

5 Year Environmental Implementation Plan

2019 – 2023
Version 4.0
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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:

Study Phase

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 Name											
	2019				2020				2021			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project 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"> - 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. - 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. - Cultural change will be incorporated into the operations systems including: <ul style="list-style-type: none"> • Functional workplace program • Annual environmental training for all employees • Daily HSE meetings (environment in work preparation) • Quarterly business updates, led by site senior executives • Bi-annual engagement survey • Purple banner reporting which includes the introduction of reporting category focused exclusively on environmental incidents
Objective / performance outcome	<ul style="list-style-type: none"> - Greater awareness of environmental risk and employee's role in controlling these risks. - Improved culture relating to process safety and environmental risk management throughout the entire organisation through the implementation of a PSMS.
Performance Indicator	<ul style="list-style-type: none"> - Completion of all major hazard workshops during the engineering phase. - 90% of major hazard critical control health completed within the first 12 months after the PSMS is implemented across site (end of 2020). - Greater than 95% of employees completing annual environmental awareness training.
Cost estimate A\$ million	- \$1 annually
Project Stage	Engineering

Comments	<ul style="list-style-type: none"> - Completed PSM major hazards are subject to ongoing auditing and review, <ul style="list-style-type: none"> • CCMP process (deep dive by GM on Critical Controls) ongoing on completed major hazards. • Monthly managers review process implemented and chaired by General Manager. - 20 PSM major hazard workshops have been completed. <ul style="list-style-type: none"> • 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. - Last quarterly business update completed in August. - Functional workplace program implementation in Raw Materials; Boilerhouse, Clarification and Digestion, rollout is ongoing. - Annual environmental training updated and implemented in January <ul style="list-style-type: none"> • >95% of employees have completed Environmental Web Based Training. - ERM organisation psychologist team has been engaged by QAL to support the organisational cultural change process. <ul style="list-style-type: none"> • The first pulse survey commenced in June 2019, • 200 face to face interviews and focus groups with employees were held in July 2019. • ERM will return in October to develop actions based on the findings of the survey and interviews.
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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)	Alkali Release Off-Site
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	- 26.0

Project Stage	<p>Study</p> <ul style="list-style-type: none"> - Install second oxalate tank, <ul style="list-style-type: none"> • Further modelling and trials are required to improve separation of alkali in the tank. - Digestion relief tank, <ul style="list-style-type: none"> • Undertake a study to determine if an additional tank is required or modification to the existing tanks will stop alkali releases from the relief system under <p>Engineering</p> <ul style="list-style-type: none"> - Install an upgraded temperature control valve on the holding tanks contact heater steam supply line to manage steam supply to the contact heater, including stopping steam flow during upset conditions that may cause alkali emissions. <p>Execution</p> <ul style="list-style-type: none"> - Upgrade and install shrouds on expansion joints; <ul style="list-style-type: none"> • Upgrade of expansion joints has been completed and shrouding replacement is to be finalised in August 2019 shutdown. - Bottom fill precipitators – reduce turbulence in the top of the tanks during filling to stop alkali misting. - Install an upgraded temperature control valve on the holding tanks contact heater steam supply line to manage steam supply to the contact heater, including stopping steam flow during upset conditions that may cause alkali emissions. - HP blowdown line redirection – redirect blowdown lines to reduce steam and alkali at the entrainment separators, - Remote stop for precip cooling towers – precip cooling tower fans to be stopped by the control room if conductivity of cooling water increases (conductivity increases are likely due to caustic liquor ingress) <p>Projects completed</p> <ul style="list-style-type: none"> - 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. - New oxalate vent tank has been installed and commissioned. - Upgrade and install shrouds on expansion joints; - Flash tank relief header shroud installation; - Digestion heater vent diversion - Flash tank relief header shroud installation
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Comments	<ul style="list-style-type: none"> - Upgrade and install shrouds on expansion joints <ul style="list-style-type: none"> • All expansion joints have been replaced and final installation of shrouds will occur during the August shutdown. - New projects from PSM workshops and stage 2 alkali workshops have been included in the alkali reduction projects schedule, further projects are being reviewed and may include: <ul style="list-style-type: none"> • Precip elevated pipelines in whiteside, • Press floor mist reduction, • Export steam systems in digestion, • Digestion spent liquor injection pumps and pipes, and • Digestion slurry pipework
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Implementation Schedule


