Spent pot lining project (feasibility of an agreement based approach to clear stockpiles)

Final national summary report

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In association with:
Spent pot lining project (feasibility of an agreement based approach to clear stockpiles)

Final national summary report

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Executive summary

In March 2016, the Department of the Environment and Energy (DoEE) engaged Randell Environmental Consulting (REC) in association with Ascend Waste and Environment to complete the Spent Pot Lining (SPL) project (feasibility of an agreement based approach to clear stockpiles). SPL is a waste material generated from aluminium smelters, of which there are four in current operation in Australia and two recently closed down. Aluminium smelting is the extraction of aluminium metal from aluminium oxide (also known as alumina). The process takes place in electrolytic cells that are known as ‘pots’\(^1\). The photo below shows one of Australia’s largest ‘potlines’ at Boyne Smelters Limited in Qld. As illustrated below each smelter has a large number of pots to maintain – the higher the number of pots the higher the smelter’s aluminium production.

**Figure E1 Aluminium smelter ‘pot line’ at Boyne Smelters Limited Qld**

A cross section of a pot is provided in Figure E2 which illustrates that pots are made up of a steel potshell with two linings, an outer insulating or refractory lining and an inner carbon lining that acts as the cathode. The pots also include a carbon based anode which is consumed during the pot operation, but can be replaced before the pot (cathode) reaches the end of its life.

\(^1\) Sometimes referred to as cells, hence SPL is often referred to as SCL – they are the same thing.
JOM 2013 explains “the lining, during operation of the cells, is subject to strong reducing conditions and fails after 5-8 years by a variety of mechanisms depending on how the cell was constructed, designed and operated” (page 1441).

When the pot lining fails – spent pot lining waste is generated.

The pot linings are removed by being broken up. The contaminated carbon lining material that is removed is referred to as first cut SPL. The contaminated refractory lining material is referred to as second cut SPL.

As the SPL is removed it breaks up into different sized pieces ranging from large blocks to fine granular pieces. Some smelters keep the first and second cut SPL separate, other do not and the SPL is removed as one ‘cut’. The photos below illustrate the SPL removal process.

During the operation of the pots, substances, including fluorides, cyanides and aluminium are absorbed into both cell linings.

Both first and second cut SPL are hazardous waste due to:

- toxicity – leachable fluoride and cyanide compounds, with fluoride levels often around 10 parts per hundred (%)
- corrosiveness – high pH due to the presence of alkali metals and oxides
reactivity with water – producing toxic, explosive, and inflammable gases.\(^2\)

E1 Project scope

DoEE provided a letter of introduction for project stakeholders that outlined the project scope as follows:

“The project will assess the feasibility of using an agreement between industry and governments to clear the stockpiles of spent pot liner (SPL) present in Queensland, New South Wales, Victoria and Tasmania, over a ten year or similar period. The project aims to determine the feasibility of such an agreement approach, and if feasible, what might be required to address the circumstances of the different SPL stockpiles across the jurisdictions.”

This project is not aiming to draft any industry-government agreements. It aims to understand if it is possible for agreements to be developed that would result in a drawdown of SPL stockpiles over a period of around 10 years.

This report is intended for publication on the DoEE website. Information that has been identified as confidential or commercial-in-confidence information is either not included in this report or has been redacted (see red blocks of text).

E2 Project background and context

In 2015 DoEE commissioned a study of hazardous waste arisings and infrastructure capacity in Australia called the Hazardous waste infrastructure needs and capacity assessment\(^3\).

The study identified that a significant SPL stockpile had accumulated in Australia and concluded the following:

“The storage of large quantities of spent potlining from aluminium smelting should be a social concern, especially given the recent decline of this industry. The three current operators able to process this waste report sufficient capacity to process the stockpile over a 10-15 year period. A mismatch between demand and capacity could cause inappropriate treatment or demand for exports. A nationally coordinated negotiation with the industry is recommended.

Recommendation 6: DoEE should consult with the aluminium industry and NSW, Vic, Qld, Tas State Governments to develop a nationally agreed approach to the management of spent potlining stockpiles that ensures their eventual removal and ongoing recovery or treatment.” Page xxi.

This project responds in part to these recommendations.

Environmental legislation administered by the Australian Government and State Government environmental regulators does not support the long term stockpiling of hazardous wastes onsite where it poses ongoing potential risks. The short term storage of SPL in suitable shedding onsite may

\(^2\) Source: JOM2013
\(^3\) Available at: https://www.environment.gov.au/protection/publications/hazardous-waste-infrastructure-needs-capacity-assessment
be appropriate; however, onsite stockpiling in sheds is not a long term solution for SPL management, where the SPL remains exposed to risks such as extreme weather events.

The Australian Government, therefore, seeks to understand if it is feasible to use an agreement based approach with the aluminium industry stakeholders that will result in a plan to drawdown the Australian SPL stockpile over the next 10 years.

E3  Aluminium production and new SPL arisings

Australia’s operational and closed aluminium smelters sites are summarised in the table below.

**Table E1: Australian aluminium smelters operational and closed**

<table>
<thead>
<tr>
<th>State</th>
<th>Majority owner</th>
<th>Common site name</th>
<th>Production began</th>
<th>Status</th>
<th>Smelter location</th>
<th>Al production (t/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSW</td>
<td>Hydro</td>
<td>Hydro Kurri</td>
<td>1969</td>
<td>Closed</td>
<td>Kurri Kurri</td>
<td>NA (180,000)</td>
</tr>
<tr>
<td></td>
<td>Tomago Aluminium</td>
<td>Tomago</td>
<td>1983</td>
<td>Operational</td>
<td>Tomago</td>
<td>590,000</td>
</tr>
<tr>
<td>QLD</td>
<td>Pacific Aluminium</td>
<td>BSL (Boyne Smelters Limited)</td>
<td>1982</td>
<td>Operational</td>
<td>Boyne Island</td>
<td>&gt;570,000</td>
</tr>
<tr>
<td>VIC</td>
<td>Alcoa</td>
<td>Portland</td>
<td>1986</td>
<td>Operational</td>
<td>Portland</td>
<td>304,000</td>
</tr>
<tr>
<td></td>
<td>Alcoa</td>
<td>Point Henry</td>
<td>1963</td>
<td>Closed</td>
<td>Point Henry</td>
<td>NA (192,000)</td>
</tr>
<tr>
<td>TAS</td>
<td>Pacific Aluminium</td>
<td>Bell Bay</td>
<td>1955</td>
<td>Operational</td>
<td>Bell Bay</td>
<td>180,000</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>~1,650,000</td>
</tr>
</tbody>
</table>

**Note:** Production tonnages for closed sites (in brackets) refers to production in year before closure.

Australia is currently producing about 1.65 Mt of aluminium per annum. Based on the JOM 2013 typical figure of 22kg SPL per tonne of aluminium production, it can be estimated that Australia is currently generating about **36,000 tonnes of SPL per annum**.

Figure E4 illustrates the locations of Australia’s currently operating and closed aluminium smelters. It also includes the locations of the Australian SPL waste management providers (WMPs) that are discussed in the report main body, Section 6.
Australia has a significant stockpile of SPL with a total of around 700,000 tonnes of SPL in either above ground or below ground storages (landfills) around Australia.\(^4\)

Just under half of Australia’s SPL stockpile (about 310,000 tonnes) is stored in above ground stockpiles. Interestingly there is a higher proportion of 1st cut SPL (about 114,000 tonnes) than 2nd cut SPL (about 74,000 tonnes) in these stockpiles. The high carbon content in 1st cut SPL has historically meant that there have been more processing options for 1st SPL cut than 2nd cut SPL. The largest portion of the above ground stockpile is mixed 1st and 2nd cut SPL (about 120,000 tonnes).

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\(^4\) SPL stockpile tonnages provided by each smelter. Note: the project scope included no audit or confirmation of the stockpile information provided beyond viewing of stockpiles during site visits.
Slightly more than half of Australia’s SPL stockpile (about 390,000 tonnes) is stored in landfills onsite at several sites around Australia. The composition of the landfilled SPL is not known, but is likely to be around 50-60% 1st cut and 40-50% 2nd cut SPL.

E5 Site aboveground SPL stockpile drawdown plans

The following definition for an ‘SPL drawdown plan’ has been adopted for this report and analysis. A ‘SPL drawdown plan’ is a plan that has at least 2 of the following:

1. The smelter can demonstrate a recent (i.e. the last 3 years) history of significant stockpile drawdown. It should be noted that, during consultation, several smelters provided data/charts that illustrated that in the last few years SPL stockpile processing rates have increased, resulting in partial drawdown of existing stockpiles.

2. Commercial arrangements are in place between the smelter and SPL WMP/s that will result in the drawdown of SPL stockpiles and the management of any new SPL arisings.

3. The estimated timeframe for the drawdown of the SPL stockpile has been provided for this public summary report.

Of the six smelting sites in Australia, only Tomago Aluminium has a drawdown plan in place that will have all SPL stockpiles removed from the site well within a 10 year period. Alcoa Portland also has a drawdown plan in place that is likely to result in all stockpiles removed in around 10 years.

Pacific Aluminium sites at Bell Bay and Boyne (BSL) have drawdown plans in place, however the plans may take up to 10 or more years to implement, depending on the SPL processing rates that are achieved in future.

At the time of writing we understand that the Alcoa Point Henry drawdown plan was still under development. The smelter is closed and undergoing site decommissioning to allow for future development.

At the time of writing we understand that the Hydro Kurri Kurri drawdown plan was still under development. The smelter is closed and undergoing site decommissioning to allow for future development. Hydro stated that they are planning for above ground SPL stockpiles to be recycled over the next 3 to 4 years.

E6 Capacity of SPL waste management providers (WMPs)\(^5\)

The capacity of Australia’s currently operating SPL WMPs consists mostly of ‘treatment and processing’ facilities in Vic and NSW. The capacity of ‘treatment and processing’ facilities is related to the off-take markets for treated and processed SPL, see Section 6.6.1 and 7.6 for further discussion.

\(^5\) SPL waste management providers (WMPs) for this report are defined as: a third party company that provides services to the aluminium smelting industry that result in the smelter’s SPL stockpiles being processed, or sent to approved long term storage facilities. As per the project brief, SPL WMP options discussed include national and international SPL processing options and long term storage facilities in Australia (only).

\(^6\) Off-take market refers to the market of options/clients for SPL that is treated and processed to a standard that is fit for a defined purpose.
Cement kilns in Qld and Tas provide the remainder of the operational SPL WMP capacity. The total licensed/process capacity of Australia’s operational SPL WMPs is estimated at around **100,000 tonnes per annum**.

The current export options for SPL management include mineral wool (Rockwool) manufacture in Germany and Befesa in Spain. Befesa recycle aluminium dross salt slags and other residues from dross recycling and use SPL to reduce energy input requirements. Australia has exported around 120,000 tonnes of SPL to European SPL WMPs since the early 1990s and has a permit pending for another 6,000t to be exported. Research, presented in Section 6, indicates that there is significant capacity for SPL processing at Befesa and Rockwool. However, their ‘spare capacity’ to receive Australian SPL is unknown and would be subject to individual contract negotiations between the aluminium smelter and Befesa or Rockwool.

Australia may also soon have long term storage options available in the NT and WA where Tellus have proposed facilities, however, these facilities are yet to be licensed.

**E7 Considerations for any agreement**

Stakeholder consultation and project research identified several important considerations for any SPL stockpile drawdown agreement to consider. They are listed below and discussed in full in Section 7 (a few of these considerations are also discussed in this summary).

1. Aluminium smelting market conditions.
2. SPL WMPs charges (fees).
3. The site specific conditions including:
   a. The site’s SPL stockpile profile
   b. Impacts on local environment and intended site afteruse
   c. Proximity of SPL WMPs.
4. Australian (State and Commonwealth) SPL legislative framework.
5. International SPL legislative frameworks and incentive programs.
6. State, national, and international SPL WMP’s capacity.
7. The stability of ‘off-take’ markets for treated and processed SPL.
8. Local community engagement.
10. SPL WMP competition and market considerations.

**E8 SPL waste management costs**

The financial costs of SPL waste management are significant. Industry has commented that historically SPL WMPs fees have been in the order of $1000/tonne. These costs have reduced significantly in recent years but still remain a significant consideration and concern for the smelting industry.
The liabilities/costs discussed above present costs to send SPL to a WMP. They are not inclusive of costs to manage other (non-SPL) landfilled materials or costs for other site remediation that could be required. These costs could be a significant addition to the total costs.

There are also costs associated with maintaining SPL in landfills onsite (not removing the stockpile using a SPL WMP).

**E9  Australian above ground SPL stockpile (plus new arisings) versus SPL WMP capacity**

The project analysis indicates that the Australian above ground SPL stockpile could theoretically be drawn down in four or more years (whilst continuing to process new arisings). It is important to note that this theoretical drawdown timeframe is indicative only as there are several important considerations, as listed under E7, which may impact on the actual drawdown timeframe.

Whilst noting these considerations, the comparison of above ground stockpile tonnages with Australia’s currently operating SPL WMPs capacity indicates that it is possible for Australia’s above ground SPL stockpile to be drawn down over a ten year period (whilst continuing to process new arisings).

The analysis also indicates that there is sufficient capacity available in Vic and NSW to drawdown SPL stockpiles within the nominal 10 year period that DoEE has identified. The analysis for Qld and Tas indicates that these states have limited SPL processing capacity beyond the tonnage of new annual arisings and would require more than 10 years to drawdown the SPL stockpiles using local capacity alone. For Qld and Tas the analysis indicates that any agreement may need to consider interstate or

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7 The estimation of the costs associated with the landfilling of SPL is beyond the scope of this project.
8 Australia’s currently licensed and operating SPL WMPs process SPL. Research, presented in Section 6, indicates that there is significant capacity for SPL processing at Befesa and Rockwool (in Europe). However, their ‘spare capacity’ to receive Australian SPL is unknown and would be subject to individual contract negotiations between the aluminium smelter and Befesa or Rockwool. Australia currently has no licensed capacity for SPL long term storage. Therefore, the capacity of SPL processing capacity in Australia (rather than overall WMP capacity) is used in the analysis of SPL stockpile drawdown rates.
9 Timeframes are presented as ‘x or more’ years reflecting the range of considerations and uncertainties that are outlined in Section 7.
international management options or the establishment of additional local SPL WMP capacity. Refer to Section 7.3.1 for discussion of the requirements for interstate movements of SPL.

E10  Australian total SPL stockpile and annual arisings versus SPL WMP capacity

It is important to note that the decision to require processing of any landfilled SPL would be made by the relevant state government regulator.

The processing of any landfilled SPL would also be subject to demonstration that the SPL removed from landfill is able to be processed. Contamination from non-SPL wastes such as asbestos could prevent processing of some landfilled SPL.

For drawdown calculation purposes, the analysis indicates that, should it be required and technically feasible, Australia’s total SPL stockpile and new arisings could theoretically be processed in eight or more years (assuming that 100% of landfilled SPL was processed) or in six or more years (assuming that 50% of landfilled SPL was processed).

E11  Agreement options and agreement co-funding

Whilst this project has identified a significant number of considerations and issues with SPL management, the project identified just three ‘agreement options’ that are discussed briefly below. The options presented in this section are not endorsed by the Australian or State Governments nor do they represent government policy.

1. Agreement that ‘no agreement’ is needed

This may be the preferred approach where there the smelter has an internally agreed SPL management plan in place and a clear timeline for the stockpile to be drawn down that has been effectively implemented over the past several years. The successful historical management of SPL would typically have resulted in a relatively small stockpile of SPL materials remaining onsite.

2. A voluntary agreement

Industry may consider entering into a voluntary agreement to demonstrate to the local community and to state regulators that a plan is in place that will ensure SPL stockpiles are being responsibly managed. A voluntary agreement may also be required to be eligible for any co-funding of SPL management costs.

3. A legally binding agreement

The use of statutory covenants by DoEE or other regulators may be required as part of any co-funding of SPL management costs. They could also be required where there is significant social concern that the SPL stockpile has no plan in place for removal or future management to ensure human health and the environment are protected. It is important to note that State Governments have existing powers under contaminated land and hazardous waste legislation that could also be used to enforce the ‘clean-up’ of SPL stockpiles.

Within the voluntary and legally binding agreement options, the project identified two models of co-funding including:

1. Agreement to co-fund the smelter for SPL WMP costs (rebate to smelter)

2. Agreement to co-fund the third party SPL WMP costs (e.g. rebate to SPL WMP).
During consultation, industry identified another co-funding model which was for the government to consider the potential to look beyond ‘subsidised processing’ models and look to an industry-government co-funded processing solution (i.e. build, own, operate) with future processing/transport pricing agreed and fixed for 10 years.

