19.0 HAZARD AND RISK

19.1 Introduction

This Chapter identifies and describes the hazards and risks that may be associated with the construction and operational phases of the Glebe Option. Decommissioning is described in Section 5.6 and based on that assessment is not addressed further here. The assessment is focused on identifying hazards and risks that may impact upon environmental values as well as public health and safety. Responsibility for the safety of a storage rests with the dam owner under the *Water Act 2000* and under common law. The '*Queensland Dam Safety Management Guidelines*' (NRW, 2007b) outline best practice in dam safety and are primarily advisory in nature. Conditions imposed on dams under the provisions of the Water Act and IPA may reference relevant sections of the Queensland Dam Safety Management Guidelines. These guidelines will be followed in all design stages associated with the Glebe Option.

Potential hazards associated with the Glebe Option have been listed and evaluated below. Additionally, mitigation measures have been applied for the construction and operation phases to reduce the likelihood and severity of the hazards.

19.2 Potential Hazards

Potential hazards associated with the Glebe Option have been listed and evaluated in to Table 19-3.

Table 19-1. Summary of construction hazards – on-site

Hazard	Cause	Consequence	Mitigation included in project design
Erosion and Sedimentation	• Areas of disturbed bare soil • Temporary stockpiles • Haul roads.	• Dust nuisance for workforce • Dust reducing road safety • Exacerbation of impacts within the construction	• Erosion and sediment control measures such as silt traps, sediment ponds and dust suppression. • Minimise the area

Hazard	Cause	Consequence	Mitigation included in project design
		footprint. • Loss of sediment	exposed at any one time • Revegetating exposed areas • Compliance with EMP • Where possible, schedule works to minimise disturbance during periods of high runoff risk
Damage to Public Utilities	• Construction damage to general and private infrastructure including cables, pipes and overhead powerlines • Excavation for pipelines, bridges and roads	• Impact on construction timeframe. - Power outage - Cost and time of repair to infrastructure • Loss of contact with emergency services – Safety and Health Risks	• Toolbox talks • Dial Before You Dig (DBYD) and accurate location of utilities in the field • Work method statements for construction activities • Daily work crew risk assessment
Fire (natural or human)	• Lightning strikes • Construction accident • Arson • Accidental (e.g.discarded cigarette) • Spontaneous combustion in mulch pile.	• Damage to machinery and equipment (Materials and work-site) • Escape to surrounding agricultural areas • Injury to site workforce	• No burning of vegetation or other activities where this is likely to significantly increase risk of uncontrolled fires • Establish and maintain contact with local emergency services • Maintain work areas and temporary accommodation clear of fire risk areas • Maintain on-site mobile fire-fighting equipment and water tank • Establish a fire management plan for the Glebe Option site • Compliance with construction EMP • Smoking only in secure and designated areas • Limit height of mulch pile and turn regularly to manage heating
Traffic	• Movements of heavy vehicles, equipment and oversize loads • Uncoordinated movements of commercial vehicles and workers' private vehicles • Inadequate road designs • Poor road safety	• Vehicle damage • Injury to site workforce • Option delays and increased costs	• Ensure all road designs for the site are suitable for predicted traffic and follow good practice (i.e. utilise one way ring roads around the construction area). • Implement Traffic Management Plan for the

Hazard	Cause	Consequence	Mitigation included in project design
	attitudes/culture • Increased volume on access roads • Failure to match driving conditions		delivery and movement of oversize loads (machinery and equipment) • Monitor performance carefully. • Provide workforce with appropriate induction training and regular reinforcement of rules and policies. • Reversing signals on construction machinery • Set speed limits on construction site and main access roads
Flood	• Rainfall in catchment	• Damage to weir and equipment • Time loss • Sediment inflow and bank erosion • Restriction of access to work area.	• Monitor flood conditions (early warning system) • Compliance with EMP • Ensure timely removal of machinery and equipment from spillway and flow areas • Schedule construction to avoid periods with highest risk from heavy rain events. • Plan flexible work program to maximise the possibility that other works can continue while river remains in flood
Construction Accidents	• Unsafe work practices • Incorrect usage of machinery and equipment	• Injury or possible loss of life.	• Ensure safe work practices. • Regular toolbox talks. • Only used qualified operators. • Set targets for LTIs
Hazardous materials	• Storage of hazardous materials / chemicals specifically fuels, oils, solvents, paints and acids • Chemical and hydrocarbon spills • Refuelling of vehicles	• Land contamination and impact on water quality • High cost of removal and treatment of contaminated material • Impact on human health • Impacts on flora and fauna • Explosion	• Compliance with relevant standards • Secondary containment/bunding • Housekeeping/immediate cleanup of leaks and spills • Locate storages away from flow paths. • Comply with Construction EMP. • No refuelling or repairs along drainage paths, or near/ within waterways • Ensure MSDS clearly

