NEW HOPE GROUP

J.4 Water Resource Management Plan

NEW HOPE GROUP

WATER RESOURCE MANAGEMENT PLAN

New Acland Coal Mine Stage 3 Project

JANUARY 2014

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1. Introduction

1.1. Purpose

This Water Resource Management Plan (WRMP) has been prepared to address the relevant Terms of Reference for the New Acland Coal Mine Stage 3 Expansion Project (the revised Project). The WRMP aims to manage issues relevant to the delivery, generation, use and management of water at the revised Project site. The WRMP is designed to provide consistency with the Environmental Management Plan (EM Plan) and regulatory requirements.

The WRMP also addresses the New Hope Group's (NHG)'s own internal standard operating procedures and commitment to safety, quality, environmental protection and community relating to water management.

The WRMP aims to meet the required objectives in the following ways:

- separation of clean water (from undisturbed sources) and mine-affected water systems;
- reuse of mine-affected water;
- sustainable process water supply through treated waste water from the Wetalla Wastewater Reclamation Facility (WWRF) from Toowoomba supplied via a 45 km pipeline;
- rigorous monitoring system to assess water quality;
- gauging of water transfer and use around the mine site to assist in improving efficiency;
- detailing operational requirements for dams on site;
- set up of systems to deal with flood, drought and infrastructure failure scenarios; and
- detailing of operational and transfer rules to ensure efficient use of water resources.

1.2. Scope

This document has been prepared in accordance with the guidance '*Preparation of Water Management Plans for Mining Activities*' (DERM, September 2010). The guidance lists the generic elements of a Water Management Plan, and all of the relevant requirements. This WRMP has been written specifically for the revised Project. Water management plans are typically developed following the issue of an Environmental Authority (EA) at a time when the mine plan is well established. It is noted that this plan was developed during the Environmental Impact Statement (EIS) process occurring concurrently to detailed design of the mine plan and activities. While the principles and objectives of this plan will not be changed, it is recognised that it will be informed by additional mine planning and design and will be updated and finalised following the issue of an EA. Furthermore, the document will be reviewed and updated annually or after significant changes to the mine water management system, regulatory criteria or the Department of Environment and Heritage Protection (EHP) licensing conditions.

This WRMP contains the following sections:

- Section 1 – Introduction, provides background on the revised Project, water management objectives and system.

- Section 2 – Environmental Values and Water Quality Objectives, describes the existing environment, water quality, downstream users and studies undertaken.
- Section 3 – Contaminate Source Study, describes the potential contaminates sources at the revised Project site.
- Section 4 – Risk Assessment, identification and assessment of the potential environmental risks to and from surface water.
- Section 5 – Proactive Water Management Strategy, references the review and implementation requirements, accountabilities and responsibilities, how water management is to be incorporated into mine planning, an overview of the drainage at site, flooding and management of drainage of mine affected areas.
- Section 6 – Site Water Balance Model, describes the site water balance model.
- Section 7 – Emergency Response, describes flood preparedness, drought planning and unplanned discharge.
- Section 8 – Implementation of the Water Resource Management Plan, describes operational monitoring and review, performance management and continual improvement.

1.3. The revised Project

The NHG currently operates the existing New Acland coal mine (the Mine), a 4.8 million tonnes (product coal) per annum (Mtpa) open cut coal mine on mining lease (ML) 50170 and ML 50216 , adjacent to Mineral Development Licence (MDL) 244, under the approval of EA No. EPML00335713. The revised Project proposes to develop an open cut mine to produce up to 7.5 Mtpa of thermal product coal. The revised Project includes the continuation and expansion of the existing open cut coal mine through the inclusion and progressive development of three new resource areas, Manning Vale East, Manning Vale West, and Willeroo. The revised Project will utilise a strip mining process with disturbed areas progressively rehabilitated. This expansion will extend the life of the revised Project to approximately 2029 at which stage the current coal resource will be depleted. Final rehabilitation of the revised Project will continue for another five to ten years until around 2039.

The revised Project site is located within southeast Queensland's Darling Downs region 14 km north-northwest of Oakey, 35 km northwest of Toowoomba and 177 km west of Brisbane, Queensland's capital city. The revised Project site is located in undulating terrain that spans the Lagoon Creek Catchment. Lagoon Creek flows into Oakey Creek which is part of the larger Condamine River Catchment. The Upper Condamine River catchment has an area of approximately 13 000 km^2. The Upper Condamine is part of the Balonne-Condamine Basin which includes most of the Darling Downs and forms part of the Murray Darling Basin Catchment.

1.4. Water Management Overview

The philosophy of the water management strategy is to provide adequate water to the revised Project site to operate successfully while minimising environmental impacts by collecting and managing runoff water from disturbed areas. The mine water management strategy for the revised Project is based on the following key principles.

- Clean water will be diverted away from disturbed areas.

- Mine-affected water will be captured and treated prior to release.
- Water stored in sediment and environmental dams will be preferentially used as a supplemental water source for coal washing and other activities to minimise the likelihood of offsite water discharges.
- Captured mine-affected water will be efficiently transferred between water management structures on site to optimise the reuse of mine-affected water, to enable efficient mining practices, and to minimise the likelihood of discharges off site.
- Where possible, beneficial recycling of mine-affected water for activities, such as dust suppression, will be maximised. For example, via water recovery from active pit areas.
- All water management structures will be designed and constructed using practical hydraulic parameters based on an appropriate risk based rainfall event, catchment size, slopes, discharge design and soil types.
- Water management practises will be designed to minimise the likelihood of discharges off site.
- Mine-affected water that may potentially be discharged off site will be adequately treated to ensure it complies with the revised Project's water discharge limits.
- Adequate flood protection will be installed as required to maximise operational safety and minimise disruption to mining activities. This approach will include the use of flood levees to protect the mining pits from inundation from Lagoon Creek.
- Recycled water from the WWRF will be the main water source for process water requirements.
- Shallow groundwater bores will only be utilised to supply potable water suitable for human use and as an emergency backup water supply for CHPP use
- The revised Project's water management practices will be reviewed on a regular basis and updated to meet the progressive development of the resource areas.
- A suitable monitoring regime will be maintained to ensure the revised Project's water management practices are functioning efficiently and to provide adequate warning should an issue or problem arise.
- All significant quantities of hydrocarbon and chemical products stored on site in a safe and secure manner and will be adequately bunded to manage the risk of containment failure.
- Refuelling and similar areas will possess spill capture and retention devices.
- Runoff from permanent 'oily water' areas will be contained and treated using an oil-water separator (e.g. workshop).
- Progressive rehabilitation of disturbed areas no longer required for operational purposes will be undertaken in a timely manner to keep total disturbance to a minimum.
- Standard Operating Procedures (SOPs) will continue to be developed, implemented and revised for the main aspects of the NHG's mining business, including those aspects that can adversely impact on surface water management if not properly conducted.

- The continued implementation of the NHG's Environmental Management System (EMS) will ensure that roles and responsibilities for mining activities that may affect surface water are clearly defined and that appropriate management actions are developed and implemented for these mining activities to provide a commensurate level of environmental protection.

1.4.1. Water Supply

A maximum supply allocation to the Mine of 5,650 ML/ year is available from two water sources. The major source is via a long term contract to the year 2055 with the Toowoomba Regional Council (TRC) to purchase up to 5,500 ML per annum of Class A^+ recycled water from the WWRF. Class A^+ is the highest class of recycled water for non-drinking purposes in Queensland. The duration of this supply contract is well beyond the projected life of the revised Project. The 45 km pipeline and infrastructure was constructed in 2009 and is currently operational. When pumping from the Wetalla pipeline, water is received at the rate of 340 cum/ hour. The second source is an agreement to receive 150 ML per annum (MLpa) from the Oakey Reverse Osmosis Water Treatment Plant.

In addition to the water sources noted, an additional 1,321 MLpa of licensed capacity is available from the Helidon (Precipice) and Marburg (Hutton) aquifers via a series of groundwater bores. The current allocations from the Helidon and Marburg aquifers are 710MLpa and 271MLpa, respectively. This capacity is available as an emergency supply for process water and is subject to the successful future renewal of licences.

Potable water originates from basalt aquifers and is sourced from licensed groundwater bores on-site and treated by a Reverse Osmosis Treatment Plant on-site. Current average consumption of potable water on site is approximately 16 KL/day, which equates to 6 MLpa. Current maximum treatment plant capacity is 22 kL/day, or 7 MLpa. Future use is projected to increase to a maximum of 50 MLpa.

1.4.2. Water Use

The Mine's current raw water demand and the revised Project's future raw water demand at a production rate of 7.5 Mtpa are outlined in Table 1-1. The raw water demand varies depending on a range of factors including rainfall/runoff and groundwater inflow within the mine pits.

The revised Project's water requirements for dust suppression will be periodically supplemented by rainfall runoff captured in water management structures, such as the sediment and environmental dams, and from operational mine pit areas.

The NHG will continue to recycle water from its TSF's to supplement the Coal Handling and Processing Plant (CHPP)'s water supplies.

Table 1-1 Current Mine and Future Project Raw Water Demands

Water Supply Activity		Current Usage (approx) (ML/year)	Future Usage (2021) (approx) (ML/year)
Operation of the CHPP Precinct	(~550 L/RoM tonne)	5,280	8,250
Wash down of machinery			
Fire suppression			

Water Supply Activity	Current Usage (approx) (ML/year)	Future Usage (2021) (approx) (ML/year)
Shower and ablution use		
Dust suppression (~ 45 L/RoM tonne)	432	675
TOTAL USAGE	5,712	8,925
Estimated recovery Tailings Storage Facilities (50%)	2,860	4,460
Estimated water collected at site (rainfall runoff & groundwater inflows)	740	1,170
TOTAL NET WATER USAGE (~220 L/RoM tonne)	2,112	3,295

Water Demand for Mining

The amount of water used for dust suppression on haul roads cannot be reliably measured. However, a good estimate is available from water truck logs. For calendar year 2012, the records indicate that a volume of approximately 500 ML was expended on watering haul roads. This usage is roughly equivalent to 45 L/ RoM tonne.

Water Demand for CHPP Precinct

The CHPP Precinct processing schedule is derived from the mine plan. The net consumption is 220 L/ RoM tonne plant feed. Using this consumption with the projected ramp up production over the life of mine, the net water consumption for the CHPP Precinct is as set out in Table 1-2.

Table 1-2 CHPP Precinct Water Demands

Year	CHPP Schedule Up to (Mt)	CHPP Water Consumption Up to (MLIpa)
2014	9.600	2,112
2015	9.600	2,112
2016	9.600	2,112
2017	9.600	2,112
2018	13.746	3,024
2019	15.150	3,333
2020	15.150	3,333
2021	14.985	3,297
2022	14.592	3,210
2023	14.592	3,210

Year	CHPP Schedule Up to (Mt)	CHPP Water Consumption Up to (MLlpa)
2024	14.592	3,210
2025	14.592	3,210
2026	14.086	3,099
2027	9.728	2,140
2028	9.728	2,140
2029	9.728	2,140

There is little requirement for dust suppression sprays at the CHPP product handling area as the plant product discharges at a free moisture content of between 7-9%. In addition, a characteristic of New Acland's coal is its hardness and low fines content in comparison to the majority of coals. Any water consumed at the CHPP Precinct for dust suppression is included in the overall CHPP consumption stated above.

Raw Water Requirements

The revised Project will produce approximately 14 Mt of RoM coal each year. Although, over the short term the net water imported onto the mine site will fluctuate, the long term predicted water usage is approximately 220 L/RoM tonne. This demand equates to a water requirement of approximately 3,080 MLpa. This quantity is substantially less than the current 5,500 MLpa available to be supplied by the WWRF take or pay contracts.

1.4.3. Water Management Structures

The NHG currently operates four Environmental Dams, two Sediment Dams, a Return Water Dam and two Process Water Dam's (PWD) at the existing Mine. The Environmental Dams and Sediment Dams are used to contain environmental flows and capture sediment laden runoff from exposed areas and effluent discharge from the existing Sewage Treatment Plant (STP). The NHG also operates three in-pit tailings storage facilities (IPTSFs).

Water from the WWRF is supplied to the Mine's Process Water Dam (PWD) 1 via the Wetalla the. PWD1 takes water from WWRF, Oakey RO plant, some on-site bores, Environment Dam 1 and direct rainfall. Water from PWD1 gravitates to a pump station from where it is supplied to the CHPP Precinct. PWD2 acts as additional storage capacity for PWD1. Between PWD1 and PWD2 there is a balance pipe with an isolation valve; water can flow in either direction depending on the water levels. Overflows from PWD1 are received by PWD2 and can be pumped from PWD2 back to PWD1. PWD2 accepts water from a reticulation network between Environmental Dam 3 and Sediment Dam 2, and from IPTSFs.

PWD1 supplies the site fire water tank. From the tank, water is pumped via a trunk main to the CHPP fire water system and from there into the CHPP fire water ring main. The existing PWDs possess sufficient capacity to supply the raw water feed to the CHPP Precinct.

The Pond Return Dam is the second source of supply to the CHPP Precinct. The Pond Return Dam receives water recycled from the IPTSFs, Environmental Dam 2 & 4 and Sediment Dam 1. The water captured in Sediment Dam 1 consists of runoff from the CHPP Precinct and treated effluent discharges from the STP.

Runoff from the Mine's infrastructure and disturbed areas is captured in Sediment Dam 1, which subsequently discharges to Environmental Dam 2. Water from Environmental Dam 1 can be pumped to PWD1. Water from Environmental Dam 2 and Environment Dam 4 is pumped to the Pond Return Dam. Water from Environment Dam 3 is pumped to Sediment Dam 2. Water balance modelling indicates that the existing Environment Dams and Sediment Dam 1 possess sufficient capacity to manage the additional mine infrastructure area and expanded CHPP Precinct area associated with the revised Project.

Rainfall and groundwater that collects in the South Pit is dewatered to Sediment Dam 2. The Centre and Northern Pits are dewatered to the IPTSF.

The new mining areas are located in the upper proportion of the Lagoon Creek catchment. Due to the catchment topography the majority of runoff from the revised Project disturbed areas will flow directly into to the new mining pits of Willeroo and Manningvale East and West. A new environment dam will be located in the vicinity of each pit to collect runoff from disturbed areas, which do not report to the pit. This strategy will typically include pre-strip or cleared areas which are located downstream of the mine pit. Water from these new Environment Dams will be recycled back to the CHPP Precinct via the Pond Return Dam or IPTSFs.

Two new sediment dams will be constructed as part of the revised Project to manage sediment laden runoff from out of pit disturbed areas which cannot be directed to the new environment dams. The sediment dams will be located at each of the Willeroo and Manning Vale West pits with Environment Dam 4 to be converted to Sediment Dams 5 and used to manage runoff from the Manning Vale East pit.

All overflows from environmental dams discharge off site. To date, off site water releases have been rare. Controlled release under environmental licence conditions in 2011 (a wet year) totalled 26 megalitres (ML). New controlled release conditions are proposed as part of the revised Project EIS with the maximum annual release under a 1% exceedance probability, which equates to less than 50 ML. This proposal is discussed further in Section 0.

Figure 1-1 provides a schematic of the water management system. The current and future water management infrastructure is summarised in Table 1-3.

Table 1-3 Water Management Infrastructure

Structure	Size	Location
Existing Water Management Infrastructure		
Environmental Dam 1	126 ML	Northwest mining lease boundary area (ML50170).
Environmental Dam 2	232 ML	Downstream of the tailings dam, southwest mining lease boundary area (ML50170).
Environmental Dam 3	45 ML	Southern mining lease boundary (ML50216)
Environmental Dam 4*	110 ML	Southwest mining lease boundary area (ML50216), captures surface water runoff from the centre pit's disturbance area.
Sediment Dam 1	97 ML (including 16 ML of sediment)	Near the product coal haul road exit, western mining lease boundary area (ML50170).
Sediment Dam 2	62 ML	Near the South Pit's out-of-pit dump (ML50216)

Structure	Size	Location
Existing Water Management Infrastructure		
Process Water Dam 1	136 ML	North of the main administration area, adjacent the main access to the Mine (ML50170).
Process Water Dam 2	175 ML	Immediately east of Process Water Dam 1 (ML50170)
Tailings Dam (Out-of-pit) TSF 1 – Stage 1 & 2	2,550 ML (of tailings)	Western mining lease boundary area (south of the RoM stockpile area) (ML 50170). – Stage 1 is under rehabilitation.
Tailings Dam (In-pit) IPTSF 1	2,800 ML (of tailings)	Within the North Pit (ML 50170)
Tailings Dam (In-pit) IPTSF 2-1	3,320 ML (of tailings)	Within the North Pit (ML 50170)
Tailings Dam (In-pit) IPTSF 2-2	3,400 ML (of tailings)	Within the North Pit (ML 50170)
Tailings Dam (In-Pit) TSF 3	TBA (under construction)	Within the Centre Pit (ML50216)
Return Water Dam	300 ML	Upstream of Environmental Dam 2, western mining lease boundary area (ML50170).
Lagoon Creek Flood Bund	Approx. 3 m high and 3 km in length	Between Lagoon Creek and the South Pit area (ML50216).
Revised Project Water Management Infrastructure		
Environment Dam 5 Manning Vale West	250 ML	Southwest of Manning Vale West final pit extent
Environment Dam 6 Manning Vale East	250 ML	South of Manning Vale East final pit extent
Environment Dam 7 Willaroo	350 ML	Southeast of Willaroo final pit extent
Sediment Dam 3 Manning Vale East Pit	160 ML	North of Manning Vale East Pit
Sediment Dam 4 Willaroo Pit	130 ML	North of Willaroo Pit
Lagoon Creek Flood Levee 2	Approximately 3.5 m high and 1.5 km in length	Between Lagoon Creek and the Manning Vale East Pit area

Structure	Size	Location
Existing Water Management Infrastructure		
Lagoon Creek Flood Levee 3	Approximately 3.5 m high and 2 km in length	Between Lagoon Creek and the Willeroo Pit area

*will become Sediment Dam 5 in the revised project.