**E12 The feasibility of an agreement based approach to SPL stockpile drawdown**

This project aimed to test the feasibility of using an agreement based approach to drawdown Australia’s SPL stockpile over a period of around 10 years.

*The analysis indicates that it is feasible to use an agreement based approach to develop site-specific agreements with the aluminium smelting industry, SPL WMPs, and Australian governments that could enable SPL stockpile drawdown in around ten years.*

The agreement type (voluntary or binding), parties, and any potential co-funding would need detailed consideration that is beyond the scope of this project.

**E13 Recommendations**

The following is recommended.

1. DoEE progress with discussions with all Australian aluminium smelters and SPL WMPs to develop site specific agreements that will help ensure the drawdown of above ground SPL stockpiles over the next 10 years. Whilst Tomago Aluminium has a short drawdown plan in place, they should still be consulted, at least initially, to ensure they are not disadvantaged for proactively processing their SPL stockpile.

2. DoEE maintain communication with the relevant state EPAs to monitor the outcomes of current assessments/audits of onsite SPL landfills.

3. Should landfilled SPL be required to be removed from site and/or processed, DoEE should look to include the additional tonnages into any agreement this is being considered.

4. The development of any agreement includes full assessment of the considerations that are listed under E7 and discussed in Section 7 of this report. Included in this assessment should be a confirmation of the stockpile tonnage figures for each site that were provided for this report.

5. Where any agreement potentially includes co-funding that DoEE ensure that the considerations included in Section 10 are fully assessed.

6. If co-funding is being considered as part of an agreement, DoEE should undertake additional analysis of the historical and current ‘baseline’ pricing for SPL WMPs. The indicative pricing information gathered during this project is insufficient to support decisions regarding the amount of co-funding that should be provided per tonne (for example).
1 Introduction

In March 2016, the Department of the Environment and Energy (DoEE) engaged Randell Environmental Consulting (REC) in association with Ascend Waste and Environment to complete the Spent Pot Lining (SPL) project (feasibility of an agreement based approach to clear stockpiles).

1.1 Project scope

DoEE provided a letter of introduction for project stakeholders that outlined the project scope as follows:

“The project will assess the feasibility of using an agreement between industry and governments to clear the stockpiles of spent pot liner (SPL) present in Queensland, New South Wales, Victoria and Tasmania, over a ten year or similar period. The project aims to determine the feasibility of such an agreement approach, and if feasible, what might be required to address the circumstances of the different SPL stockpiles across the jurisdictions.

The project will take into account domestic capacity to recover and recycle spent pot liner, whether through smelters or alternate processes such as rockwool production. The role of export for recycling in such a stockpile clearance agreement will also be identified.

The project will report on the following:

- Industry consultation including initial stakeholder responses
- Estimates of the SPL profile stockpile volumes, composition in Australia
- A summary of SPL fate options (including export) and considerations for each
- High-level estimates of relative cost for identified fate options
- Analysis of the key issues that would need to be addressed in any Government-industry agreement on SPL removal
- ‘Agreement options’ for stakeholders to consider that respond to the key issues identified (above)
- The likely implementation timeframes required for the agreement options and the feasibility of these timeframes for projects such as the Kurri Kurri development site remediation”.

This project is not aiming to draft any industry-government agreements. It aims to understand if it is possible for agreements to be developed that would result in a drawdown of SPL stockpiles over around 10 years.

This report is intended for publication on the DoEE website. Information that industry identified as confidential or commercial-in-confidence information is either not included in this report or has been redacted (see red blocks of text).
1.2 Project background and context

In 2015 DoEE commissioned a study of hazardous waste arisings and infrastructure capacity in Australia called *Hazardous waste infrastructure needs and capacity assessment*.\(^{10}\)

The study identified that a significant SPL stockpile had accumulated in Australia and included the following:

“The storage of large quantities of spent potlining from aluminium smelting should be a social concern, especially given the recent decline of this industry. The three current operators able to process this waste report sufficient capacity to process the stockpile over a 10-15 year period. A mismatch between demand and capacity could cause inappropriate treatment or demand for exports. A nationally coordinated negotiation with the industry is recommended.

Recommendation 6: DoEE should consult with the aluminium industry and NSW, Vic, Qld, Tas State Governments to develop a nationally agreed approach to the management of spent potlining stockpiles that ensures their eventual removal and ongoing recovery or treatment.” Page xxi.

This project responds in part to these recommendations.

Environmental legislation administered by the Australian Government and State Government environmental regulators does not support the long term stockpiling of hazardous wastes onsite where it poses ongoing potential risks. The short term storage of SPL in suitable shedding onsite may be appropriate; however, onsite stockpiling in sheds is not a long term solution for SPL management, where the SPL remains exposed to risks such as extreme weather events.

The Australian Government, therefore, seeks to understand if it is feasible to use an agreement based approach with the aluminium industry stakeholders that will result in a plan to drawdown the Australian SPL stockpile over the next 10 years.

1.3 Report structure

Responding to the project scope this report includes the following:

- **Section 2** provides an outline of the project method.
- **Section 3** provides a summary of what SPL waste is and how it is generated.
- **Section 4** provides the site details of Australian aluminium smelters including annual production of aluminium, site history, historical SPL management and a map of locations.
- **Section 5** provides the profile of the Australian SPL waste stockpiles including the tonnages of 1\(^{st}\) cut, 2\(^{nd}\) cut and mixtures of SPL stored at each smelting site (both above and below ground). This section also outlines each site’s SPL stockpile drawdown plan (years to draw down above ground stockpiles where a plan was provided).

Section 6 provides a summary of the different SPL management options and SPL WMPs. Section 7 provides analysis of the key issues and considerations that any potential industry-government agreement needs to consider. This section summarises the issues raised by stakeholders during consultation.

Section 8 provides analysis of Australia’s current SPL stockpile versus Australia’s SPL WMPs capacity.

Section 9 provides analysis of the agreement options that could be considered based on this project’s analysis.

Section 10 provides analysis of potential government co-funding incentive models that could be considered based on this project’s analysis.

Section 11 and 12 provides project conclusions and recommendations.

2 Project method

The table below summarises the project delivery steps and provides a brief description of each.

Table 1: Summary of project method

<table>
<thead>
<tr>
<th>Project step</th>
<th>Brief description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Project planning</td>
<td>Developed project plan including a project consultation plan.</td>
</tr>
<tr>
<td>2. Logistics planning (face to face meetings)</td>
<td>Contacted industry (including generators, processors, long term storage) and government regulators and arranged an onsite face-to-face consultation to discuss the feasibility of SPL stockpile drawdown.</td>
</tr>
<tr>
<td>3. Desktop review of SPL management</td>
<td>Completed a desktop review of SPL governance and current stockpiles by jurisdiction. Compiled a summary of the current state of SPL.</td>
</tr>
<tr>
<td>4. Consultation #1: extensive onsite stakeholder engagement</td>
<td>Held consultation meetings with SPL generators (aluminium smelters), processors, long term storage and government regulators in Vic, NSW, Qld, and Tas.</td>
</tr>
<tr>
<td>5. Confidential site consultation draft reports preparation</td>
<td>Developed site consultation reports for all smelters, SPL processors, and long term storage facilities in Australia. These reports are confidential as they contain confidential and commercial-in-confidence information about each site. The report included assessments of feasibility of SPL stockpile drawdown and types of agreements that could be considered.</td>
</tr>
</tbody>
</table>

SPL waste management providers (WMPs) for this report are defined as: a third party company that provides services to the aluminium smelting industry that result in the smelter’s SPL stockpiles being processed, or sent to approved long term storage facilities. As per the project brief, SPL WMP options discussed include national and international SPL processing options and long term storage facilities in Australia (only).
<table>
<thead>
<tr>
<th>Project step</th>
<th>Brief description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Consultation #2: consultation on Confidential site consultation draft reports</td>
<td>Issued confidential site consultation reports to each site and relevant state regulator for formal comment. Completed follow-up consultation with stakeholders (by phone) as required discussing the content of the draft report.</td>
</tr>
<tr>
<td>7. Confidential site consultation final reports preparation</td>
<td>Finalised each site consultation report, including providing a response to comments appendix for each site report.</td>
</tr>
<tr>
<td>8. Spent Pot Lining project (feasibility of an agreement based approach to clearing stockpiles) draft report preparation</td>
<td>Developed the draft report providing a summary of the project analysis and recommendations.</td>
</tr>
<tr>
<td>9. Consultation #3: Spent Pot Lining project (feasibility of an agreement based approach to clearing stockpiles)</td>
<td>Issue draft report to stakeholders for comment.</td>
</tr>
<tr>
<td>10. Spent Pot Lining project (feasibility of an agreement based approach to clearing stockpiles) final report completion</td>
<td>Amend draft national summary report and issue final report to DoEE.</td>
</tr>
</tbody>
</table>

In completing Consultation step #1 (noted in the table above), Paul Randell and/or Geoff Latimer met with site staff. The project’s aim, delivery schedule and information requirements were stepped through, including a specific conversation on handling information that may be commercially confidential.

In particular, the following project data requirements for the site were discussed:

- detailed data regarding SPL stockpiles tonnages and composition onsite (above and below ground)
- current and future management plans for SPL stockpiles onsite, including any SPL stockpile drawdown plans that are in place and anticipated timelines for total stockpile drawdown
- a brief discussion of advantages and disadvantages experienced with the SPL management options and WMPs recently utilised or investigated.

The above information requests were followed up formally via email, in parallel with the circulation of minutes of the meeting, for approval.

In discussing the possible configurations of industry agreements, views on key issues and concerns, from the site’s perspective, that any agreement would need to consider, were also sought. It was noted that the form and nature of such agreements was still evolving at the time of the site meeting and it is beyond the scope of this project to develop any actual draft agreements.
3 What is SPL waste and how is it generated?

The following section provides a concise summary of SPL waste and how it is generated.

SPL is a waste material generated from aluminium smelters, of which there are four in current operation in Australia and two recently closed down.

Aluminium smelting is the extraction of aluminium metal from aluminium oxide (also known as alumina). The process takes place in electrolytic cells that are known as ‘pots’\(^\text{12}\). The photo below shows one of Australia’s largest ‘potlines’ at Boyne Smelters Limited in Qld. As illustrated below each smelter has a large number of pots to maintain – the higher the number of pots the higher the smelter’s aluminium production.

**Figure 1 Aluminium smelter ‘pot line’ at Boyne Smelters Limited Qld**

![Aluminium smelter ‘pot line’ at Boyne Smelters Limited Qld](source: http://sales.riotintoaluminium.com/freedom.aspx?pid=356)

A cross section of a pot is provided in Figure 2 which illustrates that pots are made up of a steel potshell with two linings, an outer insulating or refractory lining and an inner carbon lining that acts as the cathode. The pots also include a carbon based anode which is consumed during the pot operation, but can be replaced before the pot (cathode) reaches the end of its life.

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\(^{12}\) Sometimes referred to as cells, hence **SPL is often referred to as SCL – they are the same thing.**
JOM 2013 explains “the lining, during operation of the cells, is subject to strong reducing conditions and fails after 5-8 years by a variety of mechanisms depending on how the cell was constructed, designed and operated” (page 1441).

When the pot lining fails – SPL waste is generated.

The pot linings are removed by being broken up. The contaminated carbon lining material that is removed is referred to as first cut SPL. The contaminated refractory lining material is referred to as second cut SPL.

As the SPL is removed it breaks up into different sized pieces ranging from large blocks to fine granular pieces. Some smelters keep the first and second cut SPL separate, other do not and the SPL is removed as one ‘cut’. The photos below illustrate the SPL removal process.

JOM 2013 also discusses the amount of SPL that is generated per tonne of aluminium smelted and states “a typical figure of 22 kg/tonne of aluminium produced” (page 1441).

During the operation of the pots, substances, including fluorides, cyanides, and aluminium are absorbed into both cell linings.
Both first and second cut SPL are hazardous waste due to:

- toxicity – leachable fluoride and cyanide compounds, with fluoride levels often around 10 parts per hundred (%)
- corrosiveness – high pH due to the presence of alkali metals and oxides
- reactivity with water – producing toxic, explosive, and inflammable gases.\(^\text{13}\)

The toxic, corrosive, and reactive nature of SPL means that particular care must be taken in its handling, transportation, and storage.

Transport Canada 1991 documented an incident in 1990 in Quebec Canada where inappropriately stored and transported SPL caused a large explosion on a ship that killed two crew members and injured several more. It should be noted that since the explosion in 1990 and following appropriate United Nations endorsed risk mitigation measures, many thousands of tonnes of spent pot lining has been shipped around the world without incident.

SPL has been recognised as a major environmental concern for the industry for decades. SPL also has recovery potential because of its fluoride and energy (carbon) content.

First cut SPL is similar or slightly higher in fluoride content than second cut SPL but, because it mostly consists of carbon, it absorbs more heavy metals and other substances of concern such as cyanide, which have the potential to leach into the environment. While first cut SPL can be more of a waste management concern than second cut SPL (the USEPA focus more on first cut SPL), both cuts are typically classed as hazardous waste. The hazard classification of SPL in Australia is discussed in detail in Section 7.3.

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\(^{13}\) Source: JOM2013
4 Australian aluminium smelters

4.1 Site details and aluminium production rates

Australia has four operational and two recently closed aluminium smelters. These are summarised in the table below.

Table 2: Australian aluminium smelters operational and closed

<table>
<thead>
<tr>
<th>State</th>
<th>Majority owner</th>
<th>Common site name</th>
<th>Production began</th>
<th>Status</th>
<th>Smelter location</th>
<th>Al production (t/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSW</td>
<td>Hydro</td>
<td>Hydro Kurri</td>
<td>1969</td>
<td>Closed</td>
<td>Kurri Kurri</td>
<td>NA (180,000)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kurri</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tomago</td>
<td>Tomago</td>
<td>1983</td>
<td>Operational</td>
<td>Tomago</td>
<td>590,000</td>
</tr>
<tr>
<td>Qld</td>
<td>Pacific</td>
<td>BSL (Boyne</td>
<td>1982</td>
<td>Operational</td>
<td>Boyne Island</td>
<td>&gt;570,000</td>
</tr>
<tr>
<td></td>
<td>Aluminium</td>
<td>Smelters Limited)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vic</td>
<td>Alcoa</td>
<td>Portland</td>
<td>1986</td>
<td>Operational</td>
<td>Portland</td>
<td>304,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Point Henry</td>
<td>1963</td>
<td>Closed</td>
<td>Point Henry</td>
<td>NA (192,000)</td>
</tr>
<tr>
<td>Tas</td>
<td>Pacific</td>
<td>Bell Bay</td>
<td>1955</td>
<td>Operational</td>
<td>Bell Bay</td>
<td>180,000</td>
</tr>
<tr>
<td></td>
<td>Aluminium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total: ~1,650,000

Note: production tonnages for closed sites (in brackets) refers to production in year before closure.

Australia is currently producing about 1.65 Mt of aluminium per annum. Based on the JOM 2013 typical figure of 22kg SPL per tonne of aluminium production, it can be estimated that Australia is currently generating about 36,000 tonnes of SPL per annum.

4.2 Site histories and historical SPL management

This section discusses the history of each of the smelting sites and their historical management of SPL. This section discusses several companies and processes used for historical SPL waste management. Refer to Section 6 for the detailed discussion of the SPL management options and SPL WMPs.

4.2.1 Hydro Kurri Kurri

The Kurri Kurri aluminium smelter began operation in 1969 and was acquired by Hydro, a member of Hydro Aluminium Group based in Norway, in 2002. Production ceased in September 2012. Prior to closure, Kurri Kurri’s smelter production capacity was approximately 180,000 tonnes per annum.

The decision to cease production at the Kurri Kurri aluminium plant in 2012 was based on the overall market situation for aluminium, such as the continued weak macro-economic environment, with low metal prices, uncertain market outlook and strong Australian dollar (AUD) relative to the U.S. dollar (USD).
After keeping the smelter in ‘care and maintenance’ mode for almost two years, Hydro began plans for significant development around the site, which includes an industrial estate, residential housing and a conservation reserve.

Hydro is now making plans to demolish the smelter and remediate the site. They have submitted Planning Proposals to both the Cessnock and Maitland City Councils that cover proposed redevelopment rezoning requirements. Hydro also submitted a Demolition Development Application to Cessnock Council in 2015 for demolition of part of the smelter infrastructure. Planning approval was received in March 2016.