Alkali Release Off-Site												
Task	2019				2020				2021			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Stage 2 Alkali Emissions Study	Study	Study	Study									
Bottom Fill Precipitators project	Study	Engineering	Engineering	Execution	Execution	Execution	Execution	Execution				
Upgrade and install shrouds on expansion joints	Execution	Execution	Execution	Execution								
Install 2nd oxalate tank				Study	Study	Study	Study					
TCV and Steam shut off valve on holding tanks heater				Engineering								
HP blowdown line redirection				Execution	Execution	Execution	Execution	Execution	Execution			
Remote stop for precip cooling tower fans				Execution	Execution	Execution						
Digestion relief system upgrade				Study	Study	Study	Study	Study				



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Alkali Release Off-Site

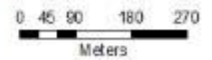
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 Alkali and
Odour
Emissions
Reduction

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:8,119



N 	Review By:	J. J. J. J.
	Created By:	Jonathan Deane
	Approved By:	Jonathan Deane
	Approved By:	Jonathan Deane

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	- 23.0
Project Stage	Study <ul style="list-style-type: none"> • 2019 <ul style="list-style-type: none"> ▪ Alumina loadout, • 2020 <ul style="list-style-type: none"> ▪ Island and Mainland A-frames ▪ Hydrate and alumina transfer system Execution <ul style="list-style-type: none"> • Improvements and upgrades to dust collectors at BSL transfer points • One BSL belt conveyor to be replaced with air slide conveyor,
Comments	- The alumina loadout dust reduction project has been identified as a priority and will be a study focus, moving into engineering in 2020. - The A frame storage's and conveyor systems study will commence in 2020.

Implementation Schedule






Alumina Dust Emissions Reduction												
Task	2019				2020				2021			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Alumina Loadout			■	■	■	■						
A-frames, alumina and hydrate transfer systems							■	■	■	■		
BSL alumina transfer upgrade	■	■	■	■								
Study	■											
Engineering		■										
Execution												



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Alumina Dust Emissions

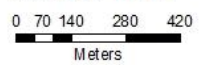
Legend

-  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



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

Project (A3)	Odour Emission to Community
Risk class	- III/High
Environmental risks	- Odour releases with potential for impact on air quality of surrounding communities.
Project solution / options	- Conduct an odour study including comparative analysis with previous 2006 study to determine an odour baseline - Capture current uncaptured organic emission sources, and - Address redundancy concerns with current treatment system
Objective / performance outcome	- Minimise QAL odour profile within the community
Performance Indicator	- Odour baseline is established when refinery is operating on Amrun bauxite. - Study phase identifies options to reduce emissions from odour sources in the refinery and they are progressed to engineering. - Selected engineering option is progressed to execution
Cost estimate A\$ million	- 39.5
Project Stage	<p>Study</p> <ul style="list-style-type: none"> - Source sampling program within the refinery to provide up to date results that reflect the current operating circumstances, including Amrun bauxite. <ul style="list-style-type: none"> • The baseline sampling program is almost complete and results will be included into updated modelling. - Trials <ul style="list-style-type: none"> • Undertake trials on effectiveness of implementing current destruction technology, i.e. condense and destroy odour vapour streams, and • Trials utilizing non thermal plasma have been run on the bad wash water tank, the blow off tank and a holding tank. <ul style="list-style-type: none"> ▪ Odour destruction has been greater than 90% and up to 95% on the bad wash water tank, with results on the blow off tank and holding tank emissions at 70% to 75%. <p>Engineering</p> <ul style="list-style-type: none"> - The project to install the second, larger capacity thermal oxidizer has progressed into execution. - The evaporation heat vent condensate collection improvement project has been moved into engineering 3 months early.

