Contents

1. Business Overview

Aughinish Alumina Limited (AAL) is the EUs largest alumina refinery, producing 30% of the EUs alumina. This manufacturing industry has been in the Mid-West of Ireland for almost 40 years, and invests heavily in a modernisation, environmental protection and efficiency programme.

AAL is considered a benchmark alumina refinery worldwide for its organisational, labour and energy efficiencies. The plant cost US$1bn to construct and a further US$750m has been spent upgrading it. AAL are currently operating with Best Available Technologies when compared to industry standard.

Globally speaking, AAL is amongst the highest-ranking Alumina refineries in terms of energy efficiency and has the 4th lowest alumina plant carbon footprint worldwide at 0.516 tCO_2/t product versus a world average of 1.29 tCO_2/t product, amongst 89 alumina refineries. AAL has the lowest carbon footprint in the world for refining bauxite that requires high temperature digestion, which is the most used technology today.

AAL has reduced its carbon emissions by 40% per tonne of product with the installation of the high efficiency combined heat and power plant (CHP) in 2006, conversion of the boilers and calcination to natural gas and implementation of energy improvement projects. The site currently meets heat demand through natural gas-fired CHP and supplementary natural gas boilers and natural gas for calcination. The site electrical demand is largely delivered from onsite generation of electricity from the CHP.

Aligned with National, European and International policies, AAL is planning to reduce CO_2 emissions further by 35% by 2030 and achieve net zero by 2050. AAL has planned a three-pronged approach:

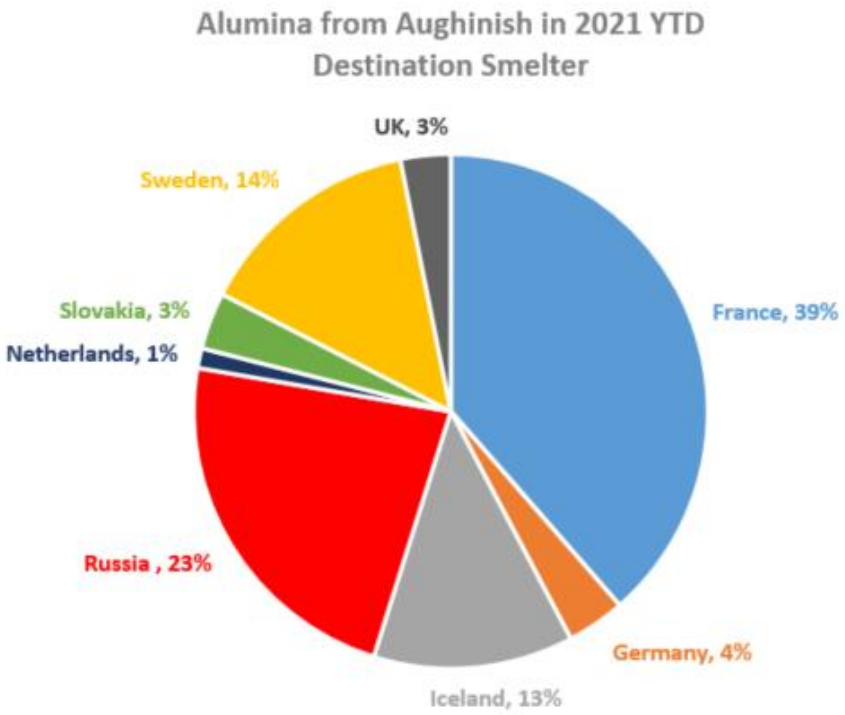
1. Energy efficiency improvements to reduce emissions
2. Process Electrification
3. Fuel switch

Refer to Section 9.3 of this application for further detail on AAL's decarbonisation strategy.

Involved in this industry in the Mid-West are 482 permanent employees and 385 on site contractors. AAL's operational activities and those of its supply chain generate €130 million in value for the Irish economy. Each €1 spent by AAL results in an additional €0.40 spend by suppliers. AAL's capital investment activities and the additional spend of suppliers generates ~€10 million in value for the Irish economy and, in particular, for the Mid-West. In 2021, capital investment was more than 60% higher than in 2020 and will grow further as AAL's own contribution to decarbonisation, waste reduction, community amenities and other environmental projects increases over the coming years.

AAL employs best management practices for the refinery operation to ensure we remain competitive and a viable operation. AAL is certified to ISO 9001 and ISO14001 level and is a leader in implementation of Energy Management Systems achieving ISO 50001 accreditation in 2015.

The alumina from AAL is delivered to customers as shown in the figure below for 2021 year to date. The largest destination by volume is France, where 39% of the output is shipped into two major smelters. The Dunkirk aluminium smelter in France is the largest of its kind in the EU and alumina from AAL represents 90% of its feedstock. The Kubal smelter in Sweden is completely dependent on alumina from AAL.



If alumina is not produced in AAL, global demand will result in alumina being produced elsewhere in the world less efficiently resulting in a global net increase in carbon emissions.

134 million tonnes of alumina was produced globally in 2020 with half of the production from China. Alumina is primarily used to produce aluminium with over 65 million tonnes of aluminium produced in 2020. The linkage between aluminium and alumina is simple – two tonnes of alumina are required to produce one tonne of aluminium. The EU has significant concerns for the provision of a number of key raw materials that are essential to the continued economic development of the Union. The EU is undersupplied in terms of alumina and aluminium – materials it has classified as key strategic raw materials.

Aluminium is a leader in the circular economy: being endlessly recyclable, with 75% of all aluminium ever produced still in use today. Aluminium is a product of choice for getting to Net-zero emissions. According to the World Bank (The new kids on the block: redefining "critical" minerals essential for a clean energy future, May 2020), just to fulfil the forecasted demand for solar, wind and other renewable energy technologies more than 100 million tonnes of aluminium will be required globally to reach net-zero by 2050. Even with increased rate of recycling primary alumina and aluminium will still be required to supply the majority of the aluminium demand.

Decommissioning and Residuals Management Plan

Condition 12.2 of the Industrial Emissions Licence covers the Financial Provision (FP) for the Decommissioning and Residuals Management Plan (Closure and Aftercare Plan) for the entire site. Condition 12.3.3 states that this FP shall be maintained in an amount always sufficient to underwrite the activities identified in the Aftercare Plan. AAL has costed the Aftercare Plan, which was updated in in 2018 and agreed with the Agency.

Financial charges and provisions are set out in Condition 12 of the current IE Licence. AAL is fully compliant with the requirements of Condition 12. For the BRDA, there is a secure fund (backed by a

Parent Company Guarantee) building over time to the required amount. For the Processing site, there is a separate Parent Company Guarantee for the required amount.

Environmental Liability Risk Assessment (ELRA) Insurance

The revised version of the ELRA has been prepared to incorporate changes to the site, including the costing of risks as requested by the EPA for quantification. The ELRA considered all potential risks to the environment including surface water, ground and groundwater, atmosphere, land, flora, fauna and human health as per the Agency Guidance.

The ELRA identified no high-level risks and all risks identified were in the medium to low level risk category. The mitigation measures implemented onsite are deemed adequate to manage the environmental risks satisfactorily.

The cost to address and remediate the current worst-case scenario cost for an unknown environmental liability relating to the site has been estimated and agreed with the EPA.

2. Operating Hours

AAL operates continuously 24 hours a day, 365 days a year with the exception of an annual plant shutdown which is required for maintenance of that equipment which must be available during plant operation. This is typically a 48 hour annual shutdown.

3. Proposed Changes

This application requests permission for the following changes. Refer to Section 1.1 of this application for further information.

1. Raise of the Bauxite Residue Disposal Area (BRDA)

The currently permitted BRDA (planning ref. Limerick County Council Reg. Ref. 05/1836; ABP Ref. PL13.217976) has capacity to provide a disposal area for bauxite residue until c.2030, for the current rate of alumina production (1.95 million tonnes per annum).

The proposed increase in disposal capacity to the BRDA will result in a height increase of c.12m above the currently permitted stage 10 level (c. 32m OD) to a final stage 16 level (c. 44m OD). This additional disposal capacity will extend the lifetime of the currently permitted BRDA from c.2030 to c.2039 – an extension of approximately 9 no. years. No increase to the existing footprint of the BRDA is proposed.

The existing BRDA can facilitate an increase in height to Stage 16 (currently permitted to Stage 10), which would provide a perimeter elevation of 36mOD and a maximum dome crown elevation of 44m OD. The proposed development will provide for the deposition of circa 0.9 million m^3 / year of bauxite residue and total of circa 8.0 million m^3 over the lifetime of the development.

The proposed method of raising the BRDA from Stage 10 to Stage 16 is the upstream method (identified by the European Commission as the 'Best Available Technique'[1]), consistent with the construction methodology for the current BRDA and involves the construction of rock fill embankments (Stages), offset internally and founded on the previously deposited and farmed bauxite residue, in 2m high vertical lifts. The overall stack is raised systematically as the Stages are filled with bauxite residue, farmed, carbonated and compacted, prior to deposition of the next layer.

No change in emissions or emission limit values are proposed associated with the raise of the BRDA.

[1] Best Available Techniques (BAT) Reference Document for the Management of Waste from Extractive Industries in accordance with Directive 2006/21/EC (European Commission, 2018)

Refer to Section 1.1 of this application for further details.

2. Raise of Saltcake Disposal Cell (SCDC)

The proposed development comprises the vertical extension of the existing SCDC to a crest height of c. 31.25m OD, which will have a maximum overall height of c. 35.50mOD when capped at cell closure. The extension of the SCDC will accommodate disposal for an additional c. 22,500 m^3 of salt cake in total. No increase to the existing footprint of the saltcake cell is proposed.

The construction of the SCDC extension will be undertaken in one step as opposed to the staged BRDA construction. Approximately 27,000m^3 of processed rock fill material will be required to construct the perimeter wall of the SCDC raise. It is proposed that this rock material will be sourced from AAL's borrow pit (see also Section 3). The composite lining, which will be placed inside the raised SCDC will comprise 4,500m^2 of a mixture of geosynthetic materials.

No change in emissions or emission limit values are proposed associated with the raise of the saltcake cell.

In parallel, AAL have developed a process modification to avoid the generation of saltcake as a waste stream. Further details are provided in Section 1.1 of this application.

3. Extension of Rock Extraction Area

An existing permitted borrow pit was granted planning permission from An Bord Pleanala (ABP Ref. 301011-18) and was the subject of an Industrial Emissions Licence review for which Licence P0035-07 was issued in September 2021. This permitted borrow pit has an extraction area of circa 4.5 hectares to extract 374,000 m3 of rock over a 10 year period. This will provide sufficient rock for the lifetime of the permitted BRDA. This rock is required for construction of embankment walls at the Licenced BRDA facility.

The proposed development will increase the extraction area of the borrow pit, increasing the footprint of the borrow pit from c.4.5ha to c.8.4ha. This extension will provide an additional 385,000m3 of rock fill material, which is needed to satisfy the requirements of the construction and operation of the proposed raised BRDA.

As per the existing permitted borrow pit, the extraction area is sought up to a maximum depth of 8.5m O.D., at which depth there is no interaction with groundwater.

The proposed development seeks to extract rock from within the confines of the AAL landholding (and licence site boundary) to reduce the dependence of the construction of the BRDA on rock sourced from commercial quarries in the local area.

No change in emissions or emission limit values are proposed associated with the borrow pit extension.

Refer to Section 1.1 of this application for further details.

4. Relevant Classes of Activity

The existing Classes of Activity remain applicable, as per IE Licence P0035-06, which are:

- Class 5.13 (e) The production of inorganic chemicals such as non-metals, metal oxides or other inorganic compounds such as calcium carbide, silicon, silicon carbide
- Class 2.1 Combustion of fuels in installations with a total rated thermal input of 50 MW or more
- Class 11.1 The recovery or disposal of waste in a facility, within the meaning of the Act of 1996, which facility is connected or associated with another activity specified in this Schedule in respect of which a licence or revised licence under Part IV is in force or in respect of which a licence under the said Part is or will be required

5. Requirement for EIAR/EIS

The proposed development outlined above is currently the subject of a Strategic Infrastructure Development application to ABP (ABP Ref. PA91.312146). This application includes an Environment Impact Assessment Report (EIAR) which covers the following aspects: site location and context, description of the proposed development, examination of alternatives, archaeology, architectural and cultural heritage, biodiversity, population and human health, land and soils and geology, landscape and visual, hydrology and hydrogeology, air quality, noise and vibration, material assets (waste, site services), traffic and transportation, and major accidents and disasters. Refer to section 27 of the non-technical summary for collation of those likely effects identified in the EIAR and associated mitigation measures.

