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Hydro Aluminium Kurri Kurri Site Audit
Hydro Aluminium Kurri Kurri Pty Ltd
06-Jul-2018
Doc No. 60342271_SAR RAP July 2018

Site Audit Report and Site Audit Statement for the Remedial Action Plan, Hydro Aluminium Kurri Kurri Smelter Site Audit

Part B2 - Appropriateness of RAP for Smelter Area

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Part B2 - Appropriateness of RAP for Smelter Area

Client: Hydro Aluminium Kurri Kurri Pty Ltd

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Assisted by	Mark Tiedeman

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Executive Summary

Executive Summary:

This Site Audit Report (SAR) is to provide the justification for a Site Audit Statement that has, in the Site Auditor's opinion, confirmed the **appropriateness of a plan of remediation** (also known as a "Section B2" audit).

The aluminium smelter was operated by (now) Hydro Aluminium Kurri Kurri Pty Ltd (Hydro) at Kurri Kurri NSW from 1969 until 2012 with final closure in 2014.

Under the NSW planning processes, Hydro proposed that the smelter and its associated buffer zone (shown in **Figures 1** and **2**, **Appendix A**) be redeveloped for ongoing industrial and related purposes. Under NSW legislation, Hydro's redevelopment proposal was required to be presented in the form of an Environmental Impact Statement (EIS) (Ramboll, 2016).

The project is considered State Significant and a Preliminary Environment Assessment (PEA) was submitted to the Department of Planning and Infrastructure in August 2014. In response to the PEA, the Secretary's Environmental Assessment Requirements requested that a Remedial Action Plan (RAP) be prepared and that the RAP be accompanied by a Site Audit Statement from an Environment Protection Authority (EPA) accredited site auditor and prepared in accordance with the contaminated land planning guidelines under section 145C of the EP&A Act and relevant guidelines produced or approved under section 105 of the Contaminated Land Management Act 1997.

While addressing all of the legislative requirements for an EIS, the 2016 EIS included the (then) Ramboll 2016 RAP that primarily focused on the demolition and remediation of the smelter operations.

In response to the Planning Secretary's Environmental requirements, a RAP (then the Ramboll, 2016) was prepared and, under the provisions of the NSW Contaminated Land Management Act (1997). The RAP has been submitted to a NSWEPA accredited Site Auditor (Ross McFarland, Accreditation No.9819) for independent technical review with the objective of providing a **Site Audit Statement (SAS)** and supporting SAR (**this SAR**), advising on the appropriateness of the RAP (i.e. a "Section B2" Audit). The "Notification of Commencement of Statutory Site Audit" (Number 2015/01) was provided by the Site Auditor to NSWEPA on 13 October 2015.

Note that this Part B2 Audit Statement would, if the remediation was deemed successful, be followed by a "Part A2" Site Audit Statement, confirming the Smelter Site's landuse suitability subject to the implementation of an active Environmental Management Plan (EMP).

The 2016 RAP was subsequently amended by Ramboll to become the 2018 RAP which is the subject of this SAR and associated SAS. It nominated the proposed uses of the Smelter Site to be a combination of General Industrial (IN1), Heavy Industrial (IN3) and Environmental Conservation (E2).

The 2018 RAP used a conventional multi-criteria-analysis process to screen a range of remedial options against key remedial objectives. The preferred remedial response was determined, in consultation with NSWEPA, to involve on-site containment with clear ongoing institutional controls to ensure that unacceptable environmental and human health risks were prevented.

Based on comparison against relevant industry and regulatory guidance, the proposed remediation is considered by the Site Auditor to be technically feasible, environmentally justifiable and consistent with relevant laws, policies and guidelines. More specifically, the proposed remedial strategy was considered by the site Auditor, having regard to the following key guidance:

- National and NSW remedial policies and procedures, including the 2013 amended ASC NEPM;
- The NSW *Protection of the Environment Operations Act 1997* and its regulations;
- The NSW *Contaminated Land Management (CLM) Act 1997,* including those guidelines listed under Section 105 of the CLM Act; and
- Other relevant National and NSW legislation including the *Environmental Planning and Assessment Act 1979* and *Environmentally Hazardous Chemicals Act 1985;*

The 2018 RAP presented a number of key attributes, including:

- A definition of the site to which the RAP was designed;
- A consolidation of relevant background environmental studies;
- Characterisation of the Smelter Site into Areas of Environmental Concern (AECs) and Potential Areas of Environmental Concern (PAECs) for more focused remedial responses;
- An outline of the demolition and remediation methodology;
- An outline of the generic EMP designed to ensure the remedial works were performed in an environmentally-responsible manner;
- An outline of the proposed generic validation protocols to assess the performance of the remedial works;
- Reference to a long-term management plan (presented in detail in a supplement to the RAP) that described the ways in which the containment cell would be maintained and managed in perpetuity;
- An overarching remedial strategy which involved the use of an engineered onsite containment system with ongoing institutional controls to maintain the containment system.

Note that the suitability of the containment system design is the subject of a separate independent technical review and subsequent Site Audit as to its appropriateness (I.e. a further Part B2 Audit).

As noted above, at the completion of the remedial works and its subsequent validation for the Smelter Site, a final Site Audit Statement (Part A2 with an active Environmental Management Plan – EMP) will be produced. Similarly, Site Audit Statements (Part A1) and associated Site Audit Reports will be prepared for the adjoining “buffer zone”, as appropriate.

This Audit has concluded that the 2018 RAP is an appropriate plan, subject to a number of comments that have been provided to clarify the next steps and to address minor uncertainties associated with the 2018 RAP. These comments are presented in ***Table ES1***.

Table ES1: Auditor Comments to ensure the appropriateness of the RAP

Item	Condition	Purpose
1	That a comprehensive Validation Plan for the AECs and PAECs be developed and endorsed by a Site Auditor prior to implementation of the remedial works.	Supplementary investigations following gaining access after the proposed demolition works will confirm the type, nature and extent of contamination within AECs and PAECS and a detailed validation plan for each area will then be possible to develop.
2	That a further Site Audit be completed to verify the successful implementation of the 2018 RAP and confirm the landuse suitability.	This is a standard requirements are per Part IV (Explanatory Notes) to the Site Audit Statement Form.
3	That the validation plan and associated reporting considers emerging contaminants such as PFAS.	The successful completion of the Smelter Site's remediation is contingent upon ensuring that the emerging contaminants are adequately addressed during the validation reporting.
4	That final Environmental Management Plan (EMP) for the AECs/PAEC is provided for Site Auditor Endorsement prior to their implementation.	Some parts of the Smelter Site are subject to supplementary investigations once access is provided as a result of the staged demolition program. Once the supplementary investigations have been completed, an EMP for the remedial works may be prepared for Auditor endorsement.
5	That a final risk assessment is performed at the completion of the remedial works currently proposed, to ensure that human health and environmental risks have been adequately addressed.	The 2018 RAP concludes that the remedial approach should result in a Site that does not pose any unacceptable risk to human health and the environment, but notes an uncertainty in the potential groundwater risk following "source removal". The Consultant concludes that a final risk assessment would be warranted to confirm that no unacceptable risk remained.
6	That the suitability of the containment cell design be independently verified.	This comment has been identified by NSWEPA to ensure the proposed containment cell meets current best practice and is appropriate for the degree and extent of contamination identified in the material to be placed in the containment cell.

The SAS is included in this SAR for completeness and readers are directed to the Explanatory notes at the end of the SAS.

Details of the basis of the conclusions provided in the SAS are provided in the Sections that follow.

Site Audit Statement

NSW Site Auditor Scheme

Site Audit Statement

A site audit statement summarises the findings of a site audit. For full details of the site auditor's findings, evaluations and conclusions, refer to the associated site audit report.

This form was approved under the *Contaminated Land Management Act 1997* on 12 October 2017.