After a period of discussions with NSW EPA and the Department of Planning and Environment, Hydro has lodged an Environmental Impact Statement (EIS) for its Demolition and Remediation Project. The EIS for the remediation has recently been through the public exhibition process.

Hydro have gone through a process of identifying various options for dealing with SPL-containing wastes in their capped waste stockpile (CWS) and have assessed each potential option against a range of criteria including: timeframe, legacy, risk, corporate social responsibility, environmental outcome, economic viability and permissibility.\textsuperscript{14}

The EIS proposes the construction of an engineered containment cell onsite, into which CWS material will be relocated.

The onsite CWS received SPL and other wastes from the 1960s to 1993. Hydro stated that other deposited wastes have been confirmed (via sampling) including friable asbestos from historically disposed casting floats, gaskets and other consumables. Hydro estimate that less than half of the in the CWS is SPL. The CWS is not an engineered landfill, and as such is likely to be leaching contaminants such as fluoride and cyanide, although Hydro have stated that the leachate contamination plume is contained to local groundwater.

From 1993 onwards SPL has been stored in above-ground shed structures.

From the mid-2000s Regain has processed some of Hydro’s SPL.

Hydro has not exported SPL overseas for processing from the Kurri Kurri site.

\textbf{4.2.2 Tomago Aluminium Tomago}

Tomago Aluminium began production in 1983. At that time, it was the world’s first large-scale Pechiney ‘AP18’ plant, with two potlines and an annual production capacity of about 240,000 tonnes. Further expansions in the 1990s, followed by a technology change in 2001 and subsequent production increases in the last seven years have taken production capacity up to 590,000 tonnes per annum.

Tomago have never landfilled SPL onsite.

Tomago arranged twelve export shipments in total, from the late 1980s/early 1990s through to the late 1990s, to manage SPL waste up to that point. From the early 2000s Tomago has utilised local solutions with Regain and more recently with Weston Aluminium.

Their earliest export shipments were to an Italian company called Selca. Selca sent mineral outputs into cement kilns and carbon outputs into steel manufacturing. Approximately 95,000t of SPL was exported to Selca.

Their next shipments were to Befesa, in Spain. Three shipments were sent to Befesa, 2 x 8,000t and 7,000t, bringing the total exported to date to approximately 118,000t.

Tomago’s approach to export has become more efficient and effective as they have learnt from each process, and this degree of planning has led to economically and logistically good export outcomes for Tomago’s SPL.

Since the early 2000s Regain has been present onsite at Tomago, processing their SPL. Pots are ‘delined’ via a lightly watered process by Tomago and stored in a single shed. Loads are taken from this shed by Regain and processed by drying, crushing, and thermal treatment via a rotary kiln (to remove cyanides and make process outputs safer to transport). Regain have kept good pace with arisings since the 2000s and when combined with the export shipments noted above, have led to the relatively small current stockpile.

Tomago also sends SPL to Weston Aluminium, who also have a history of processing Tomago’s aluminium dross (which is generated at around 1% of production volumes at Tomago and has recoverable aluminium content). This SPL stream is predominantly the refractory 2nd cut.

### 4.2.3 Pacific Aluminium Boyne Smelters limited (BSL)

BSL have never landfilled SPL onsite.

BSL produces in excess of 570,000 tonnes of aluminium per year. It has been in operation since 1982 and has been extensively expanded over several upgrade iterations.

BSL has a cement manufacturing industry nearby, which is why the COMTOR process was created. The COMTOR plant was commissioned in the mid to late ‘90s, to process that site’s SPL arisings. The solid product was destined for use at cement manufacture or other local use, such as road base. A liquid caustic soda product was sent for use at the alumina refining process at nearby Queensland Alumina Limited (QAL).

This involved a three stage process of crushing, thermal destruction of cyanide (in a calcination process) and a third wet digestion stage that consisted of adding lime and water. The outputs from the full COMTOR process were a sodium-reduced calcium fluoride rich product (called kiln grade spar) and a concentrated sodium hydroxide product (called Bayer grade caustic) that was suitable for direct reuse at the BSL refinery. During development and early operation of the COMTOR process, it was found to be advantageous to process “whole of pot” SPL rather than separate 1st and 2nd cut. Since this time BSL has not separated the two ‘cuts’ after cell de-lining.

Despite the kiln grade spar also having significant carbon calorific value, it had only limited fuel value in use as a cement feed material due to it being a damp filter cake containing lots of hydrates. The cement kiln changed from a wet process to a significantly larger capacity ‘dry’ process. This ultimately proved an advantage to BSL, because from the early 2000s, there was no longer a need to remove sodium as a separate stream. It was able to drop the wet digestion stage of COMTOR.

This partial COMTOR process consists of separation of coarse metal fragments, crushing to <1 mm and thermal drying to prevent the generation of flammable gases during transport and storage. The final crushed and dried product output is pneumatically transferred into specially designed isotainer
trucks, which are pneumatically sealed and contained for the one hour transport to Fisherman’s Landing, north of Gladstone. The third stage of COMTOR is currently ‘mothballed’ onsite.

The DoEE Hazardous waste permit applications formally received as at 4 April 2016 provides details of an export permit application from BSL to send SPL to Spain presumably to Befesa. The relevant extract is included below. At the time of writing the permit was still being assessed by the department.

<table>
<thead>
<tr>
<th>Notification Number</th>
<th>Applicant</th>
<th>Date Gazetted*</th>
<th>Movement Type</th>
<th>Origin/Destination**</th>
<th>Waste</th>
<th>Notification Number</th>
<th>Date Gazetted*</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUS15-019</td>
<td>Boyne Smelters</td>
<td>2/07/2015</td>
<td>Export</td>
<td>Spain</td>
<td>Spent pot liner</td>
<td>6 000 t</td>
<td>Recycling/reclamation of metals and metal compounds (R4)</td>
</tr>
</tbody>
</table>

* Subject to the Administrative Appeals Tribunal Act 1975, a person or persons whose interests are affected by this decision may, within 28 days of publication in the Commonwealth of Australia Gazette, make an application in writing to the Department of the Environment requesting the reasons for the decision.

An application for independent review of the decision may be made to the Administrative Appeals Tribunal on payment of the relevant fee by the applicant within 28 days of receipt of the reasons for the decision, or within 28 days of the Gazettal notice if the reasons for the decision are not sought. Applications should be made to the Deputy Registrar, Administrative Appeals Tribunal in your capital city, as listed under the Commonwealth Government Section in the White Pages.

Further enquiries should be directed to the Director, Hazardous Waste Section, Department of the Environment, GPO Box 787 CANBERRA ACT 2601, or forwarded by e-mail to hwa@environment.gov.au

**Origin and destination not specified for transit permits

***Treatment facility specified for imports only

4.2.4 Alcoa Portland

Alcoa’s website provides the following concise summary of the site history for the Portland site.

“Production began at Portland Aluminium in 1986 and today the smelter produces approximately 358,000 tonnes of aluminium a year. Alcoa is one of Victoria’s largest exporters with all of the aluminium produced at Portland Aluminium exported to the Asian market. Total exports equate to approximately $649 million per annum.”

“Potrooms
The Portland Aluminium smelter consists of four 750 metre potrooms each housing 102 smelting pots. The potrooms are the heart of the smelting process as it is here that the molten aluminium is produced.

In the potrooms, the alumina is fed into a large graphite lined steel furnace known as a pot. The alumina is dissolved in molten cryolite, also known as aluminium fluoride or ‘bath’. A high electric current is passed through the pot at low voltage via the anodes which enables the alumina solution to split into its components of aluminium and oxygen. The oxygen reacts directly with the carbon anode, which gets consumed to form carbon dioxide that bubbles away and the aluminium collects at the bottom of the pot. The electricity also maintains the temperature of the pot at 960 degrees Celsius.

The aluminium is siphoned from the bottom of the pot using a crucible and is then transferred to the ingot mill for casting.

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15 DoEE Hazardous waste permit applications formally received as at 4 April 2016 available at https://www.environment.gov.au/protection/hazardous-waste/applying-permit
Each pot at Portland Aluminium produces two tonnes aluminium a day. Over time, the graphite pot lining will wear and need to be replaced. The steel shells of the pots are also refurbished and relined in the pot lining facility.”


Note: Portland’s production is presently curtailed by approx. 15% (since July 2009) below the figures stated above to around 304,000 tonnes per annum.

During consultation Portland provided the following regarding historical SPL management:

“Historically within Australia the primary management practice for SPL have been storage or disposal to landfill. Portland Aluminium has not land-filled any SPL since operations began in 1986. Dedicated SPL storage areas (at the smelter site and at an offsite storage facility) are used at Portland Aluminium for the storage of SPL generated at the facility. These areas are maintained to ensure that the SPL is stored in an environmentally safe and recoverable condition for subsequent reuse recycling.

The aluminium industry, including Alcoa, has been assessing a range of processes for the potential to process SPL. Until recently, there were very few sustainable options available. During this time, Portland Aluminium utilised the following processes:

- The treatment of SPL occurred through a dedicated onsite Spent Pot Lining (SPL) treatment plant between 1995 to 2007. Due to the ongoing difficulties with equipment reliability and overall process stability and no outlet for the end product, this process was idled...

- Portland Aluminium began transporting to the Point Henry Regain facility for processing in 2007...

- In recent years (2011, 2013 and 2014) Portland Aluminium exported 2nd Cut SPL overseas (United Kingdom) for recycling and reclamation of the mineral content. This was a complicated process and with a significant shift in the economics relating to the exporting process and increase in demand for SPL at the Regain facility, exporting to the UK is no longer deemed necessary.”

The ‘SPL treatment plant’ mentioned above is the ‘Ausmelt’ process developed by Alcoa.

During the site visit Portland staff explained that the historical SPL shipments were to JMBI in the UK. These shipping of SPL were problematic due mainly to:

1. Lengthy export approval processes.
2. Complex requirements for shipping hazardous wastes.
3. Difficulties in gaining approval for the SPL to pass through each port.

Portland commented that they are unlikely to seek further export permits due to previous experience, having local opportunities for processing, and the impact of the low Australian dollar on export processing costs.
4.2.5 Alcoa Point Henry

Alcoa’s website provides the following concise summary of the site history for the Point Henry site.

“History of Point Henry

Point Henry was home to two Alcoa operations – the Point Henry Smelter (1963 to 2014) and the Alcoa Australia Rolled Products rolling mill (1965 to 2014).

The smelter was placed under strategic review in February 2012 due to challenging market conditions. A comprehensive review found the 51-year-old smelter had no prospect of becoming financially viable. The rolling mills served the domestic and Asian can sheet markets which were impacted by excess capacity.

After five decades of operation, in February 2014 Alcoa announced the closure of its Point Henry operations.

Former operations

In 1961 Alcoa of Australia was formed. Its first project was the construction and commissioning of the Point Henry smelter in Geelong. The first molten metal was poured on April 17, 1963.

The smelter was one of the first plants in Australia to produce primary aluminium for domestic and international markets. In its final years the plant produced more than 192,000 tonnes of aluminium per year.

Approximately 45 per cent of the aluminium produced at the Point Henry smelter was sold to the neighbouring Alcoa Australia Rolled Products, where aluminium was rolled into sheet. The remainder of Point Henry’s aluminium was sold into Asia (Japan, Korea and Taiwan).

Since 1965 Alcoa produced aluminium sheet at Point Henry, the majority being domestic beverage can end-sheet. Eighty per cent of its rolling capacity was dedicated to supplying the Asian market.

The Alcoa Point Henry industrial operations was separated into three production areas:

- the ‘electrode’ area where carbon blocks were formed for use as an anode in the smelting process,
- the ‘potrooms’ where carbon cathodes were used to line the pots where the smelting process was undertaken; and
- the casthouse and rolling area where molten metal was cast into ingots and rolled into sheet.

During its 51 years of operation, the Point Henry smelter produced more than 7.3 million tonnes of aluminium — enough to make more than 490 billion cans or 93,000 jumbo jets.”

Source: Alcoa website April 2016, see http://www.alcoa.com/australia/en/info_page/point_henry_history.asp

In April 2015 EPA Victoria issued a ‘Clean-up Notice’ for the Point Henry site16. The Clean-up Notice requires quarterly reporting to provide updates regarding notice implementation. The Alcoa (2016)

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update\textsuperscript{17} includes the following regarding current and planned activities regarding the Point Henry site remediation.

\textbf{Activities since closure:}

Alcoa has continued to engage suitably qualified consultants to develop Preliminary Conceptual Site Models and Work Plans for the Industrial Site, the Moolap Landfill, and the Industrial Landfills (SPL and General Refuse Landfill and the CPL Landfill). Work is progressing on appointing consultants for the two remaining zones, the Farmlands and the Wetlands and Grasslands. The aim of these activities is to close out identified data gaps in the Preliminary Site Investigations.

In January, Alcoa engaged a specialised groundwater consultant to conduct a Light Non-Aqueous Phase Liquid (LNAPL) extraction trial under the Rolling Mill at Point Henry. The trial was completed with the results now being reviewed by Alcoa. The EPA-Appointed Auditor, Darryl Strudwick has been briefed on progress of the environmental assessment work, and the LNAPL extraction trial throughout the quarter. An onsite meeting with engaged consultants and the Auditor to review the current status was conducted on February 25th 2016.

Onsite decommissioning works have continued with submission to the Authority of the Environmental Aspects and Impacts registers associated with the major work packs.

\textbf{Planned activities for 1 March 2016 – 31 May 2016:}

Alcoa expects to appoint consultants for the remaining two zones for the development of the Preliminary CSMs and Work Plans. Alcoa will review the Preliminary CSM and Work Plans for the Industrial Landfills, Moolap Landfill and the Industrial Site prior to executing any additional sampling activities that may be required. Alcoa also expects to engage a specialised drilling contractor in anticipation of further sampling that may be required.

Alcoa will complete a detailed review of the LNAPL extraction trial results and will continue to maintain regular contact with the EPA-Appointed Auditor”.

During the site visit Alcoa stated that from the site opening in the mid-1960s up to the early 1980s SPL and salt dross waste (from rolling of aluminium ingots) was disposed to the ‘industrial landfill’. Alcoa also stated that the ‘Moolap landfill’ received SPL and salt dross from the mid-1980s to 2003. Both the Industrial and Moolap landfills are currently undergoing an environmental assessment including by an EPA appointed auditor. The findings of this audit are expected around the end of 2016 (calendar). The findings of this audit will help determine the ongoing management requirements for the landfilled SPL at the Point Henry site.

From 2003 up until site closure in 2014, the Regain Services facility (located onsite) processed SPL arisings.\textsuperscript{18} The Regain facility remains onsite and operational, however, is not currently processing SPL from the Point Henry site.

Alcoa’s 2011 \textit{Environmental Improvement Plan} provides some historical data for the amount of SPL material managed by Regain.

\textsuperscript{17} The latest update from Alcoa for March 2016 is available here: http://www.alcoa.com/australia/en/pdf/ang_201602_quarterly_report_to_EPA.pdf

\textsuperscript{18} Apart from a period of shed storage in the first couple of years while Regain was establishing the operation.
“Alcoa continues to engage Regain Services Pty Ltd to process SPL and other carbon based by-products into alternative fuel for cement industry at its facility.

In 2009, 2,124 tonnes of SPL was produced at Point Henry and Regain Services processed 4,551 tonnes of Point Henry SPL.

2010 has seen Point Henry produce 3,184 tonnes of SPL and Regain Services have processed 4,400 tonnes of Point Henry SPL.

2011 YTD has seen Point Henry produce 2,018 tonnes of SPL and Regain Services have processed 1,898 tonnes of Point Henry SPL” (page 18).

Alcoa commented that the closed potlines onsite are as they were when production ceased in July 2014.

4.2.6 Pacific Aluminium Bell Bay

The Bell Bay aluminium smelter was the first aluminium smelter in the southern hemisphere beginning production in 1955. The site establishment was as a joint venture between the Australian and Tasmanian governments driven by the difficulties in importing aluminium to Tasmania during wartime. The Bell Bay site was chosen because of its deep water port facilities and Tasmania’s hydroelectric generating capacity. Since opening production has grown from 1,200 tonnes to around 180,000 tonnes per annum.19

Since the site began operations up until around 1996, SPL was landfilled onsite in un-engineered landfills.

In 1996 approximately 136,000 cubic meters of SPL from landfill storages onsite was removed from old landfill storages into three engineered landfills (referred to by Bell Bay as ‘encapsulations’) which were approved by the Tasmanian EPA.

