Intended for
**Hydro Aluminium Kurri Kurri Pty Ltd**

Document type
**FINAL**

Date
**October, 2017**

# CAPPED WASTE STOCKPILE
# WASTE MANAGEMENT OPTIONS EVALUATION STUDY

RAMBOLL

# CAPPED WASTE STOCKPILE
# WASTE MANAGEMENT OPTIONS EVALUATION STUDY

| | |
|---|---|
| Revision | **Final** |
| Date | **30/10/2017** |
| Made by | **Fiona Robinson** |
| Checked by | **Shaun Taylor** |
| Approved by | **Fiona Robinson** |

Ref AS130525

Ramboll Environ
Level 2, Suite 19B
50 Glebe Road
PO Box 435
The Junction
NSW 2291
Australia
T +61 2 4962 5444
F +61 2 4962 5888
www.ramboll-environ.com

# CONTENTS



# APPENDICES

**Appendix 7**
Fate and Transport Model – Onsite Containment Cell

**Appendix 8**
Cost Estimate

**Appendix 9**
Regulatory Context

**Appendix 10**
Long Term Management

**VOLUME 2**
Quantitative Capped Waste Stockpile Waste Management Remedial Options Evaluation

# 1. INTRODUCTION

The former Hydro Aluminium Kurri Kurri Smelter (the Smelter) is located on Hart Road, Loxford near Kurri Kurri in New South Wales, Australia. The area of land owned and managed by Hydro Aluminium Kurri Kurri Pty Ltd (Hydro) incorporates the former Smelter area (the Smelter Site) and the surrounding buffer zone (comprising approximately 2000 hectares of land in total) (the Hydro Land). Smelting activities ceased at the Smelter Site in September 2012, and in May 2014 Hydro formally announced the closure of the Smelter.

Demolition and remediation of the Smelter are key tasks to facilitating the future redevelopment of the Smelter. Remediation of the site includes remediation of a legacy landfill currently capped and situated within the Smelter footprint known as the Capped Waste Stockpile (CWS). Other remediation activities comprise the excavation and removal of contaminated soils, disposal of demolition waste materials and recycling of recyclable materials (Wastes).

Following a review of remediation options it was determined that relocation of these mixed Wastes to a new purpose built Containment Cell within a more geologically suitable area of the Hydro Land was the most appropriate remediation strategy.

An Environmental Impact Statement (EIS) for the 'Demolition and Remediation Project SSD 6666 (the Project) was prepared and exhibited in 2016. In response to the EIS, the NSW Environment Protection Authority (EPA) advised that the onsite containment of certain waste streams (contaminated soils and non-recyclable demolition waste) is appropriate, however any waste in the CWS that contains levels of leachable fluoride and/or cyanide above the thresholds set out in the "*Chemical Control Order in Relation to Aluminium Smelter Wastes Containing Fluoride and/or Cyanide*" (the CCO) would need to be treated prior to disposal to the Containment Cell.

Following this response, Hydro commissioned Ramboll Environ to identify the most ecologically sustainable management option for the CWS materials. The principles of the evaluation were aligned with the principles of Ecologically Sustainable Development and the NSW EPA Waste Hierarchy. The evaluation recognised that a qualitative analysis was insufficient to evaluate the benefit and cost of each option particularly for recycling. The evaluation also recognised that financial cost should not be a differentiating metric and that non-financial metrics were critical in the evaluation process. As such a full quantitative analysis was designed using an evaluation comparative tool that allows comparison of a range of metrics identified to be significant in the decision-making process. The tool adopted was the Net Environmental Benefit Analysis (NEBA) developed by Ramboll Environ for evaluation of non-financial metrics, such as environmental and social values.

The objective of the CWS management is to render the Hydro site suitable for the proposed future land use whilst providing the optimum net environmental benefit, or reduced net environmental impact, in completing the management option now and in the future.

The objective of this Options Study is to consolidate all of the information relevant to the assessment of the appropriate management of the existing CWS. The scope of work for this Management Options Analysis involved the following:

- Detailing the chemical characteristics and identifying key waste behaviours including leachability
- Identifying potential waste management options for the CWS and eliminate those which are not considered viable
- Conducting an assessment of the management option for the CWS materials using the key identified metrics of human health, worker safety, environmental impacts and greenhouse gas emissions
- Providing an outline of the regulatory context of the preferred waste management option
- Developing an overview of the long term management for the preferred waste management option

Volume 1 of this document presents:

- The key characteristics of the waste material within the CWS
- Possible management options for the CWS including Australian and international examples
- Screening process for the possible remedial options

- Detailed Containment Cell design parameters
- Fate and transport of leachate from the Containment Cell in the proposed onsite location
- Industry feedback on various aspects of the possible management options that has been used to evaluate uncertainty within the management options
- Cost estimate for the preferred management option
- Regulatory context of the preferred management option
- Proposed long term management of the preferred management option

The NEBA process is presented in Volume 2 of this report and findings are presented through this covering document.

# 2. CHEMICAL CHARACTERISTICS AND WASTE BEHAVIOUR

Reference **Appendix 2**, **Volume 1** for further information.

## 2.1 Waste categorisation

The CWS comprises approximately 365,000 tonnes of mixed historical wastes arising from the smelter operations and impacted soils lying below the stockpile. The volume of the capped waste stockpile has been approximated by survey, drilling and conversion on assume bulk density. The contents of the CWS have been approximated from historical site documents and includes spent pot lining, steel, waste anodes, asbestos containing materials and other smelter related wastes. A proportion of this waste is potentially recyclable and this has been considered in the process of identifying possible waste management options. The estimated volumes of each waste within the CWS is presented in **Figure 2-1**. 'Steel', 'other carbon' and 'spent pot lining >500mm' are considered to be recyclable and comprise an estimated 53,500T, or roughly 15% of the total CWS volume. Whilst site knowledge of the CWS content is documented, and investigations support this information, there remains uncertainty in the actual contents of the stockpile that will not be realised until the stockpile is excavated. This uncertainty results in project, environmental and health and safety risks for all management options. The risk assessment presented in **Section 4** shows that risks increase with increased handling, sorting and treatment and that due to the uncertainty in the waste these risks may increase significantly.

