

# 5 Year Environmental Implementation Plan

**2019 – 2023**  
**Version 2.0**  
**27 March 2019**

## Environment Improvement Projects

The environmental improvement project outlined in this implementation plan have been grouped into key focus areas shown in Table 1.

Table 1: Summary of improvement projects

Focus Area	Key Objective
Organisation cultural change	Risk reduction through empowering the entire workforce
Air Quality Management	Emission/particulate and risk reduction
Water Management	Impact mitigation
Land Management	Mitigate contamination: safe, stable and sustainable
Other	Amenity impact reduction

## Explanation of the Implementation Schedule

The implementation schedule shown after each project table shows the study, engineering or execution phase, which are described below:

Projects shown in study phase are at the earliest part of the implementation process and require work to identify and assess options that will deliver the required environmental outcome. The outcome of the study phase is to determine the option that best meets the defined performance criteria. In selecting the preferred option during the study phase to take to the engineering phase, options are assessed against a number of criteria, including,

- How effectively each option mitigates the risk,
- Can the project be delivered in the required timeframe?
- What is the cost of each option compared to the expected environmental outcome?
- Can the option be practically constructed?
- Can the option be implemented within an operating refinery?
- What approvals will be required to deliver the option?
- Can the option be delivered safely?

Some projects are quite complex requiring more time and resources in determining the right option. Consequently the outcome of the study phase for a project will deliver the option to take forward to the engineering phase.

### Engineering Phase

The engineering phase is where the detailed work is carried out and a set of documents is developed to allow the project to move into the final execution phase. The engineering phase covers traditional mechanical, civil, structural, process and electrical engineering input, which will provide a detailed design that can be constructed to meet applicable Australian, Queensland and QAL standards. Other aspects covered in the engineering phase include any required Commonwealth, Queensland and Local government approvals pertaining to environmental, planning and cultural heritage legislation. These approvals can only commence once the project design is nearing completion.

The output from the engineering phase will be a detailed design and issued for construction drawings (where required) that are based on risk reviews (process, safety, health, environmental and cultural), constructability reviews as well as hazard and operability assessments.

As stated, some projects will require a number of approvals from the Commonwealth, State and Local governments with approval time frames that may extend up to a year during the engineering phase for some of the more complex projects.

Towards the completion of the engineering phase QAL will be able to determine a more detailed performance indicator to demonstrate the environmental improvement at the completion of execution.

### Execution Phase

The output of the engineering phase will be a package of work that will generally include a number of deliverables that will be tracked during the execution phase. The type and complexity of the project will determine the number of deliverables required and how the deliverables are phased, as some may need to be finished before another can begin.

### How to Interpret the Tables

The study (gold) and engineering (blue) phase schedules are based on delivering milestones at the end of a specified quarter, i.e 2019 Q1 means Quarter 1 2019 January to March. The execution phase (green) schedules are based on delivering milestones within a calendar month.

This example shows the study phase milestone for a project is due in quarter 4 in 2018. This means that during quarter 4 the project will transition into the engineering phase and the implementation plan will be updated accordingly.

Task	Project Name						
	2018		2019				
	Q3	Q4	Q1	Q2	Q3	Q4	
Description	■	■					

This example shows the engineering phase milestone due in 2019 quarter 2 and the implementation plan will be updated in quarter 2 to show the execution phase.

Task	Project Name						
	2018		2019				
	Q3	Q4	Q1	Q2	Q3	Q4	
Description			■	■			

This example shows the execution phase will take 10 months with the completion date of the project in April 2020.

Task	Project																																
	2018						2019												2020														
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun									
Description																		■	■	■	■	■	■										



## Organisational Cultural Change

QAL recognises that the culture of an organisation is a significant factor impacting the environmental performance of a business. While leadership commitment and governance structures are important to ensure that environmental improvement projects are effectively executed; our environmental improvement program will only succeed if we empower all of our employees to have due and proper consideration of environmental obligations and risks in their everyday tasks.

Redefining our site culture begins with our workforce having a greater understanding of the process safety aspects of our operation, and the significant potential environmental and community impact our operations can have. We then need to empower our workforce to reduce risk around process and environmental concerns to avoid them and respond when potential process safety and environmental concerns arise. The introduction of a disciplined system for organizing workplaces and the broader QAL operating environment is underway.

Improved housekeeping and understanding of process safety critical controls will lead to early detection of leaks, spillage and situations that could lead to potential environmental impacts.

Project (C1)	Site Cultural Change
Risk class	- IV/Critical
Environmental risks	- Failure of systems causing environmental incidents that impact on the receiving environment and community
Project solution / options	<ul style="list-style-type: none"> <li>- Improve process safety and environmental risk detection for all QAL employees through a Process Safety Management System (PSMS) that ensures critical controls are identified and verified.</li> <li>- All QAL employees involved with ensuring critical controls are in place are aware of the importance of these controls and that they will be verified.</li> <li>- The process will be incorporated into the operations systems including: <ul style="list-style-type: none"> <li>• 5S housekeeping work program <ul style="list-style-type: none"> <li>▪ 5S is a specific housekeeping program that allow teams to systematically organise their work areas – Sort, set, shine, standardize and sustain.</li> </ul> </li> <li>• Annual environmental training for all employees</li> <li>• Daily HSE meetings (environment in work preparation)</li> <li>• Quarterly business updates, led by site senior executives</li> <li>• Bi-annual engagement survey</li> <li>• Purple banner reporting which includes the introduction of reporting category focused exclusively on environmental incidents</li> </ul> </li> </ul>
Objective / performance outcome	<ul style="list-style-type: none"> <li>- Greater awareness of environmental risk and employee's role in controlling these risks.</li> <li>- Improved culture relating to process safety and environmental risk management throughout the entire organisation through the implementation of a PSMS.</li> </ul>
Performance Indicator	<ul style="list-style-type: none"> <li>- Completion of all major hazard workshops during the engineering phase.</li> <li>- 90% of major hazard critical control health completed within the first 12 months after the PSMS is implemented across site.</li> <li>- Greater than 90% of employees completing annual environmental awareness training.</li> </ul>
Cost estimate A\$ million	- \$0.5 annually
Project Stage	<b>Engineering</b>

