



Application for Works Approval Amendment

Part V Division 3 of the *Environmental Protection Act 1986*

Works Approval Number	W5977/2016/1
Works Approval Holder	Tianqi Lithium Kwinana Pty Ltd
ACN	612 085 364
File Number	DER2016/001280
Premises	<p>Tianqi Lithium Hydroxide Refinery 61 Donaldson Road KWINANA BEACH WA 6167</p> <p>Legal description – Lot 201 on Deposited Plan 407762</p> <p>As depicted in the Premises map and defined by the coordinates in Schedule 1</p>
Date of Report	13/08/2024
Decision	Revised works approval granted

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1. Decision summary

Works Approval W5977/2016/1 is held by Tianqi Lithium Kwinana Pty Ltd (works approval holder, Tianqi) for the Tianqi Lithium Hydroxide Refinery (the premises), located at 61 Donaldson Road Kinana Beach.

This Amendment Report documents the assessment of potential risks to the environment and public health from proposed changes to the emissions and discharges during the construction and operation of the premises. As a result of this assessment, revised works approval W5977/2016/1 has been granted.

The revised works approval issued because of this amendment consolidates and supersedes the existing works approval previously granted in relation to the premises.

2. Scope of assessment

2.1 Regulatory framework

In completing the assessment documented in this Amendment Report, the Department of Water and Environmental Regulation (DWER, department) has considered and given due regard to its Regulatory Framework and relevant policy documents which are available at [DWER Regulatory documents | Western Australian Government \(www.wa.gov.au\)](https://www.wa.gov.au/government/publications/dwer-regulatory-documents).

2.2 Application summary

On 29 February 2024, Tianqi submitted an application to the department to amend works approval W5977/2016/1 under section 59 and 59B of the *Environmental Protection Act 1986* (EP Act). The following amendments are being sought:

- Construction and commissioning of a regenerative thermal oxidiser, wet scrubber and new calciner stack.
- Decommissioning of the existing Train 1 calciner stack (but not removed).
- Changes to emission sampling method standards for monitoring PM₁₀ discharges to air with the option of using alternative method USEPA Method 17.
- Change to the correction factor for calculation of oxides of nitrogen (NO_x) for the calciner fan stacks and sodium sulphate heater stacks to 15% (rather than existing 3%) oxygen on a dry basis.
- Update minimum stack heights.

2.2.1 Background

W5977/2016/1 was initially granted in 2016 for the establishment of a two train, lithium hydroxide refinery on the premises. The works approval has undergone a number of amendments since this time and authorises the construction and time limited operation of the refinery.

In 2023, Tianqi undertook environmental commissioning of the calciner in Train1 of the lithium hydroxide refinery. Commissioning results indicate the need to install augmented pollution control equipment at the calciner kiln to achieve further destruction of organic compounds not fully combusted in the calcination kiln. An amendment to the works approval was granted on 31 January 2024 to extend environmental commissioning to allow additional time for the design, assessment, construction, and commissioning of the augmented pollution control works.

Tianqi now seeks authorisation for the construction and commissioning of the augmented pollution control equipment in addition to changes to discharge to air sampling requirements.

2.2.2 Augmented pollution control equipment and decommissioning of the calciner off-gas stack

Tianqi proposes that gases discharged from train 1 calciner baghouse should pass through a regenerative thermal oxidiser (RTO) unit in the augmented pollution control system. The RTO will consist of a gas burner heating chamber in which gas passes through at 850 °C, with 97% of organic compounds entering the RTO combusted to carbon dioxide, eliminating odours.

Gases exiting the RTO may contain gaseous or ultrafine inorganic pollutants. Tianqi proposes to also install a packed bed wet scrubber to intercept residual inorganic pollutants. Gases directed through the wet scrubber encounter diluted caustic solution that captures fine solids by condensing volatile metal compounds. The effluent will be collected in a proposed holding tank and returned to an existing neutralisation section of the refinery. Within the neutralisation process, sodium fluoride is converted to solid calcium fluoride and captured by filters within gypsum residue filter cake.