The Bell Bay engineered landfills were designed with a 50 year life. After that time the landfilled waste will be reassessed and potentially placed into a replacement landfill. The current landfill is capped and has active leachate treatment and gas venting.

Since the late 1990s SPL has been stockpiled in above ground sheds.

In 2010, Bell Bay began processing SPL at the Cement Australia Railton site (CAR).

To prepare SPL for processing at CAR, Bell Bay Aluminium operates an SPL crushing system onsite. It is based on quarry crushing technology (that is mobile). The Bell Bay SPL pre-processing system consists of the following steps:

1. Removal of any steel (cathode rods) from the SPL wastes.
2. Crushing of SPL in crushing plant. Aluminium and steel residual is removed from the SPL during the crushing process.
3. Loading crushed SPL into purpose built container trailers for transport to Railton cement kiln. Transported under class 4.3 dangerous goods code (see photo below).
4. Feeding of the crushed SPL into cement kiln.

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19 Source: Bell Bay Aluminium website 2016, see http://bellbayaluminium.com.au/history
Rio Tinto Aluminium’s *Bell Bay Sustainable Development reports* (2010-2015) have publically reported the following tonnages of SPL from Bell Bay as processed at CAR.

### Table 3 Reported Bell Bay SPL processing at CAR

<table>
<thead>
<tr>
<th>Year</th>
<th>2010&lt;sup&gt;20&lt;/sup&gt;</th>
<th>2011&lt;sup&gt;21&lt;/sup&gt;</th>
<th>2012&lt;sup&gt;22&lt;/sup&gt;</th>
<th>2013&lt;sup&gt;23&lt;/sup&gt;</th>
<th>2014&lt;sup&gt;24&lt;/sup&gt;</th>
<th>2015&lt;sup&gt;25&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPL reported as processed at CAR (tonnes)</td>
<td>2,786</td>
<td>6,567</td>
<td>4,190</td>
<td>4,050</td>
<td>4,057</td>
<td>3,082</td>
</tr>
</tbody>
</table>

---

<sup>20</sup> Source: Rio Tinto Aluminium (Bell Bay) Limited, 2010, *Bell Bay 2010 Sustainable Development report*

<sup>21</sup> Source: Rio Tinto Aluminium (Bell Bay) Limited, 2011, *Bell Bay 2011 Sustainable Development report*

<sup>22</sup> Source: Rio Tinto Aluminium (Bell Bay) Limited, 2012, *Bell Bay 2012 Sustainable Development report*

<sup>23</sup> Source: Rio Tinto Aluminium (Bell Bay) Limited, 2013, *Bell Bay 2013 Sustainable Development report*

<sup>24</sup> Source: Rio Tinto Aluminium (Bell Bay) Limited, 2014, *Bell Bay 2014 Sustainable Development report*

<sup>25</sup> Source: Rio Tinto Aluminium (Bell Bay) Limited, 2015, *Bell Bay 2015 Sustainable Development report*
4.3 Locations of Australian aluminium smelters and SPL WMPs

Figure 5 illustrates the locations of Australia’s currently operating and closed aluminium smelters. It also includes the locations of the Australian SPL WMPs that are discussed in Section 6.

Figure 5 Map of Australian aluminium smelters and SPL WMPs facilities
## 5 Australian SPL waste stockpile profile

The table below provides the profile of the SPL stockpile in Australia. The table details the stockpiles on each site, including if the stockpile is segregated 1st or 2nd cut, or a combination of both (referred to as mixed SPL). The table also details tonnages of SPL that are currently stored above ground (in sheds) or in a landfill onsite.

**Table 4 SPL waste stockpile tonnage profile**

<table>
<thead>
<tr>
<th>Site</th>
<th>State</th>
<th>1st cut SPL</th>
<th>2nd cut SPL</th>
<th>Mixed SPL</th>
<th>Sub total</th>
<th>SPL landfilled (tonnes)</th>
<th>Total SPL stockpile onsite (tonnes)</th>
<th>Est. new SPL arisings (tonnes/year)</th>
<th>Site SPL drawdown plan (above ground) (years)</th>
<th>Data source/comments/assumptions</th>
</tr>
</thead>
</table>
| Alcoa Portland           | Vic   | 59,192      | 23,720      |           | 82,912    | 0                      | 82,912                              | 3,600                                 | 10                                        | Data provided by Alcoa in written submission.  
The drawdown plan (years) is assumed based on information provided regarding previous processing rate. |
| Alcoa Point Henry        | Vic   | 9,600       | 6,400       |           | 16,000    | 164,424                | 180,424                             | -                                    | Under development                      | Data provided by Alcoa in written submission. |
| Tomago Aluminium         | NSW   | 5,027       | 4,256       |           | 9,283     | 0                      | 9,283                               | 10,000                                | 2                                          | Data from confirmed site meeting minutes. |
| Hydro Kurri Kurri        | NSW   | 40,000      | 40,000      |           | 80,000    | 90,000                 | 170,000                             | -                                    | Under development27                    | Data from confirmed site meeting minutes. |
| Boyne Smelters Limited   | Qld   | 90,000      | 90,000      |           | 0         | 90,000                 | 12,500                              | 16 or more                            | Data provided by Pacific Aluminium in written submission. |
| Bell Bay Aluminium       | Tas   | 30,000      | 30,000      | 136,00028 | 166,000   | 3,000                  | 29,100                              | 10 or more                            | Data provided by Pacific Aluminium in written submission. |
| **Totals**               |       | **113,819** | **74,376**  | **120,000**| **308,195**| **390,424**           | **698,619**                         | **29,100**                            |                                           |

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26 The SPL above ground tonnages includes the tonnages of SPL that remain in potlines at the closed smelters at Alcoa Point Henry and Hydro Kurri Kurri.

27 Hydro stated that they are planning for above ground SPL stockpiles to be recycled over the next 3 to 4 years.

28 Pacific Aluminium reported 136,000 m$^3$. We have assumed a 1:1 conversion factor for m$^3$ to tonnes.
5.1 Analysis of SPL stockpile data

The data presented in Table 4 confirms that Australia has a significant stockpile of SPL with a total of around 700,000 tonnes of SPL in either above ground or below ground storages around Australia.\textsuperscript{29} Just under half of Australia’s SPL stockpile (about 310,000 tonnes) is stored in above ground stockpiles. Interestingly there is a higher proportion of 1\textsuperscript{st} cut SPL (about 114,000) than 2\textsuperscript{nd} cut SPL (about 74,000). The high carbon content in 1\textsuperscript{st} cut SPL has historically meant that there have been more processing options for 1\textsuperscript{st} SPL cut than 2\textsuperscript{nd} cut SPL. The largest portion of the above ground stockpile is mixed 1\textsuperscript{st} and 2\textsuperscript{nd} cut SPL (about 120,000 tonnes).

Just over the other half of Australia’s SPL stockpile (about 390,000 tonnes) is stored in landfills onsite at several sites around Australia. The composition of the landfilled SPL is not known, but is likely to be around 50-60% 1\textsuperscript{st} cut and 40-50% 2\textsuperscript{nd} cut SPL.

5.2 Site aboveground SPL stockpile drawdown plans

The following definition for an ‘SPL drawdown plan’ has been adopted for this report and analysis. An ‘SPL drawdown plan’ is a plan that has at least 2 of the following:

1. The smelter can demonstrate a recent (i.e. the last 3 years) history of significant stockpile drawdown. It should be noted that, during consultation, several smelters provided data/charts that illustrate that in the last few years SPL stockpile processing rates have increased resulting in partial drawdown of existing stockpiles.

2. Commercial arrangements are in place with between the smelter and SPL WMP/s that will result in the drawdown of SPL stockpiles and the management of any new SPL arisings.

3. The estimated timeframe for the drawdown of the SPL stockpile has been provided for this public summary report.

Of the six smelting sites in Australia, only Tomago Aluminium has a drawdown plan in place that will have all SPL stockpiles removed from the site well within a 10 year period.

Alcoa Portland also has a drawdown plan in place that is likely to result in all stockpiles removed in around 10 years.

Pacific Aluminium sites at Bell Bay and Boyne (BSL) have drawdown plans in place, however the plans may take up to 10 or more years to implement, depending on the SPL processing rates that are achieved in future.

At the time of writing we understand that the Alcoa Point Henry drawdown plan was still under development. The smelter is closed and undergoing site decommissioning to allow for future development.

At the time of writing we understand that the Hydro Kurri Kurri drawdown plan was still under development. The smelter is closed and undergoing site decommissioning to allow for future development.

\textsuperscript{29} This 700,000 tonnes stockpile estimate is around 22% less than the 900,000 tonnes stockpile that was identified in the 2015 Hazardous waste infrastructure needs and capacity assessment report. The higher figure was provided during industry consultation and it is unclear what year the data referred to and the method used to estimate the totals.
development. Hydro stated that they are planning for above ground SPL stockpiles to be recycled over the next 3 to 4 years.

5.3 Uncertainty in stockpile tonnage assessment

The information provided in the Table 4 has all been provided by site operators – who have been very helpful and forthcoming during the consultation and information gathering phase of this project. It is beyond the scope of this project to audit the data provided by sites regarding stockpile volumes/tonnages, beyond a basic site visit and viewing of the stockpiles. The authors have no reason to doubt the stockpiles data provided, however, it needs to be noted that an audit of the dimensions of storage sheds or landfill extent of SPL waste has not been completed.

The national estimated annual SPL generation rate of 29,100 tonnes per annum, tallied from site-supplied figures, is below what is estimated in Section 4.1 (36,000 tonnes per annum). The estimates of SPL generation provided by industry are around 19% lower than what might be expected based on the current annual production capacity. There may be smelting practices and/or pot lining preservation techniques that can explain this difference, however, this has not been confirmed by industry.
6 Summary of SPL management options and WMPs

A brief summary of SPL options available in Australia or via export is provided, in alphabetical order, in Table 5. These include those currently operational and planned to be operational within the nominal 10 year period of national stockpile draw down. Each of the options is discussed in more detail in the sections that follow the table.

Table 5 Summary of SPL management options and WMPs available to Australian aluminium smelters

<table>
<thead>
<tr>
<th>Option</th>
<th>SPL Waste management providers (WMPs)</th>
<th>Process description</th>
<th>Off-take market(s)</th>
<th>SPL 1st or 2nd cut or both</th>
<th>Licensed capacity (t/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement manufacturing ('direct feed')</td>
<td>Cement Australia: Railton kiln (Tas). Cement Australia: Fisherman’s Landing kiln (Qld)</td>
<td>Direct use of smelter prepared 1st and 2nd cut, and whole of pot SPL in Portland cement clinker manufacture.</td>
<td>Construction, building, major projects</td>
<td>Both</td>
<td>Limited by process capacity not licence</td>
</tr>
<tr>
<td>Co-processing SPL with salt slags (export)</td>
<td>Befesa (Spain). JBMI (UK, process used is unknown)</td>
<td>Befesa operate plants to recycle Al dross salt slags and other residues from dross recycling. SPL is used to reduce energy input requirements.</td>
<td>1. Mineral outputs to cement or mineral wool. 2. Salt for dross treatment</td>
<td>Both</td>
<td>Unknown</td>
</tr>
<tr>
<td>Long term storage</td>
<td>Tellus Holdings two sites: Chandler (NT) and Sandy Ridge (WA).</td>
<td>Long term storage or permanent isolation in deep geological (salt) repository. <strong>Not yet approved or operational. Estimated operational late 2017.</strong></td>
<td>N/A</td>
<td>Both</td>
<td>Not yet licensed. Potential: NT 400k WA 100k.</td>
</tr>
<tr>
<td>Mineral wool manufacturing (export)</td>
<td>Rockwool (Germany)</td>
<td>Blocks of 1st cut SPL are used in the process of manufacturing mineral wool, as a partial substitute for coke. Process not suited to 2nd cut or 1st cut fines SPL.</td>
<td>Insulation products for building sector</td>
<td>1st</td>
<td>Unknown</td>
</tr>
<tr>
<td>Plasma arc vitrification</td>
<td>Plascycle, Hunter region, NSW</td>
<td>Plans for pilot plant scale plasma arc destruction technology. <strong>Not yet operational - concept stage only.</strong></td>
<td>If slag is inert may have reuse options</td>
<td>Both</td>
<td>Not yet licensed.</td>
</tr>
<tr>
<td>Thermal treatment and processing</td>
<td>Regain (onsite at Tomago, NSW and Point Henry, Vic)</td>
<td>Crushing, grinding, low temperature destruction of cyanide (CN) and off-gases followed by blending to specification as mineral feedstock for cement kilns.</td>
<td>Cement industry (mostly export)</td>
<td>Both</td>
<td>Tomago:20k Point Henry: limited by process not licence.</td>
</tr>
<tr>
<td>Thermal treatment and processing</td>
<td>Weston Aluminium, Weston NSW</td>
<td>Thermal destruction of CN and off-gases to create a feedstock specification for client manufacturing processes. Currently doing ‘mixed SPL trial’ till August 2016.</td>
<td>Brick manufacturing (mostly export)</td>
<td>2nd (currently)</td>
<td>Total for Al dross and SPL: 40K Trial: 3K mixed SPL</td>
</tr>
</tbody>
</table>
Additional potential SPL management options and WMPs

It is important to note that other potential options/WMPs exist, beyond those included in Table 5, for SPL management within Australia. At the time of writing these additional SPL management options/WMPs were not developed and/or did not have approvals in place for SPL and are therefore not as likely to have capacity to receive SPL within the next 10 years.

These include the use of SPL or SPL-derived materials as feedstock in domestic industries such as:

- Cement manufacturing kilns in South Australia and NSW (beyond the Cement Australia kilns discussed).
- Steel manufacturing in NSW. Note steel manufacturing is only suited for processing 1st cut SPL.
- Brick manufacturing in NSW.
- Waste to energy plants that could have capability to process SPL.

Internationally, additional options/WMPs not included in Table 5 include:

- Additional cement or brick manufacturing sites in numerous countries that could potentially take untreated SPL for ‘direct feed’. Australia currently exports treated and processed SPL to international cement and brick kilns via Regain Materials and Weston Aluminium. This study did not identify plans or DoEE export permits for export of untreated SPL to international cement or brick kilns.
- Rio Tinto’s low caustic leaching and liming process (LCL&L) plant built in Quebec Canada in 2008. Although this is at commercial scale (80,000tpa SPL capacity), it is still in an R&D phase and not likely to be able to service Australian smelters.
- SELCA Eco-industry in Italy, historically have processed SPL however no information was identified and this site is understood to have now closed.

6.1 Cement manufacturing (‘direct feed’)

A focus of most SPL recovery options is to incorporate the SPL into other processes where the high fluoride in the SPL (and the other constituents) can be tolerated or may even give beneficial effects. This is the case in cement manufacture.

Figure 6, below, provides an overview of the eleven steps in the cement manufacturing process. At the most basic level cement manufacture can be described in the following four phases:

1. Limestone (calcium carbonate), clay, and shale (alumino silicates and iron oxides) (‘rawmix’), extraction, crushing, grinding, homogenisation (steps 1-4).
2. Rawmix preheating and/or pre-calcination (step 5).

---

30 SPL waste management providers (WMPs) for this report are defined as: a third party company that provides services to the aluminium smelting industry that result in the smelter’s SPL stockpiles being processed, or sent to approved long term storage facilities. As per the project brief, SPL WMP options discussed include national and international SPL processing options and long term storage facilities in Australia (only).
3. Rawmix heating in a rotary kiln at temperatures of up to 1450 degrees Celsius to produce ‘clinker’ (step 6).

4. Clinker cooling, storage, additions of gypsum, and grinding to make Portland cement (steps 7-11).

**Figure 6 Overview of cement manufacturing process**

---

The main advantages of SPL use in cement manufacture include:

- The carbon in 1st cut SPL provides calorific value, the fluorides acts as a mineraliser\(^{32}\), and the sodium acts as a fluxing agent lowering the temperature for clinker formation and saving fuel and reducing greenhouse gas emissions.\(^{33}\)

- Both 1st and 2nd cut SPL can be processed in cement kilns.

- The fluoride in SPL slows the rate of hardening of cement, which increases its overall strength.

- The fluoride in SPL is locked up as CaF\(_2\), which transforms SPL-fluoride from highly leachable to almost inert.

---

\(^{31}\) Smelters prepare SPL for feeding into the cement kilns to varying degrees. As a minimum 1st and 2nd cut SPL is screened and ground to a size suitable for feeding into the preheater/pre-calcination tower.