Hazard	Cause	Consequence	Mitigation included in project design
			visible where hazardous materials are stored. • Match storage volumes to usage rates (plus addition buffer volume) to reduce volumes stored on-site.
Greenhouse gas	• Failure to remove vegetation from increased inundation area • Excessive vehicle and equipment emissions	• Decrease in water quality • Impact on aquatic fauna • Emission of greenhouse gases	• Use vegetation for rehabilitation • Salvage millable timber • Ensure regular servicing and maintenance of equipment • Limit idling time for heavy machinery • Purchase green energy from grid • Turn off equipment and office machines when not in use as far as practicable • Enforce waste management hierarchy of reduce, reuse and recycle • Restrict burning of vegetation by mulching and use residual timber for terrestrial and/or aquatic habitat replacement
Public safety and site security	• Unmanaged public access to works site	• Human injury • Theft or damage to equipment and materials	• Secure fencing at construction site • After hours security control
Trenches and excavations	• Trench or pit left open / unfenced • Trench or pit collapse	• Human or animal injury • Damage to equipment	• Minimise period for which trench / pit is open • Fence and cover the area if left overnight • All trenches or pits must comply with workplace health and safety laws.
Weed invasion	• Imported material • Imported seeds on vehicles and equipment	• Spread of noxious plants	• Comply with vehicle washdown procedures • Comply with weed control plan
Workforce safety	• Wildlife hazards • Clearing vegetation • Working in or near watercourses	• Human injury • Drowning	• Safety induction to inform workers of dangerous fauna in the area • Appropriate medical facilities / trained staff on site • Ensure safe travel to site (workforce bus) and

Hazard	Cause	Consequence	Mitigation included in project design
			regular toolbox talks for individual travel.
Natural Events	• Landslip • Earthquake	• Human harm • Damage to equipment	• Compliance with EMP • Adequate level of safety in design.

Table 19-2. Summary of construction hazards – External

Hazard	Cause	Consequence	Mitigation included in project design
Erosion and Sedimentation	• Areas of disturbed bare soil • Temporary stockpiles • Haul roads • Disturbance to creek morphology • Extractive process – removing sand from Cockatoo Creek	• Dust nuisance for residents • Dust nuisance for agriculture (e.g. cropping and pastures) • Dust reducing road safety • Adverse impact on water quality and aquatic ecosystems • Alterations in stream flow conditions	• Erosion and sediment control measures such as silt traps, sediment ponds and dust suppression. • Minimise the area exposed at any one time • Revegetating exposed areas • Compliance with EMP • Where possible, schedule works to minimise disturbance during periods of high runoff risk • Design access to sand deposits to minimise the risk to channel stability.
Damage to Public Utilities	• Construction damage to general and private infrastructure including cables, pipes, overhead powerlines, roads, fences and property infrastructure • Excavation for pipelines, bridges and roads	• Impact on business - Power outage - Cost and time of repair to infrastructure • Loss of contact with emergency services – Safety and Health Risks. • Stock escape from property.	• Toolbox talks • Dial Before You Dig (DBYD) and accurate location of utilities in the field • Work method statements for construction activities • Daily work crew risk assessment. • Advise property owners of activities and coordinate with stock movement from work area.
Fire (natural or human)	• Lightning strikes • Construction accident • Arson • Accidental (e.g.discarded cigarette) • Spontaneous combustion in mulch pile	• Escape to surrounding agricultural areas • Damage to surrounding properties and recreational facilities. • Injury to animals and humans • Damage to ecosystems	• No burning of vegetation or other activities where this is likely to significantly increase risk of uncontrolled fires • Establish and maintain contact with local emergency services

Hazard	Cause	Consequence	Mitigation included in project design
			• Maintain work areas and temporary accommodation clear of fire risk areas • Fire fighting equipment to be accessible when performing a high fire risk activity. • Establish a fire management plan for the Glebe Option site • Compliance with construction EMP • Smoking only in secure and designated areas • Limit height of mulch pile and turn regularly to manage heating
Traffic	• Movements of heavy vehicles, equipment and oversize loads • Uncoordinated movements of commercial vehicles and workers' private vehicles • Inadequate road designs • Poor road safety attitudes/culture • Increased volume on access roads • Interaction with school bus set-down and pick-up times • Failure to match driving conditions	• Vehicle damage • Injury to humans and fauna • Option delays and increased costs • Negative community attitudes	• Ensure all road designs are suitable for predicted traffic and follow good practice. • Implement Traffic Management Plan for oversize loads (machinery and equipment) and avoid peak road usage hours by residents • Monitor performance carefully. • Provide workforce with appropriate induction training and regular reinforcement of rules and policies. • Reversing signals on construction machinery • Set speed limits on main access roads • Impose safe driving practices on public roads by workforce • Encourage car pooling and provide frequent bus transportation.
Flood	• Rainfall in catchment	• Damage to weir and equipment • Sediment inflow and bank erosion • Loss of cross-river access for extended periods	• Monitor flood conditions (early warning system) • Compliance with EMP • Ensure timely removal of machinery and equipment from spillway and flow areas