Comments	<ul style="list-style-type: none"> - QAL are progressing individual trials: <ul style="list-style-type: none"> • QAL will trial condensing digestion unit 2 blow off tank vapour with seawater using the wash water heater. While condensing odourous vapour streams is known technology, QAL must monitor the impact of the hot seawater entering the waste tanks. • Alternate technology will be progressively trialed after an initial review of suitability for use in the refinery: <ul style="list-style-type: none"> ▪ Non thermal plasma technology has been trialed at QAL and options to proceed with the NTP technology are being assessed. ▪ Other technology, such as catalyst destruction is being reviewed.
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Implementation schedule



Odour Emission to Community												
Task	2019				2020				2021			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Odour source sampling and modelling	Study	Study	Study	Study								
Blow off Tank vapour wash water heater condensing trial			Study	Study	Study	Study						
Alternate odour treatment technology trial - Non thermal plasma		Study	Study	Study	Study							
Evap heater vent condensate collection	Study	Study	Study	Engineering	Engineering	Engineering						
Second thermal oxidiser		Engineering	Engineering	Execution	Execution	Execution	Execution	Execution	Execution			



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Odour Emissions to Community

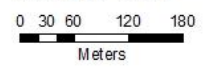
Legend

-  Alkali and Odour Emissions Reduction
-  Thermal Oxidiser

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Scale at A3: 1:5,553



	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	- Selected engineering option is progressed to execution.
Cost estimate A\$ million	- 1.0
Project Stage	Engineering - Install upgraded sprinkler system on the working coal stockpile
Comments	- The strategic coal stockpile has been treated with a chemical sealant. - Upgraded water sprays have been chosen for dust mitigation at the working coal stockpile and dry fogging on the loadout hopper.

Implementation Schedule



Coal Stockpile Dust Mitigation								
Task	2019				2020			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Install upgraded spinkler system	■	■	■	■	■	■	■	■
Study	■							
Engineering		■	■	■				
Execution			■	■				



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**Coal Stockpile
Dust Emissions**

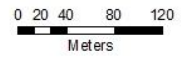
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-  Strategic Coal Stockpile
-  Working Coal Stockpile

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Scale at A3 1:3,946



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

Project (A5)	Bauxite Transfer Dust Emissions
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	- Engineering options are progressed into execution.
Cost estimate A\$ million	- 0.8
Project Stage	Engineering - Option selected - install a belt washer station and improved scrappers
Comments	- Results from a measuring system installed on the bauxite conveyor has identified carry back as a significant dust source. - Options to install a belt washer station and improved scrappers has been selected to move into engineering.

Implementation Schedule

Bauxite Transfer Dust Reduction Study								
Task	2019				2020			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Install belt wash station and upgrade scrappers	■	■	■	■	■	■	■	■
	Study	Engineering	Execution					



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Bauxite Transfer Dust Emissions

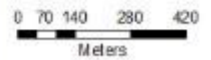
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Bauxite conveyor and transfer points

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Scale at A3 1:12,500



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

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	- 4.5
Project Stage	Study - Investigate dust reduction options for the ash dams
Comments	

Implementation Schedule

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



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**Ash Dam
Dust Emissions**

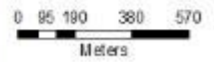
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 Ash ponds

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Scale at A3 1:16,763



	Reviewed By:	J. J. J. J.
	Created By:	J. J. J. J.
	Checked By:	J. J. J. J.
	Approved By:	J. 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	- Engineering options are progressed into execution.
Cost estimate A\$ million	- 0.75
Project Stage	<p>Study</p> <ul style="list-style-type: none"> - Third party review of operating practices relating to all unloading aspects of raw materials is being completed. - As other projects move into engineering they will be added to the schedule. <p>Engineering</p> <ul style="list-style-type: none"> - Gaps within the wharf bunds provide pathways for materials to be released into the water. - This sub-project to fill in these gaps has been moved into engineering
Comments	