Comments	<ul style="list-style-type: none"> <li>- Pilot studies for a digester failure and at the RDA for a dam wall failure have been completed,             <ul style="list-style-type: none"> <li>• CCMP process (deep dive by GM on Critical Controls) commenced on these major hazards.</li> <li>• Monthly managers review process implemented and chaired by General Manager.</li> </ul> </li> <li>- Ten further PSM major hazard workshops have been completed.             <ul style="list-style-type: none"> <li>• Major hazard workshops take 2-5 days to fully develop with input from a member of every team who works on or with the equipment.</li> </ul> </li> <li>- Quarterly business updates are ongoing.</li> <li>- 5S pilot commenced in Raw Materials, however this needs to become more functional, i.e. less administrative.</li> <li>- First Purple Banner produced for site.</li> <li>- &gt;95% of employees have completed Environmental Web Based Training.</li> <li>- Annual environmental training updated and implemented in January             <ul style="list-style-type: none"> <li>• 85% of employees have completed Environmental Web Based Training.</li> </ul> </li> <li>-</li> </ul>
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### Implementation Schedule

Site Culture Change					
Task	2018	2019			
	Q4	Q1	Q2	Q3	Q4
Site Cultural Change					
	Study	Engineering	Execution		

## Air Quality Improvement Projects

QAL's 5-year air quality improvement plan, supported by targets, actions and programme of works is summarised below. Capital spend is estimated at between A\$19 million to A\$38 million.



Project (A1)	<b>Alkali Release Off-Site</b>
Risk class	- IV/Critical
Environmental risks	- Alkali release to atmosphere with potential to impact air quality and property in the surrounding communities
Project solution / options	Identify sources at the refinery that can release alkali and put in place measures to reduce the risk of the release occurring. An initial suite of alkali emissions reduction projects are in execution. Stage 2 of the alkali emissions reduction project will include further study to identify further alkali sources where the risk of release can be reduced
Objective / performance outcome	- Sources will be identified where actions can be taken to reduce likelihood and consequence of alkali release - Reduce identified Class III and IV alkali release risks to Class I and II to mitigate impact to the community
Performance Indicator	- Study phase identifies options to reduce emissions from alkali sources in the refinery and they are progressed to engineering. - No alkali release events from completed projects due to QAL operations or maintenance activities - All emission sources assess as Class III and IV risk are identified and an engineering solution is developed or investigations exhausted to reduce risk to Class I and II.
Cost estimate A\$ million	- 8.0
Project Stage	<p><b>Study</b></p> <ul style="list-style-type: none"> <li>- Stage 2 study to identify further alkali sources and investigate options for mitigation</li> </ul> <p><b>Engineering</b></p> <ul style="list-style-type: none"> <li>- Bottom fill precipitators Project <ul style="list-style-type: none"> <li>• Bottom fill precipitator tanks to reduce alkali mist</li> </ul> </li> </ul> <p><b>Execution</b></p> <ul style="list-style-type: none"> <li>- Upgrade and install shrouds on expansion joints; <ul style="list-style-type: none"> <li>• Upgrade of expansion joints has been completed and shrouding replacement is to be finalised in August 2019 shutdown.</li> </ul> </li> <li>- Flash tank relief header shroud installation; <ul style="list-style-type: none"> <li>• Shrouds on flash tank relief pipework expansion joints</li> </ul> </li> <li>- Digestion heater vent diversion <ul style="list-style-type: none"> <li>• Re-direction of heater vents downwards or to grade</li> </ul> </li> </ul> <p><b>Projects completed</b></p> <ul style="list-style-type: none"> <li>- Existing equipment (identified as Class III and IV Risk) including piping, valving and fixtures on the Digester Pilot Steam Lines and the Flash Tank pilot steam lines have been replaced.</li> <li>- New oxalate vent tank has been installed and commissioned.</li> </ul>

Comments	<ul style="list-style-type: none"> <li>- Upgrade and install shrouds on expansion joints                             <ul style="list-style-type: none"> <li>• All expansion joints have been replaced and final installation of shrouds will occur during the August shutdown.</li> </ul> </li> </ul>
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**Implementation Schedule**


Task	Alkali Release Off-Site									
	2018		2019				2020			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Bottom Fill Precipitators project										
Stage 2 Alkali Emissions Study										
Upgrade and install shrouds on expansion joints										
Digestion heater vent diversion										
Flash tank relief header shrouds installation										

Study
Engineering
Execution



**Alkali Release Off-Site**

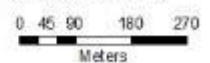
**Legend**


 Alkali and Odour Emissions Reduction

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:8,119



N  
 Revision: 0  
 Date: 28/11/2018  
 Created by: Jonathan Dallas  
 Checked by:  
 Approved by: Jonathan Dallas

Project (A2)	Alumina Dust Emission Reduction
Risk class	- III/High
Environmental risks	- Alumina dust emissions from Boyne Smelters Limited (BSL) conveyor transfer points, product load-out and island and mainland alumina storage A-frames have a potential to impact on the air quality of surrounding communities.
Project solution / options	- Identify options to reduce alumina dust emissions from high risk release points.
Objective / performance outcome	- Mitigation of alumina dust emissions
Performance Indicator	- Study phase identifies options to reduce emissions from alumina dust sources in the refinery and South Trees Island and they are progressed to engineering. - No visible dust emissions from release points from completed projects.
Cost estimate A\$ million	- 13.0
Project Stage	<b>Study</b> <ul style="list-style-type: none"> <li>Alumina ship loading,</li> <li>Island and Mainland A-frames</li> </ul> <b>Execution</b> <ul style="list-style-type: none"> <li>Improvements and upgrades to dust collectors at BSL transfer points</li> <li>One BSL belt conveyor to be replaced with air slide conveyor,</li> </ul>
Comments	

### Implementation Schedule






Alumina Dust Emissions Reduction									
Task	2018	2019				2020			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Alumina Dust Reduction Study	■	■	■	■	■				
BSL alumina transfer upgrade	■	■	■	■	■				
	■ Study	■ Engineering	■ Execution						