\(^{32}\) A “mineraliser is a substance that accelerates reaction rates and promotes the formation of desired materials in the liquid phase of cement clinker or similar materials”. Source: Regain Technologies 2014.

\(^{33}\) Source: Regain Technologies 2014
At a global level, the cement industry has very large and secure off-take markets – it is the main ingredient in concrete. Behind water, concrete is the second most consumed material on earth\(^{34}\).

The main disadvantages of SPL use in cement manufacture include:

- **SPL’s high and variable sodium content.** Too much alkaline sodium is detrimental to cement product performance, leading to lessening strength properties and potentially cracking. Too much alkali content also impacts on the preheater/pre-calcination tower performance – leading to deposits/blockages.\(^{35}\) The rotary kiln refractory lining can also be damaged by high alkali content SPL. Consequently, alkali content is tightly controlled through a regulatory maximum alkali content of 0.6% w/w sodium oxide equivalent in Australian cement product. The alkali constraint is often less of an issue elsewhere in the world due to lower alkalis in rawmix feedstocks, which allows for higher sodium levels (and therefore more tolerance of input feedstock such as SPL) in overseas markets.

- **SPL high and variable fluoride content.** As noted above, fluoride addition slows rate of hardening of concrete increasing strength development. However, slowing the hardening rate is also a disadvantage because it increases the time required before concreting formwork can be removed and the next stage of construction work commenced. The cement industry uses other additives to improve the early strength development to enable quick formwork removal in construction.

- **The ‘smelter prepared SPL’** requires careful and potentially costly management for transport and storage onsite at the cement kiln due to the hazardous characteristics of untreated SPL. For example, the SPL needs to be kept dry to avoid the generation of explosive gases and all storage areas need failsafe ventilation.

Best practice SPL management in the cement industry is to utilize as much SPL as can be accommodated (for fluoride and energy value) while limiting alkali below the 0.6% w/w maximum. This limits SPL addition\(^{36}\) to kiln feedstock to allow for variability in the alkali levels in both SPL and the kiln rawmix. The limiting of SPL addition to feedstock to allow for variability in alkali levels can lessen the fluoride mineralising effects noted above.

In Australia there are two cement kilns that currently are licensed to accept SPL (both operated by Cement Australia):

- Fishermans Landing (near Gladstone) accepts SPL from Boyne Smelters Limited (BSL)\(^{37}\)
- Railton in Tasmania, accepts SPL from Rio Tinto’s Bell Bay smelter\(^{38}\).

The available capacity of these two kilns to receive SPL is not limited by EPA licensing, it is limited by the ‘alkali gap’ (how much additional alkaline content can be tolerated beyond that in the rawmix).\(^{39}\)

\(^{34}\) Cement Industry Federation Australia 2015.

\(^{35}\) Some kilns operate a ‘alkali bypass’ which allow for the bleeding off of high alkali content gas/dust from the kiln which allows for higher alkali content rawmix and potentially additional capacity for SPL addition.

\(^{36}\) Industry consultation suggested SPL addition is limited to around 0.3% of feedstock tonnages in Australia.


During consultation, the smelting industry identified that there may be potential for the cement industry to selectively mine rawmix material (limestone, clays) for a period of 10 years that are lower in alkali content, which would allow for additional SPL processing capacity (by providing a higher alkali gap).

Important to the economics of both of the Cement Australia kilns receiving SPL is the geographic closeness of kiln to the aluminium smelter. These are good examples of how synergies of located industrial infrastructure enable SPL solutions at one site that may not be feasible at another site.

Where a cement kiln is not locally located, the smelter would likely face additional costs due to:

- long transport distances
- potentially complex approvals and transport requirements for international shipping of the SPL as a hazardous waste and Dangerous Good Div 4.3. The same could apply to a lesser extent for interstate movements.

### 6.2 Co-processing SPL with aluminium dross salt slags (export)

In Europe dross from the aluminium industry is treated with salt to recover aluminium. Aluminium dross is a residual waste that is created during aluminium smelting and casting processing.

Befesa (Spain) operate plants to recycle dross salt slags and other residues from dross recycling to recover mineral materials and salts for other industrial uses. Befesa have found that adding one part ground and screened SPL to three parts salts/residues decreases the energy input required to operate their water leach process.40

Befesa operate five plants in Europe with an installed capacity to recycle salt slags and SPL. The combined capacity is +630,000 t of salt slags and SPLs annually (+413,200 t/y of salt slags and +23,800 t/y of SPLs recycled).41

Australian smelters have sent SPL to Befesa via export permits in the past. The capacity of Befesa to receive new shipments of Australian SPL is unknown and would be subject to a contract negotiation between the Australian smelter and Befesa.

### 6.3 Long term storage

Tellus Holdings have two geological repository sites: Chandler (NT) and Sandy Ridge (WA).

Chandler underground salt mine and storage and isolation facility is a deep geological repository remotely located in Central Australia 120km south of Alice Springs. Storage of materials, equipment and waste would be in salt strata according to similar practices used in Europe or North America for similar wastes, known as salt repository. Salt repositories have very high integrity for waste disposal, due to the inert nature of the salt and its geological plasticity (salt will creep slowly over time).

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39 A possible issue for future SPL processing capacity of cement kilns in Australia (and globally) could be a reduction in SPL processing capacity due to the cement industry processing other wastes that limit SPL processing rates (beyond the alkali gap limitations discussed above).


41 Source (May 2016)

Sandy Ridge is classified as an arid near-surface geological repository. It is located approximately 150 km west/ north west of Kalgoorlie, and adjacent to the existing Mt Walton ‘intractable waste disposal’ facility, Western Australia’s only Class V landfill (their highest risk ranking of five categories of landfill).

Both facilities plan to be licensed to receive hazardous waste material such as SPL which will be stored on a ‘like with like’ basis to facilitate full retrievability of the material for future recycling and beneficial use.

The two facilities are currently progressing through feasibility, planning and regulatory approval processes. The Sandy Ridge site is planned to be accepting first wastes by late 2017, with the Chandler facility to follow approximately 12-24 months later.

Although regulatory approvals are not yet in place, the Chandler site has a proposed capacity of 400,000 tpa while the Sandy Ridge facility proposes a licensed capacity of 100,000 tpa.

6.4 Mineral wool manufacturing (export)

In 2013 Norsk Hydro in Norway entered into a contractual agreement with Rockwool™ International in Germany, to process their 1st cut SPL.42 Because it is high in carbon it has been used as a substitute for coke in the thermal process of insulation material production. It is not clear whether this agreement, which was to expire at the end of 2013, has been extended or what the outcomes of using SPL in that industry were.

Literature43 suggest that a French aluminium smelter may also have exported SPL to Germany for mineral wool manufacture.

Section 7.4.2, below discusses the European Union funding a project under the LIFE program that supported the development of the mineral wool process to process SPL. The European Commission website provides another reference44 which discusses the potential capacity of the mineral industry to receive SPL:

“From technical point of view is seems to be possible to substitute 20 - 25% what will give 64 - 80 kt/a coke saving and 105 - 130 kt/a recycled lump SPL. That is 1.5 - 2 times the amount of the total European SPL waste. Time consuming permission procedures, needed investments and an unclear market situation is the reason why a fast progress is unrealistic”.

This suggests that there is significant capacity available for SPL processing in mineral wool manufacture, however, the publication date is not provided and the current status of mineral wool capacity to receive SPL needs confirmation. Industry noted during consultation that mineral wool manufacture would only be suited to blocks of 1st cut SPL processing. The process is not suited to 2nd cut SPL or to fines of 1st cut SPL. It is assumed that the mineral wool processing of SPL is not equipped to manage 1st cut SPL fines due to dust and furnace feed-in issues.

44 European Commission LIFE05 ENV/DK/000158 WASTE AND SEWAGE RECYCLING IN STONE WOOL PRODUCTION After-LIFE Communication Plan (Section 10 in the final technical report)
Rockwool 2015, page 27, provided the following recent data regarding the tonnages of recycled product used in mineral wool manufacturing.

"Recycling and reclaimed products

<table>
<thead>
<tr>
<th>Year</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycling of residue from other industries</td>
<td>metric tons</td>
<td>564,900</td>
<td>619,400</td>
</tr>
<tr>
<td>% recycled content (secondary melt raw materials per metric ton stone wool)</td>
<td>%</td>
<td>25.9</td>
<td>27.9</td>
</tr>
</tbody>
</table>

The proportion of the 543kt of ‘residues from other industries’ that is SPL is not provided in the above references. However, the above two references do indicate that there is a significant capacity in the mineral wool industry for SPL. It is unknown if there is currently any ‘spare capacity’ for processing Australian SPL at the Rockwool sites taking SPL.

6.5 Plasma arc vitrification

A company called Plascycle has plans to establish a pilot scale plasma arc facility in the Hunter region, with the aim of destroying ‘problematic’ wastes that could include SPL. These plans would involve subsequent recovery of inert slag material for industrial or construction uses.

Discussions regarding siting are well-progressed however the facility is still in concept phase and potential future capacity remains confidential.

6.6 Thermal treatment and processing

6.6.1 Regain

Regain Services has plants onsite at Point Henry smelter (Alcoa), and Tomago Aluminium sites. Regain provided the following description of their SPL process.

"The process of SPL recovery, detoxification and manufacture of new products that are not classified as hazardous waste is shown in below.

SPL Preparation involves (a) recovery of material from storage or directly from pots, (b) primary segregation of aluminium metal, carbon materials and refractory materials, (c) sorting into like material streams and (d) crushing and size classification in preparation for further processing.

The cyanide and explosion hazards in the SPL are eliminated through the SPL Treatment process. Cyanide destruction is achieved by thermal oxidation i.e. heating the material in the presence of oxygen. Neutralisation of the reactive compounds and aluminium metal is
achieved by using water to bring on the reactions that generate the explosive gases in a controlled environment in special apparatus such that no more gas can be generated. Mineral products with fluxing and mineralising properties are manufactured by processing the detoxified SPL material and other ingredients”.

The Regain process does not destroy the fluoride hazard in SPL, which has some benefit for clinkering in downstream cement manufacturing markets.

Regain export processed SPL to cement kilns overseas as HiCal cement clinker mineralising products used to improve cement production.

Regain currently supply only limited HiCal to Australian cement kilns.\(^{45,46,47}\) The Australian cement product standards set a maximum alkali (0.6% w/w sodium oxide equivalent) content in cement clinker. The raw materials (rawmix) in Australia have elevated alkali content and hence have a small ‘alkali gap’ that limits the input of HiCal (and untreated SPL) into the kiln. In international markets cement industries either do not have such industry regulation and/or have lower alkali levels in raw materials so have more capacity for (and in some cases a need for) the increased alkali (sodium) that Regain outputs (and untreated SPL) can provide.

Regain 2015 provided analysis of the international cement industry’s capacity to receive processed SPL. Regain’s analysis states that:

“The SPL generation per tonne of primary aluminium is about equal to the potential consumption of refined byproducts per tonne of Portland cement clinker (around 20kg each). But as worldwide clinker production (4bnt in 2013) is around 100 times greater than worldwide primary aluminium production (47Mt in 2013) then statistically, only one in a hundred cement plants is required to participate in this industrial ecosystem”.

Regain’s website states they have diverted:

“more than 300,000 tonnes of cyanide and fluoride contaminated waste diverted from the waste stream including more than 200,000 tonnes of SPL. It represents a viable techno-commercial solution to what has been an intractable problem for the primary aluminium smelting industry. Progressive cost reductions have been realised as benefits accruing from the technology learning curve, continuous improvement, economies of scale and revenues from the sale of refined products”\(^{48}\)

Regain’s Point Henry plant is currently processing SPL and operates under the umbrella of the Alcoa site licence (licence 11481\(^{49}\)). The licence does not specify an annual processing capacity limit for the plant. It does limit storage of the waste materials to 3,000 tonnes.

Regain’s Tomago site is currently processing SPL and operates under licence number 13269\(^{50}\) and the site has a licensed capacity to process 20,000 tonnes per annum.

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\(^{46}\) Adelaide Brighton Cement Birkenhead site is licensed for 2.5 tph of “carbon powder (processed anodes)” see: http://www.adelaidebrightoncommunity.com.au/media/33036/epa_licence_mostcurrent.pdf

\(^{47}\) Boral Cement Berrima site is licensed for 10,000 tonnes per annum of HiCal 50 (spent aluminium electrode carbon) see: http://www.epa.nsw.gov.au/prpoeapp/ViewPOELicence.aspx?DOCID=32644&SYSUID=1&LICID=1698

\(^{48}\) Source (August 2016) http://www.regainmaterials.com/aluminium-smelting-industry/regain-spl-solution

6.6.2 Weston Aluminium

Weston Aluminium is situated in Weston in the Hunter region of NSW. They have operated historically as a salt dross processing company, to recover aluminium, but have also developed a process for 1st and 2nd cut SPL. While details of this process are not known to the authors it does involve, in a similar vein to Regain, thermal destruction of cyanide and off-gases, in this case using a furnace at 1000°C. Additional processing and off-take market information has been withheld on request from Weston Aluminium.

Weston is currently only licensed for 2nd cut SPL (under licence number 6423). The licence limits processing capacity to 40,000 tonnes per year combined total of SPL and aluminium dross. The licence also limits storage onsite to 5,000 tonnes. Weston is currently completing a mixed SPL trial (from 3.8.2015 – 2.8.2016) for a maximum of 3,000 tonnes for the 12 month trial (1,000t stored at any time). \(^{51}\)


Considerations for any agreement

Stakeholder consultation and project analysis have identified several key considerations in forming any agreement, discussed below.

7.1 Aluminium smelting market conditions

The aluminium industry is growing globally but has been in decline in Australia resulting in the recent closure of two of six smelters. The Australian aluminium industry has been under significant pressure from falling aluminium prices, since mid-2011, a strong Australian dollar, and increased global competition.

Figure 7 illustrates historical prices of Aluminium (in $US) from 1994 to 2016. Excluding the price drop in 2008 (during the global financial crisis) current prices are similar to those in 2000. The Australian dollar is currently trading at around $US 0.75 whereas it was trading at around $US 0.55 in 2000 – resulting in lower incomes for Australian aluminium exports in 2016 than in 2000.

Figure 7 Historical price of aluminium 1994 to 2016


7.1.1 SPL waste management costs

The financial costs of SPL management are significant. Industry has commented that historical costs of SPL management have been in the order of $1000/tonne. These costs have reduced significantly in recent years but still remain a significant consideration and concern for the smelting industry.
The liabilities/costs discussed above present costs to send SPL to a WMP. They are not inclusive of costs to manage other (non-SPL) landfilled materials or costs for other site remediation that could be required. These costs could be a significant addition to the total costs.

There are also costs\(^\text{52}\) associated with maintaining SPL in landfills onsite (not removing the stockpile using a SPL WMP).

7.2 Each site is different and management options vary

A significant historical stockpile of SPL has accumulated at most smelting sites in Australia that requires management. There are, however, significant differences between each of the smelter sites that need consideration in drafting any agreement.

7.2.1 SPL stockpile profile at each site

Any agreement will need to consider the profile of the SPL stockpiles onsite, including:

- the amount of SPL stockpiled (1\(^{\text{st}}\) and 2\(^{\text{nd}}\) cut) above ground and below ground
- the storage and landfill standards that are in place for the SPL stockpiles
- other wastes that may be mixed together with landfilled SPL.

7.2.2 Impacts on local environment and intended site afteruse

The level of environmental impact that SPL stockpiles have caused at each site needs to be analysed to understand if the current management of SPL stockpiles is adequate.

Where SPL stockpiles are landfilled onsite and are impacting the local environment, additional stockpile clean-up actions are likely to be required by state government regulators in the short to medium term. Industry may have constrained funding available to meet these costs.

\(^{52}\) The estimation of the costs associated with the landfilling of SPL is beyond the scope of this project.
Related to the above is the intended afteruse of the site. The more sensitive the intended afteruse of the site – the more stringent the level of site cleanup is likely to be.

### 7.2.3 Proximity of SPL WMPs

As discussed in 6.1 the proximity of different SPL WMPs can also have a significant impact on the management costs and the complexity of transport requirements.

From our work to date it is clear that a ‘one size fits all’ approach to an industry wide agreement is not a feasible. Any agreement needs to take the site context into consideration.