For information about completing this form, go to Part IV.

Part I: Site audit identification

Site audit statement no. 2015/01

This site audit is a:

✓ statutory audit

☐ ~~non-statutory audit~~

within the meaning of the *Contaminated Land Management Act 1997*.

Site auditor details

(As accredited under the *Contaminated Land Management Act 1997*)

Name Ross McFarland

Company AECOM Australia Pty Ltd

Address 17 Warabrook Blvd

Warabrook NSW Postcode 2304

Phone 02 49114900

Email ross.mcfarland@aecom.com

Site details

Address Harts Road

LOXFORD NSW Postcode 2326

Property description

(Attach a separate list if several properties are included in the site audit.)

Latitude 32 78 53 S, Longitude 151 4735 E

Currently Lots 318, 319, 411, 412, 413, 414, 769 in DP 755231, Lots 1, 2, 3 in DP 456769 and part Lot 16 in DP 1082775.

Local government area Cessnock City Council

Area of site (include units, e.g. hectares) 180 hectares

Current zoning RU2 – Rural Landscape

Regulation and notification

To the best of my knowledge:

☐ ~~**the site is** the subject of a declaration, order, agreement, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*, as follows: (provide the no. if applicable)~~

- ☐ ~~Declaration no.~~
- ☐ ~~Order no.~~
- ☐ ~~Proposal no.~~
- ☐ ~~Notice no.~~

✓ **the site is not** the subject of a declaration, order, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*.

To the best of my knowledge:

✓ the site **has** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997*

Site was notified to EPA on 09 February 2015. EPA concluded that Regulation was not required (EPA Reference DOC 15/40734)

☐ ~~the site **has not** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997*.~~

Site audit commissioned by

Name Mr Richard Brown

Company Hydro Aluminium Kurri Kurri Pty Ltd

Address PO Box 1

KURRI KURRI NSW Postcode 2327

Phone 02 4937 0406

Email Richard.Brown@hydro.com

Contact details for contact person (if different from above)

Name as above

Nature of statutory requirements (not applicable for non-statutory audits)

☐ ~~Requirements under the *Contaminated Land Management Act* 1997 (e.g. management order; please specify, including date of issue)~~

✓ Requirements imposed by an environmental planning instrument (please specify, including date of issue)

On **18 November 2014**, the Secretary's Environmental Assessment Requirements (SEAR) issued by the Department of Planning and Environment, which were to be addressed in the EIS which included requirements for the RAP. The relevant SEARS for the RAP were:

"*A Remediation Action Plan (.RAP) accompanied by a Site Audit Statement from an Environment Protection Authority (EPA) accredited site auditor prepared in accordance with the contaminated land planning guidelines under the EP&A Act and relevant guidelines produced or approved under the Contaminated Land Management Act 1997.*

The RAP must also:

- *characterise the nature and extent of contaminated material and any contaminated groundwater plumes*
- *detail the proposed remediation process, including treatment methodologies and processes*
- *justify the proposed treatment and remediation criteria based on the conclusions of a Human Health Risk Assessment prepared in accordance with the Environmental Health Risk Assessment - Guidelines for Assessing Human Health Risk from Environmental Hazards*
- *detail the proposed remediation management measures including the management of excavated material, stockpiles and wastewater*
- *include a site validation plan*
- *detail the final landform/use following remediation and the suitability of any fill material*
- *identify any on-going management of the site following remediation works*"

☐ ~~Development consent requirements under the *Environmental Planning and Assessment Act 1979* (please specify consent authority and date of issue)~~

☐ ~~Requirements under other legislation (please specify, including date of issue)~~

Purpose of site audit

❑ **A1** To determine land use suitability

Intended uses of the land:

OR

❑ **A2** To determine land use suitability subject to compliance with either an active or passive environmental management plan

Intended uses of the land:

OR

(Tick all that apply)

❑ **B1** To determine the nature and extent of contamination

✓ **B2** To determine the appropriateness of:

❑ an investigation plan

✓ a remediation plan

❑ a management plan

❑ **B3** To determine the appropriateness of a **site testing plan** to determine if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*

❑ **B4** To determine the compliance with an approved:

❑ **voluntary management proposal** or

❑ **management order** under the *Contaminated Land Management Act 1997*

❑ **B5** To determine if the land can be made suitable for a particular use (or uses) if the site is remediated or managed in accordance with a specified plan.

Intended uses of the land:

Information sources for site audit

Consultancies which conducted the site investigations and/or remediation:

Ramboll Environ Pty Ltd

Titles of reports reviewed:

- Ramboll Environ, 2018a, "*Remedial Action Plan former Hydro Kurri Kurri Aluminium Smelter*", dated 02 July 2018 (referred to herein as "the Final RAP" – 244 pages)
- Ramboll Environ, 2018b, "*Smelter Site Remedial Action Plan, Response to Auditor Comments* ", dated 23 April 2018 (referred to herein as "the Response Letter", included in **Appendix B**)
- Ramboll Environ, 2016a, "*Remedial Action Plan former Hydro Kurri Kurri Aluminium Smelter*", dated July 2016 (referred to herein as "the Draft RAP" – 144 pages)
- Ramboll Environ, 2016b, "*Change Log for Auditor Comments on the Final RAP 28th July 2016*", dated 16 September 2016 (referred to herein as, included in **Appendix B**)

- Ramboll, 2016c, "*Hydro Aluminium Smelter Kurri Kurri Remedial Action Plan Sustainability Analysis Results*", dated July 2016
- Environ, 2012a, "*Phase 2 Environmental Site Assessment, Kurri Kurri Aluminium Smelter* ", dated November 2012
- Environ, 2012b, "*Environmental Site Assessment , Alcan Mound, Kurri Kurri Aluminium Smelter*", dated December 2012
- Environ, 2012c, "*Section 60 Notification supporting information*", dated August 2012
- NSW EPA, 2012, "*Hydro Aluminium Kurri Kurri, Section 60 Notification under the Contaminated Land Management Act 1997*", Letter response dated November 2012
- Environ, 2013a, "*Phase 1 ESA, Hydro Kurri Kurri Aluminium Smelter*", dated October 2013
- Environ, 2013b, "*Preliminary Screening Level, Health Risk Assessment for Fluoride and Aluminium Part of the Kurri Kurri Aluminium Smelter Hart Road, Loxford*", dated April 2013, updated May 2016
- Environ, 2013c, "*Tier 2 Ecological Risk Assessment, Kurri Kurri Smelter*", dated March 2013
- Environ, 2013d, "*Stage 2 Aquatic Assessment – Ecological Risk Assessment, Kurri Kurri Aluminium Smelter*", dated June 2013
- Environ, 2013e, "*Preliminary Screening Level, Health Risk Assessment for Fluoride and Aluminium Part of the Kurri Kurri Aluminium Smelter, Hart Road, Loxford*", dated 2 April 2013