The NHG may utilise existing farm dams, and as required, design and construct diversion drains to ensure efficient operation of the revised Project's overall water management system. Specialised water management systems will be implemented in all areas storing significant quantities of hydrocarbons and chemicals to minimise the potential for downstream impacts.

LEGEND

- Towns and Localities
- Existing Release Point
- Proposed Release Point

Proposed Dam

- Environment Dam
- Sediment Dam

Existing Dam

- Environment Dam
- Process Water
- Sediment Dam
- Rail Spur
- Roads
- Creeks
- Jondaryan-Muldu Road Diversion
- Dumping Area
- Mining Tenements
- Stage 3 Pit Areas

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NEW ACLAND COAL MINE STAGE 3 PROJECT

Figure 1-1 - Location of Water Management Structures

Scale 1:62,000 on A4

Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Produced: 8/07/2013 Path: I:\QENV2\Projects\QE06644\SpatialArcGIS\01_Figures\01_SEIS\WaterManagementPlan\130708_WMP_Figure1_1_LocationOfWaterManagementStructures.mxd

1.4.4. Lagoon Creek

Lagoon Creek is an ephemeral creek that bisects the south eastern portion of the Manning Vale resource area. The revised Project mine plan provides an operational separation distance of approximately 150 m either side of the Lagoon Creek that includes a 50 m buffer adjacent the creek where no mining activities will occur. Importantly, there will be no disturbance to the Lagoon Creek channel as part of the revised Project's mine plan. The 50 m buffer will allow restoration of Lagoon Creek's riparian zone to improve the creek's environmental values, geomorphology and flow regime.

Flood levees will be constructed to protect the new mine areas on MLA 50232 from Lagoon Creek flood events and will be designed and constructed to manage a Probable Maximum Flood (PMF) rainfall event. This methodology is in accordance with NHG's design standards for the existing Stage 2 levee. It is noted that this level of protection is higher than the a 1 in 1,000 AEP flood immunity required by the Manual for *Assessing Hazard Categories and Hydraulic Performance of Dams*, DNRM, February 2012.

The NHG has committed to design the revised Project's final landform so that the main topographical features are located outside the PMF flood extent. As a result, there are no flood impacts predicted for the final landform's depressed and elevated landforms. Flood levees will be removed and rehabilitated as part of the revised Project's final landform.

2. Environmental Values and Impacts

2.1. Existing Studies

2.1.1. Environmental Impact Statement

This WRMP is prepared in conjunction with the revised Project's EIS. The EIS includes an assessment of the revised Projects impacts on water resources and outlines mitigation measures. This work included development of a flood model, groundwater model and water balance model as well as an assessment of water quality. As part of the EIS, the NHG have proposed a series of Project commitments which are as follows.

- Hydrocarbon spills from the CHPP Precinct area, vehicles and other plant and equipment contaminating surrounding water with chemicals, hydrocarbons, oil and grease will be captured, contained and treated.;
- Clearing of vegetation and stripping of top soils will only occur as specified by the mine plan for coal mining purposes.
- Handling and storage of fuels during construction and operation will be conducted in a safe and environmentally responsible manner.
- Short term decreases in local water quality from rain fall events during construction (i.e. soil disturbance) will be captured and treated before release to the receiving environment.
- Any releases of water from the site will comply with the statutory discharge limits for the revised Project.
- Work methods will be developed and included in the Contractor Environmental Management Plans. These methods will detail appropriate control and mitigation measures for the revised Project.

In addition to these commitments, the specific environmental management conditions will be implemented to mitigate the impacts of the construction of the railway line crossing of Lagoon Creek. The following outlines the major mitigation measures that will be implemented where practicable during the construction phase. Importantly, current good practice erosion and sediment control measures will be provided as outlined in the Institution of Engineers publication *IECA Best Practice Erosion and Sediment Control Guidelines* (2008) to comply with the EPP (Water). Proposed control measures are as follows.

- Construction work in creeks will be undertaken in dry weather and conditions of minimal or no flow.
- Weather conditions will be monitored so that work in creek crossings and erosion prone areas will not take place if rain and/or extreme weather (e.g. storms) are forecast.
- Sedimentation fences, bunds or similar will be used to contain fill or excavated material during construction.
- Fill and excavated material will be stockpiled away from gully heads, active creek banks, bank erosion or other unstable areas.
- Local runoff from undisturbed areas will be routed clear of disturbed areas.

- Assessment of the integrity and effectiveness of erosion control measures will be undertaken at regular periods, especially following significant rainfall events.

- If required, the erection of temporary waterway barriers during construction will include the provision to transfer flows from upstream of the works to the downstream channel without passing though the disturbed construction site.

Operational activities that have the potential to compromise water quality conditions at the revised Project site may include:

- runoff from the revised Project site containing in increased sediment and pollutant loads from disturbed areas;

- management of fuel, dangerous goods, hazardous chemicals and workshop wastes (batteries, oil filters) on site; and

- controlled releases from the revised Project's various water management structures.

The following management strategies will be implemented by the revised Project to protect surface water quality and the downstream receiving environment.

- An operational separation distance of approximately 150 m will be maintained between the mining pit boundaries and Lagoon Creek, and will include a 50 m conservation zone immediately adjacent the creek where no mining activities will be permitted.

- Internal crossings of Lagoon Creek will be kept to an operational minimum and will include a single creek crossing of Lagoon Creek near the Willeroo resource area for access purposes (e.g. coal haulage).

- The conservation zone along Lagoon Creek will be defined within the mine lease area for protection purposes and will have limited access by stock (i.e. for removal of fire fuel loads only).

- Sediment dams, environmental dams, pit water storage and other water management structures (e.g. bunds and drains) will be used appropriately by the revised Project's WRMP.

- The revised Project's water management will be based on the separation and management of clean and dirty water catchments.

- As a minimum, stockpile pad areas will possess a compacted clay base to minimise infiltration and be armoured with a suitable material to maximise their longevity. Surface water runoff from these areas will be directed to a sediment dam / trap for treatment before release off site under discharge criteria outlined in the revised Project's EA.

- Water capture within the revised Project's clean areas will be diverted around operational areas and where practical, allowed to discharge off site as part of normal overland flow.

- Run off from disturbed areas within the revised Project site will be diverted to sediment dams for treatment and possible reuse as a supplementary supply for the revised Project's water requirement.

- Surface runoff from the revised Project's potentially contaminated areas, such as infrastructure areas, will receive additional levels of treatment (e.g. oil-water separators and bunding). Water captured by these devices will be preferentially reused on site, while captured oil will collected for recycling by a licensed contractor.

- Progressive rehabilitation will be undertaken as the revised Project's operational areas become available to reduce the total amount of disturbed areas.
- Fuel, dangerous goods hazardous chemicals and regulated wastes will be managed as outlined by current standards, guidelines and in compliance with statutory requirements.
- Refuelling locations and handling of fuels shall be under taken away from all waterways, including creeks and drainage paths, and will possess appropriate spill retention and capture devices.
- The NHG's existing SOPs for fuel management, waste management, spills and emergency response will be expanded to incorporate the revised Project. Spill recovery and containment equipment will be available when working adjacent to sensitive drainage paths and within other areas, such as workshops.
- The NHG will continue to commit to investigate all legitimate surface water complaints, and if a genuine problem is identified, conduct immediate remediation measures and establish standard operating procedures to minimise the possibility of a reoccurrence of the original issue.
- The NHG's current water quality monitoring program will be expanded to incorporate the operational and decommissioning phases of the revised Project. The program is designed to ensure the WRMP is effective, to demonstrate compliance with Mine's strict discharge limits, and to ensure the downstream water quality (physico-chemical parameters, at a minimum) is not being adversely impacted. The WRMP will include the following actions.
- Water quality will be measured upstream and downstream of the revised Project site. Basic water quality indicators (i.e. Salinity, pH, DO, EC, temperature) will continue to be monitored on a monthly basis, or when water is present, and heavy metals, nutrients, anions and cations will be monitored twice annually at sensitive sites.
- During any release event the receiving water will be monitored upstream (50 m to 100 m upstream of the release point) and downstream (200 m downstream of the release point) locations. Water quality variables will include basic water quality indicators, suspended solids, heavy metals, nutrients, anions and cations.
- Progressive rehabilitation of areas impacted by operational activities will be undertaken in order to reduce the total amount of expose soil.
- Safe and environmentally responsible management of fuels, dangerous goods, hazardous chemicals and work shop waste will be maintained over the life of the revised Project.

As per the management intent under the EPP Water, it is the intention of the NHG to where possible to improve the environmental values of Lagoon Creek catchment through the preservation of the Lagoon Creek channel and riparian zone. Through implementing the above management strategies for surface water management, the risk of adverse impacts to the water quality of Lagoon Creek, Oakey Creek and the Condamine River downstream of the revised Project is minimal.

2.1.2. New Acland Stage 2

The NHG prepared a water management plan for the stage two operations of the Mine during November 2007 in accordance with the Mine's EA. The water management plan includes:

- the identification of environmental values of the receiving waters and how they will be protected;
- controls for managing stormwater runoff and discharge to ensure minimisation of environmental impacts and safeguard against the potential for soil erosion and acid drainage;
- a risk management approach to addressing water quality and quantity issues during different phases of the mine and during periods of flood and drought; and
- a water balance describing the Mine's water requirements.

2.1.3. Other Plans

Monitoring programs, planned emergency/contingency responses and other surface water related matters are discussed in a number of separate site based management plans including:

- Environmental Monitoring Plan;
- Tailings Storage Facility Management Plan;
- Tailings Storage Facility Decommissioning Plan;
- In-pit Tailings Storage Facility Management Plan;
- Final Land Use and Rehabilitation Management Plan;
- Waste Management Plan;
- Conservation Management Plan;
- Plan of Operations; and
- Safety and Health Management System.

2.2. Environmental Values and Water Quality Objectives

Environmental Protection Policies (EPPs) are developed under the EP Act to provide frameworks and guidelines in conjunction with *Environmental Protection Regulation 2008*, to identify environmental values to be protected, and to manage specific aspects of Queensland's environment. A key objective of the EPPs is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, and maintains the ecological process on which life depends.

The EPP Water, is intended to prevent activities that harm the environment or waterway without due regard to the provisions of the EP Act. The EPP Water provides a framework for identifying environmental values to be protected for Queensland waters and deciding the water quality objectives to protect or enhance those environmental values, including their biological integrity and suitability for drinking, recreational, agricultural and industrial uses. One or all of the environmental values in the EPP Water can be chosen for a particular water body.

Draft environmental values for surface waters in the Condamine catchment have been released by the Condamine Alliance (2012) and were used to determine the environmental values for Lagoon Creek. The draft environmental values that apply to Lagoon Creek were

those identified for the upper Oakey Creek sub-catchment (Condamine Alliance 2012) and are listed in Table 2-1.

Table 2-1 Draft environmental values and description identified for Lagoon Creek (Condamine Alliance 2012)

Environmental Value		Description
	**Aquatic Ecosystems**	A community of organisms living within or adjacent to water, including riparian or foreshore area. Levels of protection for aquatic ecosystems: • High ecological/conservation value waters (HEV): waters in which the biological integrity is unmodified or highly valued • Slightly to moderately disturbed (SMD): waters that retain biological integrity but are affected by human activity. • Highly disturbed (HD): waters that are significantly degraded by human activity and have lower ecological value
	**Irrigation**	Suitability of water supply for irrigation-for example, irrigation of crops, pastures, parks, gardens and recreational areas.
	**Farm Water Supply**	Suitability of domestic farm water supply, other than drinking water. For example, water used for laundry and produce preparation.
	**Stock Watering**	Suitability of water supply for production of healthy livestock.
	**Human Consumers of Aquatic Foods**	Health of humans consuming aquatic foods-such as fish, crustaceans and shellfish (other than oysters) from natural waterways.
	**Visual Recreation**	Amenity of waterways for recreation which does not involve any contact with water-for example, walking and picnicking adjacent to a waterway.
	**Drinking Water**	Suitability of raw drinking water supply. This assumes minimal treatment of water is required-for example, coarse screening and/or disinfection.

All relevant environmental values need to be considered when evaluating a water body. The level of environmental and water quality protection must be determined to maintain each of the environmental values. Management goals that are established to protect the environmental values should reflect the specific problems and/or threats to the values, desired levels of protection and key attributes that must be protected (ANZECC & ARMCANZ, 2000).

There are four levels of aquatic ecosystem condition and protection under EPP Water (Section 6), which are:

- high conservation / ecological value systems: the biological integrity of an aquatic ecosystem that is effectively unmodified or highly valued;
- slightly disturbed systems: the biological integrity of an aquatic ecosystem that has effectively unmodified biological indicators, but slightly modified physical, chemical or other indicators;

- moderately disturbed systems: the biological integrity of an aquatic ecosystem that is adversely affected by human activity to a relatively small but measurable degree; and
- highly disturbed systems: the biological integrity of an aquatic ecosystem that is measurably degraded and of lower ecological value than waters mentioned in the above three descriptions.

The values of Lagoon Creek have been heavily impact on by current land use practices, specifically the area used for stock access. Much of the riparian zone and creek banks have been damaged with obvious signs of scour and erosion. Lagoon Creek was defined as slightly to moderately disturbed aquatic ecosystem for the purposes of applying water quality guidelines and trigger values and this intends to produce a level of 95 % protection of species.

At present, local water quality objectives to protect the Lagoon Creek EV's have not been published, and are currently in development by EHP (EHP, 2012) in conjunction with the Condamine Alliance under the EPP Water. It is noted that in 2008, prior to the EPP Water, natural solutions on behalf of the Condamine Alliance developed local water quality guidelines for the Condamine catchment. These now superseded, local water quality guidelines are generally consistent with Australian Water Quality Guidelines (AWQG)'s (Natural Solutions, 2008). Therefore, in lieu of any local water quality guidelines under the EPP Water, the AWQG's have been adopted.

The water quality guidelines adopted for the relevant water quality parameters within Lagoon Creek are presented in Table 2-2. The parameters are based on the AWQG's guideline values for the protection of aquatic ecosystems. This approach is based on recently released local water quality objectives for adjacent catchments such as the Fitzroy River Basin, for which the objectives that apply to the protection of aquatic ecosystems and for drinking water supply are the most stringent.

Table 2-2 provides the pH, dissolved oxygen, turbidity and nutrient concentrations assessed against the AWQG's for freshwaters of south east Australia. Metals are assessed against the trigger values for freshwaters in the AWQG and trigger values were corrected for hardness according to the methodology in the guidelines (ANZECC, 2000). Electrical conductivity was assessed against the regional salinity guidelines of the Queensland Water Quality Guidelines (QWQG) using the 75th percentile for the Condamine-Macintyre zone.

Table 2-2 Lagoon Creek Water quality guidelines for the protection of aquatic ecosystems.

Water quality variable	Guideline Value	Water quality variable	Guideline Value
pH	6.5-7.5	Metals (Dissolved)	
EC (µS cm^{-1}) $	<500	Arsenic (As) (mg L-1)	<0.013
Turbidity (NTU)	<25	Cadmium (mg L-1)	<0.0002
Dissolved oxygen (DO) (% saturation (mg L^{-1})	90-110%	Chromium III (Cr) (mg L-1)	<0.0027
Total suspended solids (TSS) (mg L^{-1})	-	Copper (Cu) (mg L-1)*	<0.0014
Hardness ($CaCO_3$) (mg L^{-1})	-	Lead (mg L-1)*	<0.0034
Sulfate (SO_4)* (mg L^{-1})	-	Nickel (Ni) (mg L-1)*	<0.011
Ammonia (NH_3) (mg L^{-1})	<0.010	Zinc (Zn) (mg L-1)*	<0.008

Water quality variable	Guideline Value	Water quality variable	Guideline Value
Dissolved inorganic nitrogen (DIN) (mg L^{-1})	<0.015	Manganese (Mn) (mg L-1)	1.9
Total nitrogen (TN) (mg L^{-1})	<0.25	Mercury (Hg) (mg L-1)	<0.00006
Total phosphorus (TP) (mg L^{-1})	<0.030	Beryllium (Be) (mg L-1)**	*
Filterable reactive phosphorus (FRP) (mg L^{-1})	<0.015	Vanadium* (V) (mg L-1)**	*
TPH C6 - C9 Fraction* (mg L^{-1})	-	Cobalt* (Co) (mg L-1)**	*
TPH C10 - C36 Fraction* (mg L^{-1})	-	Barium* (Ba) (mg L-1)**	*

Notes: * indicates requirement for hardness correction of trigger values (TVs). (**) Indicates trigger values are not specified in AWQG. All trigger values derived from AWQG except for $ which is derived from the QWQG.

