SLAG RE-USE ENVIRONMENTAL MANAGEMENT PLAN

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1 ABBREVIATIONS

EMPCA	Environmental Management and Pollution Control Act 1994
EMP	Environmental Management Plan
EPA	Environment Protection Authority
EPN	Environment Protection Notice (7818/1), Feb 2019
SiMn	Silicomanganese
FeMn	Ferromanganese
LBB	Liberty Bell Bay
Liberty Bell Bay	Formerly Tasmanian Electro Metallurgical Company Pty Ltd (TEMCO)

2 INTRODUCTION

The Liberty Bell Bay (LBB) facility is situated 2 km southeast of George Town and 46 km north of Launceston on the east bank of the Tamar River estuary within the local government municipality of George Town.

Figure 1: Site location map

Liberty Bell Bay is a manganese alloy smelter supplying Australian and overseas steel makers. The site operates four submerged arc electric smelting furnaces to produce ferromanganese (FeMn) and silicomanganese (SiMn) alloys, and a Sinter Plant for producing manganese sinter.

The site is required, by Environmental Protection Licence 7818/1, condition WM3 'Management and Disposal of SiMn slag', to provide the EPA with a SiMn slag Reuse Environmental Management Plan (REMP), the plan must be approved prior to any SiMn slag being removed from the Bell Bay precinct unless otherwise approved by the Director.

3 EPN 7818/1 SLAG REUSE EMP

This Slag re-use plan has been prepared to meet the requirements of Environment Protection Notice (EPN) 7818/1 as shown in Table 1 below.

Table 1: Compliance to EPN 7818/1, WM3

EPN Requirement
Management and disposal of SiMn slag: 1. A detailed SiMn slag Reuse Environmental Management Plan (REMP) must be submitted to the Director for approval. 2. The REMP must be approved prior to any SiMn slag being removed from the Bell Bay precinct unless otherwise approved by the Director. 3. The REMP must outline the proposed reuse options and associated environmental impacts and controls. 4. Any changes to the approved REMP must be approved by the Director in writing.

4 SITE DESCRIPTION AND BACKGROUND

SITE DESCRIPTION AND HISTORY

The operational land owned by Liberty Bell Bay is split into a number of land uses, as shown in Figure 2. Operational areas occupy the centre of the site, where the furnaces, sinter plant, ERU, maintenance workshop and office buildings are located. To the east of the operational areas are the sub-station compound, car park, buffer zone and wetlands for surface run off. To the west of the operational areas are the fume dams, landfill areas, slag stockpiles and buffer zone. Storage areas for raw materials and products are located on the north side of the site along Old Bell Bay Road. An additional slagheap is located on the south side of Furnace 5 where hot slag is placed for cooling and storage. Figure 3 provides further detail of the location of site infrastructure.