  Environ, 2013f, "*Preliminary Containment Cell Study Hydro Aluminium Kurri Kurri NSW*", dated April 2013
- Environ, 2014a, "*Remedial Action Work Plan Clay Borrow Pit Area Kurri Kurri NSW*", dated December 2014
- Environ, 2014b, "*Hazardous Materials Audit Stage 1 Maintenance Workshops and Storage Sheds Hydro Aluminium Kurri Kurri NSW*", dated October 2014
- Environ, 2014c. "*Hazardous Materials Audit Stage 2 Administration, Personal Training Centre, Gatehouse, Medical Centre and Personnel, Bathhouse and EOHS Hydro Aluminium Kurri Kurri NSW*", dated August 2014
- Environ, 2014d. "*Hazardous Materials Audit Stage 3 Cast House and Associated Buildings Hydro Aluminium Kurri Kurri NSW*", dated October 2014
- Environ, 2014e, "*Hazardous Materials Audit Stage 4 Pot Rooms and Associated Structures Hydro Aluminium Kurri Kurri NSW*", dated October 2014
- Environ, 2014f, "*Hazardous Materials Audit Stage 5 Carbon Plant and Associated Buildings Hydro Aluminium Kurri Kurri NSW*", dated November 2014
- Environ, 2014, "*Hazardous Materials Audit Stage 6 Transformer Yard, Substations And Miscellaneous Areas Hydro Aluminium Kurri Kurri NSW*", dated October 2014
- DLA Environmental Services 2015, "*Validation Report Clay Borrow Pit Area Hart Road, Loxford New South Wales, Australia, 2326*" dated October 2015
- Environ, 2015, "*Phase 2 Environmental Site Assessment, Smelter Site, Additional Investigations*" dated October 2015
- Ramboll Environ, 2016d, "*Plume Delineation Report, Capped Waste Stockpile*", dated September 2016
- Ramboll Environ, 2016e, "*Hydro Aluminium Kurri Kurri Smelter, Capped Waste Stockpile, 12 Month Groundwater Report*", dated June 2016
- Ramboll Environ, 2016f, "*Environmental Impact Statement Former Hydro Aluminium Kurri Kurri Smelter Demolition and Remediation*", dated July 2016
- Ramboll Environ, 2016g. "*Hydro Aluminium Kurri Kurri Review of Remedial Options*", dated January 2016
- Ramboll Environ, 2017a, "*Remedial Options Study*", October 2017

- Ramboll Environ, 2017b. "*Hydro Aluminium Kurri Kurri Substations Assessment Trial – 3CC",* dated November 2017.
- Ramboll Environ, 2017c, "*Containment Cell – Long Term Management Plan"* Final Draft, Rev 5, December 2017
- Ramboll Environ, 2018c. "*Environmental Site Assessment. Diesel Spray Area, Hydro Aluminium Smelter",* dated March 2018.
- Ramboll Environ, 2018d. "*Hydro Aluminium Kurri Kurri CWS Waste – Gypsum Treatability Study",* dated April 2018.

Other information reviewed, including previous site audit reports and statements relating to the site:

- NSWEPA 2015 "*Hydro Aluminium Kurri Kurri Section 60 Notification under the Contaminated land Management Act, 1997*", dated 9 February 2015.
- Ramboll Environ, 2016h, Response to the Auditor's comments on DLA, 2015, "*Validation Report, Clay Borrow Pit Area, Hydro Kurri Kurri Aluminium Smelter, Hart Road, Loxford, New South Wales (2321)*", dated August 2016
- Ramboll Environ, 2016i, Response to the Auditor's comments on "*Automotive Waste Removal Validation, Clay Borrow Pit Area, Hydro Kurri Kurri Aluminium Smelter, Hart Road, Loxford, New South Wales (2321)*", dated August 2016
- Ramboll Environ, 2016j, "*Response to Auditor Comments, Hydro Aluminium Smelter, Kurri Kurri*", dated May 2016
- AECOM, 2016, "*Auditor's Interim Opinion relating to the Remedial Action Plan for the Smelter Site, Hydro Kurri Kurri, NSW "*, dated July 2016
- AECOM, 2017, "*Auditor's Interim Opinion relating to the Draft Containment Cell Long Term Management Plan for the former Hydro Smelter Site, Kurri Kurri, NSW*", dated December 2017
- AECOM, 2017, "*Auditor's Interim Advice on Containment Cell Long Term Management Plan for the former Hydro Smelter Site, Kurri Kurri*", December 2017.
- NSWEPA 2017 "*EPA advice on Hydro Aluminium Kurri Kurri Pty Ltd – Capped Waste Stockpile Waste Management Options Evaluation Study:*, dated 06 December 2017.

Site audit report details

Title:

Site Audit Report and Site Audit Statement for the Remedial Action Plan, Hydro Aluminium Kurri Kurri Smelter Site Audit

Report no. 60342271	Date 06 July 2018

Part II: Auditor's findings

Please complete either Section A1, Section A2 or Section B, not more than one section. (Strike out the irrelevant sections.)

- Use **Section A1** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **without the implementation** of an environmental management plan.

- Use **Section A2** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **with the implementation** of an active or passive environmental management plan.

- Use **Section B** where the audit is to determine:
    - (B1) the nature and extent of contamination, and/or
    - (B2) the appropriateness of an investigation, remediation or management plan[1], and/or
    - (B3) the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or
    - (B4) whether the terms of the approved voluntary management proposal or management order have been complied with, and/or
    - (B5) whether the site can be made suitable for a specified land use (or uses) if the site is remediated or managed in accordance with the implementation of a specified plan.

[1] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

Section A1

I certify that, in my opinion:

The **site is suitable** for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

- ☐ Residential, including substantial vegetable garden and poultry
- ☐ Residential, including substantial vegetable garden, excluding poultry
- ☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
- ☐ Day care centre, preschool, primary school
- ☐ Residential with minimal opportunity for soil access, including units
- ☐ Secondary school
- ☐ Park, recreational open space, playing field
- ☐ Commercial/industrial
- ☐ Other (please specify):

_____

OR

- ☐ I certify that, in my opinion, the **site is not suitable** for any use due to the risk of harm from contamination.

Overall comments:

_____

Section A2

I certify that, in my opinion:

Subject to compliance with the **attached** environmental management plan[2] (EMP), the site is suitable for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

- ☐ Residential, including substantial vegetable garden and poultry
- ☐ Residential, including substantial vegetable garden, excluding poultry
- ☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
- ☐ Day care centre, preschool, primary school
- ☐ Residential with minimal opportunity for soil access, including units
- ☐ Secondary school
- ☐ Park, recreational open space, playing field
- ☐ Commercial/industrial
- ☐ Other (please specify):

_____

EMP details

Title _____

Author _____

Date _____ No. of pages _____

EMP summary

This EMP (attached) is required to be implemented to address residual contamination on the site.

The EMP: (Tick appropriate box and strike out the other option.)

- ☐ requires operation and/or maintenance of **active** control systems[3]
- ☐ requires maintenance of **passive** control systems only[3].

[2] Refer to Part IV for an explanation of an environmental management plan.
[3] Refer to Part IV for definitions of active and passive control systems.

~~Purpose of the EMP:~~

~~Description of the nature of the residual contamination:~~

~~Summary of the actions required by the EMP:~~

~~How the EMP can reasonably be made to be legally enforceable:~~

~~How there will be appropriate public notification:~~

~~Overall comments:~~

Section B

Purpose of the plan[4] which is the subject of this audit:

The purpose of the audit is to determine the appropriateness of a remediation plan to make the Site suitable for the proposed commercial/industrial landuses.

I certify that, in my opinion:

(B1)

✓ The nature and extent of the contamination **has** been appropriately determined

☐ ~~The nature and extent of the contamination **has not** been appropriately determined~~

AND/OR (B2)

✓ The investigation, remediation or management plan **is** appropriate for the purpose stated above

☐ ~~The investigation, remediation or management plan **is not** appropriate for the purpose stated above~~

~~AND/OR (B3)~~

☐ ~~The site testing plan:~~

- ☐ ~~**is** appropriate to determine~~
- ☐ ~~**is not** appropriate to determine~~

~~if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*~~

~~AND/OR (B4)~~

☐ ~~The terms of the approved voluntary management proposal* or management order** (strike out as appropriate):~~

- ☐ ~~**have** been complied with~~
- ☐ ~~**have not** been complied with.~~

~~*voluntary management proposal no.~~

~~**management order no.~~

AND/OR (B5)

✓ The site **can be made suitable** for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

- ☐ ~~Residential, including substantial vegetable garden and poultry~~
- ☐ ~~Residential, including substantial vegetable garden, excluding poultry~~

[4] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

- ~~❑ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry~~
- ~~❑ Day care centre, preschool, primary school~~
- ~~❑ Residential with minimal opportunity for soil access, including units~~
- ~~❑ Secondary school~~
- ~~❑ Park, recreational open space, playing field~~

✓ Commercial/industrial

- ~~❑ Other (please specify):~~

IF the site is remediated~~/managed~~* in accordance with the following plan (**attached**):

*Strike out as appropriate

Plan title ***Remedial Action Plan former Hydro Kurri Kurri Aluminium Smelter***

Plan author: Ramboll Environ

Plan date 02 July 2018 No. of pages 244

~~SUBJECT to compliance with the following condition(s):~~

Overall comments:

It is noted that the Ramboll 2016 RAP was initially prepared to satisfy a planning requirement and there was some urgency in meeting the planning agency's deadline. As a result of this tight delivery, the Site Auditor's technical review comments associated with the 2016 RAP were not able to be included in the version of the RAP that was published to meet the planning agency requirements. The revised 2018 RAP has addressed the issues raised by the Auditor, except as where specifically noted in this Site Audit Report.