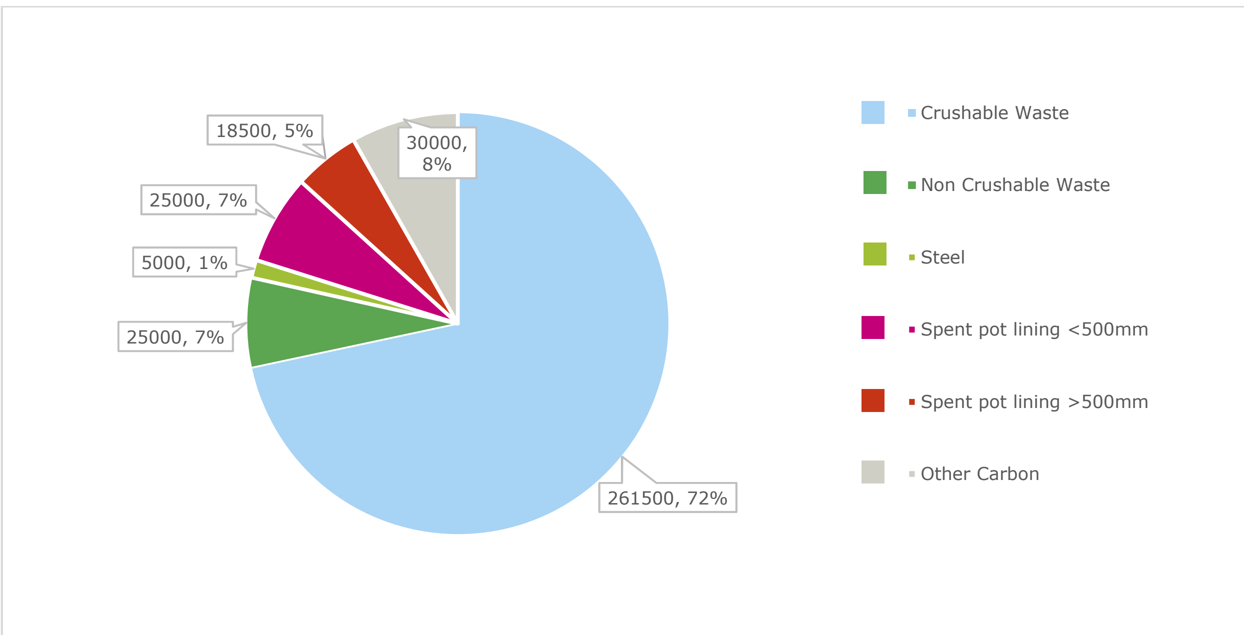



**Figure 2-1 Waste Categories by Mass (T)**

The following plates show photos of the CWS prior to capping.

## 2.2 Waste Classification Guidelines

Characterisation of the CWS has been completed in accordance with the requirements of the *Protection of the Environment Operations Act 1997* (POEO Act) and the EPA *Waste Classification Guidelines* (Waste Guidelines). The CWS is not pre-classified (as it does not meet any of the pre-classification characteristics) and accordingly the CWS is classified on the basis of the total and leachable concentrations of constituents comprised in the CWS. Applying that process the CWS is considered hazardous asbestos waste under the Waste Guidelines due to:

- The presence of asbestos fibres in samples analysed (roughly 50% of samples contained asbestos).
- Elevated total and leachable concentrations of polycyclic aromatic hydrocarbons (PAHs) including benzo(a)pyrene.

## 2.3 Chemical Control Order

The CCO was also considered for the purposes of classifying the CWS. The CCO outlines special restrictions in relation to aluminium smelter wastes where concentrations of leachable fluoride exceed 150 mg/L and leachable cyanide exceed 10 mg/L. Analysis completed on the CWS found the 95% upper confidence limit of the mean (95%UCL) to be **337 mg/L** and leachable cyanide to be **6 mg/L**. On this basis the CWS is considered aluminium smelter waste containing leachable fluoride for the purposes of the CCO.

## 2.4 Gas Emissions

Aluminium smelter waste is automatically considered Dangerous Good Class 4.3 due to the emission of flammable gases when in contact with water. Class 4.3 analysis of the CWS material on 16 samples found the waste does not exhibit Class 4.3 characteristics. This is considered likely due to the weathered nature of the waste. Analysis has found the waste emits ammonia, which requires management for health effects.

### 2.5 Leaching characteristics

Analysis of CWS materials was completed to evaluate the effects of crushing on the leachability of fluoride from samples. The analysis is presented in **Appendix 2, Volume 1** and the findings were:

- Leachable fluoride in **uncrushed** samples reported a leachable concentration maximum of 370 mg/L and average of 94 mg/L. Crushing of samples resulted in higher leachable concentrations.
- Gas evolution is increased with wetting.
- Mixing with lime at 10% by mass can reduce the fluoride concentration in the leachate to below 150 mg/L.
- Addition of cement or calcium chloride is not effective in reducing leachable fluoride.

# 3. OPTIONS FOR REMEDIATION

## 3.1 Preliminary screening

The preliminary screening of possible management options was undertaken of proven or emerging technologies identified using a range of global and local resources. The screening considered the waste characteristics, location, management objectives, and identified those options that could feasible be appropriate.