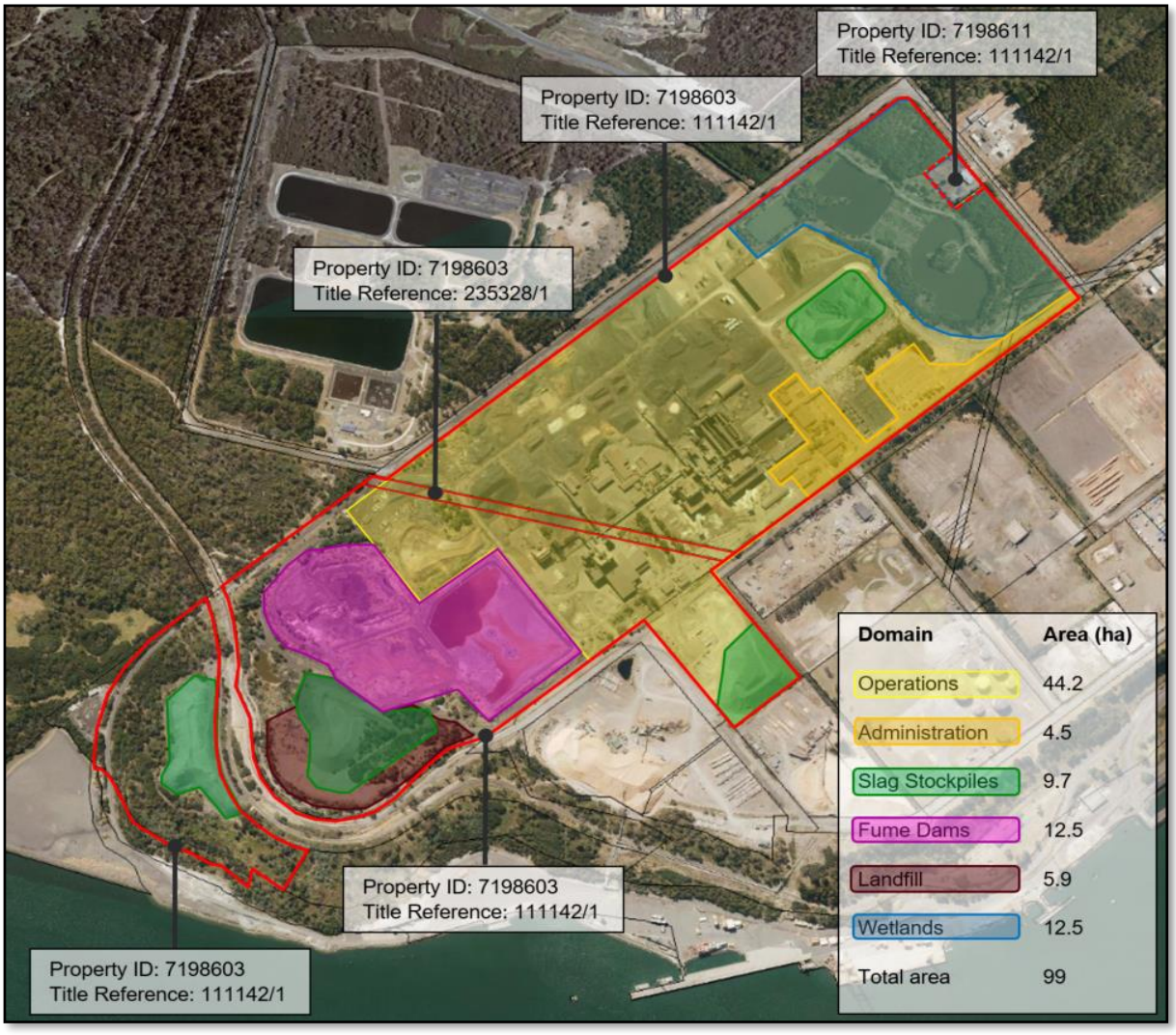

Figure 2: Current Liberty Bell Bay land uses

The plant was opened when Furnace 1 started production in May 1962. Furnaces 2, 5 and 3 were commissioned in 1966, 1976 and 1977 respectively. The Sinter Plant aided efficiency when it was commissioned in 1976. In 1987, an Energy Recovery Unit (ERU) was commissioned to utilise energy lost in carbon monoxide gases released from Furnace 5.

Figure 3: Infrastructure layout

OBJECTIVES OF THE PLAN

This Silico-Manganese (SiMn) Slag and Jigging Tailings Reuse Environmental Management Plan (REMP) sets out reuse options and controls to manage potential environmental impacts for the reuse of Silico-Manganese Slag and Jigging Tailings.

Following this REMP's approval by the Tasmanian Environmental Protection Authority (EPA), the use of slag and jigging tailings in accordance with this plan will be approved for the following applications:

- Subbase for roads and hard-stand areas; and
- Aggregate bound in concrete or bitumen.

The environmental impacts considered include those associated with all stages of storage and handling outside the Liberty Bell Bay site including transport, off-site stockpiling and final-end use of the material. The re-use applications contained in this REMP involve minimal to no long-term surface water and groundwater interaction in order to minimise the generation of leachate.

Should other reuse applications and opportunities arise then this REMP will be revised and submitted for re-approval by the EPA prior to undertaking those applications/opportunities, for example land reclamation similar to that undertaken by TasPorts at Bell Bay may, depending on the circumstances, be an appropriate reuse option.