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## Alumina Dust Emissions

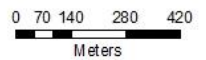
### Legend

-  Ship Loadout
-  Island A Frame
-  BSL Conveyor and Transfer Points
-  Conveyors and Transfer Points
-  Mainland A Frame

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Coordinate System: GDA 1994 MGA Zone 58

Scale at A3 1:12,834



	Revision	A
	Date	21/10/2018
	Created By	Jonathan Dalton
	Approved By	Jonathan Dalton

<b>Project (A3)</b>	<b>Odour Emission to Community</b>
Risk class	- III/High
Environmental risks	- Odour releases with potential for impact on air quality of surrounding communities.
Project solution / options	<ul style="list-style-type: none"> <li>- Conduct an odour study including comparative analysis with previous 2006 study to determine an odour baseline</li> <li>- Capture current uncaptured organic emission sources, and</li> <li>- Address redundancy concerns with current treatment system</li> </ul>
Objective / performance outcome	- Minimise QAL odour profile within the community
Performance Indicator	<ul style="list-style-type: none"> <li>- Odour baseline is established when refinery is operating on Amrun bauxite.</li> <li>- Study phase identifies options to reduce emissions from odour sources in the refinery and they are progressed to engineering.</li> <li>- Selected engineering option is progressed to execution</li> </ul>
Cost estimate A\$ million	- 4.25
Project Stage	<p><b>Study</b></p> <ul style="list-style-type: none"> <li>- Investigate sources of uncaptured organic emissions at the refinery and determine a new odour emission baseline.</li> </ul> <p><b>Engineering</b></p> <ul style="list-style-type: none"> <li>- Second thermal oxidiser</li> </ul>
Comments	QAL have progressed the installation of a 2 <sup>nd</sup> thermal oxidizer into engineering stage to provide odour destruction redundancy and to allow for further odour sources to be directed to the thermal oxidizer. The 2 <sup>nd</sup> thermal oxidizer is expected to have a larger capacity than the existing thermal oxidiser

**Implementation schedule**



Odour Emission to Community									
Task	2018	2019				2020			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Odour emissions identificaion and options analysis	Study	Study	Study	Study					
Second thermal oxidiser			Engineering	Engineering	Engineering	Engineering			
	Study	Engineering	Execution						



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**Odour Emissions to Community**

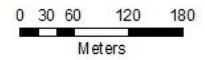
**Legend**

-  Alkali and Odour Emissions Reduction
-  Thermal Oxidiser

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Coordinate System: GDA 1994 MGA Zone 58

Scale at A3: 1:5,553



N ↑	Revision	A
	Date	21/10/2018
	Created By	Jonathan Dalton
	Approved By	Jonathan Dalton

Project (A4)	Coal Stockpile Dust Emissions
Risk class	- III/High
Environmental risks	- Fugitive dust emissions from working and strategic coal stockpiles have the potential to impact on the air quality of surrounding communities.
Project solution / options	- Investigate options for dust mitigation, including dust suppression and prevention measures on working and strategic coal stockpiles.
Objective / performance outcome	- Improved monitoring capability and reduction of potential for dust emissions
Performance Indicator	- Study phase identifies options to reduce emissions from coal dust sources in the refinery and they are progressed to engineering.
Cost estimate A\$ million	- 0.75
Project Stage	<b>Study</b> - Investigate dust reduction options for the coal stockpiles
Comments	

### Implementation Schedule

Coal Stockpile Dust Mitigation					
Task	2018	2019			
	Q4	Q1	Q2	Q3	Q4
Options study for dust mitigation					
	Study	Engineering	Execution		



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**Coal Stockpile  
Dust Emissions**

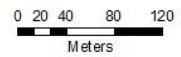
**Legend**

- Strategic Coal Stockpile
- Working Coal Stockpile

Drawn: © 2016 QAL, using Bentley Map 01110 01700 (1:1000) scale. This map is for informational purposes only. It is not intended to be used for any purpose other than that for which it was prepared. No liability is accepted for any loss or damage arising from its use.

Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:3,946



Revision: A  
Date: 21/10/2016  
Created By: Jonathan Dalton  
Reviewed By: Jonathan Dalton  
Approved By: Jonathan Dalton



Project (A5)	<b>Bauxite Transfer Dust Emissions</b>
Risk class	- III/High
Environmental risks	- Fugitive dust emissions from bauxite transfer system have the potential to impact on air quality in the surrounding community.
Project solution / options	- Investigate options for reduction of dust emissions from the bauxite transfer system.
Objective / performance outcome	- Reduced dust emissions from bauxite transfer systems
Performance Indicator	- Study phase identifies options to reduce emissions from bauxite dust sources in the refinery and South Trees Island and they are progressed to engineering.
Cost estimate A\$ million	- 0.7
Project Stage	<b>Study</b> - Identify dust sources and dust reduction options for the bauxite transfer system
Comments	- A measuring system is being installed on the bauxite conveyor to understand the amount of carry back on the underside of the conveyor.

#### Implementation Schedule


Bauxite Transfer Dust Reduction Study					
Task	2018	2019			
	Q4	Q1	Q2	Q3	Q4
Options study for dust mitigation					
	Study	Engineering	Execution		



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## Bauxite Transfer Dust Emissions

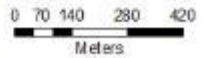
### Legend

 Bauxite conveyor and transfer points

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:12,500



N 	Revision:	1
	Date:	20/11/2018
	Created By:	Jonathan DeLore
	Approved By:	Jonathan DeLore

Project (A6)	Ash Dam Dust Emissions
Risk class	- III/High
Environmental risks	- Fugitive dust (ash) emission emissions have the potential to impact on air quality of surrounding communities.
Project solution / options	- Investigate options for reduction of dusting events from the ash through dust suppression and mitigation options
Objective / performance outcome	- Minimise dust generation from #4 Ash Dam
Performance Indicator	- Study phase identifies options to reduce emissions from the ash dam and they are progressed to engineering.
Cost estimate A\$ million	- 0.9
Project Stage	<b>Study</b> - Investigate dust reduction options for the ash dams
Comments	

### Implementation Schedule


Ash Dam Dust Emissions					
Task	2018	2019			
	Q4	Q1	Q2	Q3	Q4
Options study for dust mitigation on ash dam					
	Study	Engineering	Execution		



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**Ash Dam  
Dust Emissions**

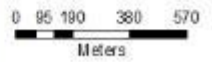
**Legend**

 Ash ponds

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This map is a summary of the information contained in the Environmental Management Plan (EMP) for the Ash Dam Dust Emissions. It is not intended to be used as a substitute for the EMP. The EMP is the primary source of information for the Ash Dam Dust Emissions. The map is a summary of the information contained in the EMP. It is not intended to be used as a substitute for the EMP. The EMP is the primary source of information for the Ash Dam Dust Emissions.

Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:16,763



	Review By:	J. J. J.
	Created By:	J. J. J.
	Checked By:	J. J. J.
	Approved By:	J. J. J.

## Water Management Improvement Projects

QAL's plan to improve water quality management over the next five years is supported by targets, actions and a program of works summarised below. Capital spend is estimated at between A\$90 million to A\$175 million.

Project (W1)	Raw Material Spill from Wharf
Risk class	- IV/Critical
Environmental risks	- Release of raw materials including caustic and bauxite to Gladstone harbour during unloading operations has the potential to impact on the water quality of Port Curtis.
Project solution / options	- Investigate options for reduction of spillage of raw materials (bauxite) from the wharf during unloading activities and mitigate the potential for release of caustic during unloading
Objective / performance outcome	- Reduce risk of release of raw material spills during unloading operations
Performance Indicator	- Study phase identifies current state for operations and identifies options to reduce spills and releases from raw material handling at the wharf at South Trees Island and they are progressed to engineering. Study phase
Cost estimate A\$ million	- 0.55
Project Stage	<b>Study</b> - Third party review of operating practices relating to all unloading aspects of raw materials
Comments	

### Implementation Schedule

Raw Material Spill from Wharf					
Task	2018		2019		
	Q4	Q1	Q2	Q3	Q4
3rd Party Review and Report					
<b>Study</b>					
<b>Engineering</b>					
<b>Execution</b>					



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## Raw Material Spill from Wharf

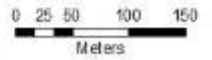
### Legend

 Wharf - Raw Material Spill

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Scale at A3: 1:4,442



	Revision:	1
	Date:	20/11/2018
	Created by:	Jonathan DeLor
	Approved by:	Jonathan DeLor

Project W2	Coal Stockpile Stormwater Runoff
Risk class	- III/High
Environmental risks	- Release of coal contaminated stormwater to receiving environment has the potential to impact on the water quality in Port Cutis.
Project solution / options	- Investigate options for reduction in total suspended solids load from the coal stockpiles into the east and west coal stilling ponds, which allows ponds to meet release limits - Investigate options to improve west coal stilling pond neutralisation capability
Objective / performance outcome	- Mitigate risk of coal contaminated stormwater leaving the coal stockpile catchment area
Performance Indicator	- Study phase identifies options to reduce coal fines runoff from coal stockpiles in the refinery and improve neutralisation capacity of the west coal stilling pond and they are progressed to engineering.
Cost estimate A\$ million	- 0.1
Project Stage	<b>Study</b> Phase 1 investigate: - Improvements to west coal stilling pond functionality Phase 2 investigate: - Improvement in neutralisation capacity in the west coal stilling pond - Investigate reduction of coal contaminated stormwater entering the west and east coal stilling pond
Comments	

**Implementation Schedule**

Coal Stockpile Stormwater Runoff									
Task	2018	2019				2020			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Phase 1 Study									
Phase 2 Study									





Study
Engineering
Execution



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## Coal Stockpile Runoff

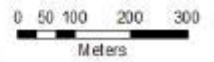
### Legend

-  East Coal Stilling Pond
-  West Coal Stilling Pond
-  Strategic Coal Stockpile
-  Working Coal Stockpile

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:8,884



	Revised By:	J. DELANEY
	Created By:	JONATHAN DELANEY
	Checked By:	JONATHAN DELANEY
	Approved By:	JONATHAN DELANEY



Project (W3)	Waste line 4 Integrity
Risk class	- IV/Critical
Environmental risks	- Failure of Waste Line 4 into marine or terrestrial environments will result in release of partially neutralised red mud with a potential to contaminate land or water and impact on the water quality in South Trees Inlet and Port Curtis.
Project solution / options	- Investigate options for replacement of waste line 4 capacity that includes options that further reduces the risk of a pipeline failure. - Ensure integrity of pipeline supports
Objective / performance outcome	- No loss of containment incidents
Performance Indicator	- Engineering option is progressed to execution.
Cost estimate A\$ million	- 10.5
Project Stage	<b>Engineering</b>
Comments	Engineering phase includes time to finalise state and federal approvals for works to be conducted over South Trees Inlet.

**Implementation Schedule**

Waste Line 4 Capacity									
Task	2018	2019				2020			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Waste line 4 capacity replacement									
<b>Study</b>									
<b>Engineering</b>									
<b>Execution</b>									



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**Waste Line 4**

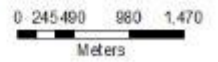
**Legend**

 Waste Line 4

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Scale at A3: 1:44,421



	Revised By:	J. DELANEY
	Created By:	JONATHAN DELANEY
	Checked By:	JONATHAN DELANEY
	Approved By:	JONATHAN DELANEY

Project (W4)	East & West Contaminants Ponds
Risk class	- III/High
Environmental risks	- The East and West contaminants ponds capture contaminated stormwater runoff for recycling into the process. Insufficient capacity has the potential to impact the capability of the contaminated stormwater treatment system prior to release and has a potential to impact on the water quality in Port Curtis. A further potential impact exists for groundwater from the unlined east contaminants pond.
Project solution / options	<ul style="list-style-type: none"> <li>- Investigate options to ensure that all core refinery process areas are directed to a contaminants pond,</li> <li>- Options for lining and expanding the east contaminants pond, and</li> <li>- Investigate options to increase the pump and pipe capacity from the ponds to the process.</li> </ul>
Objective / performance outcome	- Ensure containment ponds prevent land and groundwater contamination and mitigates the risk of stormwater contamination
Performance Indicator	- Study phase identifies options to prevent land and groundwater contamination from contaminants ponds and they are progressed to engineering.
Cost estimate A\$ million	- 8.5
Project Stage	<b>Not started</b>
Comments	