The screening identified few proven specific management options that could be applied to the CWS and a summary of existing known practices for legacy aluminium smelter landfills is provided within **Appendix 3, Volume 1**. Other options were largely unproven or not technically feasible for the waste type. Options that were identified during the preliminary screening and ruled out from further analysis include:

- Do nothing
- Material separation using density and colour
- Upgrade of the CWS with a subsurface barrier wall/ permeable reactive barrier and capping
- In-situ vitrification
- Disposal at sea
- Encapsulation in concrete products
- Acid leaching

Options that were considered technically feasible, though also largely unproven, and were included for further analysis can broadly be grouped in to options that allow partial recycling; allow reuse; options that treat; and options that dispose. Further discussion of the CWS waste management options screening is provided in **Appendix 4, Volume 1**. The short list of options includes at least one option in each category. There are combinations of each option that could occur however, a shortlist of six waste management options (referred to in this Options Study as the Management Options) as described in **Section 3.2** were identified for further analysis and comparison to a 'Do Nothing' option.

## 3.2 Management Options Considered in Detail

A detailed description of the CWS Management Options is provided in Section 3 of **Volume 2**. A brief description of the CWS Management Options is presented in **Table 3.1**.

**Table 3.1 Capped Waste Stockpile Waste Management Options**

| Management Option | Description |
|---|---|
| Do Nothing | CWS remains *in situ*. |
| Option 2 | Onsite containment in a purpose built Containment Cell. Allows for recycling where feasible to do so. |
| Option 3 | Sorting of the CWS to remove carbon pieces >500mm and steel. Segregation, crushing and washing to allow for recycling of carbon and steel. Crushing remaining materials and treatment with lime through a pug-mill. Placement in Containment Cell. |
| Option 4 | As for Option 2 but no recycling and allowing co-placement of lime to reduce fluoride in leachate, should leachate occur. |
| Option 5 | Offsite containment following steel removal and crushing and treating with lime. Allows recycling of steel. |
| Option 6 | Heat treatment to reduce water reactivity, transport and containment in salt mine in the Northern Territory or kaolin clay mine in Western Australia. The salt mine facility has been adopted for the assessment. Allows recycling of steel. |
| Option 7 | Onsite treatment by Plasma Arc. May allow carbon capitalisation for the plant use. Allows recycling of steel. |

# 4. NET ENVIRONMENTAL BENEFIT ANALYSIS

## 4.1 Introduction

The evaluation of remedial options is usually completed following a qualitative framework and assessing metrics such as time, cost, likelihood of success, health and safety of workers, and likelihood of achieving the remediation goal and sustainability of the option. Most commonly, these parameters are considered in a qualitative manner, with each metric given a score and these summed to assess the option that provides the best score based on the metrics.

With complex projects, such as this one, and with many stakeholders, it is necessary to complete these evaluations quantitatively to ensure that comparison between the options remains objective and that all relevant aspects are incorporated. For this evaluation, it was preferred by Hydro that financial cost not be included as an evaluation metric and that non-financial metrics were more critical in the evaluation process. As such a full quantitative analysis was designed using an evaluation comparative tool that allows comparison of a range of metrics identified to be significant in the decision-making process. The tool adopted was the Net Environmental Benefit Analysis (NEBA) developed by Ramboll Environ for evaluation of non-financial metrics, such as environmental and social values, consistent with the principles of ecologically sustainable development. The tool has been used internationally on other similar projects.

Net environmental benefits are defined as the gains in value of environmental services or other ecological properties attained by the action(s) minus the value of adverse environmental effects caused by the action(s)[1]. A Net Environmental Benefit Analysis (NEBA) as applied to this Options Study, is an analytical framework used to quantify and compare the effects of alternative CWS waste management options on the "environment". For the purposes of conducting a NEBA for this Options Study, the "environment" refers to the assessment parameters identified in **Section 4.3**.

**Volume 2** of this document describes the comprehensive NEBA analysis that has been completed. A summary of the NEBA is presented below. As the NEBA process is extremely detailed it is strongly recommended that further review of Volume 2 is also undertaken in order to fully understand this assessment.

## 4.2 Methodology

The objective of the NEBA was to understand the potential benefit, or reduced impact, that each Management Option would provide to the existing and future public in combination with an understanding of the adverse human and environmental impacts associated with implementation of the Management Option. As such, the assessment metrics of human health, worker safety, ecology and greenhouse gas (GHG) emissions were considered to encompass the key metrics appropriate for the Management Option comparison. Briefly, the key metrics are described as:

- Human Health: the risks to onsite workers and the surrounding community from potential health impacts associated with the chemical exposure (short term and long term) that are likely to occur during the Management Options. An example is chemical exposure in dust and from asbestos. This evaluation follows a nationally recognised process for health risk assessment.
- Worker Safety: the physical hazards and risk to workers during the Management Options. An example considered is the risk of being hit by an excavator. This evaluation was semi qualitative and recognises that risks increase with increasing task duration and number of machinery.
- Ecology: included an evaluation of impacts to vegetation from land clearing, and potential impacts to aquatic receptors. This evaluation follows nationally recognised principles for ecological risk assessment.
- GHG: calculated the GHG emissions for each option including any benefit achieved through recycling.

[1] Efroymson, R. A.; Nicolette, J. P.; Suter, G. W, II (2003). A framework for net environmental benefit analysis for remediation or restoration of petroleum-contaminated sites; ORNL/TM-2003/17; Oak Ridge National Laboratory: Oak Ridge, TN, USA3.
Efroymson, R.; Nicolette, J.; Suter, G. A (2004). Framework for net environmental benefit analysis for remediation or restoration of contaminated sites. Environ. Manag., 34, 315-331.

As discussed in **Section 1** it is recognised that financial cost should not be a differentiating metric and as such has not been included in the NEBA. However Hydro understands that the EPA considers cost an important factor, and therefore the costs for each Management Option have been provided in **Volume 1, Appendix 8**.

Each Management Option is described in detail with flow diagrams produced outlining the required steps to complete the Management Option within **Volume 2**. Health, safety and environmental management requirements were identified. **Volume 1, Appendix 6** provides technical advice from an occupational hygienist and highlights key challenges and constraints of dealing with asbestos containing material. Timelines to complete tasks were also developed and incorporated in the evaluation and are produced in **Volume 2** and summarised with the costing in **Table 4.1**.

