appropriate legislations and Australian Standards. Trucks used to transport diesel will comply with all aspects of the Australian Code for Transport of Dangerous Goods by Road and Rail.

Based on the failure impact assessment studies for the weirs, Eden Bann Weir is considered to be a referrable dam and will be separately assessed in accordance with the provisions under the *Water Supply (Safety and Reliability) Act 2008* (Qld) during the detailed design phase. Eden Bann Weir will be assessed in accordance with the following dam safety guidelines that apply to referable dams:

- Guidelines for Acceptable Flood Capacity for Water Dams (DEWS 2013)
- Guidelines for Failure Impact Assessment of Water Dams (DERM 2010)
- Queensland Dam Safety Management Guidelines (DNRM 2002).

Although the proposed Rookwood Weir has not been designated as a referrable dam it will be designed to the same safety standards as the Eden Bann Weir.

Both weirs will be assessed at five yearly intervals to determine populations at risks. Failure mode analysis indicates adequate measures to mitigate failures associated with the piping, erosion at the downstream toe from overtopping and very low risk of bushfire impacting the power supply at the weirs. Gate fault tree analysis indicates the proposed system provides reliability in accordance

with good modern practices for the gates. The weirs will be designed, constructed and operated to Australian Standards.

The hazard and risk assessment identified 19 hazards during construction which resulted in six high risks, nine medium risks and four low risks in the absence of management and mitigation. After mitigation measures are implemented, the residual risks comprise four medium risks and 15 low risks. The assessment identified 14 hazards during operation which resulted in five high risks and nine medium risks in the absence of management and mitigation. After mitigation measures are implemented, the residual risks comprise three medium risks and 11 low risks.

Residual medium risks include traffic incidents between Project related vehicles and community members/private vehicles during both phases of the Project, as well as spills or leaks from diesel storage tanks during construction. An outline of emergency response plans for oil spill, traffic related incidents and fire and explosion have been provided.

Preventative mitigation measures have been incorporated into Project design through the Safety in Design process. The Proponent will establish health and safety management systems which will be implemented at this Project in consultation with emergency services as necessary and applicable. Preventative measures will also be implemented through workplace procedures and training.

The risk assessment undertaken for the EIS assumes that there will be an ongoing hazard and risk assessment process throughout the life cycle of the Project and that this will focus on minimisation of risks to people, property and the environment as well as workers on the site.