Implementation Schedule

Raw Material Spill from Wharf								
Task	2019				2020			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Fill in opennigs on wharf								
Study								
Engineering								
Execution								



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Raw Material Spill from Wharf

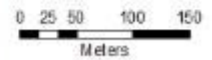
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 Wharf - Raw Material Spill

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3: 1:4,442



	Revision:	1
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	Approved by:	Jonathan Deane

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	- 2.2
Project Stage	<p>Study</p> <p>Phase 2 investigate:</p> <ul style="list-style-type: none"> - Improvement in neutralisation capacity in the west coal stilling pond - Investigate reduction of coal contaminated stormwater entering the west and east coal stilling pond <p>Engineering</p> <ul style="list-style-type: none"> - Options to improve the functionality of the west coal stilling pond have been progressed into engineering, including: <ul style="list-style-type: none"> • Works to stop seepage around the weir, • Re-establish the functionality of the dividing wall for sediment control and contaminated water segregation.
Comments	

Implementation Schedule

Coal Stockpile Stormwater Runoff								
Task	2019				2020			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Phase 2 Study	■	■	■	■	■	■	■	■
Improve west coal stilling pond functionality				■	■	■	■	

■ Study
■ Engineering
■ Execution



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Coal Stockpile Runoff

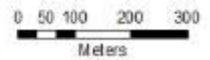
Legend

-  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



	Reviewed By:	J. DELANEY
	Created By:	JANET DELANEY
	Checked By:	JANET DELANEY
	Approved By:	JANET 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	- 50.95
Project Stage	Engineering
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									
Study									



 QUEENSLAND ALUMINA LIMITED

Waste Line 4

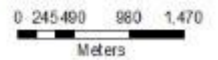
Legend

 Waste Line 4

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3: 1:44,421



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

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	- Investigate options to ensure that all core refinery process areas are directed to a contaminants pond, - Options for lining and expanding the east contaminants pond, and - Investigate options to increase the pump and pipe capacity from the ponds to the process.
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	- 11.2
Project Stage	Study - Identify options for east contaminants pond, i.e. relocation, upgrade at existing location.
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									



 **QUEENSLAND ALUMINA LIMITED**

**Contaminants
Ponds**

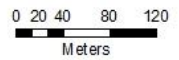
Legend

-  East Pond
-  West Pond

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Coordinate System: GDA 1994 MGA Zone 58

Scale at A3 1:4,274



N 	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	- 5.2
Project Stage	<p>Study – Phase 2</p> <ul style="list-style-type: none"> - Investigate reduction of refinery runoff to west gate wetland and improved pond functionality - Investigate improvement to Mill 10 sump management to reduce overflow to the neutralising pond - Investigate options to reduce solids to the Sweetening bauxite pond <p>Execution – Phase 1</p> <ul style="list-style-type: none"> - Wetland Release: <ul style="list-style-type: none"> • V-notch weir and flow meter installed, • Continuous water quality monitoring installed. - Sweetening Bauxite Pond <ul style="list-style-type: none"> • Continuous water quality monitoring installed, and • A level sensor installed.
Comments	

Implementation Schedule

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

Study
Engineering
Execution



Refinery Stormwater Legend

- Mill 10 Area
- Sweete... Bauxite Pond
- West Gate Release

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3: 1:11,105

0 62.5 125 250 375

Meters


 Revision: 0
 Date: 28/11/2018
 Created By: Jonathan DeWitt
 Drawn By:
 Approved By: Jonathan DeWitt