Hazard	Cause	Consequence	Mitigation included in project design
Hazardous materials	• Storage of hazardous materials / chemicals specifically fuels, oils, solvents, paints and acids • Chemical and hydrocarbon spills • Refuelling of vehicles	• Land contamination and impact on water quality • High cost of removal and treatment of contaminated material • Impact on human health • Impacts on flora and fauna • Explosion	• Compliance with relevant standards • Secondary containment/bunding • Housekeeping/immediate cleanup of leaks and spills • Locate storages away from flow paths. • Comply with Construction EMP. • No refuelling or repairs near or within waterways
Greenhouse gas	• Excessive vehicle and equipment emissions	• Emission of greenhouse gases	• Ensure regular servicing and maintenance of equipment. • Limit idling time for heavy machinery. • Purchase green energy from grid. • Enforce waste management hierarchy of reduce, reuse and recycle. • Encourage car pooling and provide frequent bus transportation for the workforce.
Public safety and site security	• Unmanaged public access to recreation area	• Human injury • Theft or damage to equipment and materials	• Secure fencing at construction site • After hours security control • Close recreation area during construction
Trenches and excavations	• Trench or pit left open / unfenced	• Human or animal injury	• Minimise period for which trench / pit is open • Fence and cover the area if left overnight
Weed invasion	• Imported material • Imported seeds on vehicles and equipment	• Spread of noxious plants	• Comply with vehicle washdown procedures • Comply with weed control plan
Workforce safety	• Wildlife hazards • Clearing vegetation • Working in stream or creeks	• Human injury • Drowning	• Safety induction to inform workers of dangerous fauna in the area • Appropriate medical facilities / trained staff on site • Ensure safe travel to site (workforce bus) and regular toolbox talks for individual travel.

Table 19-3. Summary of operational hazards

Hazard	Cause	Consequence	Mitigation measure
Sunny day dam failure – Static causes	• Bag failure	• Damage to aquatic ecosystem • Downstream damage to riverbed and banks • Loss of water storage and security of supply • Injury or loss of life	• Regular inspection and maintenance • Appropriate redundancy incorporated within the design commensurate with the risk such as back-up machinery and equipment, • Undertake Failure Impact Assessment which will identify any mitigation measures required. • Restrict access to weir when bags fixed • Maintain upstream exclusion zone to public use within Weir
Increased upstream flooding	• Failure of bag to deflate	• Damage to banks • Risk of bypass channel erosion • Failure of constructed levees	• Appropriate redundancy incorporated within the design commensurate with the risk such as back-up system for bag deflation
Impact on reservoir and/or downstream water quality	• Stratification in reservoir • Release of cold and / or deoxygenated water from low levels • Contaminated sites within impoundment • Excess biomass left in reservoir if additional area inundated is not cleared of timber	• Impacts on aquatic ecosystems • Water not suitable for intended uses	• Install multi-level offtake • Remediate all known contaminated sites and remove all significant sources of contamination from the impoundment area and nearby catchment (where possible). • Avoid disturbance of sediments that might liberate nutrients from reservoir bottom. • Monitor temperature, DO, algal levels and other parameters to identify potential problems and manage discharges accordingly. • Remove excess biomass from the additional inundation

Hazard	Cause	Consequence	Mitigation measure
			area prior to raising storage level
Physical damage to fauna from intake of water for the pipeline	• Unmitigated water intake	• Impacts on aquatic ecosystems upstream of the weir and at the intake for the pipeline	• Ensure appropriate screening at the pipeline intake to protect fauna from injury or inadvertent entry into the pipeline
Pipeline failure	• Physical failure of pipeline structures due to human or accidental factors • Deliberate vandalism	• Interruption of water supply • Costs • Major erosion • Damage to train line, roads and surrounding environment	• Adequate signage on pipeline • Appropriate system design and management • Adequate security • Register with DBYD system
Fire (natural or human)	• Lightning strikes • Arson • Accidental (e.g.discarded cigarette)	• Damage to machinery and equipment (Pump stations, pipeline and weir fabri-dam) • Escape to surrounding agricultural and recreational areas	• All pump station and pipeline assets to be enclosed in structures. • Pipeline is buried at an average of 1.5 m depth, thus will not be affected by fire. • Fire fighting equipment capable of extinguishing minor fires stored on-site. • Establish and maintain contact with local emergency services
Hazardous materials	• Spill of fuels, stored on-site for backup generators	• Damage to water quality and aquatic ecosystems. • Fire and associated damage to equipment/ structures	• All fuels to be stored in a bunded area, as per *AS1940-2004.* • Fire fighting equipment accessible on all sites. • Spill containment kits to be accessible during all fuel deliveries. • All spills to be cleaned up immediately and contaminated material removed from site by a licensed contractor.
Natural Events	• Landslip • Earthquake	• Human harm • Damage to equipment	• Appropiate level of safety in design. • Installation of automated shut-off systems to minimise the impact of pipeline

Hazard	Cause	Consequence	Mitigation measure
			rupture.

19.3 Inventory of Dangerous Goods

Some of the key hazards for the Glebe Option are associated with the substances being stored and used in construction and operations for the Option. The Glebe Option will use few hazardous substances which are regulated by the Australian Dangerous Goods Code.