In addition a Natura Impact Statement forms part of the SID application.

Refer to Section 6.3 of this Licence application for link to the relevant planning documents.

6. Relevant BAT Conclusions/Decisions, Guidance Documents and BREF Documents

Those BAT guidance documents, Commission Implementing Decisions and BREF documents which are applicable to AAL are as follows:

Document type	Year of Issue	Title
Commission Implementing Decision (CID)	2017	CID for Large Combustion Plant
Commission Implementing Decision	2016	CID for Common Wastewater and Waste Gas Treatment in the Chemical Sector
Commission Implementing Decision	2017	CID for the Non Ferrous Metals Industry
Reference Document on Best Available Techniques (BREF)	2009	BREF for Energy Efficiency
Reference Document on Best Available Techniques (BREF)	2006	BREF on Emissions from Storage
Reference Document on Best Available Techniques (BREF)	2001	BREF on Industrial Cooling Systems
Reference Document on Best Available Techniques (BREF)	2006	BREF on Economics and Cross Media Effects
Reference Document on Best Available Techniques (BREF)	2018	BREF on Monitoring of Emissions to Air and Water from IED Installations
Reference Document on Best Available Techniques (BREF)	2018	BREF on Management of Waste from Extractive Industries

Document type	Year of Issue	Title
Reference Document on Best Available Techniques (BREF)	2007	BREF on Large Volume Inorganic Chemicals, Solids and Other Industry
BAT Guidance note	2008	General Inorganic and Alumina Sector

7. Applicable Legislation

The applicable legislation is as follows, refer to Section 4.5 for further details:

1. Protection of the Environment Act, as amended, which implements the Industrial Emissions Directive (2010/75/EU)
2. Waste Management (Management of Waste from the Extractive Industries) Regulations, which implements the Extractive Waste Directive (2006/21/EC)
3. Waste Management Act, as amended, which implements the Waste Framework Directive (2008/98/EC)
4. European Communities (Greenhouse Gas Emissions Trading) Regulations, as amended, which implements Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC.
5. Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases

6. Description of How Emission Levels Have Been Determined

Emission levels have been determined as follows:

1. Current Licence Limits as determined by the Agency
2. Reference to relevant Commission Implementing Decisions
3. Reference to relevant Reference Documents on Best Available Techniques
4. Reference to EPA BAT Guidance notes
5. EPA Guidance documents including Environmental Management in the Extractive Industry

7. Derogation Sought

Derogation from Commission Implementing Decision 2016/902 for Common Waste Water and Waste Gas in the Chemical Sector

As per IE Licence P0035-07, a derogation has been granted from the TOC BAT AEL under the provisions of Article 15 (4) of the Industrial Emissions Directive and Section 86A (6) of the Protection of the Environment Act. Refer to BAT 12 in Section 4.7 of this Licence application.

This application for a review of the licence does not change the underlying basis for the derogation, the analysis supporting the derogation, or the scope of the derogation, and therefore the rationale for granting the derogation is also unchanged.

8. Description of the Facility with Measures to Avoid/Reduce Adverse Impacts on the Environment

Refer to Section 9.1 of the application for further detail.

A summary of measures taken to avoid/reduce adverse impacts on the environment are:

1. EMS in place which is certified to ISO14001:2015 environment standard
2. QMS which is certified to ISO9001:2015 quality standard

3. Energy Efficiency management system which is certified to ISO50001:2011
4. Safety management system in place which is certified to ISRS Advanced Level 8
5. Plant wide site rules in place to ensure safety of operation and people
6. Extensive training program and associated annual training needs analysis evaluation for all employees
7. Documented procedures ensure that operations are carried out in a consistent and safe manner
8. Emergency response procedures in place to effectively manage potential emergency situations including a Major Accident Prevention Policy for the Category A BRDA facility.
9. Emergency response drills in place which test the emergency procedures at a prescribed frequency. Learnings are used to update the emergency response procedures where required
10. Inventory of emergency response equipment is maintained onsite. In addition, AAL are members of the Shannon Estuary Anti-Pollution Team
11. 24 hour security and emergency response team presence onsite
12. Fire and rescue service onsite at all times and procedures in place for external assistance if required
13. All storage vessels, drums and containers are fully contained within impervious bunds
14. All process areas are bunded
15. Over 370 structures (tanks, drains, bunds, sumps, pipelines, ponds and sewer lines) are integrity tested on a 3 yearly basis and repaired as required
16. Dedicated process drainage system which are integrity tested with repairs carried out as required
17. Storm water drains equipped with stone filters and are visually inspected and maintained as required
18. Dedicated spillways and ponds which are both visually inspected and integrity tested with repairs carried out as required
19. Pipelines are inspected via visual means, pressure-testing and non-destructive testing methods as appropriate, which ensures integrity of piping systems
20. Oil interceptors, which are visually inspected and maintained, are installed to mitigate any potential minor spills during refuelling activities
21. Extensive environmental monitoring in accordance with IE Licence
22. Enclosed material handling equipment
23. Automated level controls, alarms and interlocks on tank and bund levels, as appropriate
24. Entire operation is monitored via DCS control system
25. Control room operators monitor the operation in dedicated control rooms
26. Fail safe control system allows for consistent controlled plant shutdown
27. Preventative maintenance system ensures equipment is fit for purpose
28. Asset life extension investment program to maintain asset integrity
29. Scheduled planned inspections of all plant and equipment
30. Multiple dust suppression systems including automated sprinkler system on the BRDA
31. Multiple emission abatement equipment including electrostatic precipitators on the calciners
32. Flood tidal defence system designed to protect the BRDA from a flood event
33. Multiple fire suppression systems installed
34. Waste management carried out in accordance with documented waste manual
35. Appropriate storage and handling of hazardous materials
36. ATEX zones in place as required for gas systems

9. Description of Raw Materials, Fuels and Energy Produced or Utilised

There is no change to the raw materials or fuel type used on site associated with this Licence application. Refer to Section 4.6.2 for complete details of raw materials, intermediates and products. In summary, the key raw materials are as follows:

1. Bauxite is supplied by shipment of which 420,000 tonnes can be stored onsite in the two bauxite storage sheds. The tonnage stored onsite is largely dependent on shipping schedule and weather. Approximately 4.7 million tonnes per annum of bauxite are consumed
2. Sodium Hydroxide (otherwise known as caustic soda) is a key raw material in the Bayer process which is used to extract alumina from the bauxite via dissolution in caustic at high temperature and pressure. Caustic soda (50%), delivered via shipment, is stored in two locations onsite, known as A38 and A23.
3. The water supply is from a public water treatment plant with a current approx. usage per annum of 5.3 million m^3 per annum.
4. Lime, which is supplied from an Irish supplier, is delivered via truck for addition to the process to enhance productivity.
5. Sulphuric acid is delivered by shipment to an onsite bulk storage tank. 20ktonnes are consumed per annum with a storage capacity of 5.5 ktonnes.
6. A range of chemical additives are required for process efficiency such as flocculants, anti-foam, organic impurity stabiliser and rheology modifiers
7. A range of chemicals are used in the laboratory and workshops
8. A range of chemicals are used onsite for maintenance of equipment integrity such as anti-scaling agent, paints and biocide

The only intermediate product generated onsite is slaked lime which is generated from burnt lime and is added directly to the process following slaking. Approximately 400 ktonnes are consumed per annum.

Natural gas is the primary fuel, having replaced HFO in 2014 (HFO is now < 1% of fuel consumed). The annual usage rate is approximately 610 million m^3, delivered by pipeline to an above ground installation (AGI) which is controlled by Gas Networks Ireland from which gas supply to the site is metered. For full fuel (thermal energy) consumption details refer to Section 4.6.

Electricity is generated onsite in the Combined Heat and Power (CHP) plant. The total electricity generated onsite in 2021 was 1,237,523 MWh of which 376,572 MWh was consumed for the activity while the remainder was exported to the National Grid. Refer to Section 4.6 for further details.

10. Sources of Emissions

The primary emissions from the site are emissions to air, surface water, storm water and noise. Refer to Section 7 of the application for complete detail. An emissions summary is presented below. There are no changes to emissions as part of this application.

1. Air emissions

The main air emissions points are tabulated below.

Emission Point Ref.	Description	Parameters
A1	HFO Boiler Stack	NOx, SO_2, Dust
A2	Calciner Stack	NOx, Dust
A3-A	Gas Turbine 1	NOx, CO
A3-B	Gas Turbine 2	NOx, CO
A4-A	D Boiler	NOx, CO, SOx, Dust

Emission Point Ref.	Description	Parameters
A4-B	E Boiler	NOx, CO, SOx, Dust
5	Scrubber Exhaust Fan – Transfer Tower 4 & 5	Dust
6	Bauxite Crusher and Wobbler Feeder – Scrubber Exhaust Fan	Dust
8	Scrubber Exhaust Fan – Transfer Tower 3	Dust
12	Alumina Loader Dust Fan	Dust
13	A73 Boiler	NOx, SO_2
14	A76 Boiler	NOx, SO_2
15	A79 Boiler	NOx, SO_2
16	Silo 1 – Exhaust Fan	Dust
17	Silo 2 – Exhaust Fan	Dust
18	Silo 3 – Exhaust Fan	Dust
19	Exhaust Fan between Silos 1 and 2	Dust

There are no new proposed main or minor emission points associated with this Licence application.

The HFO boilers, Emission pt. ref. No. A1, (A boiler only, as B and C boilers are decommissioned) are used only as back-up e.g. where a combustion plant is offline for maintenance. From January 2016 to December 2021 the HFO boilers have only operated for 2,296 hours. This has led to a reduction to practically zero of SOx emissions for the whole site.

The 2 gas boilers (Emission pt. ref. no. A4-A and A4-B) are in operation since 2014 in full compliance with the IE Licence for NOx and CO, SOx and dust.

The gas turbines (Emission pt. ref. no. A3-A and A3-B) are in operation for more than 10 years and have operated in compliance with Licence limits for NOx and CO.

The 3 calciners (Emission pt. ref. no. A2) emit through individual flues in a single stack and are in compliance with the IE Licence for particulates and NO_x. SO_x is not required to be monitored when operated on gas which the calciners have been since 2012.

The exhaust fans operate in compliance with the Licence limits for particulates. It is noted that emission point 11 in the current licence, P0035-07, no longer exists, as this was the old outer berth alumina loader, which was fully decommissioned in 2015.

2. Surface water emissions

All treated process effluent is discharged from the AAL site at a location adjacent to the marine terminal (otherwise known as the jetty) via the discharge point referred to as W1-1. The volume of treated process effluent discharged is largely dependent on rainfall.

The primary source of process effluent are:

1. Rainfall which collects on the Southern end of the site
2. Process condensate
3. Hosing water
4. Rainfall run-off from the BRDA
5. Boiler house effluent
6. In-house water treatment plant

7. Municipal water treatment plant return

All treated sanitary effluent is discharged at the same discharge location, W1-1, however this stream has different monitoring and compliance requirements to that for the treated process effluent. The source of sanitary effluent is the onsite sewage system.

W1-1 is the discharge location at the River Shannon Estuary.

Both treated process effluent and sanitary effluent are in compliance with the IE Licence for all parameters.

3. Storm water emissions

There are two systems for collecting storm water onsite. The storm water which collects on the Southern part of the site (Process Area) is directed to the process effluent system for treatment and ultimately discharged at W1-1 (as described for surface water emissions above). The northern end of the site (Raw Materials Storage Area) collects storm water run-off (rainfall), which is discharged via drains directly to the Shannon Estuary at the shore line at 5 locations, namely SS1 – SS5 where SS denotes surface stream. These drains are equipped with stone filters or silt traps. Visual inspections of the surface stream drains are carried out daily. Trigger levels have been established, in agreement with the Agency, for pH, soda and conductivity. The surface streams are in compliance with the trigger limits.

