KWINANA
Environmental Improvement Plan
2017-2021

Alcoa

The Element of ***Possibility***™

Contents

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2017 – 2021 Environmental Improvement Plan for Kwinana

Overview and acknowledgements

In April 2006, Alcoa of Australia (Alcoa) released for the first time an Environmental Improvement Plan (EIP) for each of its sites in Western Australia. EIPs are a voluntary initiative by Alcoa and were a first for industry in this state. Subsequent plans were released for 2008 - 2009, 2011 – 2013 and 2014 – 2016.

This EIP outlines Alcoa's commitment to continuously improve Kwinana refinery's environmental performance, reduce environmental impacts and develop more sustainable operating practices. This EIP also forms part of the refinery's operational plan for 2017 - 2021.

Alcoa recognises that input from stakeholders was vital to the development of this EIP. The environmental targets, aims and actions have been established thanks largely to key stakeholders which include community members, local government representatives and Alcoa employees.

Simon Pascoe

Acting Refinery Manager, Kwinana Alumina Refinery
General Manager, Western Australian Refining Operations

Alcoa is committed to the communities surrounding Kwinana refinery and acknowledges that initiatives based on ideas from key stakeholders help to maintain continuous improvement. It is also the intention that this EIP will give the local communities a much better understanding of Alcoa's activities.

External involvement and review is integral to the success of this EIP and the information on the following pages will be useful to measure progress in achieving set targets.

Sincere thanks are extended to everyone involved in producing this EIP, particularly members of the Kwinana EIP Advisory Group who have given their personal time to help Alcoa progress environmentally. The EIP consultation process is a working example of community, government and business coming together for a common purpose.

Overview of Alcoa of Australia's operations

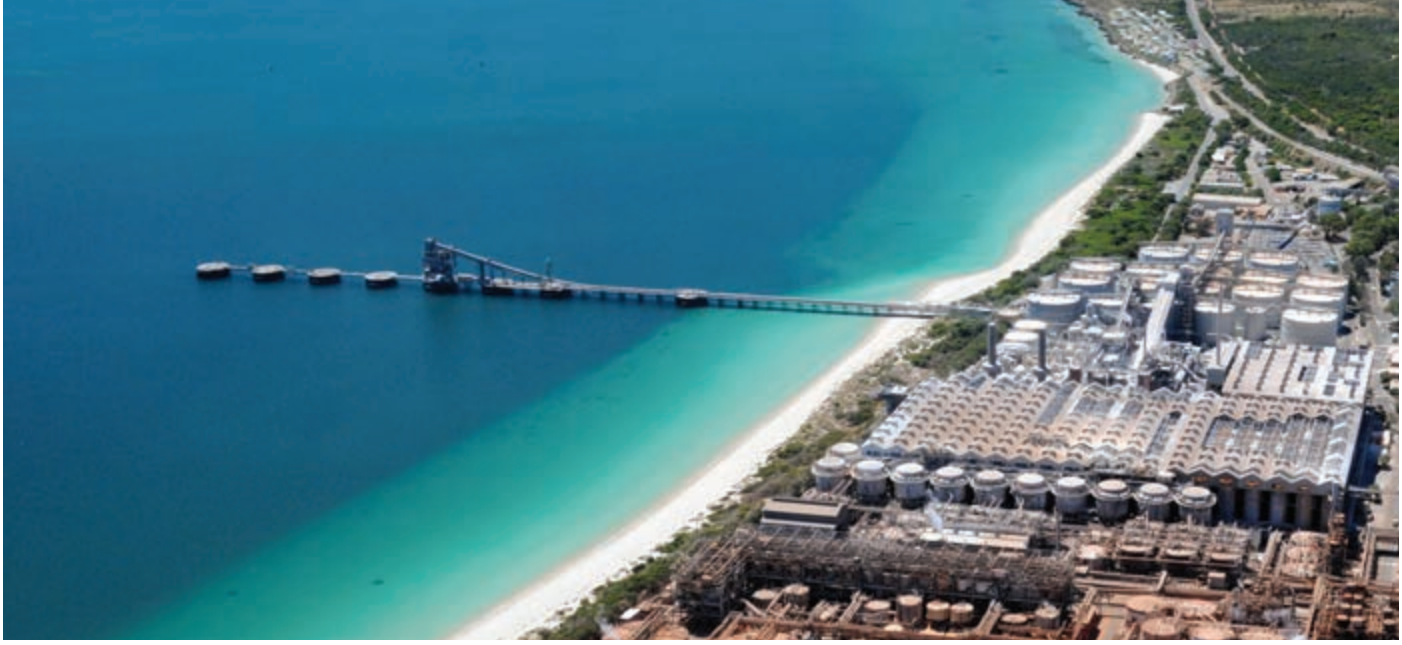
Alcoa of Australia (Alcoa) has been sustainably mining, refining and smelting in Australia since 1963 and is active in all major aspects of the aluminium industry. The company employs approximately 4,300 people, predominantly in regional Australia.