In view of the previous use of slag within the Bell Bay Heavy Industrial zone and the fact that the area is likely to remain as a heavy industrial zone, the reuse of SiMn slag is considered acceptable for inclusion in construction activities, such as fill and/or for road building for projects within the heavy industrial zone adjacent to Liberty. All re-use applications within the Bell Bay Heavy Industrial Zone must ensure minimal to no long term groundwater interaction in order to minimise the generation of leachate.

5 SIMN SLAG

DESCRIPTION OF SLAG

Liberty (LBB) produces two types of SiMn slag products:

- SiMn slag ("Slag"); and
- SiMn slag tailings ("Jigging Tailings")

Slag is a dense, relatively inert, glassy material produced as co-product of the silico-manganese smelting process.

When the furnaces producing SiMn alloy are tapped, molten alloy and slag pour from the tap hole. The alloy and slag are separated by density with the molten slag diverted into a large pot. The pot is transported to the casting bays and the slag is deposited into the casting bays (south of the main site). In the casting bays the molten slag cools to a solid then is broken up by an excavator and removed by front end loader to be stockpiled.

Jigging tailings are a further co-product produced from re-processing slag pot skulls. Skulls are a high alloy content slag (16-20% wt) layer that forms on the inside surface of the pots which is removed periodically. Once removed from the pot and cooled, the skulls are crushed, screened and processed through a gravitational separator (jig) to recover the SiMn alloy. With the alloy recovered, the remaining material is referred to as Jigging Tailings. Jigging tailings are chemically and physically similar to slag but have a slightly higher manganese content and smaller particle size as shown below.

Slag **Jigging Tailings**

SIMN SLAG CHARACTERISTICS

Geochemical

Slag is a siliceous glassy material, hence has very low primary porosity and is physically and chemically stable.

The composition of SiMn slag is approximately 41% Silica, 11% MnO, 16% Al_2O_3, 17% CaO.
Slag does not contain significant levels of sulfide (usually around 0.5%) and has high acid neutralising capacity (around 40 times the acid producing potential) and hence does not represent a risk of acid formation and subsequent increased metal leaching over time.

The pH is slightly alkaline which promotes low metal solubility except for amphoteric elements (soluble under both acidic and alkaline conditions), which includes Beryllium, Aluminium, Zinc, Tin and Lead. Aluminium and Zinc are of particular interest with respect to slag and potential generation of leachate – particularly at higher pH's.

Solid Waste and Leachate Classification

Analysis of slag and jigging tailings (GHD, 2015) against criteria in EPA Tasmania Information Bulletin 105 "*Classification and Management of Contaminated Soil for Disposal*" indicates the following :

- Total manganese concentration exceeds the EPA Level 3 landfill limit, whilst barium & beryllium concentrations exceed the Level 2 limits. All other total metal parameters meet level 1 (fill material) criteria.
- TCLP leachate exceeded manganese level 3 limits in some samples (including 3 out of 3 jigging samples) and zinc level 2 guidelines in all samples.

It is important to note that TCLP leach criteria is conservative and assumes the material is subject to acid conditions in a landfill. The above is provided for initial characterisation purposes only. Actual slag and jigging tailings reuse applications covered by this REMP will generate negligible leachate as the material will be either bound in a concrete or bitumen matrix, placed as subbase in roads and hardstands where there will be minimal contact with water or in free draining environments that minimises contact time with water.

Furthermore, Barrel leach tests (GHD, 2019) have demonstrated that in free draining environments any leachate is expected to be below environmental trigger values with short time frames (<4 months), where rainfall is similar to that experienced at Bell Bay. In a saturated environment leachate becomes alkaline and the solubility of aluminium increases and exceeds trigger values, likely due to the reducing environment of the slag. In a saturated environment, manganese concentrations in leachate is generally below the 95% trigger after 6 months. It should be noted that older slag (i.e. already weathered, prior to tests) had lower metal concentrations that the newer less weathered slag. Firstly, given the prescribed uses preclude using the slag in saturated environments, the risk of aluminium solubility is low. Secondly, utilising slag that has been weathered on site 6 months prior to any reuse will further reduce the environmental risk.

