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Environmental Assessment - Capacity
Increase at the Regain Spent Potlining
Facility, Tomago

Regain Services Pty Ltd

29-Mar-2019

Response to Submissions Report

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Client: Regain Services Pty Ltd

ABN: 8009971482

Prepared by

AECOM Australia Pty Ltd
17 Warabrook Boulevard, Warabrook NSW 2304, PO Box 73, Hunter Region MC NSW 2310, Australia
T +61 2 4911 4900 F +61 2 4911 4999 www.aecom.com
ABN 20 093 846 925

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Glossary

The terms and acronyms used in this report are provided below.

Term / acronym	Description
AQIA	Air Quality Impact Assessment
BaP	Benzo(a)pyrene
BC Act	*Biodiversity Conservation Act 2016* (NSW)
Council	Port Stephens Council
DP&E	NSW Department of Planning and Environment
DoI	NSW Department of Industry
EA	Environmental Assessment
EARs	Environmental Assessment Requirements
EHC Act	*Environmentally Hazardous Chemicals Act 1985*
EPA	NSW Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EPL	Environment Protection Licence
FRNSW	Fire and Rescue NSW
HIPAP	Hazardous Industry Planning Advisory Papers
HWC	Hunter Water Corporation
MNES	Matters of National Environmental Significance
NSWRFS	NSW Rural Fire Service
OEH	Office of Environment and Heritage
PAH	Polycyclic aromatic hydrocarbon
PM	Particulate Matter
POEO Act	*Protection of the Environment Operations Act 1997*
Roads and Maritime	NSW Roads and Maritime Services
RTS	Response to Submissions
SCADA	Supervisory control and data acquisition
SEPP	State Environmental Planning Policy
SPL	Spent potlining
TAC	Tomago Aluminium Company

Executive Summary

Regain Services Pty Ltd (Regain) operate a Spent Pot Lining (SPL) Processing Facility within the existing Tomago Aluminium smelter site, around 13 km northwest of the central business district of Newcastle. The Project involves increasing the handling capacity of the facility from 20,000 tonnes per annum (tpa) to 60,000 tpa using improvements to the existing proven technology, in order to respond to market demand.

Regain currently operates under Project Approval 06_0050 which was issued under Part 3A (repealed) of the Environmental Planning & Assessment Act (EP&A Act). As this modification request was submitted prior to the cut-off date of 1 March 2018, the provisions of the former Part 3A continue to apply to this modification request. The current Project would therefore be undertaken as a modification to the existing Project Approval (06_0050) under section 75W of the EP&A Act.

Environmental Assessment

An Environmental Assessment (EA) was prepared for Regain which considered all the potential environmental issues identified during the planning and assessment, including the preparation of specialist and technical studies to support the EA.

The EA was placed on public exhibition between 23 November 2018 and 14 December 2018 and was made available on the NSW Department of Planning and Environment (DP&E) web site. Throughout this period, stakeholders including the community, special interest groups, local council and relevant government agencies were invited to comment on the EA.

Response to submissions report

This Response to Submissions report (RTS) provides Regain's response to submissions received on the EA during the public exhibition period. A total of 11 submissions were received by DP&E which were all neutral and provided "Comments" on the project modification.

The key issue categories included the following (in alphabetical order):

- Air quality
- Ecology
- Environmental risk
- Fire safety
- SPL treatment process
- Stormwater management
- Traffic management
- Waste management

Benefits of the Project

The project would provide both continued reuse services and operational efficiency improvement opportunities. An increase in the processing capacity from 20,000tpa to 60,000 tpa would assist in the processing of SPL wastes currently being stockpiled throughout Australia, thereby decreasing the time taken to draw down these significant stockpiles. Further, upgrading the technology and increasing SPL production would reduce the frequency of plant shut-down and start-up processes and realise the benefits of reduced energy requirements and operational costs.

Mitigation measures

Comprehensive mitigation measures were provided throughout Section 7 of the EA to mitigate potential impacts associated within the Project as described in the EA. These mitigation measures have been reviewed following issues raised during submissions received on the EA and updated mitigation measures are provided in Section 5.0 of this RTS.

Ongoing consultation with community and stakeholders

Regain would continue to consult with community members and affected stakeholders as outlined in responses throughout Chapters 5 to 7 of this RTS. Consultation would also occur with relevant government agencies throughout the planning and construction of the Project, as required.

Conclusion

All submissions received on the EA have been reviewed and responses have been provided within this RTS.

It is considered that the management measures identified would effectively ensure that the environmental consequences associated with the Project are minimised and likely to remain substantially the same as those currently approved.

The benefits of the Project would outweigh its potential impacts with the implementation of the proposed management and mitigation measures as identified in the EA. It is therefore considered that it is appropriate and in the public interest to approve the Project.

1.0 Introduction

1.1 Background

Aluminium production is a continuous process where molten aluminium is produced within a refractory lined 'pot'. During the production process, the potlinings become contaminated with materials such as alumina, aluminium, calcium, fluoride compounds and sodium. The contaminated potlining, known as SPL is regularly replaced as part of the periodic individual rebuilding of the pots.

The SPL is classified as a Dangerous Good and an Environmentally Hazardous Waste. It requires careful handling and disposal in accordance with regulatory requirements. SPL materials are currently stored at Tomago smelter in a number of secure, dry storage sheds prior to disposal. Historically, SPL has been shipped internationally for processing. It is estimated that approximately 700,000 tonnes of SPL exists in storages around Australia and that around 36,000 tonnes of SPL is generated per annum (REC, 2016).

Regain has worked with a number of aluminium smelters in Australia to recycle minerals from a range of smelter wastes to develop products that would be valuable to other industry sectors. Regain has recycled more than 350,000 tonnes of waste from four aluminium smelters in Australia diverted from the waste stream and transformed into products over the last 20 years.

1.2 The Project

The Project is for the modification of the existing Part 3A Approval (06_0050) for the Tomago SPL Processing Facility (the Facility). Modification of the existing approval is proposed to provide for:

- **Plant modifications:** Opportunities have been identified to enhance the operational efficiency of the existing facility by altering the originally proposed site layout and key plant components; and
- **Facility production increase:** To ensure operational efficiencies and for Regain to meet market demand, modification is sought to increase current production from 20,000tpa to 60,000tpa.

The proposed modifications retain the general physical scale of the previously approved plant configuration. A site layout of the Project (as modified) is shown in Figure 1. A summary overview of the proposed physical modifications compared to the originally proposed Project is provided below in Table 1.

Table 1 Proposed plant modification summary

Current Approved Plant	Proposed Plant Modifications
SPL Preparation Plant in Shed 5	The internal layout would remain consistent with the existing approval. Modification is not required.
20,000 tonnes per year Thermal Treatment Plant	The existing 20,000 tpa Thermal Treatment Plant would be retained and an additional 40,000 tpa Thermal Treatment Plant installed to reach the target processing rate of 60,000tpa.
Blending, drying and grinding equipment, grinding feed bin and four large product bins integrated in the Grinding and Blending Plant	The proposed modifications would result in a reduction in size with: • no Blending Plant • A separate Drying Plant and • Fine grinding Plant with feed bin • A single product bin
The thermal treatment plant and product plant would be located between Shed 5 and Shed 6.	The thermal treatment plant and product plant elements would remain between Shed 5 & 6.

Current Approved Plant	Proposed Plant Modifications
A single stormwater catchment system	Additional stormwater catchment systems are proposed, providing opportunities for improved stormwater capture and control. An existing area of semi-permeable hardstand would be sealed to divert surface water flows to stormwater.

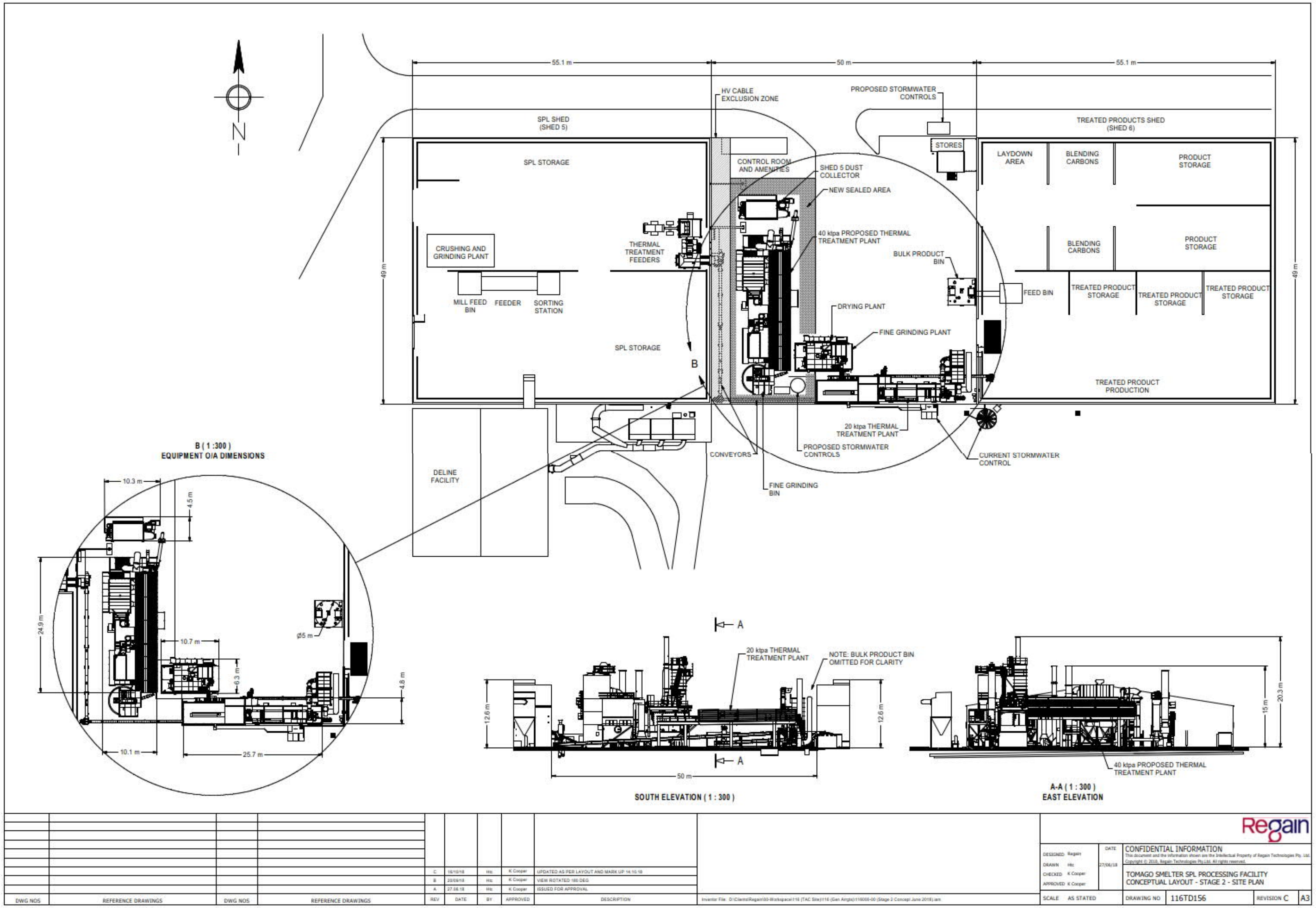

Figure 1 Conceptual Site Layout

1.3 Assessment, Approval Process and Exhibition

Regain currently operates in general accordance with Project Approval 06_0050, Environmental Protection Licence 13269 issued under the *Protection of the Environment Operations Act 1997* (POEO Act) and Environmentally Hazardous Chemicals Licence #88 issued under the *Environmentally Hazardous Chemicals Act 1985* (EHC Act).

The Project Approval 06_0050 and administrative modification of Project Approval 06_0050 (Mod 1) were issued under Part 3A (now repealed) of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Part 3A of the EP&A Act was repealed in 2011, however transitional arrangements were set out in Schedule 6A of the EP&A Act which provided that Part 3A continued to apply to the approved Part 3A project, including modifications to Project Approvals under section 75W of the EP&A Act.

On 1 March 2018, amendments to the EP&A Act were enacted to remove these Part 3A transitional arrangements. The transitional arrangements that were previously contained within Schedule 6A of the EP&A Act were transferred to Schedule 2 of the *Environmental Planning and Assessment (Savings, Transitional and Other Provisions) Regulation 2017*, with additional provisions inserted regarding the removal of these transitional Part 3A arrangements.

Regain submitted documentation describing the Project to the Department of Planning & Environment (DP&E) on 18 August 2017. Advice received from DP&E (dated 20 December 2017) confirmed that a modification to Project Approval (06_0050) under Section 75W of the EP&A Act would be the appropriate approval pathway for the Project.

As this modification request was submitted prior to the cut-off date of 1 March 2018, the provisions of the former Part 3A continue to apply to this modification request. The current Project would therefore be undertaken as a modification to the existing Project Approval (06_0050) under section 75W of the EP&A Act. The approval authority is the Minister for Planning.

The Environmental Assessment (EA) was placed on exhibition for a three week period starting from Friday, 23 November 2018 and Thursday 13 December 2018. The modification was also advertised in the Port Stephens Examiner and the Newcastle Herald on Thursday 22 November 2018. The EA was made available on the DP&E web site (http://majorprojects.planning.nsw.gov.au/).

1.4 Purpose of this Report

The public exhibition of the EA provided a formal opportunity for the community and other stakeholders and agencies to share their knowledge and opinions and provide input into the assessment by making written submissions on the Project.

This Response to Submissions report (RTS) highlights the value of this public involvement and provides responses to the submissions received during the public exhibition of the EA. Correspondence was received by Regain from DP&E providing copies of submissions received during the exhibition of the EA and requesting responses to the matters raised in those submissions.

The purpose of this RTS report is to:

- Detail and provide responses to issues raised in the submissions received during the EA exhibition period;
- Note any changes to the Project or additional management measures that have been recommended as a result of those submissions; and
- Enable the Minister for Planning or his delegate to determine the application.

1.5 Structure of this Report

This RTS Report addresses issues raised in the submissions received during the exhibition period and is structured as follows:

- **Section 1.0** and **Section 2.0** provides an overview of the project, the EA process and the RTS purpose and structure;
- **Section 2.0** provides a summary of the actions undertaken during and after exhibition of the EA;
- **Section 3.0** provides an analysis of the submissions received;
- **Section 4.0** provides a summary of the agency submissions received and responses;
- **Section 5.0** describes updated mitigation measures for the project;
- **Section 6.0** conclusion and summary of the proposed project; and
- **Section 7.0** contains appendices for information referenced in the RTS.

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2.0 Actions Taken During and After Environmental Assessment Exhibition

2.1 Engagement Activities

A number of activities were undertaken with key stakeholders both during and after the exhibition period of the EA. These activities are outlined below in **Table 2**.

Table 2 Engagement activities carried out during and after EA exhibition

Stakeholder	Activity	Date	Outcomes
Port Stephens Council	• Telephone discussion with a Council representative, post-lodgement of the EA.	14 December 2018	Council confirmed that the issues that Council had raised during the preparation of the EA has been appropriately addressed within the EA.
NSW Fire and Rescue	• Meeting with NSW Fire and Rescue to discuss requirements around the recommendations put forward by NSW Fire and Rescue in response to the EA • Written correspondence from Regain to NSW Fire and Rescue	25 January 2018 19 February 2019	Regain would send the Tomago Aluminium site wide Emergency Response Plan to NSW Fire and Rescue The Tomago Aluminium site wide Emergency Response Plan was sent to NSW Fire and Rescue for reference.
Hunter New England Health	• Meeting with HNEH representatives to discuss HNEH comments regarding Appendix F – Human Health Risk Assessment • Written correspondence with clarifications to questions raised by HNEH during the meeting on 4 February 2019	4 February 2019	The Guidelines for Stormwater Harvesting and Reuse are acknowledged as relevant national guideline which may inform detailed design. Clarifications are provided regarding the Human Health Risk Assessment methodology.
NSW Environment Protection Authority (EPA)	• Meeting with EPA representatives to discuss EPA comments regarding Appendix D – Air Quality Impact Assessment.	31 January 2019	The Air Quality Impact Assessment (AQIA) is to include in the assessment, a scenario based on typical operation. Other EPA comments are to be addressed within this RTS and revised AQIA (see Appendix A) where appropriate.
Safework NSW	• Telephone discussion with a Safework NSW representative	Week ending 20 January 2019	Safework NSW were provided a summary of the submissions process to date and offered the opportunity to comment further on the EA, with any additional feedback requested by 4 February 2019. No additional comments were received by Safework NSW.

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3.0 Analysis of Submissions Received

3.1 Overview

The EA was placed on exhibition between 23 November 2018 and 14 December 2018.

During the display period of the EA, submissions were invited from the community and other stakeholders. The receipt of submissions was coordinated and managed by DP&E. Submissions were received by the Department, and uploaded onto the Department's website. Submissions were accepted by electronic online submission or post.

A total of 11 submissions were received by DP&E and each submission can be registered as 'Objects' or 'Comments'. All government agency submissions were neutral. No objections were received from any government agencies.

3.2 Analysis

A total of 11 submissions were received, all of which were from government agencies. No submissions were received from members of the public or special interest groups.

3.2.1 Government agencies

Submissions were received from State and Local Government agencies including:

- NSW Environment Protection Authority (EPA);
- NSW Department of Planning (DP&E);
- Port Stephens Council (Council);
- Fire and Rescue NSW (FRNSW);
- NSW Office of Environment and Heritage (OEH);
- NSW Rural Fire Service (NSWRFS);
- Hunter Water Corporation (HWC);
- TransGrid;
- Hunter New England Local Health District (HNELHD);
- NSW Roads and Maritime Services (Roads and Maritime); and
- NSW Department of Industry (DoI).

The government agency submissions are summarised and responded to within **Section 4.0.**

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4.0 Response to Government Agency submissions

4.1 NSW Environment Protection Authority

Comments

The NSW EPA has reviewed the EA and has indicated that further information on air quality is required, prior to the NSW EPA assessing the proposal. An overview of the information required by the NSW EPA is listed below:

1. A detailed process description, including benchmarking proposed new plant and equipment against best practice must be provided;
2. Detail on the proposed plant configuration and design;
3. A more robust assessment of cumulative ground level concentrations;
4. An air quality impact assessment based on actual emission performance consistent with best practice, rather than nominal emission discharges;
5. An air quality impact assessment that adequately considers all pollutants from each source;
6. A more robust assessment of the ground level concentrations for cadmium and PAHs;
7. A comparison of actual emissions with prescribed limits contained in the Protection of the Environment Operations (Clean Air) Regulation 2010; and
8. Clarification of sensitive receptors must be clearly identified.

These additional questions have been tabulated with a response provided within Table 3 and an updated AQIA has been prepared which provides:

- An expanded cumulative assessment which considers a broader range of background monitoring data available within the modelling domain.
- An assessment of the expected typical operating conditions based on historical emission monitoring.
- Additional clarifications regarding proposed mitigation measures, predicted ground level concentrations and sensitive receptor locations.

The updated AQIA has been included as Appendix A.

Response

Table 3 Summary of Response to Comments

Issue Raised	Response
1. A detailed process description, including benchmarking proposed new plant and equipment against best practice must be provided;	The Regain facility is unique in that the kiln is a specialised, one-off piece of equipment which has been designed by Regain and constructed for the sole purpose of the conversion of SPL into non-hazardous material. The treatment process used by Regain involves the heating of SPL to a temperature that enables the removal and/or treatment of the chemical and physical properties that make SPL hazardous (such as free cyanide and reactivity with moisture). The end product retains the chemical constituents of the SPL without producing a physical by-product and does not rely on a waste incineration process. Proposed mitigation measures and controls are described within Section 2.4 of the EA. Dust collectors would be sized to effectively capture fugitive emissions. Indicative specifications for the pollution control equipment proposed is provided in Table 3 of the EA. Given that the Regain facility uses a specialised, unique process to specifically destroy cyanide, the facility is innovative and the controls proposed for the project are considered to reflect best practice for a facility of this type.

Issue Raised	Response
	To consider the adequacy of the proposed controls the material flows associated with the SPL treatment process can be characterised and potential emissions quantified. A quantification of the material inputs and the outputs from along with process intermediates that form and are chemically transformed in the Regain SPL treatment process was conducted by OLM Technical Services Pty Ltd (OLM) in 2016 (see Appendix B). Lab testing identified that for each 100 tonnes of SPL product processed approximately 3 grams of cyanide, 17 grams of fluoride and 53 grams of sulphur dioxide is liberated within process air which is then filtered prior to emission (OLM, 2016 – see Appendix B). The process achieved a 94% reduction in cyanide quantities with minimal emissions. This demonstrates the effectiveness of the SPL treatment process with virtually all fluoride retained as a valuable commodity within the final treated product material. Key air quality pollutants associated with the SPL process at the Regain facility are fluoride and sulfur dioxide (SO_2). The Regain facility operates under environment protection licence (EPL) 13269 which provides air concentration limits for fluoride at emission point 1. Under EPL 13269, the air concentration limit for total fluoride emissions from the Regain facility is 5mg/m^3 for an average period of one hour. Schedule 3 of the *Protection of the Environment Operations (Clean Air) Regulation* 2010 (the Clean Air Regulation) provides emissions standards for industrial premises. For fluoride (F_2) emissions or any compound containing fluorine (as total fluoride (HF equivalent)) the standard of concentration (maximum allowable) is typically 50mg/m^3. Therefore the licenced limit of fluoride emissions from the Regain facility is only 1/10th of the applicable limit specified under the Clean Air Regulation. Best practice does not require the most advanced or contemporary solution. The solution must be generally accessible, economically feasible and proven over time within the industry. The proposed controls meet this criteria as demonstrated by: • Effective proven controls which ensure emission concentrations remain substantially below the applicable limits defined within the Clean Air Regulation for all potential pollutants of concern. • Previous Air Emissions Verification Report (AECOM 2013) demonstrating actual emission performance against air quality modelling predictions and EPL licence conditions. • Previous stack emission monitoring undertaken on a six monthly basis during 2012-2016, demonstrating consistent compliance with all EPL licence emission limits (a summary of which is provided in Appendix A). • An efficient thermal treatment process which supports the Waste Avoidance and Resource Recovery Strategy 2010-2021 (WARR Strategy) and does not generate residual waste materials or introduce substantial secondary waste streams. • A thermal treatment process which achieves an approximate 94% reduction in cyanide with minimal emissions and virtually all fluoride retained as a valuable commodity within the final treated product material. The AQIA has been amended to provide further information on the proposed mitigation measures including indicative capacity and technical information for proposed dust collectors (see Appendix A).

<table>
<tr><th>Issue Raised</th><th>Response</th></tr>
<tr><td>2. Detail on the proposed plant configuration and design</td><td>
<p>The proposed plant design does not involve the convergence of multiple air streams between the various plant elements described in Section 2.2 (Modified Plant Inventory) of the EA prior to discharge. The proposed design allows for the independent functioning of each plant element with individual air streams for each plant element and emission point.</p>
<p>As discussed In Section 2.3.1 of the AQIA, the Regain facility has three independent dust extraction and collection points, being:</p>

Thermal treatment plant dust collector stack (EPL Point 1);
Drying and blending plant dust collector stack (EPL Point 2); and
SPL Shed 5 and Deline facility air filter (SPL preparation facilities) stack (EPL Point 3).

<p>The pollutants which are required to be monitored and have air concentration limits at each discharge point are described in Table 4 below.</p>
<p>Table 4 Pollutants monitored at each discharge point, as per EPL 13269</p>
<table>
<tr><th>EPL Point 1 (Thermal Treatment Plant)</th><th>EPL Point 2 (Drying and Blending Plant)</th><th>EPL Point 3 (Shed 5 Dust Collector)</th></tr>
<tr><td>Nitrogen oxides
Type 1 and Type 2 substances in aggregate
Fine Particulates
Polycyclic aromatic hydrocarbons
Sulphur dioxide
Dioxins and Furans
Total Solid Particles
Cyanide
Total Fluoride
Cadmium
Volatile organic compounds</td><td>Fine particulates
Total Solid Particles</td><td>Fine particulates
Total Solid Particles</td></tr>
</table>
<p>The flow rates and vapour stream compositions for each of the emission points included and assessed within the AQIA are provided within Section 6.5 (Emissions Inventory) of the AQIA.</p>
<p>The pollutants that were modelled within the AQIA for each source were based on those identified and licenced under Regain's EPL 13269 as being pollutants of concern. Organics, persistent organics and metals were included within the emissions inventory for both thermal treatment plants (see Section 6.5 of the AQIA). This was due to each thermal treatment plant having the potential to generate these pollutants due to the processes they perform and the temperatures at which they operate.</p>
<p>Conversely, the Shed 5 and Fine Grinding Plant operations are mechanical only and involve no heating processes or the use of natural gas or fuels during operation. As such, the only particulate emissions</p>
</td></tr>
</table>

Issue Raised	Response
	which were considered likely to occur from both Shed 5 and the Fine Grinding Plant operations were total particulates, negating the need to consider organics, persistent organics and metals for these operations. The total particulate concentration used in the assessment was derived from the concentration provided within the Regain EPL 13269. For the purposes of the assessment and as a conservative measure, a PM10 concentration limit of 10mg/m^3 was used for the Shed 5 and Fine Grinding Plant emission points, which is consistent with the PM10 limit under EPL 13269 applicable to the thermal treatment plant emission point. Indicative capacity and technical information on proposed environmental controls (dust collectors) is provided in Table 3 of the EA. The AQIA has been amended to provide a summary of average and maximum historical stack concentrations further characterising historic vapour stream composition (see Appendix D of the AQIA).
3. A more robust assessment of cumulative ground level concentrations	The Regain facility is owned and operated independently of the Tomago Aluminium Smelter operation. The Tomago Aluminium Smelter became operational in 1983, while Regain began processing SPL within the Tomago Aluminium site in 2002. The Regain facility operates under EPL 13269 while the Tomago Aluminium Smelter operates under EPL 6163. A robust cumulative assessment has been undertaken for the AQIA in accordance with the NSW EPA (2017) Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (Approved Methods), using all the data available relating to the proposed Regain Tomago operations. A conservative assessment approach was adopted based upon the maximum proposed EPL concentration limits. Proposed indicative stack parameters (e.g. velocity, flowrate, dimensions, height, locations, etc.) were taken from Regain stack emissions testing reports as provided in Appendix D and as summarised in Section 6.5.3 of the AQIA. These parameters together with other modelling input parameters such as terrain, land-use and meteorology were used to determine the incremental Regain contributions across the modelling domain. The background ambient monitoring stations used for the AQIA for sulfur dioxide (SO_2) and Fluoride were those closest to the site. However it is further clarified that these monitoring points (21 and 36) were selected based on their proximity to the location at which the maximum incremental contributions of the Project were predicted to occur. This approach establishes a conservative maximum potential cumulative contribution associated with the Project. To further support the findings of the AQIA the report has been updated to clarify the assessment methodology with regards to the background monitoring data available to support the assessment of cumulative ground level concentrations. The assessment has also been expanded to include consideration of other monitoring points (where Project contributions to ground level concentrations was predicted to be comparatively low). The revised AQIA is attached as Appendix A and confirms the findings of the original assessment while providing a robust (expanded) cumulative assessment based on the available background monitoring data.

Issue Raised	Response
4. An air quality impact assessment based on actual emission performance consistent with best practice, rather than nominal emission discharges	In the AQIA, all data that was used for calculating the emission rates for the maximum proposed EPL Emission Concentrations Scenario is provided in Section 6.5 and Appendix D of the AQIA. The stack testing data utilised in the calculation of the emission rates is provided in full in Appendix D and summarised in Section 6.5.3 of the AQIA. The stack testing parameters used for the calculations were: • Velocity; • Temperature; • Stack Dimensions (Diameter); and • Flow Rate The concentrations of each pollutant from the stack testing reports were not used in the scenario being assessed in the AQIA which was based on the maximum current and proposed EPL concentrations for each of the points. As such, the concentrations used to calculate the pollutant mass emission rates were based on EPL concentrations and detailed in Section 6.5.2 of the AQIA. Although the specific concentration data from the stack testing reports was not provided in Appendix D of the AQIA (as it was not used in the scenario being assessed), a statement of compliance was provided in Section 6.5.2 within paragraph 3, which indicated that all of the testing reported had demonstrated compliance with each of the respective sites' EPLs. Given that Regain have not previously reported any exceedances of their license conditions, using the maximum EPL limits for each of the points was considered to provide a conservative basis upon which to model maximum worst-case potential ground level concentrations. A conservative approach was taken to reflect the variable chemical composition of the input SPL material. Following consultation with the EPA, an additional scenario considering typical operating conditions was modelled to assess actual plant performance and has been included within the AQIA. The results of the typical operating scenario modelling can be seen in Appendix A. The modelling predicts that there would be no exceedance of all relevant ground level concentration criteria as a direct result of the Project during typical operating conditions.
5. An air quality impact assessment that adequately considers all pollutants from each source	The pollutants that were modelled within the AQIA for each source were based on those identified and licenced under Regain's EPL 13269 as being pollutants of concern. It is noted that the proposed modification does not introduce new material types or treatment processes beyond those currently approved under Project Approval 06_0050. The thermal treatment plant emission points are the only emission points for which organics, persistent organics and metals were adopted for the emissions inventory. This was due to the process they perform (thermal treatment of SPL material) and the temperatures at which they operate. Further information detailing the process inputs and outputs during the thermal treatment of SPL material is shown in Appendix B Conversely, the Shed 5 and Ball Mill operations are mechanical only and involve no heating processes or the use of natural gas or fuels during operation. As such, the only emissions which were considered likely to be generated by activities within Shed 5 and the Ball Mill operations were total suspended particulates, negating the need to consider organics,

Issue Raised	Response
	persistent organics and metals for these operations. The total particulate concentration used in the assessment was derived from the concentration described within EPL 13269. For the purposes of the assessment and as a conservative measure, a PM10 concentration limit of 10mg/m^3 was used for the Shed 5 and Ball Mill stacks, which is consistent with the PM10 limit under EPL 13269 applicable to the Rotary Kiln stack. PM2.5 was not specifically modelled in the assessment as initial modelling indicated acceptable performance against the relevant criteria for TSP and PM10. However following consultation with the EPA, assessment of PM2.5 has been undertaken based on a conservative assumption that all PM2.5 emissions are equal to PM10 emissions. This approach is considered suitable as monitoring data for PM2.5 is not currently available for Regain's proprietary processes and PM2.5 is typically measured as a smaller fraction of TSP compared to PM10 in most industrial applications. The modelling results indicate that the adopted cumulative ground level concentration assessment criteria for PM2.5 would not be exceeded as a result of the Project. Following consultation with the EPA, an additional scenario considering typical operating conditions was modelled to assess actual plant performance and has been included within the AQIA. The results of the typical operating scenario modelling can be seen in Appendix A.
6. A more robust assessment of the ground level concentrations for cadmium and PAHs	Whilst cadmium and PAH ground level concentrations were modelled at 99% and 91% of the impact assessment criteria respectively the modelled predictions reflect a conservative assessment approach based upon the maximum proposed EPL concentration limits. As described in the AQIA a reduced cadmium emission limit of 0.025 mg/m^3 is being proposed for both thermal treatment plants, based on conservative assumptions, to ensure compliance with ground level concentration limits. It is considered that in practice, the Project's contribution to ground level concentrations would be far lower. Following consultation with the EPA, a typical operating scenario was modelled to assess the actual plant performance and has been included within the AQIA. The results of the typical operating scenario modelling can be seen in Appendix A and predicts cadmium and PAH at 16% and 25% of the impact assessment criteria respectively. Therefore it is unlikely that ground level concentrations for cadmium or PAHs would be exceeded during typical operations. Cumulative ground level concentrations have been assessed in further detail as described for Issue 3 and a discussion of modelling results is presented in Section 7 of the AQIA.
7. A comparison of actual emissions with prescribed limits contained in the Protection of the Environment Operations (Clean Air) Regulation 2010	Following consultation with the EPA, a typical operating scenario was modelled to assess the actual plant performance and has been included within the AQIA. A summary of equivalent thermal treatment stack parameters data are provided in Appendix D of the AQIA. The AQIA presents both an 'average' typical operating condition scenario and a maximum potential operating condition scenario. All emission concentrations considered in the AQIA comply with concentrations specified in the Clean Air Regulation. The summary of stack emissions testing results, conservative assumptions and analysis of results within the AQIA demonstrates that the Project would comply with the prescribed

Issue Raised	Response
	concentrations contained in the Clean Air Regulation. A statement confirming compliance with the prescribed concentrations contained in the Clean Air Regulation is included in Section 6.5 of the revised AQIA.
8. Clarification of sensitive receptors and predicted impacts at each sensitive receptor	The AQIA was prepared in accordance with the NSW EPA (2017) Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales. Incremental and cumulative background concentrations determined in this assessment were provided in Section 7.0 Modelling Results, Table 20 – Incremental & Cumulative Predicted Ground Level Concentrations (µg/m3). The table states the averaging periods which apply to each of the specific pollutants assessed the percentile and assessment location of the result and the maximum predicted modelling ground level concentrations at the correct percentile, in accordance with the methods. The maximum incremental and applicable background ground level concentrations have been reported in the table, therefore any other results at other sensitive receptors would be lower. The Approved Methods do not require the assessment to further delineate results between different types of sensitive receptors, only that the modelling results are applied at all sensitive receptor locations assessed. Sensitive receptor locations used in the modelling are shown in Figure 6 in Section 6.4 of the AQIA. However to provide further context, cumulative ground level concentrations have been assessed in further detail for sensitive receptor locations as described for Issue 3 and a discussion of modelling results is presented in Section 7 of the AQIA.

4.2 NSW Department of Planning and Environment

Comments

DP&E's submission raised additional questions and comments around the SPL treatment process, waste management, stormwater and leachate management and traffic. These additional questions have been tabulated with a response in Table 5.

Response

Table 5 Summary of DP&E comments and Regain responses

Comment	Response
SPL Treatment Process	
How will the Proponent monitor the throughput of SPL to ensure no more than 20,000 tonnes per year of SPL waste is put through the 20,000 tonne per year thermal treatment plant?	SPL is fed to the thermal treatment plant with a continuous feeder. The SPL feeder is calibrated to deliver target feed rates in tonnes per hour based on the speed of the feeder. The feeder speed is controlled and recorded using an electronic computer based supervisory control and data acquisition (SCADA) system. The weight of the actual throughput of the thermal treatment plant is separately measured by weighing the batches of treated SPL. The feed rate is progressively calibrated against the actual weight of treated SPL batches. The processed SPL and the products dispatched are subject to batch control. The weight of material in batches is reconciled with weights of product dispatched recorded using a calibrated weighbridge for which there is a current certificate of approval. The Materials Control Standard document provides further

Comment	Response
	information on batch control and can be found in Appendix K of the EA. Both the use of the SCADA system and reconciliation of processed SPL in batches and dispatched products would enable Regain to ensure that no more than 20,000 tonnes per year of SPL waste is put through the thermal treatment plant. Further, Regain provides monitoring of the total throughput of the SPL facility within an Annual Report submitted to NSW EPA, as part of the NSW EPA Hazardous Chemicals Act Licence.
How will the Proponent manage the SPL input into the two thermal treatment plants when they are both operation?	SPL is input into each thermal treatment plant by an individual feeder, which would be separately controlled and recorded using the SCADA system.
How much SPL waste can be stored in Shed 5?	It is estimated that up to 8,000 tonnes of SPL waste may be stored in Shed 5 at any one time.
How much treated SPL waste and carbon (including treated and final product SPL) can be stored in Shed 6?	It is estimated that up to 15,000 tonnes of treated SPL material (including treated and final product SPL) may be stored in Shed 6.
What does ‘product plant elements’ refer to on p.3 of the EA?	“Product plant elements” generally refers to the Drying Plant and Fine Grinding Plant and ancillary equipment used during final product preparation. Product plant elements are used during product preparation which occurs after the SPL has been chemically treated. The term “product plant elements” is used in contrast to thermal treatment plant elements which are used for preparing and chemically treating the SPL. Further clarification of individual plant elements is provided within Section 2.2 of the EA.
What does the processing of carbon (first cut) and refractory (second cut) SPL mean?	An aluminium smelter pot (or reduction cell) has two main types of lining: • An inner carbon lining which allows for conducting electricity required for the aluminium reduction process; and • A refractory lining which contains the heat produced by the aluminium reduction process. When the lining of the pot is removed at the end of the service life of the lining, it is typically removed in two parts where the carbon lining is taken out first (first cut) and the refractory lining is then removed (second cut). The types of SPL and their compositions are explained in more detail in the Information Document – Sources and Processing of By-Products Materials Recovered from Aluminium Smelting Industry by Regain in Appendix G of the EA. Appendix H of the EA includes summary report (REC, 2016) with further information on the SPL removal, or pot de-lining process.
Is the SPL waste fed through the thermal treatment continuously or in batches?	During typical operation the SPL waste is fed through the thermal treatment plant continuously. The treated SPL and final products are then controlled in batches. The Materials Control Standard document provides further information on batch control in Appendix K of the EA.

