1.0 Tenindewa Processing Plant – Air Emissions

Response to EPA query on Referral, June 2022

1.1 Processing Plant Operations

The Tenindewa processing plant will operate 24 hours, 7 days per week.

Point source emissions to air will be from:

- Kiln off-gas stack
- Dryer stack
- Furnace stack

1.2 Air Emissions Screening Calculation

An air emissions screening calculation has been undertaken, aligned with the draft *Air Emissions Guideline* (DWER, 2019).

Emissions to air screening calculations were estimated for each of the three sources, using:

- nominal stack off-gas quality – using the expected stack concentrations achievable using modern technology (as at 2004) as specified in the *Environment Protection Policy (Air Quality) 2004* (Tasmania). As detailed engineering progresses, off-gas quality for the Proposal is expected to be mitigated further, using more current technologies in conjunction with recognized global equipment suppliers (ie. TAPC, Fowlerex and Wheelabrator). For example, we know some of these suppliers' equipment can achieve stack particulate emission levels of 20 mg/Nm3. Currently, the Proposal-specific off-gas quality has not yet been determined but will be established using an iterative mitigation process as described in the following section.
- gas emission volume – predicted gas volume discharge rate per stack from the Tenindewa processing plant bankable feasibility study process flow calculations, adjusted to standard temperature and pressure (m^3/s)
- nominal stack heights – kiln stack nominally 50 m, dryer and furnace stack nominally 20 m
- attached AVL File Note – Air Emissions Environmental Limits

Emissions from the three sources were summed and compared to the ambient air quality guideline values (DWER, 2019) (**Table 1.1**).

Table 1.1 Air Emissions Screening Calculation

Air pollutant	DWER Guideline	Screening Calculation
	Annual averaging period (µg/m³)	
Particulate matter (PM10)	25	11
Nitrogen dioxide (NOx)	62	39
Sulfur dioxide / trioxide (SOx)	60	11

The screening calculation identified that combined air emissions from the Tenindewa processing plant stacks are predicted to be below the ambient air quality guideline values for particulate matter, nitrogen dioxide and sulfur dioxide in the draft *Air Emissions Guideline* (DWER, 2019).

Other air pollutants and averaging periods will be calculated as part of the detailed air emissions modelling and mitigation – see the following section.

1.3 Mitigation and Management Strategies

Air emissions will be mitigated to ensure that they comply with relevant limits for protection of human and environmental health.

The following mitigations have already been applied through site selection and preliminary design:

- The closest sensitive human receptor is 3.2 km northeast of the processing location. This is outside of the buffer distance separation of for vanadium processing facilities and sensitive land uses (1.5-3 km) recommended in the *Guidance for the assessment of environmental factors – Separation distances between industrial and sensitive land uses* (EPA, 2005).
- Nominal stack heights – kiln stack of 50m, dryer and furnace stack of 20m

Mitigation measures will be applied iteratively during the detailed engineering design process (over the next 12 months) to ensure that air emissions comply with relevant guidelines.

Firstly, ambient air concentration limits to protect sensitive receptors from adverse impacts will be sourced from relevant guidelines, such as the draft *Air Emissions Guideline* (DWER, 2019), *National Environment Protection (Ambient Air Quality) Measure* and *Guideline for assessing and minimising air pollution in Victoria* (Victoria EPA, 2022). The EPA Victoria guideline includes environmental air pollution assessment criteria, which will be relevant for protection of nearby nature reserves and agricultural land use.

Secondly, the process for iterative planning of mitigation measures is described below:

- Engineering controls will be applied prior to emissions from the stack to minimize pollutants emitted to air. Engineering controls will be determined as part of the engineering design process and discussion with potential equipment suppliers, and may include:
    - Selection of technologies (such as burners) with low emission rates (especially NOx)
    - Scrubbers and other gas treatment processes to reduce emissions before they leave the stack (especially SOx)
    - Physical separation systems (i.e. Electrostatic Precipitators and Baghouse Filters)
- The predicted stack emissions quality and stack height will be determined.
- Predicted ambient air emissions will be modelled and compared to relevant guidelines and averaging periods.
- Additional engineering controls or adjustments to the stack height will be made as required to ensure predicted ambient air emissions comply with relevant guidelines to protect sensitive receptors.

The air emissions modelling and engineering controls to mitigate air emissions will be assessed by DWER through applications under Part V of the EP Act.

Air emissions will be monitored during commissioning and throughout operations to ensure compliance with relevant limits. These include in-line gas and particulate samplers at the stacks as well as sample collection

points in and around the site. Part of this monitoring includes mobile samplers provided regularly to employees who carry them on person. Air emissions will be reported in the Annual Environmental Report to DWER.

Air Emissions Environmental Limits

This file note provides limits for stack air emissions that may be relevant to the Australian Vanadium Project.

The first section is the Western Australian Guideline, which is the standard we need to comply with, but it requires design criteria to then calculate compliance with emissions, which is a bit backwards.

The second section is a Tasmanian regulation, which is the best source available for SO_3 emissions, and usefully includes stack emissions for the major pollutants. The stack emission criteria proposed by Wood comply with this standard.

1.0 NEPM Ambient Air Quality Measure

Source: National Environment Protection (Ambient Air Quality) Measure, compilation date 18 May 2021

This source is used by the WA EPA.