Both the TCLP leach testing and the barrel leach tests confirm that slag re-used in non-saturated (free draining) environments for uses such as those proposed in the REMP are unlikely to generate adverse environmental effects, this is particularly true for slag that is bound in concrete or bitumen and for older slag that has already been weather for more than 6 months prior to reuse. Therefore, one of the key criteria (expressed throughout this REMP) is that reuses need to be in free draining environments. Further test work would be required to reuse slag in saturated environments to determine leachate trends (aluminium) beyond 6 months and potentially develop mitigation strategies to address the risk.

4.2.3. Controlled Waste Classification

Slag is currently considered a controlled waste. A controlled waste may only be exempted from the *Environmental Management and Pollution Control (Waste Management) Regulations 2020* if the EPA Director provides an exemption.

Once the Director EPA has approved this REMP, all material reused in accordance with this REMP will also be reused in accordance with the controlled waste requirements of the *Environmental Management and Pollution Control (Waste Management) Regulations 2020.* This REMP will remove the need to obtain a Reg 21 approval for each use of slag, albeit the uses, processes and environmental controls will be broadly similar. However as a controlled waste, all transported materials must be transported by a registered controlled waste transporter.

6 REGULATORY CONTEXT

KEY LEGISLATION

Key regulatory requirements relevant to the reuse of slag and jigging tailings are summarized below:

- EPN 7818/1
- Environmental Management and Pollution Control (Waste Management) Regulations 2020
- Environmental Management and Pollution Control (Controlled Waste Tracking) Regulations 2010
- EPA Tasmania Information Bulletin 105 'Classification and Management of Contaminated Soil for Disposal"
- State Policy on Water Quality Management 1997
- Environment Protection Policy (Air Quality) 2004

7 SIMN SLAG REUSE PROCESSES

OVERVIEW

If required, Slag and jigging tailings will be re-processed (i.e. crushed and screened) at LBB, adjacent to existing stockpiles. Stockpiles of processed material will be located on the LBB site until transported off site for reuse.

Off-site reuse of the material will be restricted to:

- subbase for roads and hard-stand areas; and
- aggregate bound in concrete or bitumen.

Material used as subbase in roads and hardstands will be placed to minimise contact with water (above the water table and a free draining as realistically possible)

Material transported off-site should be used as soon as practical, should it be necessary to store prior to use, then storage/stockpiling time should be less than 90 days and adhere to the same principals as material used as road subbase or hard-stand areas.

Reuse of the slag and jigging tailings will involve the following process steps:

(1) Orders (managed by LBB's Slag contractor)

(2) Risk assessment to determine site suitability (LBB)

(3) Processing (Crushing and Screening) at LBB

(4) Processed Material Stockpiling at LBB

(5) Transport off-site to reuse location

(6) End Use Verification at off-site reuse location

ORDERS

LBB's Slag Contractor ("Contractor") will be responsible for administering orders of processed slag and jigging tailings for off-site reuse.

The criteria for each order of slag and jigging tailings will include:

- Risk assessment of activity/site to determine suitability if slag is not bound in final use
- Minimum sale quantity of 1 full truck load (subject to trucks available)

For use in one project in one location for the following purposes:

- Road Subbase as classified by *Roadworks Specification R40, Pavement Base and Subbase July 2014*; or
- Hard stand subgrade material as classified by the *Roadworks Specification R40, Pavement Base and Subbase July 2014;* or
- Aggregate to be bound in concrete or bitumen

Prior to completion of the order the Contractor will disclose the terms and conditions to the customer (e.g. An Agreement-to-Take or Sale Agreement, example provided in Appendix B) which are as follows:

The Tasmanian Environment Protection Authority (EPA) has approved the following uses of SiMn Slag and Jigging Tailings:

- Road subbase
- Hardstand subbase
- Aggregate bound in concrete or bitumen.

• EPA approval for use of the material as subbase is on the basis that there will be minimal to no interaction between the slag or jigging tailings with water (as described above) once the road or hardstand has been completed.

End users of slag and jigging tailings must:

Minimize the generation of dust by damping down the material when being unloaded, spread, covered, mixed or compacted with other road base and hard stand materials.

- Limit stockpiling of material to temporary stockpiles for temporary storage prior to application. Temporary storage should not exceed 90 days.
- Permit the Contractor or other LBB representatives to undertake site inspections/audits to verify that the material has been used only for the Approved use.