2.3. Background Water Quality

2.3.1. Water Quality Monitoring

Historical water quality data for Lagoon Creek is limited. DNRM operate one regional water quality gauge on Oakey Creek at Fairview downstream of the confluence with Lagoon Creek. Water quality at this site is unlikely to be representative of that in Lagoon Creek as it is influenced by the water quality in Oakey Creek, which up until 2009 included the releases from the upstream Toowoomba Water Treatment Facility. This gauge is located downstream of the Lagoon and Oakey Creek confluence and downstream of several towns, and agricultural areas.

Water quality data was available from routine water monitoring conducted by the NHG under its current environmental monitoring plan for the Mine and from two targeted monitoring events. The monitoring program assesses water quality at the locations outlined in Table 2-3 and illustrated in Figure 2-1.

Table 2-3 Water Quality Sampling Sites

Site Code	Description
LCU1	Monitoring site located on Lagoon Creek upstream of the existing mining operation. This site is monitored under the Mine's EA.
LCD1	Monitoring site located on Lagoon Creek downstream of the existing mining operation. This site is in the approximate location of the proposed Manning Vale East pit. This site is monitored under the Mine's EA.
LCD2	Monitoring site located on Lagoon Creek downstream of the existing mining operation. This site is downstream of the proposed Manning Vale East pit. This site is monitored under the Mine's EA.
AH 1, 3, 4 and 5	These 4 sites are located within 200 m of each other and are at the upstream boundary of the revised Project pit areas, insitu sampling was undertaken at this site in 2009 to support the revised Projects baseline activities.

Site Code	Description
AH 2	Located downstream approximately 5 kms downstream of the downstream boundary of the revised Project mining area (DS1), insitu sampling was undertaken at this site in 2009 to support the revised Projects baseline activities.
AH4	Aquatic ecology monitoring site 4, downstream of the existing mining operations and immediately adjacent to the northern extent of the Manning Vale East and Wileroo pits.
DS1	New water quality monitoring site located at the downstream boundary of the revised Project mining area.

Water quality monitoring is conducted at established monitoring sites on Lagoon Creek upstream (LCU1) and downstream (LCD1 and LCD2) of the existing mining operation in accordance with the Mine's EA. Sampling of surface waters is undertaken by the NHG environmental officers using on-site field equipment. Water samples were collected for measurements of temperature, dissolved oxygen, electrical conductivity, pH, and analysis of sulphate and suspended sediments.

A single monitoring event was conducted between 23rd January 2008 and 24th January 2008 at four sites upstream (AH1, AH3, AH4, AH5) and one site downstream (AH2) of the revised Project. In-situ measurements of temperature, dissolved oxygen, electrical conductivity, and pH, were taken with a TROLL 9500 Professional XP multi-parameter water quality probe and logger. Measurements were taken near the middle of the watercourse at each location, at a depth of approximately 15 cm. All water quality equipment was calibrated prior to undertaking the field based assessments.

An additional monitoring event was conducted on 8th of March during a period of flow at two established monitoring sites upstream (LCU1) and downstream of the Mine and at an additional two downstream sites, with one site being downstream of the revised Project. In-situ measurements of temperature, dissolved oxygen, electrical conductivity, pH, and sampling of surface waters were undertaken by the NHG environmental officers using on-site field equipment. Water samples were collected for chemical analysis of the following parameters:

- Metals - total and dissolved (As, Be, Co, Cr, Cu, Hg, Ni, Mg, Ba, V, Zn);
- Nutrients (TP, TN, FRP, DIN, NH3);
- Major cations and anions;
- Total petroleum hydrocarbons (TPH C6-C36);
- Total Suspended Solids (TSS); and
- Pesticides.

Water quality sampling was conducted in accordance with AS/NZ 5667.11:1998 Water Quality – Sampling Part 1, Part 6 and Part 11, (Standards Australia 1998) and with the Queensland Monitoring and Sampling Manual (DERM 2009). Water samples were preserved and transported to SGS, a NATA accredited laboratory within the specific holding times for analysis.

LEGEND

- Towns and Localities
- Sample Site
- Rail Spur
- Roads
- Creeks
- Mining Tenements
- Stage 3 Pit Areas

NEW HOPE GROUP

SKM

NEW ACLAND COAL MINE STAGE 3 PROJECT

Figure 2-1
Water Quality Sample Sites

Scale 1:60,000 on A4
Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Path: I:\QENV2\Projects\QE06644\Spatial\ArcGIS\03_General\NewAclandWaterManagementPlan\130705_WMP_Figure2_1_LocationsOfWaterManagementSites.mxd
Produced: 5/07/2013

2.3.2. Lagoon Creek Water Quality

Table 2-4 provides the median and ranges of water quality variables from the long term monitoring at the DNRM Oakey Creek at Fairview gauging station and NHG's existing EA monitoring. Table 2-4 also provides the physicochemistry values recorded during a period of no flow during 2008 monitoring event.

Table 2-5 provides a summary of results for water quality monitoring during a flow event (2013), including physicochemical properties, concentrations of nutrients, major ions and dissolved metals.

Table 2-4 Water Quality Data

		Temp (ºC)	Suspended Solids (mg/L)	Turbidity (NTU)	pH	DO (ppm)	Sulphate (mg/L)	EC (µS/cm)
Guideline		**N/A**	**N/A**	**<25**	**6.5-7.5**	**90-110%**	**<200**	**<500**
Site	**Time/ Date**	**Temp (ºC)**	**Suspended Solids (mg/L)**	**Turbidity (NTU)**	**pH**	**DO (ppm)**	**Sulphate (mg/L)**	**EC (µS/cm)**
Regional Water Quality Sampling								
Oakey Creek at Fairview (DNRM)	1995 – 2012	20.50 5.9-34.8	N/A	**84 (10 – 999)**	**8.10 (5.4-10.4)**	1.2 to 17.8 (mg/L)	43 (3 **- 269**)	**1018** (159 – **3204)**
Environmental Authority Monitoring								
LCU1	2008-2013	22.40 (15.5-30.5)	18 (2-179)	N/A	7.46 (6.6-**8.4**)	N/A	2 (1-190)	210.0 (97-**590**)
LCD1	2008-2013	23.85 (17.9-29.6)	11 (1-335)	N/A	**7.80 (**7.3-**8.9)**	N/A	25 (3-220)	418.5 (176-**3900**)
LCD2	2008-2013	23.40 (19.3-29.6)	10 (2-353)	N/A	**7.80 (**7.4-**8.9)**	N/A	30 (1-200)	**596.0** (136-**1700**)
Insitu Sampling No Flow Event (January 2008)								
Lagoon Creek (AH1)	23rd Jan 1325	31.42	N/A	**94.89**	**8.90**	**111.67**	N/A	**596.4**
Lagoon Creek (AH2)	23rd Jan 1540	26.34	N/A	**33.35**	**8.91**	95.23	N/A	463.1
Lagoon Creek (AH3)	23rd Jan 1730	25.99	N/A	3.15	**8.03**	94.73	N/A	**8 089.6**

Guideline		Temp (ºC)	Suspended Solids (mg/L)	Turbidity (NTU)	pH	DO (ppm)	Sulphate (mg/L)	EC (µS/cm)
		N/A	**N/A**	**<25**	**6.5-7.5**	**90-110%**	**<200**	**<500**
Lagoon Creek (AH4)	24th Jan 1430	26.89	N/A	20.45	**8.52**	**65.61**	N/A	**642.1**
Lagoon Creek (AH5)	24th Jan 1520	30.93	N/A	16.95	**8.69**	92.10	N/A	**636.9**

*Note: Bold indicates exceedance of relevant guidelines, shaded cells indicate median exceeds relevant guidelines.

Table 2-5 Water quality monitoring during a period of flow (March 2013)

Water quality variable	Unit	Guideline	LCU1	LCD1	AE4	DS1
Flow		N/A	Yes	Yes	Yes	Yes
Temperature*	°C	N/A	23.9	25.9	21.9	21.6
Dissolved oxygen	%	90-110%	**15.0**	**51.8**	**44.3**	**46.0**
pH	pH Units	6.5-7.5	7.0	7.5	**7.6**	7.4
Electrical conductivity	µS/cm	<500	240	310	240	280
Turbidity	NTU	<25	8.6	**55**	19	10
Total nitrogen	mg/L	<0.25	**1.4**	**0.84**	**1.2**	**0.97**
Ammonia	mg/L	<0.010	**0.35**	**0.037**	**0.061**	**0.040**
Total phosphorus	mg/L	<0.030	**0.15**	**0.12**	**0.31**	**0.26**
Filterable reactive phosphorus	mg/L	<0.015	**0.052**	**0.059**	**0.18**	**0.17**
DIN	mg/L	<0.015	**0.02**	**0.29**	**0.02**	<0.02
Sodium#	mg/L		12	32	15	15
Sulphate#	mg/L		1	20	4	5
Total hardness#	mg/L	Level 1 >150 Level2 > 200	95	84	98	110
Calcium*	mg/L		20	15	23	22
Magnesium*	mg/L		5.9	8.4	7.7	8.0
Potassium*	mg/L		10	6.0	12	11
Fluoride*	mg/L		<0.1	0.6	0.2	0.1
Chloride*	mg/L		9	26	10	13
Dissolved metals						
Arsenic (As)	µg/L	<0.013	2	1	2	2
Chromium, (Cr)	µg/L	<0.0027	btl (8.5)	btl (7.7)	btl (8.7)	btl (9.6)
Copper, (Cu)	µg/L	<0.0014	2 (3.7)	3 (3.4)	**4 (3.8)**	3 (4.2)
Manganese, (Mn)	µg/L	1.9	1	btl	22	1
Mercury (Hg)	mg/L	<0.00006	btl	btl	btl	btl
Nickel, (Ni)	µg/L	<0.011	5 (29)	2 (26)	4 (30)	4 (24)

Water quality variable	Unit	Guideline	LCU1	LCD1	AE4	DS1
Zinc (Zn)	µg/L	<0.008	btl (21.3)	btl 19.2)	6 (21.9)	btl (24.1)
Barium, (Ba)*	µg/L		39	28	69	61
Beryllium, (Be)*	µg/L		<1	<1	<1	<1
Cobalt, (Co)*	µg/L		<1	<1	<1	<1
Vanadium, (V)*	µg/L		2	4	8	5

Note - * indicates no guidelines currently available. # shows water quality indicator values used for protection of drinking water supply (for example the see the EPP (Water) Dawson River Sub-basin), all other indicator values apply to the protection of aquatic ecosystem. Values in brackets are the trigger values for dissolved metals that require a hardness correction (AWQG). Below detection limits (btl) indicates the variable was below detection limits of the laboratory analysis. Shaded and bold values indicate exceedance of the relevant guideline.

Physicochemistry

The water temperatures varied between sites depending on location, time and volume of water at the sample location. Guidelines are not set for temperature but long-term monitoring from Lagoon Creek and Oakey Creek provides expected ranges for waters in the subcatchments. Water temperatures during January were at the upper range temperature range, whilst water temperatures in March were closer to the mid-range. However the results were within the expected range for these seasons.

The long term monitoring undertaken under the Mine's EA illustrates a spatial trend in the pH and EC values. Median pH and EC values were higher at sites downstream of the Mine with pH exceeding guidelines at the both downstream sites and EC exceeding guidelines at LCD2. EC was below guidelines during the flow event and contrasted with the high EC values recorded in the no-flow period. pH values were higher during the no-flow monitoring event although pH varies diurnally and seasonally and single measurements were within the ranges recorded from the long term monitoring. pH measurements during the flow event were slightly lower than the long term medians. Median pH and EC values from the Fairview gauging station exceeded the guidelines and indicate that this may be a feature of the Oakey Creek subcatchment, possibly due to higher alkalinity and salinity of soils.

Dissolved oxygen was below guidelines at all sites during the flow period with very low concentrations at the site upstream of the Mine and concentrations similar at the three downstream sites. Turbidity was variable between sites during periods of both flow and no-flow and exceeded guidelines at three sites but values were not as high as commonly occur in some waterways of the Condamine catchment (CBWC, 1999) and a spatial trend was not evident.

Nutrients and major ions

Total and filterable fractions of nitrogen and phosphorus exceeded guidelines at all sites during the period of flow. Total nitrogen was similar between sites and ammonia concentrations were extremely high at the site upstream of the Mine. At the site immediately downstream, ammonia concentration was an order of magnitude lower and coincided with a spike in Dissolved Inorganic Nitrogen (DIN) concentration. This suggests substantial oxidation of ammonia occurring over this section of Lagoon Creek. Total phosphorus and FRP tended to increase downstream and may result from the greater catchment area for mobilisation of phosphorus from soils. Concentrations of major ions were similar between sites and no spatial trend was evident.

Dissolved metals and Toxicants

Dissolved concentrations of metals were below guidelines with the exception of copper, which was detected at all sites and exceeded the guidelines at AE4; this site also had a notably higher concentration of manganese. Concentrations of pesticides and hydrocarbons were below detection limits at all sites.

Environmental considerations

Water in the Condamine catchment is generally high in concentrations of total phosphorus and in turbidity (CBWC, 1999) and is indicative of catchments that are affected by agriculture. The revised Project site has been impacted by land uses including grazing and dryland cropping. These land-use practices have affected the surrounding waterways including Lagoon Creek. The very high concentrations of nutrients in Lagoon Creek during the flow period indicate mobilisation of inorganic and organic forms of nitrogen and phosphorus from catchment run-off possibly related to agricultural activities. The concentrations of dissolved oxygen during the period of flow were low and were possibly due to the decomposition of suspended and dissolved organic matter in the rainfall run-off. The turbidity in Lagoon Creek and Oakey Creek was low in comparison to other subcatchments of Condamine River basin, where high turbidity has been identified as a major influencing and limiting factor for the EV's. The long term monitoring of EC in Lagoon Creek may indicate the influence of mine water releases in increasing median values of EC in the downstream sites and this would be expected in the context of the conditional releases specified in the current EA. However, it is noted that EC values are generally below guideline values at all sites. Furthermore, EC values immediately downstream of the Mine are significantly lower than the EC values at the DNRM monitoring site on Oakey Creek. This suggests that the EC values of the Lagoon Creek catchment are generally lower than the Oakey Creek catchment.

The water quality of the Lagoon Creek catchment is also impacted by the ephemeral nature of Lagoon Creek. Ephemeral waters are variable in their water quality primarily due to the irregularity and intensity of flow/rainfall events. The Study area experiences seasonal and highly variable rainfall. Large flow events will generally carry a large sediment load, which can be intensified by a long dry period. Flows and connectivity are also impacted by the numerous waterway barriers as a result of the construction of in-stream farm dams.

The variability in the rainfall/flow/drought cycle of ephemeral streams can lead to similar variation in the physical and chemical properties of the water compared with more permanent water bodies. In view of this variability, the current Australian and New Zealand Guidelines for Fresh and Marine Water Quality, ANZEC Guidelines (the ANZECC Guidelines) are often not suitable for such ephemeral environments. Two characteristics that often typify ephemeral streams are high turbidity and high sediment loads. However, other physicochemical properties can vary greatly in these systems. Variations in water quality may also exist over small spatial scales resulting from differing land management practices and local industry discharging or releasing waters into ephemeral streams.

2.4. Downstream Users

Lagoon Creek is part of the greater Condamine and Balonne Catchment which is subject to the requirements of the Water Resource (Condamine and Balonne) Plan 2004, (the WRP) under the W Act. The WRP outlines the availability of water in the catchment and defines the framework for managing the allocations and use of water resources. The details and guidelines for the implementation of the WRP are outlined in the Condamine and Balonne Resource Operations Plan 2008 Amended December 2011 (Revision 3) (the ROP). It is noted that the ROP, in its current format, does not include the Oakey Creek catchment, therefore while the Oakey Creek Catchment is subject to the broader goals of WRP, the operational requirements have not been specified in the ROP

The ROP identifies four Water Supply Schemes for supplemented water. Supplemented water users have an authority to operate water infrastructure and have a high priority for water allocations compared to unsupplemented users. The supplemented water supply schemes include, the Upper Condamine, Chinchilla Weir, Maranoa River and St George. Lagoon Creek has no influence on the Upper Condamine or Maranoa River Supply Scheme which are upstream of the Oakey Creek Confluence.