**Table 4.1 Capped Waste Stockpile Waste Management Options Time and Cost Implications**

| Management Option | Timeframe (years) | Cost A$'000000 |
|---|---|---|
| Do Nothing | 0 | 0.4 |
| Option 2 | 2 | 40.0 |
| Option 3 | 6 | 171.9 |
| Option 4 | 2 | 56.1 |
| Option 5 | 7 | 317.3 |
| Option 6 | 18 | 1021.4 |
| Option 7 | 8 | 250.2 |

### 4.3 NEBA Output

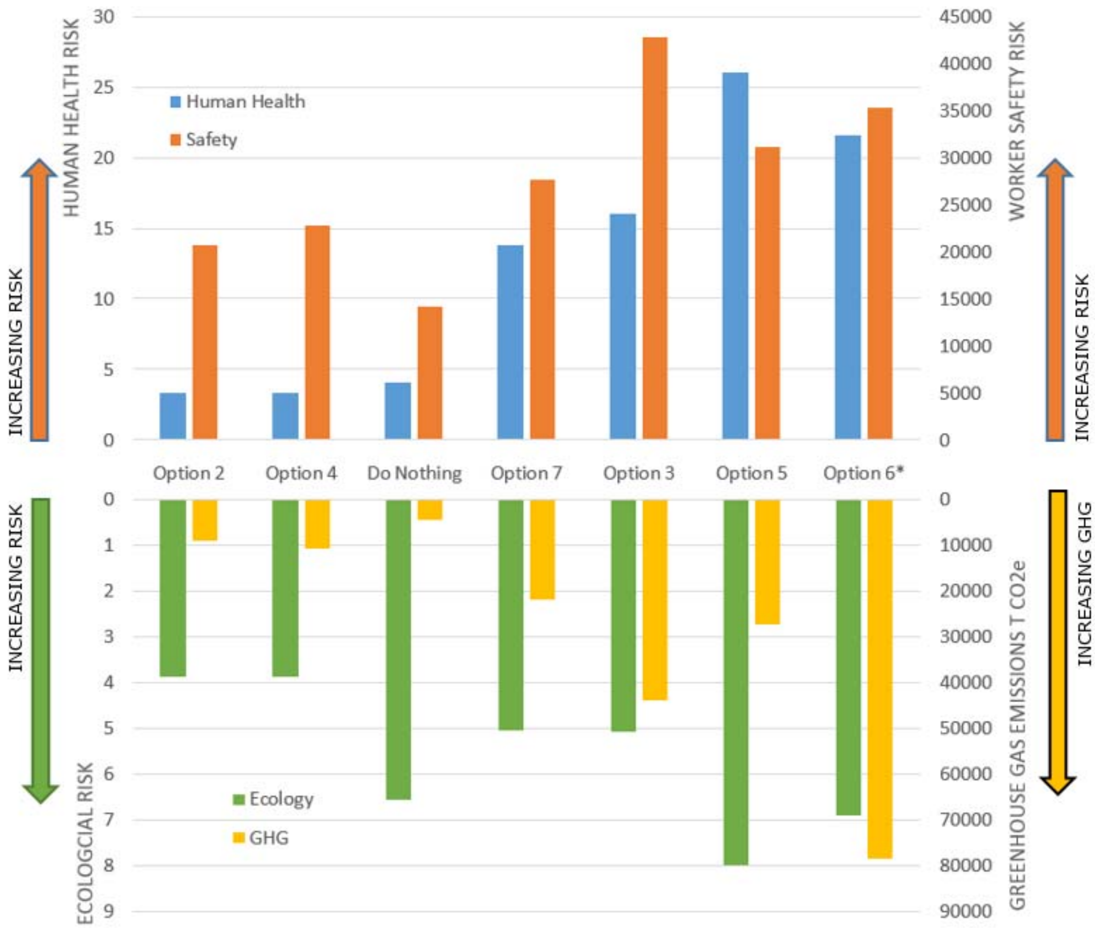
The absolute values for each key metric are presented in **Figure 4-1** although this excludes the transport GHG emissions for Management Option 6 (due to the order of magnitude of these emissions). Management Option 2 (onsite containment) has been assessed as providing the least impact to the environment of all the Management Options.

Health risk and worker safety risks are driven by duration and activity, where increased Management Option timeframes and activity increase the duration of exposure to chemicals and the risk of impact by machinery. Whilst it is recognised that these risks can be managed through implementation of controls, the relative risks remain as controls are applied equally across the Management Options.

Aquatic risks are largely driven by the risk of uncontrolled discharge and are also driven by duration. Aquatic risks are determined to be generally low for all Management Options, as was vegetation clearance.

The GHG emissions are calculated based on Management Option equipment and duration. These are not a risk, rather a prediction of the likely GHG emissions for each Management Option.