PRINCIPAL OPERATIONS IN WA

- Huntly Bauxite Mine
- Willowdale Bauxite Mine
- Kwinana Alumina Refinery
- Pinjarra Alumina Refinery
- Wagerup Alumina Refinery
- Bunbury Port

PRINCIPAL OPERATIONS IN VIC

- Portland Aluminium Smelter



Australian operations

The Huntly and Willowdale bauxite mines in the Darling Range south of Perth supply bauxite to Alcoa's three alumina refineries at Kwinana, Pinjarra and Wagerup. These refineries extract alumina from the bauxite. The Huntly mine is the world's second largest bauxite mine.

Alcoa's aluminium smelter is located at Portland in Victoria. Portland Aluminium Smelter is a joint venture between Alcoa of Australia Limited (45%), which manages the day to day operations; Eastern Aluminium Portland Pty Ltd (10%) (a wholly owned subsidiary of Alcoa of Australia); CITIC Nominees Pty Ltd (22.5%); and Marubeni Aluminium Australia Pty Ltd (22.5%).

Kwinana refinery

Kwinana Alumina Refinery is located 40 kilometres south of Perth in the Kwinana Industrial Area, Western Australia's premier heavy industrial estate. It was the first of three alumina refineries Alcoa has built in Western Australia.

The refinery was officially opened in July 1963 with production commencing three months later. The first alumina shipment left aboard the Lake Sorrel in February 1964, bound for Alcoa's then Point Henry Aluminium Smelter in Victoria. The first export shipment of aluminium left for Japan one month later.

Kwinana refinery's rated capacity is 2.19 million tonnes per year. As well as producing alumina for smelting into aluminium, Kwinana refinery also produces specialty aluminas for various industrial and manufacturing applications, including water purification, refractory materials, pharmaceuticals, artificial marble, paper sizing, ceramics, abrasives, petroleum processing, plastic and fire retardant in carpets.

In 1992 Kwinana became the first alumina refinery in the world to achieve an ISO-9002 Quality Accreditation and led the way in 1997 in achieving ISO-14001 Environmental Management Certification.

2017 - 2021 targets and actions

Alcoa is focused on developing better ways to ensure a sustainable future. Through this Environmental Improvement Plan (EIP) and other mechanisms we are committed to:

- Using fewer resources
- Protecting resources for which we are responsible
- Reducing our emissions and waste
- Reusing and recycling materials

This plan will focus on the key areas of:

- Air quality management
- Water conservation and management
- Land management
- Waste management and energy efficiency

Air quality management

The management of air quality from Kwinana Alumina Refinery receives close scrutiny from the community, government and regulators as an individual facility and refinery operating near other industries in the Kwinana Industrial Area (KIA).

For many years Alcoa has conducted extensive investigations into emissions produced from alumina refining and has a good understanding of the range and concentration of chemical compounds present in processes and how to manage them effectively.