Comment	Response
How long does it take to treat the SPL waste in the thermal treatment plant?	The processing of SPL through the thermal treatment plant takes approximately 30 minutes. The thermal treatment process is complete after a final curing process which typically lasts for one or two weeks, dependant on the treated material characteristics and final product specification.
Waste Management	
Classify the final product SPL waste in accordance with the EPA's "Waste Classification Guidelines" 2014	The final products produced by the facility are HiCAL Products, which are not classified as a waste. HiCAl products are designed for use as fluxes and mineralisers in cement manufacture. HiCAl products are not classified as Dangerous Goods. Safety Data Sheets (SDS) and a HiCAl Products Portfolio Technical document have been prepared and are included as Appendix G of the EA. SPL in NSW is regulated under a Chemical Control Order, the "Chemical Control Order In Relation to Aluminium Smelter Wastes Containing Fluoride and/or Cyanide" issued pursuant to section 21 of the *Environmentally Hazardous Chemicals Act 1985* (EHC Act)" (the Control Order). The Control Order provides for the issue of licences for processing of wastes for the recovery of components, the making of other products, or to reduce the fluoride and/or cyanide content or leachability. Regain holds EHC Act Licence Number 88 which includes: • Condition 3.2 – Aluminium Smelter Wastes may be processed on the premises for the recovery of components, the making of other products or to reduce the leachable fluorides and/ or leachable cyanide content. • Condition 4.2 – products manufactured from Aluminium Smelter Wastes may only be conveyed from the premises for the purpose of reuse in the other industrial and manufacturing processes or for the purpose of assessing the suitability of such products for use in an industrial or manufacturing process. Regain holds Environmental Protection License (EPL) Number 13269 to operate the SPL facility. The EPL includes: • Condition O5.2 - The licensee may receive waste classified as hazardous, or restricted solid waste, and aluminium Smelter Waste, as defined by the Environmentally Hazardous Chemicals Act "Chemical Control Order in relation to Aluminium Wastes Containing Fluoride and/or Cyanide in the form of spent pot-liner materials containing components of cyanide and fluoride for the purpose of recycling this waste into products. The EPA's *Waste Classification Guidelines* (2014) are not applicable to the final product SPL, being HiCAL products, as these products are not classified as waste.
Will the 'final product' SPL be transported locally, interstate or overseas? If transported overseas, where will it be transported and how often?	The final product SPL (HiCAL product) will continue to be transported overseas for use in cement manufacturing countries including the Philippines, Sri Lanka and Thailand. Historically Regain has manufactured and sold in the order of 350,000 tonnes of products derived from domestic Aluminium Smelter Wastes. The products have been used in Australian industries with the majority of product exported for use by international cement manufacturers.

Comment	Response
	In 2008 Regain received a letter from the Australian Federal Government Department of Environment, advising that Regain products are not considered hazardous waste and do not require regulation under the Basel Convention on the Transboundary Movement of Hazardous Wastes and their Control. The regular export of final product commenced in 2012. The final product (HiCAl) is exported via containerised freight and dry bulk shipments on a regular basis.
Regarding the treated SPL being blended with carbon, advise the following: • How much carbon is required to be stored on site? • How much carbon is added to the treated SPL? • Where is the carbon sourced? • Is the carbon classified as a waste? • Are there any other additives added to the final product?	Aluminium Smelter Wastes include carbon materials. Regain currently recycles carbon materials from the Tomago Aluminium Smelter only. The Tomago Smelter generates approximately 1,000 tonnes per year of carbon by-products from the manufacture and processing of carbon anodes which is typically consumed in the annual production of HiCAl at the Tomago SPL Processing Facility. Anode carbon by-products stored at the facility range between 100 tonnes to 500 tonnes. The anode carbon by-products are classified as aluminium smelter waste containing fluoride prior to processing. They are processed at the SPL facility and transformed into HiCAL products under the same licences as described above. No other additives other than aluminium smelter wastes are included in the HiCAL products. Further information on the carbon aluminium smelter waste materials including indicative compositions and material sources are explained in the Information Document – Sources and Processing of By-Products Materials Recovered from Aluminium Smelting Industry by Regain, Appendix G of the EA.
Stormwater and leachate management	
Regarding the internal drainage system in Shed 5 and 6, advise the following: • Provide further detail on the internal drainage system • What is the quality of the leachate generated in Shed 5 and 6? • How much leachate is generated in both Shed 5 and 6?	The internal drainage system in Shed 5 and 6 is designed to capture water that may have entered the respective building and become contaminated by materials within the building. The internal drainage system in each shed empties into sumps which would be pumped out in the unlikely event of water ingress to the building. In the unlikely event that some water did enter the internal drainage system the water/leachate is directed to a sump and contained. The water captured would be reused as process water in the SPL thermal treatment process. SPL received at the SPL Facility (Shed 5) is dry (containing no moisture) or damp with low levels of moisture up to 10%. The moisture in SPL is due to Tomago Aluminum's pot delining method. Any moisture in SPL is contained in the material. No leachate is generated in Shed 5 during typical operating conditions. The treated SPL received at Shed 6 from the SPL Treatment Plant has a moisture content in the range of 10% to 15%. Some moisture evaporates from the treated SPL in the final stages of curing and cooling. The final products stored in Shed 6 have a moisture content in the range of 5% to 8%. No leachate is generated in Shed 6 during typical operating conditions.

Comment	Response
Regarding stormwater discharge to the Tomago Aluminium stormwater management system, advise the following: • How much stormwater is diverted to the Tomago Aluminium stormwater management system? • What is the quality of the stormwater discharged to the Tomago Aluminium stormwater management system?	The Regain SPL Processing Facility was established on the Tomago Aluminium Smelter site within a pre-existing SPL storage facility which included the pot delining building, two SPL storage buildings (SPL Shed 5 and SPL Shed 6) and an associated stormwater management system. The Regain SPL Processing Facility stormwater system is integrated with the Tomago site-wide stormwater management system. The first flush system installed at the SPL Process Facility captures potentially contaminated water from the initial flush of stormwater from the area underneath plant installed in the courtyard area between Shed 5 and Shed 6. This water is recovered and used as process water for the SPL Processing Facility. As noted in the EA, additional stormwater capture, storage and reuse devices would be installed to improve existing site stormwater control and improve water use efficiencies. The proposed design allows for runoff from within the courtyard to be captured during a 1 in 1 year storm event. Flows in excess of the 1:1 year storm event would therefore flow through to the Tomago Aluminium stormwater system. Ultimately the quantity of water flowing to the Tomago Aluminium stormwater management system from the courtyard will be dependant on the frequency and severity of rainfall events during any given year. However it is considered that the Project would provide improved opportunities for stormwater control through the addition of a second first flush system. The courtyard catchment is estimated at 2,500m^2. By comparison the Tomago Aluminium operational area is conservatively estimated at 100,000m^2. The Tomago Aluminium stormwater management system ultimately discharges to a stormwater collection pond designed to capture flows from a 1 in 10 year storm event. Excess water overflowing from high rainfall events that exceed the first flush capture capacity has not been analysed for quality. However in the event of sustained heavy rainfall excess flows are discharged into the Hunter River in accordance with EPL 6163 (and the associated licenced discharge point). There would be no substantial change to the existing contribution of the facility to stormwater volumes discharged at EPL 6163 licenced discharged points. Tomago Aluminium operates a stormwater monitoring program for the smelter site. The stormwater from the SPL Facility is monitored in aggregate with the site wide smelter monitoring program. Regain works closely with Tomago Aluminium to ensure the site stormwater standards are maintained and improvements are implemented where necessary.
Traffic management	
Provide traffic count data for Old Punt Road and the Old Punt Road / Tomago Road intersection.	Old Punt Road provides a north-south connection between Tomago Road and the Pacific Highway for the Tomago Industrial Precinct. In 2010, a temporary traffic count station on Tomago Road, just 180 m north of Old Punt Road intersection (which is a roundabout) recorded the average daily traffic count to be 12,275

Comment	Response
	vehicles (combined in both directions of travel). Light vehicles represented 90% of the average daily traffic count, while heavy vehicles accounted for 10%. There would be no additional passenger vehicle movements associated with operation of the modified facility, as the existing workforce is not expected to change. As the Old Punt Road and Tomago Road intersection would only be utilised by passenger vehicles, further evaluation of this intersection is not necessary. The Regain facility is accessed via Old Punt Road, off the Pacific Highway. An unnamed private road links the smelter site with Old Punt Road. Internal access roads are then used to access the Regain facility. Old Punt Road is a single carriageway with one lane of travel in each direction. At the T-intersection of Old Punt Road and the unnamed access road that facilitates heavy vehicle access to the site, the intersection consists of the following features: • On Old Punt Road in the southbound direction -a southbound, slip lane that provides access to the unnamed access road for vehicles turning left. • On Old Punt Road - both a northbound and southbound lane of travel • On the unnamed access road - a T-intersection with sufficient space to accommodate heavy vehicles waiting to enter Old Punt Road, allowing both northbound and southbound turn movements. Heavy vehicles entering site would turn onto the unnamed access road using the dedicated slip lane. Heavy vehicles leaving site would turn right onto Old Punt Road, giving way to traffic on Old Punt Road. Based on estimates established in the 2018 EA the additional truck traffic generated by the Project is expected to result in a 3% increase in the total traffic movements from the Tomago Aluminium smelter site. Given the number of traffic movements, past intersection upgrades carried out by Roads and Maritime on Old Punt Road, and the proposed traffic management measures as outlined in the EA, the construction and operation of the Project is not anticipated to have a significant impact on the safety or capacity of the existing road network.

4.3 Fire and Rescue NSW

Comments

Fire and Rescue NSW have reviewed relevant sections of the EA and have provided the following notes and comments:

- It is noted that the main works to be undertaken in order to achieve the increase in processing capacity include:
  - Installation of an additional thermal treatment plant;
  - Rationalisation of plant configuration to take advantage of improvements in technology;
  - Installation of additional stormwater controls;

- It is noted that there is to be no significant increase in the volume of processed material stored on site;
- The development has previously been assessed against the requirements of State Environmental Planning Policy 33 – Hazardous and Offensive Development (SEPP 33) and a subsequent Preliminary Hazard Analysis (PHA) completed (SKM, 2007). A preliminary screening analysis undertaken for the modification including a gap analysis against the existing PHA has found that the existing risk profile would not change;
- It is noted that the SPL facility is operated in accordance with the Tomago Aluminium Emergency Response Plan and that a number of key firefighting aspects are provided within section 7.2.1 of the Report;
- It is noted that Safety Data Sheets (SDS) have been provided for materials at the SPL facility; and
- FRNSW are unable to determine whether the existing fire safety systems are adequate for the SPL facility as no relevant information regarding these has yet been provided.

Based on the above notes and comments and Fire and Rescue NSW's understanding of the project, Fire and Rescue NSW recommended the following:

- That a Fire Safety Study (FSS) be undertaken for the site in accordance with HIPAP 2. The study should be developed in consultation with and to the satisfaction of FRNSW; and
- FRNSW recommend that prior to the submission of a Fire Safety Study, consultation with FRNSW (via a meeting) shall be undertaken to determine firefighting requirements and operational expectations.

Response

A meeting was held on 25 January 2019 between Regain representatives and FRNSW. Discussions were generally centred around the following:

- The proposed project modification being physical modifications of plant and equipment to increase current plant throughput from 20,000tpa to 60,000tpa for the Tomago SPL Recycling Facility. The proposed project as modified would retain the same general physical size and scale of the originally approved project and does not require extension or substantial modifications of existing buildings;
- Existing operational procedures, site fire safety controls, Safety Data Sheets and chemical properties of SPL materials to be processed at the facility noting that the Project does not require a change in existing use or substantially alter the quantities of material stored on site;
- Previous testing of thermally treated SPL material samples with consideration of AS/NZS 4745:2012, “Code of practice for handling combustible dusts” demonstrating that materials are not classified as a combustible dust (Simtars, 2018[1]);
- Existing access to the site being generally unconstrained with existing roadways providing ready access to both Shed 5 and Shed 6;
- Buildings associated with the Project being generally constructed of cement and steel cladding materials and heat treatment plant elements being located outside in an uncovered area;
- Regain's operations occurring within the context of the broader site, being located within an operating aluminium smelter which is approved to produce up to 600,000tpa of aluminium with dedicated controls and resources to address fire safety; and
- The Tomago Aluminium site wide Emergency Response Plan which addresses fire safety risks associated with SPL material storage and processing locations and to which Regain adhere to in the event of an emergency.

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[1] Combustible Dust Properties Testing of Three Carbon Dust Samples, prepared by Simtars for Regain Services Pty Ltd 2 February 2018

In response to outcomes from the meeting on 25 January 2019, the Tomago Aluminium Emergency Response Plan was provided to FRNSW on 19 February 2019. Key aspects of this plan include:

- A three tier level of emergency response incorporating local response measures and site based emergency response teams and a clear process of escalation to external emergency services, when required (Section 6);
- Emergency identification and response procedures (Section 7);
- Consideration of specific site emergencies including the risk of fire or explosions occurring within SPL storage areas and the potential for overflow of contaminated fire water to storm water systems (Section 12);
- The available emergency resources including fire protection systems, site dedicated emergency vehicles (fully equipped fire and rescue vehicle and dry chemical fire tender), high pressure water supplies, fire and emergency teams consisting of trained site personnel, self-contained breathing apparatus (SCBA) and first aid resources (Section 15); and
- A site plan identifying buildings associated with Regain operations within the broader Tomago Aluminium site (Appendix B).

The EA indicates that the environmental consequences associated with the proposed modifications are likely to remain substantially the same as the original approved development. Quantities of material stored on site at any one time are not expected to increase substantially as a result of the proposal. Based on a comparison of the existing facility and proposed modification, the activities and process operations to be undertaken do not result in a significant change to the facility risk profile.

Following the meeting on 25 January 2019 it was considered that further assessment is unlikely to substantially improve the understanding of existing hazards or risks of the facility and that the requirements of SEPP 33 are adequately addressed by the current EA (AECOM, 2018).

4.4 Hunter New England Local Health District

Comments

Hunter New England Local Health District (HNELHD) has reviewed the EA with particular attention paid to the management of air quality, noise, water and issues which may have an impact on public health. HNEPH endorsed the NSW EPA’s submission and may make a final submission based on response to the EPA concerns.

HNELHD noted that Regain proposes to collect stormwater with an intention to utilise the collected stormwater in processing onsite. Given that it is not a public water recycling scheme, NSW Health (or HNEPH) is not the regulatory authority or a relevant authority for consultation. A reference is made to the Guidelines for Stormwater Harvesting and Reuse as a relevant national guideline to consider.

HNELHD encourages Regain to consult with SafeWork NSW and the NSW EPA to ensure aspects of worker safety and environmental protection are covered in the proposed stormwater harvesting and utilisation plan.

A meeting was held with HNELHD representatives on 4 February 2019 to discuss submissions. HNEPH raised additional questions during the meeting held between Regain and HNELHD representatives on 4 February 2019. Questions were generally centred around the assessment approach regarding PAHs and Benzo(a)pyrene (BaP) in Appendix F – Human Health Risk Assessment of the EA. The questions raised by HNELHD during the meeting on 4 February 2019 are summarised below.

Nickel

- HNELHD noted that there was a non-threshold analysis for nickel with Appendix F – Human Health Risk Assessment of the EA but that the toxicity profile in the appendix states it may be considered genotoxic;
- HNELHD noted that either nickel may require further analysis within the Human Health Risk Assessment or that the basis of the assessment may require additional clarification.

PM2.5

- HNELHD noted PM2.5 as a potential pollutant of concern for consideration with Appendix F – Human Health Risk Assessment of the EA.

Benzo(a)pyrene and total PAHs

- HNELHD requested clarification on Benzo(a)pyrene and non-threshold analysis carried out within Appendix F – Human Health Risk Assessment of the EA;
- HNELHD requested clarification around PAH's and whether all PAH was treated as Benzo(a)pyrene within Appendix F – Human Health Risk Assessment and if so, an explanation of the approach;

Response

Following the recommendation from HNELHD, The Guidelines for Stormwater Harvesting and Reuse was considered in the regard to the stormwater collection and utilisation. Stormwater design has considered potential rain volumes during storm events in accordance with Port Stephens Council Stormwater Drainage Handbook. Storage tanks would include high-level switches to prevent any overflow. Mesh screening would also act to prevent ingress of mosquitos and breeding. Water captured in the storage tanks would be reused in site processes consistent with existing operations.

Consultation with SafeWork NSW and the NSW EPA has occurred throughout preparation of the EA and subsequently following submission of the EA to DP&E. Information on Hazard and Risk Management Standards is provided in Appendix J of the EA. The Stormwater Management Plan would be reviewed and updated to accompany the modified Project.

HNEPH noted that Regain proposes to collect stormwater with an intention to utilise the collected stormwater in processing onsite. Given that it is not a public water recycling scheme, NSW Health (or HNEPH) is not the regulatory authority or a relevant authority for consultation. A reference is made to the Guidelines for Stormwater Harvesting and Reuse as a relevant national guideline to consider.

HNEPH encourages Regain to consult with SafeWork NSW and the NSW EPA to ensure aspects of worker safety and environmental protection are covered in the proposed stormwater harvesting and utilisation plan.

Nickel

The toxicity values for Nickel used in Appendix F – Human Health Risk Assessment were adopted from NEPC, 2013. *Schedule B(7) Appendix A1, Derivation of HILs for Metals and Inorganics.* In: National Environment Protection (Assessment of Site Contamination) Measure 1999 as amended May 2013. National Environment Protection Council.

The assessment of oral intakes on the basis of a threshold approach is based on current studies which indicate there was no carcinogenic concern from ingested nickel. It is noted that inhalation exposures to nickel are complex and are dependent on the form of nickel present (NEPC 2013). The non-threshold assessments of inhalation cancer risk (WHO 2000) relate to a nickel compounds, specifically nickel subsulfide. As such, carcinogenic end points are expected to be of particular importance if they are derived from nickel refinery dust of nickel subsulfide. An updated toxicity profile for Nickel is provided in Appendix C and clarifies that the non-threshold values obtained from the WHO 2000 studies relate specifically to nickel subsulfide.

Although NEPC 2013 adopted an inhalation Toxicity Reference Value (TRV) based on a threshold approach, the TRV was considered protective of both carcinogenic and non-carcinogenic effects, and was consistent with guidelines derived using a non-threshold approach (at an excess lifetime cancer risk level of 1 in 100,000).

Nickel Subsulfide was not identified as a chemical of potential concern for the site, and as such, the oral and inhalation TRV for Nickel used in the Human Health Risk Assessment (AECOM, 2018) are considered appropriate, most current and adequately protective of the most critical health effects.

PM2.5

There are no established TRVs in relevant guidelines or standards specifically related to fine particulates (PM10, PM2.5). PM2.5 was not specifically modelled during the assessment as initial modelling indicated acceptable performance against the relevant criteria for TSP and PM10. However following consultation with the EPA, assessment of PM2.5 has been undertaken based on a conservative assumption that all PM2.5 emissions are equal to PM10 emissions. This approach is considered suitable as monitoring data for PM2.5 is not currently available for Regain's proprietary processes and PM2.5 is typically measured as a smaller fraction of TSP compared to PM10 in most industrial applications. The modelling results indicate that the adopted cumulative ground level concentration assessment criteria for PM2.5 would not be exceeded as a result of the Project.

Benzo(a)pyrene and total PAHs

Not all PAHs were treated as Benzo(a)pyrene (BaP) within the Human Health Risk Assessment (AECOM,2018) as the approach was deemed too conservative. The Air Quality Impact Assessment (AECOM, 2018) data identified that the contribution of BaP to total PAH was minor (i.e. contributed to <0.1% of total PAH). An alternative approach was adopted, whereby only the carcinogenic PAHs were assessed as BaP (using a non-threshold approach) and the remainder was assessed as naphthalene. Therefore the average percent contribution of the carcinogenic PAHS to the total PAH was assessed as BaP.

4.5 Port Stephens Council

Comments

Port Stephens Council notes that they were consulted by Regain during the preparation of the EA in August 2018. Port Stephens Council has reviewed the EA and indicated that Council's comments remain consistent with those raised by Port Stephens Council during the preparation of the EA. Councils comments pertain to the consideration of the cumulative impact on the ecological constraints of the site, water quality and traffic impacts as a result of the increased capacity of the facility including the footprint, vehicle movements and stormwater within the EA.

Council also indicate that any assessment of the EA should consider and include the following:

- Traffic impact assessment and stormwater management plans should be updated to ensure they support the increase as a result of the modification
- The indirect ecological impacts due the construction and operation should include (but not be limited to):
    - Vegetation mapped as Supplementary and Marginal Habitat under the Port Stephens Comprehensive Koala Plan of Management;
    - The potential habitat and/or corridors for threatened species such as Koalas, Squirrel Glider and Wallum Froglet;
    - Wetlands identified in the Port Stephens Local Environment Plan 2013 and the State Environmental Planning Policy (Coastal Management) 2018;
- The development shall comply with the existing (and modified) Environment Protection Licence (EPL) 13269, Environmentally Hazardous Chemicals Licence #88 and the Project Approval (06_0050), including the Secretary's Environmental Assessment Requirements (SEARs) issued for the project.

Response

Following submission of the EA feedback was sought from Council via telephone on 14 December 2018. Council representative confirmed that Council was generally satisfied that all issues raised prior to submission of the EA had been appropriately addressed. A summary of where these issues have been discussed is provided in Section 5.2 of the EA.

4.6 NSW Office of Environment and Heritage

Comments

The NSW Office of Environment (OEH) and Heritage has reviewed sections of the EA relevant to biodiversity, Aboriginal cultural heritage and flooding. OEH has no concerns or comments regarding the project or the EA.

Response

As OEH had no concerns or comments, no response is required.

4.7 NSW Rural Fire Service

Comments

The NSW Rural Fire Service (NSWRFS) considered the information provided within the EA and has no specific recommendations in relation to bush fire protection.

Response

As NSWRFS had no concerns or comments, no response is required.

4.8 Hunter Water Corporation

Comments

Hunter Water acknowledges that via consultation carried out between the Proponent and Hunter Water during the preparation of the EA, Hunter Water had requested that the EA should address the effect of the proposal on the Tomago Sandbeds in terms of:

- Air emissions;
- Hazards and risk management;
- Storage and handling of by-products;
- Stormwater management; and
- Water and wastewater servicing.

Hunter Water are satisfied that these fore mentioned issues are sufficiently addressed in the EA and that from the information provided, the proposal does not appear to present a risk to the water source.

Response

As Hunter Water had no further concerns or comments, no response is required.

4.9 TransGrid

Comments

TransGrid has reviewed the EA and has no objections to the project as it does not affect any TransGrid owned infrastructure.

Response

As TransGrid had no concerns or comments, no response is required.

4.10 NSW Roads and Maritime Services

Comments

Roads and Maritime has no comments in relation to the project.

Response

As Roads and Maritime had no concerns or comments, no response is required.

4.11 NSW Department of Industry

Comments

NSW Department of Industry has no comments in relation to the project.

Response

As NSW Department of Industry had no concerns or comments, no response is required.

5.0 Statement of Commitments

In accordance with the requirements under the Part 3A (repealed) provisions of the EP&A Act, a draft Statement of Commitments was provided within the EA. Following the receipt and consideration of submissions these management measures were reviewed. The final summary of Project management measures is provided in Table 6.

Regain commits to the implementation of the environmental management measures detailed in Table 6 during construction and operation of the proposed modification.

Table 6 Final statement of commitments

Issue	Safeguard
General	1. The Proponent would implement all practicable measures to prevent or minimise harm to the environment that may result from the construction or operation of the Project. 2. The Proponent would implement all practicable measures to prevent or minimise harm to the environment that may result from the construction or operation of the Project. 3. The Proponent would prepare and implement a Construction Environmental Management Plan (CEMP) to provide environmental management practices and procedures to be followed during the construction phase, particularly in relation to the management of soils, surface waters, air quality, and noise management. 4. The Proponent would update a current EMP prepared for the existing site activities. 5. The Proponent would operate the facility in accordance with existing EPA pollution control approvals for existing operations at the Tomago smelter. 6. The Proponent would operate the facility in accordance with existing EPA Environmental Protection Licences (EPLs) issued for existing operations of the smelter. 7. The Proponent would ensure regular inspection, monitoring and auditing is undertaken to maintain effective environmental management and to highlight non-compliance of standards, conditions or licence requirements. 8. The Proponent would ensure routine monitoring of air quality, groundwater and surface water is undertaken. Groundwater and surface water monitoring is undertaken in conjunction with the TAC smelter existing monitoring program where appropriate.
Air Quality	1. The Proponent would implement dust mitigation strategies throughout the facility including: - Enclosure of external plant; - Construction of sealed processing and product storage facilities; - Installation of dust extraction systems throughout the processing plant and connected to dust generating activities; and - Installation of visual and audible alarm systems to minimise potential for dust generation in the event of plant / system breakdown or failure. 2. The Proponent would ensure residual emissions would be directed to the atmosphere via stacks, as indicated by the proposal. 3. The Proponent would implement dust mitigation strategies as part of the CEMP which will include: - Stabilisation of disturbed surfaces during construction; - Removal of excessive soil on construction vehicle tyres; and - Spraying of stockpiled earths / fine construction material during high winds to reduce potential for dust. 4. The Proponent would maintain processing plant and Shed 5 under negative pressure, treated products would be maintained in a moist condition, to mitigate fugitive emissions.

Issue	Safeguard
	5. The Proponent would control SPL processing stages to destroy cyanide and hazardous gases. 6. The Proponent would control the thermal treatment process (i.e. maintain the temperature below 850ºC) to minimise liberation of gaseous fluoride. 7. The Proponent would operate baghouse dust collectors to minimise emissions of particulate matter and particulate-bound contaminants. 8. The Proponent would apply appropriate housekeeping practices to minimise dust generation from concrete apron areas.
Hazard and Risk	1. The Proponent would prepare and implement a Safety Management System (SMS) for the SPL plant to include elements of the operations, maintenance and management of the facility. The SMS would be developed in accordance with the guidelines issued by the Department of Planning in Hazardous Industry Planning Advisory Paper No.9, “Guidelines for Safety Management Systems”. 2. The Proponent would install the following systems within the SMS: - A kiln temperature monitoring and calibration procedure to ensure the temperature control system of the kiln is operated using correct data and information; - A burner management system designed in accordance with AS1853 (“Automatic Oil and Gas Burners: Mechanical Draught”, Standards Association of Australia, Sydney, 1983); - A pressure management and monitoring / alarm system for dust extraction equipment; and - A temperature management and alarm system in the baghouse. 3. The Proponent would construct the SPL facility so that it incorporates: - Bunding of truck loading areas to prevent potential contamination of nearby drains and stormwater run-off channels; - The rotary kiln would be fitted with blast panels to minimise the potential for explosion damage to the kiln shell; and - An interlock would be fitted to the water supply system and induction fan.
Human Health	1. The environmental controls as listed in Section 2.4 of the EA would be implemented.
Traffic and Transport	1. Operate in accordance with the Road Transport Act 2013. 2. Construction vehicles carrying loose materials to and from the site would be covered after loading (prior to traversing public roads) to prevent wind-blown dust emissions and spillages. 3. In the event of a spillage of materials from construction vehicles onto a public road, the RMS & EPA would be notified and the spilled material would be removed. 4. Construction traffic would only traverse those public roads as outlined in the EA, which are public roads that are suitable for heavy vehicles. 5. Additionally, adequate on-site parking would be provided for construction traffic so that no construction vehicles would be parked on the surrounding road network. The following specific traffic mitigation measures would be applied to the Project during operation: • Site access procedures including the proposed haulage route would be communicated to site personnel and heavy vehicle operators. • Trucks would ensure loads are appropriately covered and sealed to protect transported material from wind and rain.
Noise and Vibration	1. The Proponent would implement noise mitigation strategies to achieve the following: - Operational noise levels are maintained at 10 dB(A) below the existing noise level of the smelter; and

Issue	Safeguard
	- The L1 (1 min) level of any specific noise source would not exceed the background noise level (L90) by more than 15 dB(A) when measured outside the bedroom window of the nearest residential receiver (in accordance with DECC's Environmental Noise Control Manual). 2. The Proponent would implement noise mitigation strategies in the CEMP, including but not limited to the following: - Unless otherwise agreed by DECC, construction activity, likely to impact on sensitive receivers, would only occur during the period: ▪ 7.00am to 6.00pm Monday to Friday; ▪ 8.00am to 1.00pm Saturday; and ▪ No work on Sundays or public holidays. 3. Construction noise shall not exceed 5 dB above background levels (as prescribed by EPA Environmental Noise Control Manual criteria).
Waste	1. All construction waste would be classified in accordance with the Waste Classification Guidelines (EPA, 2014) prior to disposal and transported to an appropriately licensed waste disposal facility. 2. The site EMP would be reviewed and updated following approval of the Project as modified, if necessary. 3. A variation to EPL 13269 would be sought to provide for the revised site layout and emission points following approval of the Project. 4. The EHC Licence (#88) would be reviewed following approval of the Project and if required a variation sought to maintain consistency. 5. SPL material would be maintained under cover within Shed 5 prior to processing. 6. Exposed treated product would be maintained in a moist condition to prevent dust rising. Treated product would be stockpiled within Shed 6.
Water and Soil	1. The Stormwater Management Plan would be reviewed and updated to accompany the modified Project 2. The Proponent shall implement all practicable measures to minimise the discharge of sediments, contaminants and pollutants to surface and ground water as a result of the operation of the facility. 3. The Proponent shall ensure that all drains and stormwater channels outside the SPL bunded area are directed to the existing site first flush pond. 4. The Proponent shall ensure there is no outside bulk truck loading in the SPL facility during rain periods 5. The Proponent shall implement ground water and surface water quality management strategies in the CEMP.

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6.0 Project Evaluation

Having fully considered the comments and issues raised in all submissions, responses have been prepared to address matters raised by submissions. Post-lodgement meetings were held with the EPA, FRNSW and HNELHD to discussion all or some components of their submissions. The outcomes of the engagement with these authorities are discussed below.

The EPA required more clarification regarding the AQIA attached as Appendix D to the EA. Following a review of the information required from the EPA, an updated AQIA has been included as Appendix A of this RTS, while other clarification has been provided within Section 4.1.

In their original submission, FRNSW had recommended an FSS to be undertaken for the site in accordance with HIPAP 2 and that consultation should be carried out with FRNSW to determine firefighting requirements and operational expectations. Subsequent meetings between FRNSW and Regain concluded that the activities and process operations to be undertaken as part of the project modification do not result in a significant change to the facility risk profile and that an FSS was not required.

Within the post-lodgement period, Regain attended a meeting with HNEPH representatives and additional questions were raised regarding the Human Health Risk Assessment of the EA. Responses to these questions have been provided in Section 4.4 and a nickel toxicology profile has been provided with Appendix C.

The potential environmental impacts of the project have been assessed and it is considered that the mitigation measures identified would effectively ensure that the environmental consequences associated with the proposed modifications are minimised and likely to remain substantially the same as those currently approved.

The benefits of the Project would outweigh its potential impacts with the implementation of the proposed management and mitigation measures as identified in this EA. It is therefore considered that it is appropriate and in the public interest to approve the Project.

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7.0 References

AECOM 2013, *PRP 1 – Air Emissions Verification Report, Regain Tomago (EPL 13269).* Prepared for Regain Tomago

NSW EPA (2014), *Waste Classification Guidelines.* Available on the Internet at: *https://www.epa.nsw.gov.au/your-environment/waste/classifying-waste/waste-classification-guidelines*

NSW EPA (2017) Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (Approved Methods),

REC (2016), *Spent pot lining project (feasibility of an agreement based approach to clear stockpiles) – Final national summary report*. In association with Ascend Waste and Environment

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Appendix A

Air Quality Impact Assessment (Revision 2)

Appendix A Air Quality Impact Assessment (Revision 2)

Environmental Services
Regain Services Pty Ltd
29-Mar-2019

Air Quality Impact Assessment

Capacity Increase for a Spent Pot-Liner Facility at Tomago, NSW

Air Quality Impact Assessment

Capacity Increase for a Spent Pot-Liner Facility at Tomago, NSW

Client: Regain Services Pty Ltd

ABN: 80 099 714 824

Prepared by

AECOM Australia Pty Ltd
17 Warabrook Boulevard, Warabrook NSW 2304, PO Box 73, Hunter Region MC NSW 2310, Australia
T +61 2 4911 4900 F +61 2 4911 4999 www.aecom.com
ABN 20 093 846 925

29-Mar-2019

Job No.: 60512726

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Quality Information

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Ref	60512726
Date	29-Mar-2019
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Reviewed by	David Rollings

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	22-Aug-18	Draft for Client Review	Gabriel Wardenburg Principal Environmental Scientist	
0	29-Aug-2018	Final	Gabriel Wardenburg Principal Environmental Scientist	
1	28-Sep-2018	Final	Gabriel Wardenburg Principal Environmental Scientist	
B	20-Mar-2019	Draft for Client Review	Gabriel Wardenburg Principal Environmental Scientist	
2	29-Mar-2019	Update incorporating EPA comments	Gabriel Wardenburg Principal Environmental Scientist	GWardenburg

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1.0 Introduction

1.1 Project Overview

AECOM Australia Pty Ltd (AECOM) was commissioned by Regain Services Pty Ltd (Regain) to undertake an Air Quality Impact Assessment (AQIA) for the proposed capacity increase at their Tomago facility located within the Tomago Aluminium site.

The AQIA supports the Environmental Assessment prepared by AECOM as part of an application to modify Project Approval 06_0050 under the *Environmental Planning and Assessment Act 1979* (EP&A Act). The project includes consideration and assessment of the proposed increase in Spent Pot Lining (SPL) processing capacity from 20,000 tonnes to 60,000 tonnes per annum at the Regain Tomago SPL recycling facility (herein referred to as 'the Project'). The proposed modification includes:

- Retaining the existing 20,000 tpa plant and installation of the previously approved 40,000 tpa rotary drum kiln;
- Installation of the previously approved SPL Processing Shed 5 dust collector and associated emission point;
- Installation of the previously approved Drying plant dust collector and associated emission point;
- Installation of a new fine grinding plant and associated emission points; and
- Revising the previously approved site layout to accommodate the revised plant configuration.

1.2 Scope of Work

The assessment was undertaken in accordance with the NSW Environment Protection Authority (EPA) *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (Approved Methods) (EPA, 2017). The assessment considered the following pertinent information:

- The Newcastle air shed background pollutant concentrations; and
- The proposed operational parameters and emissions for the Regain Tomago facility whilst operating at:
  - 'Average' typical operating conditions; and
  - Proposed maximum pollutant concentration limits (based on those currently listed in Environment Protection Licence (EPL) No. 13269).

Predicted emission rates associated with increased processing capacity of 60,000 tpa at the Regain Tomago facility were estimated based on historical stack emissions testing parameters obtained from Regain facilities operated at Tomago, Kurri Kurri and Point Henry. Air emissions were modelled using the CALPUFF dispersion model in accordance with the Approved Methods (EPA, 2017).

1.3 Secretary’s Environmental Assessment Requirements

In preparing this AQIA, consideration has been given to the NSW Department of Planning and Environment (DP&E) Secretary’s Environmental Assessment Requirements (SEARs) issued for the proposed modification (06_0050 MOD 2) on 7 November 2017. Key matters raised by the Secretary, and where this report addresses them, are outlined in **Table 1**.

Table 1 Secretary’s Environmental Assessment Requirements (as relevant to this AQIA)

Secretary’s Environmental Assessment Requirements	Section Addressed
A quantitative assessment of the potential air quality, dust and odour impacts of the development in accordance with relevant Environment Protection Authority guidelines.	**Section 4.0** and **Section 7.0**
The details of buildings and air handling systems and strong justification for any material handling, processing or stockpiling external to a building.	**Section 2.0**
Justification for the substantial difference between the 2009 & 2017 air dispersion modelling results.	**Section 4.1** and **Section 7.2**
Details of proposed mitigation, management and monitoring measures.	**Section 9.0**
A greenhouse gas assessment.	**Section 10.0**

1.4 Structure of Report

This AQIA has been completed to provide the DP&E and EPA with sufficient data to support the Project and has been structured as indicated in **Table 2**.

Table 2 Structure of Report

Section	Brief
Section 1	Assessment overview.
Section 2	Provides a description of the Project and the potential air quality impact sources.
Section 3	Provides the regulatory context for which this project has been assessed against.
Section 4	Describes the existing environment including background air quality details, local meteorology, terrain and land use information.
Section 5	Provides a detailed description of the air quality assessment methodology.
Section 6	Provides a detailed description of the CALPUFF model inputs adopted for the assessment.
Section 7	Provides an assessment of the potential air quality impacts of the Project on the local air shed and provides assessment of relevant criteria against identified sensitive receptors.
Section 8	Describes the mitigation measures that are currently used at the facility which will also be implemented for new plant installed as part of the modification.
Section 9	Greenhouse gas assessment (Scope 1 & 2) and potential impacts as a result of the Project.
Section 10	Provides the study conclusions.

2.0 Project Description

It is understood from discussions between Regain and AECOM that Regain want to assess the ground level concentration impacts associated with increasing the production capacity of the Regain Tomago facility, located within the Tomago Aluminium site. Regain currently hold approval to process 20,000 tpa of Spent Pot Lining (SPL) from the Tomago Aluminium smelter and are seeking planning approval from DP&E to increase their processing capacity to 60,000 tpa.

2.1 Project Location

The SPL processing facility is located within the existing Tomago Aluminium smelter site – a 500 hectare site located on the NSW east coast around 13 km northwest of the central business district of Newcastle. The site is within the Port Stephens local government area (LGA), on Tomago Road, Tomago NSW. The local area is predominantly industrial, with the nearest residence approximately 1.3km west of the Tomago Aluminium boundary. The regional context of the Tomago Aluminium site (blue point) and the Regain facility (green point) is shown in **Figure 1**. The Regain facility layout within the Tomago Aluminium site, include the stack locations are presented in **Figure 2**.

2.2 Spent Potliner (SPL)

Tomago Aluminium has a number of potlines, each containing enough pots to meet current industry demands, used for the smelting of Aluminium. Potlining has a life cycle of six to seven years, over which time it becomes contaminated with materials such as alumina, aluminium, calcium, fluoride compounds and sodium. Cyanide compounds and aluminium carbide can also be created in the reducing atmosphere of the pots and infiltrate the potlining. The deteriorated potlining, known as spent potlining (SPL), is regularly replaced as part of the periodic individual rebuilding of the pots. Potlining is typically removed in two stages. First-cut SPL is the removed carbon cathode lining, whilst second-cut SPL is the removed refractory lining. SPL is removed from the pots at the smelter's Deline facility.

The composition of the SPL material is variable. Up to 10% of the SPL is typically aluminium and sodium nitrides and carbides, which are created through the diffusion of air into the carbon lining and chemical reactions occurring in the pot. When water is introduced, these materials can react to form ammonia, hydrogen, methane and acetylene. Fluoride compounds, which are potentially hazardous materials, can also be present in the SPL at concentrations of up to 10%. The majority of the SPL consists of non-activated carbon (10 – 70%), aluminium oxide (10 – 30%), and aluminium (10 – 30%).

The fluxing properties and calorific value of the SPL are inherently useful to the cement manufacturing sector. The reprocessing of the SPL, therefore, creates valuable products as well as reducing the waste disposal issues for the aluminium smelter.