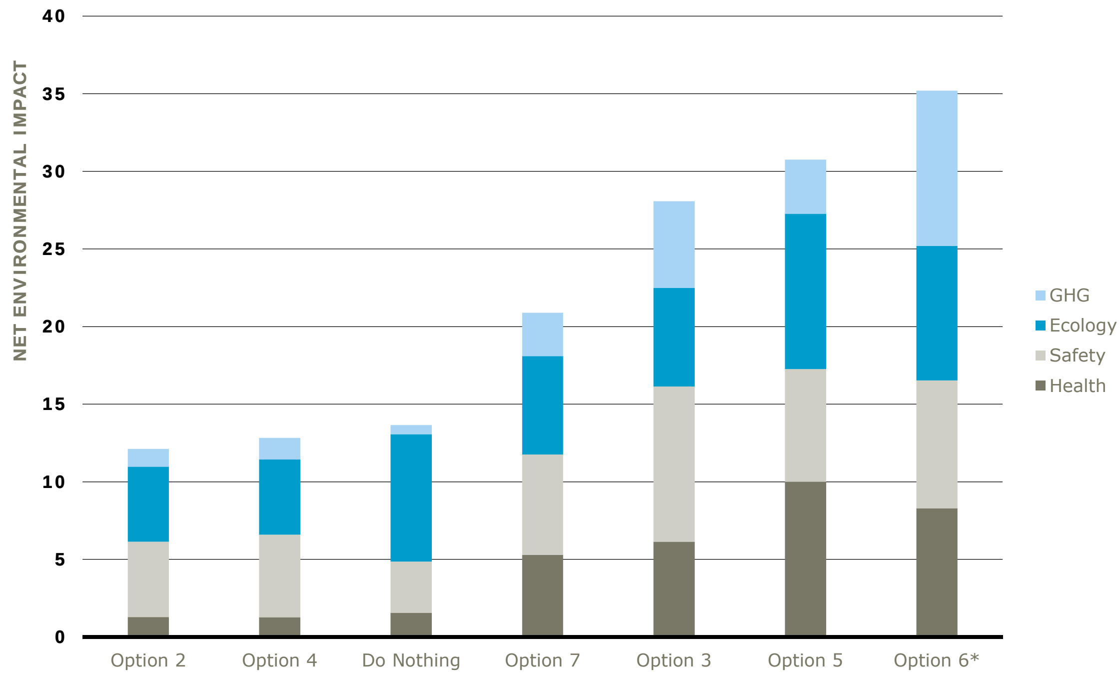
Each key metric has inherent uncertainty, as does the Management Option and the possible Additional Scenarios that could occur. For each Management Option the uncertainties remain consistent and therefore, whilst uncertainty is acknowledged it is evaluated in a consistent way for all Management Option and therefore does not affect the comparison.




* GHG for Option 6 excludes transport component

**Figure 4-1: Comparison of Key Metric Scores for all Management Options**

The NEBA output is represented as an aggregate normalised graph in **Figure 4-2** providing comparison of each Management Option for all metrics on a common scale. The process of normalisation adjust the values of different scales to a notionally common scale, in this case between 1 and 10, to allow summation of each metric resulting in a combined total comparative score. The normalised graph, as presented in **Figure 4-2** considers each metric to have an equal weighting, that is to say each metric is equally important. Sensitivity analysis for metrics identified that the ranking did not change when metrics were weighted differently. However, stakeholders can value each category differently depending on specific interests and values.




* GHG for Option 6 excludes transport component

**Figure 4-2: Net Benefit / Impact Analysis for all Management Options**

In reviewing **Figure 4-1** and **Figure 4-2** the following observations are made.

Management Options 3 and 5 incorporate higher labour hours and unacceptable worker exposure, particularly to asbestos, due to the manual effort required to segregate, clean and crush wastes for the purpose of treating and recycling. The personal protection requirements to control these risks are significant and considered impractical and unreasonable. Management Option 5 has additional impacts due to the transport of wastes through the community and the placement of the wastes within a larger waste facility with the potential for unknown waste and leachate interaction to occur.

Management Option 6 includes similar health risks to Management Options 3 and 5 due to the need to crush and treat the waste to achieve a reduction of harmful gas emissions for the safe placement of waste in an underground cavity. Greenhouse gas emissions for the transport of these wastes to the proposed repository are unacceptably high: they are the equivalent to the annual metric tonne of carbon dioxide output of approximately 740,000 passenger vehicles[2].

Management Option 7 compared with Management Options 3, 5 and 6 has lower impacts however a high technology risk and is not proven for this unique heterogeneous waste type. The risk of failure of this Management Option is considered high and the evaluation incorporates material re-treatment, disposal to landfill of treated wastes and the health and worker safety impacts resulting from increased duration and risk of failure.

Management Option 2 and 4 (onsite Containment Cell) have been assessed as providing the least impact to the environment of all the Management Options considered. The lower risk of impact to the environment presented by these options is largely driven by the efficient extraction of the CWS and minimised waste handling requirements, as well as the low future impacts posed by the dry entombment within a containment cell that incorporates best practice design, construction and management. These options also minimise risk associated with uncertainty in the waste characterisation. The characterisation of the waste is currently based on site knowledge and limited chemical evaluation. In the event of waste being encountered that is either physically or chemically different from that expected, both Option 2 and 4 have the greatest flexibility for managing health, safety, environmental and project risks due to the simple method of disposal and the short and manageable durations of exposure.

[2] US EPA https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle-0

Management Option 4 has higher greenhouse gas emissions compared to Management Option 2, resulting from the transport and handling of lime in the treatment process. Compared to Management Option 2 worker safety is also higher due to the additional machinery and effort required to add and mix lime to the waste. There is also an increased health risk to future users of the containment cell site due to potential for calcination within the leachate liner system resulting in reduced landfill drainage and the potential for gas emissions (ammonia) to increase due to increased water content. There is no change in ecological impact as fate and transport modelling has shown no impact to receptors from a treated or untreated leachate condition.

The fate and transport model considers known information for site geology, cation exchange of fluoride with site soils and the site-specific hydrogeology. The findings of this analysis are presented in **Figure 4-3** and show that cation exchange and very low site hydraulic conductivity act to restrict the movement of leachate should leachate ever escape the triple cell liner system. Modelling indicates that steady state plume migration is predicted to not occur within 10,000 years, and that the concentration of fluoride in groundwater is predicted to reduce below 1 mg/L within 200 m of the site. **Figure 4-3** represents an initial leachate at three concentrations of fluoride, namely 150 mg/L, 337 mg/L and 1880 mg/L. These represent the leachate from treated waste (as would be expected in Management Option 4), leachate from untreated waste (measured) (as would be expected in Management Option 2), and the maximum ever measured leachate condition from the existing stockpile respectively. Detailed analysis is presented in **Appendix 7, Volume 1**.