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	- 54
Project Stage	<p>Study</p> <ul style="list-style-type: none"> - The outcome of stage 2 (EE report) will identify priority areas for engineering for ground/surface water around the red mud dams. <p>Execution</p> <ul style="list-style-type: none"> - EE Stage 2 – Install a cut off wall and drain along the eastern side of the historic RDA to mitigate any impact on vegetation to the east of the historic RDA. <ul style="list-style-type: none"> • A bentonite/cement slurry wall will be installed. • A drain on the dam side of the cut-off wall will be installed • Pumps and surface water drainage. <p>Completed</p> <ul style="list-style-type: none"> - EE Stage 1 – install cut-off wall to mitigate impact on BBBQ bird habitat;

Comments	- 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.
----------	--

Implementation Schedule

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



**RDA
Groundwater
Impacts**

Legend

- EE Stage 1
- EE Stage 2

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3: 1:39,597

0 220 440 880 1,320

Meters

N

Revision	A
Date	21/10/2018
Created By	Jonathan Dalton
Reviewed By	
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	- 70.0
Project Stage	<p>Study</p> <ul style="list-style-type: none"> - Construction of a pilot treatment plant has been completed and will provide on the ground data to assist with the design of mitigation options. - Modeling of release flows is being performed, with acoustic Doppler current profiles to be installed in South Trees Inlet in October. <p>Engineering</p> <ul style="list-style-type: none"> - A northern decant pond located on the historic red mud dam is in engineering phase and will look at how the pond can be constructed in phases to provide treatment options and to include storage of water external to the red mud dams.
Comments	

Implementation Schedule

RDA Alternative Discharge Location								
Task	2019				2020			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Identify options for relocation of the RDA discharge location	■	■	■	■	■	■		
Northern Decant Pond				■	■	■	■	


Study
Engineering
Execution



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RDA Discharge

Legend

-  Licenced Discharge Point

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This map is a site plan showing the location of the licenced discharge point. It is not intended to be used for navigation or other purposes. The map is provided for information only and does not constitute a guarantee of accuracy or completeness. The map is subject to change without notice.

Coordinate System: GDA 1984 UTM Zone 58
Scale at A3 1:44,421
0 245 490 980 1,470
Meters

	Revision:	1
	Date:	28/11/2018
	Created By:	Jonathan Deane
	Approved By:	Jonathan Deane

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	Engineering
Comments	

Implementation Schedule

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



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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

0 62.5 125 250 375
Meters

N

Revision	1
Date	20/11/2018
Created By	Jonathan Deane
Checked By	
Approved By	Jonathan Deane

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.

Project (L1)	Integrity of Bunds and Drains
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	- 39.3
Project Stage	<p>Engineering</p> <ul style="list-style-type: none"> - Complete engineering design for bunds and drains that were identified during the study phase requiring repairs. <ul style="list-style-type: none"> • Complete engineering design on high risk (Class IV) bunds and drains • Complete engineering design on lower risk (Class I, II and III) bunds and drains. <p>Execution</p> <ul style="list-style-type: none"> - 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. - High risk bunds in execution: <ul style="list-style-type: none"> • HID 3/4 - High risk drains in execution: <ul style="list-style-type: none"> • Above ground section of 7th street drain, <ul style="list-style-type: none"> ▪ The schedule for delivery of this project did not anticipate the challenges of re-establishing drains within the refinery, including encountering unknown and disused underground services. ▪ This project will not meet the scheduled execution completion date and it is anticipated that there will be a 4 week delay on the completion of this project. • 5th Street drain, • Bravo Street drain, • Sierra Street drain.
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															
	2019				2020				2021				2022			
	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					█	█	█	█	█	█	█	█	█	█	█	█
5th Street Drain repairs			█	█	█											
Bravo Street Drain repair			█	█	█	█										
Sierra Street Drain repairs			█	█	█	█	█									
Tertiary tanks 1-4 nib wall replacement				█	█											
Sulphuric acid tank interim bund remediation				█	█	█										
Above Ground Section of Seventh Street Drain repair	█	█	█	█												
HID 3/4 bund repair	█	Complete														

Study **Engineering** **Execution**



Integrity of Bunds and Drains

Legend
 Bunds and Drains

Scale at A3 1:9,359
 0 50 100 200 300
 Meters

Revision 0
 Date 26/11/2018
 Created By JAMESON DILLON
 Approved By JAMESON DILLON

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	Completed
Comments	- Groundwater pumping has commenced. - Monitoring of groundwater will continue and opportunities to improve the system will continue to be investigated based on the results of the ongoing monitoring.