Sunwater operates the Chinchilla Weir and St George water supply schemes, located downstream of the revised Project Site. This water is supplied to high and medium priority water users through a number of dams and weirs. The Chinchilla Weir Water Supply Scheme is the smaller of the downstream water supply schemes with a maximum permitted distribution of 5,037 ML. The largest highest priority user of the Scheme at 165 ML per annum is the Chinchilla region of the Western Downs Regional Council. The St George Water Supply Scheme is significantly larger with maximum permitted distribution of 171,899 ML (medium and high priority), which includes 3,000 ML per annum allocated at high priority to Sunwater.

At the peak of mining operations, the revised Project's water management system will capture rainfall runoff from up to 10 km^2 of the Lagoon Creek catchment. This constitutes less than 0.1 % of the catchment to the Chinchilla Weir. Water Supply Scheme and less than 0.001 % of the catchment to the St George Water Supply Scheme. Therefore any reduction of overland flow to the downstream water supply schemes, caused by capture of run-off on the mine site, will be negligible.

The WRP also specifies Environmental Flow Objectives (EFO's) and Water Allocation Security Objectives (WASO) for the region. The EFO's for the WRP are that the extent to which a performance indicators, at each node described in Schedule 2, expressed as a percentage of the pre-development flow pattern is less than 66% or more than 133% of the same indicator is to be minimised. The closest node to the revised Project (Schedule 2) is located at Chinchilla Weir. As the revised Project constitutes less than 0.1% of the catchment to this node the percentage change to the pre-development flow pattern is expected to be well within the EFO's indicators. Similarly the impacts to water volume under the WASO's are expected to be well within the annual volume probability and 45% annual volume probability objectives.

The revised Project is not seeking a water supply allocation. A maximum water supply allocation to the Mine of 5,650 ML/year is already available from two sources. The smaller of the two sources is brine water from the Oakey Reverse Osmosis Water Treatment Plant. The major source is via a long term contract to the year 2055 with the TRC to purchase up to 5,500 ML per annum of Class A+ recycled water from the WWRF. Class A+ is the highest class of recycled water for non-drinking purposes in Queensland. The duration of this supply contract is well beyond the projected life of mine. The 45 km pipeline and infrastructure was constructed in 2009 and is fully operational. This water supply contract is a beneficial use of a wastewater and therefore does not introduce new impacts on water resource availability within the Chinchilla Weir or St George Water Supply Schemes.

A list of existing surface water users was compiled through a search of the DNRM database on surface water extraction licences within Lagoon, Oakey and Doctors Creeks downstream of the revised Project site. The search revealed 15 surface water licences, consisting of 11 licences for water harvesting purposes and three licences for irrigation purposes and one for both irrigation and water harvesting. These surface water licences are all located a significant distance downstream with the closest located 19 km downstream of the revised Project site. All but one of the licences are located downstream of the confluence with Oakey Creek and Lagoon Creek. A summary of these licences is provided in Table 2-6.

Table 2-6 Surface Water Extraction Licences

Authorisation No	Lot / Plan	Creek	Purpose
18143R	110 / AG1841	Oakey Creek	Irrigation
182982	86 / AG1796	Oakey Creek	Water harvesting
35478R	1 / RP122994	Oakey Creek	Water harvesting
35480WR	3 / RP122994	Oakey Creek	Irrigation; Water harvesting
35525WR	297 / A34722	Oakey Creek	Water harvesting
35679R	1 / RP64853	Oakey Creek	Water harvesting
42816R	1 / RP81265	Oakey Creek	Water harvesting
46029R	81 / AG1794	Oakey Creek	Water harvesting
56010R	2 / RP188947	Lagoon Creek	Water harvesting
51871R	2 / RP188947	Oakey Creek	Irrigation
55909R	83 / AG1794	Oakey Creek	Irrigation
55935R	9 / RP7980	Oakey Creek	Irrigation
56090WR	5 / RP124540	Oakey Creek	Water harvesting
58572R	3 / RP57668	Oakey Creek	Water harvesting
58674R	8 / RP7980	Oakey Creek	Water harvesting

It is also noted that Lagoon Creek includes a number of small on stream rural dams. However, all of the land on which these dams are located is owned by the Acland Pastoral Company.

All water allocations downstream of Lagoon Creek are located downstream of the confluence with Lagoon and Oakey Creek. The effect on these water users is expected to be small. The revised Project's operations are expected to have a negligible impact on the Condamine and Balonne Water Supply Schemes with Lagoon Creek representing less than 0.005% of the Condamine Balonne Catchment.

2.5. Groundwater Aquifers

In the vicinity of the revised Project site, three of the principal aquifers of interest – the Walloon Coal Measures, the Marburg Sandstone, and the Helidon Sandstone – are subartesian aquifers within the Great Artesian Basin Groundwater Management Unit (GAB GMU). The *Water Resource (Great Artesian Basin) Plan 2006*, a subordinate regulation to the Water Act (2000), covers the management of all artesian and subartesian water in the vicinity of the revised Project site.

To implement the *Water Resource (Great Artesian Basin) Plan 2006*, the Queensland Government has produced the Great Artesian Basin Resource Operations Plan (GABROP). This plan came into force during early 2007 and was amended during late 2012. The GABROP applies to artesian, subartesian and spring connected water, and provides processes for dealing with unallocated water reserves (general and State). The GABROP subdivides the

GAB GMU into 25 management areas. The revised Project is located within the Eastern Downs groundwater management area (Eastern Downs GMA) of the GAB GMU.

The revised Project access to unallocated general and State water reserves is very limited as a consequence of the status of the Eastern Downs GMA. Capping of abstraction volumes is employed to prevent overexploitation of groundwater and is essential for the Eastern Downs GMA, which is currently over allocated.

In addition to the three subartesian GAB aquifers at the revised Project site, the Tertiary Basalt and Quaternary Alluvium aquifers in the vicinity of the revised Project site contribute to the local hydrological environment.

The Quaternary Alluvial aquifer is not present within the revised Project site, except potentially for a very small portion of the far southeastern corner. However, to the south and north of the revised Project site, the Alluvial aquifer is associated with the Oakey and Myall Creeks and is known to support significant groundwater abstraction. Groundwater contained within the Quaternary Alluvium associated with Oakey Creek is managed under the Oakey Creek groundwater management area (Oakey Creek GMA). The water resource cap of the Oakey Creek GMA applies to abstraction for the mining, oil and gas industries.

The Tertiary Basalt aquifer is only present to a minor extent within the northwest of the revised Project site, however the aquifer becomes prolific immediately west of the revised Project site. Groundwater contained within the Tertiary Basalt aquifer is managed under the Eastern Downs GMA. As previously explained, the water resource cap of the Eastern Downs GMA applies to abstraction for the mining, oil and gas industries.

NAC currently holds water licences to extract groundwater from the Tertiary Basalt, the Marburg Sandstone, and the Helidon Sandstone aquifers. NAC's actual groundwater abstraction from the Helidon Sandstone aquifer is well below its 710 ML allocation, with a recorded usage of about 17 ML in 2012.

The current allocation from the Marburg Sandstone aquifer is 271 ML/year. NAC reduced its original allocation of 571 ML/year from the Marburg Sandstone aquifer during 2009. Groundwater abstraction for 2012 amounted to 10.5 ML from the Marburg Sandstone. As explained previously, NAC has a licence to extract 160 ML/year from the Tertiary Basalt, but utilises around 11 ML/year.

Groundwater abstraction from the Marburg and Helidon Sandstone aquifers has reduced to a small percentage of the licensed allocation with the commissioning of the WWRF pipeline in 2009. As a result, the revised Project's dependence on the local Eastern Downs GMA is minimal, with the usage figures for 2012 being representative of future usage (including for the revised Project), alleviating potential long term pressure on these aquifers. The abstraction of water from the Tertiary Basalt aquifer for potable use at the revised Project site will continue at 2012 rates of around 11 ML/year. All NAC's groundwater abstraction is conducted within its legal allocated limits under the *Water Act 2000*.

As excavation of the revised Project's active mine pits proceeds below the Walloon Coal Measure's water table, groundwater will discharge into the pits. Dewatering of the Walloon Coal Measures aquifer will result in the lowering of groundwater levels in the aquifer in the immediate vicinity of the revised Project site. Groundwater levels in the Tertiary Basalt and Marburg Sandstone aquifers around the revised Project site will also be affected by dewatering the Walloon Coal Measures due to induced through-flow and leakage of groundwater from these aquifers to the Walloon Coal Measures.

Mining is planned to advance in a general north to south direction for the revised Project. The active mine pits will be excavated as a progressive series of strips that advance across the

Walloon Coal Measures aquifer (resource area). As each active mine pit (new strip) advances, the previous strip is backfilled with mined material and rehabilitated. Following cessation of mining, groundwater will continue to discharge to the rehabilitated final voids, driven by evaporative discharge from the pit lakes that will form in the voids. A steady state equilibrium will be reached where the pit lake levels recover to an equilibrium where evaporation from the lakes balances groundwater inflow, at a level below that of the pre-mining water table.

The revised Project's EIS (SKM 2013) included the development and calibration of a transient groundwater flow model to predict groundwater drawdown in the surrounding aquifers over the life of the revised Project and following closure. The model is subdivided vertically into four separate layers which represent the separate hydrogeological units. The revised Project's timescale extends to 2030 and is incorporated within the model by using mining zones which are activated according to the mining schedule and de-activated as they are rehabilitated.

Impacts on groundwater levels will vary spatially over time as the mined area migrates across the revised Project site. The model predicts the greatest impacts on groundwater levels surrounding the revised Project will occur around 2030 at the end of mining. This corresponds to the Life of Mine Plan when the deepest areas of working will result in the most widespread drawdown.

Full details of the model, model calibration, predicted impacts on groundwater over the life of the revised Project are presented in Chapter 6 Groundwater Resources of the revised Project's EIS (SKM 2013) and the associated modelling report.

2.6. Environmental Accumulation of Salts and Metals

The revised Project will divert all clean water and natural catchments away from disturbed areas and capture and contain any runoff from disturbed areas for reuse on site. Water collected from direct rainfall will assist in the dilution of salts and metals such that from runoff from disturbed areas and allow water to be used on site. Discharge to the environment will only occur when absolutely necessary for continuity of mining operations. Any releases will be in compliance with authorised water quality limits, such and flow rates resulting in a low risk of contributing to the accumulation of salts and metals in the system.

The drawdown of groundwater levels in the Walloon Coal Measures aquifer around the revised Project's depressed landforms will result in the movement of groundwater towards these depressed landforms. The aquifers surrounding the revised Project site will continue to receive recharge via the same processes that occurred prior to the operational phase of the revised Project (via rainfall infiltration over time). Therefore, the groundwater quality in the vicinity of the revised Project site is not anticipated to be affected as a result of mining.

As the Marburg Sandstone aquifer is confined by the overlying Walloon Coal Measures, the potential for impacts on water quality within this aquifer from the revised Project's mining activity is considered negligible.

The operational phase of the revised Project is not expected to impact on groundwater quality.

The final land form of the revised Project will consist of three depressed land forms located outside the PMF Extent. It is therefore anticipated that volume of surface water captured by the final landform will be minimal or nil due to evaporation significantly exceeding rainfall. Ground water captured within the revised Project's depressed landforms (former final voids) possesses the potential to be saline owing to inflows of saline groundwater from the Walloon Coal Measures aquifer. This captured groundwater may be further concentrated over time

due to the region's high evaporation rate which exceeds the rate of groundwater inflow. Similarly, dilution of the captured water is expected during extended periods of rainfall. The depressed landforms will act as groundwater sinks with a permanent drawdown relative to the surrounding aquifer, and as a result, will not permit pooled water to flow outwards into the regional system. Therefore, any pooled saline water should remain confined within the depressed landforms and not have an impact on the water quality of the surrounding aquifers.

From an acid rock drainage perspective, it is unlikely that any water captured in the revised Project's depressed landforms will become acidic from oxidation of pyrites in the Walloon Coal Measures aquifer because of the neutralising effect of the surrounding sediments which are naturally alkaline. To date, NAC has not experienced any occurrences of acid rock drainage at New Acland Coal Mine.

Groundwater quality will continue to be monitored throughout the life of the revised Project to identify trends and assess whether impacts are occurring over time. Chapter 6 Groundwater Resources of the revised Project's EIS (SKM 2013) and the associated modelling report.

2.7. Potential Impacts of Discharge

The impacts of the mining operation on downstream water quality will be minimised by:

- releasing from the mine water management system only during times of flow, or following a period of flow in Lagoon Creek;
- releasing from dams only if the resultant EC and pH in Lagoon Creek does not exceed the defined criteria; and
- ensuring all runoff from disturbed areas passes through sediment and/or environmental dams before entering local creeks.

The EC level is not expected to be exceeded in downstream waters in Lagoon Creek due to releases from the revised Project's mine water management system being set at 1,000 μS/cm.

It is noted that the revised Project site has been highly disturbed by grazing and dryland cropping. These farming practices have caused obvious deleterious effects to the surrounding waterways including Lagoon Creek. The NHG's commitment to improve the health of Lagoon Creek combined by their management of contaminated runoff is expected to improve the aquatic ecosystem downstream of the revised Project activities.

3. Contaminant Source Study

3.1. Sources of Contaminants

Runoff is affected by contaminants to varying degrees depending on the contamination source, the exposure period and other climatic factors (e.g. rainfall and temperature).

3.1.1. Pit Water

Rainfall incident to the pit floor and walls will run off to the lowest point of the pit (artificial sump), collecting suspended sediments as part of the process. Over time water will evaporate from the pit concentrating salinity levels. Groundwater will also percolate into the pit from the Walloon Coal Mesures aquifer. This groundwater is already saline, and even in times of zero rainfall will require pumping from the pit for containment in storages.

Potential sources of contamination to groundwater may include incidents involving significant fuel or oil spills. In the event of this type of incident occurring, potential impacts would be contained on the surface and unlikely to impact on groundwater resources. To date, no lowering of pH in water within the mine pits has occurred at the Mine as a result of acid rock generation, and is not expected to occur within the revised Project's new mining areas, due to the shared geological and depositional formation.

3.1.2. Runoff from Mine-affected Areas

Areas disturbed by the mining activities and devoid of vegetation, such as overburden emplacements and haul roads, will produce runoff that is high in suspended sediments due to the unconsolidated nature of the material. However, salinity levels from the majority of runoff areas should not be high due to the short spoil contact time. Runoff from mine-affected areas will be sent to sediment dams, where salinity levels may increase with evaporation. The revised Project's release conditions enable good quality, low saline water, from high rainfall events to be released off site. This practice reduces the risk of salinity levels in the sediment dams increasing through evaporation and degrading the dam's water quality.

3.1.3. Runoff from Industrial Areas

Industrial Area runoff is also collected in catch drains and directed to sediment dams. Areas which are known to produce oil or chemical-affected runoff are bunded to separate contaminants from cleaner flows, and directed to storage dams, with the water being returned for use in the process.

Industrial Areas are at risk of incidents involving significant fuel or oil spills. Fuel, oil and other hydrocarbons are managed in an environmentally responsible manner at the Mine to minimise the risk of adverse impacts to the receiving environment. This management approach will continue for the revised Project and will involve actions, such as bunding around storage tanks, the use of oil-water separators for stormwater collection at workshops, the development of standard operating procedures, the maintenance of accurate inventories of materials stored on site, the use of spill kits and other similar devices and the continued use of an up-to-date emergency response plan.

The stockpile pad areas will possess a compacted clay base to minimise infiltration and will be armoured with a suitable material to maximise their longevity. Surface water runoff from these areas will be directed to a sediment dam / trap for treatment before release off site under discharge criteria outlined in the revised Project's EA.

3.1.4. Sewage Effluent

Sewage effluent is typically high in faecal coliforms, and is normally managed via a separate, dedicated and contained treatment system. The NHG will construct a new Sewerage Treatment Plant (STP), namely STP 2 for the revised Project within the infrastructure area on ML 50170. The capacity of STP 2 is expected to be up to 250 equivalent persons and will discharge to SD1. The existing mine's STP, STP 1, possesses a capacity for 130 equivalent persons and is planned to remain in operation for the Mine. Effluent from STP 1 drains to the existing on site sediment dam, SD 1. The NHG's current EA allows for the use of water from SD 1 for dust suppression purposes. To date, this practice has not been a common occurrence due to the minimal discharge from STP 1 and the normally low water levels of SD 1. As a result, it was not considered part of the mine water system and has not been considered further herein.

Any reuse or disposal of treated sewage effluent will be governed by the revised Project's EA to ensure management of contaminants and protection of the health and wellbeing of people and the environment on and off the revised Project site.

3.2. Contaminant Minimisation

The revised Project mining pits are located in the upper sections of the Lagoon Creek catchment. As a result there is little to no catchment area upstream of the mining pits that will be disturbed or flow through a disturbed area. This feature will minimise the potential for contaminants, from mine-affected waters to enter the Lagoon Creek catchment. Furthermore the 150 m separation distance from the Lagoon Creek channel to the pit boundaries and the 50 m conservation zone will minimise the potential for erosion, degradation and contamination of the Lagoon Creek from mining activities.