Given the ability of the Part B2 Site Audit Statement to include comments, a number of clarification comments have been provided below.

Item	Coment	Purpose
1	That a comprehensive Validation Plan for the AECs and PAECs will be developed and endorsed by a Site Auditor prior to implementation of the remedial works.	Supplementary investigations following gaining access after the proposed demolition works will confirm the type, nature and extent of contamination within AECs and PAECS and a detailed validation plan for each area will then be possible to develop. This is a standard requirement as per Part IV (Explanatory Notes) to the Site Audit Statement Form.
2	That a further Site Audit will be completed to verify the successful implementation of the RAP and confirm the landuse suitability.	This is a standard requirement as per Part IV (Explanatory Notes) to the Site Audit Statement Form.
3	That the validation plan and associated reporting will	The successful completion of the Smelter Site's remediation is contingent upon ensuring that the emerging contaminants are

Item	Coment	Purpose
	consider emerging contaminants such as PFAS.	adequately addressed during the validation reporting. This is a standard requirement as per Part IV (Explanatory Notes) to the Site Audit Statement Form.
4	That a final Environmental Management Plan (EMP) for AEC/PAEC consistent with the 2018 RAP will be provided for Site Auditor Endorsement prior to their implementation.	Some parts of the Smelter Site are subject to supplementary investigations once access is provided as a result of the staged demolition program. Once the supplementary investigations have been completed, an EMP for the remedial works may be prepared. This is a standard requirement as per Part IV (Explanatory Notes) to the Site Audit Statement Form.
5	That a final risk assessment will be performed at the completion of the remedial works and monitoring that is currently proposed, to ensure that human health and environmental risks have been adequately addressed.	The RAP concludes that the remedial approach should result in a Site that does not pose any unacceptable risk to human health and the environment, but notes an uncertainty in the potential groundwater risk following “source removal”. The Consultant concludes that a final risk assessment would be warranted to confirm that no unacceptable risk remained. This is a standard requirement as per Part IV (Explanatory Notes) to the Site Audit Statement Form.
6	That the suitability of the containment cell design will be independently verified.	This condition has been identified by NSWEPA to ensure the proposed containment cell meets current best practice and is appropriate for the degree and extent of contamination identified in the material to be placed in the containment cell.

Part III: Auditor's declaration

I am accredited as a site auditor by the NSW Environment Protection Authority (EPA) under the *Contaminated Land Management Act 1997.*

Accreditation no. 9819

I certify that:

- I have completed the site audit free of any conflicts of interest as defined in the *Contaminated Land Management Act 1997,* and
- with due regard to relevant laws and guidelines, I have examined and am familiar with the reports and information referred to in Part I of this site audit, and
- on the basis of inquiries I have made of those individuals immediately responsible for making those reports and obtaining the information referred to in this statement, those reports and that information are, to the best of my knowledge, true, accurate and complete, and
- this statement is, to the best of my knowledge, true, accurate and complete.

I am aware that there are penalties under the *Contaminated Land Management Act 1997* for wilfully making false or misleading statements.

Signed

Date 06 July 2018

Part IV: Explanatory notes

To be complete, a site audit statement form must be issued with all four parts.

How to complete this form

Part I

Part I identifies the auditor, the site, the purpose of the audit and the information used by the auditor in making the site audit findings.

Part II

Part II contains the auditor's opinion of the suitability of the site for specified uses or of the appropriateness of an investigation, or remediation plan or management plan which may enable a particular use. It sets out succinct and definitive information to assist decision-making about the use or uses of the site or a plan or proposal to manage or remediate the site.

The auditor is to complete either Section A1 or Section A2 or Section B of Part II, **not** more than one section.

Section A1

In Section A1 the auditor may conclude that the land is *suitable* for a specified use or uses OR *not suitable* for any beneficial use due to the risk of harm from contamination.

By certifying that the site is *suitable*, an auditor declares that, at the time of completion of the site audit, no further investigation or remediation or management of the site was needed to render the site fit for the specified use(s). **Conditions must not be** imposed on a Section A1 site audit statement. Auditors may include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

Section A2

In Section A2 the auditor may conclude that the land is *suitable* for a specified use(s) subject to a condition for implementation of an environmental management plan (EMP).

Environmental management plan

Within the context of contaminated sites management, an EMP (sometimes also called a 'site management plan') means a plan which addresses the integration of environmental mitigation and monitoring measures for soil, groundwater and/or hazardous ground gases throughout an existing or proposed land use. An EMP succinctly describes the nature and location of contamination remaining on site and states what the objectives of the plan are, how contaminants will be managed, who will be responsible for the plan's implementation and over what time frame actions specified in the plan will take place.

By certifying that the site is suitable subject to implementation of an EMP, an auditor declares that, at the time of completion of the site audit, there was sufficient information satisfying guidelines made or approved under the *Contaminated Land Management Act 1997* (CLM Act) to determine that implementation of the EMP was feasible and would enable the specified use(s) of the site and no further investigation or remediation of the site was needed to render the site fit for the specified use(s).

Implementation of an EMP is required to ensure the site remains suitable for the specified use(s). The plan should be legally enforceable: for example, a requirement of a notice under the CLM Act or a development consent condition issued by a planning authority. There should also be appropriate public notification of the plan, e.g. on a certificate issued under s.149 of *the Environmental Planning and Assessment Act 1979*.

Active or passive control systems

Auditors must specify whether the EMP requires operation and/or maintenance of active control systems or requires maintenance of passive control systems only. Active management systems usually incorporate mechanical components and/or require monitoring and, because of this, regular maintenance and inspection are necessary. Most active management systems are applied at sites where if the systems are not implemented an unacceptable risk may occur. Passive management systems usually require minimal management and maintenance and do not usually incorporate mechanical components.

Auditor's comments

Auditors may also include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

Section B

In Section B the auditor draws conclusions on the nature and extent of contamination, and/or suitability of plans relating to the investigation, remediation or management of the land, and/or the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or whether the terms of an approved voluntary management proposal or management order made under the CLM Act have been complied with, and/or whether the site can be made suitable for a specified land use or uses if the site is remediated or managed in accordance with the implementation of a specified plan.

By certifying that a site *can be made suitable* for a use or uses if remediated or managed in accordance with a specified plan, the auditor declares that, at the time the audit was completed, there was sufficient information satisfying guidelines made or approved under the CLM Act to determine that implementation of the plan was feasible and would enable the specified use(s) of the site in the future.

For a site that *can be made suitable*, any **conditions** specified by the auditor in Section B should be limited to minor modifications or additions to the specified plan. However, if the auditor considers that further audits of the site (e.g. to validate remediation) are required, the auditor must note this as a condition in the site audit statement. The condition must not specify an individual auditor, only that further audits are required.

Auditors may also include **comments** which are observations in light of the audit which provide a more complete understanding of the environmental context to aid decision-making in relation to the site.