Gases that pass through the baghouse, proposed RTO and wet scrubber will be directed to a new calciner stack 60 metre above ground level (magl). The existing stack that currently discharges the calciner baghouse off gases will be decommissioned but not removed.

2.2.3 Changes to PM₁₀ sampling methods

Tianqi requests the use of USEPA Method 5 or Method 17 with subsequent particle size analysis following ISO 13320:2020 as an alternative method to USEPA Method 201A for monitoring PM₁₀ in stack emissions.

The premises stack diameters are too small to accommodate USEPA method 201A, which requires a diameter greater than 673 mm. Furthermore, USEPA method 201A can be difficult when there are high negative stack pressures as is the case with refinery with gas exiting temperatures exceeding 205°C.

2.2.4 Changes to correction factor for calculation of NO_x emissions

Tianqi seeks to amend the correction factor used in reporting calciner fan stack and sodium sulphate heater stack NO_x emissions from 3% oxygen to 15%. Tianqi supplied the following reasoning for the requested change:

- 15 % correction factor represents oxygen concentration in the calciner off-gas and therefore is a more representative figure;
- Conventional NO_x emission reporting from gas-fired facilities is 15% oxygen content for gas engines and gas turbines.
- The works approval W6499/2021/1 for the Covalent Lithium Refinery has a 10% oxygen correction factor for reporting NO_x in the calciner-off gas.

2.2.5 Stack height changes

Tianqi has identified that stack heights listed in the works approval W5977/2016/1 do not reflect the actual height of some Train 1 and Train 2 stacks. Tianqi supplied recent air dispersion modelling (see section 2.3) with the application which used the corrected stack heights in estimating ground-level contaminate concentrations.

2.3 Air quality assessment

Tianqi provided an Emissions Impact Assessment (EIA) for air emissions undertaken by Environmental and Air Quality Consulting Pty Ltd (EAQ). The EIA included:

- Outline of the nearby receptors;
- Recent measured stack emissions for total suspended particulate (TSP), oxides of nitrogen (NO_x), sulphur dioxide (SO₂), sulphur trioxide (SO₃) and carbon monoxide (CO).
- Outlined pollutants modelled in the assessment (TSP, NO_x, SO₂, SO₃ and CO), and assessment criteria.
- Air dispersion modelling (Calmet processor and Calpuff model);
- Comparison of predicted pollutant ground level concentrations (GLC) with relevant air quality criteria (DWER Guideline: Air Emissions (Draft) 2019 and Kwinana Environmental Protection Policy 1999 and Regulations 1992);

Table 1 summarises the GLC predictions of short-term exposure for key pollutants from the refinery presented in the EIA. The GLC are based on the existing and impending (cumulative) Train 1 and Train 2 emissions.

Table 1: Predicted ground level concentrations for a two-train processing refinery and comparison with standard criterion.

Pollutant	Averaging period	Predicted ground level concentration (µg/m ³)	¹ DWER AGV (µg/m ³)	² Kwinana EPP Area A limit (µg/m ³)	² Kwinana EPP Area B limit (µg/m ³)	² Kwinana EPP Area C limit (µg/m ³)	³ NEPM (µg/m ³)
NO _x	1 hour	6.47	246				100.8
	Annual	0.05	56				18.45
SO ₂	1 hour	12.7	524	1,400	150	700	100
	24 hour	1.28	210	365	200	200	
	Annual	0.03	52	80	60	60	
CO	1 hour	0.39	30,000				
	8-hour	0.17	10,000				9,000
TSP	24 hour	0.43		150 ⁴	90 ⁴	90 ⁴	
PM ₁₀	24 hour	0.43	46				50
	1-hour						50

Note 1: DWER (2019) Guideline: Air Emissions (Draft), Perth, Western Australia

Note 2: Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1999 and Environmental Protection (Kwinana) (Atmospheric Wastes) Regulations 1992 (Kwinana EPP), noting that Medina residential area is located in Area C and Tianqi in Area A.