Table 19-4 lists the principal dangerous goods by name, classification, raw and storage concentration, UN number, and packaging group. MSDS information will be obtained and communicated to all site personnel involved in the storage, handling, use and disposal of dangerous and hazardous substances and materials.

Table 19-4. Indicative List of Dangerous Goods and Hazardous Substances

Chemical Name/ Shipping Name	DG Class	Raw conc. (wt%)	Storage conc. (wt%)	UN Number	Packaging group	Purpose/ Use
Diesel Fuel Oil	3 (Class C1)*	N/A	N/A	1202	III	Fuel for mobile equipment
Unleaded Petrol	3	N/A	N/A	1203	II	Fuel for mobile equipment
Ammonium Nitrate	5.1	100%	N/A	1942	III	Blasting on site
Lubrication Oils (hydraulic oil)	3 (Class C2)**	N/A	N/A	N/A	N/A	Lubricate plant and equipment and replenish hydraulic systems
Solvents (e.g. acetone)	3	99.5%	99.5%	1090	II	Plant maintenance
Paints	3	N/A	N/A	1263	III	Paint

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

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

19.3.1.1 Construction Phase

During the construction phase some hazards are associated with substances being stored and used primarily for motor vehicle operation. Table 19-5 details the relevant rate of use and maximum amount of the substance / material stored at the site during construction.

Table 19-5. Rate of Use of Dangerous Goods and Hazardous Substances – Construction Phase

Chemical Name/ Shipping Name	Rate of Use	Indicative maximum inventory
Diesel Fuel Oil	1,000 litres/day	15,000 litres
Unleaded Petrol	200 litres/day	1 000 litres
Lubrication Oils (hydraulic oil)	20 litres/day	1,000 litres
Solvents	As required	<200 litres
Paints	As required	<200 litres

19.3.1.2 Operational Phase

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

lists the rate of use during operations. Refer to Table 19-4 for the physical properties of these materials.

Table 19-6 Rate of Use of Dangerous Goods and Hazardous Substances - Operational Phase

Chemical Name/ Shipping Name	Rate of Use
Diesel Fuel Oil	As required
Lubrication Oils (hydraulic oil)	As required

19.3.1.3 Transport Accidents Remote from Site

Off-site transportation of materials to and from the Glebe Option site could result in accidental release or exposure to hazardous materials. The hazards of transporting chemicals by road and handling chemicals off-site are described in Table 19-7.

Table 19-7 Chemical Handling Off-site

Item - Hazard or Event	Possible Causes	Possible Consequences	Detection/ Protection Measures
Road tanker spill	Run off road	Accident with no spillage through to tanker failure.	All vehicles carry Hazchem Identification and responses for use by emergency personnel attending accident.
	Collision with other vehicle/ obstacle	Accident is serious and tank fails.	Local roadways to the construction site will be adequate for bulk transport vehicles.
		Dangerous goods escape tanker and contaminate environment.	Proponent ERP will be developed to handle such incidents.
			All tankers conform to the Australian Code for the Transport of Dangerous Goods by Road and Rail (Australian Government, 2007), and Australian Standard AS 2809.4-1986 road tank vehicles for dangerous goods.

If a tanker shell became damaged in an incident, the full contents of one tank compartment (5,000-8 500 litres) or greater (up to 20,000 litres) could spill onto an off-site roadway, and escape into the soil profile or nearby waterway. The environmental damage caused by such a spill is dependent on the area in which the accident occurs.

The expected frequency of deliveries of hazardous materials that have the potential to spill is detailed in Table 19-8. The largest requirement for delivery of chemicals to the site during construction is for diesel fuel oil.

Table 19-8 Delivery Frequency of Hazardous Goods During Construction Phase

Product	Annual Deliveries	Delivery Frequency
Diesel Fuel Oil	365,000 litres	Weekly

19.4 Risk Assessment

A risk assessment for the construction and operation phases of the Glebe Option has been undertaken with reference to *Australian Standard 4360: Risk Management*. The process of analysing risk associated with the Glebe Option involved a qualitative risk assessment methodology to assess comparative risks. Under the Standard, risk is defined as '*the chance of something happening that will have an impact upon objectives*'. It is measured in terms of consequences and likelihood. In the risk assessment methodology, the likelihood is expressed using descriptions, which are then assigned ratings in decreasing order of likelihood of occurrence. The severity of the consequence is also described and rated. A quantitative risk assessment was not undertaken due to the lack of a final design and construction plan knowledge of actual machinery to be used, final workforce

size and contractor preferences. It is appropriate for a quantitative assessment to be undertaken by the appointed contractor or part of the final construction EMP development.

The rating and likelihood description scheme are shown in Table 19-9 and the consequences of impact rating system and description are shown in Table 19-10. The risk analysis matrix is illustrated in.