The main source of contaminants is from standing water in the pits over a long periods of time (in excess of one week). Salinity levels are high due groundwater inflows and the mobilisation of salinity from the in pit spoil and coal seams. Salinity levels will increase with time, and evaporation exacerbates this effect, particularly in the pits with large surface areas. However, this situation is also undesirable for the operation of the mine, and water is therefore pumped out as soon as possible. The revised Project will seek to manage pit water such that it is contained within the pit sump which possesses a smaller surface area thereby minimising concentration of salts through evaporation. With the exception of extreme rainfall events directly over the pits, the long-term storage of water in-pit is not normally practiced.

The NHG will construct flood levees either side of Lagoon Creek adjacent the Manning Vale East and Willeroo Pits to provide a flood defence from inundation during high flow events. The Lagoon Creek flood levees will provide flood defences for a PMF event. Therefore, the likelihood of pit flooding from external catchments, and the necessity to pump saline water from flooded pits, will be greatly reduced. The flood bund will be a fully engineered structure and will be constructed using compacted clay lifts and top soiled and grass covered to minimise the potential for erosion.

All mine affected water will be managed through designated water management structures. All water management structures associated with the new infrastructure area will be designed and constructed to manage at minimum a 1 in 10 AEP rainfall event and will possess appropriate engineering design criteria and/or comply with the appropriate Australian Standards to ensure environmental protection, regulatory compliance and efficient operation.

Construction of the revised Project's water storages will be conducted by a qualified contractor and will require strict supervision to ensure the engineering design properties

(structural and hydraulic) for the dam are achieved prior to commissioning. As a minimum, the NHG will be required to demonstrate that all storages comply with the (formerly) DERM's *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams*, February 2012. The NHG has previously managed the successful construction and operation of engineered structures for the current operations such as TSF 1 for Stages 1 and the various environmental dams.

3.3. Assessment of Overburden and Reject Materials

Overburden, coal and waste material stored at a mine site has the potential to generate contaminants as surface water infiltrates the area and leaches chemicals from it. The spoil associated with the revised Project will consists of weathered and fresh overburden having slightly higher clay content than the interburden and floor material. This material is generally geochemically benign, with negligible acid generation potential. Particle size analysis varies depending on the sedimentary strata encountered. However, most strata have relatively high silt content. During the initial phases of operation, and continuing throughout the life of the revised Project, analysis of overburden and tailings material may be undertaken to confirm its geochemical characteristics, and if necessary, a series of mitigation measures will be implemented. The following measures are available to the revised Project in the event of Acid Mine Drainage (AMD).

- Low Capacity Potentially Acid Forming (PAF-LC) waste rock material would be selectively handled and buried within an encapsulated cell constructed of inert or Non-Acid forming (NAF) type material.
- PAF-LC waste rock may be amenable to blending with acid consuming materials (such as high ANC waste rock) and / or treatment with agricultural lime to reduce or eliminate its AMD potential.
- Mine spoil is currently used for rehabilitation purposes at the Mine. To date, there has been no observed impact from the use of mine spoil for rehabilitation purposes in terms of sodicity or acid production. However, a portion of samples (23%) taken for the assessment indicate that there is potential for dispersion. Therefore, the following mitigation measures will be undertaken:
  - placement of these sodic / dispersive materials at the surface and within the plant root zone will be avoided due to their tendency to form low permeability soil horizons, accelerating erosion and inhibiting plant growth;
  - spoil waste materials will not be used for construction purposes (unless treated) since they are prone to tunnelling and collapse; and
  - the revegetation of the waste spoil dumps will be managed by:
    - stripping topsoil ahead of mining operations and directly placing topsoil on rehabilitation where possible, otherwise the topsoil will be stockpiled for later use;
    - application of fertilisers and other soil treatments as required; and
    - monitoring the rehabilitation to demonstrate success and identify area requiring maintenance.

It may be necessary to treat surfaces of waste spoil dumps to ensure that negative revegetation impacts do not occur. Further information on topsoil stockpiling, storage and rehabilitation is provided in the Land Resources chapter of the revised Projects EIS and in the Topsoil Management Plan.

In addition, the overburden can affect the salinity and acidity of surface water runoff from the site. The revised Project EIS states that overburden generated by the revised Project and potential reject materials had EC values ranging from non-saline to slightly saline with the average EC for the samples is within the non-saline range (e.g. 324 µS/cm). There is little difference in salinity between the weathered and fresh overburden samples and salinity is not expected to be a significant contaminant from overburden runoff.

Overall, the material tested is likely to be suitable for revegetation. Topsoil will also be used as a surface treatment prior to revegetation to minimise any effects from sodic spoil. Alternatively, consideration may be given to incorporating calcium into the surface horizon of the final spoil dump to reduce issues related to high sodicity. Taking this action may assist in maintaining the structure of the soil and help to prevent erosion of the underlying sodic material.

In general, rehabilitation performance to-date at the Mine has not indicated any significant issues in relation to salinity, acidity or sodicity. The NHG expect a similar outcome for the revised Project and have undertaken detailed soil and overburden studies to assess the new development area. In addition, the NHG has developed a series of plans to assist rehabilitation performance (e.g. Topsoil Management Plan).

3.4. Re-use and discharge

Mine water balance modelling undertaken for the revised Project (see Section 5) has shown that for average years, the mine is in water deficit, with the water supply provided through the Wetalla pipeline will be required to satisfy the revised Project's water demands. All of the water collected from the pit catchments is pumped out to storages and reused on-site, mainly for dust suppression. Reuse is critical to the water management system, and means that controlled releases are far less likely in a normal year. This reuse of pit water in addition to supplies from the Wetalla pipeline will virtually eliminate the NHG's dependence on groundwater such that the revised Project will only require shallow groundwater for a potable water supply.

The water balance modelling has indicated that the revised Project will be able to store the majority of water captured on site with controlled releases of less than 50 ML/year for the 1% exceedance probability. That is discharge would only occur during moderate to extreme rainfall which will provide dilution for any contaminants and minimise impacts to the downstream environment. Furthermore discharges will be undertaken in accordance with the latest industry guidelines provided by the Fitzroy Final Model Conditions (DERM, 2008).

4. Risk Assessment

A preliminary risk assessment was undertaken based on the risk of the contaminants identified in the source study creating impacts to the downstream environment. It is noted that risks were considered with the application of mitigation measures identified in Section 3. This risk assessment will be expanded in the later stages of the revised Project when the design of all elements is established, and additional risk controls implemented.

4.1. Pit Water

The risk of pit water causing impacts to the regional surface water or groundwater system was considered to be low. This result is due to the containment of water within the pit, minimisation of catchment area exposed to the pits through their location in the upper sections of the catchment and the reuse of water captured in the pit for make-up water and dust suppression.

4.2. Runoff from Mine-affected Areas

The risk of impacts to downstream users and the environment from runoff from mine affected areas was considered to be low. Runoff from all areas affected by mining will be diverted to sediment dams to allow suspended sediments to settle. It is noted that controlled releases will occur from the environment dams and discharge from sediment dams will be required in extreme events. However, salinity levels are not expected to be high due to the short spoil contact time. Furthermore discharge would only occur during or following periods of heavy rainfall when there is sufficient flow in adjacent watercourses to dilute water discharged. All discharges will be undertaken in accordance with the licence conditions. Furthermore measures undertaken by the NHG including the 50 m conservation zone (no mining zone) and the 150 m operational separation of the pit boundaries from Lagoon Creek are expected to reduce sediment load in the existing waterway, and therefore, will provide a beneficial mitigation measure. In addition, the proposed flood levees will also reduce the ability of run off from the pit areas discharging directly to Lagoon Creek. Finally, the NHG minimise disturbance (exposed areas) on site and maintains dedicated flow paths (waterways) in a grassed state, which both reduce the potential for sediment transport off site.

4.3. Runoff from Infrastructure Areas

Runoff from infrastructure areas is considered to have a moderate risk to the environment. The revised Project will employ a number of water management measures including bunding, the use of oil and water separators and appropriate emergency controls. This risk is flagged as moderate to support further investigation and the further development of appropriate design controls as part of the revised Project on-going detailed design. It is noted that all infrastructure areas will be constructed with a compacted clay base to minimise infiltration and be armoured with a suitable material to maximise their longevity. Surface water runoff from these areas will be directed to a sediment dam / trap for treatment and then follow a grassed waterway to an environmental dam before release off site under discharge criteria outlined in the revised Project's EA.

4.4. Contaminant Minimisation

The risk of breach of the proposed flood defences is considered to be very low. The Lagoon Creek flood levees will be designed to provide flood immunity to a PMF flood event with a freeboard of 500 mm. In addition to this measure, the 150 m operational separation of mining activities from Lagoon Creek, including the 50 m conservation zone, provides continuity of flows to downstream users and the environment.

Lagoon Creek rail and haul road crossings will be constructed during the dry season in periods of low to no flow. Any works within the creek will be engineered and stabilised through scour protection works and or vegetation prior to any flows. If required, temporary waterway barriers will be erected on the Lagoon Creek channel and will include the provision to transfer flows from upstream of the works to the downstream channel without passing through the disturbed construction site. Weather conditions will be monitored so that work in creek crossings and erosion prone areas will not take place if rain and/or extreme weather (e.g. storms) is forecast.

Sedimentation fences and bunds will be used during construction to contain all excavated material. Excavated material will be stockpiled away from gully heads, active creek banks, bank erosion or other unstable areas. Assessment of the integrity and effectiveness of erosion control measures will be undertaken at regular periods and following significant rainfall events. Further rehabilitation and repair will be taken as necessary if erosion of reinstated areas is identified.

4.5. Proactive Water Management Strategy

The philosophy of the water management strategy is to provide adequate water to the revised Project site to operate successfully while minimising environmental impacts by collecting and managing mine-affected runoff water. The WRMP is based on the following key principles.

- Stormwater runoff from undisturbed areas, both on and surrounding the revised Project site, will be diverted away from disturbed areas and released directly into adjacent waterways.
- Disturbed area runoff will be captured in sediment and environmental dams and used preferentially for dust suppression or as process water in the CHPP.
- Recycled water from the TRC's WWRF will continue to be used by the revised Project as the main water supply source for process water requirements.
- Shallow groundwater bores will be utilised to supply potable water suitable for human use (i.e. following treatment).
- The requirements of the proactive management strategy are outlined in a number of sections of this report as indicated in Table 4-1.

Table 4-1 Location of Proactive Water Management Strategy Requirements

Item	Location
Review and implementation requirements.	Section 7
Accountabilities and responsibilities.	Table 4-2
How water management is to be incorporated into mine planning.	Section 1.4
An overview of the drainage of the site.	Section 1.4
Details of the mine affected areas drainage including overburden dumps, highwall areas and the industrial area. Details include management of runoff from these areas.	Section 5.1.2
Pit dewatering.	Section 5.1.2

Item	Location
Creeks and flooding issues for the site.	Section 1.4.4
Water storages, transfers supply and usage.	Section 5
Monitoring requirements for the water system.	Section 7.1.2

4.6. Accountabilities and Responsibilities

The NHG employees operate in divisions where each possesses a role in the design, operation and maintenance of the water management system. Table 4-2 provides a breakdown of the activities under the WRMP and accountabilities.

Table 4-2 Accountabilities and Responsibilities

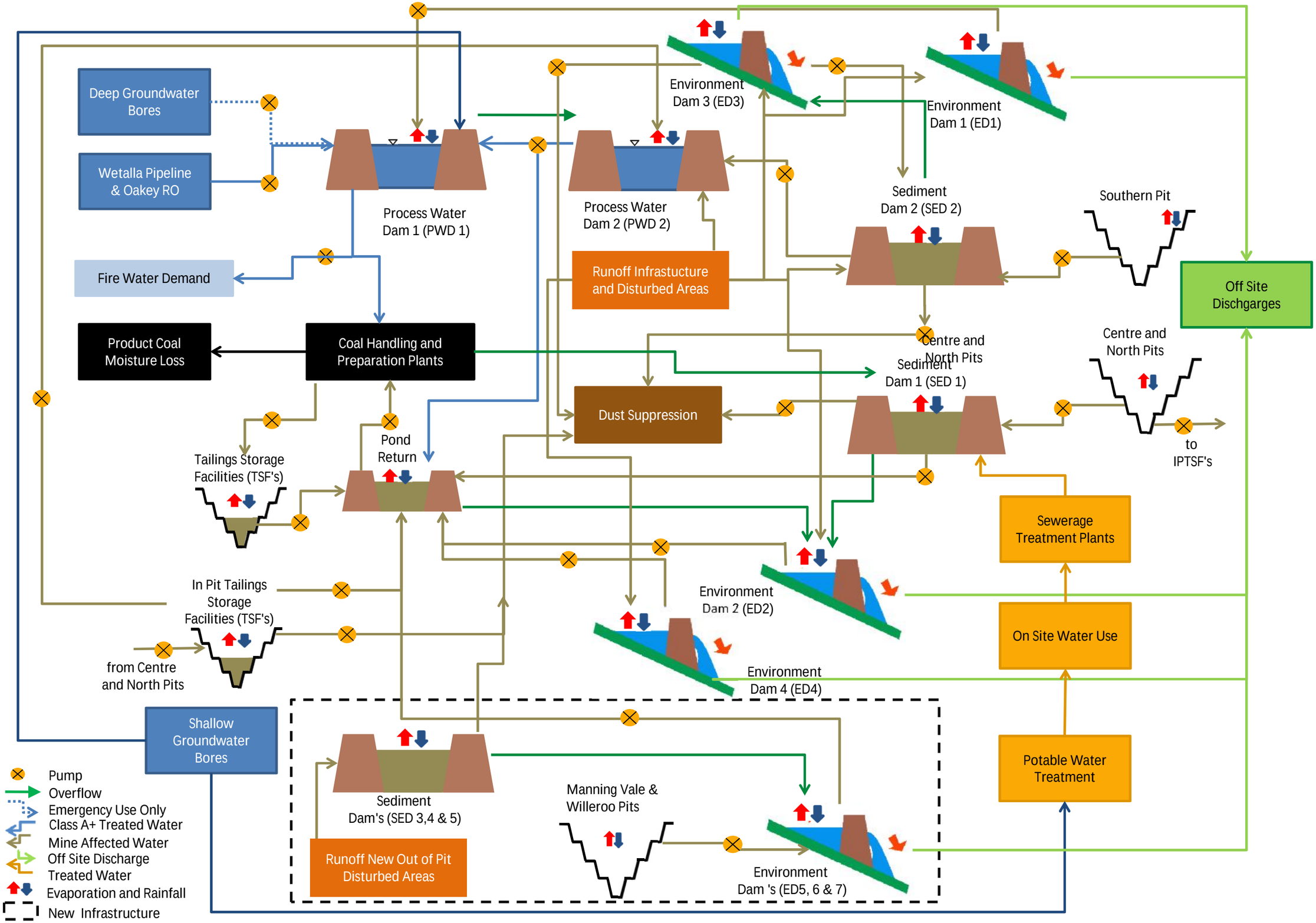
Item	Responsibility	Frequency
Develop objectives and targets that will drive improvements in site water management.	General Manager	Annually – through the Annual Plan/Budgeting process, EMS process and/or EMP process.
Assess current site water requirements and identify future needs. Test water efficiency targets and provide a forward forecast of mine water operation.	Environmental Advisor, Technical Services Superintendent, Projects Superintendent, CHPP Superintendent, Operations Manager	Annually at the end of each water year – through the Annual Plan/Budgeting process
Maintain knowledge of the quality and quantity (including resource demands) of the surface and ground waters in the mine lease area to enable effective decision making regarding water management.	Environmental Advisor, CHPP Superintendent	Monthly
Develop and maintain a site water balance detailing process and non-process water inputs, uses and outputs.	Environmental Advisor	Annually at the end of each water year.
Identify requirements for new surface water management control structures (including flood levees, sediment control, etc.) based on the medium and long term mining plans.	Mining Engineers, Environmental Advisor, Technical Services Superintendent	Annually – through the Annual Plan/Budgeting process
Review Annual Operating Plan and determine if appropriate water management structures are included	Environmental Advisor, Technical Services Superintendent, Operations Manager	Annually – through the Annual Plan process
Ensure Annual Operating Plan budget allows for water control structures so that timely	Environmental Advisor, Technical Services	Annually – through the

Item	Responsibility	Frequency
construction can occur.	Superintendent	Annual Plan/Budgeting process
Identify and obtain necessary approvals where interaction may exist with natural surface water systems prior to implementation.	Environmental Advisor	As required
Water management initiatives communicated to all personnel and externally communicated to relevant stakeholders.	Environmental Advisor	As Required
The water management system will be maintained and operated in accordance with the requirements and procedures outlined in the WRMP.	Environmental Advisor, Technical Services Superintendent, Operations Manager	As specified for each item.
Establish a water monitoring program that will periodically sample water on and adjacent to the mining lease. Aims of the program include: • Review the monitoring program to ensure its performance is consistent with the long-term water management strategy	Environmental Advisor	As stated in Monitoring Program
• Prepare a monthly water management report.		Monthly

5. Site Water Balance Model

The philosophy of the water management strategy is to provide adequate water to the revised Project site to operate successfully while minimising environmental impacts by collecting and managing mine-affected runoff water. The Mine's water management system is based on the following key principles.