Note 3: National Environment Protection (Ambient Air Quality) Measure 2021 (NEPM), National Environment Protection Council Act 1994.

Note4: Represents Kwinana EPP TSP standards rather than limits.

2.3.1 DWER findings

The department reviewed the methodology of the air quality modelling presented in the EIA and concluded it to be appropriate however identified it does not fully meet requirements of the departments *Air Quality Modelling Guidance Notes* (2006) as plant upset conditions scenarios were not considered. Tianqi advised that potential upset conditions (eg. feedstock

changes, gas flow changes, mechanical breakdown and baghouse failure) occur infrequently and the existing system baghouse controls and design (maintenance and automatic shutdown) have demonstrated that emissions are not elevated during these events, indicating that additional modelling was not required. The delegated officer accepted this as appropriate.

The EIA made comparison of predicted GLC with air guideline values in DWER's *Guideline: Air Emissions (Draft)* (2019). Noting the guideline has not been updated to incorporate national air quality standards updated by the *Variation to the Ambient Air Quality NEPM – 2021* the delegated officer compared the predicted GLC with these criteria (refer to Table 1). Predicted GLC are all well within relevant air quality criteria as presented in Table 1.

The delegated officer noted that RTOs can at times increase NOx emissions in specific setups and operations. Tianqi has indicated that the RTO selected for installation has a low burner design coupled with precise control of operating temperature and airflow to achieve low NOx emissions.

3. Risk assessment

The department assesses the risks of emissions from prescribed premises and identifies the potential source, pathway and impact on receptors in accordance with the *Guideline: Risk assessments* (DWER 2020).

To establish a Risk Event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission.

3.1 Source-pathways and receptors

3.1.1 Emissions and controls

The key emissions and associated actual or likely pathway during premises construction and operation which have been considered in this Amendment Report are detailed in Table 2 below. Table 2 also details the control measures the works approval holder has proposed to assist in controlling these emissions, where necessary.

Table 2: Works approval holder controls

Emission	Sources	Potential pathways	Proposed controls
Gaseous air emissions (NOx, SO ₂ /SO ₃ , CO), odour (organic compounds), metal fume and particulates	Calcliner off-gases (via RTO and wet scrubbing system)	Air/windborne pathway	Monitoring of discharges to air for TSP, PM ₁₀ , NOx and flow rate as per existing works approval (condition 15) NOx and TSP emission limits as per existing works approval (condition 14) Installation of low burner RTO with precision temperature control and a wet scrubbing system for treatment of off-gas from the calciner baghouse. Decommissioning of the existing calciner off-gas stack and installation of a new stack for discharge of off gas from the RTO/Wet scrubbing system.
Scrubber effluent (dilute caustic)	Wet scrubbing system and scrubber	Direct discharge to land, overland flow and seepage	The effluent tank is carbon steel with rubber lining. The tank will be kept within a bunded area

Emission	Sources	Potential pathways	Proposed controls
- sodium fluoride)	effluent tank	through soil due to loss of containment event/s	<p>equal to 110% of tank volume.</p> <p>Effluent is constantly recirculated around the tank through a heat exchanger to keep the tank's temperature below 50°C</p> <p>The volume of the tank is 70 m³, with four days of storage for a nominal blow-down from the scrubbers.</p> <p>The tank will have a live volume of 50m³.</p>

3.1.2 Receptors

In accordance with the *Guideline: Risk assessments* (DWER 2020), the delegated officer has excluded employees, visitors and contractors of the works approval holder from its assessment. Protection of these parties often involves different exposure risks and prevention strategies, and is provided for under other state legislation.

Table 3 below provides a summary of potential human and environmental receptors that may be impacted because of activities upon or emission and discharges from the prescribed premises (*Guideline: Environmental siting* (DWER 2020)).