4. Noise and vibration emissions

The site is located in a remote, rural location. There are no significant noise emissions from the site. Annual noise monitoring is carried out by an independent 3rd party at 5 noise sensitive locations as prescribed in the IE Licence. Daytime, evening time and night time noise limits are applied to the noise sensitive locations. Noise monitoring has consistently shown compliance with these limits.

There are currently no vibration emissions from the site. Operation of the permitted borrow pit will commence in April 2022, in compliance with existing emission limits values for air over pressure and vibration. The proposed extended borrow pit area will also be operated in compliance with these emission limit values. There is no proposed change to emission limits associated with noise and vibration. Refer to Section 1.1 for further detail.

11. Environmental Site Conditions

The site condition is outlined in the original 2014 baseline report and 2019 technical memorandum that was submitted with the licence review application for P0035-07. Golder Associates Ltd. were commissioned by AAL to provide an update to the technical memorandum outlining any changes since the production of the 2019 technical memorandum. This updated technical memorandum (20447003.TM01.A1) is included in this licence review application. The key changes between 2018 to present are summarised below:

- During 2019: BRDA access road drain, A04 bund upgrade, A07 bund extension, A41 bund plating, gravel replacement;
- During 2020: BRDA access road drain, A07, A41 and A48 bund plating and A04 drain repairs;
- During 2021: A04 and A07 bund plating, A41 drain lining, groundwater recovery at POW11 and POW18;
- and
- One reported environmental incident (Category 1 – Minor).

In summary, the main changes to the site relate to the ongoing annual groundwater improvement projects carried out at the site.

The site continues to mitigate the risk of caustic contamination from spills or leaks in the plant area by intercepting and recovering water from a number of Estuarine Streams, as well as other recovery wells. Two additional recovery wells have been added since the 2019 memo. This recovery programme is resulting in improvements to pH as compared to the reporting in 2014. Refer to Section 7 of this Licence application.

The site continues to make investment in environmental management with the ongoing Asset Life Extension. This ongoing work targets priorities for plant repair and replacement identified through groundwater monitoring and integrity testing.

Industrial mud farming in the BRDA has resulted in overall improvements to the waste stored in the BRDA. Through this process, the bauxite residue is carbonated and the overall pH is decreased to <11.5.

12. Nature and Extent of Proposed and Existing Emissions

1. Air emissions

There are no proposed changes to air emissions. The following provides a summary of existing emissions.

A and C HFO boilers (Emission pt. ref. No. A1) operated for < 3,000 hours in total for the period 2016-2021. The average SO_2 48-hour average for A and C boiler in the period July 2014 – September 2021 was 827 mg/m^3 against an ELV of 1700 mg/m^3. The average NOx 48-hour average for A and C boiler in the period July 2014 – September 2021 was 313 mg/m^3 against an ELV of 750 mg/m^3. There is no proposed change to emissions from the HFO boilers.

The 3 calciners (Emission pt. ref. no. A2) which operate continuously (with the exception of maintenance periods) emit through individual flues in a common stack. A summary of emissions from the calciners are tabulated below for the period from July 2014 to September 2021, all compliant.

Licence Parameter	Average Value (mg/Nm^3) Calciner 1 / 2 / 3	Licence Limit (mg/Nm^3)
Particulates (Continuous Daily)	8 / 11 / 14	50
Particulates (Continuous Max Hourly)	12 / 15 / 22	100 (hourly mean)
Particulates (Manual Quarterly)	8 / 13 / 15	50
Nitrogen Oxides (Manual Quarterly)	65 / 86 / 66	200 (60 minute mean)

The 2 gas turbines (Emission pt. ref. no. A3-A and A3-B) operate continuously (with the exception of maintenance periods) and emit through 2 separate stacks. A summary of emissions from the gas turbines are tabulated below for the period from July 2014 to September 2021, all compliant.

Licence Parameter	Average Value (mg/Nm^3) GT1 / GT2	Licence Limit (mg/Nm^3)
NOx (Continuous Daily)	31 / 31	75
NOx (Continuous Max Hourly)	36 / 39	150
CO (Continuous Daily)	4 / 4	110
CO (Continuous Max Hourly)	6 / 7	200

The 2 gas boilers (Emission pt. ref. no. A4-A and A4-B) which operate continuously (with the exception of maintenance periods) emit through 2 separate stacks. A summary of emissions from the gas boilers are tabulated below for the period from July 2014 to September 2021, all compliant.

Licence Parameter	Average Value (mg/Nm^3) D Boiler / E Boiler	Licence Limit (mg/Nm^3)
NOx (Continuous Daily)	71 / 72	110
NOx (Continuous Max Hourly)	77 / 77	200
CO (Continuous Daily)	13 / 7	110
CO (Continuous Max Hourly)	22 / 14	200

A summary of emissions for the 6 dust collection units (Emission pt. ref. no. 6, 12, 16, 17, 18 and 19) is tabulated below for the period from July 2014 to September 2021. Particulates are monitored biannually at these locations.

	Particulates (mg/Nm^3)						
Emission Point Ref. No.	**5**	**6**	**12**	**16**	**17**	**18**	**19**
Q3 2014	-	8	19	14	20	19	24
Q4 2014	-	8	18	19	15	18	16
Q2 2015	-	13	21	23	21	19	18
Q4 2015	-	6	21	41	7	14	22
Q1 2016	-	4	5	15	39	9	16
Q3 2016	-	11	-	8	4	3	-
Q4 2016	-	-	18	-	-	-	4
Q1 2017	-	-	28	-	-	-	-
Q2 2017	-	14	-	8	9	4	3
Q3 2017	-	-	19	8	31	14	4
Q4 2017	-	2	-	-	-	-	-
Q1 2018	-	-	-	-	-	-	-
Q2 2018	-	38	13	18	48	2	2
Q3 2018	-	-	-	12	3	18	33
Q4 2018	-	4	2	-	-	-	-
Q1 2019	-	-	6	5	-	3	2
Q2 2019	-	4	-	-	6	-	-
Q3 2019	-	-	2	3	3	3	4
Q4 2019	6	6	-	-	-	-	-
Q1 2020	2	4	4	7	12	6	2
Q2 2020	-	-	-	-	-	-	-
Q3 2020	3	2	8	8	8	2	6
Q4 2020	-	-	-	-	-	-	-
Q1 2021	-	-	-	-	-	-	-
Q2 2021	2	3	9	4	10	1	8

	Particulates (mg/Nm^3)						
Emission Point Ref. No.	**5**	**6**	**12**	**16**	**17**	**18**	**19**
Q3 2021	2	2	-	-	-	-	-

2. Surface water emissions

There is no proposed change to surface water emissions. The following Table provides a summary of existing emissions via the Licenced discharge point W1-1 for the period July 2014 to September 2021, showing that the discharge complies with the licence limits.

Licence Parameter	**Average Value**	**Licence Limit**
Daily Flow (Volume) (m^3)	13,971	30,000
Hourly Flow (Volume) (m^3)	861	1,250
pH (Max)	7.8	6 – 9
pH (Min)	7.5	6 – 9
Toxicity – Tisbe battagliai (TU)	2.9	5
Toxicity – Microtox (TU)	1.6	5
BOD (kg/day)	691	2,360
Suspended Solids (mg/l)	13	50
Oils, fats and greases (mg/l)	1.81	15
Licence Parameter	**Average Value (since September 28th 2021)**	**Licence Limit (Annual Average)**
Total Organic Carbon (mg/l)	71.4	150
Total Phosphorus (mg/l)	0.06	2

A summary of emissions of sanitary effluent to the Licenced discharge point W1-1 is tabulated below for the period July 2014 to September 2021, showing that the discharge complies with the licence limits.

Licence Parameter	**Average Value**	**Licence Limit**
Daily Flow (Volume) (m^3)	60	240
Hourly Flow (Volume) (m^3)	8	10
pH (Max)	7.3	9
pH (Min)	7	6
BOD (kg/day)	5.9	25
Suspended Solids (mg/l)	3.8	35

3. Storm water emissions

There are no proposed changes to storm water emissions. The following table provides a summary of existing emissions from the 5 surface streams (SS1, SS2, SS3, SS4 and SS5) for the period from July 2014 to September 2021. Trigger levels have been established and agreed with the Agency, as shown below. These trigger levels apply to discharges unaffected by saline intrusion. Sampling is undertaken at low tide, when possible, to avoid saline intrusion.

Parameter	**SS1**	**SS2**	**SS3**	**SS4**	**SS5**	**Trigger Warning Level**	**Trigger Action Level**
pH	8.2	8.2	8.2	8.1	8.2	≤ 6.5 ≥ 9	≤ 6 ≥ 9.5

Parameter	SS1	SS2	SS3	SS4	SS5	Trigger Warning Level	Trigger Action Level
Conductivity (µS/cm)	170	187	174	133	361	> 2000	> 2500
Soda (g/l)	.02	.02	.01	.01	.04	> 1.5	> 2

4. Noise and vibration emissions

Annual noise monitoring is carried out at 5 noise sensitive locations, which consistently confirms compliance with the noise limits (day, evening and night time limits) prescribed in the IE Licence.

Vibration limits are in place associated with the operation of the borrow pit as per below.

Parameter	Proposed Emission Limit Value (ELV)
Ground-borne Vibration	12 mm/s PPV
Air overpressure	125 dB

Operation of the permitted borrow pit has not yet commenced, expected to commence in April 2022. Therefore there are currently no emissions associated with vibration.

The proposed extension of the borrow pit will operate in compliance with these emission limit values. The proposed borrow pit extension will be operational between April and September, with blasting occurring up to 7 times within this period (per year). AA employs specialist blast contractors to design and carry out each blast in the Borrow Pit. All blasts at the site are subject to a specific design, which is carried out in accordance with the relevant design standards, which establish best practice and safety, and has regard to the built environment.

Noise emissions from rock breaking subsequent to blasting will be covered by the existing noise limits at the NSLs. Rock breaking will not present a vibration impact.

Refer to Section 1.1 for further information.

13. Assessment of Effects of Emissions on the Environment as a Whole

Environmental Impact Assessment (EIA) is the process of examining the anticipated environmental effects of a proposed project - from consideration of environmental aspects at design stage, through consultation and preparation of an Environmental Impact Assessment Report (EIAR). An EIAR is a report or statement of the effects, if any, which the proposed project, if carried out, would have on the environment.

An EIAR has been submitted with this application. Cumulative impacts are assessed in the EIAR. Refer to section 6 of this Licence application for further details.

14. Technology to Prevent, Eliminate or Reduce/Abate Emissions

There are no new abatement systems associated with the proposed changes at the site.

Existing techniques for emissions abatement are summarised as follows:

1. Air emissions

Emission Source	Emission Pt. Ref.	Abatement Techniques
HFO boilers (A and C)	A1	1. DCS/BMS control system 2. Low NOx burners 3. Low sulphur HFO
Gas boilers	A4-A & A4-B	1. Natural gas is clean fuel source 2. Dry low NOx burners 3. DCS/BMS control system
Gas turbine 1 & 2	A3-A and A3-B	1. Natural gas is clean fuel source 2. Dry low NOx burners 3. DCS/BMS control system 4. Water/steam addition when operating on gasoil
Calciners	A2	1. Electrostatic precipitators 2. DCS control system
Wet scrubber	5, 6 and 8	1. General extraction
General extraction	12, 16, 17, 18 and 19	1. Dry fabric bag filters
Boilers for building heating	13, 14 and 15	1. Gas oil with <0.2% sulphur

Fugitive air emissions are abated as per dust management plan which includes controls such as:

- A speed limit of 50km/h applies on the main access road and a 30km/h limit applies on the internal site roads thereby minimising potential for dust on roads due to vehicle movements.
- Trucks and loading shovels are inspected to ensure they are clean and fit for purpose
- Automated sprinkler system which wets entire BRDA in 4 hours
- Screening of BRDA with vegetation
- Mud berm placement (up to 3 metre high) on BRDA to reduce wind velocity
- Sprinkler system for alumina hydrate storage pad
- Enclosed storage of bauxite and alumina
- Enclosed conveying systems and transfer points
- Conveyor systems fitted with negative air extraction systems with bag filtration
- Bag filter houses fitted with pulse cleaning and differential pressure monitoring gauges
- Minimal transfer points
- Regular washing of transfer and process areas to prevent dust formation
- Road cleaning
- Application of dust bind on roadways as required
- Regular inspection and preventative maintenance of bag house filter

2. Surface water emissions

Process effluent is slightly alkaline containing traces of sodium aluminate and sodium carbonate. It is collected in ponds and from there pumped to the Effluent Neutralisation and Clarification area. Concentrated sulphuric acid is employed to neutralise the dilute sodium aluminate and this generates a fine aluminium hydroxide ($Al(OH)_3$) precipitate. The resulting water stream containing up to 5,000 mg/l suspended aluminium hydroxide precipitate is flocculated using an anionic flocculant and then clarified in a large diameter raked gravity settler. The overflow stream containing <30 mg/l suspended solids reports to the Liquid Waste Pond where it is re-used or discharged to the river as neutralised effluent. The underflow sludge from the effluent clarifier is recycled back into the acid neutralisation

tank to seed and densify the fresh precipitate. On a daily basis a portion of this sludge is transferred to the Alumina production process to keep the recycling sludge inventory in the effluent neutralisation unit in balance. At the target recycling rate of ~20:1 the sludge density can be controlled at 15-20% solids but normal practice is to operate at a lower recycle rate to minimise any potential odour associated with the sludge.