- Where possible, stormwater runoff from undisturbed areas, both on and surrounding the revised Project site, will be diverted away from disturbed areas and released directly into adjacent waterways.
- Disturbed area runoff will be captured in sediment and environmental dams and used preferentially for dust suppression or as process water in the CHPP or dust suppression purposes.
- Water from the IPTSFs will be recycled to reduce water consumption for coal washing purposes.
- Mine-affected water will be adequately treated so that it may be potentially discharged off-site under appropriate discharge arrangements and in compliance with the revised Project's EA.
- Pit water will be preferentially used for dust suppression purposes to minimise retention time.
- A suitable pumping arrangement will be established between the main water management structures to maximise the opportunities to recycle water and minimise the potential for discharges off site.
- Recycled water from the TRC's WWRF will continue to be used as the main water source for process water requirements.
- Shallow groundwater bores will be utilised in comparatively small quantities to supply potable water suitable for human use and an emergency supply for CHPP use;
- Infrastructure and mining areas will receive maximum protection from flooding using flood levees.
- All significant quantities of hydrocarbons chemical products and wastes stored on site will be managed in a safe and environmentally responsible manner using appropriate engineered controls and standard operating procedures. Spills, containment failure and stormwater treatment will be key aspects of environmental management process.
- Progressive rehabilitation will be applied to disturbed areas no longer required for operational purposes to minimise total disturbance on site.
- Figure 5-1 illustrates the mine water management system.


Deep Groundwater Bores
Wetalla Pipeline & Oakey RO
Process Water Dam 1 (PWD 1)
Process Water Dam 2 (PWD 2)
Environment Dam 3 (ED3)
Environment Dam 1 (ED1)
Sediment Dam 2 (SED 2)
Southern Pit
Off Site Dischgarges
Fire Water Demand
Runoff Infrastucture and Disturbed Areas
Product Coal Moisture Loss
Coal Handling and Preparation Plants
Centre and North Pits
Sediment Dam 1 (SED 1)
Centre and North Pits
Dust Suppression
Pond Return
Tailings Storage Facilities (TSF's)
to IPTSF's
Sewerage Treatment Plants
In Pit Tailings Storage Facilities (TSF's)
Environment Dam 2 (ED2)
On Site Water Use
from Centre and North Pits
Environment Dam 4 (ED4)
Shallow Groundwater Bores
Potable Water Treatment
Sediment Dam's (SED 3,4 & 5)
Manning Vale & Willeroo Pits
Runoff New Out of Pit Disturbed Areas
Environment Dam 's (ED5, 6 & 7)
Pump
Overflow
Emergency Use Only
Class A+ Treated Water
Mine Affected Water
Off Site Discharge
Treated Water
Evaporation and Rainfall
New Infrastructure

5.1.1 Components of the Water Management System

The revised Project's water management system will, in its initial stages, operate in conjunction with the Mine water management system. As a result, the water management strategy for the revised Project will utilise existing water management infrastructure designed and constructed as part of the Mine. The key components of the mine water management system are the:

- Wetalla pipeline;
- process water dams;
- environmental dams;
- sedimentation dams; and
- in-pit tailings storage facilities.

Where practical, the stormwater runoff from clean, undisturbed catchments will be diverted around disturbed areas using bunds and channels and released directly into adjacent gullies and waterways. Rainfall runoff from disturbed areas including un-rehabilitated spoil areas will be collected. Spoil area runoff will report to environmental water dams for treatment before release as described below. Water that reports to a mine pit floor in smaller quantities will be used directly from sumps or in larger quantities will be pumped to environment dams and stored for use to supplement the revised Project's water demands for activities, such as dust suppression.

The sections below outline the purpose of each component of the water management system.

Process Water Dams

The process water dams are used to supply process water to the CHPP Precinct. The process water dams also aid in the management and segregation of clean and dirty water at the revised Project site. The process water dams generally do not have a local catchment and will only receive clean water inflows from the Wetalla pipeline, recycled water from the mine water management system and direct rainfall. Water that has been settled in the sediment dams and in-pit tailings storage facilities can be transferred to the process water dams to maximise sediment dam capacity, which provides optimal storage volume for flood events.

Environment Dams for Pit Water Storage

The new mining areas of Manning Vale East and Manning Vale West and Willeroo are located within the upper sections of the Lagoon Creek catchment. As a result, the area of undisturbed or disturbed catchment upstream of the pits is minimal. The majority of water that collects on the site accumulates in the pits as a result of direct rainfall runoff and groundwater infiltration from in situ strata (high wall) and backfilled areas (low wall). Water that collects in the mine pits will be captured in small temporary sumps where it is used for dust suppression activities. During high rainfall periods, excess pit water will be pumped to sedimentation dams for eventual use by the CHPP Precinct. Three additional environment dams will be constructed for the revised Project's Manning Vale East, Manning Vale West and Willeroo resource areas. These dams will be constructed in close proximity and on the downstream edge of the pit to minimise pumping costs.

Rainfall runoff from the two out of pit spoil dumps at the Manning Vale West and Willeroo mine pits will be captured in sediment dams with any overflows diverted to the environment dams via diversion bunds. The placement of these bunds will be determined through the detailed mine planning and will change as the mine pit progresses. As the disturbed area is in the upper parts of the catchment and the out of pit dump areas are relatively small, the

environment dams will manage a relatively small catchment area. As a result inflows to the environment dams can be largely controlled through the pump rates from the adjacent pit.

A controlled release system is proposed from the new Environment Dams. The purpose of the controlled releases is to allow relatively clean water from a significant rainfall event to be removed from the site, rather than collected in the pits and increase in salinity through evaporation. This controlled release system will also assist in minimising the revised Project's impacts to flows in Lagoon Creek. The controlled release system will be based on water quality targets.

The environmental dams are normally located downstream of existing sedimentation and raw water dams. The environmental dams provide additional storage and treatment for water in significant rainfall events and mitigate against uncontrolled releases to the downstream environment. As is currently practised, water captured by the environmental dams will be used to supplement the revised Project's water requirements. This practice is employed to maximise the EDs storage capacity and reduce the risk of off-site discharges. Water may also be transferred from the sediment dams to the environmental dams to maintain the optimum operating level for the sediment dams. The placement of the environmental dams will require consideration of the mine pit progression and will be finalised through the detailed mine planning.

Sediment Dams

Sediment Dams will be required to entrap soil and other particles eroded from moderately disturbed areas due to rainfall runoff within the revised Project's site. The Mine area currently employs Sediment Dams 1 and 2. As required, new Sediment Dams will be constructed for the revised Project's Manning Vale West, Manning Vale East and Willeroo resource areas.

Typically, the Sediment Dams will receive rainfall runoff from out-of-pit dumps that are being progressively rehabilitated or areas disturbed by clearing and access tracks. These dams will also provide additional emergency storage for water captured in the revised Project's operational mining pits by direct rainfall or groundwater infiltration. Water from the Sediment dams will also be used preferentially for dust suppression and as appropriate to supplement the CHPP Precinct's process water demands.

Sediment Dams will be designed to provide enough storage volume to capture a 24 hr 10 yr ARI storm event for sufficient time to settle 0.05 mm diameter (course silt) particles; and maximise the length of the dam relative to the width of the dam to maximise hydraulic retention time and deposition. The placement of the Sediment Dams will require consideration of the mine pit progression and will be finalised through the detailed mine planning. Bunding and or catch drains will be used to direct runoff into sediment dams and or overflows from the sediment dams. These bunds and / or catch drains will be incorporated into the mine pit progression, this will minimise the sites reliance on pumping infrastructure.

Tailings Dams

The current tailings strategy that is being utilised on-site involves progressive construction of in-pit tailings cells as part of the dump design. This approach will continue to be practised for the revised Project, with the concept of utilising out-of-pit tailings dams being a less favourable option for a variety of reasons. The in-pit tailings storage facilities currently on site, under development and proposed for the future will have sufficient capacity to hold the tailings produced by the revised Project.

5.1.2 Water Balance Modelling

Methodology

The performance of the revised Project's water management system was assessed using the modelling software program, GoldSim. GoldSim is a software package developed by the GoldSim Technology Group to model continuous systems and has the ability to track the movement of water with time based inputs and operating rules.

The water balance model was established at a daily resolution and developed to predict the operation of the Mine's current and proposed water management system. The results of the water balance illustrate the revised Project's capacity to manage weather extremes over the 20 year mine life. The objectives of the mine water balance are to:

- control the release of water from the storages so that that releases occur in a manner that minimises impacts upon downstream users and the environment;
- manage dam storages so that they maintain water to the operation of the revised Project;
- maximise pit operability through bunding and transferring water to sedimentation dams; and
- control and manage the separation and use of clean and mine-affected water.

The water balance model was developed from a schematisation of the water management system, based on the component descriptions outlined in Section 1.4.3.

Climate Inputs

The water balance model was based on a probabilistic rainfall generation. The purpose of the probabilistic rainfall generation is to develop a range of climate sequences for the life of the revised Project based on the recorded historical rainfall data of the Study area. The probabilistic rainfall data was generated from recorded historical data using the Stochastic Climate Library for 500 replicates over a 20 year sequences of daily rainfall data. This method allows assessment of a wide range of rainfall sequences which may be experienced over the life of the revised Project and the calculation of a range of exceedance probabilities. Evaporation from the site was determined based on monthly averages as recorded at gauge 041359 Oakey Aero.

Mine Water Sources and Demands

The revised Project's water sources and demands vary over its life. A summary of the annual average volumes is shown below in Table 5-1 and Table 5-2. The catchments that contribute to the water balance are discussed in further detail in Section 5.1.4.4.

Table 5-1 Mine Water Inflows

Description	Value
Rainfall	500 Stochastic Replicates based on data generated from gauge 041053 at Jondaryan Post Office.
Wetalla Pipeline	5,500 ML per annum from the Wettalla Wastewater Reclamation Facility (WWRF) at a rate of 340 cum /hr
Oakey Reverse Osmosis Plant	150 ML per annum
Ground and surface water capture	Varying with mine life climate, refer to contributing catchments
Deep and Shallow	Not considered in the Water Balance. Water Balance developed assuming zero inputs from groundwater bores. Shallow Groundwater bores will be used to

Description	Value
Groundwater Bores	supply potable water to the site and it is assumed that this supply will be sufficient to meet potable water demands.
Groundwater Inflow to the Pits	Output of groundwater modelling, varies over the lift of mine (typically between 2.5 to 0.5 ML/d)

Table 5-2 Mine and Future Project Raw Water Demands

Water Supply Activity		Current Usage (approx) (ML/ year)	Future Usage (2021) (approx) (ML/ year)
Operation of the CHPP Precinct	(~550 L/RoM tonne)	5,280	8,250
Wash down of machinery			
Fire suppression			
Shower and ablution use			
Dust suppression (~ 45 L/RoM tonne)		432	675
TOTAL USAGE		5,712	8,925
Estimated recovery Tailings Storage Facilities (50%)		2,860	4,460
Estimated water collected at site (rainfall runoff & groundwater inflows)		740	1,170
TOTAL NET WATER USAGE (~220 L/RoM tonne)		2,112	3,295

Contributing Catchments

The revised Project's water demands and catchments change over its operation. To assess this change over time, several mine stages were examined. Catchment areas were determined from the mine plans and GIS analysis and are presented below in Table 5-4. A description of each catchment type is provided below.

- Ex Pit Dump – Surface runoff reports to sedimentation basins and seepage through the dump flows to the dump toe and into sedimentation basins.
- In Pit Dump – Surface runoff reports to sedimentation basins or the pit floor dependant on the topography of the mine pit. The majority of water from the Manning Vale East and West in-pit dumps report to their pit floors. Seepage from spoil will report to the mine pit floor and be considered by the water balance.
- Ex Pit Rehabilitated – The direction of runoff is consistent of that with the ex-pit dump until the area becomes fully rehabilitated and is diverted clear of the system to the natural waterway. Until this time, the rehabilitated area differs only from the dump area by the assumed soil storage characteristics outlined in Table 5-3.
- In Pit Rehabilitated – Differing from the ex-pit dump, rehabilitated areas have been backfilled to natural surface levels and may be bunded to report directly to the sedimentation dams, thereby maximising pit operability. Seepage from these areas will

report to the mine pit. Once the area is fully rehabilitated it will be diverted clear of the system to the natural waterway.

- Mining Area/Pit Floor – This area represents the active mining area and mine pit floor. All runoff reports to the mine pit floor.
- Disturbed and Pre-Strip Area – This represents areas that have already been stripped of top soil in preparation for mining or have been disturbed from their natural state in some way. Runoffs from these areas will typically runoff into the pit or a sedimentation dam based on the slope and orientation of the area.
- Undisturbed Area – Where possible, areas that have not been disturbed will be diverted around water storages and discharged to local stream. Where this is not practical, runoff will be collected and used to meet site demands.

A key difference between each of these areas is the assumed soil storage characteristics. Surface water runoff in the model is generated based on a conceptual soil storage capacity and base flow index. The soil storage capacity represents the depth of soil storage which must be filled before runoff occurs. This soil storage capacity is based on the stage of mining or rehabilitation. The base flow index designates the rainfall that becomes surface runoff and a proportion that goes to groundwater. Table 5-3 outlines the conceptual soil storage capacities and base flow index for the revised Project site. The values adopted in Table 5-3 are consistent with those adopted from similar open cut mining operations in Queensland.

Table 5-3 Conceptual Soil Storage Characteristics

Land Use	Mining Pits	Spoil Dump	Undisturbed Area	Pre Strip Area	Rehabilitated Spoil Dump
Small Storage Capacity (mm)	5	40	7	20	7
Medium Storage Capacity (mm)	10	220	120	150	120
Large Storage Capacity	25	300	150	220	150
Small Area Proportion	0.134	0.134	0.134	0.134	0.134
Medium Area Proportion	0.134	0.134	0.134	0.134	0.134
Baseflow Index	0.1	0.1	0.1	0.1	0.1
Baseflow Coefficient	0.8	0.5	0.5	0.5	0.5

Table 5-4 Mine Water Balance Catchment Areas

Catchment		AREA (ha)					
		2013	2019	2021	2023	2025	2029
MANNING VALE EAST PIT	Mining Area	-	28	36	46	23	16
	Disturbed Area	-	44	48	43	37	28
	Undisturbed Area	-	168	168	-	33	44
	In Pit Dump	-	29	45	53	58	40
	In Pit Rehabilitated	-	-	15	48	-	-
MANNING VALE WEST PIT	Mining Area	-	29	25	35	26	31
	Disturbed Area	-	46	32	33	32	32
	Undisturbed Area	-	135	15	-	-	14
	In Pit Dump	-	163	33	41	37	42
	In Pit Rehabilitated	-	-	118	-	-	55
WILLEROO PIT	Mining Area	-	33	41	37	25	14
	Disturbed Area	-	39	44	45	39	63
	Undisturbed Area	-	72	45	-	-	71
	In Pit Dump	-	81	53	72	53	76
	In Pit Rehabilitated	-	-	90	-	-	-

Water Balance Operating Rules and Assumptions

The water balance is based on several operating rules and assumptions as outlined below.

- The water balance starts at a volume of zero.
- Process water demands have priority. These demands can only be withdrawn from water in the raw water dams.
- A minimum Wetalla pipeline inflow of 3,000 ML per annum must be used or stored on-site.
- If the Mine has less than two days CHPP process water supply in storage, the Wetalla pipeline pumping hours may be increased up to 4,800 ML per annum to ensure the Mine does not dry out.
- The Wetalla pipeline inflows are delivered to RWD 1. Water is supplied to the revised Project's CHPP Precinct via a gravity fed pipeline.
- Water collected from rainfall runoff within the revised Project mining areas can be transferred back to the Mine's water management system, via the Pond Return dam to be used to supplement process water requirements.

- With the exception of the central connection to the Pond Return dam, water could not be pumped between storages more than 1 km apart. That is water from storages to the south of the South Pit could not be pumped up to the existing storages in the north east section of the Mine.
- Pumping rates for transfers between eligible storages are up to 4 ML/d.
- Pit dewatering rates are typically 40 l/s increasing up to 200 l/s following periods of extended significant rainfall.
- Dust suppression demands can be withdrawn from sediment dams, environmental dams, pit sumps or mine voids. Dust suppression demands are preferentially withdrawn from sediment dams to maximise available storage.
- Dust suppression demands are reduced on days when the daily rainfall total is in excess of 5 mm.
- Dust suppression is not required on days when rainfall is exceeds 10 mm.