### 7.3 Australian SPL legislative framework

As discussed in Section 3, electrolytic cells from aluminium smelting, known as pots, are made up of steel shells with two linings, an outer insulating or refractory lining (known as ‘second cut’ pot liner waste) and an inner carbon lining that acts as the cathode (known as ‘first cut’ pot liner waste). After some years of operation, the pot lining fails and is removed.

The removed material is SPL, a hazardous waste due to:

- the presence of fluoride and cyanide compounds that are leachable in water
- its corrosiveness – it exhibits high pH due to the presence of alkali metals and oxides
- its reactivity with water - producing inflammable, toxic and explosive gases, such as hydrogen, methane, and ammonia.

The toxic, corrosive, and reactive nature of SPL means that particular care must be taken in its handling, transportation, and storage.

Typical concentrations of contaminants in first and second cut SPL from Australian smelters are shown in Table 6.

#### Table 6 Range of chemical analysis of SPL in Australia

<table>
<thead>
<tr>
<th>Component</th>
<th>Unit</th>
<th>1st cut SPL</th>
<th>2nd cut SPL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon as C</td>
<td>%</td>
<td>30 – 50</td>
<td>2 – 10</td>
</tr>
<tr>
<td>Silicon as SiO₂</td>
<td>%</td>
<td>2 – 15</td>
<td>10 – 40</td>
</tr>
<tr>
<td>Iron as Fe₂O₃</td>
<td>%</td>
<td>2 – 4</td>
<td>1 – 6</td>
</tr>
<tr>
<td>Aluminium as Al₂O₃</td>
<td>%</td>
<td>10 – 30</td>
<td>15 – 30</td>
</tr>
<tr>
<td>Calcium as CaO</td>
<td>%</td>
<td>1 – 5</td>
<td>1 – 5</td>
</tr>
<tr>
<td>Magnesium as MgO</td>
<td>%</td>
<td>0 – 2</td>
<td>0.5 – 2.5</td>
</tr>
<tr>
<td>Sodium as Na₂O</td>
<td>%</td>
<td>3 – 25</td>
<td>5 – 30</td>
</tr>
<tr>
<td>Potassium as K₂O</td>
<td>%</td>
<td>0.2 – 1</td>
<td>0.5 – 1.5</td>
</tr>
<tr>
<td>Fluorine as F</td>
<td>%</td>
<td>5 – 15</td>
<td>5 – 15</td>
</tr>
<tr>
<td>Cyanide as CN</td>
<td>mg/kg</td>
<td>100 – 4,000</td>
<td>100 – 1,500</td>
</tr>
</tbody>
</table>

Source: Regain Technologies 2014.
7.3.1 State and Territory level

Hazardous waste in Australia is regulated at the state/territory level, addressing risks arising from generation, workplace health and safety, transport, treatment and disposal. Increasingly, the Commonwealth Government has taken an overarching role in coordination, consistency and prioritising areas of policy intervention at a national level, in concert with states and territories.

Hazardous waste classification is often done for the purposes of disposal, typically to landfill, so classification systems tend to be based around this. States and territories have developed guidelines for a number of organic and inorganic contaminants in wastes, soils or waste derived materials based on these two drivers. As such these guidelines have been developed based on risks such as leaching of contaminants to groundwater, potential for impact of leachate to surface waters and potential for impacts of such leachate on humans and ecological health. These risks are relevant to hazard characterisation and categorisation of SPL.

The process of classification in each state is the primary legislation relevant to determining how the waste should be regulated and managed.

Table 7 assesses each SPL-relevant state’s regulatory framework, using the typical values from Table 6, to classify both cuts of SPL in an Australian jurisdictional context. Note that SPL is in the upper end of the range for total cyanides and may also fall into the highest hazard category for fluoride and cyanide, although this is immaterial to the classification outcome.
### Table 7 SPL waste classification in Australia

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Most relevant legislation</th>
<th>Jurisdictional hazard classification of SPL</th>
<th>Regulatory consequence&lt;sup&gt;53&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1&lt;sup&gt;st&lt;/sup&gt; cut SPL</td>
<td>Due to</td>
</tr>
</tbody>
</table>
• Fluoride | Hazardous waste | • ADGC Div. 4.3  
• Fluoride | Both 1<sup>st</sup> & 2<sup>nd</sup> cuts cannot go to direct to landfill. Immobilisation approval must be obtained and require chemical treatment of SPL to reduce the hazardous properties of SPL before landfilling. |
| Qld          | Environment Protection Regulation 2008 | Regulated waste | • ADGC Div. 4.3  
• Fluoride, cyanides | Regulated waste | • ADGC Div. 4.3  
• Fluoride, cyanides | Regulated waste in Qld. Individual landfill licence conditions determine acceptance of SPL. |
| Tas          | Environmental Management and Pollution Control (Waste Management) Regulations 2010 | Controlled waste | • ADGC Div. 4.3  
• Fluoride | Controlled waste | • ADGC Div. 4.3  
• Fluoride | The handling of controlled waste requires approval from the Director, EPA. |
| Vic          | Environment Protection (Industrial Waste Resource) Regulations 2009 | Prescribed industrial waste, Category A | • ADGC Div. 4.3  
• Fluoride | Prescribed industrial waste, Category A | • ADGC Div. 4.3  
• Fluoride | Both 1<sup>st</sup> & 2<sup>nd</sup> cuts cannot go to direct to landfill. Immobilisation or other treatment to destroy /reduce hazard must occur. |

These classifications have been arrived at using the following jurisdictional information sources:


<sup>53</sup> Hazardous waste categorisation and the associated management requirements are generally only triggered where waste leaves the site of generation.

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<sup>PRECO63 SPL project</sup>
Based on the indicative composition data in Table 7, both 1st and 2nd cut SPL in NSW and Victoria are classified at the highest level of hazardous waste in these jurisdictions and as such cannot be sent directly to landfill. They must undergo treatment to immobilise or otherwise treat the hazard so as to remove it.

Queensland and Tasmania are less prescriptive about the allowable management pathway but both classify 1st and 2nd cut SPL as hazardous waste, and would be unlikely to provide (in 2016) an approval offsite landfill as a management approach.

Movement of ‘controlled wastes’ (SPL) across state and territory borders

Table 7 analyses how SPL is classified (as hazardous waste) within the respective regulatory frameworks of Australian states and territories. Where transport of SPL crosses interstate borders en route to the management destination, the movements are subject to the National Environment Protection Measure (Movement of Controlled Waste Between States and Territories) 2004. This NEPM is discussed in the context of Commonwealth responsibilities in Section 7.3.2, but its implementation is at the state/territory level. ‘Controlled waste’ is a term specific to the NEPM which has essentially the same meaning as hazardous waste in a national context, and includes SPL. Jurisdictions such as WA, NT and Tasmania also use the ‘controlled waste’ term within their intrastate classification and legislative structures as well as in regard to interstate movements.

Prior to such movements, a waste producer must apply to obtain a Consignment Authorisation from the waste receiving jurisdiction’s environment agency. Discussions occur between the agency of the jurisdiction of origin and the agency of the jurisdiction of destination. Discussions would consider:

- the appropriateness of the receiving facility’s licence to accept the waste
- whether the environmental policy and legislative context supports the application.

There are two specific examples of jurisdictional “environmental policy and legislative context”, one in Victoria and one in NSW, that are particularly relevant for SPL interstate movements.

In the case of movements of prescribed industrial waste (PIW) out of Victoria, an additional approval under Clause 26(1)(c) of Victoria’s Environment Protection (Industrial Waste Resource) Regulations 2009 is required, obtainable by application to EPA Victoria. In granting approval, EPA must deem the interstate receiving facility to have ‘better environmental performance standards’ than a facility licensed in Victoria. This clause is aimed at ensuring appropriate levels of environmental management apply to all waste generated in Victoria.

NSW also has a number of policy levers aimed at ensuring accountability in the management fate of wastes. The one with the most potential relevance to interstate movements of waste is the ‘proximity principle’. The proximity principle is a requirement that waste should be managed as close to the source of generation as possible – within 150km of source, or further only if the treatment/disposal facility is one of “the two nearest lawful disposal facilities.” However, the majority of hazardous wastes (including SPL) were made exempt from this requirement via NSW EPA notice54 in 2015.

7.3.2 Commonwealth level

The Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal\(^55\) (the “Basel Convention”) regulates the movement of hazardous wastes across international boundaries. Australia was a foundation signatory to it in 1992, when it came into force. The Convention puts an onus on exporting countries to ensure that hazardous wastes are managed in an environmentally sound manner in the country of import. These obligations are placed on countries that are party to the Convention. One hundred and fifty-one countries have ratified the Basel Convention as at December 2002. The obligations are to:

- minimise generation of hazardous waste
- ensure adequate disposal facilities are available
- control and reduce international movements of hazardous waste
- ensure environmentally sound management of wastes
- prevent and punish illegal traffic.

Hazardous Waste Act

The Commonwealth Government implements its Basel Convention responsibilities through the Hazardous Waste (Regulation of Exports and Imports) Act 1989\(^56\) (the “Hazardous Waste Act”), which regulates (via a permitting system) movement of hazardous wastes in and out of Australia. The object of the Hazardous Waste Act is to:

“... regulate the export, import and transit of hazardous waste to ensure that exported, imported or transited waste is managed in an environmentally sound manner so that human beings and the environment, both within and outside Australia, are protected from the harmful effects of the waste.”

The Hazardous Waste Act and (indirectly) the Basel Convention are relevant considerations in any agreement where export of hazardous wastes is integral to a management option.

Key aspects to be considered are:

- the definition of ‘waste’ (Section 4, p.9 of Hazardous Waste Act)
- the definition of ‘disposal’ (Section 4, p.5 of Hazardous Waste Act)
- the definition of ‘hazardous waste’ (Section 4, p.5 of Hazardous Waste Act)
- the definition of environmentally sound management (ESM) (Section 4E, p.14 Hazardous Waste Act)
- facilities within Australia that may provide management alternatives for the hazardous waste.

With regard to the last point, Section 17(5) (p.32) of the Hazardous Waste Act allows for a permit to be refused on the basis of the existence of a facility in Australia, if its management in such a facility is consistent with ESM and can be done “safely and efficiently” which reflects Basel Convention Article 4, Clause 9(a) p. 23:

“9. Parties shall take the appropriate measures to ensure that the transboundary movement of hazardous wastes and other wastes only be allowed if:

(a) The State of export does not have the technical capacity and the necessary facilities, capacity or suitable disposal sites in order to dispose of the wastes in question in an environmentally sound and efficient manner...”

The Hazardous Waste Act is also supported by the Hazardous Waste (Regulation of Exports and Imports) (OECD Decision) Regulations 1996, which specifically facilitate export of hazardous wastes from Australia to other OECD countries where these wastes are to be recycled or recovered.

NEPM for Movement of Controlled Waste between States and Territories

The Commonwealth Government administers the National Environment Protection Measure (Movement of Controlled Waste between States and Territories) 2004 (the “Controlled Waste NEPM”) but, because this is enshrined in law in states and territories for implementation, it is essentially just framework legislation at the national level.

Australian Code for the Transport of Dangerous Goods by Road & Rail

SPL is classified as a dangerous good for the purposes of transport under Division 4.3 of the Australian Code for the Transport of Dangerous Goods by Road & Rail (ADGC). The relevant extract is included below.

“DIVISION 4.3 - SUBSTANCES WHICH IN CONTACT WITH WATER EMIT FLAMMABLE GASES

2.4.4.1 Definitions and properties

Certain substances in contact with water may emit flammable gases that can form explosive mixtures with air. Such mixtures are easily ignited by all ordinary sources of ignition, for example naked lights, sparking hand tools or unprotected lamps. The resulting blast wave and flames may endanger people and the environment. The test method referred to in 2.4.4.2 is used to determine whether the reaction of a substance with water leads to the development of a dangerous amount of gases which may be flammable. This test method should not be applied to pyrophoric substances” (page 91).

SPL is also a dangerous good for the purposes of transport under Class 9 - miscellaneous dangerous substances and articles, including environmentally hazardous substances of the ADGC due to SPL being an Environmentally hazardous substance as defined in the ADGC.
7.4 International SPL legislative frameworks and incentive programs

7.4.1 United States of America

Regulation of SPL

In 1998, under the Resource Conservation and Recovery Act (RCRA), US EPA published Land Disposal Restrictions; Treatment Standards for Spent Potliners From Primary Aluminum Reduction (K088); Final Rule. The ruling classified SPL as a hazardous waste in the USA (K088).

The ruling requires that SPL is “prohibited from land disposal unless the wastes have been treated in compliance with the numerical standards contained in this rule. These treatment standards are necessary to minimize threats to human health and the environment from exposure to hazardous constituents which may potentially leach from landfills to groundwater”.

The ruling noted the importance of the destruction of cyanide which it states is the most “dangerous constituent of SPL based on its concentration, toxicity, and the extent of contamination caused by past land disposal of untreated spent potliners” (page 5254).

The ruling established treatment standards for: Cyanide, Polyaromatic Hydrocarbons, certain metals, total Arsenic, and Fluoride.

In developing the ruling US EPA also undertook an analysis of the capacity of readily available treatment technology that could meet the required level of treatment (which at the time was dominated by the Alcoa/Reynolds Metal Company treatment process). The EPA ruled that with the Alcoa/Reynolds facility and other emerging technologies there was sufficient treatment capacity and capability to enforce the ruling.

An example of SPL site clean-up requirements in the USA

A number of SPL landfill sites in the USA have had clean-up requirements put in place. The requirements for these site clean-ups provide useful context in understanding the international response to the clean-up of sites with contamination resulting from landfilling SPL in un-engineered landfills.

The Washington State Department of Ecology cleanup requirements for SPL contaminated land at the former Kaiser Aluminum site in Tacoma Washington are provided in detail in:


The cleanup area related to an area “which was historically used to dismantle reduction cells and temporarily store SPL and potroom duct dust. From 1943 to 1967, the area was not paved and, for most of the earlier part of this period, the area was not at its present grade” (page 1-1).

Landau 2014, and additional supporting reports, provided a detailed site investigation to identify the extent of the SPL waste stored below ground and the extent of contamination resulting from the SPL.
Landau 2014 provided the following summary regarding the SPL disposal process that was required.

“2.7 SPL MATERIAL DISPOSAL

Excavated SPL material was temporarily stockpiled along the edge of the excavations, and was subsequently transferred into lined trucks and transported under appropriate hazardous waste manifests for disposal at the Waste Management Subtitle C landfill in Arlington, Oregon. Trucking and disposal records are provided in Appendix F and summarized in Table 1. The originally estimated weight of SPL material to be removed for disposal was 12,500 tons; however, a total of 38,837.94 tons of material from the SPL Area was disposed at the Waste Management hazardous waste landfill between August 6, 2013 and November 14, 2013 (see the waste disposal summary in Table 1). In addition, approximately 1,600 pounds of residual sludge from the automated wheel wash facility was drummed and sent to Waste Management for solidification and landfilling. Additional trucking and disposal records are provided in Appendix G” (page 2-5).

Landau 2014 Appendix B includes regulatory approvals that state that the SPL from this site was permitted for disposal to a hazardous waste landfill offsite without prior treatment (after site specific detailed assessment). Below are two photos from the site clean-up which provide some insight into the physical state of SPL that has been stored below ground (photo 1 source figure A3, photo 2 source figure A6).

Incentives programs for SPL stockpile cleanup

In 1980, the US Congress established the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The CELCLA was established in response a number of significant human health and environmental impacts from the dumping of hazardous wastes. CERCLA is informally called Superfund. The Superfund program is administered by US EPA in cooperation with each state government. The fund to designed to enable the clean up hazardous waste sites by either forcing potentially responsible party (PRP) to perform cleanups or reimburse the government for cleanups led by US EPA.
An important part of the Superfund is special accounts. EPA establishes special accounts to provide ready access to PRP cleanup funds for sites where future response work remains. The use of funds secured in special accounts preserves the funding held in the Superfund Trust Fund for cleanup of sites without viable PRPs.

Special accounts are funded entirely with money received from PRPs, and not with funds provided by the US Government through the Superfund Trust Fund. US EPA retains money received through settlements with PRPs in special accounts to conduct planned future cleanup work at the site based on the terms of the settlement agreement.

“More than $4 billion have been deposited in special accounts through PRP settlements. Over $2 billion of those settlement dollars have been spent on Superfund site cleanups and the balance is planned to be used for ongoing or future Superfund cleanup work.”