Table 3: Sensitive human and environmental receptors and distance from prescribed activity

Human receptors	Distance from prescribed activity
Closest dwelling	2.35 km south-east in the residential suburb of Medina
Closest industrial premises	Adjacent to premises on the north, south and western boundaries.
Environmental receptors	Distance from prescribed activity
Cockburn Sound Groundwater Area (proclaimed under <i>Rights to Water and Irrigation Act 1914</i>) (RIWI)	<p>Groundwater encountered at 6 m relative to ground level or 1 m relative to AHD.</p> <p>Groundwater moves east to west towards the ocean</p>
Cockburn Sound	Approximately 1.2 km west of the premises western boundary.

3.2 Risk ratings

Risk ratings have been assessed in accordance with the *Guideline: Risk Assessments* (DWER 2020) for those emission sources which are proposed to change and take into account potential source-pathway and receptor linkages as identified in Section 3.1. Where linkages are in-complete they have not been considered further in the risk assessment.

Where the works approval holder has proposed mitigation measures/controls (as detailed in Section 3.1), these have been considered when determining the final risk rating. Where the delegated officer considers the works approval holder's proposed controls to be critical to maintaining an acceptable level of risk, these will be incorporated into the works approval as regulatory controls.

Additional regulatory controls may be imposed where the works approval holder's controls are

not deemed sufficient. Where this is the case the need for additional controls will be documented and justified in Table 4.

The revised works approval W5977/2016/1 that accompanies this Amendment Report authorises construction and time-limited operations. The conditions in the Revised Works Approval have been determined in accordance with *Guidance Statement: Setting Conditions* (DER 2015).

A licence is required following the time-limited operational phase authorised under the works approval to authorise emissions associated with the ongoing operation of the premises i.e. lithium refinery. A risk assessment for the operation of the additional infrastructure has been included in this Amendment Report, however licence conditions will not be finalised until the department assesses a licence application for the premises.

Table 4. Risk assessment of potential emissions and discharges from the Premises during construction and operation

Risk Event					Risk rating ¹ C = consequence L = likelihood	Reasoning	Conditions of works approval
Source/Activities	Potential emission	Potential pathways and impact	Receptors	Works approval holder's controls			
Construction							
Construction of RTO, wet scrubbing system and new stack including vehicle movements	Dust	Air/windborne pathway causing impacts to health and amenity	Closest dwelling 2.35 km south-east in Medina	Refer to W5977/2016/1 Decision Report 2016	C = Minor L = Unlikely Medium Risk	The delegated officer referred to the previous risk assessment for construction noise and dust emissions for the premises and formed the view that there are no aspects of proposed construction works that would cause the risk profile for fugitive dust and noise emissions to change from the previous assessment. The types of controls determined in the previous assessment are adequate and appropriate to control fugitive dust and noise during construction works. Therefore, the delegated officer considers that further detailed risk assessment is not required, and existing controls sufficiently manage the risk of health and amenity impacts.	Existing condition 7
	Noise						
Operation							
Calcliner (via RTO and wet scrubbing system)	Point source emissions to air comprising NOx SO ₂ , SO ₃ , CO, particulates odour (organic compounds) and metal fume	Air/windborne pathway causing impacts to health and amenity	Closest dwelling 2.35 km south-east in Medina	Refer to Table 2	C = Minor L = Unlikely Medium Risk	The delegated officer referred to the previous risk assessment for point source air emissions and formed the view that there are no aspects of the proposal to install augmented pollution control equipment that would cause the risk profile of point source emissions to air to change from the previous assessment. The delegated officer reviewed information in the application including the EIA for air emissions and determined that emissions are expected to be within the works approval emission limits during ongoing operations and GLC are predicted to remain well within relevant air quality criteria. The types of controls determined in the previous assessment together with the additional pollution control equipment (RTO and wet scrubber) are considered adequate and appropriate to control the risk of air emission impacts to amenity or health.	<u>Construction</u> Calcliner stack, RTO and wet scrubber added to Table 2 pyro operations and hydro operations. <u>Operations</u> Calcliner 1 offgas treatment requirements added (RTO, wet scrubber and effluent tank). The calcliner fan stack for Train 1 was removed and the calcliner RTO stack was added for train 1
Wet scrubbing system and scrubber effluent	Scrubber effluent (dilute)	Direct discharge to land, overland	Soil on the premises	Refer to Table 2	C = Slight	The previous assessment determined the operational risk of loss of containment or contaminated stormwater runoff as low subject to relevant controls specified in the works approval. The delegated officer	<u>Construction</u> Calcliner wet scrubber