Site Surface Water Quality

The water balance model was developed to include a high level salt balance to track both the quantity and quality of water on-site. The salt balance tracks the water quality in all of the inflows to the revised Project's Sediment and Environment Dams and subsequent affects from evaporation and releases on the storage water quality. The water quality values are presented in Table 5-5. These adopted values are consistent with other water balance models developed from Mine site records.

Table 5-5 Assumed Salinity

Source	Assumed Salinity (µs/cm)
Undisturbed Catchments	400
Spoil Dumps and Industrial Areas	500
Raw water pipeline	250
Receiving Waters	400
Pit Water	4,000

The above salinity values are converted to a concentration in milligrams per litre using a multiplication factor of 0.67 (Measuring Salinity DERM, June 2007) to quality the mass of salt transferred in the model. The salt balance is used as an indicator of water quality. Actual releases will be made based on sampling and monitoring of a number of water quality parameters.

Salinity values for undisturbed catchments and receiving waters are based on water quality records from other Project sites. For modelling purposes, a conservative assumption was made to assume a salinity level of 4,000 µs/cm for all water pumped from the in-pit sumps.

Controlled Release Conditions

A controlled release strategy is proposed as part of the revised Project's site water management to minimise the risk of an uncontrolled release during periods of extended rainfall. The controlled release strategy has been developed to minimise the potential for impacts on water quality, aquatic ecology and existing users downstream. The strategy seeks

to optimise the potential for the controlled release of good quality water, so that it does not become saline through extended storage.

Following the 2008 flooding in the Fitzroy Basin, the then DERM published several documents to provide guidelines on the discharge licensing for coal mines in the Fitzroy Basin. These documents are as follows.

- *A Study of the Cumulative Impacts on Water Quality of Mining Activities in the Fitzroy River Basin* (Qld Environmental Protection Agency (now DERM), April 2009). This study recommended approaches to standardise the licensing and discharges from mines to the Fitzroy River basin. The study also provides a cumulative risk assessment matrix to assess the mine discharges. This approach is discussed further below.

- *Conditions for Coal Mines in the Fitzroy Basin – Approach to Discharge Licensing Version 10*, (DERM, June 2009). This document includes references to studies by Hart (2008) and states that salinity effects on macroinvertebrates are unlikely at or below 1,000 µs/cm.

- *Final Model Water Conditions for Coal Mines in the Fitzroy Basin* (EHP, 2013). This document outlines how discharge conditions should be determined and managed under the Environmental Authority.

The above guidelines are considered to form the latest industry standards for mine water releases and in lieu of catchment specific guidelines were adopted for the revised Project. The revised Project proposes that controlled releases be made to the Lagoon Creek on the Mine. Releases will be made in accordance with the principles outlined in the *Final Model Water Conditions for Coal Mines in the Fitzroy Basin* (EHP,2013). The release conditions were developed to only allow discharges that are less than 1,000 µs/cm downstream of the point of discharge.

At the time of writing the Department of Science, Information Technology, Innovation and the Arts (DSITIA), is in the process of finalising the development of a daily rainfall runoff model for the upper Condamine catchment using the Sacremento model. The model has been developed to provide a long term historical flow series for the Gowrie Oakey Creek catchment to support the ROP amendment. The model was developed using upstream and downstream gauges and calibrated back to 1922. While this project was not finalised at the time of writing, the DISITA has provided the output for the flow apportioned to the Lagoon Creek catchment for use in this revised Project. This flow was apportioned based on the creek catchment area.

The Lagoon Creek historical flow series which was provided by the DSITIA and was used to derive flow statistics to inform the Lagoon Creek release conditions as an output of the calibrated Sacremento Model for the Oakey Creek catchment Missing days and dry days within the streamflow series were excluded from the analysis. As a conservative measure, flows which recorded less than 1 ML/d were considered to be dry and also excluded from the analysis. Percentage exceedence values were then calculated on the remaining data set and are presented in Table 5-6.

Table 5-6 Release Conditions

Receiving Water Flow Criteria for Discharge (ML/d)	Approximate % of Lagoon Creek Streamflow	Maximum release rate	Electrical Conductivity Release Limits (µs/cm)
Low Flow < 4 ML/d for a period of 28 days after natural flow events that exceed 4 ML/d	< 20%	<1.5 ML/d	700
Medium Flow (low) > 4ML/d	> 20%	<1.5 ML/d	1,500
		<0.7 ML/d	2,500
		<0.5 ML/d	3,500
Medium Flow (high) > 11.5 ML/d	> 40%	<3 ML/d	1,500
		<2 ML/d	2,500
		<1.3 ML/d	3,500
High Flow > 34 ML/d	> 60%	<8ML/d	1,500
		<6ML/d	2,500
		<6 ML/d	3,500
		<2.8 ML/d	4,500
		<1.7 ML/d	7,500
Very High Flow > 66ML/d	> 80%	<4.5 ML/d	4,500

In order to simulate flow conditions in Lagoon Creek for the 500 replicates of probabilistic rainfall data, a Sacramento rainfall runoff model was developed within the GOLDSIM model. Parameters for the Calibrated Oakey Creek Sacramento model were provided by the DSITIA and are shown in Table 5-7.

The controlled release strategy proposes one release point to Lagoon Creek. No release points are proposed on any adjacent gullies including Spring and Myall Creek as these gullies are considered to have insufficient annual flows to support a new controlled release strategy. The connection of the three environmental dams to this release point will be established through detailed design of the water management system and take into account infrastructure and site constraints, this may include gravity fed pipelines and or the placement of smaller intermediate storages to support a pumping regime.

Table 5-7 Sacramento Model parameters for Lagoon Creek

Parameter	Value
Lztwm	100
Uzfwm	90
Uzk	0.18

Parameter	Value
Rexp	1
Uztwm	72
Pfree	0.1475
Zperc	200
Lzfpm	30
Side	0.001
Lzsk	0.8
Pctim	0.0028
Lzfsm	40
Sarva	0.0029
Lzpk	0.005
Adimp	0.0001
Ssout	0.001

Mine Water Balance Results

Demand Reliability

The water balance model was used to predict the reliability of the demands for the operations including the clean water, process water and dust suppression demands from varying water sources. The model also predicts the adequacy of the site storage to manage extreme rainfall events. The model was run for 500 climates replicates over the 20 year mine sequence. Table 5-8 below presents the reliability of the major site water demands. The water balance predicted zero days of deficit for the CHPP plants supply with demands supplied on 100 % of days for all scenarios modelled. Similarly, the dust suppression demands are met on 99.9% of days with only a minor volumetric deficit predicted for the 1% exceedance over the total life of mine.

Table 5-8 Reliability Demand for Site

Demands	Number of Days Demand Supplied (%)		Total Mine Life Volume Deficit (ML)	
	50% Exceedance	1% Exceedance	50% Exceedance	1% Exceedance
Potable Water/Fire Fighting	100	100	0	0
CHPP Precinct Demands	100	100	0	0
Dust Suppression	100	99.9	0	200

Mine Water Management

Three additional environment dams and two sediment dams are proposed to manage rainfall runoff from mine affected areas. These dams are located adjacent to Manning Vale East Manning Vale West and Willeroo Pits. Figure 5-2 illustrates the combined volume contained within these storages over the life of mine. The results indicate that the proposed water management system, and combined storage of 800 ML will be more than sufficient to manage the revised Project's climate extremes.

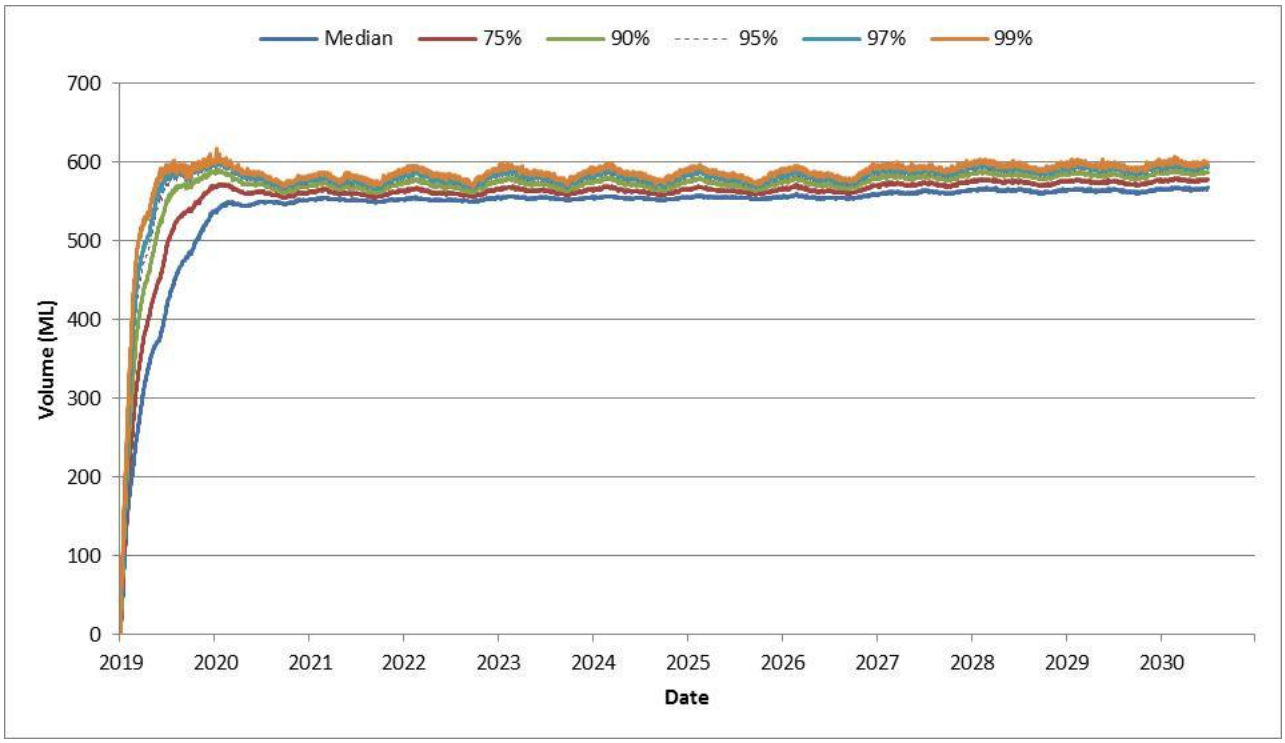


Figure 5-2 Combined volume in additional on-site storages

The potential for in-pit flooding due to an extreme rainfall event or period of continuous heavy rainfall was also examined. Figure 5-3 illustrates the number of days over the life of the revised Project where in pit flooding would exceed 100 ML, resulting in disruptions to the mining operations. The results indicate that for the 3 % exceedance probability there would be a risk of up to 30 days of mining interruptions and a risk of up to 4 months of delays at the 1 % exceedance probability through the first 10 years of mining operations. Additional water accumulation is expected in later mine life to an increase in predicted groundwater inflows. This risk is considered to be a low likelihood, and in the event that this occurs the NHG will manage the impacts through additional pump infrastructure.

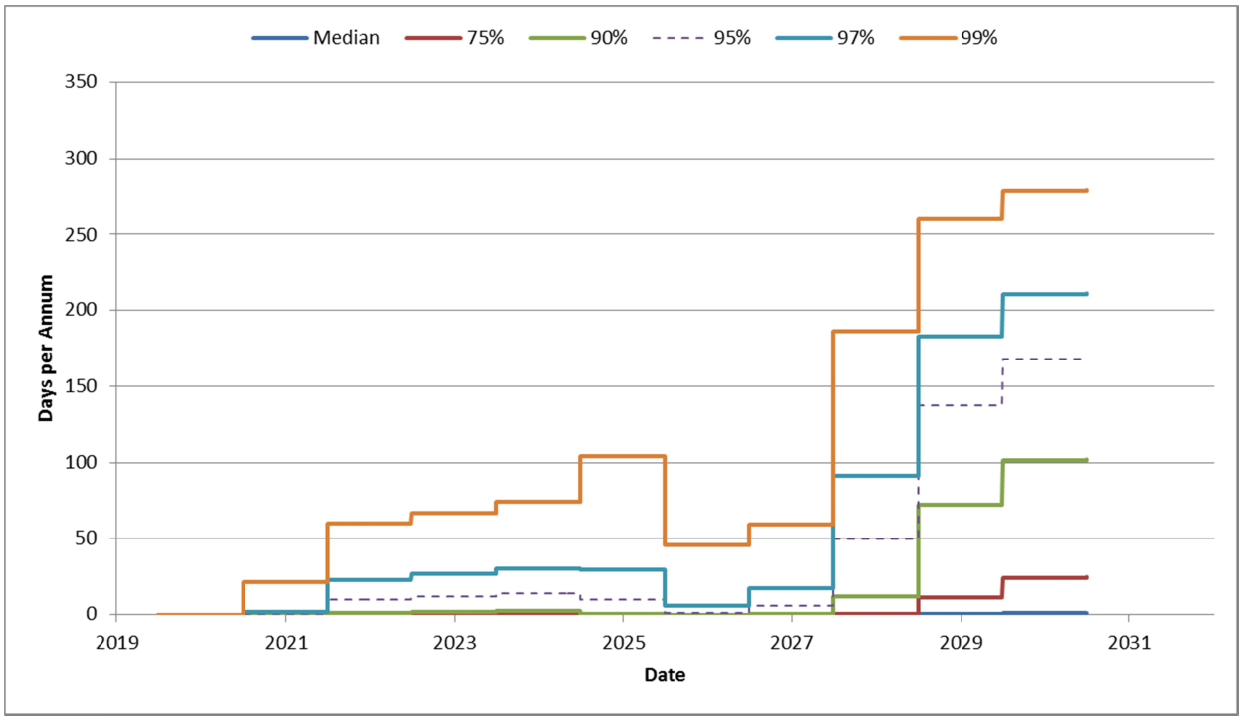


Figure 5-3 Days of pit flooding greater than 100 ML per annum

Controlled Release

The average annual volume released to Lagoon Creek over the revised Project's life of mining operations is illustrated in Figure 5-4. The results indicate that in an average year only minor releases in the order of 20 ML/year will be made to Lagoon Creek with releases increasing to a maximum of 170 ML/year in the 1 % exceedance probability. This volume of water is minimal, with the ephemeral nature of Lagoon Creek restricting the opportunity for release of large volumes of mine-affected water. However, the release condition is still considered important for the revised Project and in keeping with current industry guidelines. The release condition allows for good quality water to be released off site following periods of significant rainfall. This approach prevents good quality water increasing in salinity through evaporation and maximises the available storage within the mine site to manage climatic extremes.

Figure 5-5 illustrates the predicted salinity within Lagoon Creek at the point immediately downstream of the mine water releases. The results illustrate the baseline salinity of approximately 400 µS/cm (consistent with the median values from water quality monitoring (refer to Section 2.3.2), with salinity values increasing to up to 700 µS/cm during the 1% exceedance probability release conditions. These results indicate the proposed controlled release system mine water management system is unlikely to result in significant changes to the salinity in Lagoon Creek with values well below the median values recorded for the area of 1,000 µS/cm.