Table 19-9. Measures of likelihood

Likelihood category	Description
Almost certain	The event is expected to occur in most circumstances
Likely	The event will probably occur in most circumstances
Possible	The event might occur at some time
Unlikely	The event could occur at some time but is unlikely
Rare	The event may occur in exceptional circumstances

Table 19-10. Measures of consequences of impact for different risk types

Descriptor	Environment	Health and Safety	Property and assets
Insignificant	No damage to on or off-site natural resource	Minor and first aid injury, no health effects	Very minor property damage (< $ 5000)
Minor	Minor detrimental effect to on or off-site natural resource and promptly contained	Medical treatment	Minor property damage (< $ 50 000)
Moderate	Short-term detrimental effect to off-site natural resource with full recovery	Significant injury requiring hospital treatment	Property damage (< $0.5 m)
Major	Prolonged but reversible detrimental effect to off-site natural resource	Extensive injury, serious injury or permanent disability	Property damage (<$5 m) Loss of supply up to 6 months
Catastrophic	Serious environmental harm, irreversible or widespread impacts	Fatality	Property damage (> $5 m) Loss of supply > 6 months

Table 19-11. Consequence and Likelihood Matrix

	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood	1	2	3	4	5
A (almost certain)	H	H	E	E	E
B (likely)	M	H	H	E	E
C (possible)	L	M	H	E	E
D (unlikely)	L	L	M	H	E
E (rare)	L	L	M	H	H

Notes:
E= Extreme risk; detailed research, management and planning required at senior levels.
H = High risk; senior management attention – substantial and site specific controls required.
M = Moderate risk; management responsibility must be specified.
L = Low risk; manage by routine procedures

The method of assigning a risk rating is set out in and the risk rating and residual risk (i.e. following mitigation) are shown in Table 19-12 to Table 19-14.

Table 19-12. Environmental risk

	Initial risk assessment (Without Mitigation)			Risk assessment (with mitigation)		
Risk Area	Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Erosion and Sedimentation (Construction) - adverse impact on water quality - loss of sediment	A	3	E	D	3	M
Fire - natural or human (Construction/Operation) - Damage to ecosystems - Damage to animals and human injury	D	4	E	E	4	H
Flood (Construction/Operation) - Sediment inflow and bank erosion	C	4	E	C	3	H

Risk Area	Initial risk assessment (Without Mitigation)			Risk assessment (with mitigation)		
	Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Hazardous materials (Construction) - Land contamination and impact on water quality - Impacts on flora and fauna	C	4	E	E	2	L
Greenhouse gases and water quality (Operation) - Decrease in water quality - Impact on aquatic fauna - Emission of greenhouse gases	A	3	E	D	1	L
Impact on reservoir and/or downstream water quality (Operation) - Impacts on downstream aquatic ecosystems - Water not suitable for agriculture - Reduced oxygen downstream impacts on aquatic ecosystems and sensitive species	C	3	H	E	3	M
Increased upstream flooding due to bag failure (Operation) - Significant damage to banks - Risk of bypass channel erosion - Failure of constructed levees	E	4	M	E	1	L

Table 19-13. Public risk

	Initial risk assessment (Without Mitigation)			Risk assessment (with mitigation)		
Risk Area	Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Erosion and Sedimentation (construction) - dust nuisance for residents	A	3	E	D	3	M
Fire - natural or human (construction/operation) – Public safety	C	5	E	E	5	H
Traffic (construction) - vehicle damage - project delays and increased costs	B	3	H	D	3	M
Hazardous materials and contamination(Construction) - Impact on human health	D	5	E	D	1	L
Public safety and site security (Construction)	B	3	H	E	3	M
Sunny day weir failure – static causes (construction /operation)	E	5	H	N/A	N/A	N/A
Pipeline failure – interruption of water supply (Operation)	D	4	H	E	4	H

Table 19-14 Property Risk

	Initial risk assessment (Without Mitigation)			Risk assessment (with mitigation)		
Risk Area	Likelihood	Consequence	Risk Rating	Likeihood	Consequence	Risk Rating
Damage to Public Utilities (Construction/Operation) –- Construction damage to general and private infrastructure	D	3	M	E	3	M
Fire (natural or human) (Construction/Operation) – Damage to property, machinery and agriculture	D	3	M	E	3	M

The information contained in Error! Reference source not found. to Error! Reference source not found. shows the risk profile for the Glebe Option. The calculated risk is generally 'Low' or 'Moderate', with exception of environmental risks from fire and flood which have been assessed as ' High'. Public risk relating to fire and pipeline failure have also been assessed as ' High'.

The environmental risks relating to flood and fire are high as the prevention of the impact cannot be fully achieved. Fire mitigation measures can only reduce the probability of the event as it relates to the Glebe Option whereas the probability of occurrence is largely unrelated to the Glebe Option. Similarly the public risks relating to fire and pipeline failure only see the probability reduced but not the consequence. There are no 'High' risks identified for property. An Emergency Management Plan will be developed to assist in this regard. There are no 'Extreme' risk scenarios identified for any of the risk categories.