The US EPA reports the following status of special accounts for the fiscal year (FY) 2015 is as follows:

- created approximately 49 special accounts,
- deposited about $1.778 billion into special accounts,
- earned over $16.8 million in interest on its special accounts,
- for a total of $1.795 billion,
- disbursed or obligated more than $259 million for response work,
- reimbursed itself for over $36 million worth of past cleanup related costs at sites,
- closed 29 special accounts, and
- transferred $974,098 of special account receipts to the Superfund Trust Fund”.

Source: US EPA website 2016, see https://www.epa.gov/enforcement/superfund-special-accounts#status

This review did not identify references that detailed how the Superfund legislation and funds have been used in the US for the clean-up of SPL stockpiles.

Alcoa’s website provides some detail regarding the cleanup of the Reynolds Metal Company site in Troutdale, Oregon:

“A partnership between Alcoa and federal, state, and local governments quickly transformed a former aluminum smelter and Superfund site in Troutdale, Oregon (USA), into an industrial park that has the long-term potential to add almost five times more jobs than were lost and generate millions in annual local taxes...

... In 1994 when the smelter was still owned by Reynolds, the U.S. Environmental Protection Agency (EPA) declared the smelter and surrounding property a Superfund site due to the spent pot lining, carbon, fluoride, and other hazardous substances that had been landfilled on the site before current disposal laws. While the remedial investigation, feasibility study, and some remediation work on these legacy issues had been completed before Alcoa’s acquisition of the site, significant work remained.

In 2002, Alcoa decided to permanently curtail the smelter and began evaluating options for the site. One viable alternative was to consolidate all of the remediation waste to a central landfill and cap it. The concern was that this would have rendered a significant portion of the site, which had great redevelopment potential due to its location near major...
waterways, highways, and Portland’s airport and port facilities, largely unusable and undevelopable.

Alcoa decided on a US$55 million decommissioning and remediation effort to maximize development of the property. After detailed risk assessments conducted in conjunction with government authorities, the company initiated remediation that would protect the health and safety of people and the environment.

Actions undertaken included removing contaminated soil, utilities, tanks, vessels, pipes, and building foundations, with the latter being removed down to eight feet below grade so they wouldn’t interfere with new foundations. Alcoa also reclaimed a 16-acre lake on the site, replanted original vegetation, cleared invasive species, addressed a groundwater issue, and installed a new pipeline system for stormwater management.”

The Troutdale smelter clean-up provides a good example of the use of the US EPA Superfund to work on the clean-up of SPL stockpiles. *The Oregonian* online article *Cleaned-up Reynolds Metals site in Troutdale sprouts promise* indicates that the clean-up costs for the site were US$223 million and that Alcoa spent more than $50 million to meet its Superfund clean-up obligations on the site. The article also indicates that the 26,000 tons of SPL wastes were taken offsite to a landfill.

### 7.4.2 European Union

**Regulation of SPL**


The European Commission *Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste* requires that all waste, including hazardous wastes, sent to landfill in the EU be pre-treated. It is unclear if treated SPL is permitted to be disposed to landfill in the EU and the prohibition of landfilling of particular treated hazardous wastes, such as SPL, would be governed differently in each country.

The European Commission *Waste framework directive*, Article 5 and 6, page 312/11 provides useful context for defining when SPL would be considered a hazardous waste and when it would be considered a product.

Article 5 provides the following criteria for a substance resulting from a production process being regarded as a by-product rather than a waste:

- Further use of the substance or object is certain
- The substance can be used directly without any further processing other than normal industrial practice
- The substance is produced as an integral part of a production process

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Further use is lawful, i.e. the substance fulfills all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts.

Article 6 provides the following criteria for waste to reach ‘end of waste status’:

- The substance or object is commonly used for specific purposes
- A market or demand exists for such a substance or object
- The substance or object fulfills the technical requirements for the specific purposes and meets the existing legislation and standards applicable to products
- The use of the substance or object will not lead to overall adverse environmental or human health impacts.

**Incentives programs for SPL stockpile cleanup**

LIFE is the EU’s current financial instrument supporting environmental, nature conservation and climate action projects. Beginning in 1992, LIFE has co-financed over 4000 projects. For the 2014-2020 funding period, LIFE will contribute approximately €3.4 billion to the protection of the environment and climate.  

A review of SPL waste processes co-funded by LIFE identified the project **RECYCLING/SYMBIOSIS - Waste and Sewage Recycling and Symbiosis in Stone Wool Production LIFE05 ENV/DK/000158**. 

The 2007 co-funded project successfully piloted the use of first cut SPL as a substitute for coke in the mineral wool industry. Emissions of fluoride were also effectively managed. This project is a good example of the co-funding of SPL management, however, the amount of industry versus government funding is not known.

The USA Superfund site cleanup of the Alcoa site in Troutdale and the process development trials with Rockwool in the EU provide examples of federal government involvement in the SPL cleanup and processing.

**7.5 State, national, and international SPL WMPs capacity**

To understand the feasibility of agreeing to a stockpile drawdown, over a nominal 10 year period, requires an understanding of SPL WMPs capacity (tonnes per annum) in each state, nationally, and globally.

Historically SPL management options/WMP’s capacity and reliability have been limited (globally). In Australia, local processing capacity has improved in recent years.

Australia’s currently operating SPL WMPs process SPL. Research, presented in Section 6, indicates that there is significant capacity for SPL processing at Befesa and Rockwool (in Europe). However, their ‘spare capacity’ to receive Australian SPL is unknown and would be subject to individual contract negotiations between the aluminium smelter and Befesa or Rockwool.

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Australia currently has no licensed capacity for SPL long term storage. Therefore, the processing capacity of Australia’s operational WMP’s (rather than overall WMP capacity) is used in the analysis of SPL stockpile drawdown rates. An assessment of currently operating SPL WMP’s licensed/process capacity in each state versus the SPL tonnages stockpiled in each jurisdiction has been completed (see Section 8).

7.6 Stable ‘off-take’ markets for treated and processed SPL

There have been a number of financially unsuccessful attempts to process SPL in the past. One of the main reasons for the failure of historical SPL processes has been unstable off-take markets.\(^\text{60}\)

Where off-take markets are weak the SPL processors ‘in-take’ charges are usually pushed higher and/or there may be a higher risk that treated and processed SPL is stockpiled (by reprocessors) in effect risking the creation of another hazardous waste stockpile.

In the past few years off-take markets have matured and have been more stable resulting in more consistent processing of SPL arisings.

7.7 Local community engagement

Untreated and unprocessed SPL is a hazardous waste. Any facility currently stores or that plans to receive SPL will need to have the appropriate environmental and planning approvals in place and these approvals are typically publically advertised and contestable. The local community of any site that currently stores or plans to receive SPL should be actively engaged to ensure that they are well informed regarding the proposal and how any risks to the local community that storing or receiving SPL could create will be effectively mitigated and safely managed.

7.8 Parties to agreements

There are a number of parties that could be involved in any agreement. Who needs to be included, how, and the arrangement for any international parties involved in an agreement needs consideration.

The parties that could be considered in forming an agreement for SPL stockpile drawdown include:

- DoEE and potentially other Australian Government Departments
- State Government regulatory agencies
- Aluminium smelting companies
- SPL WMPs companies
- Hazardous waste long term storage facilities.

The inclusion of any of these parties will depend entirely on the type and form of the agreement, which in turn would depend on the site-specifics of the SPL stockpile.

Any agreement would need to clearly establish the **roles and accountabilities** of each of the parties involved in the agreement.

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\(^{60}\) **Off-take market** refers to the market of options/clients for SPL that is treated and processed to a standard that is fit for a defined purpose.
7.9 SPL WMPs competition and market considerations

The development of any agreement will need to consider the economic impact of the agreement on the stakeholders included in the agreement and/or other parties that do not form part of an agreement.

Any potential agreement would need to take into consideration the currently limited competition in the SPL WMPs market, so as not to create monopolies or lock out alternatives. For example, in areas where there is only one feasible processing option available, any agreement would need to consider commercial and competition concerns.

Figure 8 below provides a summary of the parties that could be included in an agreement and also provides a summary of the issues that any agreement would need to consider.

**Figure 8 Summary of agreement parties and considerations**

**Issues for consideration in any agreement**
- Site-specific conditions
- Market conditions, value of Aluminium and charges of SPL WMPs
- Compliance with the *Hazardous waste Act* and State environmental legislation
  - Tonnes of stockpiled SPL material to be managed
  - The timeframe for removing the SPL stockpile from smelting site
  - The proposed SPL fate according to the waste hierarchy
  - SPL WMP capacity (state, national and international providers)
  - The stability of ‘off-take’ markets for treated and processed SPL
  - Local community engagement
- The parties involved in the agreement and their roles and responsibilities
- The information and data audit trail requirements
8 Analysis of Australian SPL stockpile and new arisings versus SPL WMP capacity

This section provides analysis of Australia’s SPL stockpile (above ground and below ground) plus annual arisings, against annual licensed/process capacity for currently operating SPL processing facilities.

Australia’s currently operational SPL WMPs involve SPL processing.

Australia currently has no licensed capacity for SPL long term storage.

Australia has exported around 120,000 tonnes of SPL to European SPL WMPs since the early 1990s and has a permit pending for another 6000t to be exported. Research, presented in Section 6, indicates that there is significant capacity for SPL processing at Befesa and Rockwool. However, their ‘spare capacity’ to receive Australian SPL is unknown and would be subject to individual contract negotiations between the aluminium smelter and Befesa or Rockwool.

Therefore, the licensed/process capacity of SPL WMPs in Australia (rather than overall SPL WMP capacity) is used in the analysis of SPL stockpile drawdown rates.

8.1 Analysis of above ground stockpile plus new annual arisings

The table below provides the summary of the analysis of the Australian above ground SPL stockpile plus new arisings versus annual licensed/process capacity for currently operating SPL processing facilities in Australia.

Table 8 Australian above ground SPL stockpile plus annual SPL arisings versus estimated annual licensed/process capacity

| State | SPL above ground (tonnes) | Est. SPL new arisings (tonnes per year) | Estimated local SPL licensed/process capacity (tonnes per year) | Theoretical years to process above ground SPL locally

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<td>NSW</td>
<td>89,283</td>
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<td>308,195</td>
<td>29,100</td>
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</tr>
</tbody>
</table>

* This capacity is not limited by licensed capacity. Capacity is limited by the installed capacity or process SPL input limitation.

The analysis in Table 8 compares the above ground SPL stockpile and the new arisings from operating smelters with annual licensed/process capacity in each state.

The analysis indicates that the Australian above ground stockpile could theoretically be processed in four or more years (whilst continuing to process new arisings). It is important to note that this
theoretical drawdown timeframe is indicative only as there are several important considerations, as discussed in Section 7, which may impact on the actual drawdown timeframe.

Whilst noting these considerations, the comparison of above ground stockpile tonnages with national processing capacity indicates that it is possible for Australia’s above ground SPL stockpile to be drawn down over a 10 year period (whilst continuing to process new arisings).

The analysis in Table 8 also indicates that there is sufficient processing capacity available in Vic and NSW to process SPL stockpiles within the nominal 10 year period that DoEE has identified.

The analysis for Qld and Tas indicates that these states have limited processing capacity beyond the tonnage of new annual arisings and would require more than 10 years to process the SPL stockpiles using local processing capacity alone. For Qld and Tas the analysis indicates that any agreement may need to consider interstate or international processing options or the establishment of additional local SPL WMP capacity.
8.2 Analysis of total stockpile drawdown and annual arisings

The analysis in Table 9 compares SPL stockpiles above ground, plus new arisings, and modelled proportions of landfilled SPL for processing against annual licensed/process capacity in each state.

It is important to note that the decision to require processing of any landfilled SPL would be made by the relevant state government regulator. The modelling included below is provided simply to help understand the approximate theoretical timeframes that would be required to process differing percentages of the landfilled stockpile (should processing be required). In addition to the considerations flagged in Section 7, the ability to process landfilled SPL stockpiles via the processes included in Section 6 is not clear. This project’s literature review did not identify examples of landfilled SPL that has been processed – the examples identified required the removal of SPL to an offsite hazardous waste landfill (see Section 7.4).

Table 9 Australian SPL stockpile above ground, plus annual arisings, plus modelled landfill tonnage percentage requiring processing

<table>
<thead>
<tr>
<th>State</th>
<th>SPL above ground (tonnes)</th>
<th>SPL landfilled onsite (tonnes)</th>
<th>Est. SPL new arisings (tonnes per year)</th>
<th>Local SPL licensed/ process capacity (tonnes per year)</th>
<th>Assumed SPL landfilled processed (tonne)</th>
<th>Theoretical years to process all SPL stockpiles via local capacity</th>
<th>Theoretical years to process all SPL stockpiles via local capacity</th>
<th>Theoretical years to process all SPL stockpiles via local capacity</th>
<th>Theoretical years to process all SPL stockpiles via local capacity</th>
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<tbody>
<tr>
<td>NSW</td>
<td>89,283</td>
<td>90,000</td>
<td>10,000</td>
<td>0</td>
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<td>5 or more</td>
<td>164,424</td>
<td>8 or more</td>
</tr>
<tr>
<td>National</td>
<td>308,195</td>
<td>254,424</td>
<td>29,100</td>
<td>~100,000</td>
<td>4 or more</td>
<td>127,212</td>
<td>5 or more</td>
<td>254,424</td>
<td>8 or more</td>
</tr>
</tbody>
</table>

Notes:
1. The above analysis of SPL drawdown to process all SPL stockpiles includes 1. above ground SPL, 2. the required % of landfilled SPL, and 3. ongoing annual arisings from Al smelting.
2. The ongoing annual arisings of new SPL are assumed to remain constant (at the 2016 annual arisings of 29,100 tonnes/year).
3. The landfilled SPL in Tas has been excluded from the drawdown calculations due to the current landfill licence (with a 50 year life) permitting landfill till at least 2046. This is beyond the likely timeframe of any agreements that may be put in place.
4. Timeframes are presented as ‘x or more’ years reflecting the range of considerations and uncertainties that are outlined in Section 7.

For drawdown calculation purposes, the analysis indicates that, should it be required and technically feasible, Australia’s total SPL stockpile and new arisings could theoretically be processed in eight or more years (assuming that 100% of landfilled SPL was processed) or in six or more years (assuming that 50% of landfilled SPL was processed).

The processing of any landfilled SPL would be subject to direction by state regulators and demonstration that the SPL removed from landfill is able to be processed. Contamination from non SPL wastes such as asbestos could prevent processing of some landfilled SPL.
9 SPL drawdown agreements

The type and form of the agreements that could be put in place to enable the drawdown of SPL stockpiles in Australia are varied and the DoEE have not proposed a set type or form of agreement to be proposed for this project.

Important context for this project is the DoEE Hazardous Waste (Regulation of Exports and Imports) Act 1989 (Hazardous waste Act) reforms and cost benefit analysis. The potential reforms are outlined in the report that DoEE released last year titled Hazardous waste reform proposals analysis report (see https://www.environment.gov.au/protection/publications/hazardous-waste-reform-proposal-analysis). The report recommended that the following reform progress to the full cost benefit analysis:

“Option i) Power to establish agreements targeting particular wastes

A power to establish a statutory covenant or similar agreement for dealing with particular wastes (e.g. an agreement with legal status to phase out of stocks of spent pot linings, via domestic and international facilities)” (page 39).

This reform is currently undergoing a full cost benefit analysis. This proposed reform clearly has relevance to the establishing of agreements between the Australian Government and industry on SPL stockpile drawdown. However, it is not intended that all potential agreements that this project recommends would need to be statutory or legally binding; they may be voluntary; or not be needed at all. Each of these options is discussed below.

9.1 Agreement options

9.1.1 Agreement that ‘no agreement’ is needed

Following on from this project and the assessment of a site’s SPL stockpile and drawdown plan, it may be decided that no additional agreement between governments and the smelter needs to be established.

This may be the preferred approach where there the smelter has an internally agreed SPL management plan in place and a clear timeline for the stockpile to be drawn down that has been effectively implemented over the past several years. The successful historical management of SPL would typically have resulted in a relatively small stockpile of SPL materials remaining onsite.

9.1.2 Voluntary agreement

Smelters, governments and SPL WMPs may decide to enter into a non-legally binding agreement for the drawdown of the SPL stockpile on a site. Whilst not legally binding, the agreement would still be supported by:

- An agreed timeline for stockpile drawdown that also considers new SPL arisings.
- Information regarding the SPL WMP/s that will be utilised.
- A financial plan for implementing the agreement, including forecast budget allowances required over the drawdown period.

64 The options presented in this section are not endorsed by the Australian or State Governments nor do they represent government policy.
Consideration of contingencies should the future context of the agreement change significantly. For example, changes in commodity values, the failure of a SPL WMP to safely process SPL, or failure in the off-take market for treated and processed SPL.