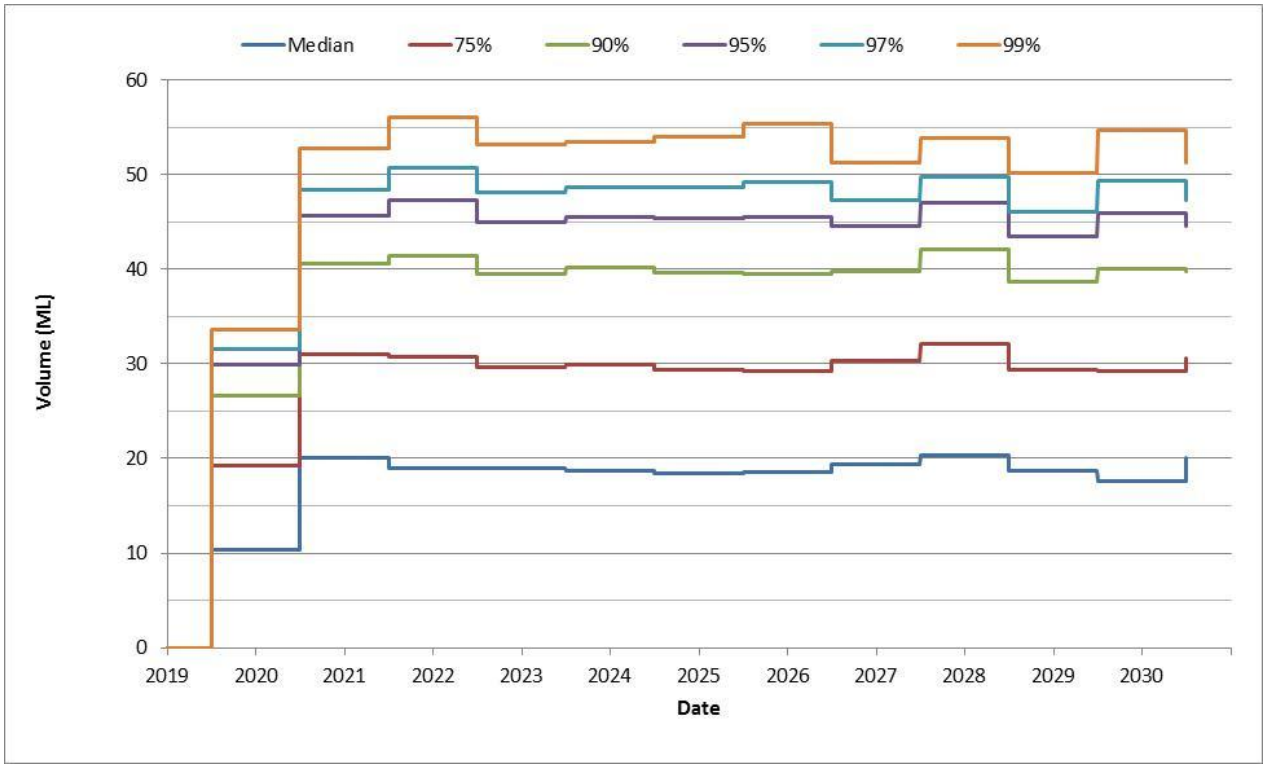


Figure 5-4 Annual Controlled Release Volume

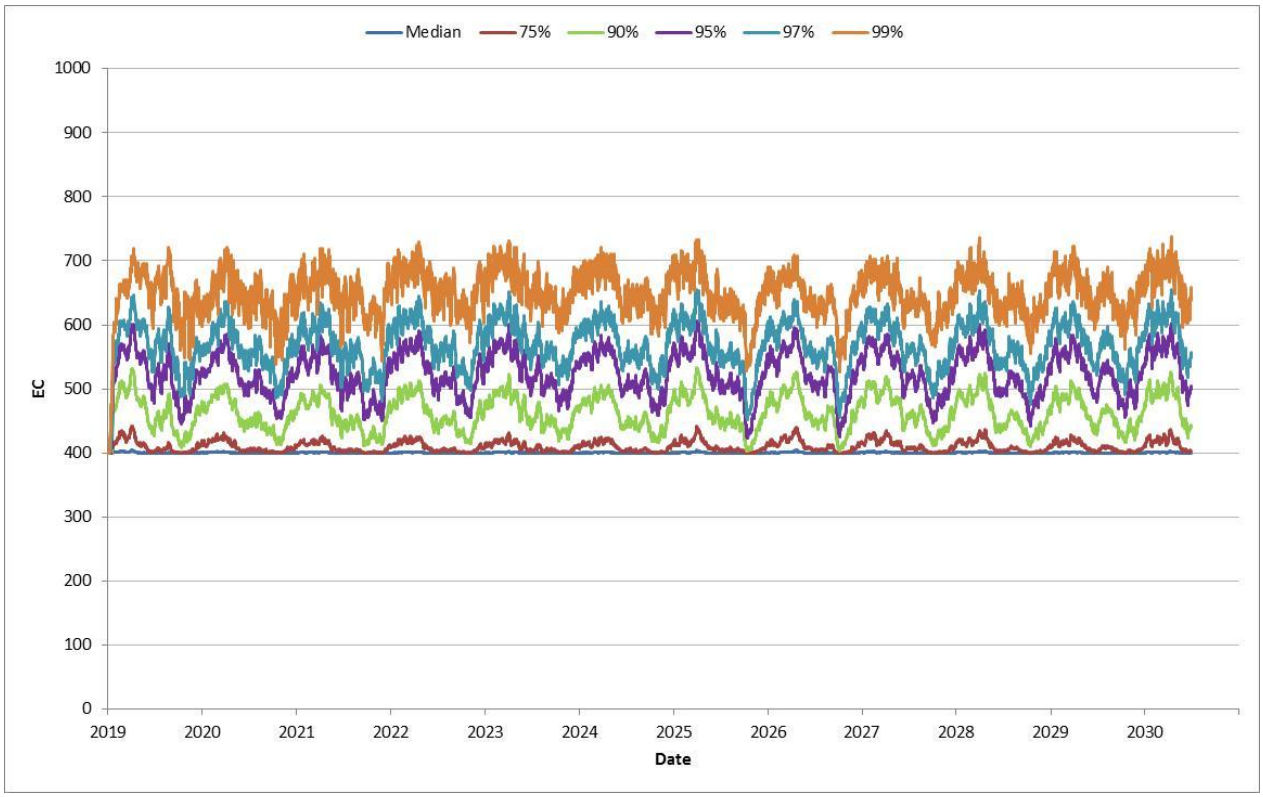


Figure 5-5 Salinity of Lagoon Creek downstream of mixing point

A study by the then DERM in 2009 developed a risk assessment framework based on the ambient EC levels and the frequency and volume of mine discharges in the Fitzroy River catchment. The study was aimed at identifying the risks of cumulative mine releases within a catchment. While there is limited mining activity in the Condamine River catchment the process of the development of the framework is relevant. The results of the water balance modelling indicating a high probability (1 % exceedance) of an annual discharge volume of less than 50 ML/year and water quality of the receiving environment being less than 700 µS/cm. This is considered to be a "Low" water quality risk to receiving waters being less than the 90th percentile EC value at the downstream Fairview gauging station. The flow frequency and volume is also considered to be a "Very Low" risk with release on only a few days and average volumes of less than 100 ML per year. The revised Project's controlled release system is therefore predicted to be a 'Low' risk. As such the impacts of the proposed controlled release system on water quality and the downstream environment is predicted to be minimal.

It is noted that while the mine water management indicates there are no uncontrolled release from the revised Project there is the potential for uncontrolled release due to the failure of water storage infrastructure. The risk of failure of this infrastructure is addressed through the regulated structures guideline. Under this guideline, storages considered to present a significant hazard to the downstream environment, water quality or people will be designed to comply with the guidelines and are required to be inspected annually by a registered professional engineer. It is therefore considered highly unlikely that there would be any uncontrolled releases form the revised Project's mine water management system.

It should be noted that during the revised Project's operations, the Mine's site will be fully rehabilitated. At this time, rainfall runoff from these fully rehabilitated areas will overflow to existing drainage lines transferring water to the downstream environment and water users.

5.1.1. Mine Water Balance Summary

The water balance modelling is based on conservative estimates for 500 stochastic rainfall replicates. The results predict that the Project's water management infrastructure combined with the Mine infrastructure is able to adequately manage mine water to minimise risks to operations and adverse impacts to the downstream environment.

5.2. Management of Water Management Structures

5.2.1. Regulated Storages

All of the storages will be subject to a risk assessment as outlined in the '*Manual for Assessing Hazard Categories and Hydraulic Performance of Dams*' (DERM, 2012).

The Environment Dams will receive pit water and is therefore likely to contain contaminant concentrations (salinity) that will exceed the guidelines. It is therefore anticipated that the three new Environment Dams will be classified as regulated *structures* and will need to be designed and licensed accordingly. The proposed Lagoon Creek flood protection levee will also require licencing as a *regulated structure*.

Each regulated storage will have a spillway, designed and maintained to pass the peak flow from a design storm of critical duration for the relevant contributing catchment. Regulated storages are assigned Design Storage Allowances (DSA) and Mandatory Reporting Levels (MRL), in accordance with current DERM guidance. The DSA prevents a release from the system within the AEP according to the risk assigned to the storage. The MRL is determined as the volume below the spillway crest, equivalent to the AEP (design risk) 72 hour storm. The operator will advise the Administering Authority when that water level is reached. It is expected that the new Environment Dams will be assessed as regulated storage during the detailed design phase.

The remaining dams on site are unlikely to be considered *regulated structures* as it is doubtful that they will exceed the water quality guidelines due to their containment of either raw water or spoil run-off. These dams will also be small and are unlikely to meet the criteria as *referable dams* under the WSSR Act, based on the likely capacity, wall heights, and the low risk to populations downstream in the event of failure. During the development of the revised Project, should a referable dam be required, appropriate assessment and approvals will be sought from the Administering Authority.

5.2.2. Proposed Maintenance Actions

All regulated storages will be inspected annually by a suitability qualified and experienced person for their structural, geotechnical and hydraulic adequacy and the results of the assessment reported to DNRM. Maintenance of pumps is the responsibility of the Maintenance Department, who will provide 24-hour support across the site, this will include a 250-hour interval time on all pump maintenance, stepped in complexity and thoroughness as the pump accumulates hours.

5.2.3. Water Pumping Equipment

Water pumping equipment will be selected during the revised Projects detailed design phase. It is envisaged that multiple pumps will be supplied for the revised Project to support transfers between the storages and for dewatering of the pit sump. It is also envisaged that larger pumps will be available for transfer of water during emergency conditions.

5.2.4. Water Treatment Methods

It is not envisaged that any highly contaminated water would be released to the environment. Nevertheless, the system has been designed to contain many inherent treatment techniques, including the settling of suspended sediments, and biological remediation offered by the natural vegetation in many of the storages. Any discharges off site will comply with the revised Project's environmental authority.

5.3. Impacts of the Mining Project

As discussed in Section 3.1 the water in system derives from different sources and has different levels of contaminants. These contaminates will be minimised through proactive management strategies such as progressive rehabilitation, bunding and segregation of different pollution generation sources. These containment measures minimise the exposure of these areas to water in the system.

The mine design seeks to minimise the potential for surface water impacts through the 150m operational separation distance from the pit boundaries to Lagoon Creek and include a 50 m conservation zone where no mining is allowed. The preservation of this area is expected to improve the riparian vegetation, bank stability and subsequent the aquatic habitat and water quality of Lagoon Creek.

There is limited information regarding the impacts of accumulation of metals in the environment. Limiting the frequency and volume of releases from the revised Project will minimise the potential for impacts due to the accumulation of metals. Monitoring of receiving water will be undertaken as part of the revised Project to provide a greater understanding of the impacts of mine-affected water releases on downstream water quality and aquatic ecosystems. In general, most metals are found in an inert state (bound up) within the soil, overburden and coal and are not easily bio-available or able to obtain a soluble state without extreme pH or other conditions. As these conditions are unlikely to be experienced on site, the NHG further believes the risk of exposure to metals is minimal. Nevertheless, the NHG is committed to understanding its potential impacts on the receiving environment through a broad monitoring program. The program will involves comprehensive sampling of water quality on site and will permit a greater understanding of the levels of metals and other contaminants in storages on site.

As part of the water management system, runoff from disturbed areas will be captured and treated with an amount available for reuse by the revised Project's water management system. In line with current industry guidelines the mine water management system will include a controlled release system to manage rainfall events and minimise impacts on the downstream flow regime. The ephemeral nature of Lagoon Creek means that controlled releases will occur over the life of the revised Project but will be minimal and are therefore expected to have minimal impacts to water quality, aquatic ecology and downstream water users.

In addition to this it is noted that the density of mining operations in the Surat basin is significantly less than that of other Queensland mining areas and as such the risk of cumulative effects of other industries discharging into the same waterway is minimised. It is also recognised that the NHG's use of recycled water from the TRC's WWRF provides economic support to the community and is a beneficial use of a wastewater stream that may have otherwise been discharged to the environment.

6. Emergency and Contingency Planning

A number of emergency situations may arise during the life of the revised Project. Preparation for a range of scenarios is essential with each scenario requiring an appropriate response relative to the urgency of the emergency. For example a flood emergency will require a rapid response with drought requiring careful observation and management over a long period of time.

6.1. Flood Preparedness

The revised Project will include flood defences in the form of levees for Lagoon Creek. All flood defences will have annual inspections after each wet season and significant flow event. Levees will not be to be altered or interfered with unless there has been thorough consultation with a professional engineer.

All flood defences for the revised Project have been designed for a PMF with a freeboard of 500 mm. However, all flood defence structures have risks associated with the uncertainty in the flood estimates and structural integrity of the bund. Although very unlikely, evacuation of the pit will be required to ensure the safety of workers. The revised Project industrial area will be located on higher ground and will serve as a suitable evacuation point during a flood event. Management of this type of event will be based on a thorough risk assessment process and will be detailed in the Mine's safety and health system and emergency response procedure.

Rainfall events have the potential to cause rapid inflow to the pits and pit pumping will be required to ensure continuity of operations. Testing of pit flood pumps should be undertaken in preparation for each wet season and the pumps should remain in a location that they are accessible during flood events and be immune from flooding. Positioning of pumps in pit sumps and connecting pipeline must occur prior to the start of the wet season to allow a rapid recovery from any forecast or unexpected rainfall events.

The NHG will also monitor 3 month rainfall outlooks provided by the BoM to manage the risk of high to extreme rainfall events.

6.2. Drought Planning

Drought planning will be proactive with a reduction of water use being a key element of the plan. The revised Projects use of recycled water provides a reliable source of water and a highly reduced dependency on rainfall events. Furthermore under the agreement between the NHG and TRC, the NHG possesses an option to increase its allocation from the WWRF, which provides further drought security.

The mine water balance will be reviewed annually at the end of every water year to assess the system reliability for the upcoming season and to identify potential efficiency gains. This approach will include a review of the BoM published 3 month outlook for the chance of above or below average rainfall. This approach will also allow adequate time for alternative strategies to be sought and water use minimisation techniques to be implemented.

Drought planning will involve monitoring and review of existing water use. Monitoring of existing water uses and analysis of the data will allow inefficiencies in the system to be identified and targeted for reduction in forward planning.

6.3. Emergency Response Action Plans

The NHG's Emergency Response Manual includes a section on actions to be taken in response to an environmental emergency. The discharge of water from the water

management structures are included as an individual issue with specific requirements outlined in the Emergency Response Manual, which will be reviewed and updated as required. The NHG's emergency response plans also include incident reporting. These plans will be updated to incorporate risks specific to the revised Project.

7. Implementation of the Water Resource Management Plan

7.1. Operational Monitoring and Review

7.1.1. Water Balance Updates

Water balance updates are required to ensure that the model is representative of the true operating system. This approach will also enable the water balance model to act as a predictive tool. The water balance will be reviewed annually, and or whenever significant changes have taken place to the water management system. Monitoring is essential to the success of these updates. Calibration data will be collected for use in any future updates.

This WRMP will be reviewed every 12 months prior to the end of September and after any event involving the uncontrolled release of water to the environment. The review will consider any updates to the system, predictions from the water balance model and any changes to regulatory or licensing conditions.

7.1.2. Performance Monitoring

Monitoring of performance will involve the testing and gauging of a number of different systems. Monitoring programs will be in place and documented for the following areas:

- dam safety inspections;
- water quality monitoring;
- groundwater monitoring;
- dam level monitoring;
- water use gauging;
- levee audit and safety assessment; and
- Lagoon Creek channel stability.

Outputs of some of this monitoring will be used in updating the water balance model and the WRMP so that the modelling tool can be thoroughly calibrated and be used as a predictive tool for mine water management operations.

The revised Project's EM Plan will outline monitoring locations, methods and frequency to ensure consistency across the revised Project's life of mine. The monitoring program will be designed to.

- ensuring compliance with the EA and water licences;
- ensuring that no unacceptable impacts to surface and groundwater systems are occurring as a result of activities;
- ensuring that any regulatory non-compliance is detected and managed in accordance with procedures and regulatory requirements;
- support operational control and update on-site water balances and off-site catchment models;

- assess current and cumulative impacts of on the environment;
- meet corporate and regulatory reporting requirements;
- maintain safety and environmental inspection procedures, including the verification of identified hazards and compliance with licence conditions, for all licensed water control facilities; and
- in addition to the monitoring program, a monthly report will be compiled to compare actual site water usage to target water usage and describe mine water storage levels and volumes. The report will be used to:
- forecast mine water storage volumes and evaluate quality of mine site water and water not affected by mining against water quality criteria;
- review the site water balance; and
- identify any anomalies in data and recommended action items.

7.2. Performance Measurement

The key items that will be used to gauge performance of the WRMP will include:

- performance of water conservation measures such as management of dust suppression demands;
- controlled transfers between dams and dam levels are within appropriate limits;
- releases to receiving waterways are controlled to the requirements of the revised Project's EA; and
- appropriate actions have been taken when problems are detected, which may include situations such as structural issues detected in dams, water quality levels exceeding set levels or water levels in dams are greater than set limits.

7.3. Continual Improvement

Improvement of the water management system is essential to reduce the risk of the mine water management system being unable to meet demands or having uncontrolled releases. This management will include active participation in forums relevant to the region's water supply and identification of new technologies.

Strategies for improvement in water use will form a mandatory part of the water balance review. Water usage targets will be established and progress against these targets will be monitored. The revised Project will be operated according to a series of documented procedures - Safe Operating Procedures (SOPs). The SOPs relating to the water management system are:

- surface water management;
- monitoring and reporting;
- regulated dam management;
- levee management;

- water storages management;
- water usage and release;
- collecting water and groundwater monitoring data;
- operation and maintenance of sediment dams, environment dams and sumps; and
- groundwater management and reporting.

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