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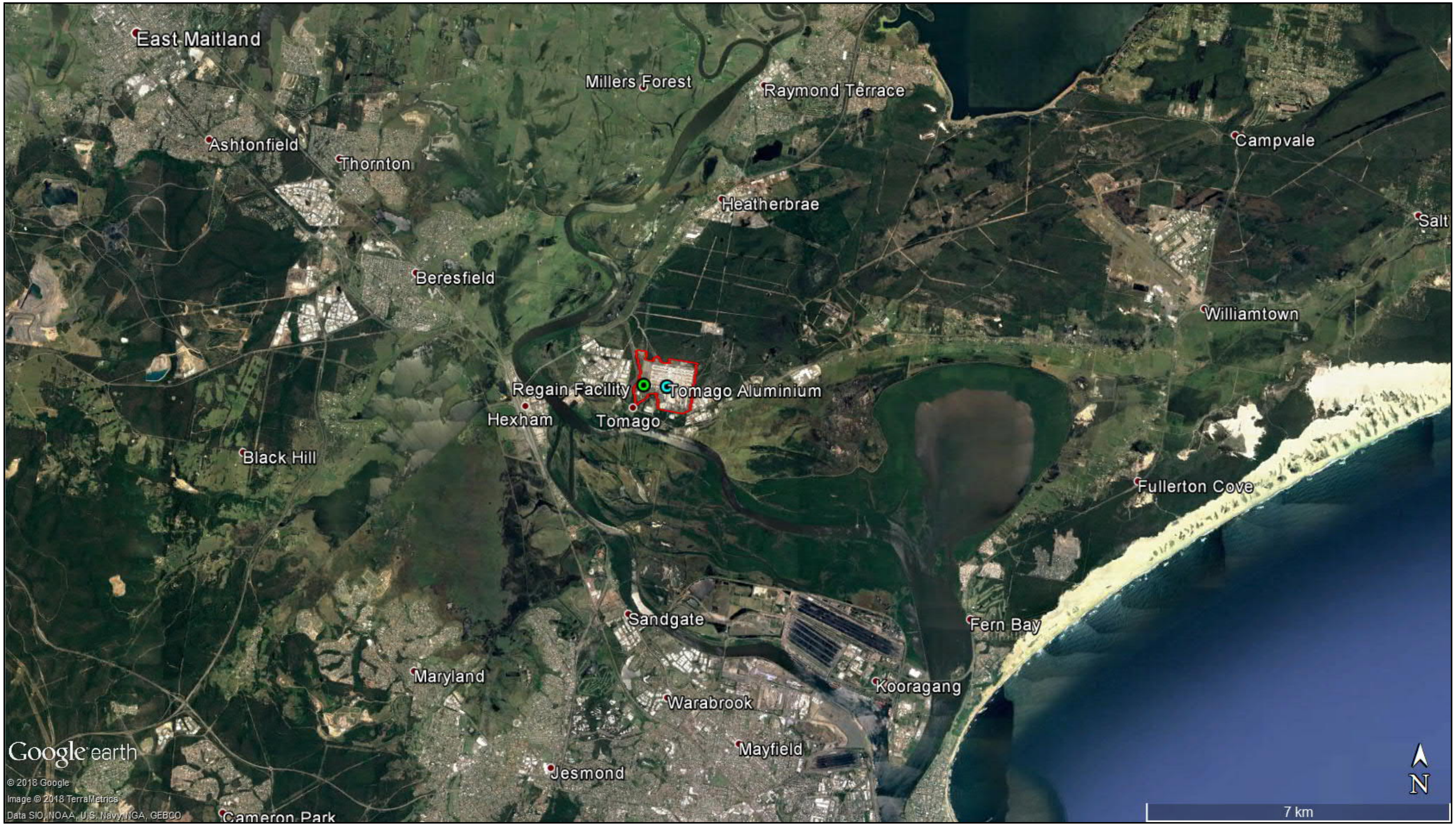

Figure 1 **Regional Site Context**

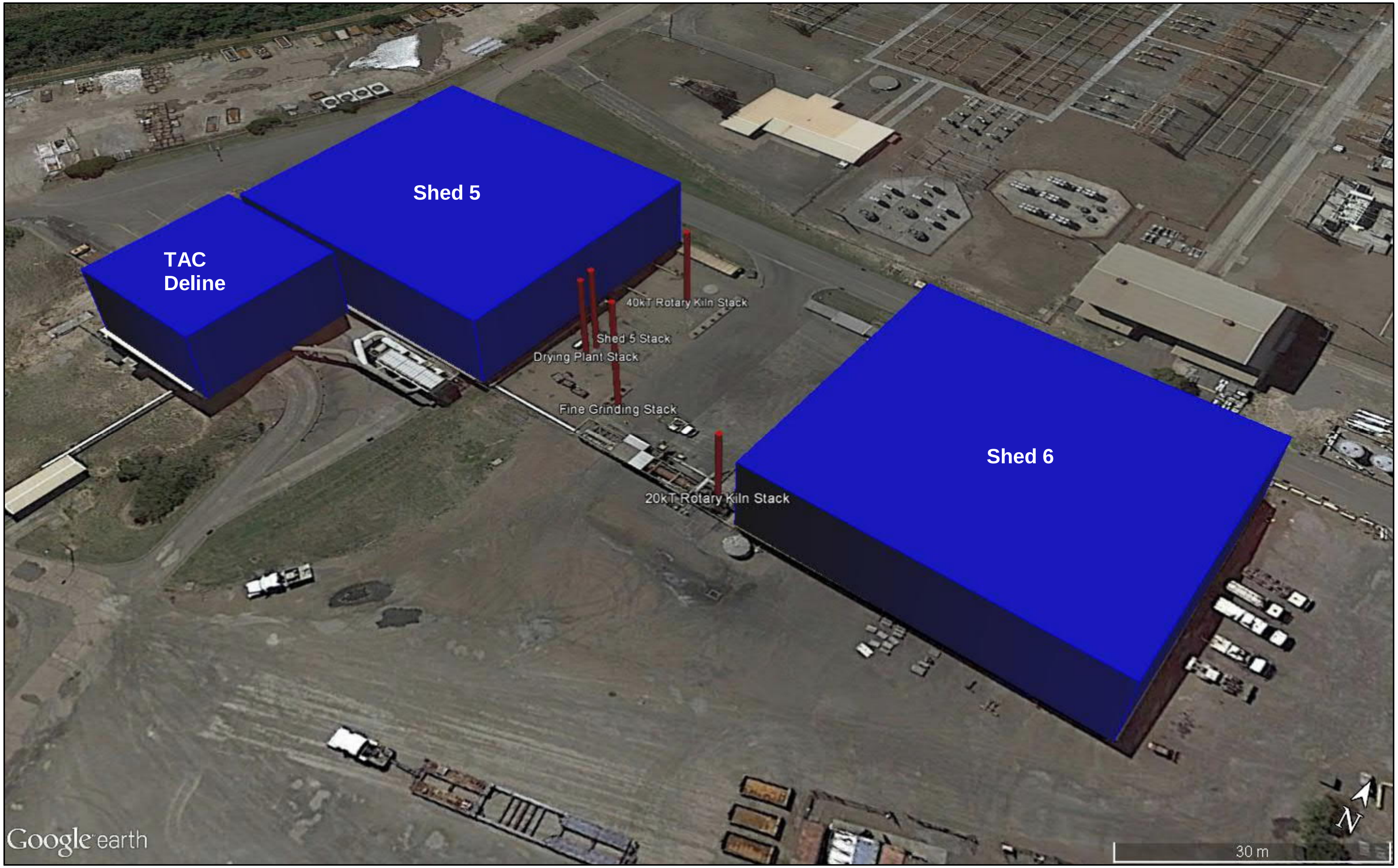

Figure 2 Regain Facility Layout (Including nearby Tomago Aluminium Deline Shed D

2.3 Approved Operations & Process Description

The current SPL processing plant and amenities are located in two adjacent existing buildings on the Tomago Aluminium site, known as SPL Sheds 5 and 6. SPL Shed 5 is adjacent to the Tomago Aluminium Deline facility, where the SPL is removed from the pots. Each building is 55 m long x 50 m wide (floor area of 2,750 m^2) with a height of 12m. The building sides (north and south) are fitted with louvre type ventilation panels. The steel retaining walls are sealed to the floor excluding the two doorways per building.

The current approval associated with the 2009 EA includes the plant items as follows:

- Materials preparation – including SPL crushing, sizing, grinding and storage facilities;
- SPL Thermal treatment – including a rotary kiln and water reaction mixer; and
- Product plant – including blending, drying and final product crushing and storage facilities.

The existing plant constructed to date is in general accordance with the project description provided in the 2009 EA which stated that:

- The heat treatment plant (which would include a rotary kiln and water reaction mixer) and product plant (where grinding and blending, drying, final product crushing and storage would be undertaken) would be located between Shed 5 and Shed 6; and
- Plant associated with the existing 20,000 tpa plant, including conveyors, crushing, grinding and sizing equipment, raw material and product bins, etc., may be retained and utilised in the proposed project.

2.3.1 Discharge Points

The current Approval for the Regain facility has all externally-located plant enclosed, and all emissions from the project occur via three independent dust extraction and collection points:

- Thermal treatment plant dust collector stack;
- Drying and blending plant dust collector stack; and
- SPL Shed 5 and Deline facility air filter (SPL preparation facilities) stack.

The SPL processing facilities are fully sealed, including covered conveyors and sealed atmospheric storage bins. Ductwork is installed throughout the process plant system and connected to dust generating areas such as mills, crushers, conveyors, storage bins and the kiln/dryer. The dust extraction systems will maintain a negative pressure within the process system and buildings, preventing the escape of fugitive dust. The material in the storage building is wetted to maintain a moisture content of approximately 5-7%, to minimise the potential for the generation of dust.

Dust will be collected via the baghouse dust collectors, which will be fitted with alarm systems to immediately shut down plant operations in the event of baghouse failure. Visual and audible alarms will sound within the plant buildings, with the alarm displaying on the plant control system monitoring display. Collected particulate matter will be fed back through the production cycle.

The dust extraction systems will draw air from within each building at the roof ridgeline, and pass it through dust filter/baghouse facilities. The air discharge from each baghouse will be directed to atmosphere via stacks. The solid discharge from each baghouse will be collected and fed back into the process.

2.3.2 Control Measures

Regain has developed an extensive control system for their facilities to manage air emissions from their plant. Control measures are focused around the operation of suitable baghouse dust collectors and process operational controls e.g. control of process materials, housekeeping etc.

The approved SPL processing facility is operated and maintained to ensure the following:

- Mitigation of fugitive emissions by maintaining the processing plant and buildings under negative pressure.
- Destruction of cyanide and hazardous gases by control of the processing stages.

- Minimal formation of incomplete combustion products and liberation of gaseous fluoride by control of the thermal treatment process (i.e. maintaining the temperature below 850°C).
- Minimal emissions of particulate matter and particulate-bound contaminants such as fluoride by the appropriate operation of baghouse dust collectors.
- Minimal dust generation from concrete apron areas by the application of appropriate housekeeping practices.

2.4 Proposed Site Modifications & Operations

The project is to modify the existing SPL processing facility on site at the Tomago Aluminium smelter which reduces the hazardous nature of a waste material through thermal treatment thereby recycling a waste material into a useable end-product.

The project (as modified) would generally comprise:

- Materials preparation: This would involve SPL crushing and sizing, and would be located in Shed 5. Quantities of SPL would continue to be stockpiled in Shed 5. No modification to existing material preparation processes is proposed as a result of this modification;
- Thermal treatment: This would involve a heat treatment process which would destroy the cyanide and neutralise the flammable gas hazard associated with SPL while retaining valuable materials such as carbon, fluorides, and other inorganic compounds. Thermal treatment would occur between Shed 5 and Shed 6;
- Product preparation: The product plant would involve drying and grinding treated SPL to suit product specification. Product plant elements would be located between the two existing buildings;
- Storage of materials: Quantities of SPL would continue to be stored in Shed 5. Treated product would be stored in Shed 6; and
- Daily truck movement to and from site for unloading SPL material for treatment and loading for delivery and distribution of treated products via road trucks.

To reach the target capacity of 60,000tpa and other product specifications, it is proposed to operate an optimised configuration utilising the thermal treatment process elements of both the originally proposed project and an additional thermal treatment plant and fine grinding mill stack. An overview of the revised project configuration which pertains to this air quality impact assessment is provided in **Table 3**.

Table 3 Overview of Revised Project Configuration

Project Configuration (2009 EA)	Revised Project Configuration
Stack 1 - Thermal treatment plant dust collector (EPL Point 1)	Stack 1 – Thermal treatment plant dust collector (EPL Point 1)
	Stack 2 - Additional thermal treatment plant dust collector (New EPL Point)
Stack 2 Drying and blending plant dust collector (EPL Point 2)	Stack 3 – Drying plant (EPL Point 2)
	Stack 4 – Fine Grinding Stack (New EPL Point)
Stack 3 - Shed 5 and Deline facility air filter (EPL Point 3)	Stack 5 - Shed 5 and Deline facility air filter (EPL Point 3)

The proposed design allows for the independent functioning of each plant element described in Table 3 with individual air streams for each plant element and emission point. The proposed plant design described above does not involve the convergence of multiple air streams between the various plant elements.

3.0 Regulatory Context and Criteria

In assessing any project with potential emissions to air, it is necessary to compare the impacts of the project with relevant air quality goals. Air quality standards or goals are used to assess the potential for ambient air quality to give rise to adverse health or nuisance effects. The following sections detail relevant legislation and guidelines.

3.1 Air Quality Legislative Framework

In *NSW the Protection of the Environment Operations Act 1997 (NSW) (POEO Act)* provides the statutory framework for managing air emissions. Under the *POEO* Act the *Protection of the Environment Operations (Clean Air) Regulation 2010 (NSW)* (Clean Air Regulation) provides regulatory measures to control air emissions.

Part 5 of the Clean Air Regulation refers to the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (EPA 2017) (Approved Methods), that lists the statutory methods for the modelling and assessment of air emissions from stationary sources in NSW.

3.2 NSW EPA Approved Methods

The *Approved Methods* provide the assessment criteria against which emissions from a site or activity are to be assessed. The primary air pollutants of concern for assessment of the Project are presented in **Table 4**.

For the purposes of this AQIA and in accordance with *Section 2.1* of the *Approved Methods* a Level 2 Impact Assessment was undertaken using site specific input data. *Section 7.1.*2 and Section *7.2.2* of the *Approved Methods* requires the impact assessment criteria to be applied as follows:

Section 7.1.2 – SO_2, NO_2, O_3, Pb, $PM_{2.5}$, PM_{10}, TSP, deposited dust, CO and HF

1. At the nearest existing or likely future off-site sensitive receptor.
2. The incremental impact for each pollutant must be reported in concentration units consistent with the criteria.
3. Background concentrations must be included using the procedures specified in *Section 5,* which assessment includes:
    - Obtaining ambient monitoring data that includes at least one year of continuous measurements;
    - Determine the maximum background concentration of the pollutant being assessed for each relevant averaging period; and
    - At the maximum exposed off-site receptor, add the maximum background concentration and the 100th percentile dispersion model prediction.
4. Total impact must be reported as the 100th percentile in concentration or deposition units consistent with the impact assessment criteria and compared with the relevant impact assessment criteria.

Section 7.2.2 – Individual Toxic Air Pollutants

1. At or beyond the boundary of the facility; and
2. The incremental impact for each pollutant must be reported in concentration units consistent with the criteria, for an averaging period of 1 hour and as the:
    a. 99.9th percentile of dispersion model predictions for Level 2 impact assessments.

These criteria are intended to minimise the adverse effects of airborne pollutants on sensitive receivers. In general, these criteria relate to the total burden of air pollutants at ground level and not just from project specific sources. Where background data was available, the ground level concentrations from the project have been assessed cumulatively with the background data against the NSW EPA criteria.

Table 4 NSW EPA Assessment Criteria

Pollutant	Assessment Criterion (µg/m^3)	Averaging Period	Percentile	Reportable Location
Sulfur Dioxide (SO_2)	570	1 hour	100th	At the nearest sensitive receptor
	228	24 hours	100th	At the nearest sensitive receptor
	60	Annual	100th	At the nearest sensitive receptor
Nitrogen Dioxide (NO_2)	246	1 hour	100th	At the nearest sensitive receptor
	62	Annual	100th	At the nearest sensitive receptor
Carbon Monoxide (CO)	30,000	1 hour	100th	At the nearest sensitive receptor
	10,000	8 hour	100th	At the nearest sensitive receptor
PM_{10}	50	24 hour	100th	At the nearest sensitive receptor
	25	Annual	100th	At the nearest sensitive receptor
Lead	0.5	Annual	100th	At the nearest sensitive receptor
Total Suspended Particulates	90	Annual	100th	At the nearest sensitive receptor
Hydrogen Fluoride (general land use)[1]	2.9	24 hours	100th	At the nearest sensitive receptor
	1.7	7 days	100th	At the nearest sensitive receptor
	0.84	30 days	100th	At the nearest sensitive receptor
	0.5	90 days	100th	At the nearest sensitive receptor
Cyanide	200	1 hour	99.9th	At and beyond the boundary
Dioxins & Furans	$2x10^{-6}$	1 hour	99.9th	At and beyond the boundary
PAH's as benzo(a)pyrene	0.4	1 hour	99.9th	At and beyond the boundary
Antimony	9	1 hour	99.9th	At and beyond the boundary
Arsenic	0.09	1 hour	99.9th	At and beyond the boundary
Cadmium	0.018	1 hour	99.9th	At and beyond the boundary
Chromium	0.09	1 hour	99.9th	At and beyond the boundary
Manganese	18	1 hour	99.9th	At and beyond the boundary
Mercury	1.8	1 hour	99.9th	At and beyond the boundary
Nickel	0.18	1 hour	99.9th	At and beyond the boundary
Acetone	22,000	1 hour	99.9th	At and beyond the boundary
Benzene	29	1 hour	99.9th	At and beyond the boundary
Toluene	360	1 hour	99.9th	At and beyond the boundary

[1] ANZECC (1990) goals for ambient air fluoride are designed to protect against injury to plants and grazing animals rather than to protect human health.

3.2.1 ANZECC (1990) Ambient Fluoride Assessment Criteria

The applicability of the ambient fluoride ground level concentration criteria for this assessment needs to be considered in regards to the land use surrounding the project being assessed. The Australian and New Zealand Environment Council (ANZECC) *National Goals for Fluoride in Ambient Air and Forage (1990)* states that '*unlike most ambient objectives, guidelines or standards for common air pollutants, goals for ambient air fluoride are designed to protect against injury to plants and grazing animals, rather than to protect human health. This is because fluoride can injure vegetation at one thousandth the level of concern to human health*'.

Additionally, ANZECC further advise that '*the ambient air goals for fluoride are intended for areas of commercial or conservation value and not intended for comparison with airborne or foliar fluoride levels within industrial areas or buffer zones associated with fluoride emitting industries'*

In the context of this assessment, **Figure 3** highlights the local area surrounding the aluminium smelter, including the approved buffer zone highlighted in green, the Tomago Aluminium site boundary marked in red, and the locations of the sensitive receptors included in this assessment.

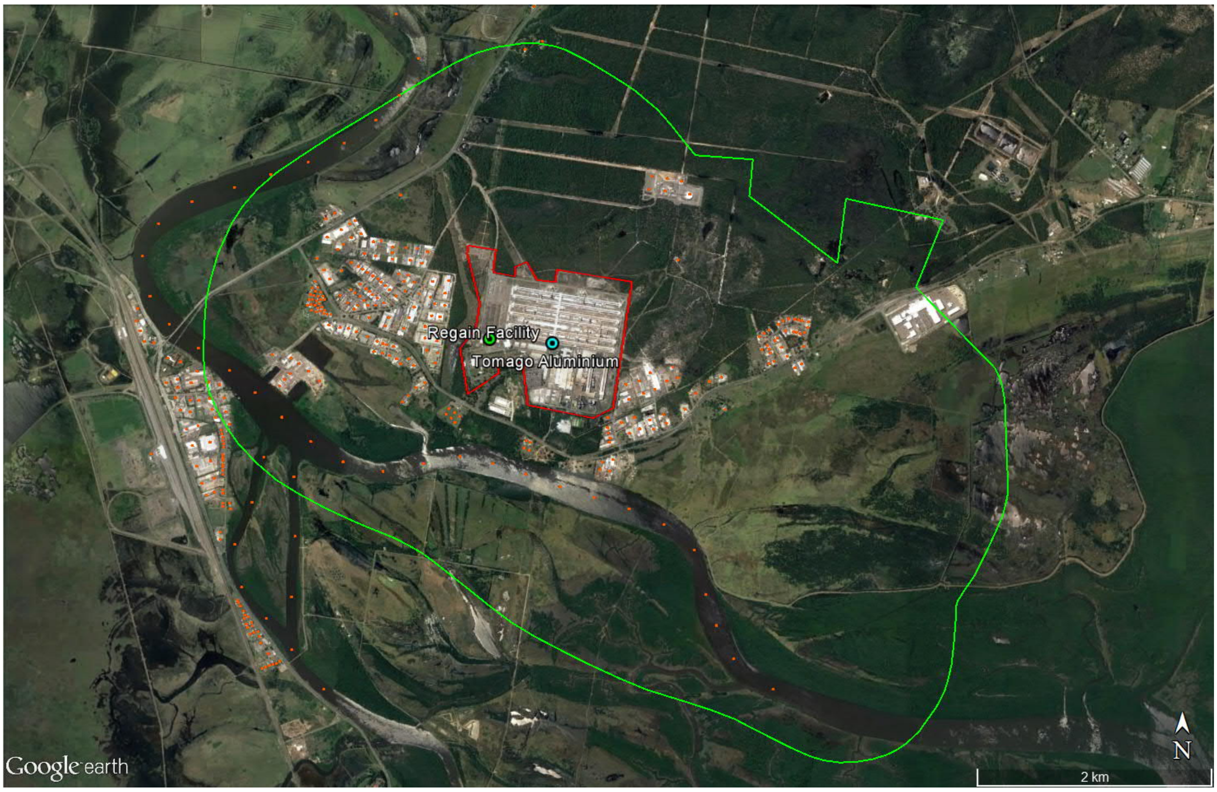

Figure 3 Tomago Aluminium Buffer Zone (Green), Site Boundary (Red) & Modelled Sensitive Receptor Locations (Orange)

The sensitive receptors identified within approximately 2km of the aluminium smelter are all within the approved buffer zone, where high background ambient fluoride levels are expected as a result of existing approved operation of the smelter. The high density of sensitive receptor locations immediately to the west, and east of the aluminium smelter are all zoned for industrial/commercial use, and do not have vegetation or grazing animals at those locations.

In accordance with the ANZECC (1990) guidance, the intent of the fluoride ambient air criteria suggests it may not be suitable to be applied at the industrial sensitive receptor locations, or those which fall within the approved buffer zone.

For the purpose of this assessment however, comparison with the ambient fluoride criteria was completed to provide an indication of the potential Regain contribution to cumulative ambient fluoride concentrations at those locations.

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4.0 Existing Environmental & Meteorological Conditions

The major factors of the existing environment that can influence the level of air pollutants adjacent to a particular site include:

- Existing air quality due to regional and local sources of air pollution (natural and anthropogenic);
- Meteorological conditions; and
- Surrounding terrain/land use.

The following section describes the existing air quality, general meteorology and terrain of the study area.

4.1 Existing Air Quality

The EPA monitors air quality each year and assesses it against the impact assessment criteria outlined in the *Approved Methods*. The air quality objectives which are linked to the impact assessment criteria are set at levels that are designed to protect beneficial uses, including human health and wellbeing, visibility, aesthetic enjoyment and local amenity. The goals in the *Approved Methods* specify the maximum permissible number of exceedances of the objectives per year and guide the formulation of strategies for the management of human activities that may affect the environment.

The ambient data collected by the EPA captures pollutants from both man-made (industry, motor vehicles, domestic sources such as fires, construction) and natural (bushfires, dust storms, pollen, marine particles) sources. A variety of pollutants are present in air monitoring data from each source; the contribution of each source varies depending on the monitor's location, sources of pollution in the surrounding environment and meteorological conditions.

The primary pollutants of interest in the Newcastle airshed are particulate matter and photochemical smog/ozone and its precursors (oxides of nitrogen)[1]. Significant industrial pollutant sources are located in the surrounding area, including the Tomago Aluminium site and a number of other smaller industrial sites.

4.1.1 Air Toxics

Although no recent measured background concentrations are available for air toxics in the Newcastle airshed, between 1996 and 2001 the EPA conducted an Ambient Air Quality Research Project (EPA 2002 and DEC 2004) to study the presence of air toxics in Sydney, Newcastle and Wollongong, including the monitoring of 41 organic compounds. In summary the results of the study concluded that ground level air quality concentrations of most air toxics in NSW were well below current international standards and benchmarks. As such, existing background concentrations were assumed to be negligible, and not included in this study.

4.1.2 Particulate Matter & Combustion Gases

The EPA currently operates a continuous monitoring station at Beresfield, approximately 5km from the Regain Tomago site, to help characterise the air quality in the region. The pollutants which are monitored at the Beresfield site and relevant to this assessment are oxides of nitrogen (NOx), ozone, fine particulate matter (PM_{10}) and sulphur dioxide (SO_2). The 2015 monitoring data from the Beresfield NSW EPA monitoring station (the closest station to the site) is summarised in **Table 5**.

Carbon Monoxide (CO) background data is not measured at the Beresfield monitoring station, however a background result was sourced from the NSW Annual Compliance Report (2015)[2] for the max 8-hour rolling average, which has also been included in **Table 5**.

The data from the OEH Beresfield monitoring station for the 2015 calendar year shows that the background levels of the measured pollutants are compliance with the NSW EPA ambient air quality criteria, with exception to the maximum 24-hr average PM_{10} concentration.

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[1] Newcastle City Council. (2009). 2008/09 State of the Environment Report – The City of Newcastle.

[2] Office of Environment & Heritage (2015), *NSW Annual Compliance Report – NEPM Ambient Air Quality, May 2017*

Table 5 NSW EPA Beresfield Monitoring Station Data Summary 2015

Parameter	NO_2 1hr Average		SO_2 1hr Average		CO 1hr Average		PM_{10} 24hr Average	$PM_{2.5}$ 24hr Average
	pphm	µg/m^3*	pphm	µg/m^3*	ppm	mg/m^3 *	µg/m^3	µg/m^3
Maximum	4.9	92.1	8.2	214.8	N/A	N/A	-	-
Average	0.9	16.9	0.1	2.7	N/A	N/A	-	-
NSW EPA 1 hr Average Criterion	*12*	*246*	*20*	*570*	*25*	*30*	-	-
Max 8 hr Average	-	-	-	-	1.5[#]	-	-	-
NSW EPA 8 hr Average Criterion	-	-	-	-	*9*	*10*	-	-
Max 24 hr Average	-	-	0.8	22.2	-	-	**64.9**[1]	**25.9**[2]
NSW EPA 24 hr Average Criterion	-	-	*8*	*228*	-	-	*50*	*25*
Max Annual Average	0.9	16.9	0.1	2.7	-	-	18.7	7.4
NSW EPA Annual Average Criterion	*3*	*62*	*2*	*60*	-	-	*30*	*8*

* converted at 0'C as per NSW EPA criteria correction

[1] There are two exceedances of the ambient background concentration for Max 24hr PM_{10} results

[2] There is one exceedances of the ambient background concentration for Max 24hr $PM_{2.5}$ results

N/A = Result not available from Beresfield Monitoring Station

[#] Result taken from the latest (2015) NSW Air NEPM Compliance Report, and is a max 8-hour rolling average from the Newcastle EPA Monitoring site

At the NSW EPA Beresfield monitoring station in 2015, there were two days where the ambient air background concentration exceeded the maximum 24-hr average PM_{10} criteria of 50µg/m^3. According to the NSW Annual Compliance Report (2015) the two days which resulted in exceedances of the criteria were the result of 'exceptional events' and are summarised in **Table 6**, along with the highest 24-hr PM_{10} result, which was compliant.

Table 6 Summary of Background 24-hr Average PM_{10} Results – NSW EPA Beresfield Station

Date	Concentration (µg/m^3)	Notes
06/05/2015	64.9	Result of a state-wide dust storm that travelled throughout NSW during 5 & 6 May 2015
26/11/2015	57.4	Due to bushfires in the Hunter Valley region on 26 November 2015
19/11/2015	43.3	Highest concentration reported at Beresfield monitoring station that is compliant with criteria

At the NSW EPA Beresfield monitoring station in 2015, there was one day where the ambient air background concentration exceeded the maximum 24-hr average $PM_{2.5}$ criteria of 25µg/m^3. According to the NSW Annual Compliance Report (2015) the day which resulted in exceedance of the criteria was the result of an 'exceptional event' and is summarised in **Table 7**, along with the highest 24-hr $PM_{2.5}$ result, which was compliant.

Table 7 Summary of Background 24-hr Average $PM_{2.5}$ Results – NSW EPA Beresfield Station

Date	Concentration (µg/m^3)	Notes
21/08/2015	25.9	Result of smoke from a number of hazard reduction burns
20/08/2015	20.2	Highest concentration reported at Beresfield monitoring station that is compliant with criteria

4.1.3 Fluoride – Tomago Aluminium

The continuous monitoring station operated by the NSW EPA at their Beresfield location does not monitor for ambient fluoride. As the Regain Tomago facility is located within the Tomago Aluminium site, Regain provided AECOM with the 2015 ambient fluoride data for the monitoring sites operated by Tomago Aluminium. The location of each of the ambient fluoride monitors operated by Tomago Aluminium in relation to the site and the Regain facility is provided in **Figure 4**.

The monitoring results provided by Regain were reported as a 7-day average, with the 30-day and 90-day averages calculated from those concentrations. The ambient fluoride monitoring site which measured the highest ambient concentrations across the modelling domain was EPL Point 24 (The Farm), which is located approximately 2km ESE from the Regain facility. A summary of the ambient fluoride monitoring results and associated calculated values for EPL Point 24 are provided in **Table 8**.

Table 8 Tomago Aluminium Ambient Fluoride Results Summary – 2015 (EPL Point 24)

Parameter	Units	Averaging Period		
		7-day	30-day	90-day
Maximum Ground Level Concentration (GLC)	µg/m^3	**5.8**	**4.31**	**3.34**
No. of Exceedances	Integer	17	8	3
Maximum Non-Exceedance GLC	µg/m^3	1.64	0.77	0.33
Criteria	**µg/m^3**	**1.7**	**0.84**	**0.5**

It should be noted that existing background ambient fluoride concentrations are all elevated at this location, with all averaging periods showing exceedances of the NSW EPA criteria. These elevated background concentrations for fluoride are expected as a result of the general smelter operations, and also fall within the approved buffer zone surrounding the Tomago Aluminium site.

The location of this monitoring site is to the ESE of the Regain facility, which is the opposite direction to where the dispersion modelling predicts the peak concentrations associated with the Regain facility are likely to occur. This monitoring site is not considered to be representative of the expected background concentrations for fluoride across the entire domain, which is demonstrated in the 2015 data for all monitoring sites provided in **Appendix C**.

The closest ambient fluoride monitoring site relative to the Regain facility is EPL Point 21. This monitoring site is located on Old Punt Road, Tomago approximately 850m west of the Regain facility. The dispersion modelling carried out as part of this AQIA and detailed in the subsequent sections indicated that the expected offsite maximum concentrations associated with the Regain operations were expected to occur within close proximity to EPL Point 21.

A summary of the ambient fluoride monitoring results and associated calculated values for EPL Point 21 are provided in **Table 9**.

Table 9 Tomago Aluminium Ambient Fluoride Results Summary – 2015 (EPL Point 21)

Parameter	Units	Averaging Period		
		7-day	30-day	90-day
Maximum Ground Level Concentration (GLC)	µg/m³	1.18	0.81	**0.60**
No. of Exceedances	Integer	0	0	2
Maximum Non-Exceedance GLC	µg/m³	1.18	0.81	0.20
Criteria	µg/m³	1.7	0.84	0.5

It should be noted that the background ambient fluoride concentrations are elevated, with the calculated 90-day average for fluoride showing 2 exceedances of the NSW EPA criteria. The elevated background concentrations for fluoride are expected as a result of the Tomago Aluminium smelter operations, and they also fall within the approved buffer zone surrounding the Tomago Aluminium site.

4.1.3.1 Background Adoption - Ambient Fluoride

For the purposes of this cumulative assessment, we have adopted the background data from EPL Point 21 as it is considered to be more representative of the background concentrations in the area where the Regain facility is predicted to have the highest incremental impact. The calculated maximum ground level concentrations for each averaging period for fluoride which do not exceed the criteria were adopted to assess whether the Project impacts may result in additional exceedances of the ground level concentration criteria.

4.1.4 Sulfur Dioxide – Tomago Aluminium

As well as monitoring for ambient Hydrogen Fluoride, Tomago Aluminium also operates a number of Sulfur Dioxide ambient monitoring locations, which have also been considered in this assessment. As the Regain Tomago facility is located within the Tomago Aluminium site, the 2015 ambient sulfur dioxide data recorded at monitoring sites operated by Tomago Aluminium were reviewed to establish existing background concentrations. The location of each of the TAC ambient sulfur dioxide monitors in relation to the site and the Regain facility is provided in **Figure 4**.

The monitoring results provided by Regain were reported as 1-hour averages, with the 24-hour and annual averages calculated from those concentrations. The ambient sulfur dioxide monitoring site which measured the highest ambient concentrations across the modelling domain was EPL Point 24 (The Farm), which is located approximately 2km ESE from the Regain facility. A summary of the ambient sulfur dioxide monitoring results and associated calculated values for EPL Point 24 are provided in **Table 8**.

Table 10 Tomago Aluminium Ambient Sulfur Dioxide Results Summary – 2015 (EPL Point 24)

Parameter	Units	Averaging Period		
		1-hour	24-hour	Annual
Maximum GLC	µg/m³	440.2	196.5	24.7
Criteria	µg/m³	570	228	60

The location of this monitoring site is to the ESE of the Regain facility, which is the opposite direction to where the dispersion modelling suggests the peak concentrations associated with the Regain facility are likely to occur. This monitoring site is therefore not considered to be representative of the expected background concentrations for sulfur dioxide across the entire domain, which is further demonstrated in the 2015 data for all monitoring sites provided in **Appendix C**.

The closest ambient sulfur dioxide monitoring site relative to the Regain facility is EPL Point 36. This monitoring site is located on Laverick Avenue, Tomago approximately 800m south west of the Regain facility. The dispersion modelling carried out as part of this AQIA and detailed in the subsequent sections indicated that the expected offsite maximum concentrations associated with the Regain operations were expected to occur within close proximity to EPL Point 36.

The 2015 monitoring results provided by Regain for the Tomago Aluminium EPL Point 36 SO_2 monitoring location are presented in **Table 11**. A summary of the ambient sulfur dioxide concentrations for the entire 2015 calendar year for all of the Tomago monitoring locations are presented in **Appendix C**.

Table 11 Tomago Aluminium Ambient Sulfur Dioxide Results Summary – 2015 (EPL Point 36)

Parameter	Units	Averaging Period		
		1-hour	24-hour	Annual
Maximum GLC	µg/m^3	212.2	73.4	9.8
Criteria	µg/m^3	570	228	60

It should be noted that the background ambient sulfur dioxide concentrations for all of the monitoring locations are reasonably elevated. The elevated background concentrations for sulfur dioxide are expected as a result of the Tomago Aluminium smelter operations and fall within the approved buffer zone surrounding the Tomago Aluminium site.

4.1.4.1 Background Adoption - Ambient Sulfur Dioxide

For the purposes of this cumulative assessment, we have adopted the background data from EPL Point 36 as it is considered to be more representative of the background concentrations in the area where the Regain facility is predicted to have the highest incremental impact. The calculated maximum ground level concentrations for each averaging period for fluoride which do not exceed the criteria were adopted to assess whether the Project impacts may result in additional exceedances of the ground level concentration criteria.

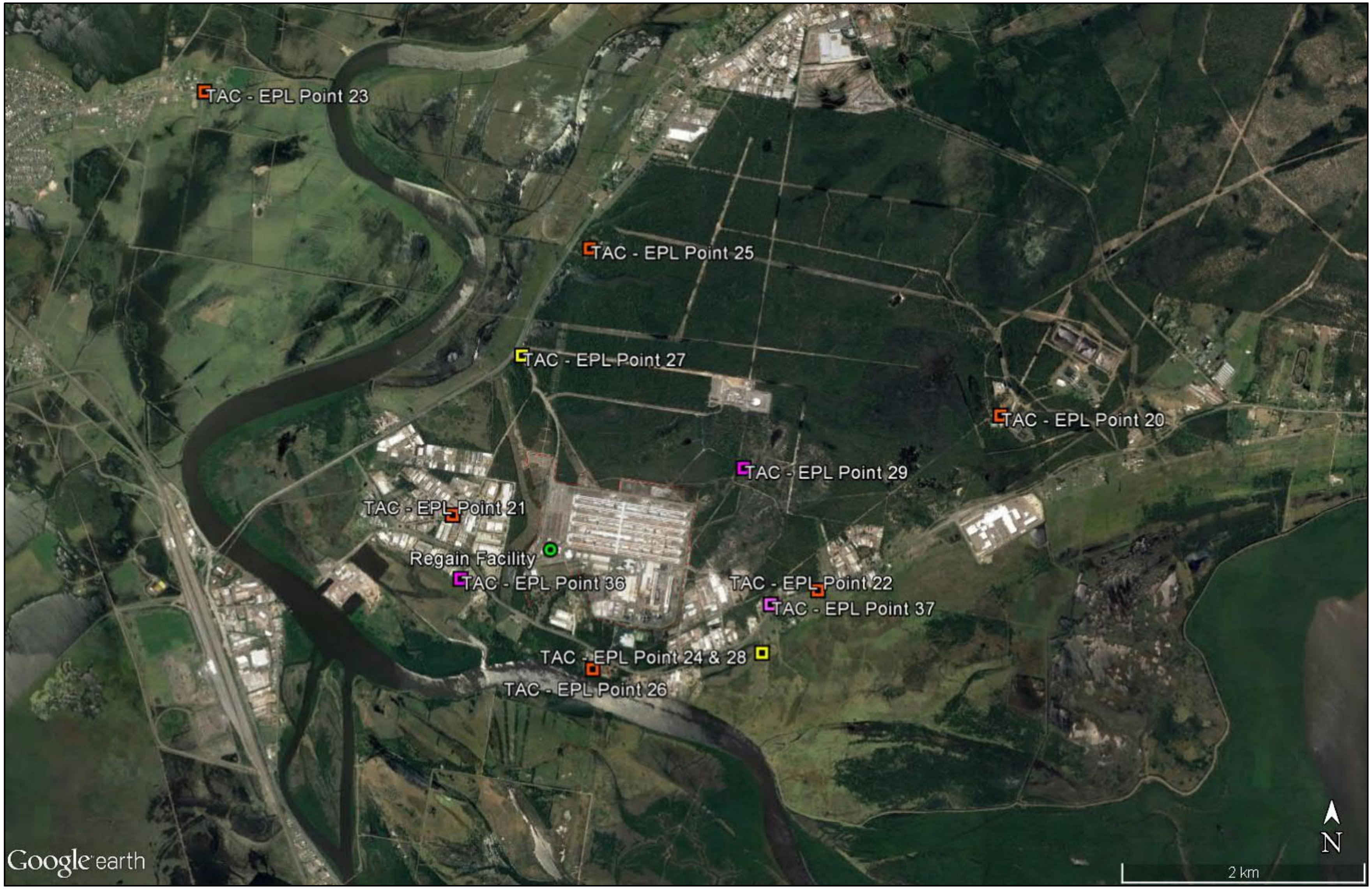

Figure 4 Tomago Aluminium Ambient Fluoride & Sulfur Dioxide Monitoring Locations (Orange = Fluoride Only, Purple = SO_2 Only, Yellow = Fluoride + SO_2)

4.1.5 Adopted Background Data

For the purposes of this assessment, at all sensitive receptor locations, the 100th percentile background pollutant concentrations (where available) for the 2015 calendar year were adopted. For most pollutants this resulted in background values below the assessment criteria.