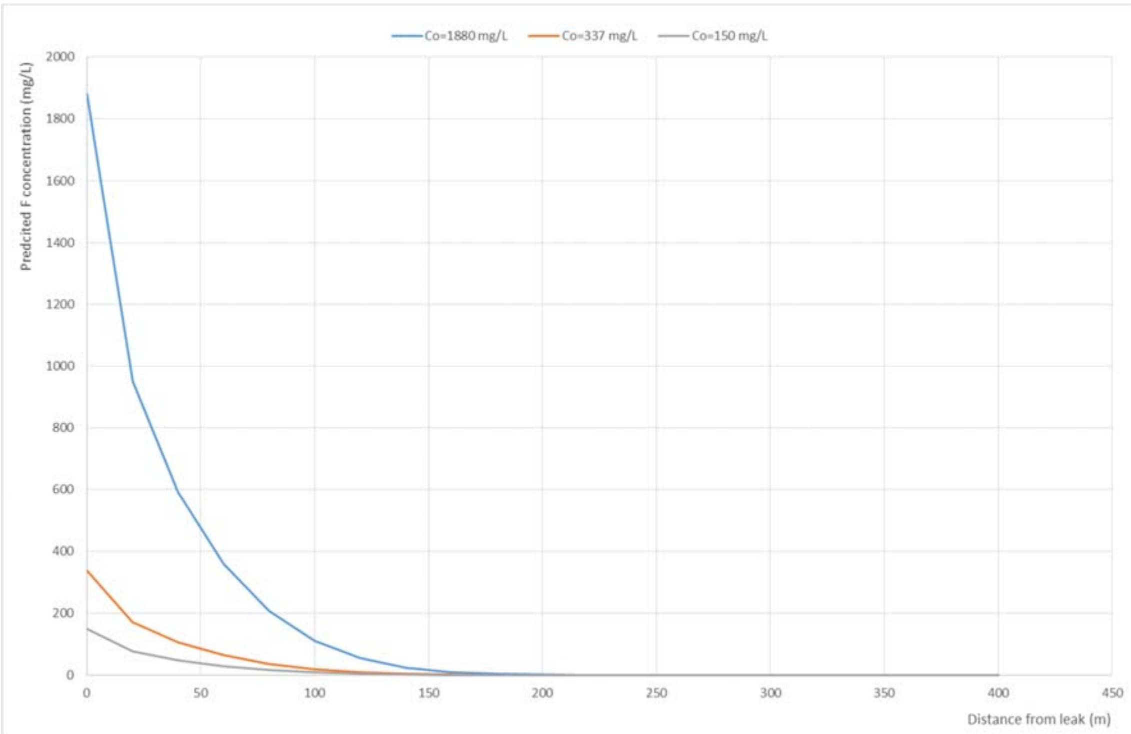



Figure 4-3: Fate and Transport of leachate at 10,000 years

On the basis of the NEBA review Management Option 2 is the preferred option as it represents the lowest overall environmental and human health impact when compared to all other options.

# 5. PREFERRED WASTE MANAGEMENT OPTION

## 5.1 Location

Management Option 2 (onsite Containment Cell) incorporates containment of all wastes within a purpose built cell situated onsite. The site for the Containment Cell construction is within a short distance of the CWS, minimising haulage distance. The site is geologically suited to containment comprising low permeability clays overlying competent siltstones. Groundwater is presented within the competent siltstones at 2.0m below the base of the proposed containment cell. The site is also positioned 400 m from the nearest water course, 1.5 km from the nearest point of groundwater discharge at Wentworth Swamp and above the 1 in 100 year flood and Probable Maximum Flood levels.

The site is substantially disturbed and requiring minimal vegetation clearance, having been a hobby farm prior to the construction of the Smelter and used for clay borrow historically. The site, and future Containment Cell, could be located adjacent to a future heavy industrial land use. Further details are contained in **Appendix 7, Volume 1**.

### 5.2 Containment Cell Design

GHD has completed a detailed Containment Cell design for the wastes developed by adopting a risk based approach in accordance with the standards for design, operation and rehabilitation for landfill facilities in New South Wales, and addressing additional risk areas, by utilising Australian and International regulations and best practice. The design itself and the technical specification for the works recognises the dry entombment objectives for the wastes. The design incorporates several layers of redundancy comprising:

- Triple base lining system consisting of low permeability clay overlain by two geocomposite lines each comprising a geosynthetic clay liner and high density polyethylene liner.
- Primary and secondary leachate and groundwater collection system
- Liner durability testing using site won leachate which demonstrated liner performance was unaffected by the leachate
- Dry entombment work methodology to minimise moisture entrainment
- Double capping system comprising a linear low density polyethylene liner and 1.5 m soil and vegetation layer
- Precautionary gas venting system
- Leachate collection including ability for long term periodic pump out

The detailed Containment Cell design is in **Appendix 5, Volume 1**. **Figure 5-1** and **Figure 5-2** shown liner and capping detailed cross-sections.