The slag and jigging tailings customer ("Customer") will provide the Contractor with a request for bulk product and enter into a agreement to take the product. The agreement is to include acknowledgement of the conditions the customer is required to meet in relation to handling and use of the slag.

The Contractor will:

- document and record all relevant details prior to commencing processing; and
- notify LBB following receipt of all slag and jigging tailings orders.

TRANSPORT OFF-SITE

Transport off-site of processed slag and jigging tailings to the end use location will be undertaken by LBB's Slag Contractor ("Contractor") via covered loads. All materials will be tracked and monitored by the Contractor via a tracking and recording system described below.

Tracking of Materials

The Contractor will track the off-site transport and delivery of all slag and jigging tailings to the Customer. Details recorded by the Contractor for all material leaving LBB will include:

- Date of delivery
- Customer name
- Delivery job site
- Contractor truck and trailer fleet numbers
- Contractor driver name
- Activity/work conducted
- Time the work commenced and finished (including the time the load left LBB and arrived at the reuse location)
- Number of loads and the tonnage of each load (as weighed over the LBB weighbridge)
- Signature of the Customer and the driver once the cartage has been completed, acknowledging receipt of the material.

A copy of the above details will be provided to the Customer.
The Contractor will:

- Keep a record of all material transported from the LBB site and make these records available to LBB and the EPA upon request.
- Provide LBB with a monthly report summarising the quantity of material transported off-site each month and the receiving Customer.

END USE VERIFICATION

End Use Verification

The conditions of EPA's approval for the reuse of slag and jigging tailings are specified at the Order stage and documented in the Agreement-to-Take with the Customer (as described above).

Verification

Verification of all off-site slag and jigging tailings end use will be undertaken in the form of a site visual inspection to confirm that all material has been used for the intended project and location.

The visual inspection will be undertaken by the Contractor on behalf of LBB. The Contractor will provide documented evidence of the verification inspection including photo evidence where appropriate to LBB, linking to the original Purchase order.

The verification record provides a documented record of end use quantities, application and final location of the slag and jigging tailings.

RESPONSIBILITIES

LBB maintains overall responsibility for the management of slag and jigging tails. LBB has responsibility for the Agreement-to-Take process, processing (crushing), stockpiling, off-site transport and end use verification.

1. Raw Stockpiling (LBB)
2. Orders/Agreements (Contractor)
3. Processing (LBB/Contractor)
4. Processed Material Stockpiling (LBB/Contractor)
5. Transport (Contractor)
6. End Use Verification (End User/LBB/Contractor)

SiMn Slag Reuse Stages and Responsibilities (shown in brackets)

8 ENVIRONMENTAL IMPACTS AND CONTROLS

DUST

Potential Impacts

Slag and jigging tailings contain manganese at levels that have the potential to adversely impact on human health if inhaled in dust form in high concentrations over a prolonged period of time. Dust created by the handling of slag and jigging tailings also has the potential to cause nuisance fallout in the surrounding environment.

Dust generation during the handling and processing of slag and jigging tailings should therefore be minimised.

The potential impact from dust during off-site transport is not considered significant as all transportation loads will be covered prior to moving off the LBB site.

There is potential for dust to be generated during temporary off-site storage (to be managed through the agreement-to-take and during final use/placement of the materials, however the final reuse applications of the material as proposed in this EMP will not generate dust.

Mitigation Strategies

All off-site transport of slag and jigging tailings will be in covered loads.

The conditions of the agreement-to-take will require that slag and jigging tailings only be stored in temporary stockpile(s) prior to immediate application as road subbase or hardstand sub material and damping down prior to unloading and handling to minimise dust.

SURFACE WATER

Potential Impacts

Leachate from slag and jigging tailings has the potential to contain low concentrations of manganese, zinc, aluminium and other metals. However if the material is stored or used above the water table and/or in a free draining environment the risk of leachate generation is significantly reduced.

The final reuse applications proposed in this EMP will generate little to no leachate as there will be minimal contact with water (free draining and/or bound up), and material used as aggregate in concrete or bitumen will be bound.

8.2.2 Mitigation Strategies

The conditions of the agreement-to-take will require that slag and jigging tailings only be stored in temporary stockpiles prior to immediate application as road or hardstand subbase. Temporary storage should not exceed 90 days.