Hydrogen Fluoride, PM_{10} and $PM_{2.5}$ concentrations were elevated above their respective criteria for the maximum background concentration. The typical approach to addressing a situation where a pollutant's background concentration exceeds the ambient criteria is to adopt the highest background concentration which is compliant with the criteria, to assess if the incremental impacts from the project cause any additional exceedances.

The project specific background concentrations adopted for this assessment are presented in **Table 12**.

Table 12 Project Specific Background Values

Pollutant	Averaging Period	Adopted Concentration ($\mu g/m^3$)	% of Criteria	Assessment Criteria ($\mu g/m^3$)
Sulfur Dioxide (SO_2)	1 hour	214.8	38	570
	24 hours	73.4	32	228
	Annual	9.8	16	60
Nitrogen Dioxide (NO_2)	1 hour	92.1	37	246
	Annual	16.9	27	62
Carbon Monoxide (CO)	1 hour	N/A	N/A	30,000
	8 hour	1.5	0.02	10,000
PM_{10}	24 hour	43.3	87	50
	Annual	18.7	75	25
$PM_{2.5}$	24 hour	20.2	81	25
	Annual	7.4	93	8
Lead	Annual	N/A	N/A	0.5
Total Suspended Particulates	Annual	N/A	N/A	90
Hydrogen Fluoride (general land use)	90 days	0.20	40	0.5
	30 days	0.81	96	0.84
	7 days	1.18	69	1.7
	24 hours	N/A	N/A	2.9
Cyanide	1 hour	N/A	N/A	200
Dioxins & Furans	1 hour	N/A	N/A	$2x10^{-6}$
PAH's as benzo(a)pyrene	1 hour	N/A	N/A	0.4
Antimony	1 hour	N/A	N/A	9
Arsenic	1 hour	N/A	N/A	0.09
Cadmium	1 hour	N/A	N/A	0.018
Chromium	1 hour	N/A	N/A	0.09
Manganese	1 hour	N/A	N/A	18
Mercury	1 hour	N/A	N/A	1.8

Pollutant	Averaging Period	Adopted Concentration (μg/m^3)	% of Criteria	Assessment Criteria (μg/m^3)
Nickel	1 hour	N/A	N/A	0.18
Acetone	1 hour	N/A	N/A	22,000
Benzene	1 hour	N/A	N/A	29
Toluene	1 hour	N/A	N/A	360

4.2 Local Meteorological & Climatic Conditions

The Bureau of Meteorology (BoM) records long-term meteorological data at a number of automatic weather stations across the country. The BoM operate a meteorological weather station at Williamtown (Station number 061078) located approximately 12km east northeast of the site, and records temperature, rainfall, wind speed and wind direction. The station has been operational since 1942 with long term meteorological and climatic data for the Williamtown Airport BoM monitoring station provided in **Appendix A**.

The study area experiences a warm to moderate climate. The warmest temperatures occur during the summer months, with the highest average maximum temperature (28.1^{o}C) occurring in January. July is the coldest month, with a recorded average minimum temperature of 6.4^{o}C.

The annual average rainfall for the area is 1127 millimetres (mm) over 85 days a year. June is the wettest month, with an average rainfall of 121 mm, while August is driest month with an average rainfall of just 60.5mm. Humidity follows a diurnal cycle, with higher humidity in the morning compared to the afternoon.

Daytime wind speeds were found to be moderate, with higher wind speeds occurring in the afternoon compared to the morning. The annual average 9am wind speed recorded is 13.7 kilometres per hour (km/h) and the annual average 3pm wind speed was 20.2 km/h. Seasonally, wind speeds are higher during the warmer months with the highest average wind speed occurring in December at 23.5 km/h. The long-term wind roses show that on an annual basis the dominant wind direction is from the northwest quadrant during the mornings and from the southeast quadrant during the afternoons.

4.3 Terrain & Land Use

The Regain facility is situated with the Tomago Aluminium site, and lies approximately 9m above mean sea level (MSL). The terrain in the immediate area surrounding the facility is relatively flat. In the wider context the study area lies approximately 12km to the west of the Eastern Australian coastline and terrain height within the study area range from between 0 and 96 metres with higher elevations to the west and southwest. To the west and south of the site the Hunter River runs west to east, meeting Newcastle Harbour on the Stockton side 6.5km to the southeast of the site.

The surrounding land use is largely comprised of medium to large scale industrial premises. The area beyond the industrial premises is largely bound by native vegetation on all sides, with the Hunter River approximately 1km to the south. The closest urban residential receptors are approximately 1.4km from the Facility.

Land use categories used in the CALMET meteorological model we assigned using satellite imagery in accordance with the U.S. Geological Survey Land Use and Land Classification System.

5.0 Assessment Methodology

The following section provides a summary of the methodology adopted for the Regain Tomago assessment.

5.1 Air Dispersion Model

Various air dispersion models are required for the successful modelling of air quality impacts from the Site. These are: The Air Pollution Model (TAPM), which is used to generate prognostic meteorological data; CALTAPM, which is used to process the TAPM output into a format suitable for input into the CALMET model; CALMET, which generates three-dimensional wind fields used in the dispersion modelling; CALPUFF, which predicts the movement and concentration of pollutants; and CALPOST, which is used to process the CALPUFF output files. The programs are briefly described in the following sections.

The flow diagram in **Figure 5** shows the general flow of programs and data required for the dispersion model.

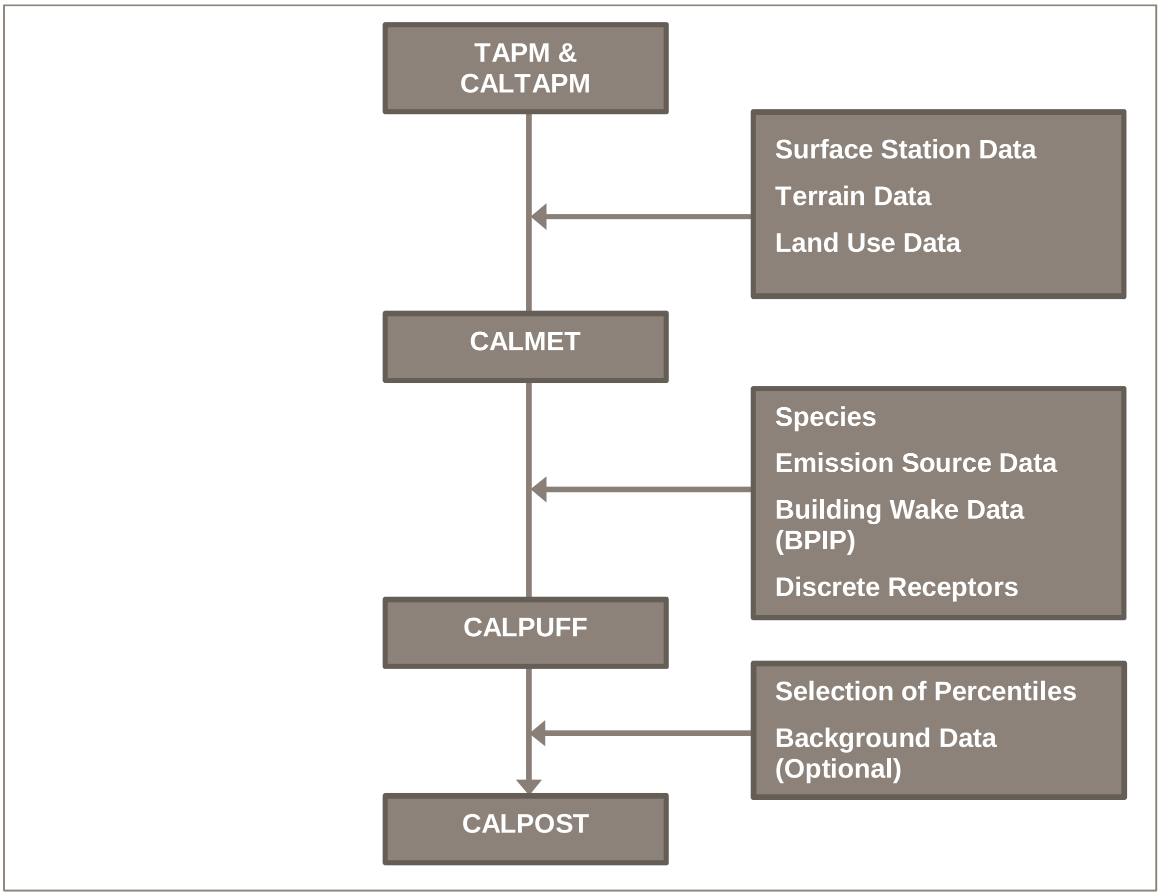

Figure 5 **Site Model Program and Input Flow Chart**

The selection of the dispersion modelling for this assessment was undertaken in accordance with the guidelines published by the NSW EPA[3]. Details of the modelling inputs and assumptions are provided in the following sections.

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[3] DEC (2005). Approved Methods for the Modelling and Assessment of Air Pollutants in NSW.

5.2 TAPM

TAPM predicts three-dimensional meteorology, including terrain-induced circulations. TAPM is a PC-based interface that is connected to databases of terrain, vegetation and soil type, leaf area index, sea-surface temperature, and synoptic-scale meteorological analyses for various regions around the world. TAPM is used to predict meteorological parameters at both ground level and at heights of up to 8,000 m above the surface; these data are required by the CALPUFF model. The TAPM output file requires processing through a program such as CALTAPM to generate a file that is used within CALMET to generate the three-dimensional wind fields required by the CALPUFF dispersion model.

The NSW EPA has released guidance documentation (Barclay and Scire, 2011) on the optimum settings for the use of the CALPUFF modelling system. One modelling approach provided in the document is the use of a ‘Hybrid Mode’ whereby numerical prognostic three-dimensional meteorological model data, in a 3D.DAT file, along with surface observation data gained from a representative nearby surface monitoring station, are combined. The CALTAPM program converts the TAPM data into a 3D.DAT file, which can be input directly into the CALMET meteorological processer.

The settings used for the TAPM program are provided in **Table 13**.

Table 13 TAPM Settings

Parameter	Setting
TAPM Version	4.0.5
Grid centre coordinates	-32 deg 53 min E
	151 deg 48 min S
Date parameters	20150101 to 20151231
Number of grid points	nx = 40
	ny = 40
Outer grid spacing	dx1 = 30000 m
	dy1 = 30000 m
Number of grid domains	4
Grid spacing for CALTAPM	Inner most grid (t010a)
Number of vertical grid levels	nz = 25
Observation file	Not used

The modelling domain generated in the TAPM model provides prognostic data across 4 nested grids. The first outer grid covers an area of 1,440,000km^2 at 30km resolution. The nested grids step down progressively in dimensions, to the final innermost grid, which covers an area of 81km^2 at a resolution of 300m. In the vertical direction there are 25 levels (40 layers) from the surface to 100 hPa. The lowest layer is approximately 10m above the ground.

5.3 CALPUFF Modelling Package

CALPUFF is the NSW EPA model of choice for areas that are affected by coastal breezes, coastal fumigation or complex terrain. The Site is located in a coastal area and, hence, the CALPUFF model was chosen for use in the AQIA.

The CALPUFF modelling system consists of three main components and a set of pre-processing and post-processing programs. The main components of the modelling system are CALMET (a diagnostic three-dimensional meteorological model), CALPUFF (an air quality dispersion model), and CALPOST (a post-processing package). The three main CALPUFF software package programs are described in the following sections.

5.3.1.1 CALMET

CALMET is a meteorological model that develops hourly wind and temperature fields on a three-dimensional gridded modelling domain. Associated two-dimensional fields such as mixing height, surface characteristics and dispersion properties are also included in the file produced by CALMET. CALMET produces a meteorological file that is used within the CALPUFF model to predict the movement of pollution.

The settings in **Table 14** were specifically selected in order to run CALMET in the ‘obs’ mode discussed in Barclay and Scire (2011). Only those parameters that deviate from the program default values or are significant to the AQIA are provided.

Table 14 CALMET Settings

Parameter	Setting
CALMET version	6.5.0
Grid Spacing	0.200 km
Grid Size	30km x 30km
# Cells NX	150
# Cells NY	150
Source of Land Use Data	Site-specific creation based on USGS data system
Geo Processer Used	Used external data in the Geophysical Processer program
Surface Stations	• Williamtown Airport BoM • Beresfield OEH • Mayfield OEH • Carrington OEH • Stockton OEH
Upper Air	TAPM Derived Upper Air Stations • TAPM_11111 • TAPM_22222 • TAPM_33333 • TAPM_44444 • TAPM_55555
Convective mixing height method	Maul-Carson for land and water
Overwater surface flux method	COARSE with no wave parameterisation
Use 3D temperature from	Station observations (surface & upper air)
Surface temperature	Compute internally from 2-D spatially varying
Wind field guess	Compute externally
Cloud cover data options	Generate from upper air stations (unless cloud.dat available)
Seven Critical Parameters	
TERRAD	4 km
RMAX1	5 km
RMAX2	10 km
R1	2 km
R2	4 km
IEXTRP (Surface wind vertical extrapolation)	-4 Extrapolate using similarity theory and exclude upper air observations from level 1
BIAS	-1/-1/-0.8/-0.5/0/0/0.5/0.8/1/1

5.3.1.2 CALPUFF

CALPUFF is a non-steady-state three-dimensional Gaussian puff model developed for the US Environmental Protection Agency (US EPA) and approved by the NSW EPA for use in situations where basic Gaussian plume models are not effective, such as areas with complex meteorological or topographical conditions, including coastal areas with re-circulating sea breezes. The CALPUFF model substantially overcomes the basic limitations of the steady-state Gaussian plume models, and as such, was chosen as the most suitable dispersion model for the AQIA. Some examples of applications for which CALPUFF may be suitable include:

- Near-field impacts in complex flow or dispersion situations:
  - complex terrain;
  - stagnation, inversion, recirculation, and fumigation conditions;
  - overwater transport and coastal conditions;
  - light wind speed and calm wind conditions;
- Long range transport;
- Visibility assessments and Class I area impact studies;
- Criteria pollutant modelling, including application to development applications;
- Secondary pollutant formation and particulate matter modelling; and
- Buoyant area and line sources (e.g. forest fires and aluminium reduction facilities).

Those parameters that deviate from the program default values or are significant to the AQIA are provided in **Table 15**.

Table 15 CALPUFF Settings

Parameter	Setting
CALPUFF version	7.2.1
Sampling Grid	6km x 6km (200m spacing)
Calculation Type	Concentration
Chemical transformation method	Not modelled
Dispersion Option	Dispersion coefficient. use turbulence computed from micrometeorology
Use PDF method for Sigma-z in the convective BL	On
Puff splitting	No puff splitting
Plume rise method	Briggs
Transitional plume rise	On
Stack tip downwash	On
Partial plume penetration	On
Partial plume penetration (buoyant)	On
Terrain adjustment method	Partial plume path adjustment
Building wake calculation	PRIME algorithm

5.3.1.3 CALPOST

The CALPOST program is used to process the outputs of the CALPUFF program into a format defined by the user. Results can be tabulated for selected options including percentiles, selected days, gridded results or discrete locations, and can be adjusted to account for chemical transformation and background values.

The program default settings were used for the CALPOST program, ensuring that the correct averaging periods, percentiles and receptors were selected to meet the NSW EPA ambient pollutant criteria assessed (DEC, 2005). CALPOST version 7.1.0 was used in the assessment.

5.4 Modelling Scenario

In order to demonstrate that all potential emissions meet relevant ground level air quality standards, the operational scenarios presented in **Table 16** were assessed.

Table 16 Assessment Scenario

Scenario ID	Description
1	Proposed 60,000 tpa Operations (‘Average’ Emission Concentrations Scenario) • Assumed 24 hour operations • Emission rates calculated from the average stack testing concentrations reported between 2012 – 2015 (provided in **Appendix D**) for the following emission points: - 20,000 tpa Rotary Kiln Stack - 40,000 tpa Rotary Kiln Stack - Drying Plant Stack - Shed 5 Stack - Fine Grinding Mill Stack *Note 1 –Emissions from the 20,000 tpa Rotary Kiln are generally representative of the expected emissions from the 40,00 tpa Rotary Kiln, as they will be processing the same feed material utilising the same technology.*
2	Proposed 60,000 tpa Operations (Maximum proposed EPL Emission Concentrations Scenario) • Assumed 24 hour operations • Emission rates calculated from the maximum EPL concentration limits listed in the Regain Tomago license for: - 20,000 tpa Rotary Kiln Stack - 40,000 tpa Rotary Kiln Stack - Drying Plant Stack - Shed 5 Stack - Fine Grinding Mill Stack *Note 1 – Where no available limit was listed in the current EPL for the expected pollutants from that source, a commensurate EPL limit was proposed in line with the current limits imposed on EPL Point 1.* *Note 2 – For the speciated VOC's, where no EPL Limit was available for an individual VOC species, the relative percentage of each species was obtained from stack testing VOC data collected from the Regain site.* *Note 3 - For all Type 1 & 2 Metals, where no EPL Limit was available for the individual species, the relative percentage of each elemental species was obtained from stack testing data collected from the Regain site.*

Years of historical stack emissions testing data from the Regain facility has demonstrated that due to the variable nature of the Spent Pot Line material from the aluminium smelting process, stack pollutant concentrations can vary by a significant margin, whilst still achieving compliance with the listed EPL Limits.

Given the variable nature of the feed material, and as such the associated variable nature of the emissions concentrations, Scenario 1 adopted the average stack testing concentrations for calculation of the expected emission rates, to demonstrate what impact 'typical' operations may have.

Scenario 2 adopted the proposed maximum EPL concentration limits for calculating the expected mass emission rates. Scenario 2 is a conservative scenario which models the facility operating at its maximum proposed emission limits (rather than typical emissions). The scenario is not considered to reflect typical operations but provides a conservative basis for the purpose of assessing potential impacts. Historic operations and monitoring of the Regain facility have demonstrated that all stack pollutant concentrations levels are typically recorded below the listed EPL Limits, however a number of the recorded concentrations have at times approached those limits.

5.5 Limitations

The atmosphere is a complex, physical system, and the movement of air in a given location is dependent on a number of different variables, including temperature, topography and land use, as well as larger-scale synoptic processes. Dispersion modelling is a method of simulating the movement of air pollutants in the atmosphere using mathematical equations. The model equations necessarily involve some level of simplification of these very complex processes based on our understanding of the processes involved and their interactions, available input data, and processing time and data storage limitations.

These simplifications come at the expense of accuracy, which particularly affects model predictions during certain meteorological conditions and source emission types. For example, the prediction of pollutant dispersion under low wind speed conditions (typically defined as those less than 1 m/s) or sub-hourly emissions. To accommodate these known deficiencies, the model outputs tend to provide conservative estimates of pollutant concentrations at particular locations.

The results of dispersion modelling provide an indication of the likely level of pollutants within the modelling domain. While the models, when used appropriately and with high quality input data, can provide very good indications of the scale of pollutant concentrations and the likely locations of the maximum concentrations occurring, their outputs should not be considered to be representative of exact pollutant concentrations at any given location or point in time.

6.0 CALPUFF Model Inputs

CALPUFF requires several main categories of data to determine the dispersion of pollutants:

- Meteorology;
- Terrain;
- Building wake effects;
- Sensitive receptor locations; and
- Emissions inventory.

The above inputs are addressed separately in the following sections.

6.1 Meteorology

The meteorological data are used by the model in different ways to estimate the dispersion of air pollutants:

- Ambient temperature is used to incorporate thermal buoyancy effects when calculating the rise and dispersion of pollutant plumes;
- Wind direction determines the direction in which pollutants will be carried;
- Wind speed influences the dilution and entrainment of the plume into the air continuum;
- Atmospheric stability class is a measure of atmospheric turbulence and the dispersive properties of the atmosphere. Most dispersion models utilise six stability classes, ranging from A (very unstable) to F (stable/very stable); and
- Vertical mixing height is the height at which vertical mixing occurs in the atmosphere.

The AQIA used meteorological data from a number of automatic weather stations in the Newcastle region, including the BoM Williamtown Airport, OEH Carrington, OEH Mayfield & OEH Stockton meteorological monitoring stations for the period January 2015 to December 2015.

A review of the CALMET data against the closest meteorological monitoring station (OEH Beresfield), and the long-term BoM Williamtown Airport data is provided in **Appendix B** in order to validate that the data used in the model are representative of the area and appropriate for use in the assessment. The review concluded that the CALMET data from this site are considered to be representative of meteorological conditions around the Site.

6.2 Terrain

Digital terrain data used to generate the upper air prognostic meteorological data were obtained from the TAPM 9 second DEM database covering an area of 30km by 30 km on a 1 km grid. For the CALMET model, the geophysical processor was used to convert land use and terrain data from WebGIS (SRTM1 for terrain at approximately a 30 metre resolution) and GLCC Australia Pacific (approximate 1 kilometre resolution) throughout the meteorological domain.

The terrain file is provided graphically in **Appendix B**, which also shows the locations of the surface meteorological stations.

6.3 Building Wake Effects

The dispersion of pollutants around the site is likely to be affected by aerodynamic wakes generated by winds having to flow around the buildings near the stack locations on the site. Building wakes generally decrease the distance downwind at which the stack plumes comes into contact with the ground. This may result in higher ground level pollutant concentrations closer to the emission source.

CALPUFF includes the PRIME building wake algorithm and the Building Profile Input Program (BPIP) for entering the location and dimension of buildings where building wakes may be important for dispersion. The nearby buildings were included in BPIP to estimate the building wakes required for the CALPUFF model. Building and point source locations are presented previously in **Figure 2**.

6.4 Sensitive Receptor Locations

The NSW EPA considers sensitive receptors to be areas where people are likely to either live, work, or engage in recreational activities. The area surrounding the facility is largely comprised of medium to large scale industrial premises. The area beyond the industrial premises is largely bound by native vegetation on all sides, with the Hunter River approximately 1km to the south. The closest urban residential receptors are approximately 1.4km from the facility. The Tomago Aluminium site, Regain facility and the surrounding area falling within a range of approximately 2-3km from the Tomago Aluminium site are located within the buffer zone identified in the Tomago Aluminium Development Consent.

All non-gridded sensitive receptor locations modelled are provided in **Figure 6**.

Given the proximity of some of the sensitive receptor locations to the site, gridded receptors were selected covering a 6km x 6km grid, with 200m spacing between receptors. Additionally, a denser grid of receptors was added in a 2km x 2km grid centred on the Regain facility with 50m spacing between them. The gridded receptors were selected to ensure a representative sample of all nearby potential sensitive receptor locations (not specifically identified in **Figure 6**) were included in this assessment. All gridded receptor locations modelled are presented in **Figure 7**

Finally, for the purposes of this assessment, some of the pollutants being assessed are categorised as being individual toxic air pollutants by the NSW EPA, and must show compliance with the ground-level assessment criteria “*at or beyond the boundary of the site*”. Receptors at or beyond the Tomago Aluminium site boundary were included for this assessment.

Figure 6 **Modelled specific sensitive receptor locations**

Figure 7 **All gridded receptor locations**

6.5 Emissions Inventory

The emissions inventory for the assessment was prepared using site specific stack emissions testing data obtained from the current Regain Tomago facility, the previously operational Regain Hydro & Point Henry facilities and the Tomago Aluminium Delining shed. Stack emissions testing data also informed operational parameters such as expected temperatures, velocity & volumetric flow rates.

Flow rate data from the Regain Point Henry facility was used to determine the expected pollutant emission rates from the 40,000 tpa Rotary Kiln proposed for the site (which would be relocated from Point Henry). Regain have advised that this kiln is expected to operate at the Tomago site in the same manner as currently operational plant and as such the same pollutant concentrations are expected, and EPL concentration limits achievable.

Stack testing data from the Regain Hydro facility informed parameters for both the Drying Plant and Fine Grinding Mill to be installed at the Regain Tomago facility as it is current and most representative of expected emission parameters from those sources.

Data from the Tomago Aluminium Delining shed stack was provided by Regain for use in this assessment as it is the most representative of the current materials handling work which occurs within Shed 5 at the Regain facility. The Regain Shed 5 is currently vented to the same baghouse which serves the Tomago Aluminium Delining shed.

Table 17 presents a summary of the emission points considered in this assessment, and the data source for each emission point.

Table 17 Emission Points Data Summary

Proposed EPL Point No.	Stack Name	Data Source	Years Used	No. of Tests Used
1	20,000 tpa Rotary Kiln	Regain Tomago Stack Testing Reports	2014 – 2016	10
2	40,000 tpa Rotary Kiln	Regain Point Henry Stack Testing Reports	2017	1
3	Drying Plant Stack	Regain Hydro Stack Testing Reports	2014 – 2015	8
4	Shed 5	Tomago Aluminium Deline Stack Testing Reports	2014 – 2016	3
5	Fine Grinding Mill	Regain Hydro Stack Testing Reports	2014 – 2015	8

The use of site specific data is considered to be best practice and likely to reflect an accurate representation of the facilities potential operational parameters.

6.5.1 Scenario 1 - Historical Stack Emissions Testing Data & Concentrations

Stack emissions testing was previously conducted by AECOM between 2014 - 2017 for the relevant emission points at the Regain Tomago, Hydro & Point Henry facilities, along with the Tomago Aluminium Deline baghouse stack. A summary of the average concentrations adopted for Scenario 1 are provided in **Table 18**, with the full data set provided in **Appendix D**.

Table 18 Scenario 1 – Average Historical Stack Concentration Results Summary

Pollutant	Units	20,000 tpa Rotary Kiln Stack	40,000 tpa Rotary Kiln Stack	Drying Plant Stack	Shed 5 Stack	Fine Grinding Mill Stack	EPL Concentration Limits
Cadmium	mg/m^3	0.0040	0.0040	N/A	N/A	N/A	0.035
Cyanide	mg/m^3	0.26	0.26	N/A	N/A	N/A	1.0
Dioxins & Furans	ng/m^3	0.0051	0.0051	N/A	N/A	N/A	0.1
Fine Particulates (PM_{10})	mg/m^3	3.2	3.2	4.2	0.4	2.8	10
Nitrogen Oxides (Equivalent NO_2)	mg/m^3	5.5	5.5	N/A	N/A	N/A	100
Polycyclic Aromatic Hydrocarbons	mg/m^3	0.14	0.14	N/A	N/A	N/A	0.5
Sulfur Dioxide	mg/m^3	2.6	2.6	N/A	N/A	N/A	50
Total Fluoride	mg/m^3	0.8	0.8	N/A	N/A	N/A	5
Total Solid Particulates	mg/m^3	4.4	4.4	5.9	4.0	13.0	20
Type 1 & 2 Substances	mg/m^3	0.03	0.03	N/A	N/A	N/A	1.0
Volatile Organic Compounds	mg/m^3	1.59	1.59	N/A	N/A	N/A	20
N/A – No stack testing required for these pollutants from this point source.							

EPL and POEO Regulation 2010 Compliance

All of the stack testing results provided in **Appendix D** demonstrated compliance with the respective EPL licenses for each site and their associated concentration limits. Additionally testing was also compliant with the general concentration limits that form the *Protection of the Environment Operations (Clean Air) Regulation 2010*. It should be noted that in some cases, Regain's EPL's have lower concentration limits than those proposed in the *Clean Air Regulation 2010*.

6.5.2 Scenario 2 - Current and Proposed EPL Point Concentration Limits

The relevant EPL concentration limits for the pollutants of interest in this assessment are provided in **Table 19** for each of the respective stacks where they were available. Where no current limit was available a concentration limit has been proposed and is based on the current or previous limits imposed on those emission points at the Tomago or Kurri facilities.

Preliminary modelling suggested that the current Cadmium limit for EPL Point 1 of 0.035 mg/m^3 when adopted for both the current and proposed kiln may result in an exceedance of the ground level concentration limits. A new limit of 0.025 mg/m^3 is being proposed for both EPL Point 1 and 2, to ensure compliance with ground level concentration limits. The concentrations presented in **Table 19** were adopted for this assessment.

Table 19 Scenario 2 - Current & Proposed EPL Concentration Limits

Pollutant	**Units**	20,000 tpa Rotary Kiln Stack	40,000 tpa Rotary Kiln Stack[1]	**Drying Plant Stack**[1]	**Shed 5** Stack[1]	Fine Grinding Mill Stack[1]
Cadmium	mg/m^3	0.025[2]	0.025[2]	N/A	N/A	N/A
Cyanide	mg/m^3	1	1	N/A	N/A	N/A
Dioxins & Furans	ng/m^3	0.1	0.1	N/A	N/A	N/A
Fine Particulates (PM_{10})	mg/m^3	10	10	10	10	10
Nitrogen Oxides (Equivalent NO_2)	mg/m^3	100	100	N/A	N/A	N/A
Polycyclic Aromatic Hydrocarbons	mg/m^3	0.5	0.5	N/A	N/A	N/A
Sulfur Dioxide	mg/m^3	50	50	N/A	N/A	N/A
Total Fluoride	mg/m^3	5	5	N/A	N/A	N/A
Total Solid Particulates	mg/m^3	20	20	20	20	20
Type 1 & 2 Substances	mg/m^3	1	1	N/A	N/A	N/A
Volatile Organic Compounds	mg/m^3	20	20	N/A	N/A	N/A

[1] EPL Limits have been adopted for this assessment from the currently approved limits for EPL Point 1 at the Regain Tomago facility

[2] Preliminary modelling suggested that the current Cadmium limit of 0.035 mg/m^3 adopted for both the current kiln and proposed kiln may result in an exceedance of the ground level concentration limits. A new limit of 0.025 mg/m^3 is being proposed for both EPL Point 1 and 2 to ensure compliance with the ground level concentration limit is achieved. The proposed Cadmium limit is achievable under normal operating conditions, based on years of historical stack emissions testing results.

An emissions inventory was prepared based on these stack parameters and the EPL Concentration limits for the scenario being assessed as discussed in **Section 5.4**.

The EPL Concentrations adopted for this scenario are believed to be representative of the ongoing achievable maximum concentrations that Regain are capable of operating under given the variable nature of SPL feed material originating from the aluminium smelting process. The stack testing data provided in **Appendix D** (particular for the Rotary Kiln) demonstrates that whilst operations typically achieve results below relevant EPL limits that some results have at times approached the approved limits.

6.5.3 Stack Parameters & Emission Rates

Table 20 provides a summary of the 5 point sources considered in this assessment and their associated emission parameters. **Table 21** and **Table 20** provide a summary of the calculated emission rates considered in this assessment for Scenario 1 & 2 respectively, as described in **Section 5.4**.

Table 20 Summary of Modelled Emission Points

Source	Units	20,000 tpa Rotary Kiln Stack	40,000 tpa Rotary Kiln Stack[4]	Shed 5 Stack[4]	Fine Grinding Mill Stack	Drying Plant Stack
Easting	mE MGA94	379631	379605	379598	379609	379598
Northing	mN MGA94	6367514	6367551	6367534	6367523	6367531
Height	mAGL	12.52	14.10	14.94	20.26	14.94
Temperature	K	359	360[1]	299[2]	306[3]	324[2]
Inside Diameter	m	0.9	1.1	1.1	0.75	0.75
Exit Velocity	m/s	17.6	13.7	23.1	5.0	16.1
Exhaust Flow	Am^3/s	11.2	13.0[1]	22.0[2]	2.2[3]	7.1[2]
	Nm^3/s	**8.5**	**9.9**[1]	**20.1**[2]	**2.0**[3]	**6.0**[2]
Release Type	-	Wake-Affected	Wake-Affected	Wake-Affected	Wake-Affected	Wake-Affected
Operational Hours (per year)	hr	8760	8760	8760	8760	8760

[1]Adopted from the Regain Point Henry Kiln operational parameters

[2]Adopted from the Regain Hydro operational parameters

[3]Adopted from the Tomago Aluminium Deline operational parameters

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[4] The locations of these two stacks were modelled based on the proposed site concept layout. Since the completion of this assessment, the location of these two stacks has been swapped in the final design phase as a result of site layout and engineering optimisation. The stacks are separated by a distance of 18m. However both are similar in height and equally impacted by building wake effects of the adjacent shed. It is not expected that this swap of stack location would have a substantial effect on the reported pollutant ground level concentrations. The outcomes of this assessment would be addressed in a validation assessment undertaken upon completion of the proposed site modifications.

Table 21 Scenario 1 – ‘Average’ Operating Conditions Summary of Modelled Emission Rates

Source	Units	20,000 tpa Rotary Kiln Stack	40,000 tpa Rotary Kiln Stack	Shed 5 Stack	Fine Grinding Mill Stack	Drying Plant Stack
Cyanide	g/s	0.00224	0.00259	-	-	-
Dioxins & Furans	g/s	4.38E-11	5.07E-11	-	-	-
Fine Particulates (PM_{10})	g/s	0.02705	0.03133	0.00509	0.01326	0.00548
Fine Particulates ($PM_{2.5}$)*	g/s	0.02705	0.03133	0.00509	0.01326	0.00548
Nitrogen Oxides	g/s	0.04687	0.05429	-	-	-
Polycyclic Aromatic Hydrocarbons	g/s	0.00116	0.00135	-	-	-
Sulfur Dioxide	g/s	0.02233	0.02586	-	-	-
Total Fluoride	g/s	0.00717	0.00831	-	-	-
Total Solid Particulate	g/s	0.03787	0.04386	0.03310	0.01857	0.00767
Type 1 & Type 2 Substances	g/s	0.00027	0.00031	-	-	-
Antimony	g/s	3.17E-06	3.67E-06	-	-	-
Arsenic	g/s	2.34E-06	2.71E-06	-	-	-
Cadmium	g/s	3.41E-05	3.95E-05	-	-	-
Chromium	g/s	2.14E-05	2.48E-05	-	-	-
Lead	g/s	1.23E-05	1.42E-05	-	-	-
Manganese	g/s	1.27E-04	1.47E-04	-	-	-
Mercury	g/s	2.02E-06	2.34E-06	-	-	-
Nickel	g/s	4.57E-05	5.29E-05	-	-	-
Volatile Organic Compounds	g/s	0.01357	0.01571	-	-	-
Acetone	g/s	0.00626	0.00725	-	-	-
Benzene	g/s	0.00058	0.00067	-	-	-
Toluene	g/s	0.00746	0.00864	-	-	-

*In the absence of available stack testing data for $PM_{2.5}$, it has been conservatively assumed for this assessment that all $PM_{2.5}$ emissions are equal to PM_{10} emissions. It would be expected that $PM_{2.5}$ concentrations would be significantly less than PM_{10} in practice.

Table 22 Scenario 2 – Maximum EPL Concentration OperationsSummary of Modelled Emission Rates

Source	Units	20,000 tpa Rotary Kiln Stack	40,000 tpa Rotary Kiln Stack	Shed 5 Stack	Fine Grinding Mill Stack	Drying Plant Stack
Cyanide	g/s	0.00852	0.00987	-	-	-
Dioxins & Furans	g/s	8.52E-10	9.87E-10	-	-	-
Fine Particulates (PM_{10})	g/s	0.08523	0.09871	0.20104	0.01953	0.06004
Fine Particulates ($PM_{2.5}$)#	g/s	0.08523	0.09871	0.20104	0.01953	0.06004
Nitrogen Oxides	g/s	0.85225	0.98706	-	-	-
Polycyclic Aromatic Hydrocarbons	g/s	0.00426	0.00494	-	-	-
Sulfur Dioxide	g/s	0.42613	0.49353	-	-	-
Total Fluoride	g/s	0.04261	0.04935	-	-	-
Total Solid Particulate	g/s	0.17045	0.19741	0.40207	0.03906	0.12008
Type 1 & Type 2 Substances	g/s	0.00852	0.00987	-	-	-
Antimony*	g/s	1.02E-04	1.18E-04	-	-	-
Arsenic*	g/s	7.51E-05	8.70E-05	-	-	-
Cadmium	g/s	2.09E-04	2.42E-04	-	-	-
Chromium*	g/s	6.88E-04	7.97E-04	-	-	-
Lead*	g/s	3.94E-04	4.57E-04	-	-	-
Manganese*	g/s	4.07E-03	4.71E-03	-	-	-
Mercury*	g/s	6.51E-05	7.53E-05	-	-	-
Nickel*	g/s	1.47E-03	1.70E-03	-	-	-
Volatile Organic Compounds	g/s	0.17045	0.19741	-	-	-
Acetone*	g/s	0.07460	0.08640	-	-	-
Benzene*	g/s	0.00691	0.00801	-	-	-
Toluene*	g/s	0.08893	0.10300	-	-	-

* See Section 6.5.3.3 for discussion of emission rate calculation

In the absence of available stack testing data for PM2.5, it has been conservatively assumed for this assessment that all PM2.5 emissions are equal to PM10 emissions. It would be expected that PM2.5 concentrations would be significantly less than PM10 in practice.