Sanitary effluent from all buildings is transferred to a sanitary treatment system via underground sewers. There are a number of sewage lifting stations which pump the effluent from low areas in the plant. On arrival at the treatment plant, the effluent enters the influent tank where the larger particles are broken down in a commutator pump. From there it is pumped into the aerator which mixes the organisms which live in the activated sludge with the raw sewage. Through aerobic digestion, the bacterial organisms convert the organic waste to carbon dioxide, etc. and an aerator is provided to ensure an adequate supply of oxygen is available to the organisms. On leaving the aerator chamber, the activated sludge particles coagulate and settle out from the waste water in the clarifier. The clear supernatant overflows via a serrated edge into the effluent tank from where it is pumped to the Shannon via surface water emission point W1-1. The clarifier underflow (activated sludge) is removed on a weekly basis by an approved contractor for transfer to a licenced treatment plant.

3. Storm water emissions

Storm water drains which discharge to 5 monitoring locations are fitted with interceptors and silt traps. Refer to Section 7.2 of this Licence application for further information.

4. Noise emissions

The following BAT techniques are applied to control noise emissions:

- Standard commercial cooling towers are utilised which are low noise emitting equipment
- Heavy duty construction of the plant achieves noise prevention by suitable construction as confirmed by absence of noise complaints and compliant annual noise survey completed by a 3rd party.
- Operational measures are taken to reduce noise emissions. For example, each boiler system has its own DCS /BMS computerised control system. This ensures optimum boiler energy performance, maximum combustion safety and optimum emissions control. This includes during periods of start-up and shutdown.
- Silencers are installed on steam relief valves.
- Acoustic enclosures are installed around blowers and compressors.
- Noise limits are specified at equipment design stage.
- Noise suppression equipment is installed in the CHP plant.
- Vibration is controlled via bellows installed between equipment and pipework and anti-vibration supports installed e.g. on air handling units.

15. Description of Wastes

No waste is accepted from external sources other than alum sludge transferred by pipeline from the nearby Limerick County Council Water Treatment Plant. Those waste streams generated and disposed of onsite are tabulated below.

AAL produces in the region of 16,000t per annum of saltcake from a side stream of 6% of the main refinery liquor stream through an evaporation and salting out process (organics control process). The saltcake is deliquored on belt filters and trucked to a dedicated storage cell in the BRDA. The Saltcake is classified as a hazardous waste. The production of saltcake via this organics control process is

required to manage the balance or concentration of organic compounds in the process liquor. These organics come from trace humic materials in bauxite.

AAL have developed, in conjunction with a number of laboratories and technology suppliers, a process modification to avoid the production of Saltcake from its facility. The research at AAL began in 2015 with a review of the available technologies and in 2018 it was concluded that the most suitable way of modifying the process was to install a Wet Air Oxidation (WAO) system. In summary, WAO was chosen because it was a mature technology with hundreds of installations worldwide. It allows the oxidation products to be recovered to the refinery without any gaseous, liquid or solid emissions. Extensive testing and development has been carried out in Europe and North America to verify the technology and optimise its operability. Refer to Section 1.1 of this application for further information.

The wet air oxidation of saltcake is a positive development with respect to the environment given it will lead to a significant national reduction in hazardous waste disposal. There are no environmental emissions associated with the project and it is fully compliant with all applicable BAT. A detailed project schedule has been developed with commissioning starting in Q4 2022 and fully operational in 2023.

In the interim and during periods of maintenance necessitating the down time of the WAO system, an extension to the SCDC is proposed as part of this application to provide headroom disposal.

The WAO project has been the subject of a Request for Approval under the IE Licence (refer to Licence Return LR 058832).

* Saltcake will no longer be generated once the WAO process is operational.

Waste stream	LOW Code	Description	Tonnes generated per annum (2020)
Saltcake*	01 03 07	Deposited in engineered cell in the BRDA	15,312
Sand	01 03 06	Deposited in the BRDA	107,378
Red mud	01 03 09	Also known as farmed bauxite residue, deposited in the BRDA	1,419,920
Lime grits	01 03 99	Deposited in the BRDA	6,030
Process Wastes	01 03 99	Sand, scales, tank cleanout sludges – deposited in the BRDA	18,073
Flue stack residue	16 11 04	Deposited in the BRDA	72

Those waste streams generated on site and disposed of offsite are tabulated below.

Waste stream	LOW Code	Disposal/Recovery code	Tonnes generated per annum (2020)
Aerosol Cans	15 01 11	R4	3.75
Asbestos	17 06 01	D1	14
Batteries	16 06 01	R4	0.99
Cardboard	20 01 01	R3	13.1
Chemical Waste	16 05 06	R1	0.97
Clinical Waste	18 01 03	D9	0.12
Copper	17 04 01	R4	3.2
Fluorescent Bulbs	20 01 21	R4	12

Waste stream	LOW Code	Disposal/Recovery code	Tonnes generated per annum (2020)
General Waste	20 03 01	D1	152.4
Mercury Liquid	06 04 04	R4	0.013
Oil Filters	16 01 07	R11	0.20
Oily Rags / Oil Dry	13 08 99	D10	5.5
Paper/Documents	20 01 01	R3	1.3
Plastic containers (clean empty IBC's & drums)	20 01 39	R3	50.0
Printer Toner Cartridges	20 01 36	R4	0.14
Radiation Sources	16 02 15	D1	0.003
Sanitary Effluent Sludge	19 08 05	D8	526.5
Steel & Aluminium & Nickel Scrap Metal	17 04 07	R4	933.9
Timber Reels (used)	20 01 38	R11	10.1
Used Hosing & Belting (Rubber)	19 12 04	R11	172
Vegetable Oils & Greases	20 01 25	R3	2.2
Waste Electrical & Electronic Equipment (WEEE)	16 02 14	R4	0.002
Waste Food	02 03 99	R3	15.7
Wood - recycling	20 01 38	R3	108.3
Wood - landfill	20 01 38	D1	17.8
Waste engine, gear and lubricating oils	13 02 08	R9	48.7
Waste lubricating oils	13 02 05	R9	12.0
XRay Fixer Replenisher	09 01 04	R4	0.9
XRay Film	09 01 07	R4	0.2

Refer to section 8.1 of this application.

16. Description of Implementation of Waste Hierarchy

As required by Industrial Emissions Licence P0035-07, AAL has developed a Waste Management Manual which outlines waste management procedures applied at AAL and are intended to ensure effective waste management. Local, legal and environmental requirements, available treatment and disposal options and specific waste streams have been accounted for. The manual provides details for the following aspects of waste management: types of waste generated, list of licensed waste disposal contractors, waste control forms for particular waste streams and waste management procedures.

Waste prevention is not possible due to the nature of the Bayer process. However, the following are measures taken to minimise waste generated:

A. Bauxite residue is the principal extractive waste arising from the Bayer process for production of alumina from bauxite. However, AAL processes the highest grade bauxite available globally. This is the most significant determinant of the waste factor (t waste / t alumina). In addition, AAL also employs triple digestion to maximise alumina recovery which in turns minimises waste factor.
B. AAL employs closed loop cooling water systems for precipitation cooling. This cooling water is itself cooled via direct air contact in a cooling tower.

C. Chemical additives are added to the process to reduce process scaling of equipment. This reduces the volume of process scale to be disposed of in the BRDA
D. Saltcake is an existing waste stream which is a product of an organic impurities removal process. Saltcake is currently being disposed of on-site in a dedicated, lined cell within the BRDA. Saltcake is considered to be a hazardous waste. A wet air oxidation process has been developed that will avoid the generation of saltcake through a process modification of the existing organics control process. This will be achieved via an additional step in the existing organics control process, which avoids production of saltcake. Refer to Section 1.1 of this application for further information. There are no environmental emissions associated with this process modification.

Waste (and process water) is re-used where possible, as follows:

A. Approximately 5% of the bauxite residue after alumina extraction reports as a granular material (150-1000µm) and is termed process sand. This material is removed from the process, washed and trucked to the BRDA for construction of internal roadways within the BRDA.
B. The plant is designed to collect all waste water streams in one area, recycle them to the appropriate process area to substitute for fresh water addition or process them via the licensed effluent treatment and disposal system. The use of recycled water for washing, flocculent dilution, cleaning-acid dilution, dust suppression (sprinkler system) and hosing is standard practice.
C. Used oil from certain equipment is applied as lubricant for other equipment.
D. Construction rubble, generated onsite, is used for road construction in the BRDA.
E. Burnt limestone is slaked onsite, via conventional water slaking, to generate slaked lime which is a key additive to the Bayer process for impurities control and extraction efficiency. There is a fraction which is rejected after the slaking process as stones and grits. These limestone grits (LoW code 10 13 04) are trucked to the BRDA for construction of internal roadways.
F. Calciner refractory material is used for the construction of internal roadways in the BRDA.
G. The industrial effluent sludge from waste water treatment plant is recycled to the alumina process.
H. Batteries, copper, fluorescent bulbs, mercury liquid, metal containers (IBC's and drums), printer toner cartridges, steel and aluminium scrap metal, waste electrical and electronic equipment are recycled off-site for metals recovery.
I. Cardboard, paper, vegetable oils and greases, waste food and wood are recycled off-site for organic substances.
J. Plastic containers and waste oil are recycled off-site for oil refining.
K. Chemical waste is recovered offsite for energy recovery.

Given that bauxite residue is the principal waste by-product of the Alumina refinery process, extensive research has been and is being undertaken in respect of its management with a view to minimising the volume required to be disposed of.

The alumina refinery industry as a whole continues to search with growing interest and success, for technically and economically viable options for residue critical element extraction and residue bulk utilisation, with the overall objective of producing less residue and contributing more to the circular economy. Innovative residue treatments can change residue properties, potentially allowing different long-term storage, rehabilitation and utilisation options.

However, it should be noted that bauxite residue management is not "one-size fits all" and technology selection and management practices have to be adapted to local circumstances. The solutions and

practices used at each refinery are further influenced by local climatic, geographic and environmental conditions, as well as government policies, regulatory frameworks and community factors.

In this regard, AAL have, since 2015, been involved in research and developing technological options for bauxite residue reuse at the AAL facility, in collaboration with industry partners, European Universities and Research Institutes. Examples of these research projects include Al Geopolymer, Al Source, RECOVER, RemovAl, and ReActiv.

The Al Geopolymer project carried out by the University of Limerick for the EPA, involved a desk-based study focused on a state-of-the-art review related to geopolymers, including a technology overview. The objective of the research was to investigate the potential for wastes at the AAL facility (fly ash, bauxite residues, etc.) to be used in geopolymer applications and the opportunities for these geopolymer applications within Ireland.

The Al Source project carried out by the University of Limerick for the EPA, looked at bauxite residue as a potential source for Critical Raw Materials or CRMs, which are fundamental to Europe's economy, growth and jobs and are essential for maintaining and improving our quality of life.

The RECOVER, RemovAl and ReActiv projects are three EU funded projects, which AAL are involved in. These projects study the potential for the re-use of bauxite residue, at a pilot scale, in the construction sector, as an alternative raw material. These projects, as well as potentially finding a use for bauxite residue, aim to enable the construction sector to reduce their CO_2 emissions by utilising secondary raw materials in production. Research in this area is ongoing.