Part III

In **Part III** the auditor certifies their standing as an accredited auditor under the CLM Act and makes other relevant declarations.

Where to send completed forms

In addition to furnishing a copy of the audit statement to the person(s) who commissioned the site audit, statutory site audit statements must be sent to

- the **NSW Environment Protection Authority**: nswauditors@epa.nsw.gov.au or as specified by the EPA

  AND

- the **local council** for the land which is the subject of the audit.

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1.0 Introduction

1.1 Background

Ross McFarland of AECOM Australia Pty Ltd (AECOM) was engaged by Hydro Aluminium Kurri Kurri Pty Ltd (Hydro) as a New South Wales Environment Protection Authority (NSW EPA) Accredited Contaminated Sites Auditor (No. 9819) for the Environmental Site Assessments (ESAs) and remediation of the former aluminium smelter in Kurri Kurri, NSW. The area comprises approximately 2,000 ha of buffer land and the smelter operation, which is approximately 180 ha. This Site Audit Report and Site Audit Statement (SAR / SAS) relate to the 2018 RAP for the smelter site only ("the Site"). The Site location and layout are presented on **Figures 1 – 4** in **Appendix A** and further detail on the "Site" is provided in **Section 5** of this Site Audit Report.

The former Aluminium Smelter was in operation from 1969 until it ceased operations in 2012, and closed down in 2014 after two years of care and maintenance. The smelter operated a single pot line until 1979, when a second pot line was commissioned. A third pot line was added in 1985, and upgrades were undertaken in 2002, resulting in a production of 180,000 tonnes of aluminium per annum.

Hydro has produced a master plan for the proposed re-zoning of the Site, which includes General Industrial (IN1), Heavy Industrial (IN3) and Environmental Conservation (E2). Ramboll ("the Consultant", previously Environ) undertook several ESAs (as outlined in **Section 1.3**) and identified Areas of Environmental Concern (AECs) that need remediation and management at the Site, and a further Potential Areas of Environmental Concern (PAEC) that need to be investigated when access is obtained following removal of buildings / services.

This SAR / SAS relates to the 2018 Remedial Action Plan (RAP) for the Site.

1.2 Purpose of the Audit

The demolition and remediation of the Site is considered State Significant, and the Audit of the 140ha Smelter Site is statutory as it is a requirement by the Department of Planning and Infrastructure in response to a Preliminary Environment Assessment (PEA). The Secretary's Environmental Assessment Requirements requested that an RAP was to be prepared and that the RAP *"…be accompanied by a Site Audit Statement from an Environment Protection Authority (EPA) accredited site auditor and prepared in accordance with the contaminated land planning guidelines under section 145C of the EP&A Act and relevant guidelines produced or approved under section 105 of the* Contaminated Land Management Act 1997".

The purpose of the **final Audit** is to determine if the land can be made suitable for General Industrial (IN1), Heavy Industrial (IN3) and Environmental Conservation (E2) by implementation of the RAP (i.e. B(iii)).

The specific purpose of the current Audit is to "determine the appropriateness of a remediation plan"[1] (also known as a "Part B2 Site Audit Statement").

1.3 Key Reports and Related Documentation

In preparing this SAR, the Site Auditor has reviewed the following key reports:

- Ramboll Environ, 2018a, "*Remedial Action Plan former Hydro Kurri Kurri Aluminium Smelter*", dated 02 July 2018 (referred to herein as "the Final RAP" – 244 pages)
- Ramboll Environ, 2018b, "*Smelter Site Remedial Action Plan, Response to Auditor Comments* ", dated 23 April 2018 (referred to herein as "the Response Letter", included in **Appendix B**)
- Ramboll Environ, 2016a, "*Remedial Action Plan former Hydro Kurri Kurri Aluminium Smelter*", dated July 2016 (referred to herein as "the Draft RAP" – 144 pages)

[1] NSWEPA Site Audit Statement page 4 (revision EPA2017P0289), October 2017.

- Ramboll Environ, 2016b, "*Change Log for Auditor Comments on the Final RAP 28th July 2016*", dated 16 September 2016 (referred to herein as, included in **Appendix B**)
- Ramboll, 2016c, "*Hydro Aluminium Smelter Kurri Kurri Remedial Action Plan Sustainability Analysis Results*", dated July 2016

In addition, a number of previous and / or supplementary reports have been referred to in the process of preparing this SAR, including but not limited to:

- Environ, 2012a, "*Phase 2 Environmental Site Assessment, Kurri Kurri Aluminium Smelter* ", dated November 2012
- Environ, 2012b, "*Environmental Site Assessment , Alcan Mound, Kurri Kurri Aluminium Smelter*", dated December 2012
- Environ, 2012c, "*Section 60 Notification supporting information*", dated August 2012
- NSW EPA, 2012, "*Hydro Aluminium Kurri Kurri, Section 60 Notification under the Contaminated Land Management Act 1997*", Letter response dated November 2012
- Environ, 2013a, "*Phase 1 ESA, Hydro Kurri Kurri Aluminium Smelter*", dated October 2013
- Environ, 2013b, "*Preliminary Screening Level, Health Risk Assessment for Fluoride and Aluminium Part of the Kurri Kurri Aluminium Smelter Hart Road, Loxford*", dated April 2013, updated May 2016
- Environ, 2013c, "*Tier 2 Ecological Risk Assessment, Kurri Kurri Smelter*", dated March 2013
- Environ, 2013d, "*Stage 2 Aquatic Assessment – Ecological Risk Assessment, Kurri Kurri Aluminium Smelter*", dated June 2013
- Environ, 2013e, "*Preliminary Screening Level, Health Risk Assessment for Fluoride and Aluminium Part of the Kurri Kurri Aluminium Smelter, Hart Road, Loxford*", dated 2 April 2013

  Environ, 2013f, "*Preliminary Containment Cell Study Hydro Aluminium Kurri Kurri NSW*", dated April 2013
- Environ, 2014a, "*Remedial Action Work Plan Clay Borrow Pit Area Kurri Kurri NSW*", dated December 2014
- Environ, 2014b, "*Hazardous Materials Audit Stage 1 Maintenance Workshops and Storage Sheds Hydro Aluminium Kurri Kurri NSW*", dated October 2014
- Environ, 2014c. "*Hazardous Materials Audit Stage 2 Administration, Personal Training Centre, Gatehouse, Medical Centre and Personnel, Bathhouse and EOHS Hydro Aluminium Kurri Kurri NSW*", dated August 2014
- Environ, 2014d. "*Hazardous Materials Audit Stage 3 Cast House and Associated Buildings Hydro Aluminium Kurri Kurri NSW*", dated October 2014
- Environ, 2014e, "*Hazardous Materials Audit Stage 4 Pot Rooms and Associated Structures Hydro Aluminium Kurri Kurri NSW*", dated October 2014
- Environ, 2014f, "*Hazardous Materials Audit Stage 5 Carbon Plant and Associated Buildings Hydro Aluminium Kurri Kurri NSW*", dated November 2014
- Environ, 2014, "*Hazardous Materials Audit Stage 6 Transformer Yard, Substations And Miscellaneous Areas Hydro Aluminium Kurri Kurri NSW*", dated October 2014
- DLA Environmental Services 2015, "*Validation Report Clay Borrow Pit Area Hart Road, Loxford New South Wales, Australia, 2326*" dated October 2015
- Environ, 2015, "*Phase 2 Environmental Site Assessment, Smelter Site, Additional Investigations*" dated October 2015
- Ramboll Environ, 2016d, "*Plume Delineation Report, Capped Waste Stockpile*", dated September 2016

- Ramboll Environ, 2016e, "*Hydro Aluminium Kurri Kurri Smelter, Capped Waste Stockpile, 12 Month Groundwater Report*", dated June 2016
- Ramboll Environ, 2016f, "*Environmental Impact Statement Former Hydro Aluminium Kurri Kurri Smelter Demolition and Remediation*", dated July 2016
- Ramboll Environ, 2016g. "*Hydro Aluminium Kurri Kurri Review of Remedial Options*", dated January 2016
- Ramboll Environ, 2017a, "*Remedial Options Study*", October 2017
- Ramboll Environ, 2017b. "*Hydro Aluminium Kurri Kurri Substations Assessment Trial – 3CC",* dated November 2017.
- Ramboll Environ, 2017c, "*Containment Cell – Long Term Management Plan"* Final Draft, Rev 5, December 2017
- Ramboll Environ, 2018c. "*Environmental Site Assessment. Diesel Spray Area, Hydro Aluminium Smelter",* dated March 2018.
- Ramboll Environ, 2018d. "*Hydro Aluminium Kurri Kurri CWS Waste – Gypsum Treatability Study",* dated April 2018.