6.5.3.1 Fine Particulates ($PM_{2.5}$)

When examining the available data for the pollutants in this assessment, there was no available stack emissions testing data for Fine Particulates ($PM_{2.5}$) from any of the point sources considered. No testing has previously been carried out for this pollutant, as it is not currently a license requirement in the Regain Tomago EPL. In the absence of available data, it has been assumed that all Fine Particulates ($PM_{2.5}$) is equivalent in concentration to the Fine Particulates (PM_{10}) previously measured (or calculated) for each of the respective point sources. This is a conservative approach to determine the potential impact from $PM_{2.5}$, as it is expected that in practice, $PM_{2.5}$ would be a small fraction of the PM_{10} result.

6.5.3.2 NO_x Conversion to NO_2

Nitrogen oxides are produced in most combustion processes and are formed during the oxidation of nitrogen in fuel and nitrogen in the air. During high-temperature processes, a variety of oxides are formed including nitric oxide (NO) and NO_2. NO will generally comprise 95 % of the NO_X by volume at the point of emission. The remaining NO_X will consist of NO_2. Ultimately, however, all nitric oxides emitted into the atmosphere are oxidised to NO_2 and then further to other higher oxides of nitrogen.

This assessment adopted the conservative methodology for nitrogen oxide chemical transformation, which assumes that 100% of NO is converted to NO_2 in the atmosphere.

6.5.3.3 Hazardous Elemental Metals & Speciated VOC's (Scenario 2)

Where there was no EPL Concentration limit was listed in the Regain Tomago license for a number of the elemental metals and individual VOC species which are currently sampled for as part of the Regain Tomago EPL requirements, historical stack testing data was used to determine the percentage breakdown for each of the elemental metals and speciated VOC's.

These percentages were then used to calculate the theoretical maximum emission rates expected for Scenario 2, for each of the individual substances based on the maximum licence concentration limits for the respective Type 1 & 2 Metals or Total VOC's. The percentage ratio's used in this assessment are provided in **Table 23** and **Table 24** below.

Table 23 Type 1 & Type 2 Metals Percentage Breakdown

Type 1 & 2 Elemental Metals	Antimony	Arsenic	Chromium	Lead	Manganese	Mercury	Nickel
Percentage of Total Type 1 & 2 Metals*	1.2%	0.9%	8.1%	4.6%	47.8%	0.8%	17.2%

* The total percentage does not add up to 100% as some of the elemental Type 1 & 2 substances included in the analysis do not have associated ground level concentration limits, and as such have not been included in this assessment.

Table 24 Speciated VOC's Percentage Breakdown

Individual VOC's Species	Acetone	Benzene	Toluene
Percentage of Total VOC's*	43.8%	4.1%	52.2%

* Based on historical testing, only the three VOC species listed in the table above returned a result above the detection limit of the method, and as such only these species have been used to calculate the percentage breakdown of the total VOC's.

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7.0 Modelling Results

The NSW EPA's assessment criteria for the assessed pollutants apply to both the 100th & 99.9th percentile for site-specific assessments, such as this AQIA. The data are presented for the respective pollutants of concern at the nearest sensitive receptor, or at/beyond the boundary as required by the *Approved Methods*.

7.1 Scenario 1 – 'Average' Typical Operating Conditions (Historical Stack Concentrations)

The predicted maximum cumulative ground level concentrations for the 'average' typical operating condition scenario from the dispersion model are summarised in **Table 25**. The incremental impacts for each pollutant assessed in the modelling have also been expressed as a percentage of the criteria.

The maximum cumulative values are inclusive of the incremental impacts from the site, and the background values identified in **Section 4.1.5**.

Table 25 Scenario 1 - Incremental & Cumulative Predicted Ground Level Concentrations (µg/m^3)

Pollutant	Averaging Period	Percentile	Assessment Location	Incremental GLC		Incremental % of Criteria	Background GLC	Cumulative GLC	GLC Criteria
				Residential	Industrial				
Sulfur Dioxide (SO_2)	1 hour	100th	Sensitive receptor	0.49	1.43	0.3%	214.8	216.23	570
	24 hours	100th		0.09	0.28	0.1%	73.4	73.68	228
	Annual	100th		0.01	0.03	0.1%	9.8	9.83	60
Nitrogen Dioxide (NO_2)	1 hour	100th	Sensitive receptor	1.03	3.00	1.2%	92.1	95.10	246
	Annual	100th		0.01	0.07	0.1%	16.9	16.97	62
Carbon Monoxide (CO)	1 hour	100th	Sensitive receptor	14.2	41.40	0.1%	N/A	N/A	30,000
	8 hour	100th		7.44	20.70	0.2%	N/A	N/A	10,000
PM_{10}	24 hour	100th	Sensitive receptor	0.1	0.44	0.9%	43.30	43.74	50
	Annual	100th		0.01	0.05	0.2%	18.70	18.75	25
$PM_{2.5}$	24 hour	100th	Sensitive receptor	0.1	0.44	1.8%	20.2	20.64	25
	Annual	100th		0.01	0.05	0.6%	7.4	7.45	8
Lead	Annual	100th	Sensitive receptor	3.60E-06	1.73E-05	0.003%	N/A	N/A	0.5

Pollutant	Averaging Period	Percentile	Assessment Location	Incremental GLC		Incremental % of Criteria	Background GLC	Cumulative GLC	GLC Criteria
				Residential	Industrial				
Hydrogen Fluoride	90 days	100th	Sensitive receptor	0.003	0.02	3.9%	0.20	0.22	0.5
	30 days	100th		0.005	0.03	3.2%	0.81	0.84	0.84
	7 days	100th		0.01	0.04	2.2%	1.18	1.22	1.7
	24 hours	100th		0.03	0.09	3.1%	N/A	N/A	2.9
TSP	Annual	100th	Sensitive receptor	0.01	0.08	0.1%	N/A	N/A	90
Cyanide	1 hour	99.9th	At boundary	0.19		0.1%	N/A	N/A	200
Dioxins & Furans	1 hour	99.9th	At boundary	3.74E-09		0.2%	N/A	N/A	2.00E-06
PAH	1 hour	99.9th	At boundary	0.10		24.8%	N/A	N/A	0.4
Antimony	1 hour	99.9th	At boundary	0.00026		0.003%	N/A	N/A	9
Arsenic	1 hour	99.9th	At boundary	0.00018		0.2%	N/A	N/A	0.09
Cadmium	1 hour	99.9th	At boundary	0.0029		16.2%	N/A	N/A	0.018
Chromium	1 hour	99.9th	At boundary	0.0018		2.0%	N/A	N/A	0.09
Manganese	1 hour	99.9th	At boundary	0.0109		0.06%	N/A	N/A	18
Mercury	1 hour	99.9th	At boundary	0.00017		0.01%	N/A	N/A	1.8
Nickel	1 hour	99.9th	At boundary	0.0039		2.2%	N/A	N/A	0.18
Acetone	1 hour	99.9th	At boundary	0.54		0.002%	N/A	N/A	22000
Benzene	1 hour	99.9th	At boundary	0.05		0.2%	N/A	N/A	29
Toluene	1 hour	99.9th	At boundary	0.64		0.2%	N/A	N/A	360

*The maximum ground level concentration at either sensitive receptor type was used to determine the Incremental % of Criteria and Cumulative GLC concentrations for comparison to the regulatory criteria.

As shown in the table, the predicted maximum cumulative pollutant concentrations were all compliant with their respective GLC assessment criteria for this Scenario. The following observations can be made:

- The incremental PAH concentration of 0.10 µg/m^3, and the Cadmium concentration of 0.0029 µg/m^3, represent the pollutants with their GLC closest to their respective EPA criterion (0.4 µg/m^3 and 0.018 µg/m^3 respectively). The modelling shows that the maximum incremental GLC's are located on the western boundary approximately 200m from the Regain facility. Based on the emissions inventory, the two rotary kilns are the main source of these pollutants; and
- The pollutants with the highest cumulative concentrations when compared to the NSW EPA criteria were Hydrogen Fluoride & $PM_{2.5}$. Hydrogen Fluoride has the highest cumulative result for the 30-day averaging period of 0.84 µg/m^3 when compared to the criteria of 0.84 µg/m^3. The cumulative annual $PM_{2.5}$ result was the second highest, at 7.45 µg/m^3, when compared to the criteria of 8 µg/m^3. The modelling demonstrates that the maximum cumulative GLCs are located at one of the industrial sensitive receptors approximately 500m to the west of the Regain facility.

  Whilst the cumulative impacts for these pollutants are notable, the incremental Hydrogen Fluoride and $PM_{2.5}$ Regain contributions at the same location are very low at 0.03 µg/m^3 and 0.05 µg/m^3, well below their respective criteria. Additionally, the $PM_{2.5}$ result is also highly conservative given it has been assumed for this assessment that the $PM_{2.5}$ concentration is equal to the PM_{10} concentration, so this result would be expected to be significantly less in practice.
- Given the location of the Regain facility and the range of sensitive receptors in the immediate vicinity being dominated by industrial/commercial premises, ground level concentrations were further examined at a range of residential sites across the modelling domain. The results indicate that at all residential receptors identified in this assessment, the ground level concentrations for the respective pollutants listed in **Table 25** show significantly reduced incremental ground level concentration impacts. The reduced impacts at these residential locations are expected due to the nearest residences being located approximately 1.4km from the Regain facility. No incremental or cumulative exceedances are predicted at any residential receptor identified across the modelling domain.
- Isopleths have not been included for this Scenario, as they are similar to those presented in **Section 7.2**, however demonstrate significantly lower ground level concentrations.
- Further analysis of the modelling results in relation to cumulative Hydrogen Fluoride & Sulfur Dioxide ground level concentrations is provided in **Section 7.3**. This analysis examined the predicted Regain incremental contributions at the same location as each of the ambient monitoring sites. The analysis demonstrated that the Regain incremental impacts at the ambient monitoring sites are all orders of magnitude lower than the respected ground level concentration limits. The cumulative impacts at these locations also show no additional exceedances for any of the averaging periods at all of the sites as a result of the Regain contributions at those locations.

7.2 Scenario 2 - Maximum Potential Operating Conditions (Current & Proposed EPL Concentration Limits)

The predicted maximum cumulative ground level concentrations for the maximum EPL concentrations scenario from the dispersion model are summarised in **Table 26**. The incremental impacts for each pollutant assessed in the modelling have also been expressed as a percentage of the criteria.

The maximum cumulative values are inclusive of the incremental impacts from the site, and the background values identified in **Section 4.1.5**.

Table 26 Scenario 2 - Incremental & Cumulative Predicted Ground Level Concentrations (µg/m^3)

Pollutant	Averaging Period	Percentile	Assessment Location	Incremental GLC*		Incremental % of Criteria	Background GLC	Cumulative GLC	GLC Criteria
				Residential	Industrial				
Sulfur Dioxide (SO_2)	1 hour	100th	Sensitive receptor	9.34	27.30	4.8%	214.8	242.10	570
	24 hours	100th		1.72	5.28	2.3%	73.4	78.68	228
	Annual	100th		0.13	0.61	1.0%	9.8	10.41	60
Nitrogen Dioxide (NO_2)	1 hour	100th	Sensitive receptor	18.70	54.60	22.2%	92.1	146.7	246
	Annual	100th		0.25	1.22	2.0%	16.9	18.12	62
PM_{10}	24 hour	100th	Sensitive receptor	0.98	3.87	7.7%	43.30	47.17	50
	Annual	100th		0.09	0.41	1.6%	18.70	19.11	25
$PM_{2.5}$	24 hour	100th	Sensitive receptor	0.98	3.87	15.5%	20.2	24.07	25
	Annual	100th		0.09	0.41	5.1%	7.4	7.81	8
Lead	Annual	100th	Sensitive receptor	1.17E-04	5.63E-04	0.1%	N/A	N/A	0.5
TSP	Annual	100th	Sensitive receptor	0.12	0.70	0.8%	N/A	N/A	90
Hydrogen Fluoride	90 days	100th	Sensitive receptor	0.02	0.12	23.2%	0.20	0.32	0.5
	30 days	100th		0.03	0.16	18.9%	0.81	**0.97**	0.84
	7 days	100th		0.06	0.22	12.9%	1.18	1.4	1.7
	24 hours	100th		0.17	0.53	18.2%	N/A	N/A	2.9
Cyanide	1 hour	99.9th	At boundary	0.73		0.4%	N/A	N/A	200

Pollutant	Averaging Period	Percentile	Assessment Location	Incremental GLC*		Incremental % of Criteria	Background GLC	Cumulative GLC	GLC Criteria
				Residential	**Industrial**				
Dioxins & Furans	1 hour	99.9th	At boundary	7.28E-08		3.6%	N/A	N/A	2.00E-06
PAH	1 hour	99.9th	At boundary	0.36		91.0%	N/A	N/A	0.4
Antimony	1 hour	99.9th	At boundary	0.0087		0.1%	N/A	N/A	9
Arsenic	1 hour	99.9th	At boundary	0.0064		7.1%	N/A	N/A	0.09
Cadmium	1 hour	99.9th	At boundary	0.0179		99.2%	N/A	N/A	0.018
Chromium	1 hour	99.9th	At boundary	0.059		65.3%	N/A	N/A	0.09
Manganese	1 hour	99.9th	At boundary	0.35		1.9%	N/A	N/A	18
Mercury	1 hour	99.9th	At boundary	0.0056		0.3%	N/A	N/A	1.8
Nickel	1 hour	99.9th	At boundary	0.13		70.0%	N/A	N/A	0.18
Acetone	1 hour	99.9th	At boundary	6.38		0.03%	N/A	N/A	22000
Benzene	1 hour	99.9th	At boundary	0.59		2.0%	N/A	N/A	29
Toluene	1 hour	99.9th	At boundary	7.60		2.1%	N/A	N/A	360

*The maximum ground level concentration at either sensitive receptor type was used to determine the Incremental % of Criteria and Cumulative GLC concentrations for comparison to the regulatory criteria.

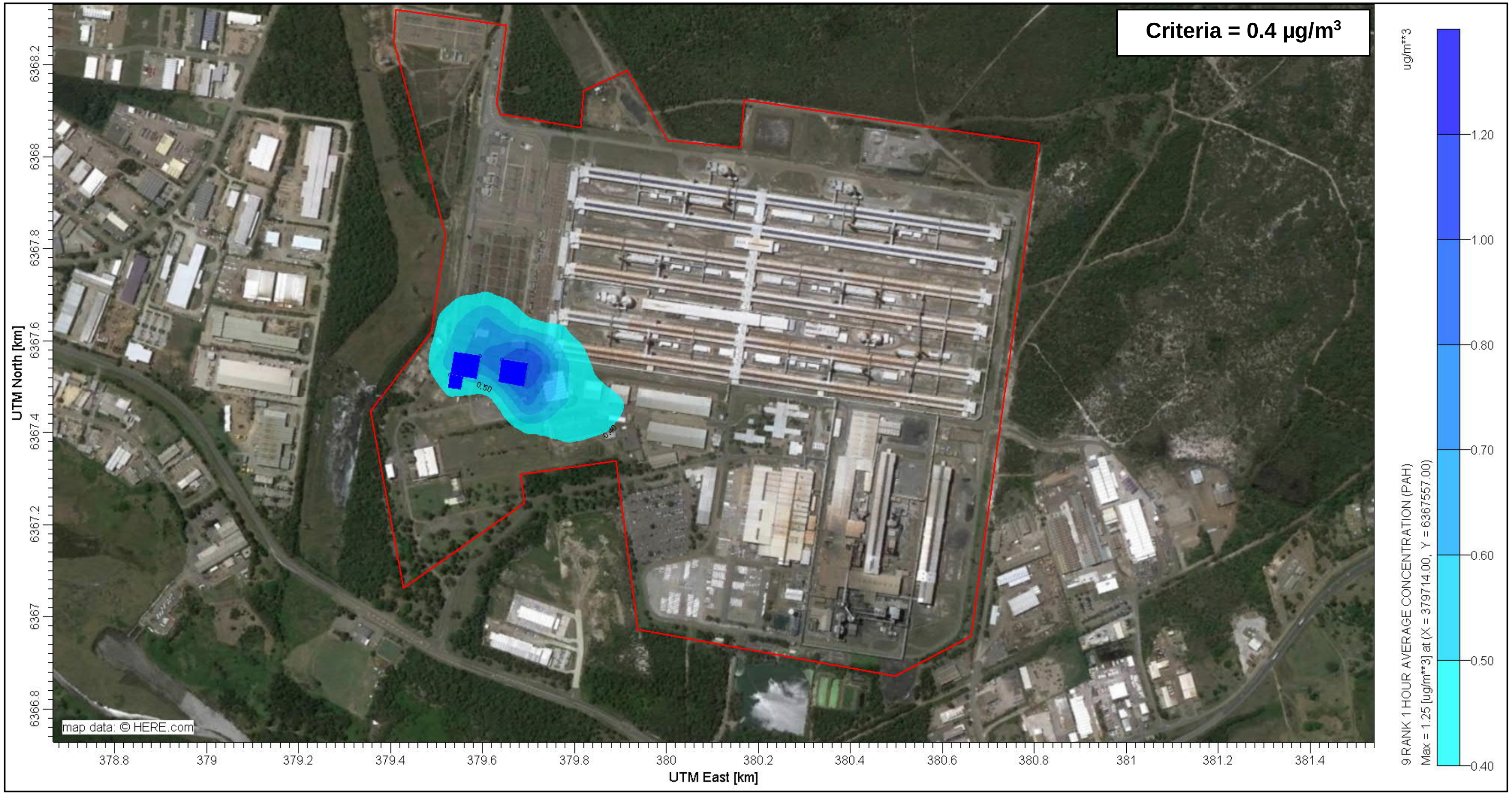

Figure 8 Maximum Incremental PAH Isopleth 99.9th Percentile

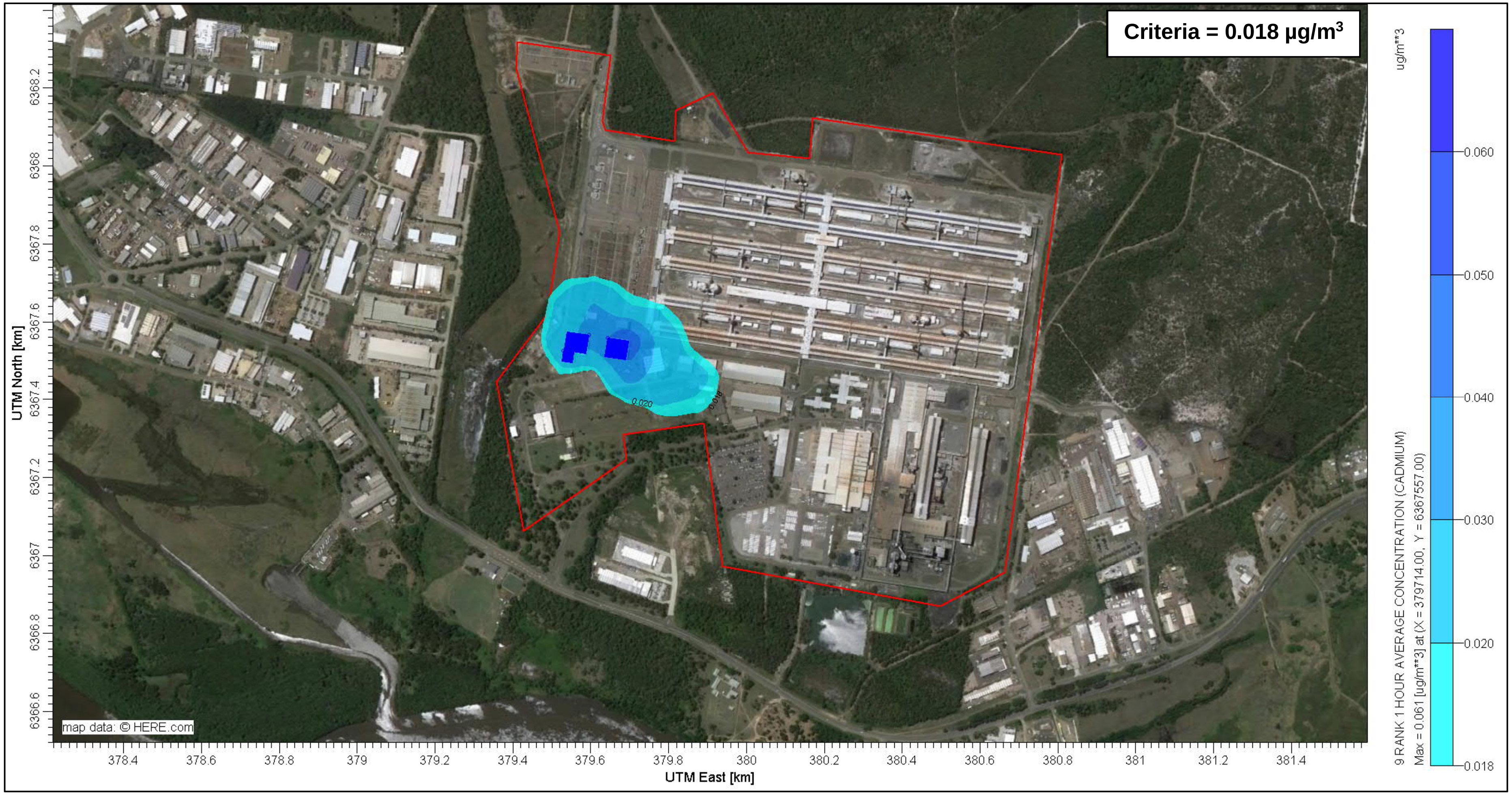

Figure 9 Maximum Incremental Cadmium Isopleth 99.9th Percentile

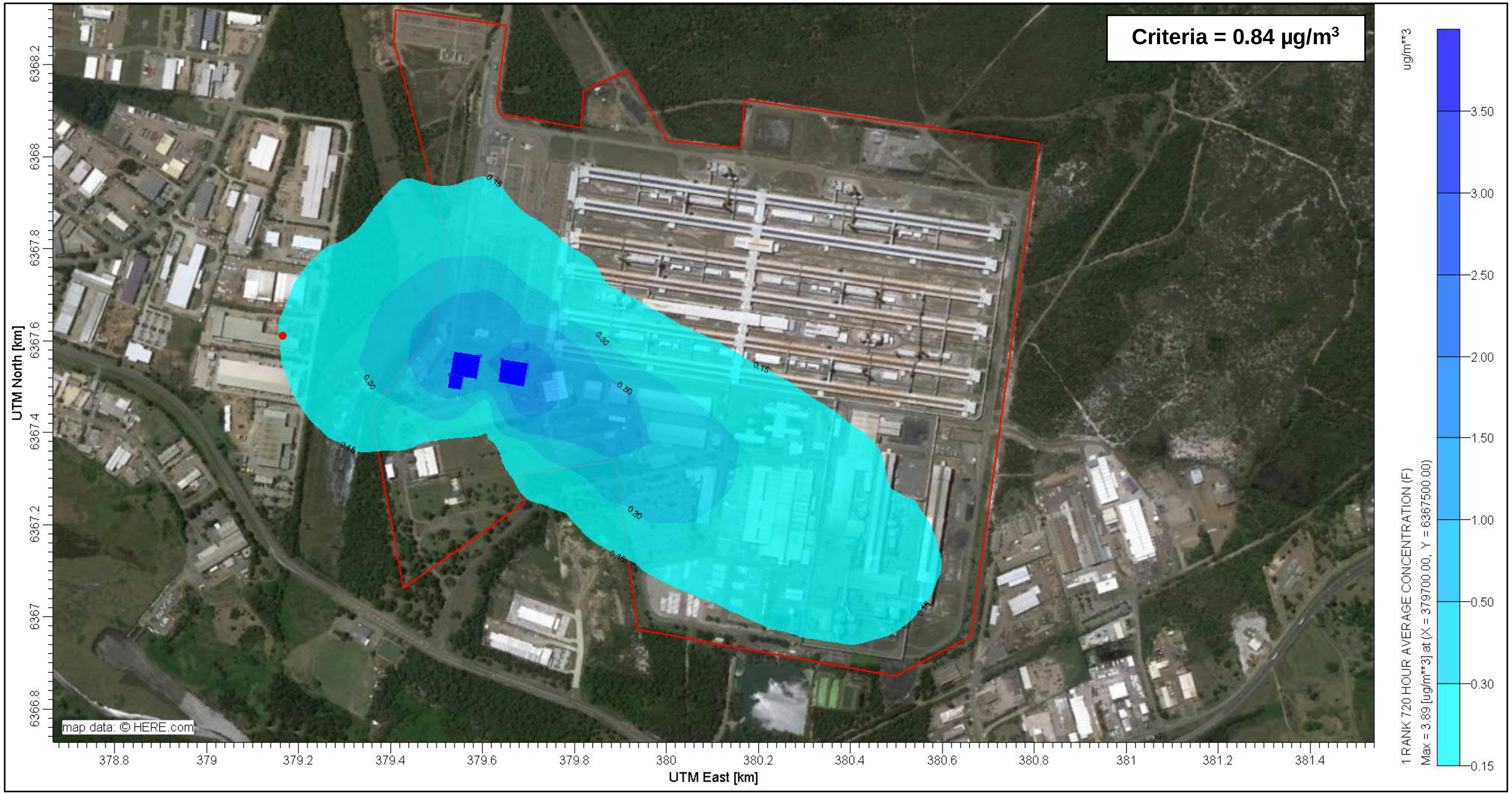

Figure 10 Maximum Incremental 30-day (720-hour) Hydrogen Fluoride Isopleth 100th Percentile

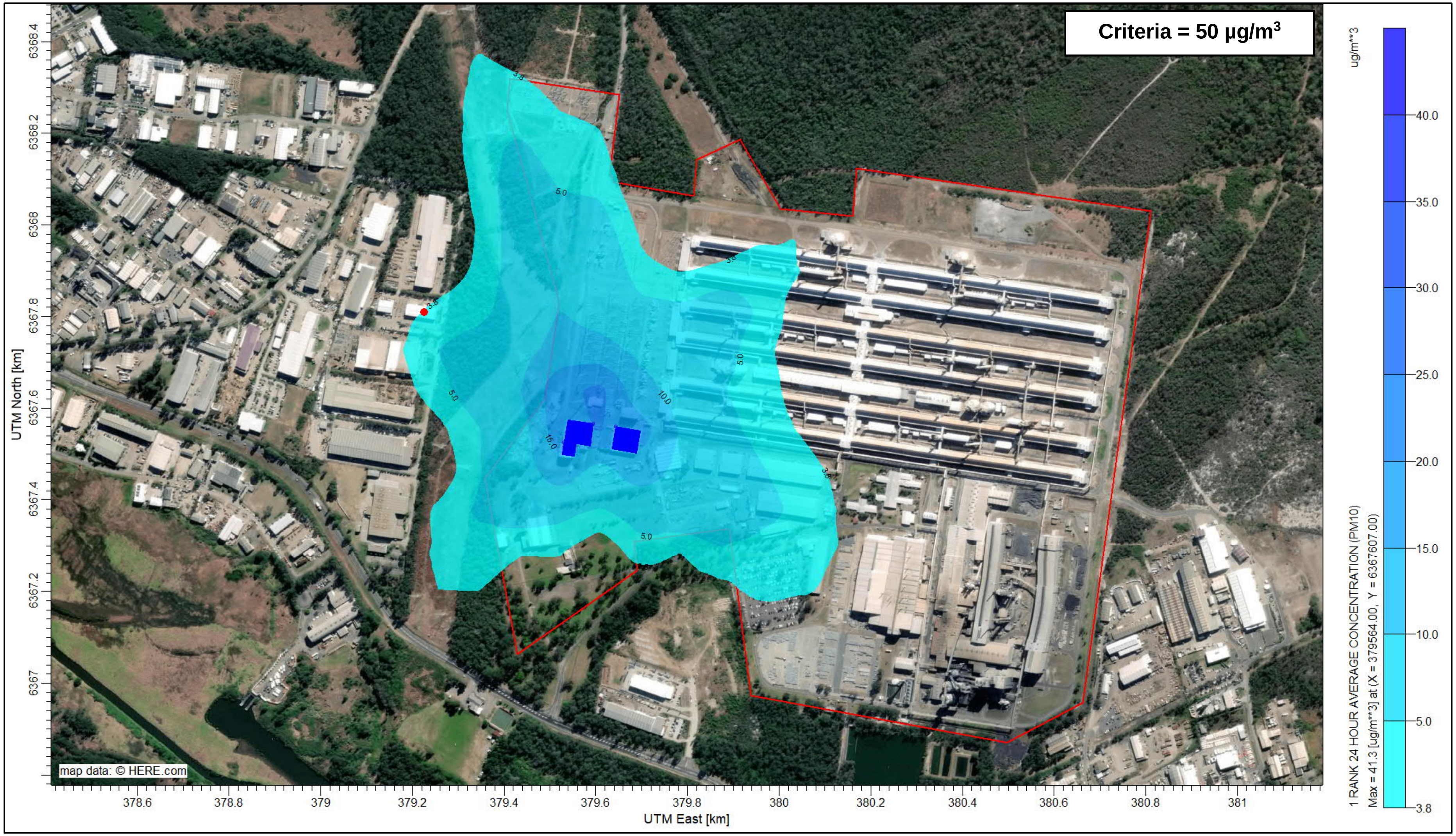

Figure 11 Maximum Incremental 24-Hour PM_{10} Isopleth 100th Percentile

As shown, the predicted maximum cumulative pollutant concentrations were all compliant with their respective GLC assessment criteria, with the exception to the 30-day Hydrogen Fluoride result. The following observations can be made:

- The incremental PAH concentration of 0.36 µg/m^3, and the Cadmium concentration of 0.0179 µg/m^3, represent the pollutants with their GLC closest to their respective EPA criterion (0.4 µg/m^3 and 0.018 µg/m^3 respectively). The predicted incremental PAH & Cadmium isopleths are provided in **Figure 8** and **Figure 9** respectively. The isopleths show that the maximum incremental GLC's are located on the western boundary approximately 200m from the Regain facility. Based on the emissions inventory, the two rotary kilns are the main source of these pollutants.
- The pollutants with the highest cumulative concentrations when compared to the NSW EPA criteria were Hydrogen Fluoride & $PM_{2.5}$/PM_{10}. Hydrogen Fluoride has the highest cumulative result for the 30-day averaging period of 0.97 µg/m^3 when compared to the criteria of 0.84 µg/m^3. The cumulative 24-hour PM_{10} result was the second highest, at 47.17 µg/m^3, when compared to the criteria of 50 µg/m^3. The predicted incremental Hydrogen Fluoride & PM_{10} isopleths are presented in **Figure 10** and **Figure 11** below. The isopleths show that the maximum cumulative GLCs are located at one of the sensitive receptors approximately 500m to the west of the Regain facility.

  Whilst the cumulative impacts for these pollutants are notable, and in the case of Hydrogen Fluoride being elevated above the GLC criteria, the incremental Hydrogen Fluoride and PM_{10} Regain contributions at the same location are small at 0.16 µg/m^3 (30-day HF) and 3.87 µg/m^3 (PM_{10}), well below their respective criteria.
- Given the location of the Regain facility and the range of sensitive receptors in the immediate vicinity being dominated by industrial/commercial premises, ground level concentrations were further examined at a range of residential sites across the modelling domain. The results indicate that at all residential receptors identified in this assessment, the ground level concentrations for the respective pollutants listed in Table 25 show significantly reduced incremental ground level concentration impacts. The reduced impacts at these residential locations are expected due to the nearest residences being located approximately 1.4km from the Regain facility. No incremental or cumulative exceedances are predicted at any residential receptor identified across the modelling domain.
- Further analysis of the modelling results in relation to cumulative Hydrogen Fluoride & Sulfur Dioxide ground level concentrations is provided in **Section 7.3**. This analysis examined the predicted Regain incremental contributions at the same location as each of the ambient monitoring sites. The analysis demonstrated that the Regain incremental impacts at the ambient monitoring sites are all at least an order of magnitude lower than the respective ground level concentration limits.

  The cumulative impacts at these locations also show that one additional exceedance is expected to occur at the Old Punt Road ambient monitoring station for the 30-day Fluoride averaging period. It should be noted that this site is situated in the industrial zone to the west of the facility, and was already impacted by a significantly high background concentration value of 0.81µg/m^3. The potential Regain incremental contribution at this location is only 0.05 µg/m^3, even when the maximum EPL concentration for fluoride was used to calculate the emission rate from the proposed Regain operations for this scenario.

7.3 Hydrogen Fluoride & Sulfur Dioxide Results Analysis at Ambient Station Locations

Given the elevated background concentrations across the modelling domain (recorded by Tomago Aluminium ambient monitoring stations), further analysis has been undertaken on the cumulative ground level concentration results for Hydrogen Fluoride and Sulfur Dioxide. This analysis was undertaken to examine the potential incremental impacts from the Project at each of the ambient monitoring locations. The results indicate that whilst the ambient background concentrations are elevated (likely as a result of operations at the Tomago Aluminium smelter) contributions from the Project are small and are unlikely to significantly impact the existing air quality environment at these locations.

The maximum background concentrations recorded by ambient air quality monitoring stations in the local area are reported in **Table 27**. The location of each ambient air quality monitoring station is shown in **Figure 4**.

Table 27 Summary of Maximum Hydrogen Fluoride & Sulfur Dioxide Ambient Station Concentrations

EPL Point	Site Name	Pollutants Monitored	Station Location		Distance From Regain Facility	Sulfur Dioxide			Hydrogen Fluoride		
						100th %	100th %	100th %	100th %	100th %	100th %
			x (m)	y (m)	km	1 hr	24 hr	Annual	7 day	30 day	90 day
18	Met Station	SO2	381194.0	6368226.0	1.7	259.4	115.3	7.6	-	-	-
20	HWC Offices	F	383297.2	6368684.6	3.9	-	-	-	0.34	0.21	0.18
21[1]	Old Punt Rd	F	378809.5	6367813.5	0.8	-	-	-	1.18	0.81	**0.60***
22	Lot D Tomago Rd	F, SO2	381815.8	6367234.6	2.2	319.6	123.1	9.4	**1.78***	**0.90***	**0.71***
23	Woodbury	F	376729.8	6371249.5	4.7	-	-	-	0.24	0.18	0.16
24	The Farm	F, SO2	381363.0	6366718.0	2.0	440.2	196.5	24.7	**5.80***	**4.31***	**3.34***
25	Botanic Gardens	F	379909.5	6370007.5	2.5	-	-	-	0.70	0.29	0.26
26	Detention Centre	F	379973.6	6366568.2	1.0	-	-	-	0.92	0.59	0.42
27	Pacific Hwy	F, SO2	379362.0	6369127.0	1.6	275.1	104.8	10.5	1.36	0.70	0.44
36[2]	Laverick Avenue	SO2	378880.0	6367293.0	0.8	212.2	73.4	9.8	-	-	-
					CRITERIA	570	228	60	1.7	0.84	0.5

[1] This station was adopted for the assessment of hydrogen fluoride as discussed in **Section 4.1**.

[2] This station was adopted for the assessment of sulfur dioxide as discussed in **Section 4.1**.

[1, 2] These stations are considered most representative of the background concentrations expected in the vicinity of peak concentrations modelled for incremental Project operations.

*These values are an exceedance of the respective ambient ground level concentration limits.

7.3.1 Scenario 1 – Ambient Station Results Analysis

The Hydrogen Fluoride and Sulfur Dioxide results summary tables for Scenario 1 (provided in **Table 28** and **Table 29** respectively) demonstrates that all of the incremental contributions from the Project at the ambient station locations are orders of magnitude less than the respective ground level concentration criteria. This would indicate that the elevated background values recorded are unlikely to be significantly influenced by the Project and may be attributed to local aluminium smelter operations. Examination of the cumulative ground level concentrations demonstrates that no further exceedances at any of the ambient monitoring locations (including The Farm which has the highest reported background concentrations) are expected due to incremental contributions from the Project.

Table 28 Regain Tomago Hydrogen Fluoride Ground Level Concentration Summary – Scenario 1 ('Average' Typical Operations)

EPL Point	Site Name	Pollutants Monitored	Incremental			Background			Cumulative		
			100th %	100th %	100th %	100th %	100th %	100th %	100th %	100th %	100th %
			7 day	30 day	90 day	7 day	30 day	90 day	7 day	30 day	90 day
20	HWC Offices	F	0.004	0.002	0.001	0.34	0.21	0.18	0.344	0.212	0.181
21	Old Punt Rd	F	0.014	0.009	0.007	1.18	0.81	**0.60***	1.194	0.819	**0.607***
22	Lot D Tomago Rd	F, SO2	0.009	0.005	0.004	**1.78***	**0.90***	**0.71***	**1.789***	**0.905***	**0.714***
23	Woodbury	F	0.002	0.001	0.001	0.24	0.18	0.16	0.242	0.181	0.161
24	The Farm	F, SO2	0.021	0.011	0.008	**5.80***	**4.31***	**3.34***	**5.821***	**4.321***	**3.348***
25	Botanic Gardens	F	0.002	0.002	0.001	0.70	0.29	0.26	0.702	0.292	0.261
26	Detention Centre	F	0.010	0.005	0.004	0.92	0.59	0.42	0.930	0.595	0.424
27	Pacific Hwy	F, SO2	0.008	0.003	0.002	1.36	0.70	0.44	1.368	0.703	0.442
CRITERIA			**1.7**	**0.84**	**0.5**	**1.7**	**0.84**	**0.5**	**1.7**	**0.84**	**0.5**

*These values are an exceedance of the respective ambient ground level concentration limits.