Notwithstanding the ongoing research efforts outlined above and AAL's continued commitment to exploring alternative uses and applications for bauxite residue, there are at present no alternative methods which would eliminate the existence of bauxite residue as a by-product from the alumina refinery process. As such, there is a need to facilitate the storage of bauxite residue. The current BRDA storage arrangement of the bauxite residue represents best practice in the industry and ensures that the bauxite residue is fully secured and risks of spillage or leakage of the residue beyond the BRDA is fully ameliorated.

Waste is segregated where possible, as follows:

A. Process water is segregated from uncontaminated rainwater and other uncontaminated water releases.
B. Sanitary effluent is segregated from process effluent for treatment by an on-site licenced waste treatment facility.
C. The following waste is segregated onsite to allow for recycling, recovery or disposal offsite: batteries, cardboard, timber, aerosol cans, asbestos, canteen waste, clinical waste, fluorescent light tubes, plastic drums and containers, hazardous material, radioactive sources, oil filters, oily rags, plastic, rubber, printer cartridges and scrap metal.

Refer to Section 8.1 of this application.

17. Preventative Measures Taken Against Pollution, In Particular through Application of BAT

Compliance with BAT is assessed within the application (Section 4.7) in the context of the following documents which demonstrates that all preventative measures are taken against pollution within the existing facility and within the design of the proposed changes:

Document type	Year of Issue	Title
Commission Implementing Decision (CID)	2017	CID for Large Combustion Plant
Commission Implementing Decision	2016	CID for Common Wastewater and Waste Gas Treatment in the Chemical Sector
Commission Implementing Decision	2017	CID for the Non Ferrous Metals Industry
Reference Document on Best Available Techniques (BREF)	2009	BREF for Energy Efficiency
Reference Document on Best Available Techniques (BREF)	2006	BREF on Emissions from Storage
Reference Document on Best Available Techniques (BREF)	2001	BREF on Industrial Cooling Systems
Reference Document on Best Available Techniques (BREF)	2006	BREF on Economics and Cross Media Effects
Reference Document on Best Available Techniques (BREF)	2018	Monitoring of Emissions to Air and Water from IED Installations
Reference Document on Best Available Techniques (BREF)	2016	BREF for Management of Waste from Extractive Industries
Reference Document on Best Available Techniques (BREF)	2007	BREF on Large Volume Inorganic Chemicals, Solids and Other Industry
BAT Guidance note	2008	General Inorganic and Alumina Sector

18. Measures Taken Under Abnormal Operating Conditions

Potential emissions are emissions that are not active under normal operation, as outlined in Section 7.4.2 of this application. Measures are in place to prevent such conditions, as outlined below. Such conditions do not occur given these mitigation measures.

Abnormal condition	Mitigation measures
Failure of digester back pressure control valve leading to steam entrained with process chemicals	1. Non-destructive testing program 2. Extensive digestion wear program 3. Preventative maintenance
Failure of pressure control system leading to steam entrained with process chemicals in flash tanks	1. Non-destructive testing program 2. Preventative maintenance
Fire in CHP plant	Fire protection system installed
Gas leak from CHP plant	Protection measures are in place to prevent gas release. For example (1) The GNI AGI is secured and maintained by GNI, emergency shut off v/v is tested every 6 months and area is ATEX rated (2) The AAL AGI is secured, emergency shutdown v/v's operated manually from control room and area is ATEX rated. The CHP plant and pressure reducing station also have similar controls in place.
Over-pressure CHP steam safety release leading to steam release	Automatic trip point based on pressure which is integrated into control logic

Abnormal condition	Mitigation measures
Failure of gas pressure reduction gas system leading to natural gas release	Protection measures are in place to prevent gas release. For example (1) The GNI AGI is secured and maintained by GNI, emergency shut off v/v tested every 6 months and area ATEX rated (2) The AAL AGI is secured, emergency shutdown v/v's operated manually from control room and area is ATEX rated. The CHP plant and pressure reducing station also have similar controls in place.
Failure of calciner and gas safety vents leading to release of natural gas	Protection measures are in place to prevent gas release. For example (1) The GNI AGI is secured and maintained by GNI, emergency shut off v/v tested every 6 months and area ATEX rated (2) The AAL AGI is secured, emergency shutdown v/v's operated manually from control room and area is ATEX rated. The CHP plant and pressure reducing station also have similar controls in place.

Start up and shutdown conditions are defined in standard work methods for the calciners and combustion plant. These methods are designed to ensure optimum emissions control during start up and shut down.

Additional measures are summarised in Part 10 of this non-technical summary.

19. Measures to be Taken Following Cessation of Activities

A detailed and fully costed Closure, Restoration and Aftercare Management Plan (CRAMP) was agreed with the Agency in 2014. In 2018, the CRAMP and associated closure costs were reviewed and updated by the PM Group in accordance with the EPA 2014 guidance document '*Guidance on Assessing and Costing Environmental Liabilities*'. This was subsequently approved by the Agency in June 2018. An update of this 2018 CRAMP was provided in 2019 as part of the licence review application for P0035-07,

In addition, a separate CRAMP has been submitted with this application to reflect the impact of the proposed changes on the closure plan and associated costs.

The objective of the CRAMP is to ensure no long term risks of environmental pollution post closure.

Refer to Section 9.1 of this application for the detailed CRAMP and associated costs.

Financial provisions have been put in place and agreed with the Agency for the costs associated with closure and aftercare of the site.

20. Measures Planned to Monitor Emissions to the Environment

There are no proposed changes to monitoring of emission.

A. Borrow pit

It is proposed that noise and vibration monitoring during blasting within the proposed borrow pit extension will be conducted at the nearest noise sensitive receptors, i.e. NSL2 and NSL5, as well as an additional location NV1 (Walsh residence, for vibration only). There are no proposed changes to frequency of monitoring: specifically for each blasting event, for which there will only be one each time blasting is to occur. Blasting will occur approximately 6 to 7 times per year between the months of April and September.

B. Noise monitoring

It is proposed to complete noise monitoring annually at the 5 No. noise sensitive locations, at which noise limits apply. Refer to Section 1.1 of this Licence application for further details.

Existing monitoring is summarised as follows:

1. Air

Emission Source	Emission Pt.	Control parameter	Monitoring Frequency	Monitoring Method
HFO boiler stack	A1	Opacity PM_{10} and $PM_{2.5}$	Continuous Annually	Opacity monitor Isokinetic sampler
		NOx	Continuous	Flue gas analyser
		SOx	Continuous Quarterly manual	Flue gas analyser Flue gas analyser
Calciner stack	A2	Particulates	Quarterly	Isokinetic/gravimetric
			Continuous	Scattered light monitor
		NOx	Quarterly	Electrochemical cell
Gas Turbines	A3-A, A3-B	NOx	Continuous	Flue gas analyser
		Carbon monoxide	Continuous	Flue gas analyser
Gas boilers	A4-A, A4-B	NOx	Continuous	Flue gas analyser
		SOx	Bi-annually	Flue gas analyser
		Particulates	Bi-annually	Gravimetric
		Carbon monoxide	Continuous	Flue gas analyser
Wet scrubber	5, 6 and 8	Particulates	Bi-annually	Gravimetric
General extraction	12, 16, 17, 18 and 19	Particulates	Bi-annually	Gravimetric

Ambient SO_2 monitoring is carried out via SO_2 diffusion tubes at 2 locations offsite (Foynes and Ballysteen).

Fugitive air emissions (particulates) are monitored via dust deposition gauges and continuous particulates monitors. There are 35 dust deposition gauges located both onsite (no. 30) and offsite (no. 5) which are monitored monthly. Dust deposition monitoring is carried out using the Bergerhoff dust deposition method with dust deposition reported in $mg/m^2/day$. In addition, ambient dust monitoring (PM_{10} and $PM_{2.5}$) using continuous Osiris particulate monitors is carried out at 6 locations (2 no. onsite and 4 no. offsite).

2. Water

Treated effluent (which is a waste water to surface water emission), sanitary effluent and storm water are monitored as tabulated below. In addition to aluminium, those metals which are monitored for are: arsenic, cadmium, chromium, copper, iron, lead, magnesium, mercury, nickel, titanium and zinc.

Parameter	Treated effluent	Sanitary effluent	Storm water
Volume	Continuous	Continuous	N/A
Temperature	Continuous	N/A	N/A
pH	Continuous	Continuous	1/month

Parameter	Treated effluent	Sanitary effluent	Storm water
Conductivity	N/A	N/A	1/month
BOD	4/year	4/year	N/A
Suspended solids	Daily	1/week	N/A
Total Organic Carbon	Daily	N/A	N/A
Total Phosphorus	Daily	N/A	N/A
Soda	1/week	N/A	1/month
Oils, fats and greases	4/year	N/A	N/A
Organics	2/year	N/A	N/A
Toxicity	2/year	N/A	N/A
Aluminium	4/year	N/A	N/A
Other metals	2/year	N/A	N/A

Groundwater is monitored as tabulated below. Those metals analysed for are: aluminium, arsenic, cadmium, chromium, copper, iron, lead, magnesium, mercury, nickel, titanium and zinc. The organics monitored for are those associated with fuel.

Parameter	Plant observation wells	Observation wells at the BRDA	Estuarine streams	Boreholes	South pond wells	North pond wells
pH	4/year	4/year	4/year	N/A	4/year	4/year
Level	4/year	4/year	N/A	N/A	4/year	4/year
Total alkalinity	4/year	4/year	N/A	N/A	4/year	4/year
Conductivity	4/year	4/year	4/year	N/A	4/year	4/year
Chloride	4/year	4/year	N/A	N/A	4/year	4/year
Fluoride	4/year	4/year	N/A	N/A	4/year	4/year
Soda	4/year	4/year	4/year	N/A	4/year	4/year
Sulphate	4/year	4/year	N/A	N/A	4/year	4/year
Metals	2/year	2/year	4/year (Al only)	N/A	2/year	2/year
Organics	N/A	N/A	N/A	1/year	N/A	N/A
Relevant Hazardous Substances	2/year	2/year	N/A	N/A	2/year	2/year

There are a number of other surface water monitoring points in the area of the BRDA, as below.

Parameter	Mangan's Lough	OPW channel	Phase 2 West Robertstown Gate	Toe Drains 1, 2 and 3	Boreholes 4 and 5
pH	1/month	1/month	1/month	1/month	1/month
Conductivity	1/month	1/month	1/month	1/month	1/month
Soda	1/month	1/month	1/month	1/month	1/month

3. Noise Emissions

Noise emissions are monitored annually by an independent external contractor at 5 specified noise sensitive locations.

Furthermore, air overpressure monitoring and vibration monitoring will be carried out at 3 locations for each blast at the permitted borrow pit, as per Licence P0035-07, and the proposed borrow pit extension.

Refer to Section 7.5 of this Licence application for further details.

4. Waste

Waste is monitored as tabulated below. Those metals analysed for are: aluminium, arsenic, cadmium, chromium, copper, iron, lead, magnesium, mercury, nickel, titanium and zinc.

Parameter	Farmed bauxite residue	Saltcake	Sand	BRDA Leachate
pH	4/year	4/year	4/year	4/year
Dry matter	4/year	4/year	4/year	4/year
Total alkalinity	4/year	4/year	4/year	4/year
Chloride	4/year	4/year	4/year	4/year
Fluoride	4/year	4/year	4/year	4/year
Soda	4/year	4/year	4/year	4/year
Metals	4/year	4/year	4/year	4/year

5. Soil

Soil monitoring is carried out every 5 years, as per Licence requirement at soil monitoring locations agreed by the Agency. Those parameters which are monitored for are: pH, total sulphate, metals, sodium and organics associated with HFO, petrol and gas oil.

6. BRDA

Monitoring of the BRDA is carried out as follows:

Location	Parameter	Frequency
BRDA embankment	Phreatic surface	4/year
	Hydrostatic pore pressure	4/year
BRDA embankment wall	Standard walk-over condition and stability checks	1/day
	Settlement / movement	4/year
	Annual review	1/year
	Independent review	1/2 years
	Formal 'Safety Evaluation of Existing Dam (SEED)' audit	1/15 years
BRDA and residue	Volume of residue disposed	Continuous
	Tonnage of residue disposed	1/month

Location	Parameter	Frequency
	Used capacity	1/year
	Remaining capacity	1/year
BRDA perimeter interceptor channel	Water level	Weekly
	Quantity of seepage loss from BRDA	1/month

21. Measures to Comply with an Environmental Quality Standard

AAL has been certified to an environmental standard, ISO14001 since 2000 and is currently certified to ISO14001:2015 since 2017.