Groundwater Impacts at South Trees Island Tank Farm

Legend

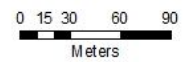
 Bund 2

 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	- Execute the design for the mineral waste disposal facility.
Performance Indicator	- Minimise and contain seepage from the mineral waste disposal facility.
Cost estimate A\$ million	- 2.6
Project Stage	Execution
Comments	-

Implementation Schedule


Mineral Waste Disposal Facility												
Task	2019				2020				2021			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Implement design for stage 2 of the MWDF	■	■	■	■	■	■	■	■	■			
	Study	Engineering	Execution									



 QUEENSLAND ALUMINA LIMITED

Mineral Waste Facility - Stage 2

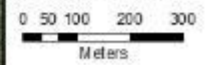
Legend

 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 Dallas
	Approved By	Jonathan Dallas

Project (L4)	Sewerage System Upgrade
Risk class	- III/High
Environmental risks	<ul style="list-style-type: none"> - Potential for land contamination from sewerage system installed during initial and subsequent plant construction phases and potential to contaminate groundwater. - Introduction of inadequately treated effluent to the RDA
Project solution / options	<ul style="list-style-type: none"> - Investigate the condition of the sewerage system to identify issues and assess options to rectify identified issues - Review the current operation of the sewage treatment system and look at requirement for upgrade
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	- 2.0
Project Stage	Study
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



 QUEENSLAND ALUMINA LIMITED

Sewerage System Review

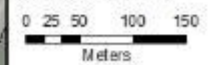
Legend

 Sewage Treatment Plant

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Geographic System: GDA 1984 UTM Zone 56

Scale at A3: 1:4,600



N ↑	Reviewed By:	J. J. J.
	Created By:	J. J. J.
	Checked By:	J. J. J.
	Approved By:	J. J. J.

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	Study
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					
Study Engineering Execution					



 QUEENSLAND ALUMINA LIMITED

RDA Rehabilitation - Pilot Study

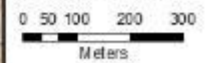
Legend

 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:	JANET DELANEY
	Checked By:	JANET DELANEY
	Approved By:	JANET 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	- 0.835
Project Stage	Execution - 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

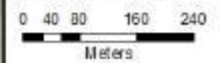
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Oil water facility

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Coordinate System: GDA 1984 UTM Zone 58

Scale at A3 1:7,019



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

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	- Execution phase – all operational caustic storage tanks are inspected, all faults repaired and returned to service with RPEQ signoff.
Cost estimate A\$ million	- 18.1
Project Stage	Execution
Comments	- QAL has decided to continue to store caustic soda in bunds 2 and 4 at South Trees Island. - All operational caustic storage tanks in bunds 2 and 4 at South Trees Island will be brought off-line, cleaned, inspected and any faults rectified prior to the tanks being returned to service.

Implementation Schedule

Caustic Storage Strategy

Task	2019				2020			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Inspect and repair tank T1515	■	■	■	■				
Inspect and repair tank T15Q005			■	■	■	■	■	
Inspect and repair tank T15Q006				■	■	■	■	■

Study Engineering Execution



Groundwater Impacts at South Trees Island Tank Farm

Legend

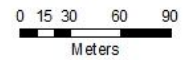
 Bund 2

 Bund 4

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Coordinate System: GDA 1994 UTM Zone 58

Scale at A3 1:2,981



N 	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.

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

Implementation Schedule

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