19.4.1 Cumulative Risk

The assessment undertaken as part of this study has identified the potential hazards and risks associated with the construction and operational phases of the Glebe Option. Cumulative risk relates, for example, to the likelihood of risks occurring sequentially or simultaneously at a range of sites spatially distributed or occurring as multiple risks at the one location. The assessment identified 'High' risk ratings relating to flood and fire (environmental risk) and fire and pipeline failure (public risk). Whilst these risk ratings are high, the likelihood of these risks occurring is either rare or unlikely, except for 'Flood' risk, which has a probable rating. As raising the weir will not materially alter flooding characteristics locally or downstream, it is unlikely to modify the risk profile of other aspects of the Glebe Option. Any effects of overbank flooding will remain essentially the same as without the weir due to the 'drown out' effect of the weir design.

One cumulative risk likely to occur for the Glebe Option is if one event closely follows another. As an example, if a flood event immediately follows a large-scale bushfire and there was no mitigation, there would be a greater risk of erosion, which would lead to an increase in runoff and sediment load, and impacts upon water quality. The likely impact on downstream water quality and aquatic habitats would be greater if these events only occurred in sequence over a short timeframe as ground cover would not have time to re-establish. The implementation of fire management strategies around the weir to reduce the severity of local fires will lower the risk of such an event. It is not possible to mitigate the risk on a catchment wide basis due to the difficulty of coordinating a large number of landholders. As such events are not directly attributable to the weir Option, this risk is considered to be low. Impacts on erosion/sedimentation and water quality are considered consequential risks rather than cumulative risks.

Cumulative risks can be reduced by the management of each individual risk. As flooding has been identified as having the highest likelihood to occur, the management of cumulative risks during the Glebe Option needs to focus on associated mitigation measures, such as sediment and erosion control, site restoration, bank stability and site evacuation plans. Through managing the risks associated with flooding, the potential cumulative risks are minimised.

The Glebe Option will be subject to few if any cumulative risks if appropriate mitigation measures are implemented.

19.4.2 Emergency Management Plan

An Emergency Management Plan will be prepared for the Weir and associated infrastructure in accordance with the Queensland *State Planning Policy 1/03 'Mitigating the Adverse Impacts of Flood, Bushfire and Landslide'* (Department of Emergency Services, 2003) and the requirements of the Queensland Dam Safety Management Guidelines (QDSMG)(NRW, 2007b). This emergency plan will be developed and maintained through consultation with local emergency services, stakeholders (NRW) and counter-disaster expertise.

The emergency plan will be based on the following components:

- analysis of the emergency incidents likely to occur in the Glebe Option area;
- assessment of the degree of potential impact;
- assessment of what constitutes an 'emergency';
- on-site plan to mitigate/ handle incidents;
- off-site plan with references to emergency services;
- communication hierarchy, emergency responsibilities, control centre establishment;
- post-emergency procedures, including recovery, debriefing and review of the plans performance; and
- testing the plan under simulated emergency conditions.

A significant aim of the emergency plan is to be proactive in mitigating the potential for an incident to develop into an emergency situation. The plan is an active document that will be regularly reviewed and revised through consultation with all relevant stakeholders. This will ensure any changes in; personnel, stakeholder responsibility, population distribution in potentially affected areas and industry best practice are identified and addressed accordingly. If relevant, emergency exercises will be held to test the effectiveness of this plan.

19.4.2.1 Emergency Response

During the construction and operational phases of the Glebe Option, designated first aid and emergency rescue facilities and equipment will be readily available. Appropriately trained personnel will always be available on-site during the life of the Glebe Option. These staff members will be clearly identified during site induction training, and their names and contact details will be signposted around each site (stores, workshops and office building) to minimise potential response delays.

The induction training will include fire response procedures and techniques. The site will have adequate fire-fighting equipment, with extinguishers, fire hoses and fire blankets in site buildings, and a fire truck (or suitably equipped water truck or trailer that can support fire response requirements) being located on-site. Fire drills will be undertaken on a six monthly basis (or what is deemed suitable by the management team).

Chemicals (predominantly hydrocarbons) will be stored on-site during the construction activities It is essential that all staff are aware of the potential hazards to humans and surrounding ecosystems if these chemicals are mishandled. The volumes and exact list of materials that will be on-site during the course of the Glebe Option are

not yet known, and as such an inventory of specific hazardous material deliveries, dosing rates or storage facilities can not be presented. All hazardous materials will be stored as specified by Australian Standards (i.e. *AS1940: Storage and handling of flammable and combustible liquids*) and as per details listed on individual MSDSs. In all areas where hazardous materials are stored, there will be an appropriate spill kit (hydrocarbon for fuels and hazardous chemical for all other materials), with staff working in these areas receiving training in the use of the spill kits and spill containment procedures.

The constructors and operators will liaise with the local emergency services including the Queensland Ambulance Service, Queensland Fire and Rescue Service, State Emergency Service (or similar local rescue organisation) and hospital services with respect to all aspects of emergency responses and the development of emergency plans. It is vital that the local emergency services are aware of all potential emergency situations and are adequately equipped and know the best route to the site to provide immediate assistance following an incident.

A summary of construction and operation hazards, potential implementation strategies, routine monitoring, auditing, reporting and suggested corrective actions identified for the Glebe Option are given in Table 19-15 and Table 19-16.