Table 29 Regain Tomago Sulfur Dioxide Ground Level Concentration Summary – Scenario 1 ('Average' Typical Operations)

EPL Point	Site Name	Pollutants Monitored	Incremental			Background			Cumulative		
			100th %	100th %	100th %	100th %	100th %	100th %	100th %	100th %	100th %
			1 hr	24 hr	Annual	1 hr	24 hr	Annual	1 hr	24 hr	Annual
18	Met Station	SO2	0.400	0.103	0.005	259.4	115.3	7.6	259.800	115.403	7.605
22	Lot D Tomago Rd	F, SO2	0.287	0.063	0.007	319.6	123.1	9.4	319.887	123.163	9.407
24	The Farm	F, SO2	0.494	0.143	0.014	440.2	196.5	24.7	440.694	196.643	24.714
27	Pacific Hwy	F, SO2	0.478	0.105	0.006	275.1	104.8	10.5	275.578	104.905	10.506
36	Laverick Avenue	SO2	0.616	0.092	0.013	212.2	73.4	9.8	212.816	73.492	9.813
CRITERIA			**570**	**228**	**60**	**570**	**228**	**60**	**570**	**228**	**60**

7.3.2 Scenario 2 – Ambient Station Results Analysis

The Hydrogen Fluoride and Sulfur Dioxide results summary tables for Scenario 2 (provided in **Table 30** and **Table 31** respectively), at the more conservative 'Max EPL Concentrations' adopted for this scenario demonstrates that all of the incremental contributions from the Project at the ambient station locations are orders of magnitude less than the respective ground level concentration criteria. The Regain incremental impact at The Farm monitoring station location is only 2% or less of the maximum background concentration measured at that location. This would indicate that the elevated background values recorded are unlikely to be significantly influenced by the Project and may be attributed to local aluminium smelter operations.

The cumulative results show that an additional exceedance is predicted to occur at the Old Punt Rd site for the 30-day Fluoride averaging period, previously presented in **Section 7.2**. It should be noted that this site is situated in the industrial zone to the west of the facility, and recorded an existing elevated background concentration value of 0.81µg/m^3. The potential Project incremental contribution at this location is only 0.05 µg/m^3 and is based on a conservative scenario using the maximum EPL concentration for fluoride to calculate the emission rate from the proposed Project.

Table 30 Regain Tomago Hydrogen Fluoride Ground Level Concentration Summary – Scenario 2 (Max EPL Operations)

EPL Point	Site Name	Pollutants Monitored	Incremental			Background			Cumulative		
			100th %	100th %	100th %	100th %	100th %	100th %	100th %	100th %	100th %
			1 hr	24 hr	Annual	7 day	30 day	90 day	7 day	30 day	90 day
20	HWC Offices	F	0.023	0.011	0.009	0.34	0.21	0.18	0.363	0.221	0.189
21	Old Punt Rd	F	0.085	0.054	0.041	1.18	0.81	**0.60***	1.265	**0.864***	**0.641***
22	Lot D Tomago Rd	F, SO2	0.054	0.029	0.023	**1.78***	**0.90***	**0.71***	**1.834***	**0.929***	**0.733***
23	Woodbury	F	0.014	0.005	0.005	0.24	0.18	0.16	0.254	0.185	0.165
24	The Farm	F, SO2	0.122	0.067	0.050	**5.80***	**4.31***	**3.34***	**5.922***	**4.377***	**3.390***
25	Botanic Gardens	F	0.014	0.010	0.006	0.70	0.29	0.26	0.714	0.300	0.266
26	Detention Centre	F	0.058	0.032	0.022	0.92	0.59	0.42	0.978	0.622	0.442
27	Pacific Hwy	F, SO2	0.046	0.017	0.014	1.36	0.70	0.44	1.406	0.717	0.454
CRITERIA			1.7	0.84	0.5	1.7	0.84	0.5	1.7	0.84	0.5

*These values are an exceedance of the respective ambient ground level concentration limits.

Table 31 Regain Tomago Sulfur Dioxide Ground Level Concentration Summary – Scenario 2 (Max EPL Operations)

EPL Point	Site Name	Pollutants Monitored	Incremental			Background			Cumulative		
			100th %	100th %	100th %	100th %	100th %	100th %	100th %	100th %	100th %
			1 hr	24 hr	Annual	1 hr	24 hr	Annual	1 hr	24 hr	Annual
18	Met Station	SO2	7.630	1.960	0.089	259.4	115.3	7.6	267.030	117.260	7.689
22	Lot D Tomago Rd	F, SO2	5.480	1.200	0.128	319.6	123.1	9.4	325.080	124.300	9.528
24	The Farm	F, SO2	9.430	2.740	0.269	440.2	196.5	24.7	449.630	199.240	24.969
27	Pacific Hwy	F, SO2	9.130	2.000	0.109	275.1	104.8	10.5	284.230	106.800	10.609
36	Laverick Avenue	SO2	11.800	1.760	0.251	212.2	73.4	9.8	224.000	75.160	10.051
CRITERIA			570	228	60	570	228	60	570	228	60

7.4 Results Comparison with 2009 Environmental Assessment

A summary of the predicted incremental and cumulative ground level concentrations for the Project are provided in **Table 32**, with the results from the previous ENSR (2009) EA included for comparison. It must be recognised that the 2009 EA used actual expected pollutant concentrations as opposed to the maximum current or proposed emission concentration limits adopted for this assessment to demonstrate a 'worse-case' scenario.

Table 32 Incremental Results Comparison - 2009 Environmental Assessment

Pollutant	Averaging Period	2009 EA (20,000 tpa)[1]		2018 DA Modification (60,000 tpa EPL Limits)[2]		Criteria (µg/m^3)
		Incremental Results	Cumulative Results	Incremental Results	Cumulative Results	
Sulfur Dioxide (SO_2)	1 hour	0.09	**572.1**	27.30	242.10	570
	24 hours	0.02	217.4	5.28	78.68	228
Nitrogen Dioxide (NO_2)	1 hour	0.92	126.9	54.60	146.70	246
	Annual	0.03	28	1.22	18.12	62
PM_{10}	24 hour	3.2	**91.2**	3.87	47.17	50
	Annual	0.33	21.3	0.41	19.11	25
Total Suspended Particulates	Annual	0.77	53.2	0.70	N/A	90
Hydrogen Fluoride	90 days	0.009	**2.91**	0.12	0.32	0.5
	7 days	0.016	**5.5**	0.22	**1.4**	1.7
	24 hours	0.04	N/A	0.53	N/A	2.9
Cyanide	1 hour	0.27	N/A	0.73	N/A	200
PAH's	1 hour	0.0094	N/A	0.36	N/A	0.4
Dioxins & Furans	1 hour	8.8×10^{-10}	N/A	7.28×10^{-8}	N/A	1.0×10^{-6}

[1] Results reported were the respective maximums across the whole modelling domain
[2] Results reported are either at a sensitive receptor location offsite, or at or beyond the site boundary in accordance with the *Approved Methods*.
N/A = Background data not available

When comparing the incremental results from this assessment, with those reported in the ENSR (2009) EA it can be seen that increasing the production rate from 20,000 tpa to 60,000 tpa, corresponds to an increase in the predicted ground level concentrations for most of the assessed pollutants. The incremental ground level concentrations resulting from Regain operations are all well below the relevant ground level concentration criteria, with the cumulative results also demonstrating compliance.

When comparing the results from this AQIA with the previous ENSR (2009) EA, the following should be noted:

- The model used in this assessment was the CALPUFF model (in accordance with the *Approved* Methods) compared to AUSPLUME used in 2009, which calculates the dispersion of pollutants differently, and can result in varying results between the two models. CALPUFF is the currently recognised model for use by the NSW EPA for this Project.

- A more recent and representative meteorological year (2015) and ambient pollutant background data set was used for this assessment in comparison to the 2008 data used in the ENSR (2009) EA. Ambient background pollutant concentrations can vary significantly year to year depending on a number of factors in the local area, which may include (but not limited to) the following:
    - The location of the ambient monitoring stations and the sampling equipment used;
    - Natural events, such as bushfires and dust storms;
    - Industries improving their environmental emissions controls;
    - New industries operating in the area, or sites ceasing operations; and
    - Increase or decrease in traffic volume through the area.

  The ambient pollutant background year selected for this assessment was done to be consistent with the updated meteorological dataset used in the modelling, which is more consistent with current expected background concentrations than a dataset for 10 years prior.
- The input data used in this assessment is based on the maximum currently approved and proposed EPL concentration limits, as opposed to a single data set at average operational conditions used in the ENSR (2009) AQIA. Based on years of historical stack emissions testing data from the Regain facility, it is considered that adopting the maximum EPL concentration limits to determine the mass emission rates for the Project is a very conservative approach. Typical operations of the Regain facility have demonstrated that all stack pollutant concentrations levels are well below the listed EPL Limits.
- In this assessment, in accordance with the current *Approved Methods*, the ground level impact has been assessed at offsite sensitive receptors, or at/beyond the Tomago Aluminium site boundary which the Regain facility operates within. The ENSR (2009) assessment reported the maximum ground level concentrations across the whole modelling domain, which fell within the Tomago Aluminium site boundary.

Whilst the incremental ground level concentration results for the increase in production capacity of the Project show an increase in the potential ground level concentrations of the assessed pollutants, when examining the cumulative impacts, there is no predicted cumulative increase compared to the original EA (2009). Therefore potential air quality impacts associated with the current proposed modification are likely to remain substantially the same as the original approved development.

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8.0 Modelling Results Summary

This assessment predicts that when considered in isolation (incremental concentration only), no adverse impacts are likely to occur as a result of the facility operating under both typical ‘average’ and proposed maximum operational conditions at or beyond the site boundary or at any sensitive receptor location. When considered cumulatively with background concentrations, there is a potential exceedance of the GLC criteria for the 100th percentile 30-day Hydrogen Fluoride concentration in Scenario 2.

The potential for cumulative fluoride exceedances exist due to elevated background concentrations of fluoride, likely related to the operation of the Aluminium smelter. The location of sensitive receptors recording modelled elevated cumulative ground level concentrations for Hydrogen Fluoride are located approximately 200m to the west of the Regain facility, beyond the Tomago Aluminium boundary. These receptors are located within the nearby industrial estate, which fall within the Tomago Aluminium buffer zone. Guidance from the ANZECC (1990) document from which the NSW EPA limits are derived, indicates that the intent of the ambient fluoride criteria was for application at receptors where sensitive vegetation or grazing animals are located. Neither of these sensitive receptor types are present at the industrial receptors identified as having cumulative concentrations above the criteria in this assessment.

The increase in incremental Fluoride concentrations associated with the Regain operations as described in Scenario 2 are predicted to be only 0.16 µg/m^3 for 30-day Fluoride at these industrial receptor locations and as such are unlikely to cause any significant additional environmental impact beyond the elevated background concentrations already present in the environment. As such, the assessment indicates that the proposed modification to the Regain facility is not predicted to cause any potential increase in environmental harm associated with any of the pollutants examined in this AQIA when operating at concentrations for both the typical ‘average’ and the maximum permitted stack limits.

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9.0 Operational Mitigation Measures

The following section provides a discussion of operational mitigation measures related to air quality, currently adopted at the Regain facility. The same measures are proposed to be implemented for the additional 40kT per annum Rotary Kiln/Dryer. These mitigation measures were implemented by Regain to minimise air pollutant emissions from their facility.

9.1 SPL Handling and Preparation

Preparation of SPL for thermal treatment including handling, sorting, crushing, sizing and stockpiling would be conducted in a building with roller shutter doors that could be opened and closed, as required, along with dust extraction to manage potential dust escape from the preparation and storage area. This approach would contain any generated dust within the confines of the building. Process equipment such as conveyors, crushers and grinding mills would be enclosed to prevent dust release from the process plant.

9.2 Enclosed External Plant

External plant elements are not in a covered building, however would be enclosed such, that there would be no open material transfer points. External plant would be connected to dust extraction, filtration and control equipment such that air pressure with the process plant would be lower than atmospheric pressure thus preventing fugitive dust escape from the process plant.

9.3 Dust Extraction

The operation of loading SPL to the process circuit has the potential to liberate dust into the atmosphere within the building. This dust has the potential to escape from vents and doors that may be open from time to time. Dust control from the facility would occur via the following five independent dust extraction and collection points:

1. 20kT thermal treatment plant dust collector;
2. 40kT thermal treatment plant dust collector;
3. Drying plant dust collector;
4. SPL Shed 5 and Deline facility air filter (SPL preparation facilities); and
5. Proposed fine grinding mill dust collector.

Ductwork would be installed throughout the process plant system and connected to dust generating areas such as mills, crushers, conveyors, storage bins and the kiln/dryer. The dust extraction system would maintain a slightly negative pressure within the building, ensuring air is always drawn into the building through any openings (e.g. ventilation louvers, roller doors, etc.), preventing the escape of fugitive dust.

Each dust extractor would be fitted with a filter bag unit to remove the dust from the extracted air streams. Particulate concentrations within exhausted air from the dust extractors would be below permissible licence levels. Collected particulate matter would be returned to the production cycle.

Dust collectors would be sized to effectively capture fugitive emissions. Indicative specifications for the pollution control equipment proposed is provided in **Table 33**.

Table 33 Dust Collectors – Indicative Capacity and Technical Information

Description	Process Rate m^3 per hour	Temperature Sensor	Particulate Sensor	Polyester Filter Bags
Shed 5 Dust Collector	47,000	NA	Standard particulate sensor is Goyen EMP7 – 3200 Particulate Emission Monitor or equivalent.	Oleophobic Treated
20ktpa Thermal Treatment Plant Dust Collector	35,850	Temperature Controls Pty Ltd Type K Thermocouple		Standard
40ktpa Thermal Treatment Plant Dust Collector	50,000	Manufacturer to be determined.		Standard
Drying Plant Dust Collector	50,000			Standard
Fine Grinding Plant Dust Collector	15,000	NA		Oleophobic Treated

9.4 Alarms & Shut Down

The building dust extraction system, including filter bags, would be fitted with a visual and audible alarm system that would sound within the plant buildings to immediately shut down plant operations in the event that the dust extraction failed.

9.5 Baghouse Temperature Monitoring

The alarm system would be triggered by temperature probes installed in the baghouses that would alarm and shut down the plant if the inlet gas temperature to the baghouses exceeded 130^{o}C.

9.6 Rotary Kiln Temperature Control and Safety Design

The key process control for the rotary kilns would be temperature control via the burner management system. The product temperature in the kiln would be measured using thermo-couples connected to a digital control system. The burner management controls would maintain the required temperature. Independent High/Low temperature monitoring and alarms would be installed on the system. The rotary kilns would also be fitted with blast panels to ensure that, in the unlikely event of explosion, damage to the kiln shell would be minimised.

9.7 Burner Management

The plant would be fitted with a burner management system that would be designed in accordance with AS1853 (“Automatic Oil and Gas Burners: Mechanical Draught”, Standards Association of Australia, Sydney, 1983). This standard requires burners to be fitted with isolation valves and flame detectors. In the event of a “flame-out”, the flame detector would activate and the gas isolation valve would close.

9.8 Treated Product (HiCAl) Handling

Once treated in the kiln, the product is transferred via an enclosed conveyer system to the Shed 6 storage building. The material is wetted inside the storage building to achieve a moisture content of approximately 5-7%, to minimise the potential for the generation of dust, particularly during bulk truck loading operations.

Truck loading operations take place within the bunded courtyard area between the two large sheds at the Regain facility, whereby the front end loader collects product from Shed 6, and loads the truck outside. Loading activities only taking place during dry weather, with any spillages cleaned up and the loading area swept regularly to maintain good housekeeping practices. Trucks are covered upon completion of the loading activities before the leave the Regain facility.

The bunded courtyard area drains directly to the Regain facility stormwater recycling system, which prevents the potential for material to enter any stormwater drains.

9.9 Emissions Testing

The Regain Tomago Environment Protection License (EPL) No. 13269 currently requires stack emissions testing of EPL Point 1 (20,000 tpa Rotary Kiln stack) to be undertaken on a biannual basis whilst processing both 1st Cut and 2nd Cut SPL.

With the installation of the new plant, and operation of five point sources onsite, Regain propose to conduct licensed testing as outlined in **Table 34**, with operational EPL Concentration Limits as outlined in **Table 19**. The EPL Concentration Limits proposed are believed to be representative of the ongoing achievable maximum concentrations that Regain are capable of operating under given the variable nature of the Spent Pot Lining feed material originating from the aluminium smelting process.

Table 34 Proposed EPL No. 13269 Emissions Testing

EPL Point	Stack Name	Feed Material	Frequency	Pollutants
1	20,000 tpa Rotary Kiln Discharge Stack	1st Cut & 2nd Cut	Biannual	Nitrogen Oxides Type 1 & 2 Substances Fine Particulates (PM_{10}) Polycyclic Aromatic Hydrocarbons (PAH) Sulfur Dioxide Dioxins & Furans Total Solid Particulates (TSP) Cyanide Total Fluoride Cadmium Volatile Organic Compounds
2	Drying Plant Discharge Stack	Any	Biannual	Total Solid Particulates (TSP) Fine Particulates (PM_{10})
3	Shed 5 Discharge Stack	Any	Biannual	Total Solid Particulates (TSP) Fine Particulates (PM_{10})
4 (Proposed)	40,000 tpa Rotary Kiln Discharge Stack	1st Cut & 2nd Cut	Biannual	Nitrogen Oxides Type 1 & 2 Substances Fine Particulates (PM_{10}) Polycyclic Aromatic Hydrocarbons (PAH) Sulfur Dioxide Dioxins & Furans Total Solid Particulates (TSP) Cyanide Total Fluoride Cadmium Volatile Organic Compounds
5 (Proposed)	Fine Grinding Plant Discharge Stack	Any	Biannual	Total Solid Particulates (TSP) Fine Particulates (PM_{10})

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10.0 Greenhouse Gas Assessment

10.1 Methodology

A greenhouse gas assessment was undertaken in accordance with the requirements outlined in the SEAR's and the *Australian National Greenhouse Accounts; National Greenhouse Accounts Factors, July 2017*. The assessment provides a qualitative assessment of GHG emissions during operation of the Regain facility and a qualitative analysis of the facilities relative contribution to national greenhouse emissions.

10.2 Key Definitions and Terms

10.2.1 Greenhouse Gases Global Warming Potentials

The Global Warming Potential (GWP) is an index used to convert relevant non-carbon dioxide gases to a carbon dioxide equivalent (CO_2^{-e}) by multiplying the quantity of the gas by its GWP. GWPs for common greenhouse gases are presented in **Table 35**.

Table 35 Global Warming Potentials (Australian Government 2014)

GHG Gas	Global Warming Potential
Carbon Dioxide (CO2)	1
Methane (CH4)	21
Nitrous Oxide (N2O)	310
Hydrofluorocarbons (HFCs)	140-11,700
Perfluorocarbons (PFCs)	6,500-9,200
Sulphur hexafluoride (SF_6)	23,900

10.2.2 Direct and Indirect Emissions

Direct emissions are produced from sources within the boundary of an organisation and as a result of the organisations activities. These include generation of energy or electricity, manufacturing processes that produce emissions, transportation of materials, fugitive emissions and onsite waste management (Australian Government 2017).

Indirect emissions are emissions generated in the wider economy as a consequence of organisations activities that are physically produced by the activities of another organisation. This includes consumption of electricity, upstream emissions generated in the extraction and production of fossil fuels, downstream emissions from transport of an organisations product to customers and emissions from contracted and outsourced activities (Australian Government 2017).

10.2.3 Types of Emission Factors

Emission factors are activity specific and the activity being undertaken defines the emission factor used. The scope that emission factors are reported under is determined by whether the activity is within the organisations boundary or outside it and is defined as follows:

- **Scope 1:** All direct GHG emissions; and
- **Scope 2:** Indirect GHG emissions from the consumption of purchased electricity.

10.3 GHG Impact Assessment

The following section provides a summary of the greenhouse gas emissions related to the project.

10.3.1 Emissions Estimation

Table 36 provides a breakdown of the Scope 1 and Scope 2 emissions during operation of the existing and proposed augmentation of the facility. Due to both the wide distribution of upstream and downstream users and cyclic nature of the pot production for the aluminium smelting process which produces the SPL that Regain use as a feed material Scope 2 has been limited to electricity consumption only, and Scope 3 items have been excluded entirely.

It can be seen from **Table 36** there would be an increase in the GHG emissions from the existing to the proposed operations with estimated total GHG emissions changing from 1,611 CO_2^{-e}t/y to4,834 CO_2^{-e} t/y. This is largely attributed to the operation of the additional rotary kiln, increasing production from 20 kT/y to 60 kT/y.

When predicted GHG emissions from the proposal are compared to state and national GHG emissions for 2016, the facilities contribution is relatively small, contributing 0.0044% of NSW, GHG emissions and 0.0011% of national emissions[5] accounting for Scope 1 and Scope 2 emissions.

Table 36 Existing and Proposed GHG Emissions (CO_2^{-e}t/y)

Source	Type	Current Production (20 kT/y)		Proposed Production (60 kT/y)	
		Qi Value	Emissions (CO_2-e t)	Qi Value	Emissions (CO_2-e t)
Natural gas consumption	Scope 1	24000	1237	72000	3710
Diesel (Vehicles)	Scope 1	40	109	120	327
Electricity consumption	Scope 2	320000	266	960000	797
	Total		**1611**		**4834**

10.3.2 GHG Emission Intensity

The intensity of greenhouse emissions from the project (per unit of production) has been estimated from the total GHG emissions under existing and proposed operations. These results are shown in **Table 37**. It can be seen from **Table 37** that the under the proposal the GHG emission intensity is predicted to be maintained, as the production process has not been altered, only increased in capacity from 20kT to 60kT per annum.

Table 37 Emission Intensity per Unit of Production

Operation	Production Rate (kT/y)	GHG Emissions (CO2e- t/y)	CO2e- t/t
Existing (20 kT/y)	20	1,611	0.081
Proposed (60 kT/y)	60	4,834	0.081

10.4 Proposed Safeguards

During operations of the Regain facility safeguard measures would include ensuring all mobile and plant equipment is well maintained, limiting haul routes, and light oil usage and undertaking an energy audit for the site to identify potential energy efficiency opportunities.

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[5] National Greenhouse & Energy Reporting (http://www.cleanenergyregulator.gov.au/NGER/National%20greenhouse%20and%20energy%20reporting%20data/Data-highlights/2016-17-published-data-highlights), Accessed 7 August 2018

11.0 Conclusion

This air quality impact assessment was undertaken for the proposed capacity increase modification to the Regain facility located within the Tomago Aluminium site at Tomago, NSW. The proposed modification includes increasing the processing capacity of the site from 20,000 tpa to 60,000 tpa , by the addition of a 40,000 tpa Rotary Kiln, as well as construction of a Fine Grinding Plant. The main emissions of concern for this assessment associated with the proposed Regain operations include a range of primary air pollutants and principal air toxic substances, released during the thermal treatment of SPL.

The air quality assessment examined the existing air quality and local meteorology, outlined the relevant air quality standards and guidelines, detailed the assessment methodology through the use of the air dispersion model CALPUFF and considered the effects on air quality from the potential operational emissions.

The assessment indicates that the proposed modification to the Regain facility in isolation from background pollutant sources is not likely to result in any exceedances of the ground level concentration criteria for any pollutants assessed in this AQIA. The assessment demonstrates that when Regain are operating at their typical average operational conditions, that no cumulative exceedances of the criteria are predicted.

Although there was a cumulative exceedance of the short term 30-day Hydrogen Fluoride criteria predicted by the modelling during operations at the maximum EPL concentration limits, it is principally the result of the high background levels of ambient fluoride associated with the operation of the aluminium smelter within which the Regain facility is located. Additionally, the industrial location of the receptors which may potentially exceed the criteria are unlikely to be impacted by the marginally increased levels of ambient fluoride associated with the Regain contribution as there are no sensitive flora or grazing animals present.

A GHG inventory was also prepared as part of this assessment, which predicts an increase in GHG emission intensity associated with the increased production capacity, however the facilities overall contribution is very small to the state and national GHG emissions, and not expected to be of concern.

It is recommended that Regain apply the same operational mitigation measures currently in place at the facility for the 20,000 tpa rotary kiln to the additional 40,000 tpa rotary kiln to ensure the facility is able to minimise any potential for environmental harm. The current/proposed EPL Concentrations adopted for Scenario 2 is believed to be representative of the ongoing achievable maximum concentrations that Regain are capable of operating under, considering the variable nature of the Spent Pot Lining feed material originating from the aluminium smelting process.

Additionally, after commissioning of the proposed site modifications, it is recommended that Regain undertake a validation assessment, which includes emissions monitoring of all sources and a validation model to address any variations between this assessment and the operational plant. Biannual emissions monitoring should be undertaken for all point source locations once they are all installed and operational to continually demonstrate compliance with currently licensed (and proposed) EPL concentration limits.

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12.0 References

AECOM 2009 *Air Quality Impact Assessment, Spent Potliner Processing Facility, Tomago Aluminium*, ENSR | AECOM, 7 December 2007

AECOM 2014a *Regain Hydro Emissions Testing Report – 1st Quarter 2014*, 23 January 2014

AECOM 2014b *Regain Hydro Emissions Testing Report – 2nd Quarter 2014*, 11 April 2014

AECOM 2014c *Regain Hydro Emissions Testing Report – 3rd Quarter 2014*, 6 June 2014

AECOM 2014d *Regain Hydro Emissions Testing Report – 4th Quarter 2014*, 15 September 2014

AECOM 2014e *Regain Hydro Emissions Testing Report – 1st Quarter 2015*, 9 December 2014

AECOM 2015a *Regain Hydro Emissions Testing Report – 2nd Quarter 2015*, 12 February 2015

AECOM 2015b *Regain Hydro Emissions Testing Report – 3rd Quarter 2015*, 23 April 2015

AECOM 2015c *Regain Hydro Emissions Testing Report – 4th Quarter 2015*, 10 August 2015

AECOM 2014 *Regain Tomago Air Emissions Testing Report - Biannual Round 1*, 28 March 2014

AECOM 2014 *Regain Tomago Air Emissions Testing Report - Biannual Round 2*, 5 November 2014

AECOM 2015 *Regain Tomago Air Emissions Testing Report - Biannual Round 1*, 16 June 2015

AECOM 2015 *Regain Tomago Air Emissions Testing Report - Biannual Round 2*, 4 December 2015

AECOM 2016 *Regain Tomago Air Emissions Testing Report - Biannual Round 1*, 30 June 2016

AECOM 2014 *Tomago Aluminium Deline Shed D Duct Emissions Testing Report* , 14 April 2014

AECOM 2015 *Tomago Aluminium Deline Shed D Duct Emissions Testing Report* , 18 February 2015

AECOM 2016 *Tomago Aluminium Deline Shed D Duct Emissions Testing Report* , 23 February 2016

AECOM 2017 *Regain Point Henry Air Emissions Testing Report – Annual Round 2017*, 6 July 2017

OEH (2017) *NSW Annual Compliance Report – NEPM Ambient Air Quality,* Office of Environment & Heritage, Sydney, NSW, Australia

DEC (2004) *Ambient Air Quality Research Project (1996-2001): Internal working paper no.2, Ambient concentrations of toxic organic compounds in NSW*, Department of Environment and Conservation, Sydney, NSW, Australia

EPA (2017) *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales.* Department of Environment and Conservation: Sydney, Australia

EPA (2002) *Ambient Air Quality Research Project (1996-2001); Dioxins, Organics, Polycyclic Aromatic Hydrocarbons and Heavy Metals*, Atmospheric Science and Air Policy Sections, Operations Division New South Wales Environment Protection Authority, Sydney, NSW, Australia.

TRC (2011) Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales. Office of Environment and Heritage NSW, Sydney

ANZECC (1990) *National Goals For Fluoride In Ambient Air And Forage*, Australian and New Zealand Environment Council

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Appendix A

Regional Climate Data - Williamtown RAAF BoM

Appendix A Regional Climate Data - Williamtown RAAF BoM

Regional Climate Data - Williamtown BoM

The long-term climate averages recorded at the BOM Williamtown station between 1968 and 2016 are shown in **Table 38**. The 9am and 3pm windroses for 1968 to 2010 are presented in **Table 39**.

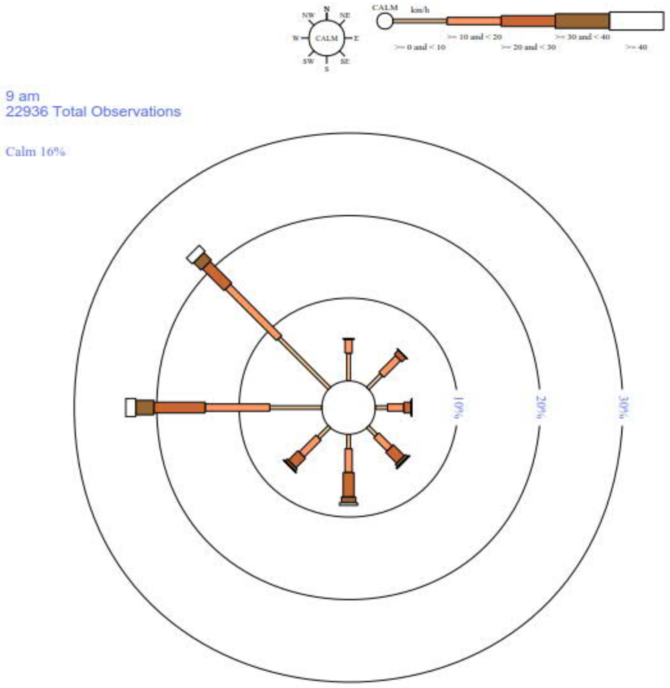
Table 38 Long Term Climate Averages, BOM Cessnock (1968-2016)

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Temperature													
Mean maximum temperature (°C)	28.1	27.6	26.3	23.7	20.3	17.7	17.1	18.7	21.4	23.7	25.5	27.3	23.1
Mean minimum temperature (°C)	18	18.1	16.3	13.2	10.1	7.9	6.4	6.9	9.1	11.9	14.4	16.5	12.4
Rainfall													
Mean rainfall (mm)	101.7	119.2	118.2	111.8	112.2	121.3	72.5	74.2	60.5	72.7	83.4	79.8	1126.7
Mean number of days of rain ≥ 1 mm	7.2	7.3	8	7.4	7.8	8.2	6.4	6.1	5.6	7.2	7.3	7.1	85.6
9 am Conditions													
Mean 9am temperature (°C)	23	22.5	21.2	18.2	14.3	11.6	10.5	12.2	15.7	18.8	20.5	22.2	17.6
Mean 9am relative humidity (%)	72	76	77	76	79	80	77	71	66	64	66	68	73
Mean 9am wind speed (km/h)	11.9	10.6	10.2	11.4	13.7	15.9	16.4	16.8	15.3	14.4	14.4	12.9	13.7
3 pm Conditions													
Mean 3pm temperature (°C)	26.5	26.1	24.9	22.5	19.3	16.8	16.2	17.6	20	21.9	23.8	25.6	21.8
Mean 3pm relative humidity (%)	59	62	61	59	60	60	55	50	50	54	55	56	57
Mean 3pm wind speed (km/h)	21.9	20.6	18.9	17.2	15.8	17.5	18.7	20.9	22	22.5	23.5	23.5	20.2

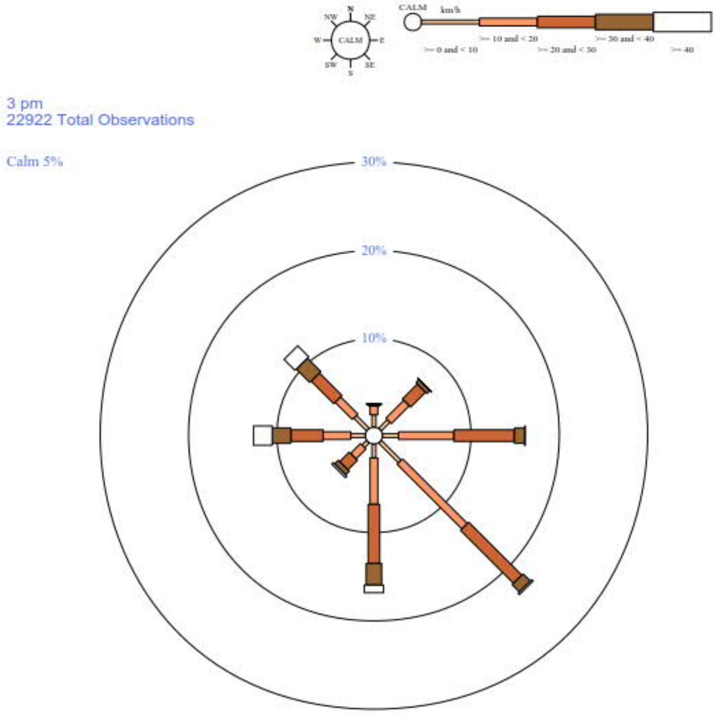
Red = Highest Value
Blue = Lowest Value

Table 39 9am and 3pm Long-Term Wind Roses - BOM Williamtown

BoM Williamtown



9am Wind Rose



3pm Wind Rose

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Appendix B

CALMET Meteorological Data Review

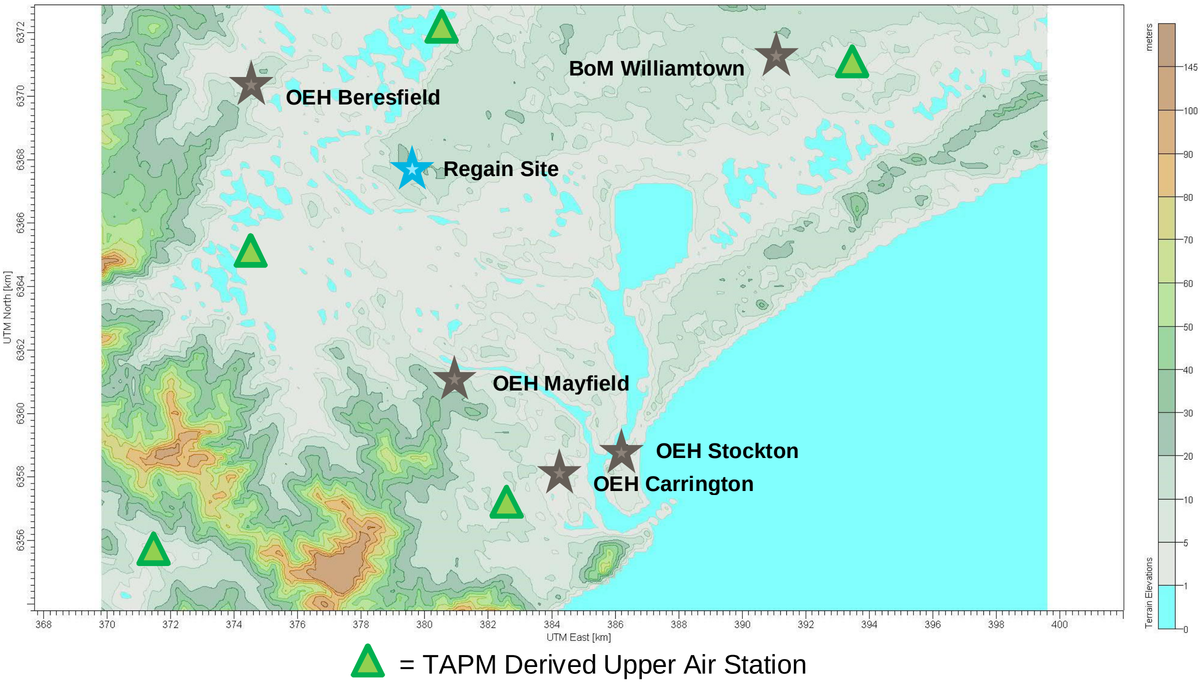
Appendix B CALMET Meteorological Data Review

Overview

This section presents a summary of CALMET model predictions at the Site, with reference against observations recorded at the Office of Environment & Heritage (OEH) Beresfield Automatic weather station. This AWS constitutes the closest observations station within the modelling domain, which has all required data for verification, along with a similar location close to the Hunter River, being located approximately 5.8 km northwest from the Site. Given the similarities in topography between the observation site and the Regain site (refer to **Table 40**), minimal differences are expected between the examined locations, and general meteorological trends should be comparable. Accordingly, this section includes a review of the meteorological data in the contexts of expected meteorological behaviours.

Table 40 Terrain Elevations of Meteorological Grid showing Surface & Upper Air Stations

Terrain and Surface Stations



Winds

Wind predictions have been extracted from CALMET at the Regain Tomago Site (hereafter referred to as CALMET Regain) for reference against regional observations. **Table 41** presents a summary of wind speed statistics. **Table 43** to **Table 45** present wind roses at the OEH Beresfield and CALMET Regain, with wind frequency data shown in **Table 46**.

The wind speed statistics in **Table 41** suggest that the CALMET Regain data show considerable similarities with the BOM data.

Table 41 Regional Wind Statistics Comparison 2015

Wind Parameters	OEH Beresfield	CALMET Regain
Minimum (m/s)	0.0	0.0
Average (m/s)	2.5	2.81
Maximum (m/s)	14.1	14.5
Calms (%) (<0.5m/s)	4.1	4.0

The annual wind roses in **Table 42** show similar general wind directions for both data sets, with winds blowing predominantly from the northwest, attributed to winds blowing down to the coast from the Hunter Valley region. Both meteorological data sets show similar overall wind speeds, and distribution. Both wind pattern data are common for the Hunter Valley region.