Industry may consider entering into a voluntary agreement to demonstrate to the local community and to state regulators that a plan is in place that will ensure that SPL stockpiles are being responsibly managed. A voluntary agreement may also be required to be eligible for any co-funding of SPL WMP costs.

9.1.3 Legally binding agreement

As discussed above the DoEE are currently completing a cost benefit analysis on the establishment of “power to establish agreements targeting particular wastes” under the Hazardous Waste Act.

A binding agreement would likely include the same content as outlined above for voluntary agreements, however, the agreement would be binding and would have to include actions to be taken if the agreement was broken.

The use of statutory covenants by DoEE may be required as part of any co-funding of SPL WMP costs. They could also be required where there is significant social concern that the SPL stockpile has no plan in place for removal or future management to ensure human health and the environment are protected.

It is important to note that State Governments have existing powers under contaminated land and hazardous waste legislation that could also be used to enforce the ‘clean-up’ of SPL stockpiles.
10 Co-funding model options

Section 7.4.1 discussed the USA Superfund site cleanup of the Alcoa site in Troutdale and the process development trials with Rockwool in the EU. Both are examples of federal government co-funding involvement in the SPL cleanup and SPL WMP development. However, neither example provides an obvious co-funding model relevant to the current Australian context.

Stakeholder consultation completed to date has emphasized the importance of the following for any co-funding of potential agreements in the current Australian context.

- Co-funding should not financially disadvantage smelters that have proactively processed SPL in the past (at a significant cost) by providing competing companies that have accumulated large historical stockpiles (and deferred WMP costs) with more co-funding for SPL WMPs costs.
- Co-funding should not fund any particular third party SPL WMP as it would skew market competition.
- There needs to be a clear audit trail and evidence provided for co-funding and the administration of a potential co-funding agreement needs to be practical.
- Any co-funding of SPL WMPs would need to incentivise the highest practicable environmental outcome according to the waste management hierarchy.
- Any co-funding would need to ensure the SPL WMPs co-funded are compliant with the DoEE Hazardous Waste (Regulation of Exports and Imports) Act 1989.
- Any co-funding should facilitate a short to medium term (10 years) removal of SPL stockpiles.
- The SPL waste stream is highly toxic, corrosive, and reacts with water. If it is not carefully managed, SPL represents significant risk to human health and the environment. The risk of incentivising mis-management of SPL needs to be carefully considered. There have been a number of financially unsuccessful attempts to process SPL in the past. Co-funding should only be available for management options that are proven.

Figure 9 and Figure 10 below, illustrate two potential funding models that, should any co-funding become available, could provide effective incentive for SPL stockpile drawdown whilst considering the points noted above.

The Figure 9 model of co-funding smelters would be most practical if agreements (either voluntary or binding) were in place between the smelters and state/federal government/s for the SPL stockpile drawdown. This model would allow state/federal government more strategic control of which stockpiles drawdown received co-funding.

The Figure 10 model of co-funding of SPL WMPs would be most practical if no, or few, agreements were in place with smelters and state/federal government/s for SPL stockpile drawdown. The co-funding model could be simpler to administer and simply co-fund an amount per tonne for SPL managed (for approved SPL WMPs only).

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65 The options presented in this section are not endorsed by the Australian or State Governments nor do they represent government policy.
Potential for Government/s co-fund of SPL WMPs costs

Audit trail data
- process detail
- tonnes managed
- cost

SPL WMPs
- Australian provider
- International provider

Aluminium smelting site
- SPL stockpile

$ rebate for part SPL WMP costs

Smelter $ payment for SPL WMPs costs

Potential co-funding agreement detail that would need consideration
- Tonnes of stockpiled SPL material to sent to WMPs
- The timeframe for clearance of SPL stockpile
- The SPL fate according to the waste hierarchy
  - The current Aluminium commodity value
- The ‘off-take’ market for treated and processed SPL
- Compliance with the Hazardous waste Act
  - The information and data audit trail
- The resultant amount of SPL processing rebate.
Figure 10 Co-funding of SPL WMPs model to clear stockpiles

Co-funding agreement with SPL WMP

Potential for Government/s co-fund of SPL WMPs costs

Aluminium smelting site
SPL stockpile

Smelter subsidised $ for WMP costs

$ rebate for part WMP’s costs

SPL WMPs

Australian provider

International provider

Audit trail data
- process detail
- tonnes managed
- cost

Potential co-funding agreement considerations
- Tonnes of SPL material to be managed with co-funding
  - The timeframe for management of the SPL
  - The SPL fate according to the waste hierarchy
  - The ‘off-take’ markets for treated and processed SPL
- Compliance with the *Hazardous waste Act*
  - The information and data audit trail
- The resultant amount of SPL processing rebate.

Aluminium smelting site
SPL stockpile

Smelter subsidised $ for WMP costs

$ rebate for part WMP’s costs

SPL WMPs

Australian provider

International provider

Audit trail data
- process detail
- tonnes managed
- cost

Potential for Government/s co-fund of SPL WMPs costs

Potential co-funding agreement considerations
- Tonnes of SPL material to be managed with co-funding
  - The timeframe for management of the SPL
  - The SPL fate according to the waste hierarchy
  - The ‘off-take’ markets for treated and processed SPL
- Compliance with the *Hazardous waste Act*
  - The information and data audit trail
- The resultant amount of SPL processing rebate.
10.1 Other co-funding options suggested during consultation

The following co-funding option has been suggested:

“Potential to look beyond a ‘subsidised processing’ model and look to an industry-government co-funded processing solution (i.e. build, own, operate) with future processing/transport pricing agreed and fixed for 10 years. Advantage of all parties having the security of knowing final fate and cost of addressing SPL stockpiles until they are fully depleted and industry only has to address annual arisings. There would also be the advantage of eliminating geographical disadvantages of some smelters if they have fixed pricing that is the same for all smelters, regardless of location. This option could eliminate the external market forces that will always complicate the agreement option that relies on a market-driven approach. The processing solution may also be suitable for other types of problematic waste.”
11 Conclusions

11.1 Aluminium production and new SPL arisings

Australia has four operational and two recently closed aluminium smelters and is currently producing about 1.65 Mt of aluminium per annum. The Aluminium smelters have estimated new arisings of SPL of 29,100 tonnes per annum.

11.2 Australia's SPL stockpile profile

Australia has a significant stockpile of SPL with a total of around 700,000 tonnes of SPL in either above ground or below ground storages (landfills) around Australia.

Just under half of Australia's SPL stockpile (about 310,000 tonnes) is stored in above ground stockpiles. Interesting there is a higher proportion of 1st cut SPL (about 114,000) than 2nd cut SPL (about 74,000) in these stockpiles. The high carbon content in 1st cut SPL has historically meant that there have been more processing options for 1st SPL cut than 2nd cut SPL. The largest portion of the above ground stockpile is mixed 1st and 2nd cut SPL (about 120,000 tonnes).

Slightly more than half of Australia's SPL stockpile (about 390,000 tonnes) is stored in landfills onsite at several sites around Australia. The composition of the landfilled SPL is not known, but is likely to be around 50-60% 1st cut and 40-50% 2nd cut SPL.

11.3 Site aboveground SPL stockpile drawdown plans

The following definition for an ‘SPL drawdown plan’ has been adopted for this report and analysis.

An ‘SPL drawdown plan’ is a plan that has at least 2 of the following:

1. The smelter can demonstrate a recent (i.e. the last 3 years) history of significant stockpile drawdown. It should be noted that, during consultation, several smelters provided data/charts that illustrate that in the last few years SPL stockpile processing rates have increased resulting in partial drawdown of existing stockpiles.

2. Commercial arrangements are in place between the smelter and SPL WMP/s that will result in the drawdown of SPL stockpiles and the management of any new SPL arisings.

3. The estimated timeframe for the drawdown of the SPL stockpile has been provided for this public summary report.

Of the six smelting sites in Australia, only Tomago Aluminium has a drawdown plan in place that will have all SPL stockpiles removed from the site well within a 10 year period.

Alcoa Portland also has a drawdown plan in place that is likely to result in all stockpiles removed in around 10 years.

Pacific Aluminium sites at Bell Bay and Boyne (BSL) have drawdown plans in place, however the plans may take up to 10 or more years to implement, depending on the SPL processing rates that are achieved in future.

At the time of writing we understand that the Alcoa Point Henry drawdown plan was still under development. The smelter is closed and undergoing site decommissioning to allow for future development.
At the time of writing we understand that the Hydro Kurri Kurri drawdown plan was still under development. The smelter is closed and undergoing site decommissioning to allow for future development. Hydro stated that they are planning for above ground SPL stockpiles to be recycled over the next 3 to 4 years.

11.4 Capacity of SPL WMPs

The capacity of Australia’s currently operating SPL WMPs consists mostly of ‘treatment and processing’ facilities in Vic and NSW. Cement kilns in Qld and Tas provide the remainder of the operational SPL WMP capacity. The total licensed/process capacity of Australian SPL WMPs is estimated at around 100,000 tonnes per annum.

The current export options for SPL management include mineral wool (Rockwool) manufacture in Germany and Befesa in Spain. Befesa recycle aluminium dross salt slags and other residues from dross recycling and use SPL to reduce energy input requirements. Australia has exported around 120,000 tonnes of SPL to European WMPs since the early 1990s and has a permit under consideration for another 6,000t to be exported. Research, presented in Section 6, indicates that there is significant capacity for SPL processing at Befesa and Rockwool. However, their ‘spare capacity’ to receive Australian SPL is unknown and would be subject to individual contract negotiations between the aluminium smelter and Befesa or Rockwool.

Australia may also soon have long term storage options available in the NT and WA where Tellus have proposed facilities, however, these facilities are yet to be licensed.

11.5 Considerations for any agreement

Stakeholder consultation and project research identified several important considerations for any SPL stockpile drawdown agreement to consider. They are listed below.

1. Aluminium smelting market conditions
2. The charges (fees) for SPL WMPs.
3. The site specific conditions including:
   a. The sites SPL stockpile profile
   b. Impacts on local environment and intended site afteruse
   c. Proximity of SPL WMPs.
4. Australian (State and Commonwealth) SPL legislative framework.
5. International SPL legislative frameworks and incentive programs.
6. State, national, and international SPL WMP’s capacity.
7. The stability of ‘off-take’ markets for treated and processed SPL.
8. Local community engagement.
10. SPL WMP competition and market considerations.
11.6 SPL waste management costs

The financial costs of SPL waste management are significant. Industry has commented that historically SPL WMPs fees have been in the order of $1000/tonne. These costs have reduced significantly in recent years but still remain a significant consideration and concern for the smelting industry.

The liabilities/costs discussed above present costs to send SPL to a WMP. They are not inclusive of costs to manage other (non-SPL) landfilled materials or costs for other site remediation that could be required. These costs could be a significant addition to the total costs. There are also costs\(^6\) associated with maintaining SPL in landfills onsite (not removing the stockpile using a SPL WMP).

11.7 Australian SPL stockpile and new arisings versus SPL WMPs capacity

11.7.1 Above ground stockpile

The project analysis indicates that the Australian above ground SPL stockpile could theoretically be processed in four or more years (whilst continuing to process new arisings). It is important to note that this theoretical drawdown timeframe is indicative only as there are several important considerations, as listed above, which may impact on the actual drawdown timeframe.

Whilst noting these considerations, the comparison of above ground stockpile tonnages with national processing capacity indicates that it is possible for Australia’s above ground SPL stockpile to be drawn down over a 10 year period (whilst continuing to process new arisings).

The analysis also indicates that there is sufficient processing capacity available in Vic and NSW to process SPL stockpiles within the nominal 10 year period that DoEE has identified.

The analysis for Qld and Tas indicates that these states have limited processing capacity beyond the tonnage of new annual arisings and would require more than 10 years to process the SPL stockpiles using local processing capacity alone. For Qld and Tas the analysis indicates that any agreement may

\(^6\) The estimation of the costs associated with the landfilling of SPL is beyond the scope of this project.
need to consider interstate or international processing options or the establishment of additional local SPL WMP capacity.

11.7.2 Total stockpile plus annual arisings

It is important to note that the decision to require processing of any landfilled SPL would be made by the relevant state government regulator.

The processing of any landfilled SPL would also be subject to demonstration that the SPL removed from landfill is able to be processed. Contamination from non SPL wastes such as asbestos could prevent processing of some landfilled SPL.

For drawdown calculation purposes, the analysis indicates that, should it be required and technically feasible, Australia’s total SPL stockpile and new arisings could theoretically be processed in eight or more years (assuming that 100% of landfilled SPL was processed) or in six or more years (assuming that 50% of landfilled SPL was processed).

11.8 Agreement options and agreement co-funding

Whilst this project has identified a significant number of considerations and issues with SPL management, the project identified just three ‘agreement options’ that are discussed briefly below.

11.8.1 Agreement that ‘no agreement’ is needed

This may be the preferred approach where the smelter has an internally agreed SPL management plan in place and a clear timeline for the stockpile to be drawn down that has been effectively implemented over the past several years. The successful historical management of SPL would typically have resulted in a relatively small stockpile of SPL materials remaining onsite.

11.8.2 A voluntary agreement

Industry may consider entering into a voluntary agreement to demonstrate to the local community and to state regulators that a plan is in place that will ensure that SPL stockpiles are being responsibly managed. A voluntary agreement may also be required to be eligible for any co-funding of SPL WMPs costs.

11.8.3 A legally binding agreement

The use of statutory covenants by DoEE may be required as part of any co-funding of SPL WMPs costs. They could also be required where there is significant social concern that the SPL stockpile has no plan in place for removal or future management to ensure human health and the environment are protected. It is important to note that State Governments have existing powers under contaminated land and hazardous waste legislation that could also be used to enforce the ‘clean-up’ of SPL stockpiles.

Within the voluntary and legally binding agreement options, the project identified two models of co-funding including:

1. Agreement to co-fund the smelter for SPL WMPs costs (rebate to smelter)
2. Agreement to co-fund the third party SPL WMPs costs (e.g. rebate to SPL WMPs).

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67 The options presented in this section are not endorsed by the Australian or State Governments nor do they represent government policy.
During consultation, industry identified another co-funding model which was for the government to consider for the potential to look beyond a ‘subsidised processing’ models and look to an industry-government co-funded SPL processing solution (i.e. build, own, operate) with future processing/transport pricing agreed and fixed for 10 years.

11.9 The feasibility of an agreement based approach to SPL stockpile drawdown

This project aimed to test the feasibility of using an agreement based approach to drawdown Australia’s SPL stockpile over a period of around 10 years.

The analysis indicates that it is feasible to use an agreement based approach to develop site-specific agreements with the aluminium smelting industry, SPL WMPs, and Australian governments that could enable SPL stockpile drawdown in around ten years.

The agreement type (voluntary or binding), parties, and any potential co-funding would need detailed consideration that is beyond the scope of this project.
12 Recommendations

The following is recommended.

1. DoEE progress with discussions with all Australian aluminium smelters and SPL WMPs to develop site specific agreements that will help ensure the drawdown of above ground SPL stockpiles over the next 10 years. Whilst Tomago Aluminium has a short drawdown plan in place, they should still be consulted, at least initially, to ensure they are not disadvantaged for proactively processing their SPL stockpile.

2. DoEE maintain communication with the relevant state EPAs to monitor the outcomes of current assessments/audits of onsite SPL landfills.

3. Should landfilled SPL be required to be removed from site and/or processed, DoEE should look to include the additional tonnages into any agreement this is being considered.

4. The development of any agreement includes full assessment of the considerations that are included in Section 7 of this report. Included in this assessment should be a confirmation of the stockpile tonnage figures for each site that were provided for this report.

5. Where any agreement potentially includes co-funding that DoEE ensure that the considerations included in Section 10 are fully assessed.

6. If co-funding is being considered as part of an agreement, DoEE should undertake additional analysis of the historical and current ‘baseline’ pricing for SPL WMPs. The indicative pricing information gathered during this project is insufficient to support decisions regarding the amount of co-funding that should be provided per tonne (for example).
13 References


• Transportation Safety Board of Canada 1991 (Transport Canada 1991), Investigation Marine, Report of investigation into the circumstances surrounding the explosion on board the Norwegian vessel “Pollux” causing the death of two crew members and injuring twelve other persons on March 19, 1990, at la Baie, Quebec.


• US EPA website May 2016, see https://www.epa.gov/enforcement/superfund-special-accounts#status