**Implementation Schedule**

East and West Contaminants Ponds									
Task	2018	2019				2020			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Identify options for upgrade of contaminants ponds									
	Study	Engineering	Execution						



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**Contaminants  
Ponds**

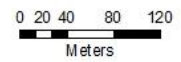
**Legend**

-  East Pond
-  West Pond

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Coordinate System: GDA 1994 MGA Zone 58

Scale at A3 1:4,274



	Revision	A
	Date	21/10/2018
	Created By	Jonathan Dalton
	Approved By	Jonathan Dalton

Project (W5)	Refinery Water Release Management
Risk class	- III/High
Environmental risks	- Releases from the sweetening bauxite pond and the west gate wetland have the potential to impact on water quality in Port Cutis.
Project solution / options	- Investigate options to improve monitoring at the sweetening bauxite pond and the wetland release - Identify options to upgrade mill sump water system to minimise release to the stormwater system
Objective / performance outcome	- Ensure pH, suspended solids and other release water quality parameters are maintained within limits and no uncontrolled release to receiving environment
Performance Indicator	- Study phase identifies options to improve water quality at the west gate wetland, mill 10 area and sweetening bauxite pond and they are progressed to engineering. - 85% availability of online instruments at the sweetening bauxite pond and wetland release point
Cost estimate A\$ million	- 3.75
Project Stage	<p><b>Study – Phase 2</b></p> <ul style="list-style-type: none"> <li>- Investigate reduction of refinery runoff to west gate wetland and improved pond functionality</li> <li>- Investigate improvement to Mill 10 sump management to reduce overflow to the neutralising pond</li> <li>- Investigate options to reduce solids to the Sweetening bauxite pond</li> </ul> <p><b>Execution – Phase 1</b></p> <ul style="list-style-type: none"> <li>- Wetland Release: <ul style="list-style-type: none"> <li>• Install v-notch weir and flow meter,</li> <li>• Install continuous water quality monitoring.</li> </ul> </li> <li>- Sweetening Bauxite Pond <ul style="list-style-type: none"> <li>• Install continuous water quality monitoring, and</li> <li>• Install a level sensor.</li> </ul> </li> </ul>
Comments	

**Implementation Schedule**




Refinery water release improvement									
Task	2018	2019			2020				
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Phase 2 Study									
Install V notch weir and continuous monitoring at Westgate Release Point									
Install continuous monitoring at sweetening bauxite pond Release Point									

Study    Engineering    Execution



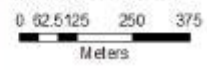
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**Refinery  
Stormwater  
Legend**

-  Mill 10 Area
-  Sweetener Pond
-  West Gate Release

Details of this plan shall be subject to the conditions of the relevant licence and permit. This plan is for information only and does not constitute a contract. The user of this plan shall be deemed to have accepted the conditions of the relevant licence and permit. The user of this plan shall be deemed to have accepted the conditions of the relevant licence and permit.

Coordinate System: GDA 1984 UTM Zone 58  
Scale at A3: 1:11,105



Revision	1	01/11/2018
Created By	Jonathan Dallas	
Checked By		
Approved By	Jonathan Dallas	

Project (W6)	RDA Surface/Ground water Impacts
Risk class	- IV/Critical
Environmental risks	- Impacts to surface and groundwater from the RDA that have the potential to impact on the water quality in South Trees Inlet and Port Curtis and terrestrial ecosystems surrounding the RDA.
Project solution / options	- Identify the sources, pathways and receptors of potential RDA surface and groundwater impacts and options for any required mitigation.
Objective / performance outcome	- Prevent impact of contaminants from RDA on groundwater - Mitigate the impact of the RDA on adjacent surface water systems and ensure relevant environmental values are protected
Performance Indicator	- Vegetation in Black Breasted Button Quail (BBBQ) habitat do not show any signs of degradation and rehabilitated areas (to be completed) show no sign of impact after cut off wall is installed and soil in impacted areas is flushed. - A robust monitoring program is in place for the early detection of impact to vegetation, groundwater and marine communities. - Study phase (Environmental Evaluation) identifies options to address any areas of concern and these options are progressed to engineering. - Engineering options are progressed to execution
Cost estimate A\$ million	- 40

Project Stage	<p><b>Study</b></p> <ul style="list-style-type: none"> <li>- The outcome of stage 2 (EE report) will identify priority areas for engineering for ground/surface water around the red mud dams.</li> </ul> <p><b>Engineering</b></p> <ul style="list-style-type: none"> <li>- The historic (northern end) red mud dam has been identified as a priority and has been progressed into engineering.             <ul style="list-style-type: none"> <li>• A cut-off wall/trench has been identified as a suitable option for this area.</li> </ul> </li> </ul> <p><b>Execution</b></p> <ul style="list-style-type: none"> <li>- EE Stage 1 – install cut-off wall to mitigate impact on BBBQ bird habitat;             <ul style="list-style-type: none"> <li>• The bentonite/cement slurry wall installation is completed.</li> <li>• Execution works, including pumps and surface water drainage to be completed by the end of Q3 2019.</li> </ul> </li> </ul>
Comments	<ul style="list-style-type: none"> <li>- Groundwater removal on the dam side of the cut-off wall has resulted in sustained lower water levels and there has been no matching decrease in groundwater level within the BBBQ habitat, strongly indicating that the cut-off wall is functioning as designed.</li> </ul>

**Implementation Schedule**

RDA Surface/Groundwater Impacts									
Task	2018	2019				2020			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Complete environmental evaluation	Study	Study	Study	Study	Study	Study	Study		
EE Stage 1 - Install cut-off wall to mitigate impact on BBBQ habitat and recovery pumps	Engineering	Engineering	Engineering	Engineering					
EE Stage 2 - Install cut-off wall/trench around historical RDA			Execution	Execution	Execution				

Study
Engineering
Execution





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**RDA  
Groundwater  
Impacts**