Table 42 Annual Wind Rose Comparison 2015

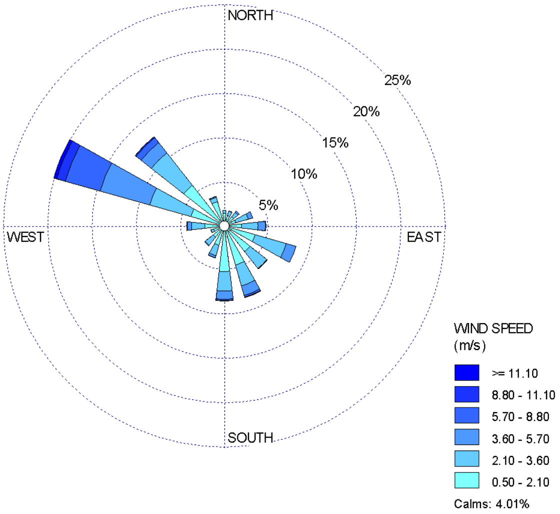
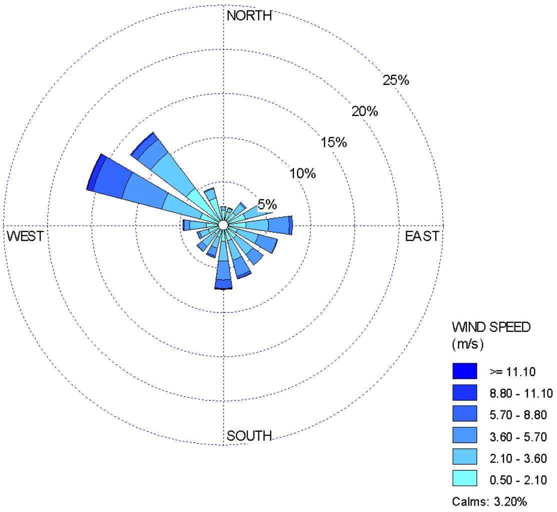
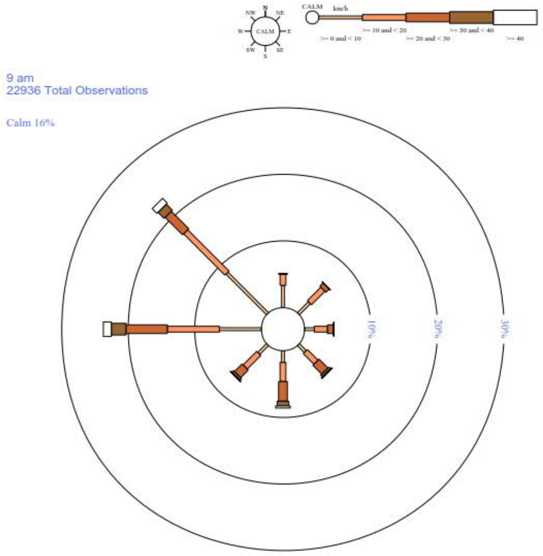
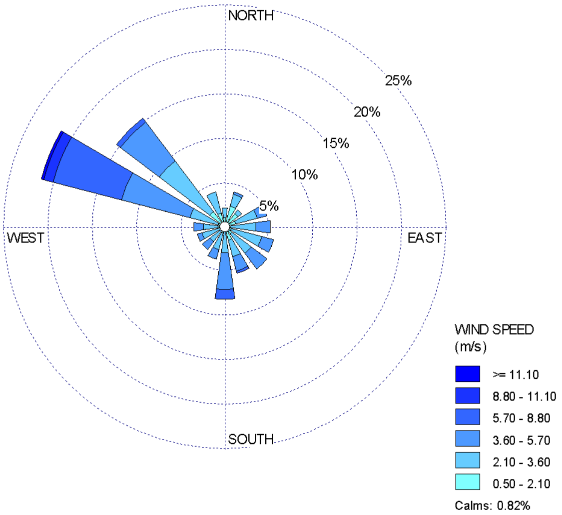
OEH Beresfield	CALMET Regain
	

Table 43 9am and 3pm Wind Rose Comparison CALMET Regain 2015 to Long Term BOM Williamtown

9am Wind Rose

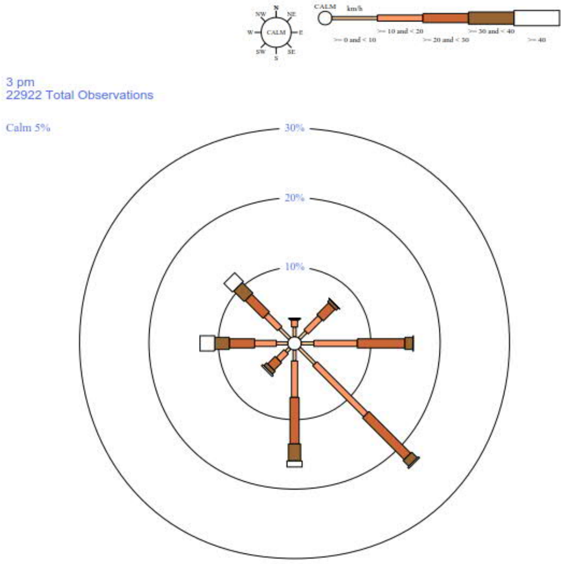


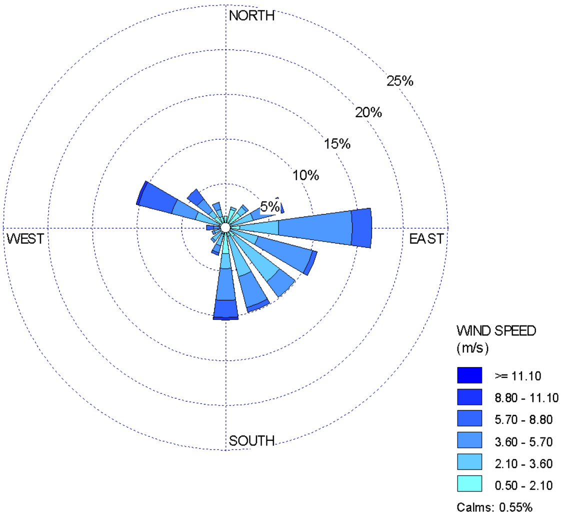


BoM Williamtown

CALMET Regain

3pm Wind Rose





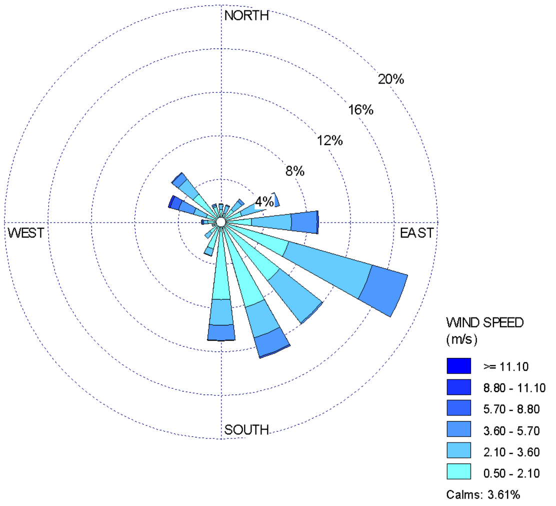
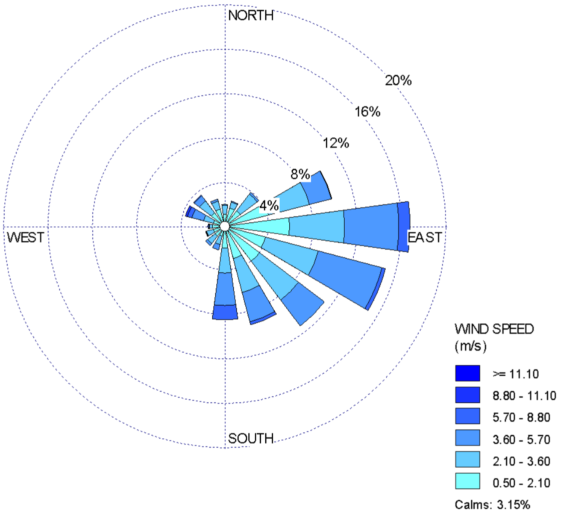
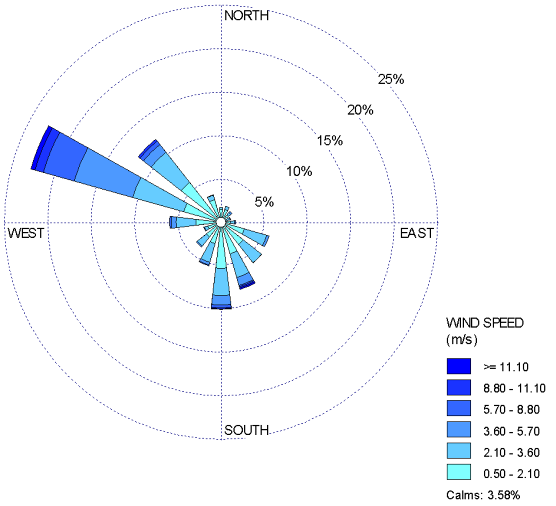
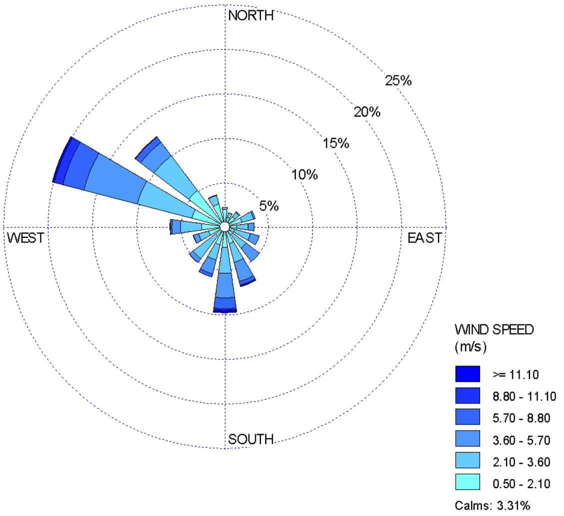
BoM Williamtown

CALMET Regain

*Note – The BoM data is presented in km/hr, however WRPLOT View can only present data in m/s

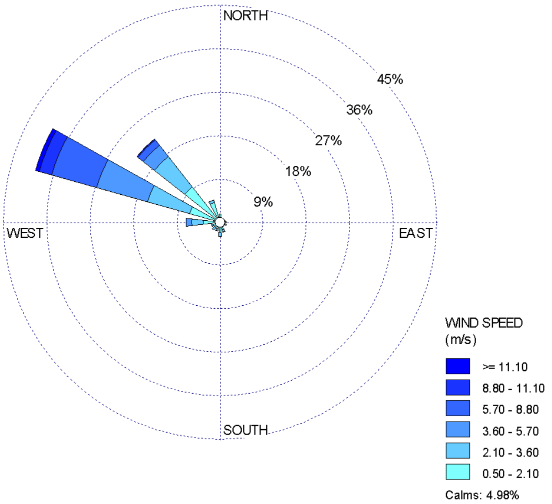
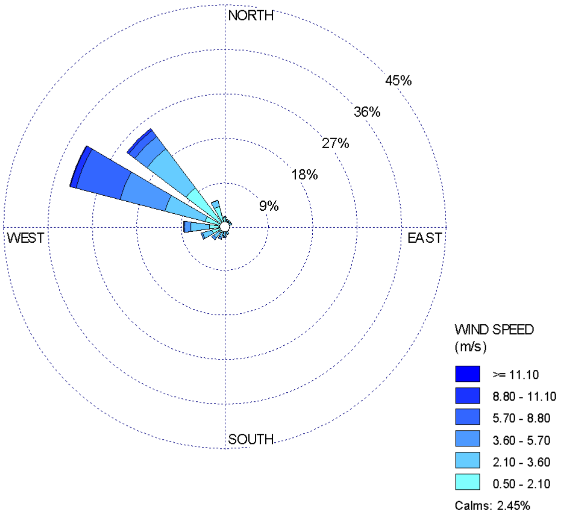
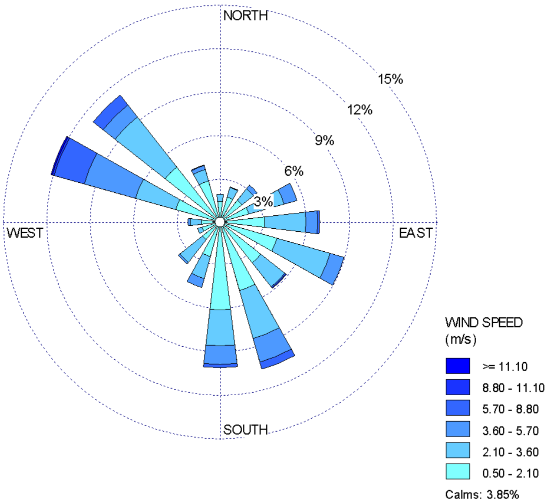
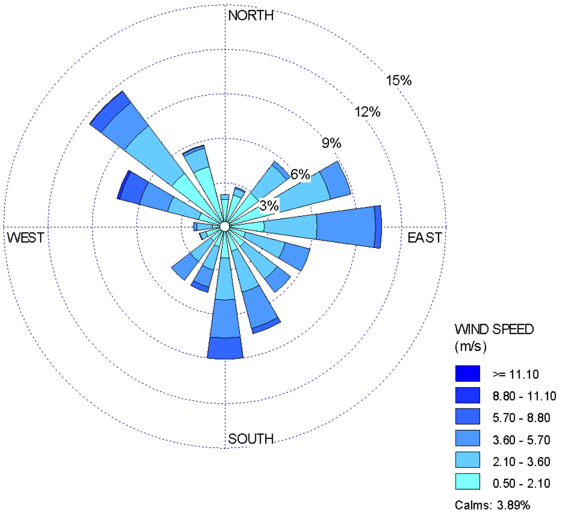
The Bureau of Meteorology (BoM) Williamtown meteorological station was used for the long term wind rose comparison, as it is the closest local station to the site with the available long term data. The 9am and 3pm wind roses presented in **Table 43** show a good general correlation. The 9am data for both have strong Northwest portions, although BoM Williamtown has a greater proportion of winds from the west as CALMET Regain is more affected by the expected north westerly winds blowing down the valley towards the site. For the 3pm data both locations have consistent wind directions, with a high easterly portion attributed to the sea breeze blowing from offshore in the afternoon.

Table 44 Summer and Autumn Wind Rose Comparison 2015

Summer Wind Rose	
	
OEH Beresfield	CALMET Regain
Autumn Wind Rose	
	
OEH Beresfield	CALMET Regain

The summer and autumn data in **Table 44** show similar wind direction patterns, as would be expected for two sites being located within similar terrain, and around 5km of each other. In the summer both datasets show a higher proportion of winds from the east, with the winds in Autumn generally blowing from the northwest.

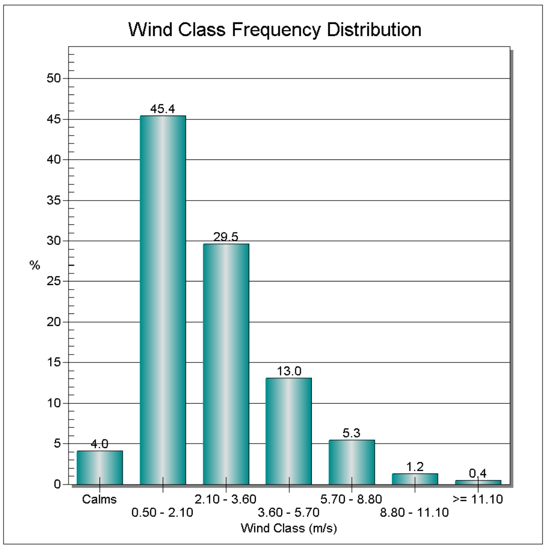
Table 45 Winter and Spring wind rose comparison 2015

<table>
<tr><th colspan="2">Winter Wind Roses</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>OEH Beresfield</td><td>CALMET Regain</td></tr>
<tr><th colspan="2">Spring Wind Roses</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>OEH Beresfield</td><td>CALMET Regain</td></tr>
</table>

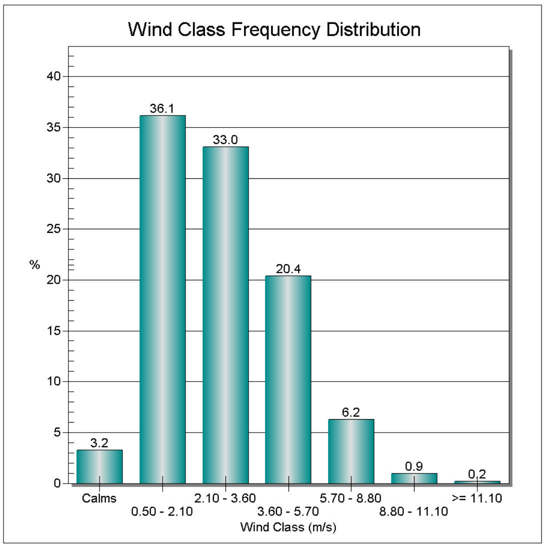
The winter and spring data in **Table 45** show similar wind direction patterns. In the winter, both datasets show a high percentage of winds originating from the northwest, whereas in the spring, both datasets show more even wind distribution, with a tendency of winds blowing from the northwest and southeast quadrants.

Table 46 Wind Speed Frequency Distributions Comparison 2015

Wind Class Frequency



OEH Beresfield



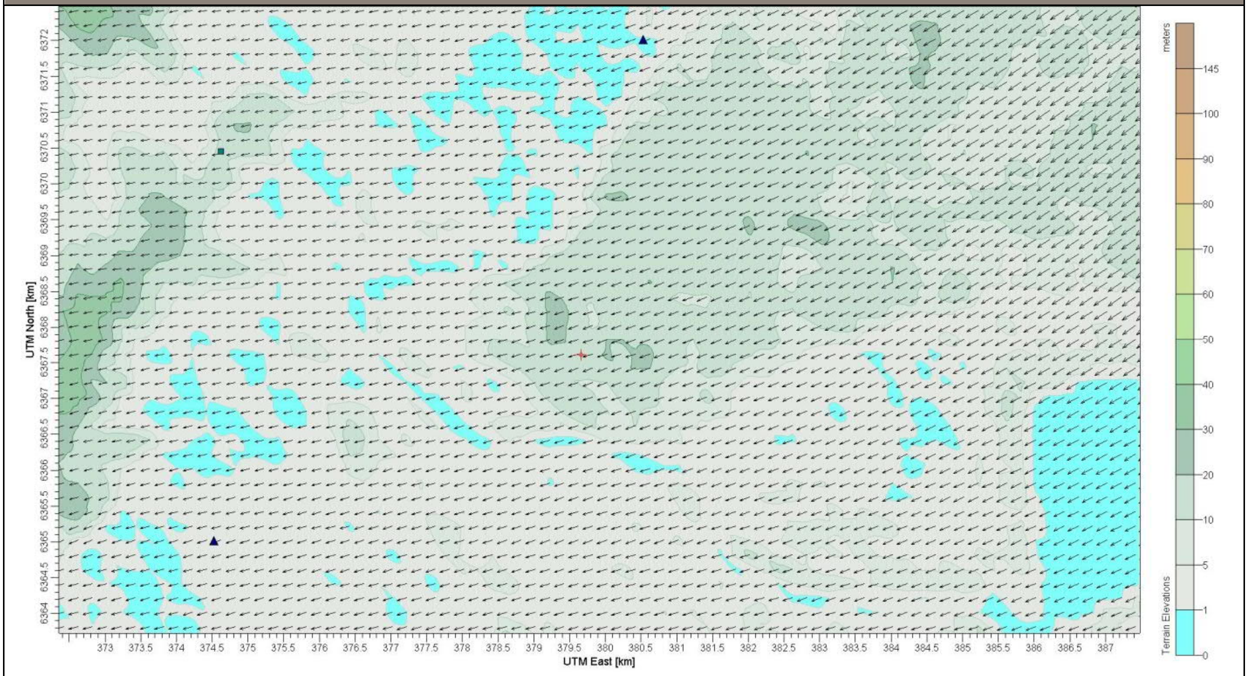
CALMET Regain

The wind speed frequencies presented in **Table 46** show very similar trends between the two datasets, with the winds being predominantly light to moderate in nature. The OEH Beresfield data shows a higher percentage of light winds and lower moderate winds compared to the CALMET Regain data, however this is expected due to that surface station being located 5.7km further inland from the more coastal CALMET Regain site.

Example wind fields were selected based on an hour of day when stable atmospheric conditions (class F) dominated and were selected to represent the middle of each season. This period was examined as it represents the period when worst case dispersion is likely to occur and when it is critical that the wind fields be performing well. The selected wind fields are shown in **Table 47** and **Table 48**.

Table 47 Selected 2015 Wind Fields for the Regain CALMET Modelling Domain

Year: 2015 Month: 01 Day: 01 Hour: 19



Year: 2015 Month: 04 Day: 13 Hour: 23

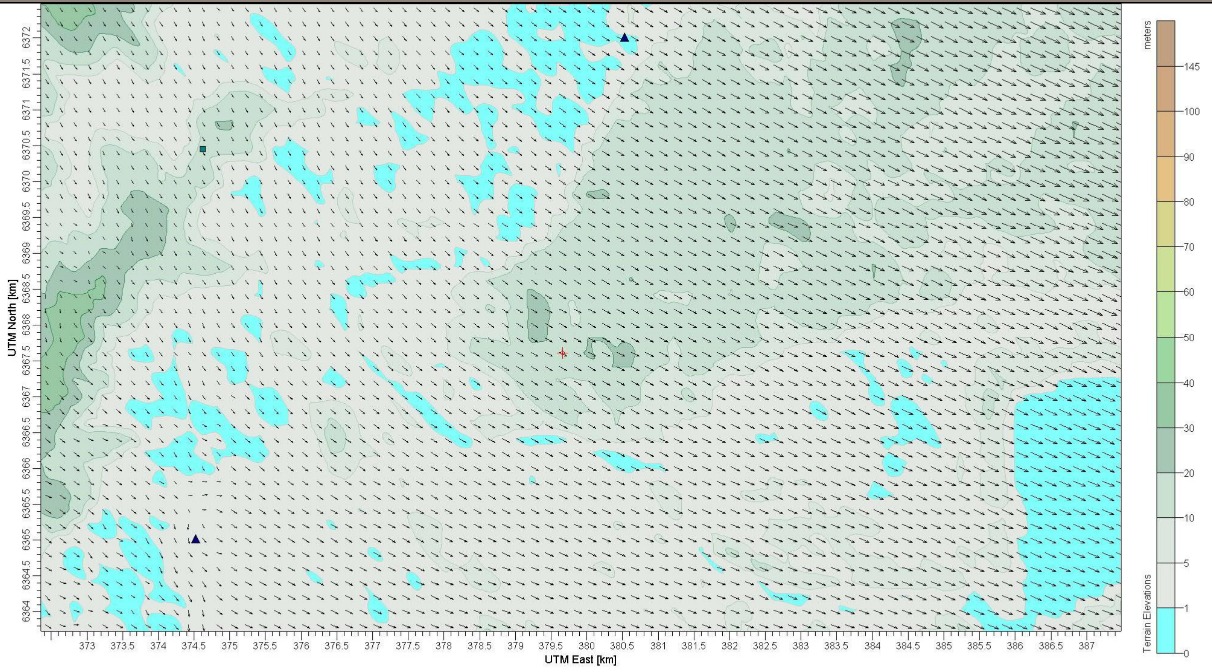
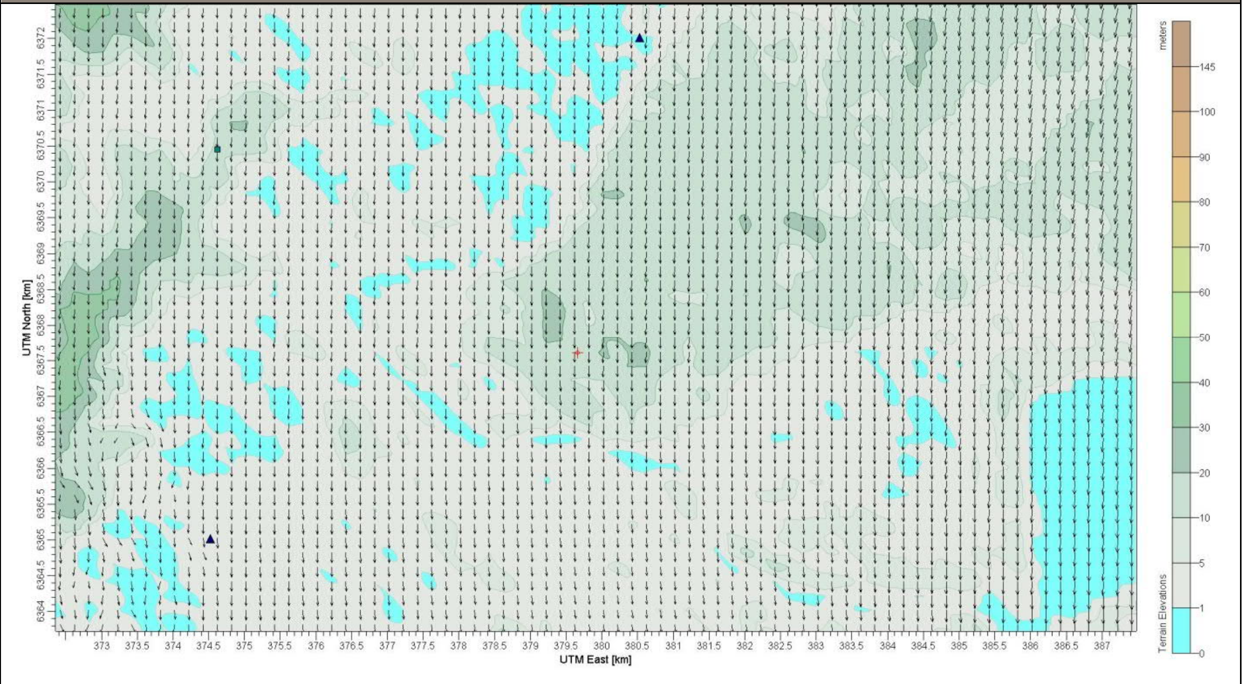
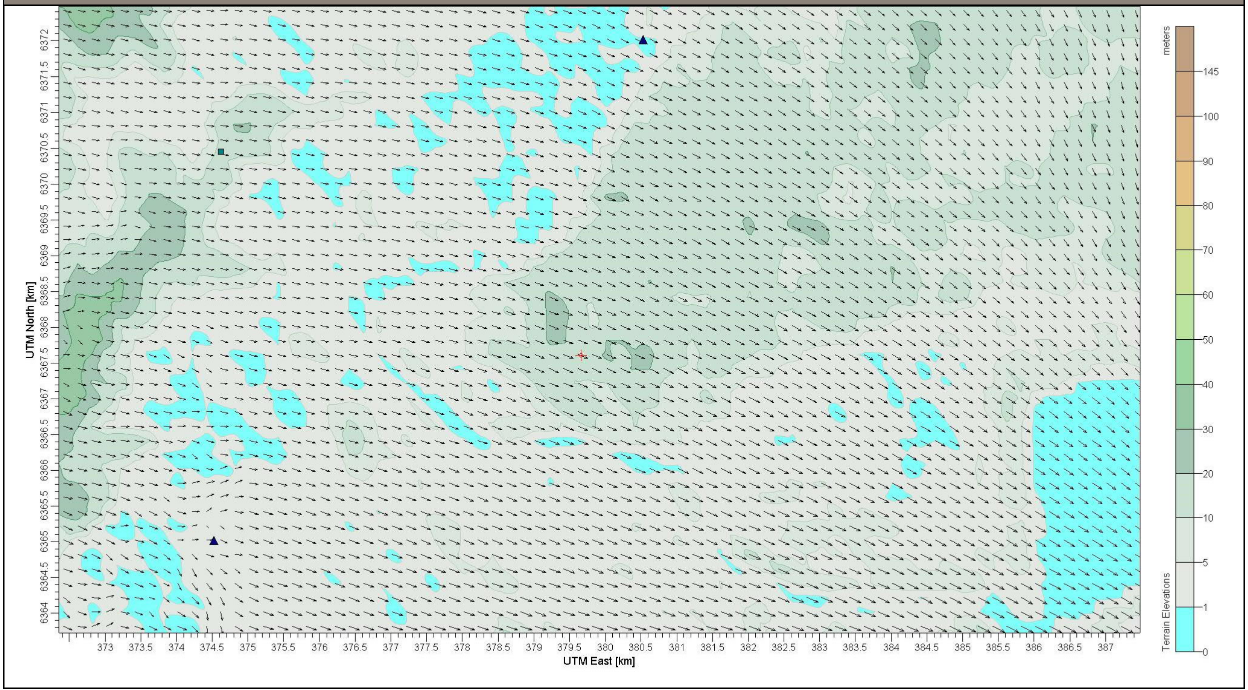


Table 48 Selected 2015 Wind Fields for the Regain CALMET Modelling Domain

Year: 2015 Month: 06 Day: 08 Hour: 17



Year: 2015 Month: 09 Day: 01 Hour: 22



Temperature

Temperature data is estimated within the CALMET program for each hour of the meteorological data set. A comparison of the temperature data between the OEH Beresfield and the CALMET Regain predicted temperatures for the assessed 12 month period is shown in **Figure 12**. A comparison of the temperature vs. hour of day for CALMET Regain is presented in **Figure 13.** The results are consistent with expected patterns for the Hunter region.

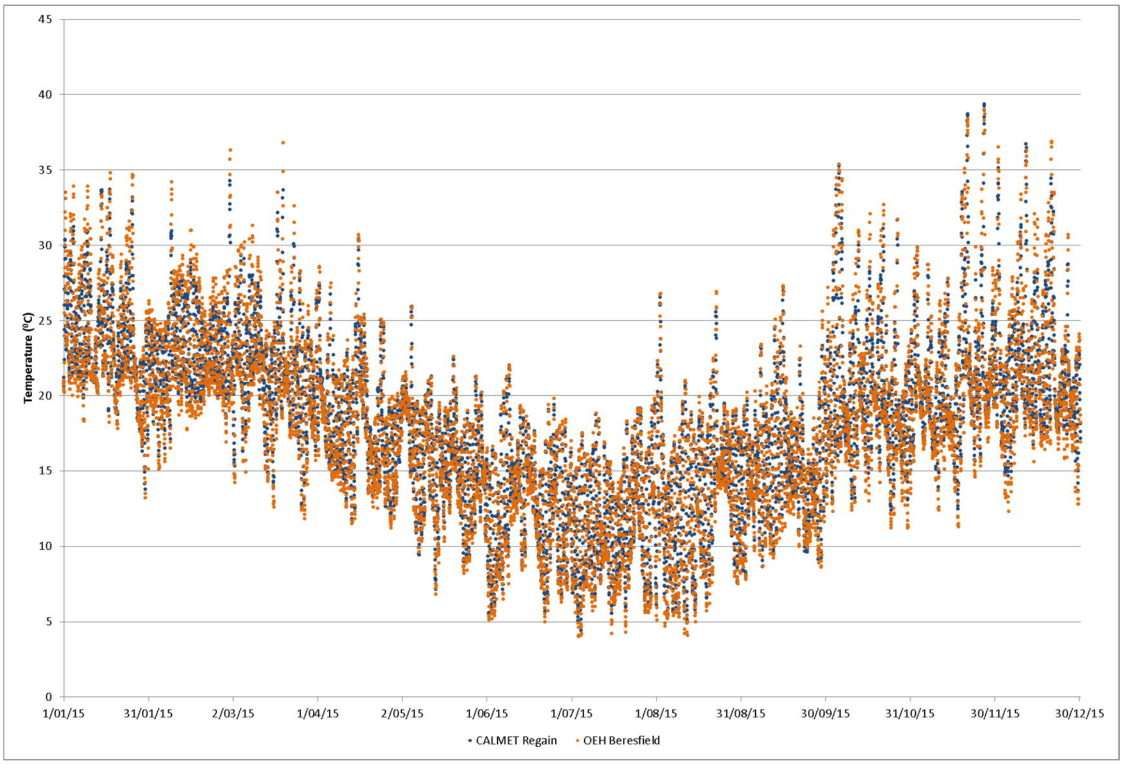


Figure 12 Temperature data for the CALMET Regain and OEH Beresfield 2015

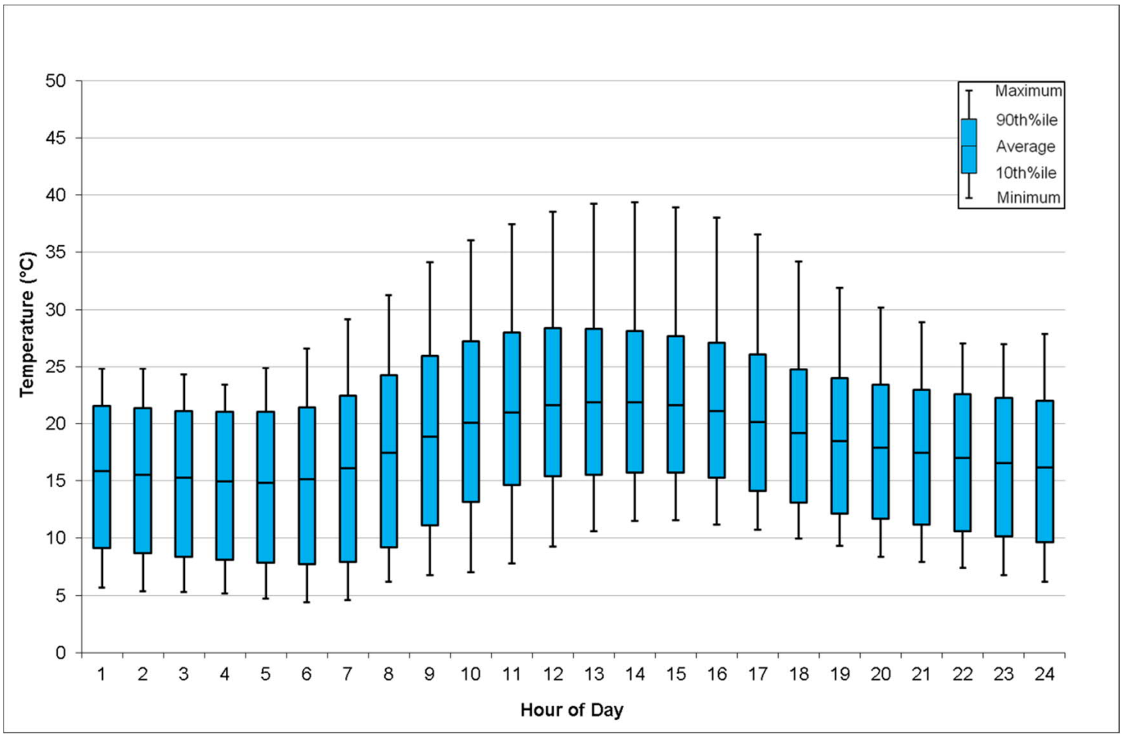


Figure 13 Box & Whisker plot of Temperature data for the CALMET Regain 2015

Mixing Height

Mixing height is estimated within CALMET for stable and convective conditions (respectively), with a minimum mixing height of 50 m. **Figure 14** presents mixing height statistics by hour of day across the meteorological dataset, as generated by CALMET at Regain. These results are consistent with general atmospheric processes that show increased vertical mixing with the progression of the day, as well as lower mixing heights during night time. In addition, peak mixing heights are consistent with typical ranges.

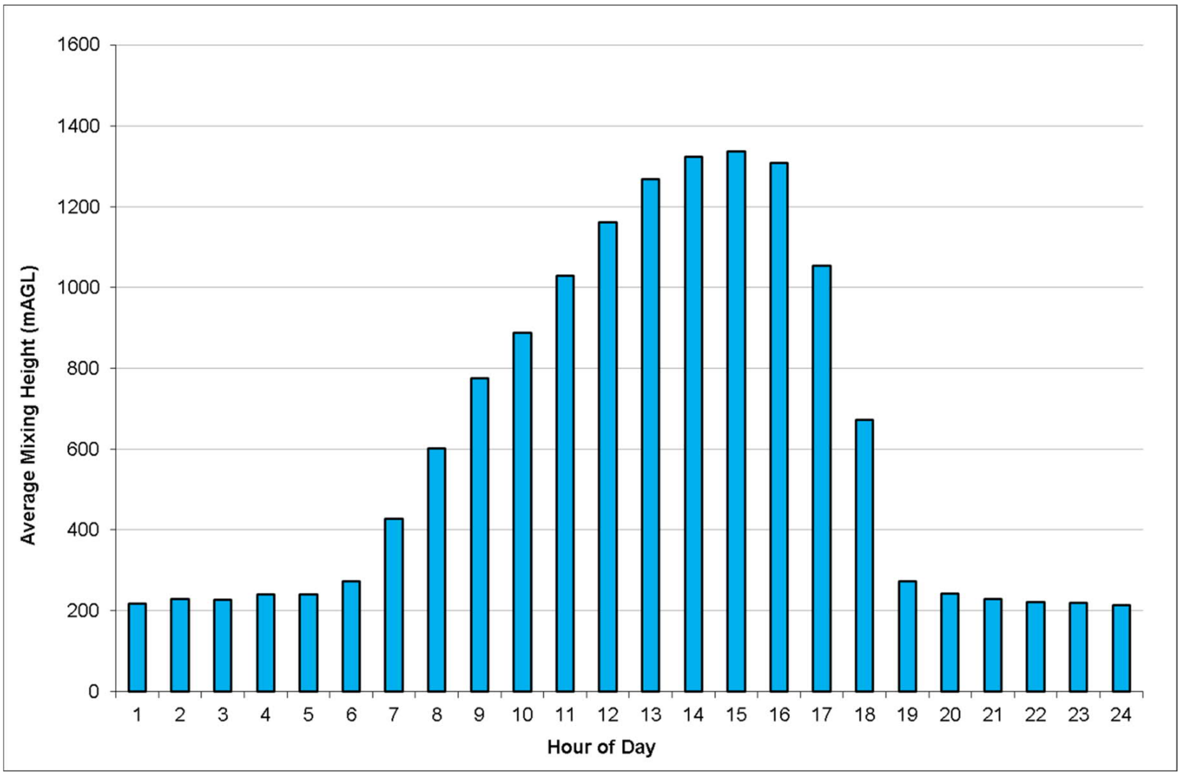


Figure 14 Mixing Height Statistics by Hour of Day for CALMET Regain 2015

Atmospheric Stability

Stability class is used as an indicator of atmospheric turbulence for use in meteorological models. The class of atmospheric stability generally used in these types of assessments is based on the Pasquill-Gifford-Turner (PG) scheme where six categories are used (A to F) which represent atmospheric stability from extremely unstable to moderately stable conditions respectively. The stability class of the atmosphere is based on three main characteristics, these being:

- Static stability (vertical temperature profile/structure)
- Convective turbulence (caused by radiative heating of the ground)
- Mechanical turbulence (caused by surface roughness).

Whilst CALPUFF centrally uses Monin-Obukhov (MO) similarity theory to characterise the stability of the surface layer, conversions are made within the model to calculate the PG class based on Golders method (Golder 1972[6]) as a function of both MO length and surface roughness height. The PG Stability class frequencies for the CALMET Regain data are provided in **Table 49**.