The primary air emissions from the refinery include:

- Nitrogen oxide (NOx)
- Carbon monoxide (CO)
- Particulates (bauxite residue and alumina dust)
- Volatile organic compounds (VOCs)
- Trace levels of metals

The refinery is part of the KIA and Western Trade Coast and is an active participant in the Kwinana Industries Council's Environmental and Planning Committee Group.

Air emissions, both particulates and gaseous emissions, are actively managed and monitored in accordance with the Alcoa Kwinana Department of Water and Environmental Regulation licence requirements.

Noise and odour management is a complex issue because of the number of heavy industries operating in close proximity. Alcoa periodically undertakes field monitoring for noise and has also carried out odour surveys.

Past community perception surveys have not highlighted noise as an issue for the Kwinana operations. It has been agreed as part of the EIP review process that there need not be any specific actions for noise or odour in Kwinana refinery's EIP, and the focus will be on particulates and gaseous emissions.

Air quality improvement targets

Particulates

Objective	Action
Minimise risk of dust generation from operations.	Maintain the current dust control standards and investigate opportunities to further improve dust management and implement where practical. Provide status reports on dust control to the Kwinana EIP Advisory Group.

Gaseous emissions

Objective	Action
Identify options to reduce air emissions.	Provide an annual update to the Kwinana EIP Advisory Group on air emission management, trends and improvements.

Water conservation and management

Water is a valuable community resource and Alcoa has a strong commitment to water conservation and using fit for purpose water. This means, where possible, Alcoa deliberately sources and uses lower quality water which has less value to other water users.

Kwinana refinery's water is obtained through a variety of sources:

- Water recycling
- Rainfall harvesting
- Ground water extraction
- Scheme water

The refinery operates a closed water circuit. Rainwater runoff from the refinery's operational areas, including the residue area, is captured and reused in the alumina production process. The refining process does not discharge process water, either as cooling water or effluent. Process water losses occur through steam, evaporation and leaching.

Ground water is drawn from both recovery and production bores with potable water purchased from the Water Corporation. Recovery bore systems form part of the groundwater monitoring and management plan for the refinery and residue areas, the objective of which is to monitor, contain, control and reduce the known groundwater plumes. The effectiveness of recovery is assessed by monitoring and the results are reported to the Department of Water and Environmental Regulation annually, in accordance with licence conditions.

Water management improvement targets

Usage

Objective	Action
Target reduced water consumption in refining operations.	Proactively manage water consumption.
Reduce the use of high quality water sources at the refinery.	Seek out economically viable opportunities to substitute higher quality water sources with lower quality water sources that are fit for purpose.

Containment

Objective	Action
Contain, control and where possible contract existing groundwater plumes in retired and operating residue areas.	Review as appropriate the success of plume containment efforts for Areas ABC and Area F and determine whether further action is required.
Reduce existing contamination under the refinery and adjacent property.	Sustain and where appropriate optimise the existing recovery bore system within the refinery.
Reduce the risk of groundwater contamination from existing containment facilities including residue pipeline facilities.	Prioritise actions for progressing improvements to refinery containment. Complete inspection of pipeline corridor and prioritise remediation actions.
Progress contaminated sites investigation and reporting requirements as required by the Contaminated Sites Act 2003.	Provide an annual update as appropriate to the Kwinana EIP Advisory Group on relevant milestones in the reporting program.

Land management

This EIP overlaps with other important planning processes to address the visual amenity impact of our operations. These include the Long Term Residue Management Strategy (LTRMS) and Land Use Management Plan.

Through these processes, sustainable rehabilitation practices associated with our residue areas and wetlands are undertaken. Additionally, through the LTRMS community members continue to work with Alcoa to determine final land uses for residue areas.

Alcoa also has several landholdings of local cultural and conservation significance, including the Spectacles wetlands in Mandogalup, Wellard wetlands in Baldivis and a section of Mount Brown, part of the Beeliar Regional Park in Naval Base. Alcoa works collaboratively and strategically with relevant interest groups and local and state government to ensure the ongoing health and sustainability of these important natural resources.

Land management improvement targets

Rehabilitation

Objective	Action
Residue rehabilitation programs enhance the visual amenity in and around Alcoa landholdings.	Provide annual updates as appropriate to the Kwinana EIP Advisory Group on the progressive rehabilitation of external/final-form embankments.