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Risk Event					Risk rating ¹ C = consequence L = likelihood	Reasoning	Conditions of works approval
Source/Activities	Potential emission	Potential pathways and impact	Receptors	Works approval holder's controls			
tank	caustic - sodium fluoride)	flow and seepage through soil due to loss of containment event/s	Groundwater 6 metres below surface.		L = Rare Low Risk	formed the view that operation of the wet scrubber and effluent tank would not cause the risk profile of loss of environmentally hazardous substances to change from the previous assessment. The works approval holder's proposed controls align with the types of controls determined in the previous assessment and are considered adequate and appropriate to control the risk of contamination from loss of containment events. The applicant's proposed containment controls have therefore been included in the works approval to maintain a low risk.	effluent system to be constructed as follows: <ul style="list-style-type: none"> • Effluent tank is carbon steel with rubber lining. • Tank will be kept within a bunded area equal to 110% of tank volume. • Volume of the tank is a minimum of 70 m³

Note 1: Consequence ratings, likelihood ratings and risk descriptions are detailed in the *Guideline: Risk assessments* (DWER 2020).

4. Decision

The delegated officer has determined to amend works approval W5977/2016/1 to authorise construction and time limited operation of augmented pollution control equipment for the Train 1 calciner off-gases, consisting of an RTO, wet scrubber system and new off-gas stack.

The delegated officer also determined to make the following amendments to the works approval:

- Change the PM₁₀ stack emission sampling method for monitoring to USEPA Method 5 or 17.
- Change the correction factor for calculation of oxides of nitrogen (NO_x) emissions for the calciner fan stacks and sodium sulphate heater stacks to STP to 15% oxygen on a dry basis.
- Revised minimum stack heights for calciner stacks, spodumene mill stacks, acid roast kiln stacks, acid roast scrubber stacks and steam generator stacks.

In assessing the proposed changes, the delegated officer determined there is not likely to be any material change to the risk profile of emissions and discharges from the premises associated with the amendment as per the reasons set out below.

Augmented pollution control equipment and decommissioning of calciner off-gas stack

On the basis of the EIA for air emissions the proposed augmented pollution control equipment, consisting of an RTO, wet scrubber system and new calciner stack is expected to ensure compliance with the works approval emission limits and relevant air quality criteria.

Changes to PM₁₀ sampling method

The department does not currently have the required specialist knowledge of emissions testing methods or methodology. The delegated officer has therefore relied upon the specialist advice provided to Tianqi by Ektimo in 2022 on the suitability of the proposed emission measurement methods for a previous works approval amendment issued on 2 August 2022 for Tianqi. The amendment included the removal of USEPA Method 17 and replacement with the alternative PM₁₀ stack sampling measurement using either ISO 13320:2020 or USEPA Method 201A.

It is noted that USEPA Method 201A, is a semi-isokinetic sampling method that uses a cyclone sampling head to separate the PM₁₀ particulate fraction from the larger particulate matter fraction. This method is 'in stack' and the temperature of the stack is relied upon to maintain the sampling head above the dew point in the same manner as USEPA Method 17. USEPA Method 201A requires a large head and will not fit in sample ports smaller than four inches (100 mm).