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[6] Golder, D. 1972, “Relations among stability parameters in the surface layer”, Boundary Layer Meteorology, 3, 47-58

Table 49 Stability Class Frequency for CALMET Regain 2015

Stability Class	Frequency CALMET Regain
A (Extremely Unstable)	2%
B (Moderately Unstable)	15%
C (Slightly Unstable)	21%
D (Neutral)	14%
E (Slightly Stable)	6%
F (Moderately Stable)	42%

Figure 15 and **Table 50** present an analysis of stability class frequency against wind speed at CALMET Regain and confirm a typical distribution.

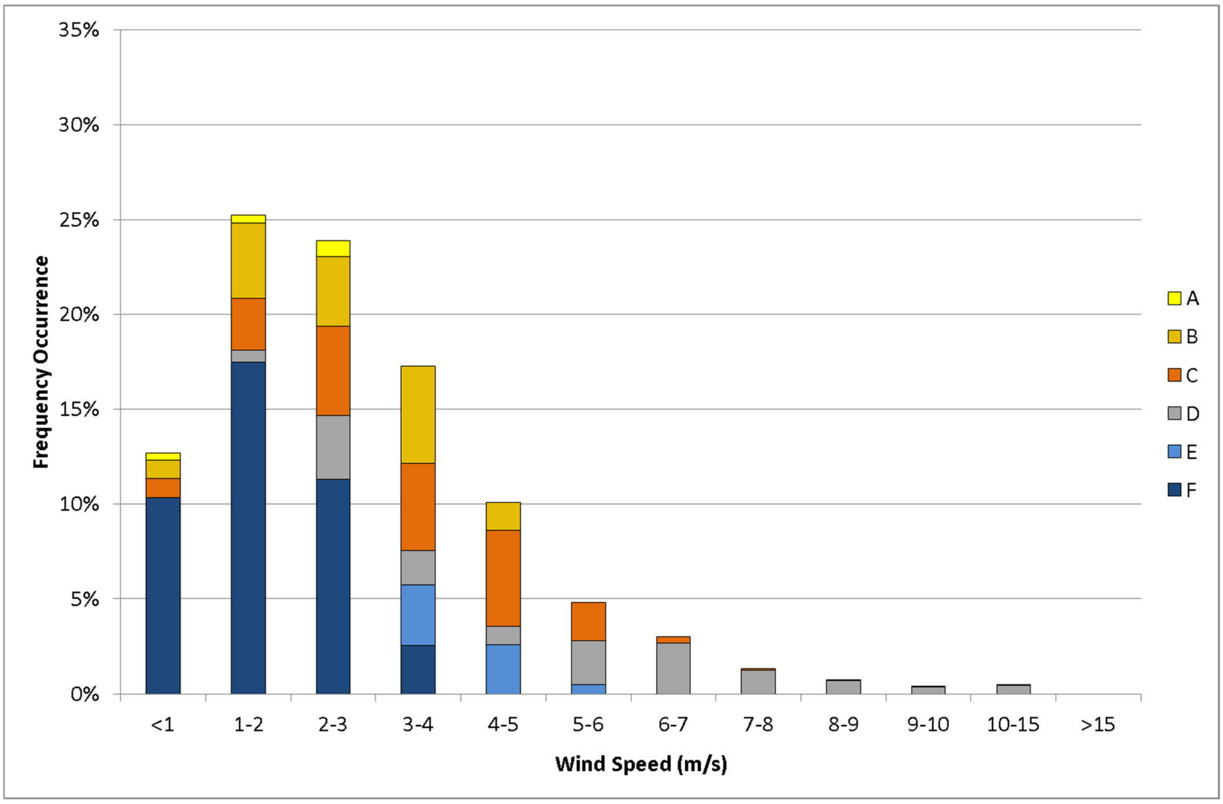

Figure 15 Stability Class Frequency by Wind Speed CALMET Regain 2015

Table 50 Stability Class Frequency by Wind Speed CALMET Regain 2015

Stability Class	Frequency by Wind Speed (m/s)												
	<1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-15	>15	All
A	34	37	75	0	0	0	0	0	0	0	0	0	146
B	85	349	321	450	128	0	0	0	0	0	0	0	1333
C	88	240	413	402	445	177	32	8	2	3	3	0	1813
D	0	55	295	160	84	200	232	109	62	32	38	0	1267
E	0	0	0	281	228	43	0	0	0	0	0	0	552
F	907	1530	990	221	0	0	0	0	0	0	0	0	3648
TOTAL	**1114**	**2211**	**2094**	**1514**	**885**	**420**	**264**	**117**	**64**	**35**	**41**	**0**	**8759**

Figure 16 presents an analysis of stability class at CALMET Regain by hour of the day and confirms a typical distribution.

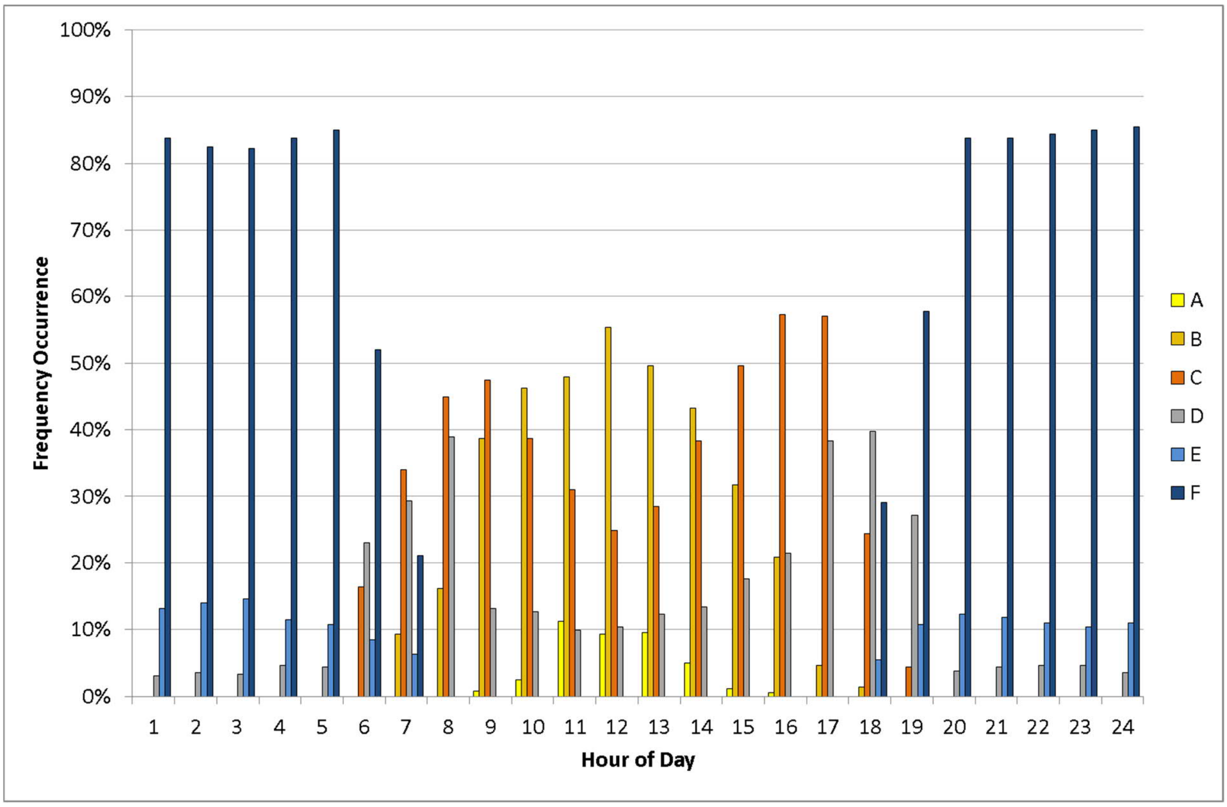

Figure 16 Stability Class by Hour of Day CALMET Regain 2015

Conclusion

A 12 month meteorological dataset has been prepared for the Regain facility using a combination of local observations and prognostic modelling. Data has been evaluated using hourly observation data. The findings of the data analysis show that the CALMET model is performing well. The predicted meteorology is considered to be fit for purpose and acceptable for use in modelling of emissions from the Regain site.

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Appendix C

Tomago Aluminium - 2015 Ambient Monitoring Results

Appendix C Tomago Aluminium - 2015 Ambient Monitoring Results

A summary of the Tomago Aluminium ambient monitoring results from all of their stations for the 2015 calendar year, which have been considered for this assessment are provided in **Table 51**.

Table 51 Tomago Aluminium Ambient Monitoring Results Summary - 2015

EPL Point	Site Name	Pollutants Monitored	Station Location		Distance From Regain Facility	Sulfur Dioxide			Hydrogen Fluoride		
						100th	100th	100th	100th	100th	100th
			x (m)	y (m)	km	1 hr	24 hr	Annual	7 day	30 day	90 day
18	Met Station	SO2	381194.0	6368226.0	1.7	259.4	115.3	7.6	-	-	-
20	HWC Offices	F	383297.2	6368684.6	3.9	-	-	-	0.34	0.21	0.18
21[2]	Old Punt Rd	F	378809.5	6367813.5	0.8	-	-	-	1.18	0.81	**0.60***
22	Lot D Tomago Rd	F, SO2	381815.8	6367234.6	2.2	319.6	123.1	9.4	**1.78***	**0.90***	**0.71***
23	Woodbury	F	376729.8	6371249.5	4.7	-	-	-	0.24	0.18	0.16
24[1]	The Farm	F, SO2	381363.0	6366718.0	2.0	440.2	196.5	24.7	**5.80***	**4.31***	**3.34***
25	Botanic Gardens	F	379909.5	6370007.5	2.5	-	-	-	0.70	0.29	0.26
26	Detention Centre	F	379973.6	6366568.2	1.0	-	-	-	0.92	0.59	0.42
27	Pacific Hwy	F, SO2	379362.0	6369127.0	1.6	275.1	104.8	10.5	1.36	0.70	0.44
36[2]	Laverick Avenue	SO2	378880.0	6367293.0	0.8	212.2	73.4	9.8	-	-	-
					CRITERIA	**570**	**228**	**60**	**1.7**	**0.84**	**0.5**

[1] This station was adopted for the assessment as discussed in **Section 4.1**.

[2] These stations are considered more representative of the background expected in the vicinity of the peak concentrations associated with the incremental Regain Tomago operations.

*These values are an exceedance of the respective ambient ground level concentration limits.

Appendix D

Stack Emissions Testing Results Summary

Appendix D Stack Emissions Testing Results Summary

A summary of the Regain Tomago Rotary Kiln, Regain Hydro Ball Mill, Regain Point Henry Rotary Kiln and the Tomago Aluminium Deline Shed D Duct stack parameters data are provided in **Table 52** - **Table 55** respectively.

Table 52 Regain Tomago Rotary Kiln Stack Parameters Summary

Parameter	Units	Feb 2014		Sep 2014		April 2015		October 2015		Apr/May 2016		Ave	Max	EPL Limit
		First Cut SPL	Second Cut SPL	First Cut SPL	Second Cut SPL	First Cut SPL	Second Cut SPL	First Cut SPL	Second Cut SPL	First Cut SPL	Second Cut SPL			
Carbon Monoxide	mg/m^3	8	56	112	112	56	31	121	67	122	65	**75**	122	N/A
Cyanide	mg/m^3	0.0037	0.021	<0.0031	<0.0028	0.1	0.7	0.0075	0.23	0.99	0.57	**0.2625**	0.99	1
D&F Lower Bound	ng/m^3	0.0011	0.00033	0.0086	0.016	0.0007	0.00036	0.0036	0.0052	0.0005	0.0004	**0.0037**	0.016	0.1
D&F Middle Bound	ng/m^3	0.0017	0.00072	0.013	0.02	0.0011	0.00084	0.0041	0.0055	0.0022	0.0022	**0.0051**	0.02	0.1
PM_{10}	mg/m^3	0.54	3.1	5.6	2.1	7	6.6	1.4	1.2	2.1	2.1	**3.2**	7.0	10
Nitrogen Oxides	mg/m^3	7	8	11	1	4	6	5	2	8	3	**5.5**	11.0	100
PAH's	mg/m^3	0.4	0.039	0.41	0.19	0.0061	0.0058	0.23	0.071	0.0068	0.0067	**0.1365**	0.41	0.5
Sulfur Dioxide	mg/m^3	13	9	<3	<3	<0.1	<0.1	<1	<1	<0.1	<0.1	**2.6**	13.0	50
Total Fluoride	mg/m^3	0.42	0.6	0.85	0.57	1.8	2.7	0.28	0.74	0.074	0.38	**0.8**	2.7	5
TSP	mg/m^3	<0.28	1.9	8.7	8.2	8.9	3.8	4.7	4.5	2.6	1	**4.4**	8.9	20
T1 & T2 Sub.	mg/m^3	0.013	0.028	0.03	0.0054	0.12	0.066	0.023	0.0085	0.00025	0.017	**0.0311**	0.12	1
Antimony	mg/m^3	0.0026	0.00037	0.000039	<0.0002	<0.00032	<0.00024	<0.00017	<0.00014	<0.00017	<0.00017	**0.0004**	0.0026	N/A
Arsenic	mg/m^3	<0.00018	<0.00015	0.00074	0.000051	0.00016	0.0013	<0.00017	<0.00014	<0.00017	<0.00017	**0.0003**	0.0013	N/A
Cadmium	mg/m^3	0.0018	0.015	<0.00016	<0.0002	0.0016	0.0036	0.0087	0.0064	0.00017	0.0026	**0.0040**	0.015	0.035
Chromium	mg/m^3	0.0018	0.0022	0.0016	0.001	0.0063	0.0048	0.00026	<0.00014	<0.00017	0.007	**0.0025**	0.0070	N/A

Parameter	Units	Feb 2014		Sep 2014		April 2015		October 2015		Apr/May 2016		Ave	Max	EPL Limit
		First Cut SPL	Second Cut SPL	First Cut SPL	Second Cut SPL	First Cut SPL	Second Cut SPL	First Cut SPL	Second Cut SPL	First Cut SPL	Second Cut SPL			
Lead	mg/m^3	0.0009	0.0015	0.0023	0.00066	0.0014	0.0024	0.0035	0.00025	<0.00017	0.0014	**0.0014**	0.0035	N/A
Manganese	mg/m^3	0.0019	0.0075	0.016	<0.0002	0.095	0.016	0.0079	0.00071	0.000085	0.0034	**0.0149**	0.095	N/A
Mercury	mg/m^3	<0.00045	<0.00037	<0.00039	<0.00051	<0.00079	<0.0006	<0.00044	<0.00035	<0.00042	<0.00043	**0.0002**	0.0004	N/A
Nickel	mg/m^3	0.0027	0.0015	0.0062	0.0011	0.013	0.024	0.0017	0.00071	<0.00017	0.0026	**0.0054**	0.024	N/A
VOC's	mg/m^3	N/A	N/A	5.8	0.3	2.6	3.3	<0.38	<0.37	<0.36	<0.36	**1.5919**	5.8	20
Acetone	mg/m^3	N/A	N/A	4.8	0.33	<0.089	0.33	<0.19	<0.19	<0.18	<0.18	**0.7343**	4.8	N/A
Benzene	mg/m^3	N/A	N/A	<0.085	<0.086	<0.089	<0.089	<0.19	<0.19	<0.18	<0.18	**0.0681**	0.095	N/A
Toluene	mg/m^3	N/A	N/A	0.99	<0.086	2.6	3	<0.19	<0.19	<0.18	<0.18	**0.8754**	3.0	N/A
Flow	m^3/s	6.4	8.6	8.03	8.3	8.8	8.7	7.9	8.5	8.9	9.4	**8.4**	9.4	N/A
Temp	^{0}C	77.8	78.9	80.3	71.7	77.5	76.5	85.4	82.2	83.1	83.5	**79.7**	85.4	N/A
Velocity	m/s	13.3	18	17	17	18.3	18.5	17	18	18.75	20	**17.6**	20.0	N/A

Table 53 Regain Hydro Dryer Stack Testing Results Summary

Parameter	Units	2014				2015				Average	Maximum	Regulatory Limit
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4			
Carbon Monoxide	mg/m^3	6.25	5	3.75	5	5	5	5	12.5	**5.9**	12.5	N/A
PM$_{10}$ *	mg/m^3	0.9	0.5	1.4	2.6	1.6	3.6	4.2	2.9	**2.2**	4.2	N/A
Flow	Am^3/s	13	7.3	7	6.5	6.4	6.7	5.8	4.2	**7.1**	13.0	N/A
Temperature	^{0}C	65	56	60.5	40	42.5	50.5	51.5	37.5	**50.4**	65.0	N/A
TSP	mg/m^3	1.2	0.74	1.9	3.7	2.2	5	5.9	4.1	**3.1**	5.9	20
Velocity	m/s	12	6.4	6.2	5.7	5.7	6	5.2	4.4	**6.5**	12.0	N/A

*PM$_{10}$ was not directly measured at the facility. This was calculated using the same ratio of TP:PM$_{10}$ as reported in the Rotary Kiln

Table 54 Regain Hydro Ball Mill Stack Testing Results Summary

Parameter	Units	2014				2015				Average	Maximum	Regulatory Limit
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4			
Carbon Monoxide	mg/m^3	0	0	0	0	0	0	0	0	**0.0**	0.0	N/A
PM$_{10}$ *	mg/m^3	1.3	0.8	0.9	1.5	1.6	1.6	9.3	5.5	**2.8**	9.3	10
Flow	Am^3/s	2.1	2	2.1	2	2.4	1.8	2.8	2.2	**2.2**	2.8	N/A
Temperature	^{0}C	38	40.5	40.2	27	19.3	39	20	37.5	**32.7**	40.5	N/A
TSP	mg/m^3	1.8	1.1	1.3	2.1	2.2	2.2	13	7.7	**3.9**	13.0	20
Velocity	m/s	4.7	4.8	4.6	4.6	5.4	4.1	6.3	5.1	**5.0**	6.3	N/A

Table 55 Tomago Aluminium Deline Shed D Duct Stack Testing Results Summary

Parameter	Units	2014	2015	2016	Average	Maximum	Regulatory Limit
Carbon Monoxide	mg/m^3	0	0	0	**0.0**	0.0	N/A
PM$_{10}$ *	mg/m^3	0.16	0.16	0.44	**0.3**	0.4	10
Flow	Am^3/s	23	23	20	**22.0**	23.0	N/A
Temperature	^{0}C	24	24.8	28.5	**25.8**	28.5	N/A
TSP	mg/m^3	0.23	4	0.71	**1.6**	4.0	20
Velocity	m/s	18	19	16	**17.7**	19.0	N/A

Table 56 Regain Point Henry Kiln Testing Results Summary

Parameter	Units	2017					Average
Flow (Am^3/s)	Am^3/s	14	13	11	14	13	**13**
Temperature (^{0}C)	^{0}C	90	84.5	78.5	90	90	**86.6**

Appendix B

Clarification of Emissions and Material Flows

Appendix B Clarification of Emissions and Material Flows

Tomago SPL Processing Plant Environmental Assessment Process Emission Rates and Material Processing Rates

Introduction

This document sets out a quantification of key emissions and associated material flows in the Regain spent potlining (SPL) processing plant.

Quantification Methodology

A quantification of the material inputs and the outputs from along with process intermediates that form and are chemically transformed in the Regain SPL treatment process was conducted by OLM Technical Services Pty Ltd (OLM) in 2016. The quantification was based on emission measurements, direct process measurements, laboratory analysis and chemical calculation.

A copy of the report on the study conducted by OLM is included as an attachment to this document.

Emissions and Material Flows

Process inputs, intermediates and outputs associated with a nominal 100 tonnes of SPL with 10% fluoride as F by weight are summarised in the following table.

Tabulation of SPL Treatment Process Inputs and Outputs

Material	Inputs	Outputs
Spent pot lining	100 tonnes	
HiCAL product		108 tonnes
Natural gas	3429 m^3	
Water	Water addition 45 t Water from fuel combustion 9 t Water from cooling air 8 t	Water in spent pot lining 8 t Water in exhaust gas 54 t
Cyanide	In untreated SPL 50kg	Included in HiCAL product 3 kg Emission 3 g
Fluoride	In untreated SPL 10 t	Included in HiCAL product 10 t* Emission 17g
Process Intermediates	Methane 0.6 t Hydrogen 0.3 t Ammonia 1.3 t	
Carbon dioxide emission		8.0 t
Particulate emission		53 g
Hydrocarbon emission		Carbon monoxide 1056 g Dioxin and Furan 0.0001µg Volatile organic compound 32 g Polycyclic aromatic hydrocarbons 3 g
Acid gas emissions		Nitrogen oxide 91 g Sulphur dioxide 53 g Fluoride (see above) (included)
Metal emissions		0.1 g

*Rounded

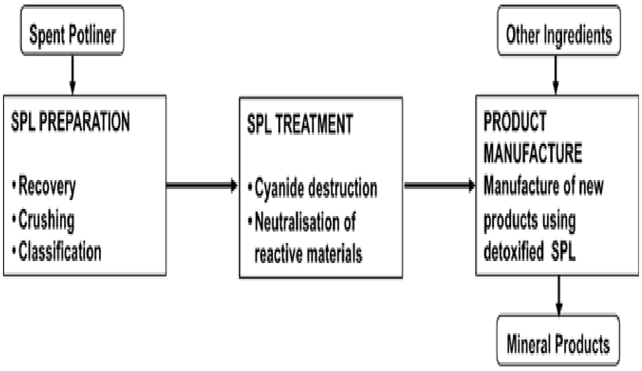
Attachment

OLM Technical Service Report, "*Quantification of the material flows in the Regain Spent Potlining Treatment Process*", March 2016

Regain Materials

Quantification of the material flows in the Regain Spent Pot Lining treatment process

A study of process inputs and outputs and the formation and fate of process intermediates



OLM Technical Services Pty Ltd

March 2016

Report for

Bernie Cooper
Principal
Regain Materials
Level 12
390 St Kilda Rd
Melbourne 3001

Report prepared by

Brian McGrath

OLM TECHNICAL SERVICES

15 Police Lane Geelong Victoeia 3220
PO Box 7058 Geelog West Victoria 3218
Tel +61488902465
Email brian@olmtechservices.com.au

Regain Materials

Quantification of the material flows in the Regain Spent Pot Lining treatment process

A study of process inputs and outputs and the formation and fate of process intermediates

OLM Technical Services Pty Ltd

March 2016

Contents

1. Introduction

1.1 Terms of reference

Regain Materials has developed a patented process for the management of spent pot lining, a hazardous waste derived from aluminium production, to produce a non-hazardous product which has multiple reuse options in the cement and brick industry.

Regain Materials requested OLM Technical Services to undertake a study of the Regain spent pot lining treatment process to enable quantification of the material inputs to the process and the outputs as well as the process intermediates that form and are transformed as part of the treatment process.

The Regain process includes a preparation stage involving crushing and grinding, a treatment process and a product manufacture stage involving blending, drying and grinding.

This scope of this study is the treatment process that follows preparation and precedes the product manufacture stage. It is this process stage that allows the destruction of cyanides and the neutralisation of the active components in spent pot lining.

1.2 Methodology

The basis for the study is 100 tonne of prepared first cut spent pot lining.

Spent pot lining is a catch all term to describe what is further discriminated by the industry as first cut and second cut spent pot lining. First cut spent pot lining is the carbon cathode and has a relatively higher carbon component and lower refractory component compared to second cut. Second cut spent pot lining is predominately refractory with a small carbon component.

This study is based upon first cut spent pot lining. The use of second cut spot lining would make some minor differences to the production of intermediates and natural gas usage but would not materially impact the understanding of the material flows in the treatment process.

The quantification is based upon direct process measurements, emission measurements, laboratory analysis and calculation.

2. Derivation of material flows in the Regain treatment process

A description of the means by which the material flow numbers were derived is provided in this section of the report. The tabulation of the numbers as process inputs and outputs is included in section 3 of the report.

2.1 Spent pot lining

The prepared spent pot lining enters the process essentially dry and leaves the process with a level of moisture that is typically around 8%. The material flows for the spent pot lining reflect this change.

The numbers quoted in the tabulation of process inputs and outputs are derived from process measurement.

2.2 Natural gas

Natural gas is used in the treatment process to provide the energy to raise the spent pot lining to a temperature that will allow the cyanide present to be destroyed.

Natural gas forms carbon dioxide and water according to the following reaction equation:

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

The carbon dioxide and water exits the process in the exhaust gas.

The numbers quoted in the tabulation of process inputs and outputs are derived from process measurement.

2.3 Cyanide

Cyanide enters with the prepared but untreated spent pot lining and is destroyed in the high temperature treatment process according to the reaction equation:

$$CN + 2O_2 \rightarrow CO_2 + NO_2$$

Residual cyanide leaves with the treated spent pot lining and a trace quantity is present in the exhaust gas.

The numbers quoted in the tabulation of process inputs and outputs are derived from laboratory testing.

2.4 Water

Water is added to the process at high temperature and combines with the reactive components to release ammonia, hydrogen and methane. Water enters the process as humidified air for cooling and is generated in the process from the combustion of methane, hydrogen and natural gas.

Water leaves the process in the exhaust gases and in the treated spent pot lining.

The numbers quoted in the tabulation of process inputs and outputs are derived from process measurement, emission testing and calculation.

2.5 Process intermediates

Ammonia, hydrogen and methane are generated in the treatment process from aluminium nitrides, aluminium metal, sodium metal and aluminium carbides present in the untreated spent pot lining according to the reaction equations:

$$2AlN + 3H_20 \rightarrow 2NH_3 + Al_20_3$$

$$2Al + 3H_2O \rightarrow 3H_2 + Al_2O_3$$

$$2Na + 2H_2O \rightarrow H_2 + 2NaOH$$

$$Al_4C_3 + 6H_2O \rightarrow 3CH_4 + 2Al_2O_3$$

The ammonia, hydrogen and methane generated react to generate heat that is reused in the treatment process and form water, carbon dioxide and nitrogen that leave in the exhaust gases according to the reaction equations:

$$2NH_3 \rightarrow 3H_2 + 2N_2$$

$$H_2 + 1/2O_2 \rightarrow H_2O$$

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

The alumina (Al_2O_3) and sodium hydroxide exits the process with the treated spent pot lining.

The numbers quoted in the tabulation of process inputs and outputs are derived from laboratory testing and calculation.

2.6 Carbon dioxide emissions

The carbon dioxide emissions are formed from the hydrocarbon in the natural gas and methane produced as a process intermediate.

The numbers quoted in the tabulation of process inputs and outputs are derived from calculation.

2.7 Regulated emissions

Each jurisdiction has specific compliance requirements for emissions from industrial processes. These emissions can be broadly categorised as particulate, hydrocarbon, acid gases and metals. The actual species required to be monitored within each category will vary according to jurisdiction. In the Australian context, the actual species monitored are:

- Particulates.
- Hydrocarbons: Carbon monoxide, Dioxins and Furans, Volatile organic compounds. Polycyclic aromatic hydrocarbons.
- Acid gases: Nitrogen oxides, Sulphur dioxide, Fluoride.
- Metals: The sum of - Antimony, Arsenic, Beryllium, Cadmium, Chromium, Cobalt, Lead, Mercury, Manganese, Nickel, Selenium, Tin, Vanadium

The numbers quoted in the tabulation of process inputs and outputs are derived from emission measurements.

3. Material flow quantities

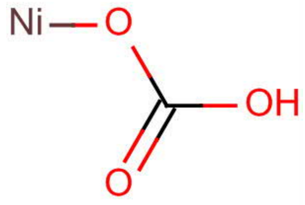
3.1 Tabulation of process inputs and outputs

Material	Inputs	Outputs
Spent pot lining	100 tonnes	108 tonnes
Natural gas	3429 m^3	
Water	Water addition 45 t Water from fuel combustion 9 t Water from cooling air 8 t	Water in spent pot lining 8 t Water in exhaust gas 54 t
Cyanide	Untreated spent pot lining 50kg	Treated spent pot lining 3 kg Emission 3 g
Process Intermediates	Methane 0.6 t Hydrogen 0.3 t Ammonia 1.3 t	
Carbon dioxide emission		8.0 t
Particulate emission		53 g
Hydrocarbon emission		Carbon monoxide 1056 g Dioxin and Furan 0.0001µg Volatile organic compound 32 g Polycyclic aromatic hydrocarbons 3 g
Acid gas emissions		Nitrogen oxide 91 g Sulphur dioxide 53 g Fluoride 17 g
Metal emissions		0.1 g

Appendix C

Nickel Toxicology Profile

Appendix C Nickel Toxicology Profile



Nickel – Toxicological Profile

The following information has been taken from ATSDR (2005):

General

Nickel is found naturally in the environment and can also be released into the environment from industrial furnaces, power plants or rubbish incinerators.

In the environment, it is primarily found combined with oxygen or sulfur as oxides or sulfides. Nickel is released into the atmosphere during nickel mining and by industries that make or use nickel, nickel alloys, or nickel compounds. These industries also might discharge nickel in waste water. Nickel is also released into the atmosphere by oil-burning power plants, coal-burning power plants, and trash incinerators.

Food is the major source of exposure to nickel. You may also be exposed to nickel by breathing air, drinking water, or smoking tobacco containing nickel. Skin contact with soil, bath or shower water, or metals containing nickel, as well as, metals plated with nickel can also result in exposure. Stainless steel and coins contain nickel. Some jewelry is plated with nickel or made from nickel alloys. Patients may be exposed to nickel in artificial body parts made from nickel-containing alloys and it can be transferred from mother to infant during breastfeeding.

The concentration of nickel in air, rivers and lakes is generally very low and is barely detectable however you may be exposed to higher than average levels of nickel if you live near industries that process or use nickel.

Significance of Exposure Pathways and Background

In accordance with the ASC NEPM (2013), background intakes from other sources (as a % of the TRV):

Bio = 60% for oral and dermal intakes

Bli = 20% of inhalation

Non-carcinogenic Health Effects

The general population can be exposed to nickel via inhalation, oral, and dermal routes of exposure. Based on occupational exposure studies, reports of allergic contact dermatitis, and animal exposure studies, the primary targets of toxicity appear to be the respiratory tract following inhalation exposure, the immune system following inhalation, oral, or dermal exposure, and possibly the reproductive system and the developing organism following oral exposure.

Contact dermatitis is the result of an allergic reaction to nickel that has been reported in the general population and workers exposed via dermal contact with airborne nickel, liquid nickel solution, or prolonged contact with metal items such as jewelry and prosthetic devices that contain nickel. Once an individual becomes sensitized to nickel, dermal contact with only a small amount of nickel can result in dermatitis. Approximately 10–20% of the general population is sensitized to nickel.

Both noncancerous and cancerous respiratory effects have been observed in humans and animals exposed to airborne nickel compounds. Chronic bronchitis, emphysema, pulmonary fibrosis, and impaired lung function have been observed in nickel welders and foundry workers. These effects were not consistently seen across studies, and co-exposure to other toxic metals such as uranium, iron, lead, and chromium confounds the interpretation of the results. Studies examining the risk of death from nonmalignant respiratory disease among nickel workers have not found significant increases; however, many studies found that the number of observed deaths was significantly lower than expected, suggesting a healthy worker effect.

Adverse respiratory effects have been reported in humans and animals exposed to nickel compounds at concentrations much higher than typically found in the environment. The available data on noncancerous respiratory effects in humans are limited. In nickel workers, exposure to nickel did not result in increases in the risk of death from nonmalignant respiratory system disease. Studies examining potential nonlethal respiratory effects have not found consistent results. Animal data provide strong evidence that nickel is a respiratory toxicant; lung inflammation is the predominant effect. Evidence of lung inflammation has been observed following acute-, intermediate-, and chronic-duration exposure of rats to nickel sulfate, nickel subsulfide, or nickel oxide. Human and animal data provide strong evidence that inhalation exposure to some nickel compounds can induce lung cancer.

The potential for nickel compounds to induce reproductive effects has not been firmly established in either humans or animals. A significant increase in human leukocyte antigen (HLA)-DRw6 antigens were found among individuals with nickel contact dermatitis compared to individuals with no history of atopy or contact dermatitis. Nickel sensitization typically involves initial prolonged contact with nickel or exposure to a very large nickel dose. In the general population, the initial nickel contact often comes from body piercing with jewelry that releases large amount of nickel ions. The resulting dermatitis, which is an inflammatory reaction mediated by type IV hypersensitivity, typically occurs beneath the metal object.

Carcinogenicity and Genotoxicity

The carcinogenicity of nickel compounds (specifically Nickel subsulfide from nickel refineries) via the inhalation pathway has been well documented in occupationally-exposed individuals. Inhalation exposures to nickel are complex, with the toxicity dependent on the form of nickel present (NEPC 2013).

Significant increases in the risk of mortality from lung or nasal cancers were observed in several cohorts of nickel refinery workers. Studies of workers in other nickel industries, including nickel mining and smelting, nickel alloy production, stainless steel production, or stainless steel welding, which typically involve exposure to lower concentrations of nickel, have not found significant increases in cancer risks.

No studies were located regarding cancer in humans after oral exposure to nickel, and nickel acetate was found to be noncarcinogenic in lifetime drinking water studies in rats and mice.

The Department of Health and Human Services has determined that metallic nickel may reasonably be anticipated to be a human carcinogen and nickel compounds are known to be human carcinogens. IARC classified metallic nickel in group 2B (possibly carcinogenic to humans) and nickel compounds in group 1 (carcinogenic to humans). USEPA has classified nickel refinery dust (nickel subsulfide) in Group A (human carcinogen). Other nickel compounds have not been classified by the EPA. These classifications are based on evidence of carcinogenicity via the inhalation, rather than oral, pathway.

Both *in vitro* and *in vivo* studies in mammals indicate that nickel compounds are genotoxic

Published Dose-Response Values

The following is a review of nickel toxicity with respect to the consideration of inhalation exposures (NEPC 2013):

- Nickel and compounds are established carcinogens via the inhalation route with tumours of the respiratory tract a consequence of occupational exposure to both soluble and insoluble nickel salts.
- Nickel compounds are generally considered to be genotoxic; however the mechanism of action associated is not well understood. The lack of understanding has resulted in a conservative approach that genotoxicity is critical in the development of tumours and that a non-threshold may be appropriate.
- Non-threshold assessments of inhalation cancer risk have relied on occupational studies to derive a quantitative value (unit risk). These occupational studies relate to specific nickel compounds in the occupational environment including nickel subsulfide (WHO 2000) and nickel refinery dusts (US EPA IRIS 2012).
- WHO (1991) notes that very high concentrations of nickel are required to produce teratogenic and genotoxic effects.
- Review by RIVM (2001) suggested the mechanism of action suggests a cytotoxic effect and that a threshold was appropriate for inhalation exposure to nickel. Review by EPAQS (2008, as referenced by EA 2009b) also suggested a non-genotoxic threshold mechanism of action and that a threshold can be considered.

- A threshold value can be adopted for inhalation exposure that is protective of both carcinogenic and non-carcinogenic effects. However it is noted that the assessment of carcinogenic issues relies on the non-threshold values available and acceptance of a 1 in 100,000 excess lifetime cancer risk.

Available chronic dose-response values published by sources recognised and endorsed by NEPC (2013) and enHealth (2012) are summarised in the following table.

Table 1: Published Dose-Response Values for Nickel

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Tolerable Daily Intake (TDI)	Threshold	0.012 mg/kg/day	NEPC (2013)	Based on WHO (2011) toxicity reference value.
Oral	Acceptable Daily Intake (ADI)	Threshold	0.005 mg/kg/day	NHMRC (2011)	Safety factor does not include that for carcinogenicity as effects have only been observed upon inhalation
Oral	Tolerable Daily Intake (TDI)	Threshold	0.012 mg/kg/day	WHO (2011)	
Oral	Reference Dose (RfD)	Threshold	0.02 mg/kg/day	USEPA (2010)	
Inhalation	Toxicity Reference Value (TRV)	Threshold	0.00002	NEPC (2013)	Based on the TRV published by EA (2009)
Inhalation	Minimal Risk Level (MRL)	Threshold	0.00009 mg/m^3	ATSDR (2005)	Chronic duration
Inhalation	Unit Risk	Non - threshold	0.0004 (ug/m^3)$^{-1}$	WHO (2000a)	Review by WHO (2000) established a range of air guideline values for nickel based on a non-threshold approach with a unit risk derived from occupation studies associated with nickel subsulfide
Inhalation	Unit Risk	Non - threshold	0.00038 (ug/m^3)$^{-1}$	WHO (2000b)	

Adopted Threshold Dose-Response Values

For assessment of potential threshold effects associated with oral exposure to nickel, AECOM has adopted the TDI of 0.012 mg/kg/day used by NEPC (2013) for derivation of the health investigation level.

For assessment of potential threshold effects associated with inhalation exposure to nickel, AECOM has adopted the TRV of 0.00002 mg/m^3 used by NEPC (2013) for derivation of the health investigation level, noting the value derived is protective of carcinogenic and non-carcinogenic effects.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

Non-threshold dose-response criteria for oral exposure to nickel have not been published, and nickel is not considered to be carcinogenic via the oral exposure route.

Nickel is not considered to be carcinogenic via the inhalation exposure route, therefore no inhalation reference concentration has been adopted.

References

ATSDR, 2005. *Toxicological Profile for Nickel*. Agency for Toxic Substances and Disease Registry. August, 2005.

EA, 2009. Contaminants of soil: updated collation of toxicological data and intake values for humans, Nickel, Science report: SC050021/TOX8, May 2009.

enHealth, 2012. *Environmental Health Risk Assessment*, *Guidelines for Assessing Human Health Risks from Environmental Hazards.* June 2012.

NEPC, 2013. *Schedule B(4) Guideline on Health Risk Assessment Methodology.* In: National Environment Protection (Assessment of Site Contamination) Measure 1999 as amended May 2013. National Environment Protection Council.

USEPA, 2013. *Integrated Risk Information System (IRIS).* Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed October 2013.

NHMRC, 2011, *Australian Drinking Water Guidelines (ADWG)*. National Health and Medical Research Council , 2011.

WHO, 2000a. *Air Quality Guidelines for Europe. Second Edition.* World Health Organization (WHO) Geneva, 2000.

WHO, 2000b. *Guidelines for Air Quality. Second Edition.* World Health Organization (WHO), or Europe. WHO Regional Publications, European Series, No. 91. 2000.

WHO, 2008. *Guidelines for Drinking-water Quality. First and Second Addenda to the Third-Edition. Volume 1. Recommendations.* World Health Organization.