Flora and fauna

Objective	Action
Actively manage Alcoa landholdings to enhance and conserve natural ecological attributes.	Undertake vertebrate pest control on Alcoa landholdings. Undertake relevant weed control around Area F to complement adjoining Bush Forever program. Continue to seek and support community partnerships which align and support conservation goals. Maintain commitment to ongoing fauna and flora surveys. The focus of the surveys will be reviewed and adapted where appropriate.

Wetlands

Objective	Action
Maintain the health of the Spectacles as an important regional wetland.	Develop and implement ongoing land management programs for wetlands located on Alcoa's land. Work with local government and community interest groups to promote appropriate wetland use. Evaluate opportunities for participation in conservation activities.
Recognise the value to the community of the Wellard wetlands, consistent with Alcoa's clay extraction requirements.	Develop and implement ongoing land management programs for wetlands located on Alcoa's land. Include Wellard wetlands in the triennial fauna assessment on a periodic basis. Evaluate opportunities for participation in conservation activities. Maintain relationship with interested stakeholders to provide eucalyptus leaves for Koala fodder.

Fire hazard reduction

Objective	Action
Actively manage Alcoa landholdings to minimise bush fires.	Evaluate fire management options for landholdings and implement applicable strategies.

Waste management and energy efficiency

Innovation improves bauxite residue processes

Alcoa commissioned an innovative technology known as residue filtration at Kwinana refinery in 2016. With this technology, bauxite residue generated from the alumina refining process is forced through very large filters that squeeze out the waste water, which is recycled in the refining process. The filtered material allows for more efficient utilisation of existing residue areas, deferring the need to build new areas every five years. The water recovered from filtration also significantly reduces the refinery's freshwater needs. Alcoa continues to evaluate the potential use of this technology at other refineries around the world with the next plant approved for Pinjarra refinery in Western Australia's Peel region.

From waste to resource

For more than 30 years Alcoa has been investigating opportunities to produce economically viable products from bauxite residue. By identifying and demonstrating a range of alternative uses, bauxite residue may become a resource rather than a waste in the future.

Alcoa's residue sand is currently used for the construction of residue storage areas, with excess being stored within these storage areas. Alcoa has developed a process to wash and carbonate the sand so it can be considered for alternative value-adding applications. The resulting product is known as Red Sand™, which has a nominal particle size of +100 micron and is physically similar to crushed bauxite.

Red Sand™ is a well-structured material and exhibits beneficial phosphate retention properties. Red Sand™ has been successfully trialled in various applications, including turf top dressing, road base construction, industrial land development and as an alternative material for golf course bunker sand.

Energy efficiency

Energy is a key input of the alumina refining process. Alcoa's refinery systems are fully integrated from an energy efficiency perspective with process heat recovery optimised where feasible. The refinery steam and energy systems utilise natural gas and energy efficiency is optimised in the process.

No specific commitments are made to improvements in energy usage at Kwinana for this plan.

Waste management improvement targets

Residue reuse

Objective	Action
Support projects which identify and research residue reuse strategies.	Provide regular updates on the status of residue re-use projects.

Oxalate

Objective	Action
Implement long term oxalate management strategy.	Evaluate feasibility of options for management of stored oxalate.

Waste synergy

Objective	Action
Identify waste synergies to reduce waste within the Kwinana Industrial Area.	Contribute to the Kwinana Industries Council's synergy programs with other industries and evaluate projects with potential to reduce waste.

Environmental regulation and management

Environmental regulation

Alcoa's Western Australian operations are subject to environmental regulation under the Environmental Protection Act 1986 and its regulations. As such the refineries are licensed by the Department of Water and Environmental Regulation. Alcoa is committed to meeting the terms and conditions of its environmental licence and environmental approval conditions.

Alcoa's commitment to this EIP is voluntary. It both complements and exceeds the requirements of the company's environmental protection licence.