National environmental protection standards must be assessed in accordance with protocol in Part 4 of the Measure. Part 4 requires monitoring stations to be established by a jurisdiction to monitor ambient air quality – as a representative measure of the air quality likely to be experienced by the general population in the region or sub-region. Performance monitoring stations required only for regions with a population of 25,000 people or more.

Each jurisdiction must evaluate and report population exposures to PM2.5 from June 2018 and NO2 from June 2021.

Schedule 2 – Standards and Goal

Column 1 Item	Column 2 Pollutant	Column 3 Averaging period	Column 4 Maximum concentration standard	DWER	Tas EPP
1	Carbon monoxide	8 hours	9.0 ppm	= DWER	= Tas EPP
2	Nitrogen dioxide	1 hour 1 year	0.08 ppm 0.015 ppm	< DWER (0.12) < DWER (0.03)	< Tas (0.16) N/A
3	Photochemical oxidants (as ozone)	8 hours	0.065 ppm	N/A	
4	Sulfur dioxide	1 hour 1 day	0.10 ppm 0.02 ppm	< DWER (0.2) < DWER (0.08)	N/A – SO3 0.033 mg/m3
5	Lead	1 year	0.50 µg/m^3	N/A	
6	Particles as PM_{10}	1 day 1 year	50 µg/m^3 25 µg/m^3	= DWER = DWER	< Tas (150)
7	Particles as $PM_{2.5}$	1 day 1 year	25 µg/m^3 8 µg/m^3	= DWER = DWER	

Reference material (WA NEPM): https://www.der.wa.gov.au/your-environment/air/203-air-quality-publications

2.0 DWER WA Air Guideline

Source: Guideline Air Emissions, Department of Water and Environmental Regulation (DWER), Draft 2019

DWER (environmental regulator) has limits expressed as **Ambient Air Quality Guideline Values (AGV)**, which are based on predicted ground level concentrations.

Ground level concentrations can be calculated using a preliminary screening method to determine whether they are likely to exceed to AGV. Inputs to this calculation are:

- relevant emission concentration (mg/m^3)
- emission volumetric flow rate (m^3/s) (dry basis at STP)
- stack height (to closest 10 m)

The calculated ground level concentrations need to be "insignificant" in relation to the AGV, otherwise detailed analysis and dispersion modelling of air emissions is required.

"Insignificant" means:

- Averaging period of 1 hour: <10% of AGV
- Average period of 24 hours: <3% of AGV
- Annual averaging period: <1% of AGV

Design specifications for relevant plant should ensure that the above inputs are such that the calculated ground level air emissions are insignificant with respect to the AGV**.** The AGV for 'Criteria pollutants' that are potentially relevant to the Project are listed in **Table 1**.

Table 1 Ambient air quality guideline values (AGV) for criteria pollutants

Substance	Averaging period	Max Ambient Concentration		
		ppm	µg/m³ at 0°C	µg/m³ at 25°C
Carbon monoxide	1 hour	25		30,000
	8 hours	9		10,000
Nitrogen dioxide	1 hour	0.12	246	226
	Annual	0.03	62	56
Particles (PM10)	24 hours		50	46
	Annual		25	23
Particle (PM2.5)	1 day		25	23
	Annual		8	7
Particle (TSP)	24 hours		90	82
Sulfur dioxide	1 hour	0.2	570	524
	24 hours	0.08	228	210
	Annual	0.02	60	52

Toxic substances – includes a long list of metals and "nasty" stuff, limits must be met everywhere within the modelling domain except within the specific processing plant premises. The AGV for relevant toxic substances are listed below.

- Vanadium – 24 hours averaging period, max ambient concentration 1 µg/m^3 at 0°C
- Ammonia – 1 hour averaging period, maximum ambient concentration 330 µg/m^3 at 25°C

3.0 EPP Air Quality, Tas

Source: Environment Protection Policy (Air Quality) 2004, Tasmania.

There is no WA standard that specifies sulfur trioxide. The clearest and most relevant document with SO3 emissions is a regulatory Environment Protection Policy (EPP) from Tasmania.

The Tasmania EPP also usefully lists expected standards for stack emissions using accepted modern technology (as at 2004). Relevant limits are provided in **Table 2** below.

Table 2 Tasmania EPP Air Quality – Relevant Limits

Pollutant	Stack emission at STP	Predicted maximum ground level concentration at premises boundary	
	mg/m^3	ppm	mg/m^3
Oxides of nitrogen	350 (as NO_2)	0.16 (NO_2, 1 hr avg)	-
Particulate matter	100	-	0.15 (PM_{10}, 24 hr avg)
Sulfuric acid mist or sulfur trioxide or both	100 (as SO_3 equivalent)	-	0.033 (sulfuric acid, 3 min avg)
Ammonia	-	0.83 (3 min avg)	0.6 (3 min avg)
Carbon monoxide	-	9.0 (8 hr avg)	-

4.0 Alternative sufur trioxide limits

Source: Toxicological Profile for Sulfur Trioxide and Sulfuric Acid, Agency for Toxic Substances and Disease Registry, USA, 1998.

Arizona acceptable ambient air concentration for sulfur trioxide (quoted source: NATICH 1996):

- 1 hour – 1300 µg/m^3
- 24 hour – 365 µg/m^3