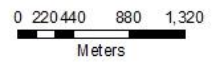
**Legend**

-  EE Stage 1
-  EE Stage 2

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Coordinate System: GDA 1994 MGA Zone 58

Scale at A3: 1:39,597



	Revision	A
	Date	21/10/2018
	Created By	Jonathan Dalton
	Approved By	Jonathan Dalton

Project (W7)	RDA Release to Receiving Environment
Risk class	- IV/Critical
Environmental risks	- The chemistry of the red mud dam discharge into South trees Inlet has been changing over the past 5 to 10 years. This, together with the siltation of South Trees Inlet and decrease in water flow, has resulted in low dissolved oxygen between the discharge site and confluence of the Boyne River and has the potential to impact on the water quality in South Trees Inlet and the Boyne River.
Project solution / options	- Identify the cause of the change in water quality and investigate mitigation options, including improvements to release water quality, alternative release point locations or improving flow in South Trees Inlet.
Objective / performance outcome	- Ensure the environmental values of South Trees Inlet are protected in the long term
Performance Indicators	- Study phase identifies options to reduce the impact of the RDA discharge and options are progressed to engineering.
Cost estimate A\$ million	- 68.0
Project Stage	<b>Study</b> <ul style="list-style-type: none"> <li>- A pilot treatment plant is being designed and installed to provide on the ground data to assist with the design of mitigation options.</li> <li>- Modeling of release flows is being performed.</li> </ul>
Comments	

**Implementation Schedule**


RDA Alternative Discharge Location									
Task	2018	2019				2020			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Identify options for relocation of the RDA discharge location									
<b>Study</b> <b>Engineering</b> <b>Execution</b>									



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**RDA Discharge**

**Legend**

-  Licenced Discharge Point

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:44,421

0 245 490 980 1,470

Meters



Reviewed By:	J. J. J.
Checked By:	J. J. J.
Approved By:	J. J. J.

Project (W8)	High Risk Pipelines
Risk class	- IV/Critical
Environmental risks	- Caustic release to the environment as a result of failure of pipeline from the storage area (island) to refinery (mainland) across causeway with potential to impact on the water quality in Port Curtis.
Project solution / options	- Investigate options to upgrade high risk pipelines (caustic and contaminated water) to reduce the risk of a pipeline failure
Objective / performance outcome	- Reduce the risk of off-site contamination
Performance Indicator	- Engineering options are progressed to execution.
Cost estimate A\$ million	- 10.5
Project Stage	<b>Engineering</b>
Comments	

### Implementation Schedule


High Risk Pipelines									
Task	2018	2019				2020			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Investigate options for replacement of high risk pipelines									
	<b>Study</b>	<b>Engineering</b>	<b>Execution</b>						



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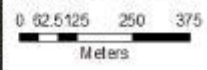
**High Risk Pipelines**

**Legend**

 High Risk Pipelines

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Coordinate System: GDA 1984 UTM Zone 58  
 Scale at A3: 1:11,096



	Revision:	1
	Date:	20/11/2018
	Created By:	Jonathan Dallas
	Approved By:	Jonathan Dallas

## Land management improvement projects

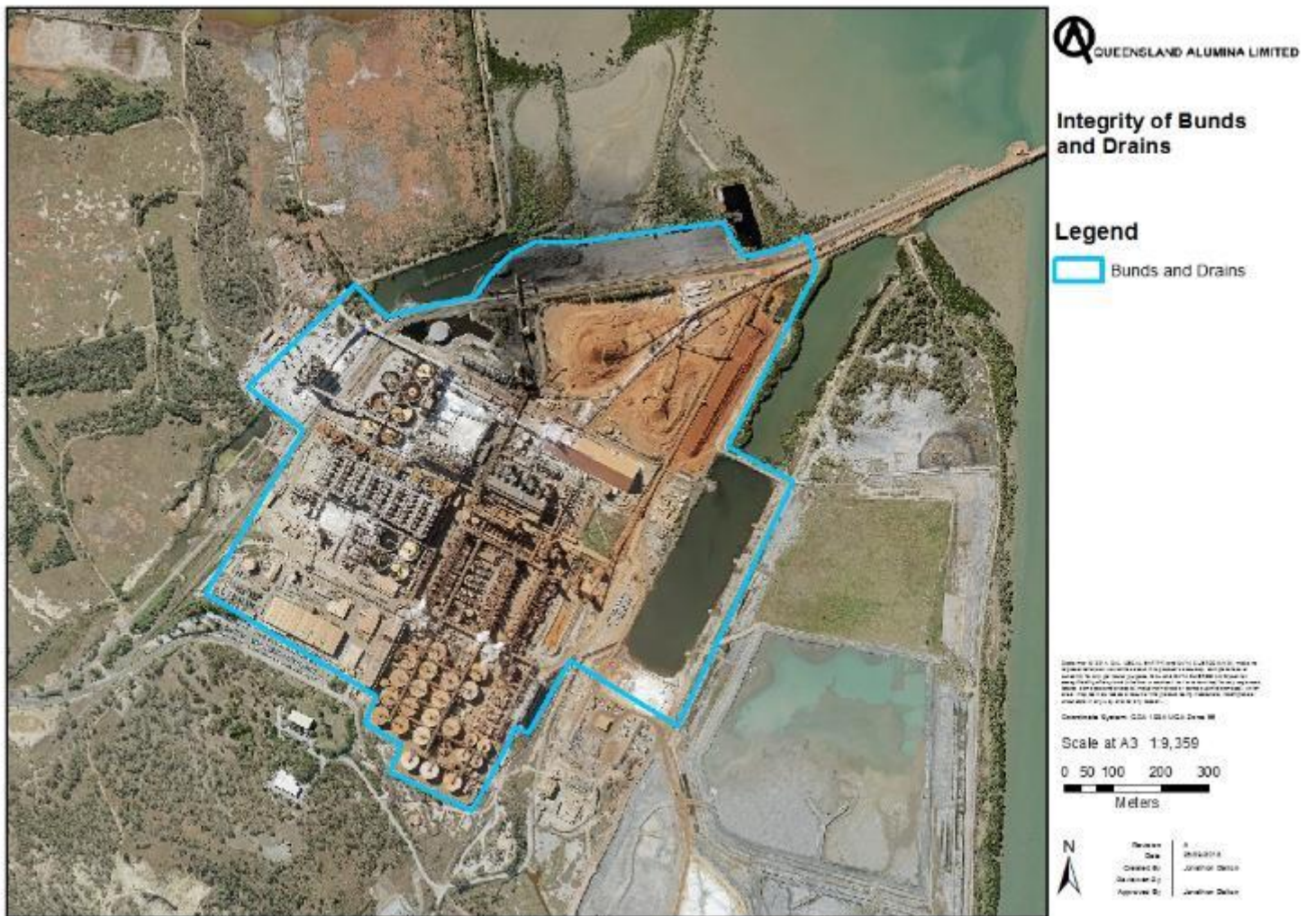
QAL's five-year land stewardship programme, supported by targets, actions and a programme of works is summarised below. Capital spend is estimated at between A\$20 million to A\$35 million.