Relevant correspondence during the course of the Site Audit is included in **Appendix C** of this SAR, and comprises:

- NSWEPA 2015 "*Hydro Aluminium Kurri Kurri Section 60 Notification under the Contaminated land Management Act, 1997*", dated 9 February 2015.
- Ramboll Environ, 2016h, Response to the Auditor's comments on DLA, 2015, "*Validation Report, Clay Borrow Pit Area, Hydro Kurri Kurri Aluminium Smelter, Hart Road, Loxford, New South Wales (2321)*", dated August 2016
- Ramboll Environ, 2016i, Response to the Auditor's comments on "*Automotive Waste Removal Validation, Clay Borrow Pit Area, Hydro Kurri Kurri Aluminium Smelter, Hart Road, Loxford, New South Wales (2321)*", dated August 2016
- Ramboll Environ, 2016j, "*Response to Auditor Comments, Hydro Aluminium Smelter, Kurri Kurri*", dated May 2016
- AECOM, 2016, "*Auditor's Interim Opinion relating to the Remedial Action Plan for the Smelter Site, Hydro Kurri Kurri, NSW* ", dated July 2016
- AECOM, 2017, "*Auditor's Interim Opinion relating to the Draft Containment Cell Long Term Management Plan for the former Hydro Smelter Site, Kurri Kurri, NSW*", dated December 2017
- AECOM, 2017, "*Auditor's Interim Advice on Containment Cell Long Term Management Plan for the former Hydro Smelter Site, Kurri Kurri*", December 2017.
- NSWEPA 2017 "*EPA advice on Hydro Aluminium Kurri Kurri Pty Ltd – Capped Waste Stockpile Waste Management Options Evaluation Study*, dated 06 December 2017.

These key documents are referenced within this Site Audit Report, as appropriate. Other documents are also referenced, where they relate to specific issues (e.g. ecological risks assessment).

2.0 The Site Audit Process

2.1 Legislative Background

The Contaminated Land Management Act (CLM Act) provides the following definition: '*a site audit is a review:*

a. that relates to management (whether under this Act or otherwise) of the actual or possible contamination of land, and

b. that is conducted for the purpose of determining any one or more of the following matters:

i. the nature and extent of any contamination of the land,

ii. the nature and extent of any management of actual or possible contamination of the land,

iii. whether the land is suitable for any specified use or range of uses,

iv. what management remains necessary before the land is suitable for any specified use or range of uses,

v. *the suitability and appropriateness of a plan of management, long-term management plan, a voluntary management proposal.*'

The site audit process is undertaken by a Site Auditor, accredited by NSW EPA under the CLM Act and comprises an independent review of reports prepared by a consultant. This site audit has been undertaken by Ross McFarland of AECOM (accreditation number 9819) with assistance from Anna Lundmark, Graham Hawkes and Mark Tiedeman who are also employees of AECOM.

Note that NSW EPA, the body that administers the CLM Act, was previously incorporated in the Office of Environment and Heritage (OEH) and was also formerly known as the NSW Department of Environment, Climate Change and Water (DECCW), the Department of Environment and Climate Change (DECC) and the Department of Environment & Conservation (DEC).

It is noted that the National Environment Protection Council (NEPC) National Environment Protection (Assessment of Site Contamination) Measure, 1999, as amended 2013 (*ASC NEPM*, 2013) was endorsed by NSW EPA in June 2013. The earlier stages of works at the Site were undertaken prior to endorsement of *ASC NEPM* (2013). However, this is not considered to impact on the overall outcomes of this Site Audit.

It is also noted that the bulk of the consultants' works were completed and reviewed by the Site Auditor prior to the publication of the Third Edition of the Guidelines for Site Auditor Scheme (2017). However, this is not considered to impact on the overall outcomes of this Part "B" Site Audit.

2.2 Stages of a Site Audit

The Site Audit process generally includes review of assessment and investigation reports developed by an environmental consultant pertaining to the environmental condition of the land and the suitability of the land for a given land use. The Site Audit may also include the review of a RAP which, if implemented, may render the land suitable for a given land use. Until the RAP has been implemented, the Site Auditor cannot certify the suitability of the land. The Site Audit may also include review of a Validation Plan, which is prepared by an environmental consultant to document the requirements for successful completion of the requirements of an RAP. At the conclusion of any remedial works, the Site Audit process also includes review of a Validation Report.

The Site Audit process is completed by preparation of a SAR, which summarises the results reported by the consultant and a SAS, which certifies in Section A the suitability of the land for one or more uses with or without an ongoing management plan, or in Section B whether the extent of contamination has been appropriately determined and / or the appropriateness of an investigation / RAP / management plan and / or the Site can be made suitable for one or more uses if it is remediated / managed in accordance with a RAP / management plan.

The investigation of the environmental condition of the land and any required remediation is carried out by the environmental consultant by reference to guidelines endorsed by NSW EPA under Section

105 of the CLM Act. If the report(s) prepared by the consultant are in substantial conformance with the guidelines the Site Auditor is entitled to accept the results and conclusions stated therein and complete the SAR and issue a SAS. The Site Auditor is also entitled to form other opinions based on the results and conclusions stated in the report(s) by the consultant.

The Site Auditor does not normally carry out independent sampling or chemical analyses of soil, fill, groundwater or other media on the subject site, but rely on the testing and reporting that has been carried out by the consultant if it has been demonstrated to be of adequate reliability by reference to quality indicators listed in the endorsed guidelines.

It is expressly recognised that, even when a qualified environmental consulting firm has substantially followed guidelines endorsed by NSW EPA, unidentified contamination or sub-surface structures may remain present. The processes of investigation, remediation and validation are statistically based and no liability is accepted by the Site Auditor for unidentified contamination or sub-surface structures subsequently found to be present on a site, which has been subjected to investigation, remediation and validation processes that are in substantial conformance to guidelines endorsed by NSW EPA. In addition, Site Audits do not address heritage (including indigenous), geotechnical or engineering suitability of the site, for which specialist advice is recommended and is expressly noted to be outside the contaminated land Site Audit process.