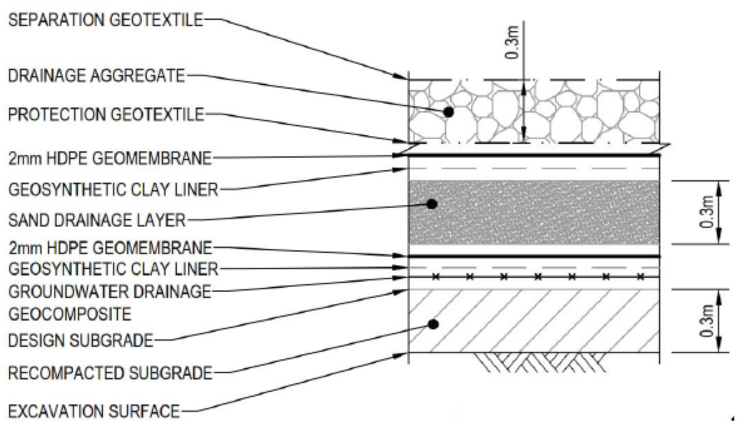



**Figure 5-1: Cross section showing liner elements**

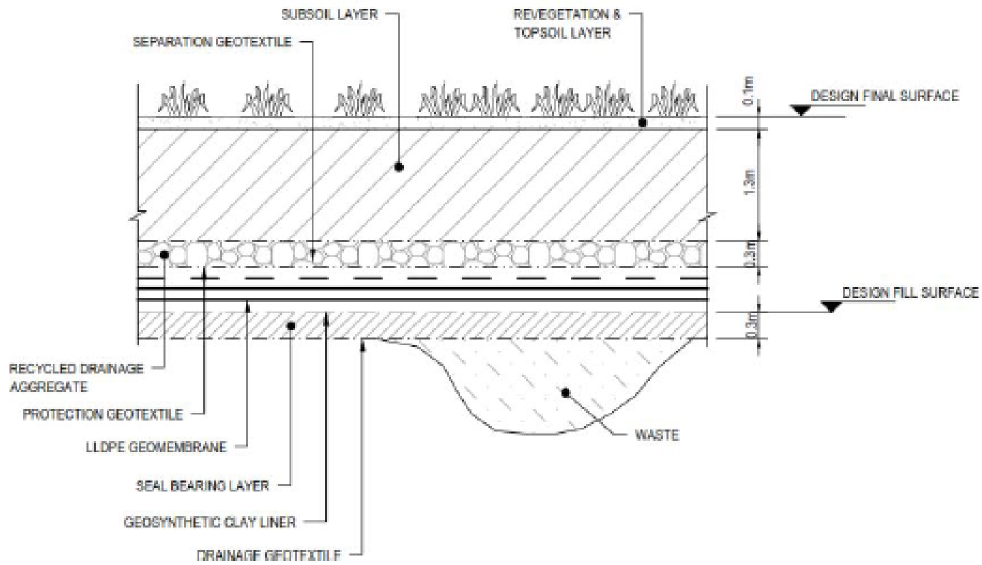



**Figure 5-2: Cross section showing capping elements**

# 6. REGULATORY CONTEXT

## 6.1 Introduction

The regulatory context of the onsite Containment Cell is discussed in detail in **Appendix 9, Volume 1**.

## 6.2 Environmentally Hazardous Chemicals Act 1985

The Aluminium Smelter Waste Chemical Control Order (ASW CCO) regulates aluminium smelter waste with leachable fluoride and/ or leachable cyanide, such as the CWS material.

It is Hydro's position that the proposed placement of the CWS material in the Containment Cell is permitted as "keeping" under the ASW CCO. However, Hydro understands that it is the EPA's position that placing the CWS material directly into the Containment Cell without treatment is not permitted. One of the following would allow the Containment Cell to proceed:

1. The development of a new regulation under the *Protection of the Environment Operations Act 1997*, or amendment of the existing POEO Regulation, addressing compliance with the ASW CCO
2. A regulation under the *Environmentally Hazardous Chemicals Act 1985* exempting application of the ASW CCO
3. Creation of a new CCO specifically applying to the material and/ or the Containment Cell activity
4. Amendments to the ASW CCO
5. Revocation of the ASW CCO

## 6.3 Protection of the Environment Operations Act 1997

It is anticipated that the existing Hydro Environment Protection Licence (EPL) (No. 1548) would be modified to include the following scheduled activities:

- Contaminated soil treatment
- Chemical storage

A number of monitoring and management measures to be implemented during and following completion of construction of the Containment Cell could also be included within a revised EPL. The EPA can also add conditions that relate to the management of the completed Containment Cell:

- Financial assurance to secure the performance of environmental obligations.
- A policy of insurance for the payment of costs for clean-up action, and for claims for compensation or damages, resulting from pollution.
- Arrangement of a positive covenant under section 88E of the *Conveyancing Act 1919*.

The EPA can determine that the EPL can be surrendered if it believes that the scheduled activities have ceased and there will not be an ongoing environmental impact from the activity once it has ceased.

## 6.4 Protection of the Environment Operations (Waste) Regulation 2014

Under Clause 98 of the Regulation, the EPA can grant an immobilised contaminants approval, which permits reassessment and reclassification of a waste to enable its placement in a Containment Cell or landfill appropriate to its reclassification.

A specific immobilised contaminants approval would be required for the containment of the CWS material due to the concentrations of total polycyclic aromatic hydrocarbons and benzo(a)pyrene resulting in the material being deemed hazardous waste. Due to the nature of these contaminants (they have been vitrified) approval of natural immobilisation would be required.

## 6.5 Environmental Planning and Assessment Act 1979

The placement of the CWS material in the Containment Cell is permitted under the *Environmental Planning and Assessment Act 1979*. Clause 8(1)(b) of the State Environmental Planning Policy (State and Regional Development) 2011 provides that development is declared to be State Significant Development for the purposes of the EP&A Act if the development is specified in Schedule 1 or 2 to the S&RD SEPP.  Schedule 1 to the S&RD SEPP identifies 'waste and resource management facilities'. Approval of the current State Significant Development Application would allow the CWS material to be placed in the Containment Cell.

# 7. LONG TERM CONTAINMENT CELL MANAGEMENT

## 7.1 Introduction

The Long Term management, monitoring and ongoing liability of the onsite Containment Cell is discussed in detail in **Appendix 10, Volume 1**.

## 7.2 Management and Monitoring

The management and monitoring requirements for the Containment Cell would be described in a Containment Cell Environmental Management Plan (EMP). The EMP would address the following:

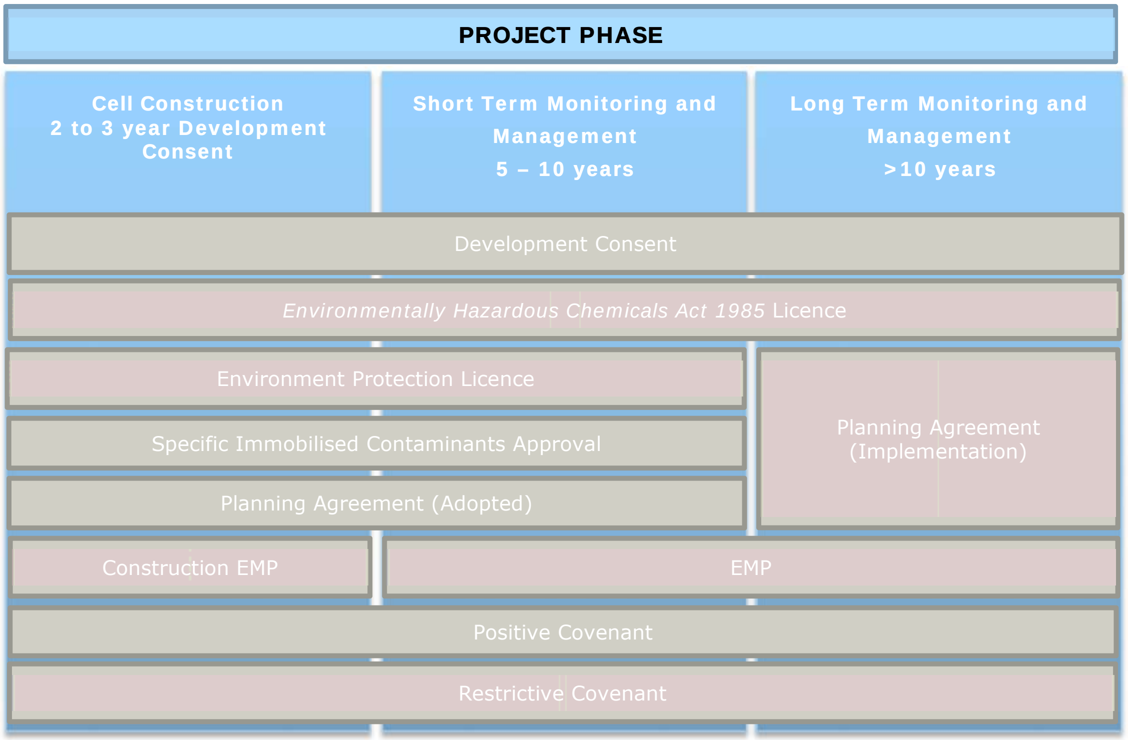
- Introduction
- Regulatory Mechanisms
- Activities covered by the EMP
- Management Structure
- Environmental Management
- Monitoring
- Reporting

The key proposed Containment Cell monitoring and management activities are summarised below.

| Monitoring or Maintenance Activity | Parameters |
|---|---|
| **Visual Monitoring** | |
| Cap stability | Annually |
| Vegetation Cover | Immediately after ≥5% AEP or greater storm event |
| Safety Barrier/ Bollards | Immediately after earthquake of magnitude ≥5 |
| Gas Vents | |
| **Leachate Monitoring** | Quarterly |
| Leachate Presence/ Volume | Immediately after ≥ 5% AEP storm event |
| Determine if removal and treatment required | Immediately after earthquake of magnitude ≥5 |
| **Leachate Treatment** | |
| Onsite water treatment plant | As required (when trigger level reached). |
| Licensed liquid waste contractor for off-site treatment. | |
| **Gas Monitoring** | |
| Ammonia and methane.<br>EMP to outline:<br>• Trigger levels for a contingency response.<br>• Process for ceasing gas monitoring based on results | Quarterly |
| **Water Treatment Plant Inspection and Maintenance**<br>Inspected and serviced. | In accordance with manufacturer's requirements |
| **Vegetation Maintenance**<br>As determined to be required by inspection | As determined to be required by inspection |
| **Capping Layer Maintenance** | |
| Repair damage | As required |
| Identify source of damage and rectify | |

### 7.3 Funding, Liability, Ownership and Financial Security

The key potential regulatory mechanisms available to ensure the long term environmental management of the Containment Cell and how they could apply during the life span of the Containment Cell is illustrated below.



# 8. CONCLUSION

Ramboll Environ on behalf of Hydro has carried out an assessment that applies recognized international methods for an evaluation of waste management options for the CWS. Applying overarching principles of Ecologically Sustainable Development the assessment considered key non-financial metrics that were relevant to the evaluation of the waste type and the particular concerns of Hydro and stakeholders. The evaluation identified that placement of the wastes within an onsite Containment Cell was the most appropriate management strategy. Options that include recycling were found to present increased risks to human health and the environment due to the effort required to recycle the materials and the likelihood that the production of a clean material appropriate for recycling could not be achieved. The need for treatment of the waste to reduce leachable fluoride was also not found to be beneficial. Due to the Containment Cell design, the location of the Containment Cell and the construction methodology that would be implemented, the fate and transport of worse case untreated wastes in the event of future cell leakage estimated low and acceptable risk to the groundwater receptor.

A detailed design for the Containment Cell has been prepared to accommodate the site wastes, including other contaminated soils from the site remediation activities, and non-recyclable wastes arising from demolition activities. The cell design is specific to the wastes proposed and includes liners verified as suitable for the site-specific leachate. The cell design includes a triple base liner and dual liner capping system comprising both geotextiles and natural low permeability clays local to the site. The cell design includes a detailed constructability report, a technical specification for the various construction materials and a construction quality assurance plan that outlines the quality controls to be followed during construction.

This detailed Options Study has confirmed that remediation of the Smelter Site through development of an onsite Containment Cell would have the least impact on the health, diversity and productivity of the environment, therefore safeguarding the environment for future generations.  Further the Containment Cell anticipate the needs of future generations, by making the Hydro Land suitable for future use including employment land, residential land, rural land and a large area dedicated for biodiversity conservation. These new land uses would provide long-term environmental, social and economic benefits consistent with the principle of intergenerational equity.

To protect the surrounding environment and future generations an appropriate long term management and monitoring program has been developed so that the long term monitoring and financial assurance would be in place for the life of the Containment Cell, therefore affirming its compliance with the principle of intergenerational equity.

Appropriate development control mechanisms have been presented to manage development around the site into the future.

The management strategy proposed has been demonstrated to be environmentally and socially responsible, allows the site redevelopment to occur, and can be managed appropriately and with acceptable environmental risk, in to the future.