Environmental management system

Kwinana refinery's Environmental Management System (EMS) is certified to the ISO14001:2004 standard. The EMS was recertified in May 2015 for a three-year period. During the period of this current EIP, the refinery will be transitioning to the latest ISO14001:2015 standard.

ISO14001 requires the location to identify activities with the potential to significantly affect the environment, define the controls in place to manage those risks and develop action plans for improvement.

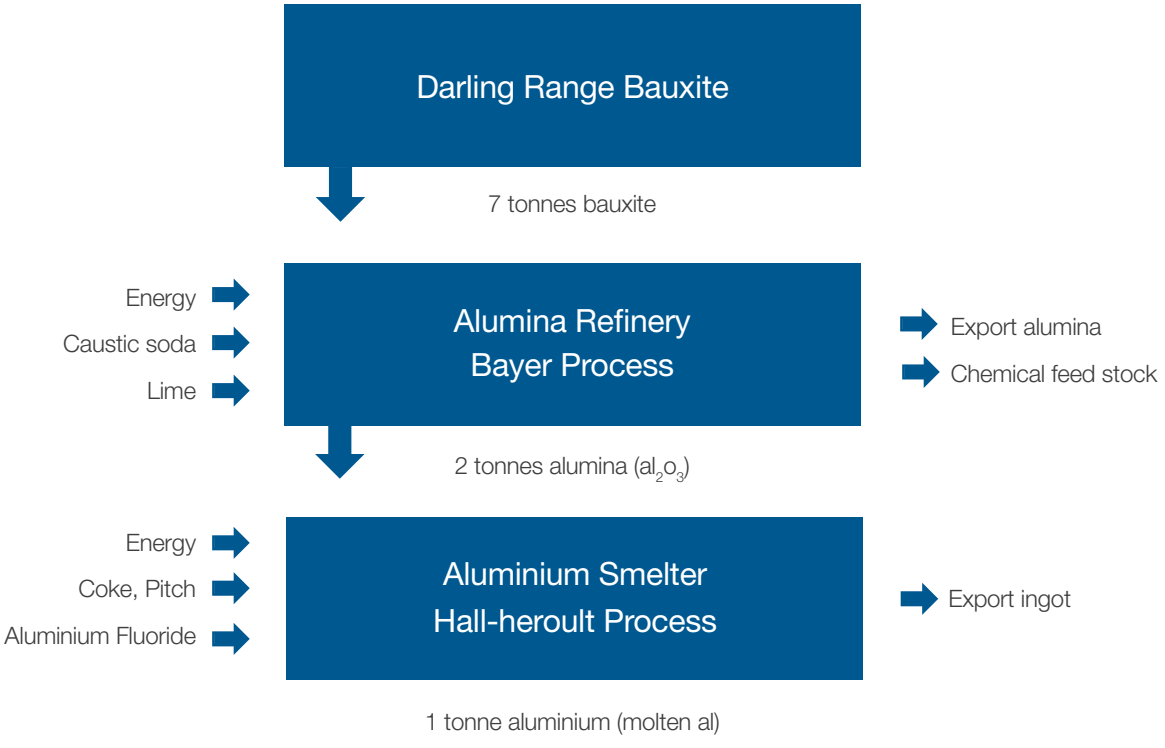
To ensure the EMS continues to be an effective environmental management tool, both internal and external audits of the system are conducted regularly. Auditing is a systematic method to review the effectiveness of operational controls to ensure unacceptable risks to the environment are effectively managed and to identify corrective actions and opportunities for improvement. An audit involves analysis, testing and confirmation of procedures and practices.

How aluminium is made

From bauxite ore to versatile metal

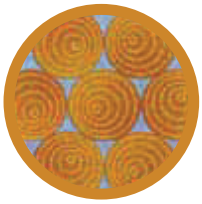
The aluminium making process starts with a chemically altered and weathered rock known as bauxite. Its colour and texture looks little more than ordinary gravel. However, its careful extraction from mines in the Darling Range of Western Australia starts a process which since the beginning of the 20th century has revolutionised the transport, building and other high technology industries.