Table 19-15. Construction Emergency Management Plan.

Safety, Emergency and Fire Management		
Issues	Operational Policy	Performance Criteria and Indicators
• Potential safety hazards for workers and other parties (e.g., residents of, or visitors to neighbouring properties) associated with construction activities. • Planning for, and responses to, potential emergencies including bushfire, rain events and flooding, and fuel spills. • Fire control.	To carry out construction activities in a safe and responsible manner. This will include: • identifying risk reduction strategies for potential safety hazards; and • developing appropriate response plans for potential emergencies including bushfire, rain events, flooding and fuel spills.	• Development and implementation of a Workplace Health and Safety Plan (SMP). • Development and implementation of Emergency Response Plans (ERP). • No burning of vegetation and any regional fire restrictions observed. • Low number of incident reports and extent of incidents (e.g., fatality, injury, major spill, uncontrolled fire, etc.). • No repeat of incidents that are of a similar nature or by the same cause.
Implementation Strategies		
Pre Construction • The Contractor will develop, and submit for approval to SunWater at least 28 days prior to commencement of construction, a SMP and ERPs for relevant potential emergencies and hazards. • The SMP must be developed to the satisfaction of local Emergency Services. It will include obligations, requirements, processes and systems for managing safety hazards and statutory requirements. • Advice from the local Rural Fire Division of the Queensland Fire and Rescue Services (QFRS) on minimising and responding to fire risks will be obtained. • Responses to unplanned fire will include procedures for contacting the local QFRS and neighbouring landholders, for organising all personnel on site and for distributing PPE and fire fighting equipment. • The Environmental Coordinator (EC) will become familiar with all ERPs relating to procedures for dealing with emergencies. • Site inductions will include training of all personnel (including sub-contractors) in the obligations, requirements, processes and systems for managing safety hazards and emergency procedures, including basic fire fighting techniques and reducing fire risks at the site.		

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Construction • Run trials to test ERPs on site at least twice for each separate work site, the first test within 40 days of construction commencement and at least once every six months thereafter during construction activities or more frequently should significant changes in site conditions / work areas occur. • Implement all relevant measures specified in the SMP. • Respond to emergencies in accordance with the relevant ERP. • Provide personnel with appropriate resources to ensure they can carry out their tasks in a safe manner. • Ensure that all site personnel have received the site induction and are trained in fire prevention and basic fire-fighting techniques. • Vehicle and machinery exhaust systems will be inspected regularly for leaks and accumulated vegetation debris. Fuel systems will also be inspected for leaks. Vehicle and machinery exhaust systems must be fitted and maintained in accordance with relevant Australian Standards. • Ensure that areas around equipment and operations that generate a fire risk (e.g. welding) are clear of vegetation and any other flammable materials. Unnecessary build-up of flammable material in working areas will be prevented, with vegetation and other flammable material being stockpiled well clear of hot work activities. • Construct any boundary firebreaks between the site and neighbouring properties if this has been advised as necessary by the QFRS. • Install adequate fire-fighting equipment at the storage site. This should include mobile equipment that may be assigned to work crews working at sites distant from the storage area. All vehicles will be equipped with a fire extinguisher. • Ensure that all work crews working distant from the storage area have access to adequate fire-fighting equipment and PPE necessary to respond to fires.	
Monitoring	Auditing
The EC or Safety Officer will inspect the site and pipeline at regular intervals to ensure that there are no safety or fire management issues (e.g. inspection of flammable materials on work sites). The EC / Safety Officer will conduct an inspection of the following at least bimonthly for: • The availability of PPE and working fire-fighting equipment at work sites; • Site induction records for new personnel / sub-contractors; • The OH&SO or the CM should inspect fire-fighting and safety equipment periodically and a record of inspection kept; and	Auditing must demonstrate implementation of construction management strategies included in the EMP and compliance with relevant 'Performance Criteria'. These will occur at a minimum of every three months by an independent auditor. Permanent records of any Fire Control inspections conducted must be kept on Site and updated regularly to enable periodic audit/review.

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• The inspection of work sites for flammable material. In the advent of fire the EC will inspect the post-fire scene and document the fire event through interviews with witnesses and photographs.	
Reporting	Corrective Action
The EC / Safety Officer will document that safety, emergency and fire management procedures have been followed in accordance with this EMP by completing the weekly environmental checklist as applicable. All incidents or near misses will be reported to the EC, recorded and, if corrective action is needed, lodged in the manner described in the corrective action section of this element. The EC shall report to the PM on the issue of safety, emergency and fire management with respect to this EMP's requirements: • regularly (monthly), during construction; and • within seven days, if requests for 'Corrective Action' are lodged or within 48 hours if a non-conformance with the EMP occurs. Post construction, all site records will be maintained (for possible future audit) and a copy given to the PM. Landholder complaints will be recorded by the EC and closed out by the CM or PM where necessary.	Should a failure to meet the 'Performance Criteria' outlined above occur, a request for Corrective Action will be lodged (with the PM) using the Contractor's equivalent to the SunWater QM 2 F1 Incident Nonconformance Improvement and Corrective Action Report and the offending operation(s) ceased until 'Performance Criteria' are met. If Corrective Action is required to improve safety, emergency or fire control measures or implement better safety measures: • Consult with the Department of Emergency Services or Rural Division of the QFRS for expert advice; and • Revise relevant 'Performance Criteria' and follow any relevant complaints and incidents procedures set down in the EMP.