Only slag that has been weathered on site for at least 6 months will be supplied.

The verification inspection undertaken by the Contractor will provide evidence of temporary storage (when, where and for how long) and that the final reuse is consistent with the approved end use.

Delivery records, tracking and verification reports will provide a record confirming the location and final use of the material. The Contractor will provide records to LBB of verification inspections.

GROUND WATER

8.3.1 Potential Impacts

While leachate from slag and jigging tailings has the potential to contain low concentrations of manganese, aluminium, zinc and other metals, the approved use of slag (as subbase for roads and hardstands, or as aggregate in concrete and bitumen) will prevent exposure to groundwater and therefore the risk to groundwater is considered insignificant.

8.3.2 Mitigation Strategies

The conditions of the agreement-to-take will require that the slag and jigging tailings only be used as approved (i.e. as subbase for roads and hardstands, or as aggregate in concrete and bitumen). Furthermore, the agreement will require that slag and jigging tailings only be stored in temporary stockpiles prior to application. Temporary storage should not exceed 90 days.

Only slag that has been weathered on site for at least 6 months will be supplied.

Delivery records, tracking and verification reports will provide a record confirming the location and final use of the material. The Contractor will provide records to LBB of verification inspections.

REVIEW

The following review activities will be conducted:

• LBB and the Contractor will review annually the processes for slag and jigging tailings reuse to identify opportunities for improvement.

• LBB will incorporate in its annual report to EPA:

  - The quantity of material transported off-site for reuse
  - A summary of reuse verification inspections.

• Any revisions or amendments to this EMP will be submitted to the EPA for approval and communicated to the Contractor

9 COMMITMENTS SUMMARY

A summary of the key commitments to control environmental impacts associated with reuse of slag and jigging tails are summarised in Table 1.

Table 1 Commitments

Commitment	Requirement	Responsibility	Timeframe
Dust	• Off-site transport will be in covered loads • Conditions of agreement-to-take to identify dust management controls and approved end uses	Contractor/Customer	Prior to Agreement and Processing
Surface Water	• Conditions of agreement-to-take to identify temporary storage requirement and approved end uses	Contractor/Customer	Prior to Agreement and Processing
Groundwater	• Conditions of agreement-to-take to specify approved end uses	Contractor/Customer	Prior to Agreement and Processing
Tracking & Verification	• Maintain Tracking Record System for all slag and jigging tails	Contractor	Ongoing

	• Visual inspection and verification report to confirm location, quantity and that end use is consistent with conditions of agreement-to-take	Contractor	Within 1 month of project completion / or within 6 months of sale.
Review	• Annual review of slag and jigging tailings reuse processes	LBB	Annually
	• Include in Annual Report to EPA: quantity of material removed from site for reuse; and summary of reuse verification inspections.	LBB	Annually
	• Submit any REMP amendments to the EPA for approval and communicate any changes to the Contractor	LBB	As required

10 APPENDICES

APPENDIX A: EXAMPLE AGREEMENT-TO-TAKE

Attn: Customers,

LIBERTY BELL BAY SiMn Slag & Jigging Tailings Agreement-to-Take

In accordance with a Services Agreement between LBB and "Contractor" Bell Bay, the requirements for the off-site reuse ("controlled reuse") of slag are as follows:
>>insert "End User Customer"
>> insert Contractor Order reference
>> insert project name, location (end use location), SiMn Slag or Jigging Tailings Purchase qty,
The Tasmanian Environment Protection Authority (EPA) has approved the following uses ("Approved Use") of SiMn Slag and Jigging Tailings:

- Road subbase
- Hardstand subbase
- Aggregate bound in concrete or bitumen.

Use as subbase has been approved on the basis that there will be minimal to no interaction between the SiMn Slag or Jigging Tailings with water, including groundwater, once the road or hardstand has been completed.

End users of SiMn Slag and Jigging Tailings must:

- Minimize the generation of inhalable dust by damping down the material during unloading and handling.
- Limit stockpiling to temporary stockpiles for temporary storage and immediate application. Temporary storage should not exceed 90 days.
- Permit the Contractor or other LBB representatives to undertake site inspections to verify that the material has been used only for the Approved Use.