<b>Project (L1)</b>	<b>Integrity of Bunds and Drains</b>
Risk class	- IV/Critical
Environmental risks	- Seepage from bunded refinery areas has the potential to contaminate groundwater.
Project solution / options	- Bunded refinery area and drainage integrity rectification.
Objective / performance outcome	- Restore the integrity of refinery area bunds and drains
Performance Indicator	- All areas identified for remediation are repaired
Cost estimate A\$ million	- 7.5
Project Stage	<p>Engineering</p> <ul style="list-style-type: none"> <li>- Complete engineering design for bunds and drains that were identified during the study phase requiring repairs. <ul style="list-style-type: none"> <li>• Complete engineering design on high risk (Class IV) bunds and drains</li> <li>• Complete engineering design on lower risk (Class I, II and III) bunds and drains.</li> </ul> </li> </ul> <p>Execution</p> <ul style="list-style-type: none"> <li>- High risk bunds and drains will be prioritised for repair works and will move from engineering into execution once a construction package has been prepared.</li> <li>- High risk bunds and drains in execution: <ul style="list-style-type: none"> <li>• HID 3/4</li> <li>• Above ground section of 7<sup>th</sup> Street drain</li> </ul> </li> </ul> <p>Completed</p> <ul style="list-style-type: none"> <li>- Inspection of bunds and drains has been completed</li> </ul>
Comments	- The Bund and drain inspection program has identified high, medium and low risk bunds and drains requiring remediation.

### Implementation Schedule

Task	Integrity of bunds and Drains																	
	2018		2019				2020				2021				2022			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Complete design on remaining high risk (class IV)	■	■	■	■	■	■	■	■	■									
Complete design package for Class I, II and III						■	■	■	■	■	■	■	■	■	■	■	■	
HID 3/4 bund repair	■	■	■	■														
Above Ground Section of Seventh Street Drain repair	■	■	■	■														

Study
Engineering
Execution



Project (L2)	Ground Water Impact to South Trees Island Tank Farm
Risk class	- III/High
Environmental risks	- Caustic impact to ground water and potential to migrate to receiving environment (DES EPO STAT 1249 related) and has the potential to impact on groundwater quality.
Project solution / options	- Maintain and monitor current extraction program beneath bund 4, South Trees Island - Review integrity of existing groundwater monitoring wells reinstate/upgrade as necessary and recommence monitoring program
Objective / performance outcome	- Historic ground water impact to South Trees Island does not migrate and is reduced over time
Performance Indicator	- No increase in pH in groundwater bores outside of bund with extraction system operational
Cost estimate A\$ million	- 1.0
Project Stage	<b>Execution</b>
Comments	- Groundwater pumping has commenced.

**Implementation Schedule**

South Trees Inlet Groundwater Remediation					
Task	2018	2019			
	Q4	Q1	Q2	Q3	Q4
Groundwater Extraction system installation					
	Study	Engineering	Execution		






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**Groundwater Impacts at South Trees Island Tank Farm**

**Legend**

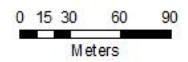
 Bund 2

 Bund 4

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Coordinate System: GDA 1994 MGA Zone 58

Scale at A3 1:2,981



N 	Revision	A
	Date	21/10/2018
	Created By	Jonathan Dalton
	Approved By	Jonathan Dalton

Project (L3)	Mineral Waste Disposal Facility – Stage 2
Risk class	- III/High
Environmental risks	- Potential for land contamination from landfilled mineral wastes and potential for impact on water quality in South Trees Inlet; secondary potential impact to effectiveness of current recycling program
Project solution / options	- Investigate the options for location of another mineral waste disposal facility - Investigate options to ensure design improves land contamination controls
Objective / performance outcome	- Identify the most suitable option for expanding the mineral waste disposal facility that meets the design requirements to mitigate land contamination and includes capping design for the entire mineral waste disposal facility
Performance Indicator	- Engineering option is progressed to execution.
Cost estimate A\$ million	- 2.25
Project Stage	<b>Engineering</b>
Comments	- Options investigated in study phase included siting and interface with the existing facility

**Implementation Schedule**


Mineral Waste Disposal Facility					
Task	2018	2019			
	Q4	Q1	Q2	Q3	Q4
Develop design for stage 2 of the mineral waste disposal facility					
	Study	Engineering	Execution		



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**Mineral Waste Facility - Stage 2**

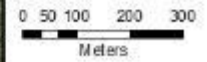
**Legend**

 Mineral Waste Facility

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3: 1:9,359



N 	Revision:	1
	Date:	20/11/2018
	Created By:	Jonathan DeLore
	Approved By:	Jonathan DeLore

Project (L4)	Sewerage System Upgrade
Risk class	- III/High
Environmental risks	<ul style="list-style-type: none"> <li>- Potential for land contamination from sewerage system installed during initial and subsequent plant construction phases and potential to contaminate groundwater.</li> <li>- Introduction of inadequately treated effluent to the RDA</li> </ul>
Project solution / options	<ul style="list-style-type: none"> <li>- Investigate the condition of the sewerage system to identify issues and assess options to rectify identified issues</li> <li>- Review the current operation of the sewage treatment system and look at requirement for upgrade</li> </ul>
Objective / performance outcome	- Reduce the risk of the release of sewage to land
Performance Indicator	- Study phase identifies current state of sewerage system integrity and identifies options to improve sewage treatment plant and prevent sewage leaks in the refinery and they are progressed to engineering.
Cost estimate A\$ million	- 1.1
Project Stage	<b>Study</b>
Comments	