2.3 Site Inspections

The Site Auditor's assistants (Anna Lundmark and Mark Tiedeman) and/or the Site Auditor (Ross McFarland) undertook inspections of the Site on the following dates:

Table 1 Site Inspections

Date	Description
April 2014	Site visit to obtain an overview of the complete Site.
December 2014	Smelter Site programmed inspection
April 2015	Site visit / inspection of the remedial works associated with the Clay Borrow Pit.
August 2015	Inspection of the remedial works at the Clay Borrow Pit and a brief walkover of the Site.
December 2015	Smelter Site programmed inspection
February 2016	Smelter Site programmed inspection
August 2016	Smelter Site programmed inspection
December 2016	Smelter Site programmed inspection
06 June 2017	Waste stockpile inspection.
26 June 2017	Remedial Options Workshop (at Ramboll offices)
04 Dec 2017	Smelter Site programmed inspection
28 June 2018	Smelter Site programmed inspection and on-site progress meeting

2.4 EPA Notifications / Regulation / Declarations

In response to an EPA letter dated 18 October 2012, Hydro provided progressive information to the NSWEPA in relation to whether the EPA should "regulate" the Site under the provisions of the CLM Act. In its letter of 09 February 2015 (presented as an Appendix 2 to the RAP), EPA advised that:

> *"… under the existing use of the land and with the current site configuration, there are unlikely to be any significant risks from the contamination to either human health (site users) or nearby receptors while the management of the leachate contamination is undertaken."*
>
> *and*
>
> *"The remediation of the land will be performed in accordance with the requirements of the NSW Department of Planning and Environment. The site (including the surrounding Hydro owned buffer lands) is then anticipated to be rezoned for a range of landuses. A site auditor accredited under the CLM Act is required as part of this process to oversee the works on site relating to contamination issues. The auditor will be required to verify the adequacy of the proposed remedial strategy, suitability of the site for the proposed land use as well as the effectiveness of the remedial works in preventing the migration of contaminated groundwater from the site."*
>
> *and*
>
> *"[EPA] consider that the site contamination issues can be appropriately managed under the planning process in accordance with the requirements of State Environmental Planning Policy No.55 – Remediation of Land."*
>
> *and*
>
> *"The record for the site on EPA website of site notified under Section 60 of the CLM Act will be updated to reflect that regulation under the CLM Act is not required."*

The Site Auditor has noted the EPA's assessment that the Site is being appropriately managed under the planning process which includes the use of an EPA-accredited site auditor to address contamination issues and the appropriateness of the remedial strategy, as well as confirming landuse suitability at the satisfactory completion of the remedial works.

4.0 Remedial Action Plan Objectives and Scope of Works

4.1 Objectives

The Consultant stated that the objective of the 2018 RAP was to compile a plan of the remediation of the Site with the aim to make the Site suitable for the proposed commercial and industrial land uses (refer to note in the "*Auditor's opinion*" below). The Consultant also listed the following objectives:

- Ensuring that the remediation of the Site is protective of human health and environment; and
- Facilitating the completion of remedial works relevant to national and state regulatory requirements.

The Consultant also noted that demolition of the infrastructure is to be undertaken with the remediation, and that management of the waste materials resulting from the demolition would form part of the remediation evaluation.

4.2 Scope of Works

The Consultant identified the following scope of work for the 2018 RAP:

- Review of previous reports relating to the Site;
- Define a sampling plan for the three Potential Areas of Environmental Concern (PAEC) identified requiring further investigation and any Areas of Environmental Concern (AEC) requiring lateral delineation of contamination;
- Define and assess remedial options for the AECs (including the leachate plume) and consult with Hydro personnel in order to define the most appropriate remedial option;
- Consultation with regulatory guidelines;
- Define how the preferred remedial options would be implemented to meet the remediation objective;
- Define Data Quality Objectives (DQOs) for the Validation Plan; and
- Develop a Validation Plan for the remediation aimed at assessing the suitability of the Site for the proposed use.

In developing the RAP, the Consultant referred to the following key legislation:

- Contaminated Land Management Act, 1997.
- Protection of the Environment Operations Act, 1997.
- Environmental Planning and Assessment Act, 1979.

The Consultant also referred to the Secretary's Environmental Assessment Requirements (SEAR)[2] issued by the Department of Planning and Environment, which were to be addressed in the EIS which included requirements for the RAP. The relevant SEARS for the RAP were:

"*A Remediation Action Plan (.RAP) accompanied by a Site Audit Statement from an Environment Protection Authority (EPA) accredited site auditor prepared in accordance with the contaminated land planning guidelines under the EP&A Act and relevant guidelines produced or approved under the Contaminated Land Management Act 1997.*

The RAP must also:

- *characterise the nature and extent of contaminated material and any contaminated groundwater plumes*
- *detail the proposed remediation process, including treatment methodologies and processes*

[2] Department of Planning, Secretary's Environmental Assessment Requirements, 18 November 2014

- *justify the proposed treatment and remediation criteria based on the conclusions of a Human Health Risk Assessment prepared in accordance with the Environmental Health Risk Assessment - Guidelines for Assessing Human Health Risk from Environmental Hazards*
- *detail the proposed remediation management measures including the management of excavated material, stockpiles and wastewater*
- *include a site validation plan*
- *detail the final landform/use following remediation and the suitability of any fill material*
- *identify any on-going management of the site following remediation works*"

4.3 Proposed Remedial Options

The Consultant's preferred option identified for soil remediation is the relocation and consolidation of all contaminated soils and the contents of Capped Waste Stockpile in one specifically designed Containment Cell. The Containment Cell will be constructed at the location of the Clay Borrow Pit. This option involves the excavation of the Capped Waste Stockpile, transportation of excavated material by trucks to be mixed with gypsum, disposal of material in Containment Cell, and capping of material (Ramboll Environ, 2016f). This proposed remediation methodology is shown in **Figure 16** in **Appendix A**.

The Consultant's preferred option identified for the remediation of the leachate plume in groundwater at the Capped Waste Stockpile is a combination of leachate interception, source removal and on-going monitoring. Source removal will be achieved during the soil remediation works by the relocating of the Capped Waste Stockpile contents to the containment cell. At this time, leachate contained within the wastes will be drained to a sump within the Capped Waste Stockpile bund. Leachate will be extracted and treated through the water treatment plant to a level suitable for discharge to the North Dam, which is irrigated under Hydro's EPL. The sump within the Capped Waste Stockpile will remain and groundwater will continue to be treated until visible signs of leachate are removed from the upper sand aquifer. The Capped Waste Stockpile footprint will then be backfilled and reshaped to above the groundwater table. On-going monitoring will be used to determine the success of leachate interception and source removal as a remedial strategy for the leachate plume (Ramboll Environ, 2016d). This proposed remediation methodology is shown in **Figure 17** in **Appendix A**.

4.4 Auditor's opinion

The Auditor notes that the proposed landuse was confirmed to be General Industrial (IN1), Heavy Industrial (IN3) and Environmental Conservation (E2).

The Auditor considers the objectives and scope of works adequate for the purpose of the RAP and Audit and reported in general accordance with *Guidelines for Consultants Reporting on Contaminated Sites* (NSW OEH, 2011).

The Auditor has considered the 2018 RAP in light of the proposed landuses as noted further, below.

5.0 Site Information

5.1 Site Identification

The Consultant provided Site information details as presented in **Table 2** below.

Table 2 Site Identification

Item	Description
Site owner	Hydro Aluminium Kurri Kurri Pty Ltd (subject to deed of company arrangement)
Street address	Hart Road, Loxford, NSW, Australia, 2326
Local government area (LGA)	Cessnock City Council
Parish	Heddon
County	Northumberland
Distance from nearest CBD	Approximately 3.5 km north-west of Kurri Kurri, and 30 km north-west of Newcastle
Geographical Coordinates	Latitude 32 78 53 S, Longitude 151 4735 E
Lot and DP numbers	Lots 318, 319, 411, 412, 413, 414, 769 in DP 755231, Lots 1, 2, 3 in DP 456769 and part Lot 16 in DP 1082775.
Site Area	Approximately 180 ha.
Zoning (current)	RU2 – Rural Landscape
Zoning (proposed)	General Industrial (IN1), Heavy Industrial (IN3) and Environmental Conservation (E2)
Site Elevation	Reduced Level (RL) 20 to 30 m in the centre and north of the Site, to RL 10-15 m in the south and south east.
Site Figures	Figure 1: Site Location Figure 2: Smelter Site Plan Figure 3: Study Boundary Figure 4: Smelter Layout Figures are included in **Appendix A**.
Surrounding environment	**East**: Bushland within the Buffer Zone owned by Hydro **North**: Bushland within the Buffer Zone owned by Hydro **West**: The former Bishops Bridge Road (now an internal access road only due to the construction of the new Hunter Expressway) and bushland within the Buffer Zone owned by Hydro **South**: The Hunter Expressway then bushland within the Buffer Zone owned by Hydro

Auditor's opinion

The Site Auditor considers that the Site was appropriately identified in accordance with the requirements of NSW OEH (2011).