Table 19-16. Operational Emergency Management Plan.

Safety, Emergency and Fire Management		
Issues	Operational Policy	Performance Criteria and Indicators
• Potential safety hazards for workers and other parties (e.g. residents of neighbouring properties) associated with operation activities. • Planning for, and responses to, potential emergencies including bushfire, rain events and flooding, and fuel spills. • Fire control. • Fabri-dam failure (i.e. downstream or upstream flooding) • Pipeline failure	To undertaken operations in a safe and responsible manner. This will include: • identifying risk reduction strategies for potential safety hazards; and • developing appropriate response plans for potential emergencies including bushfire, rain events, flooding and fuel spills.	• Development and implementation of a Workplace Health and Safety Plan (SMP). • Development and implementation of Emergency Response Plans (ERP). • No burning of vegetation and any regional fire restrictions observed (relevant for routine maintenance of access roads and pump station/ weir landscaping). • Low number of incident reports and extent of incidents (e.g. fatality, injury, major spill, uncontrolled fire, etc.). • No repeat of incidents that are of a similar nature or by the same cause.
Implementation Strategies		
<u>Operation</u> • A SMP and ERPs for relevant potential emergencies and hazards to be developed and approved prior to commencement of operational phase. • The SMP must be developed to the satisfaction of local Emergency Services. It will include obligations, requirements, processes and systems for managing safety hazards and statutory requirements. • Advice from the local Rural Fire Division of the Queensland Fire and Rescue Services (QFRS) on minimising and responding to fire risks will be obtained. • Install adequate fire fighting equipment at the site. • Responses to unplanned fire will include procedures for contacting the local QFRS and neighbouring landholders, for organising all personnel on site and for distributing PPE and fire fighting equipment. • The operator will become familiar with all ERPs, relating to procedures for dealing with emergencies. • Site inductions will include training of all personnel (including sub-contractors) in the obligations, requirements, processes, and systems for managing safety hazards and emergency		

procedures, including basic fire-fighting techniques and reducing fire risks at the site.

- Clearly marked smoking areas, with suitable cigarette disposal facilities (i.e. bucket full of sand).
- Vehicle and machinery exhaust systems will be inspected regularly for leaks and accumulated vegetation debris. Fuel systems will also be inspected for leaks. Vehicle and machinery exhaust systems must be fitted and maintained in accordance with relevant Australian Standards.
- Regular inspection and maintenance of fabri-dam.
- Restrict access to weir and maintain upstream exclusion zones to public use.
- Appropriate redundancy incorporated within the design of the fabri-dam to commensurate risks.
- Adequate signage on pipeline.
- Appropriate system design and management to ensure rapid shutdown in the event of a rupture.

Monitoring	Auditing
The Operational personnel will inspect the weir pump station and pipeline at regular intervals to ensure that there are no safety or fire management issues. This inspection should include: • All access roads are well maintained and free of fire hazards (minimal fuel/ debris/ litter build-up). • All PPE and fire-fighting equipment are maintained and in working order. • Staff induction and training registers are up to date. • Fabri-dam is regularly inspected and services as per the manufacturer's specifications. • Regular inspection of pipeline route and assets for evidence of damage and vandalism. In the advent of fire the Operations staff will inspect the post-fire scene and document the fire event through interviews with witnesses and photographs.	Auditing must demonstrate implementation of operational management strategies included in the EMP and compliance with relevant 'Performance Criteria'. Permanent records of any Fire Control inspections and maintenance to the fabri-dam conducted must be kept on site and updated regularly to enable periodic audit/review.
Reporting	**Corrective Action**
All incidents or near misses will be reported to SunWater and the site operator, recorded and, if corrective action is needed, lodged in the manner described in the corrective action section of	Following any incident or near miss that occurs as a result of weir and pipeline operation, the appropriate procedures are to be reviewed and revised to minimised the possibility of future

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this element. The operator shall report to SunWater on the issue of safety, emergency and fire management when any concern arises. Landholder complaints will be recorded by the SunWater and closed out by the Operational manager where necessary.	risks and ensure 'lessons learnt' are documented. Should a failure to meet the 'Performance Criteria' outlined above occur, a request for Corrective Action will be lodged the SunWater QM 2 F1 Incident Nonconformance Improvement and Corrective Action Report and the offending operation(s) ceased until 'Performance Criteria' are met. If Corrective Action is required to improve safety, emergency or fire control measures or implement better safety measures: • Consult with the Department of Emergency Services or Rural Division of the QFRS for expert advice; and • Revise relevant 'Performance Criteria' and follow any relevant complaints and incidents procedures set down in this EMP.