In addition to ISO14001 environment standard, AAL is also certified to the following management standards:

A. ISO9001: 2015 Quality Standard (certified to ISO9001 since 1995)
B. ISO50001: 2011 Energy Standard (certified since 2016)
C. International Safety Rating System (ISRS) Advanced Level 8 (certified to Level 8 since 2002)
D. Aluminium Stewardship Initiative (ASI) Performance Standard (since 2022)

An EMS/QMS Manual provides an overview of the Environmental Management System (EMS). This manual outlines the approach taken to address the elements/subjects of the standard. Refer to Section 9 of this Licence application for the EMS/QMS Manual which describes how AAL complies with the environmental and quality standards.

22. Measures to Comply with Council Directive 80/68/EEC and 2006/118/EC Relating to Groundwater Protection

Measures employed at the AAL site to protect groundwater include an extensive bunding regime, where all process areas are fully bunded in accordance with licence conditions and EPA guidance. All bunds, tanks, open process drains, sumps, pipelines, ponds and sewer lines are integrity tested every 3 years in accordance with the requirements of the IE licence. The site also provides large storage ponds and spillways to allow for remote bunding of process areas with large volume storage. Ponds and spillways are all checked for integrity as part of the integrity testing schedule. Process drainage systems are visually inspected on a regular basis by each Local.

AAL continues to mitigate the risk of groundwater contamination by intercepting and recovering water from a number of Estuarine Streams, as well as other recovery wells on site. Three additional recovery wells have been installed in recent years to the east of the site as part of the groundwater improvement programme, as well as a further 2 POWs (POW11 and POW18) which are now recovered. These wells report to the East Pond to join the plant process effluent stream, which ultimately goes for treatment at the site wastewater treatment plant in Area 34. This recovery programme has resulted in pH improvements since the site baseline report which was developed in 2014.

AAL continues to make investment in environmental management by targeting priorities for plant repair and replacement identified through groundwater monitoring and integrity testing. This has resulted in significant upgrades to the site including the provision of new drainage of the BRDA access road, recovery well installation, significant bund plating works in A41, A48, A04 and A07, drain lining upgrades, bund extensions, and removal of gravel areas in certain locations. AAL have an annual groundwater improvement programme which involves a capital expenditure of circa €750,000 per year.

Protecting and improving the groundwater environment is a high priority for AAL.

23. Measures Taken to Minimise Pollution over Long Distances or Outside the Territory of Ireland

There are no measures required as emission of pollutants (apart from CO_2) to air from AAL are not significant.

24. Main Alternatives to Proposed Technology, Techniques and Measures

Raise of the bauxite residue disposal area

Given that bauxite residue is the principal waste by-product of the Alumina refinery process, extensive research has been and is being undertaken in respect of its management with a view to minimising the volume required to be disposed of.

The alumina refinery industry as a whole continues to search with growing interest and success, for technically and economically viable options for residue critical element extraction and residue bulk utilisation, with the overall objective of producing less residue and contributing more to the circular economy. Innovative residue treatments can change residue properties, potentially allowing different long-term storage, rehabilitation and utilisation options.

However, it should be noted that bauxite residue management is not "one-size fits all" and technology selection and management practices have to be adapted to local circumstances. The solutions and practices used at each refinery are further influenced by local climatic, geographic and environmental conditions, as well as government policies, regulatory frameworks and community factors.

In this regard, AAL have, since 2015, been involved in research and developing technological options for bauxite residue reuse at the Aughinish facility, in collaboration with industry partners, European Universities and Research Institutes. Examples of these research projects include Al Geopolymer, Al Source, RECOVER, RemovAl, and ReActiv.

The Al Geopolymer project carried out by the University of Limerick for the EPA, involved a desk-based study focused on a state-of-the-art review related to geopolymers, including a technology overview. The objective of the research was to investigate the potential for wastes at the AAL facility (bauxite residues, etc.) to be used in geopolymer applications and the opportunities for these geopolymer ap-plications within Ireland.

The Al Source project carried out by the University of Limerick for the EPA, examined bauxite residue as a potential source for Critical Raw Materials or CRMs, which are fundamental to Europe's economy, growth and jobs and are essential for maintaining and improving our quality of life.

The RECOVER, RemovAl and ReActiv projects are three EU funded projects, which AAL are involved in. These projects study the potential for the re-use of bauxite residue, at a pilot scale, in the construction sector, as an alternative raw material. These projects, as well as potentially finding a use for bauxite residue, aim to enable the construction sector to reduce their CO2 emissions by utilising secondary raw materials in production. Research in this area is ongoing.

Notwithstanding the ongoing research efforts outlined above and AAL's continued commitment to exploring alternative uses and applications for bauxite residue, there are at present no alternative methods which would eliminate the existence of bauxite residue as a by-product from the alumina

refinery process. As such, there is a need to facilitate the storage of bauxite residue. The current BRDA storage arrangement of the bauxite residue represents best practice in the industry and ensures that the bauxite residue is fully secured and risks of spillage or leakage of the residue beyond the BRDA is fully ameliorated.

Raise of the saltcake disposal cell

With regard to the expansion of the SCDC, ongoing investigations into the alternative treatment of Salt Cake have determined that a Wet Air Oxidation (WAO) System would eliminate the need for Salt Cake storage within the SCDC. Arising from this, a project schedule relating to the installation of this system has been developed with commissioning to be completed in 2023.

There are no additional environmental emissions associated with this process and it is fully compliant with all relevant EU 'Best Available Technique'. The EPA have approved the operation of the process under Condition 1 of AAL's existing IE Licence. It is anticipated that this process will be integrated into the Plant in 2023. Until such time, the current SCDC is required to provide Salt Cake disposal capacity. The proposed SCDC extension will also facilitate salt cake disposal during periods of maintenance necessitating the down-time of the WAO system.

Extension of the rock extraction area

The preliminary design of the borrow pit extension provided for a larger extraction area of c. 4.5ha which projected further to the south of that now proposed. In the preparation of the EIAR for the proposed development, a recorded monument (LI010-108; Enclosure) which may have been intersected by the application boundary was identified. Associated with this, it was also calculated that the rockfill requirements for construction of the proposed development were less than previously anticipated (due to the on-going importation of rockfill from a local quarry up to and including Quarter 1 of 2022 and the existing stockpile of rock on site).

The revised design of the borrow pit extension area now ensures that there is a set-back from the boundary of the recorded monument to ensure there is no direct impact on this enclosure. The EIAR for the proposed development states that *'The recorded enclosure (LI010-108) possesses no surface expression; however, the proximity of the development will result in a slight negative indirect impact on the setting of the monument.'*

The location and design of the proposed development represents the most appropriate option to ensure the ongoing operation of the alumina refinery facility adjoining the application site. The proposed development will ensure that high levels of demand for alumina for use in products such as renewable energy technologies is secured and satisfied within Europe into the future beyond 2030.

25. Likely Effects for Those Changes which Required an EIAR

EIAR for BRDA Raise

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
Archaeology, Architectural and Cultural Heritage	Recorded enclosure site (LI010-108), is located outside of the proposed development boundary. As a result, there is no predicted direct impact on the recorded monument. However, the geophysical survey (Licence 21R0086, Leigh 2021) identified isolated anomalies to the north of the enclosure and within the planning application site. It is possible that these anomalies represent small-scale archaeological features. There is also potential for previously unidentified archaeological features of deposits to survive within the planning application site, which were not indicated in the geophysical survey.	Groundworks associated with the proposed development (prior to the application of mitigation) may have a direct significant negative impact on the archaeological features or deposits, if they survive. The recorded enclosure (LI010-108) possesses no surface expression; however, the proximity of the development will result in a slight negative indirect impact on the setting of the monument.	A programme of targeted archaeological test-trenching will be carried out within the north eastern, previously undisturbed, section of the planning application site. These works will be carried out under licence to the National Monuments Service. If any features of archaeological potential are discovered during the course of the works further archaeological mitigation may be required, such as preservation in-situ or by record and/or monitoring. Any further mitigation will require approval from the National Monuments Service of the Department of Housing, Local Government and Heritage (DoHLGH).

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
Biodiversity	The BRDA surface is farmed bauxite residue (ED5/ED2) with no vegetative cover. The BRDA surface is of negligible ecological value. There will be a localised loss of a small area of scrub and grassland habitat associated with the proposed development. Activities associated with the proposed borrow pit development have the potential to disturb and/or displace key faunal species of the designated site The River Shannon & River Fergus Estuaries SPA and Lower River Shannon SAC (Otter only) through increased disturbance such as, noise and/or visual cues. Blasting has the potential to cause localised disturbance of fauna. The borrow pit extension will require the clearance of an area of scrub which is likely to marginally decrease the local foraging resource for bats. In the absence of	The clearance of vegetation and operation of the extended borrow pit, in particular, could potentially result in localised disturbance and displacement effects on faunal species. Similarly, the NIS which was prepared to accompany the EIAR determined that while the development site is not located within any Natura 2000 site it is located proximate to several designated conservation areas which are considered within the zone of influence of the proposed development (i.e. indirect hydrological impact and ex-situ disturbance impacts).	Detailed mitigation measures have been provided and assessed as part of the EIAR. Mitigation specific to the proposed project includes a commitment to carry out vegetation clearance only outside of the bird breeding season. Lighting has been minimised and where necessary has been specified in keeping with the current guidance on Bat friendly lighting design. The progressive restoration and closure plan has integrated pollinator friendly and preference for native species. With the implementation of the environmental controls and mitigation described in the EIAR it is concluded that the residual impacts on habitats, birds, mammals (including bats) and other fauna will be at most slight neutral in the medium to longer term. In the longer term the landscaping and other mitigation (including the creation of grassland with hedgerows on the capped BRDA) are likely to see a moderate to significant positive effect on local biodiversity, particularly in the BRDA area.

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
	mitigation (e.g. in relation to the timing of vegetation removal and of blasting) there is potential for likely significant negative effects on birds occurring locally. This would include some potential for disturbance and displacement of waterbirds present in areas relatively close to the borrow pit area, particularly Poulweala Creek.		
Land and Soils (Geology and Hydrogeology)	Stability issues may arise during excavation of borrow pit faces, during the forming of stockpiles of blast and processed rock fill or from the stockpiling of imported soil for restoration activities.	Extraction of rock by drilling and blasting, creating a void and stockpiling materials has the potential to affect human health of workers if the earthworks were to become unstable.	Site operations at the Borrow Pit Extension will be managed in accordance with relevant health and Safety legislation (Safety, Health & Welfare at Work Act (2005, as amended); and the Mines and Quarries Act (1965, as amended)) and subsequent Quarries Regulations relating to health and safety, training, and appropriate site management.
Land and Soils (Geology and Hydrogeology)	Stability issues may arise in the BRDA and/or SCDC, in the proposed Borrow Pit Extension, or at the stockpiles as a result of vibration from a trigger event.	A trigger event, e.g., seismic event or a blast event, could cause instability and failure within the BRDA and/or SCDC (existing and proposed), within the Borrow Pit Extension or for stockpiles of materials.	The site for the Borrow Pit Extension is at a greater distance from the BRDA than the permitted Borrow Pit and instability resulting from blasting within this area is considered to be even less likely than from the permitted Borrow Pit site. The vulnerability of the existing BRDA and SCDC, and the vulnerability of the proposed raises to structural failure has been considered in detail in the Engineering Design