#### Implementation Schedule


Sewerage System									
Task	2018	2019				2020			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Investigate the current state of the sewerage system at the refinery									
	Study	Engineering	Execution						



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**Sewerage System Review**

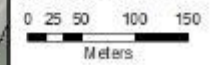
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 Sewage Treatment Plant

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3: 1:4,600



	Reviewed By:	J. DELANEY
	Created By:	JONATHAN DELANEY
	Checked By:	JONATHAN DELANEY
	Approved By:	JONATHAN DELANEY

Project (L6)	Closure Pilot - RDA rehabilitation
Risk class	- II/medium
Environmental risks	- Implementation of a long term effective cover system for closure at the RDA
Project solution / options	- Undertake research of cover systems for closure of the RDA.
Objective / performance outcome	- Determine if a long term cover system can be sustained at the RDA.
Performance Indicator	- Study phase identifies options for long term remediation of the red mud dams. - Trial plot at RDA sustains vegetation to show proof of concept for the project.
Cost estimate A\$ million	- 1.75
Project Stage	<b>Study</b>
Comments	- A Pilot rehabilitation trial is being established at the Residue Disposal Area.

**Implementation Schedule**


RDA Closure Rehabilitation					
Task	2018	2019			
	Q4	Q1	Q2	Q3	Q4
Investigate closure cover options for the RDA					
<b>Study</b> <b>Engineering</b> <b>Execution</b>					



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**RDA Rehabilitation - Pilot Study**

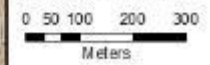
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 Rehabilitation Trial Area

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:9,359



	Revised By:	J. DELANEY
	Created By:	JONATHAN DELANEY
	Checked By:	JONATHAN DELANEY
	Approved By:	JONATHAN DELANEY

Project (L7)	Oil/water facility resizing
Risk class	- II/Medium
Environmental risks	- Land contamination from oily wastes with the potential to impact groundwaters and the water quality in South Trees Inlet.
Project solution / options	- Install an oil/water separator at the waste transfer facility
Objective / performance outcome	- To improve management of oily wastes.
Performance Indicator	- Engineering package for oily water separate finalised and handed over to execution team.
Cost estimate A\$ million	- 0.45
Project Stage	<b>Execution</b> - All oil/water separator and storage facility has been designed and has been moved into execution
Comments	- This facility will provide a permanent location for the storage of oil waste prior to transport off-site to a recycling facility.

#### Implementation Schedule

Oil/water Separation Facility					
Task	2018	2019			
	Q4	Q1	Q2	Q3	Q4
Complete design for upgrade to oil/water separator at waste transfer station					
	Study	Engineering	Execution		






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**Proposed Oil Water Facility**

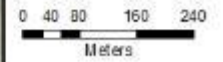
**Legend**

 Oil water facility

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:7,019



N ↑	Revision:	1
	Date:	20/11/2018
	Created By:	Jonathan DeLore
	Approved By:	Jonathan DeLore

Project (L8)	Strategy for Caustic Storage
Risk class	- III/High
Environmental risks	- Current South Trees Island storage location has risks (substrate) for location of a tank farm and a risk of groundwater contamination.
Project solution / options	- Investigate options for a long term caustic storage tank farm.
Objective / performance outcome	- Confirm current locations suitability for the tank farm or; - Identify suitable alternate locations for the caustic storage tank farm
Performance Indicator	- Study phase identifies long term viability of caustic storage tanks at South Trees Island and any recommendations are progressed to engineering as required and/or maintenance and operational recommendations are adopted.
Cost estimate A\$ million	- 10.0
Project Stage	<b>Study</b>
Comments	

**Implementation Schedule**

Caustic Storage Strategy					
Task	2018	2019			
	Q4	Q1	Q2	Q3	Q4
Investigate suitability of South Trees Island for long term caustic storage					
	Study	Engineering	Execution		




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**Groundwater Impacts at South Trees Island Tank Farm**

**Legend**

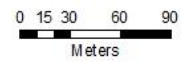
 Bund 2

 Bund 4

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Coordinate System: GDA 1984 MGA Zone 58

Scale at A3 1:2,981



	Revision	A
	Date	21/10/2018
	Created By	Jonathan Dalton
	Approved By	Jonathan Dalton

## Other Environmental Improvement Projects

In addition to projects that address the specific environmental parameters of air, water and land, projects that address other aspects of the operation have also been identified below.

<b>Project (O1)</b>	<b>Noise Emissions</b>
Risk class	- III/High
Environmental risks	- Community noise impact from operational and maintenance works
Project solution / options	<ul style="list-style-type: none"> <li>- Review current noise impact management including: <ul style="list-style-type: none"> <li>• Efficacy of implemented controls on hydro-blasting</li> <li>• Adequacy of noise monitoring program;</li> <li>• Noise source assessment;</li> <li>• Plant and equipment noise mitigation options; and</li> <li>• Operational improvements (e.g. timing of noisy work practices)</li> </ul> </li> </ul>
Objective / performance outcome	- Reduce QAL noise footprint
Performance Indicator	<ul style="list-style-type: none"> <li>- Study phase – <ul style="list-style-type: none"> <li>• Verifies high risk noise sources are adequately managed.</li> </ul> </li> </ul>
Cost estimate A\$ million	- 0.4
Project Stage	<p><b>Study</b></p> <ul style="list-style-type: none"> <li>• Study phase to commence at the beginning of 2020</li> </ul> <p><b>Completed Projects</b></p> <ul style="list-style-type: none"> <li>• Emergency diesel generator building noise reduction paneling has been installed.</li> </ul>
Comments	

### Implementation Schedule

Noise Emissions									
Task	2018	2019				2020			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Review current noise impact management									
<b>Study</b>									
<b>Engineering</b>									
<b>Execution</b>									