By mixing bauxite with caustic soda, and then pressure heating, Alcoa extracts alumina in a fine white powder form. Alumina is shipped to Portland Aluminium smelter in Victoria and exported around the world. The alumina is then smelted at very high temperatures and an electric current passed through it to form aluminium – one of the world's most versatile metals.



From dirt to aluminium

Mining and Rehabilitation



Preparation of mining area

After clearing of timber and other material, topsoil and overburden are carefully removed and returned after mining when the areas are being rehabilitated.

Bauxite mining

A 4-5 m layer of caprock and bauxite is removed using large excavators or loaders and haul trucks.

Crushing plant

Ore is taken to a crusher where it is crushed into smaller pieces.

Ore conveyors

The ore is then transported by conveyor belt and rail to the refineries for processing.

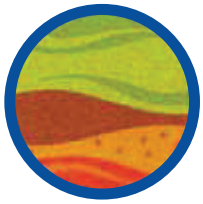
Rehabilitation

After mining, topsoil and overburden are returned to the area and the site is prepared for revegetation.

Refining Process

Digestion

Finely ground bauxite is mixed with hot caustic soda solution to dissolve the alumina from the bauxite. Every seven tonnes of bauxite makes two tonnes of alumina.



Clarification

Insolubles, such as sand and mud, are settled and filtered out, leaving a solution of dissolved alumina hydrate.

Precipitation

The liquid containing alumina hydrate is then cooled in large open tanks and seed crystals added, causing the alumina to crystalise out of solution.

Calcination

The alumina hydrate is washed, then heated to remove water, leaving a pure dry alumina in the form of a fine white powder. This is cooled and stored, then shipped to smelters for processing.

Smelting Process

Dissolving alumina

Alumina is dissolved in an electrolytic bath of molten cryolite within a large lined furnace known as a “pot”. There are hundreds of pots at a typical smelter.

Chemical process

Alumina is made up of aluminium and oxygen, which need to be separated to produce the metal. Every two tonnes of alumina makes one tonne of aluminium.

Reduction process

A high electric current is passed through pots via carbon blocks. The current flows continuously from the carbon block (positive) through the alumina/ cryolite mix to the lining of the pot (negative), and then on to the next pot.

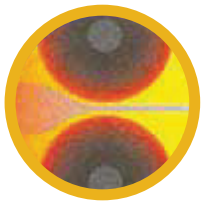
Forming aluminium

Electricity maintains the temperature of the process at about 950°C and enables the alumina to split into aluminium and oxygen, with aluminium settling to the bottom of the pot.

Casting

The molten aluminium is cast at a temperature of just over 700°C to form ingots.

Rolling Process



Hot rolling

Aluminium ingot is reheated to around 600°C, then passed through a hot finishing mill where it is reduced in thickness to 3-6mm.

Coiling

The aluminium strip from the hot rolling mill is coiled and cooled before being sent to the cold rolling mill.

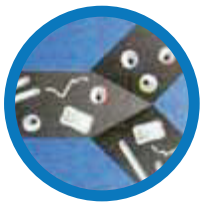
Recycling Process

Final processing and casting

Molten aluminium is transferred to a holding furnace and then cast into ingots. Recycling aluminium consumes approximately five per cent of the energy required to make new aluminium, with no loss in quality.

Initial processing

Coated aluminium (painted or lacquered) is processed through a gas fired rotary furnace before being sent to a “melter” where it is mixed with uncoated or new aluminium.



Classification

Upon receipt, the recycled aluminium is classified so the optimal end use and processing path can be determined.

Preparation

Recycling aluminium starts with preparation for transporting, which involves compaction to improve the density of the aluminium and to reduce freight, storage and handling costs.

Sheet finishing

Most sheet products require a finishing step such as cleaning, coating and slitting. All products are trimmed to customer specified widths.

Cold rolling

The aluminium coil is further reduced (to as thin as 0.24 mm) by three passes through a cold rolling mill. Exit speeds of cold rolling mills are as high as 1000 metres per minute.