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
			Report for the BRDA Raise Development and under Major Accidents and Disasters. Vibration thresholds for peak particle velocity (PPV) have been determined for the BRDA and for the gas transmission line.
Land and Soils (Geology and Hydrogeology)	Structural failure could occur in either the existing or proposed SCDC, independently of the existing of the existing or proposed BRDA.	Structural failure of the SCDC could include dam wall failure, crest settlement or slope instability.	The SCDC is located within the Phase 1 BRDA Extension footprint, if the SCDC were to be breached and salt cake were to mobilise, it would be contained within a composite lined area. Regular operational monitoring and management by Contractors will be conducted, along with implementation of design and best practice.
Land and Soils (Geology and Hydrogeology)	Containment failure of bauxite residue and/or water from the BRDA or ancillary facilities.	There is potential for increased volume of discharge and increased extent of discharge during a breach scenario due to the proposed increase in elevation of the BRDA to Stage 16.	The Phase 1 BRDA has a Very Unlikely (≈1 in 10,000) to Highly Improbable (≈1 in 100,000) annual risk of containment failure and Phase 2 BRDA has a Highly Improbable (≈1 in 100,000) to Almost Impossible (≈1 in 1,000,000) annual risk of containment failure These values are significantly less than the annual average probability of worldwide tailings dam failures based on statistical data (≈ 1 in 2,000). If the FTDB is breached due to a tidal surge, and a BRDA breach scenario occurred, the bauxite residue and containment wastewater would potentially be washed into the Robertstown and Shannon Rivers. However, the expected break-out volumes are relatively small. With implementation of good operational practices, regular monitoring, and the mitigation procedures the

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
			potential impact of the BRDA raise is predicated to be low (adverse).
Land and Soils (Geology and Hydrogeology)	Fuel and other substance leaks or spills from stored substances, or from machinery/equipment used during development, construction of the BRDA, SCDC closure works, and Borrow Pit Extension.	Leaks and spills could affect the chemistry of the soil and lead to ground contamination.	There will be no underground tanks, no septic tanks, and refuelling will take places using a mobile bowser fuelling plant, only in designated areas suitable for refuelling. There are no planned discharges to ground, and hazardous materials will be managed and stored appropriately.
	Import of additional commercial soils to the site.	Imported soils on to site, required to complete the proposed closure and restoration works for the BRDA, SCDC, and the Borrow Pit Extension area, may introduce a source of contamination.	Imported commercial soils will be uncontaminated and sourced from approved and licenced providers in accordance with EPA guidance. These imported soils are proposed to be stockpiled in the existing stockpile yard to the south of the BRDA and be utilized for progressive restoration during the operational and closure phases of the Proposed Development.
Land and Soils (Geology and Hydrogeology)	Visual and environmental issues resulting from built structures following closure of the facility.	Potential for dust blow, seepage, leaching, erosion and negative visual aspects.	Detailed design provided for progressive closure during operations and final capping, restoration, landscaping and water management / treatment structures upon closure. Continued aftercare monitoring (including stability checks and assessments) for a minimum of 30 years following closure. Known design, construction management and operation measures were accounted for in the assessment of initial impacts and effects. Where additional mitigation

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
			measures could be incorporated to reduce the initial impacts and effects, these were identified and included in an assessment of residual impacts and effects.
Landscape and Visual Impact	Negative effects on a range of landscape and visual receptors are predicted as a result of the Operational Phase. There may be cumulative effects resulting from the combination of the Proposed Development and the N69 upgrade and Shannon Foynes Extension.	The nature of the proposed development is dynamic, due to the progression of the BRDA stages, changing volumes of stockpiling and successive planting / seeding works resulting in varying impacts throughout the lifespan of the development. As construction works would occur mainly within established BRDA the Construction Phase effects would be Not Significant or Imperceptible, with exception of Moderate, Negative, Temporary effects for scrubland in the proposed borrow pit area. In the Operational Phase, Moderate Negative landscape effects would occur for the Shannon Estuary ICMZ landscape character area, but effects on landscape / seascape receptors would be Slight Negative or less. There would be no significant landscape effects. Significant Negative visual effects during the Operational Phase are limited to a small number of residential receptors in Robertstown, Sroolane North and Oorla. Moderate, Negative effects are limited to	Progressive mitigation measures are proposed for the Operational and Completed Phase. The intention of the mitigation proposals is to ensure that the extents of unmitigated rock side-slopes are kept to a minimum throughout the Operational Phase, as far as is operational feasible. These include successive planting / seeding to the side slopes and top domed surface of the BRDA, to aid integration with surrounding landscape and reduction of visual effects from engineered features. Mitigation Proposals are likely to result in a neutralisation of the landscape and visual effects in the Completed Phase. Once established towards the end of the medium-term the mitigation proposals will be successful in integrating the development into the landscape context as well as providing a benefit to visual amenity. Over the long-term it is expected that there will be positive improvement of the landscape and visual resource when compared to both the baseline environment and the restoration proposals specified under the existing permitted development.

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
		these same areas and to elevated land to the west of Foynes. All other visual receptors would experience a Slight/Moderate, Negative or lower effect.	
Hydrology	The assessment considers the potential sources of change resulting from the Proposed Development on hydrological (surface water) receptors, hydrogeological (groundwater) receptors and the potential secondary effects on land, people, ecology (including water dependent habitats or ecological receptors) and infrastructure, as appropriate. It considers groundwater levels, flow regime, and quality; and surface water flows, quality and flood risk. The potential effects identified are: • Mobilisation of leachate by operational works, e.g., earth movements, that could impact water quality and use;	The following potential sources have been identified through the project description and experience of similar construction activities: • Refuelling leaks or spills could introduce hydrocarbons to the water environment at the Borrow Pit extension site. • Seepage from the BRDA site. • Leaks and spills of substances during storage, transport, use and/or disposal. • Operational activities such as excavations and earth movement represent potential sources of suspended solids. • Changes in recharge to groundwater could occur on the proposed Borrow Pit Extension site due to the removal of superficial deposits and bedrock. This could, in turn, result in a change in groundwater resource availability.	The proposed Borrow Pit Extension extraction elevation has no interaction with the groundwater. No surface water bodies, or streams are present in the vicinity of the proposed Borrow Pit Extension site or the existing Borrow Pit site. A hydrological assessment for the existing BRDA water management system (Golder 2021) was conducted for the worst-case operational scenario. In this scenario, there is no opportunity for storage of surface water on the topography of the BRDA, surface water runoff will report directly to the PIC segments and all of the waters are required to be managed within the water management system for the facility i.e., no emergency discharge permitted for the inflow design flood (IDF) event. The proposed activities at the Site are all extensions to existing activities, systems and monitoring of groundwater and surface water quality in the vicinity of the Site are in compliance with the IEL requirements. Therefore, activities, systems and monitoring installations are already in place to manage and limit the potential impact from refuelling, seepage from the BRDA, and leaks and spills from stored and used substances.

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
	• Changes in groundwater levels and flow regimes (and, therefore, water availability); and • Activities that might impact water quality and use, e.g., increased suspended solids, leaks and spills from machinery or stored substances, or discharges – including drainage and waste-water discharges, leakages and seeps from the BRDA/SCDC and their potential impacts, and effects on water quality at the SACs/SPAs. • Seepage / leakage from the BRDA after closure.		Seepage modelling has been undertaken by Golder for the BRDA at closure following the construction to Stage 16 and the construction of the dome and the capping and restoration works. The results of the modelling that there is negligible seepage through the base of the facility, either in the unlined or lined phases. There is potential for leachate leakage from the BRDA after closure, however, it is likely that leakages would be minor and isolated and modelling completed by Golder indicates that water accumulating in the PIC at closure will be predominantly from surface water runoff, not from basal seepage. Active monitoring of the observation well field will be continued for a minimum of 5 years after closure and will identify any potential contamination at an early stage which can be remediated. The monitoring is the passive after-care phase is expected to continue for a minimum of an additional 30 years. Closure impacts on human water users in the area are likely to have minimal impact. The nearest mapped water borehole is located c. 1.7 km from the Site and the area is serviced by mains water supplies. There is limited potential for the mobilisation of contamination from the Site as the majority of the BRDA is within a separate groundwater aquifer to mapped wells and these wells are also upgradient. Capping of the BRDA and SCDC will also result in no additional storage of bauxite residue or salt cake on site and no surface water infiltration.

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
Air Quality	The greatest potential impact on air quality during the construction phase is $PM_{10}/PM_{2.5}$ emissions and the potential for nuisance dust.	Dust generated during the construction phase, if unmitigated, could lead to $PM_{10}/PM_{2.5}$ concentrations beyond the site boundary which exceed the ambient air quality standards for these parameters. In addition, nuisance dust levels beyond the site boundary, if unmitigated, could exceed the TA Luft guidance level for dust deposition.	In order to minimise dust emissions, a series of mitigation measures have been prepared in the form of a dust minimisation plan. This includes mitigation measures recommended in the Institute of Air Quality Management *Guidance on the Assessment of Dust from Demolition and Construction Version 1.1* for sensitive receptors. Provided the dust minimisation measures outlined in the Plan (see Appendix 11.2) and site management plan are adhered to, the air quality impacts during the construction phase will not be significant. In summary the measures which will be implemented will include: • Hard surface roads will be swept while any un-surfaced roads will be restricted to essential site traffic. • Furthermore, any road that has the potential to give rise to fugitive dust is regularly watered using tractor tower bowser tanks, as appropriate, during dry and/or windy conditions. • Vehicles using site roads have their speed restricted, and this speed restriction will be enforced rigidly. The speed limit on the main access road is 50 km/hr whilst 30 km/hr is applied on internal site roads. • Vehicles delivering material with dust potential use a dedicated wheel wash prior to leaving the site. • Material handling systems and site stockpiling of materials are designed and laid out to minimise exposure to wind. Water misting or sprays is used as required if particularly dusty activities are necessary during dry or windy periods.

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
Air Quality	The greatest potential impact on air quality during the operational phase is $PM_{10}/PM_{2.5}$ emissions and the potential for nuisance dust.	Dust generated during the operational phase, if unmitigated, could lead to $PM_{10}/PM_{2.5}$ concentrations beyond the site boundary which exceed the ambient air quality standards for these parameters. In addition, nuisance dust levels beyond the site boundary, if unmitigated, could exceed the TA Luft guidance level for dust deposition.	The main BAT mitigation measures are the extensive network of automatic water sprinklers which mitigate against dust erosion from the BRDA and the extensive use of raised residue berms to reduce wind speed thus reducing the potential for dust migration off-site. The operation of the water sprinklers increases the moisture of the bauxite residue and thus reduce dust emissions. This mitigation measure is defined as best available technology (BAT) (BAT 49 – Water or water-based solutions spraying) as outlined in the European Commission publication "*Best Available Techniques (BAT) Reference Document for the Management of Waste from Extractive Industries in accordance with Directive 2006/21/EC*". In addition to the extensive network of automatic water sprinklers, activities in place include placement of residue berms on the residue surface, residue farming which roughens the surface, monitoring weather forecasts, managing residue placement and water levels as well as inspection and water washing of plant roads. In addition, there is ongoing tree and hedge planting and hydroseeding along the perimeter of the BRDA. AAL have implemented an extensive monitoring programme of on-site emission points and ambient monitoring of $PM_{10}/PM_{2.5}$ and dust deposition as per their Industrial Emissions Licence No. P0035-07. They have recently introduced additional measures to monitor dust

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
			deposition and PM_{10}/$PM_{2.5}$ from the facility through increasing the number of monitoring locations. In addition, visual inspection patrols of the site are undertaken as part of the daily management programme. AAL have a high compliance rate with monitoring records for PM_{10}/$PM_{2.5}$ and dust deposition, as submitted to the EPA, demonstrate continuing high compliance by AAL with the ambient standards / guidelines, with the concentrations of each of the parameter well below the relevant standard. The facility receives few complaints, and on the occasion of a dust complaint, AAL has a proactive approach to dealing with the complaint. Each complaint is carefully considered in line with a standard operating procedure to gather information and to determine the cause.
Air Quality	The greatest potential impact on odour during the operational phase is the risk of odour from the process effluent treatment system at the AAL facility and the LWP in the BRDA.	Odours associated with the process effluent treatment system at the AAL facility and the LWP in the BRDA during the operational phase, if unmitigated, could lead to odour concentrations beyond the site boundary which exceed the ambient air quality guidelines for odour and lead to odour nuisance.	The following odour mitigation measures are currently operational and will remain operational with the Proposed Development in place: • An odour treatment agent and antifoam are dosed to the 35m clarifier overflow launder, which discharges into the LWP. Dosing is monitored regularly and adjusted as required. Furthermore, an odour prevention agent is added to the feedwell of the clarifier, which contains sulphide consuming bacteria. • The LWP is cleaned out at regular intervals. • The LWP level is managed to ensure that there is no potential to expose any solids at the base of the LWP.