The alternative method recommended by Ektimo is ISO 13320:2020, which uses a laser diffraction analysis technique to determine the particle size distribution of the collected particulate matter. The sample is collected isokinetically by either USEPA Method 5 or USEPA Method 17. The advantage of using particle size analysis is the full particle size distribution can be obtained rather than just the PM₁₀ contribution.

Ektimo considers both methods will provide similar results for roughly spherical particles of known density. The delegated officer has therefore amended the works approval to include provision for stack sampling and measuring PM₁₀ using either and/or a combination of ISO 13320:2020, USEPA Method 17, USEPA Method 5 and USEPA Method 201A.

Changes to correction factor for calculation NO_x emissions

The fuel source for the lithium hydroxide refinery is gas. The Industrial Emission Directive (IED 2010/75/EU), a European Union Directive, specifies that emission limit values for gas turbines

and gas engines using gaseous fuel are calculated at STP using a standardized oxygen content of 15 % oxygen on a dry basis. In the absence of Australian alternative to the IED, the delegated officer considers a 15 % oxygen correction factor for NO_x for the calciner fan stack and sodium sulfate heater stacks to be appropriate.

Stack height changes

The air quality modelling presented in the EIA was undertaken on the basis of the adjusted stack heights. As predicted GLC were all well within relevant air quality criteria indicating the adjusted stack heights will not increase the risk of air emission impacts, the delegated officer determined it appropriate to update stack heights in the works approval.

5. Consultation

Table 5 provides a summary of the consultation undertaken by the department.

Table 5: Consultation

Consultation method	Comments received	Department response
Works approval holder was provided with draft amendment on 5 August 2024	Works approval holder responded on 7 August 2024 and waived the 21 day comment period and provided no comments.	The delegated officer notes this information.

6. Conclusion

Based on the assessment in this Amendment Report, the delegated officer has determined that a revised works approval will be granted, subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

6.1 Summary of amendments

Table 6 provides a summary of the proposed amendments and will act as record of implemented changes. All proposed changes have been incorporated into the revised works approval as part of the amendment process.

Table 6: Summary of works approval amendments

Condition no.	Proposed amendments
Definitions Table 1	Inclusion of RTO
Condition 6 Table 2	Update of stack heights and off-gas calciner stack. Inclusion of calciner RTO, wet scrubber and effluent tank construction requirements
Condition 12 Table 5	Inclusion of calciner off-gas system for train 1 (RTO, wet scrubber and effluent tank)
Condition 13 Table 6	Update of stack heights Inclusion of calciner RTO stack and removal of redundant calciner fan stack for train 1
Condition 15 Table 8	Inclusion of calciner RTO stack for train 1 and update methods for PM ₁₀ Update Note 2 from 3% to 15% oxygen
Maps	Update discharges to air location map

References

1. Department of Environment Regulation (DER) 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
2. Department of Water and Environmental Regulation (DWER) 2020, *Guideline: Environmental Siting*, Perth, Western Australia.
3. DWER 2020, *Guideline: Risk Assessments*, Perth, Western Australia.
4. DWER 2022, *Tianqi Lithium Kwinana Pty Ltd Works Approval W5977/2016/1 Amendment Report*, issued 2 August 2022, Perth Western Australia
5. DWER 2024, *Tianqi Lithium Kwinana Pty Ltd Works Approval W5977/2016/1*, issued 31 January 2024, Perth Western Australia
6. EAQ Consulting 2024, *Works Approval Emission Impact Assessment of Lithium Hydroxide Process Plant*, February 2024, Joondalup, Western Australia.
7. European Commission 2024, Industrial Emission Directive (IED 2010/75/EU) [Industrial Emissions Directive - European Commission \(europa.eu\)](https://european-council.europa.eu/media/documents/legislation/2010/75/2010_75_en.pdf).
8. Tianqi Lithium Kwinana Pty Ltd 2024, *Application and supporting documents for Works Approval Amendment W5977/2016/1*, Perth, Western Australia