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
			• Additional biological odour control is added at regular intervals to the LWP. In terms of the proposed development, the bauxite residue which is deposited in the BRDA is not odorous nor is the saltcake deposited in the saltcake cell. Activities associated with the quarry are also not odorous with limestone itself being non-odorous. Thus, with the proposed development in place, the facility will experience no change in the odour profile. Indirectly, the AAL facility will continue to employ the extensive range of mitigation measures which are in place to control odour emitted from the facility. Where odour complaints are received, which do occur on an infrequent basis, the facility has developed a comprehensive complaints investigation procedure which is rapidly deployed to determine the source of the odour and, where necessary, implement corrective action.
Noise and Vibration	Operational phase activity generating noise offsite.	During the operation of the BRDA the existing machinery will continue to be used. However, the phasing of the BRDA raise over time will result in the elevation of this machinery increasing above ground as each stage is completed. There is potential for the elevated BRDA activities to generate noise.	Best practice control measures for noise and vibration during operation will be implemented from BS 5228 (2009 +A1 2014) Code of Practice for Noise and Vibration Control on Construction and Open Sites Parts 1 and 2. Whist noise and vibration impacts are expected to vary during the operational phase depending on the distance between the activities and noise sensitive buildings, best practice noise and vibration control methods will be used, as necessary in order to ensure impacts at off-site noise sensitive locations are minimised.

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
			The best practice measures set out in BS 5228 (2009) Parts 1 and 2 includes guidance on several aspects of construction site mitigation measures, including, but not limited to: • noise control at source; • screening, and; • liaison with the public.
Noise and Vibration	Borrow Pit blasting generating noise, air overpressure and vibration impacts.	Blasting will be required within the Borrow Pit, up to 7 blasts will be required per year. Blast activity will generate noise, vibration and air overpressure emissions. There is potential for these emissions to impact on offsite locations.	Air overpressure and vibration will be controlled at source by careful attention to blast design. A method statement will be produced by the blasting contractor to ensure that the noise, vibration and air overpressure impacts of blasting operations are minimised. Monitoring of air overpressure levels will be carried out at three locations agreed with the EPA which are representative of the nearest residential dwellings during blasts to ensure that acceptable levels are not exceeded. The monitoring data will enable control of the blast noise, air-overpressure and vibration levels as the data will enable blast technicians to modify blasting techniques (i.e. charge sizes) if required. As air blast intensity is a function of total charge weight, then a reduction in the total amount of explosives used can also reduce the air overpressure value. Other practical methods to reduce noise, air overpressure and vibration will be adopted as follows: • There shall be no more than one blast per week at the Borrow Pit.

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
			• Restriction of hours within which blasting can be conducted (08.00 to 18.00 hours Monday to Friday). • A public information campaign undertaken before any work and blasting starts (e.g. 24-hour written notification). • The firing of blasts at similar times to reduce the 'startle' effect. • On-going circulars informing people of the progress of the works. • The implementation of an onsite documented complaints procedure. • The use of independent monitoring by external bodies for verification of results. • Ensuring appropriate burden to avoid over or under confinement of the charge. • A method statement for blasting operations will be submitted to the EPA for approval prior to commencement of blasting. The method statement shall include the noise, vibration and air-overpressure control measures. • Initial blasts to assist in blast designs and identify potential zones of influence. • Accurate setting out and drilling; • Appropriate charging; • Appropriate stemming with appropriate material such as sized gravel or stone chipping; • Delay detonation to ensure small maximum instantaneous charges; • Decked charges and in-hole delays;

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
			• Blast monitoring to enable adjustment of subsequent charges; • Good blast design to maximise efficiency and reduce vibration; • Avoid using exposed detonating cord on the surface.
Material Assets – Waste	A variety of waste streams are expected to be generated by the Proposed Development during its preparatory, construction, operational and closure stages. Limited tonnes of wastes will be generated from the maintenance of mobile plant and equipment associated with the extraction process at the Borrow Pit Extension, the construction of the BRDA stage raises, the SCDC raise and the BRDA closure woks.	All waste generated during the construction or operation of the Borrow Pit Extension, the BRDA stage raises or the SDCC raise, is the responsibility of AAL as the originator in accordance with the licence. All transporting of waste off-site is undertaken by AAL via licenced waste contractors. Therefore, Contractors are only responsible for the sorting and internal transport to the designated internal waste transfer locations and notification to AAL of the appropriate units of construction waste generated. No waste soils are generated by the construction of the BRDA stages raises or by the raise of the SCDC. Soils to be removed at the proposed Borrow Pit site are not categorised as waste; but are considered to be a material asset to be utilized in the works.	As required by the current IEL (P0035-07) AAL has developed a Waste Management Manual. This manual outlines the waste management principles applied at AAL and are intended to assist effective waste management. The principles of waste hierarchy, in accordance with the Waste Management Act (Section 21(A)) are applied as a priority order of: • Waste prevention; • Waste minimisation; • Waste recycling / reuse; • Waste recovery; and • Waste disposal Due to the nature and minor quantities of the waste assessed to be generated and the use of the AAL existing waste management procedures, it is considered that will be imperceptible impact on the receiving environment and waste management infrastructure. The arising wastes from the Proposed Development will be managed and reported in line with existing waste management practices at the overall AAL facility, and in accordance with the waste records and reporting requirements of the facility's IEL.

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
Traffic and Transportation	The proposed development shall likely have a small effect on the operation of the local road network, with a small decrease in the Year of Opening (YoO) and YoO+5 assessment years compared with the 'Do Nothing' scenario and a small increase in traffic compared with the 'Do Minimum' scenario in these years. There is also envisaged to be a small increase in traffic in the YoO+15 and Year of Construction (YoC) years in all scenarios. The proposed development shall also include changes to the internal site layout, however these are confined to areas in the immediate vicinity of the development works.	Changes to traffic volumes on the local road network shall have little effect on their operation, with the critical N69 national road expected to carry traffic volumes well below its theoretical capacity in all future year scenarios assessed. Similarly, the L1234 local road is anticipated to operate satisfactorily in all scenarios, with only slight impacts envisaged.	As the proposed development will have no material impact upon the operation of the local road network, no mitigation measures are proposed. However, sourcing of rock material on-site can be considered to mitigate potential impacts of the development on the local road network, with HGV movements concentrated on-site. Furthermore, the proposed Foynes to Limerick (including Adare Bypass) scheme will provide an alternative high-quality route to the N69 between Foynes and Askeaton to the west and east of the proposed development site respectively. This scheme, which is anticipated to proceed to construction in the near future, has been forecast to produce a ca. 78% reduction in AADT on the N69 at Ballyculhane between Foynes and Askeaton (in the vicinity of the L1234/ N69 junction) in both the YoO and YoO+15.
Material Assets – Site Services	Material Assets – Site Services within and in the vicinity of the IEL boundary	It is considered that the value (sensitivity) of the Material Assets - Site Services in the vicinity of the Application Site is no greater	The Material Assets – Site Services that service the AAL facility and users in the vicinity are largely located outside of the IEL boundary.

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
	comprise of built services and infrastructure such as electricity, gas, telecommunications, water supply infrastructure, surface water drainage and sewerage. The built services and infrastructure have the potential to be affected by: • Ground disturbance through activities associated with extraction of rock from the Borrow Pit Extension; • Increased height of the Salt Cake Disposal Cell (SCDC); and • Increased height of the BRDA.	than Medium, i.e., not of national scale, rarity or limited potential for substitution. The likely effects are potential disruption and/or reduction in quality of service.	Works on and around built services and infrastructure are obliged to be carried out in accordance with the service provider's codes of practice and subject to their consultation and authorization. The potential effects on all of the local networks (electrical, gas, telecommunications, potable water, surface water and foul water) have been assessed to be negligible and imperceptible.
Major Accidents and Disasters	The Risk Assessment and Break-Out Study for the BRDA (Golder 2019) assessed the viable failure mechanisms that present a risk of containment breach and associated bauxite residue release:	The BRDA is classified as a facility with a 'High' hazard potential classification in accordance with the Canadian Dam Association (CDA) guidelines. This classification takes into account three categories of incremental losses: • Loss of Life - the population at risk is deemed to be 10 or fewer and is temporary. There is no resident	The BRDA is designed and operated in accordance with the Best Available Techniques (BAT) Reference Document for the Management of Waste from Extractive Industries arising from Directive 2006/21/EC (MWEI BREF 2018) and with international guidelines and good practice for tailings management facilities. In accordance with MWEI BREF 2018 and in the absence of a national or EN standard, AAL have selected to adopt the target level criteria for design parameters (inflow design flood,

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
	• Earthquake Event - leading to slope failure or dynamic liquefaction. • Tidal Surge or Wave Event (River Shannon) - leading to erosion induced slope failure. • Storm Event - leading to erosion induced slope failure. • Blast Event (Borrow Pit) - leading to static liquefaction induced slope failure or dynamic liquefaction. • Slope Instability – as a result of either strength failure through the bauxite residue or erosion of the side-slopes. • Static Liquefaction - of the bauxite residue leading to lower or overall slope failure. Trigger events are excessive rate of rise, excessive strain / creep within the bauxite residue, foundation creep or a storm event	population downstream of the BRDA within the break-out zone. • Environmental and Cultural Values – immediately downstream of the BRDA, wildlife habitats and special areas of conservation (SAC) and special protection areas (SPA) present to the north and west of the BRDA, have the potential to be adversely affected by a failure to the BRDA. However, there are no notable protected species of wildlife or plants and/or habitats that would be considered irreplaceable and the nature of the bauxite residue and mitigating measures present would mean that restoration of affected areas is highly possible • Infrastructure and Economics - a failure of the BRDA will, in all likelihood, result in minimal economic losses to third parties i.e., beyond the footprint of lands owned by AAL and no impact to infrastructure or services.	seismic event and factors of safety for static, pseudo-static and post-seismic stability). AAL have recently undertaken an independent Dam Safety Review (DSR) of the BRDA (SLR 2019) which comprised an objective assessment of the design, performance and management of the BRDA and ancillary infrastructure to confirm whether they meet best practices for dam safety in accordance with CDA Guidelines (CDA 2013, 2014). Internal and External Emergency Response Plans are in place which specify the measures to be taken on-site and off-site in the event of a significant BRDA related incident.

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
	leading to erosion induced slope failure • Foundation Failure – as a result of strength failure through the foundation soils leading to overall slope failure via static liquefaction. • Overtopping Event (Discharged Bauxite Residue) - leading to erosion induced slope failure. The document concludes that the probability of BRDA failure resulting in containment breach and release of bauxite residue is in the range Very Unlikely to Almost Impossible.		

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Climatic Factors	Vehicle traffic is expected to be the dominant source of greenhouse gas emissions as a result of the combined construction and operational phases of the Proposed Development.	Vehicles, generators etc., may give rise to some CO_2 and N_2O emissions.	A series of mitigation measures will be implemented which will mitigate GHG emissions including: • All vehicles will be required to switch off engines when stationary (no idling); • All vehicles will be serviced and maintained to ensure emissions are minimised; • Limestone will be sourced from the onsite borrow pit thus minimising transportation distances for the construction phase of project. In relation to indirect emissions, AAL operates a long-established alumina extraction plant. The facility is licenced, under IE Licence P0035-07, to produce alumina from bauxite using the Bayer process. AAL operates under the ETS based on Permit Register Number IE-GHG038-10361-3 with verified emissions of 1,224,809 tonnes CO_{2eq} in 2020. If the BRDA raise does proceed the facility will continue to operate beyond 2030. The do-something scenario will lead to indirect GHG emissions from the Alumina Plant continuing beyond 2030. However, the ETS market will have to meet a target of a 61% reduction by 2030 based on annual reductions of 4.2% compared to the previous annual reduction level of 2.2% per year and thus it is likely that there will be a gradual reduction in GHG emissions from the facility under the facility's ETS Permit.

Environmental Factor	Likely effects identified	Brief description of effect	Mitigation measures proposed to control effects
			Under the EU ETS, AAL will continue to be regulated and will continue to pay gradually increasing carbon cost as there are no free allocations for power generators. In relation to the impact of climate on the Proposed Development, if appropriate, additional measures, such as an increase in berms in the BRDA, to ensure the resilience of the Proposed Development to impacts during extreme weather events will be implemented for the construction phase.