It is noted that the Property Description details may vary due to rezoning and related planning matters and caution is warranted in the use of these definitions.

5.2 Site Conditions

The Consultant included Site condition summaries from the previous investigation reports in table format. The information is included in below as being considered to be correct at the time of the 2018 RAP preparation.

Table 3 Site Conditions (from Tables 5-1 and 5-2 of the RAP)

Item	Site Condition
Topography	The Site was described as being located between low residual hills to the west and low lying swampy land to the north and east. It's relatively flat with a gentle slope from west to east, from the plant area towards the surrounding water courses in the east and north-east. Low lying areas were filled to create a flat, elevated platform at approximately 14 m Australian Height Datum (AHD) for construction. The Site increases in elevation to the west in the vicinity of the Clay Borrow Pit, which is at an elevation of approximately 25 m AHD.
Geology	According to the Consultant's review of the Sydney Basin Geological Sheet, the regional geology at the Site and Buffer Zone are underlain by siltstone, marl and minor sandstone from the Permian aged Rutherford Formation (Dalwood Group).
Location and extent of fill	The Site was described as being located in low lying land that was filled to create a level area for the construction of the smelter. The fill material was understood to comprise locally derived fill. During the Phase 2 ESA investigations, crushed refractory brick fill was observed within fill material underlying the Carbon Plant and the Pot Lines. The Consultant further stated that a portion of the Site between the north-western fence line and the Clay Borrow Pit was filled with material likely to include refractory bricks and concrete waste, and that the area was filled with excess Excavated Natural Material (ENM) from the construction of the Hunter Expressway recently. A classification of this material was completed by the Consultant (Classification for Stockpiled Soil, Grahams Lane, dated 8 April 2014) under the Excavated Natural Material Exemption 2012.
Borehole logs	During the Phase 2 ESA, the Consultant supervised the drilling of 52 boreholes across the Site. These boreholes extended to a maximum depth of 16 m below ground surface (bgs). The subsurface conditions varied across the Site, but generally comprised fill material overlying estuarine sediments. The fill material, where encountered, generally comprised clayey gravelly sand and included gravel brick fragments. The estuarine sediments generally comprised fine grained sand, with high plasticity clay encountered in some boreholes.
On-site wells	During the Phase 2 ESA, the Consultant supervised the installation of 21 monitoring wells at the Site. The wells were installed at AECs, including the Carbon Plant, the Diesel Spray Area, the Refuelling Area and the Anode Waste Pile. Prior to the Phase 2 ESA, a pair of shallow and deep nested wells were installed at the Carbon Plant as part of the geotechnical investigations for the bake furnace reconstructions.
Depth to groundwater	Groundwater in the east of the Site was identified at shallow depths within the estuarine sands, between 1 and 5 m bgs during the Phase 2 ESA. At the Clay Borrow Pit in the western part of the Smelter site, groundwater was identified within residual clay at depths ranging between 8 and 9 m bgs.
Aquifers	Two aquifer systems are present at the Site, one shallow aquifer within alluvium and one deeper aquifer within the underlying bedrock / residual clay. The shallow aquifer system is limited in extent due to the nature of the alluvium (interbedded sands and clays, with groundwater limited to the sands). There are some licensed groundwater bores located within the shallow alluvium immediately east of the Site, which are used for monitoring of the leachate plume from the Capped Waste Stockpile. Groundwater bores licensed for uses such as domestic, recreation, irrigation and stock watering are located at distances of greater than 3 km.

Item	Site Condition
Direction and rate of groundwater flow	During the Phase 2 ESA, groundwater was identified flowing north to north east across the Smelter Site. The Consultant referred to Douglas Partners (2002) measurement of permeability within the fill of $5x10^{-6}$ m/s and in the sand of $8x10^{-6}$ m/s. At the Clay Borrow Pit, groundwater was expected to be towards the north east following the topography.
Direction of surface water run-off	Stormwater runoff was described by the Consultant as managed at the Site via a series of drainage channels and three surge ponds. The surge ponds were described to discharge to the two North Dams (the five ponds are included in **Figure 4**, **Appendix A**), from which excess stormwater is spray irrigated over an adjacent paddock in accordance with EPL1548. The Consultant stated that there were no other surface water bodies located on the Site.
Background water quality	A background monitoring well was installed as part of the Phase 2 assessment. The well was installed approximately 60m west of the smelter in bushland within the Site, in an upgradient location. Analysis of water from the background well in 2012 was completed and the results were below the adopted guidelines, including ANZECC (2000) 95% protection of fresh water species, irrigation and stock watering guidelines for heavy metals, aside from zinc, fluoride, free cyanide, PAHs, Semi Volatile Organic Compounds (SVOCs). The zinc concentration (78 µg/L) exceeded the ANZECC (2000) hardness modified trigger value of 70 µg/L.
Preferential water courses	The Consultant stated that the 1951 historical aerial photograph showed a former water course extending in a northeast / southwest direction towards Wentworth Swamp in the west of the Site. It was understood that the water course was filled in and relocated to the west to provide a level platform on which to construct Pot Lines 2 and 3. The water course was described to be an ephemeral unnamed creek situated on the sites western boundary at the time of reporting.
Meteorology	The Consultant stated that median, daily highest and lowest hourly average temperatures were collected over the past 20 years. It referred to AECOM (2013) indicating that the 2012 temperatures were above average. Further, the annual rainfall in 2012 was 515 mm, which was below the 20 year average of 619 mm. The quarterly wind roses showed a pattern of strongest winds from the northwest in winter, moderate winds from the south and southwest (spring and autumn) and moderate to strong southeast winds (summer).
Quality of surface water	Surface water from the smelter was described by the Consultant as being directed to the five storage ponds described above via open channels and some concrete subsurface drainage lines. Water from the surface water ponds known as ‘East’, ‘West’ and ‘South’ was pumped to two North Dams where excess surface water discharged to an irrigation area under license from NSW Office of Environment and Heritage (EPL 1548). Surface water dams were constructed by excavation into the residual underlying extremely weathered bedrock. The Consultant stated that surface water quality at the East Surge Pond and North Dams are monitored and fluoride concentrations were found to be elevated compared to background levels. The Consultant considered it likely that flow from Site sources such as the anode pile (which was not covered previously) caused the elevated concentrations.
Flood potential	The majority of the Site was described as located on low lying swampy ground that has been filled. Low lying areas of the Site remain susceptible to flooding. The western portion of the Smelter site was described as located on ground at a higher elevation and not likely to flood.
Local sensitive environment	The Consultant stated that sensitive environments including a creek and a wetland swamp were located in the vicinity of the Site. Swamp Creek, located approximately 400 m to the south and east of the Smelter Site, was described to flow in a northerly direction. Swamp Creek flows north into Wentworth Swamp, a large wetland located approximately 1.6 km north of the Smelter Site. Swamp Creek was described as the receptor for groundwater from the eastern portion of

Item	Site Condition
	the Site. The location of Swamp Creek is shown on **Figure 2, Appendix A**. Black Waterholes Creek was described to be located approximately 700m to the north of the Site, flowing in a northerly direction into the western portion of Wentworth Swamp. Black Waterholes Creek was also described as the receptor for groundwater from the western portion of the Site.
Boundary conditions	The Consultant included the boundary of the Site in **Figure 2, Appendix A**, and the study boundary in **Figure 3, Appendix A**. The western, northern and southern boundaries were identified by roads or tracks, including the recently completed Hunter Expressway on the southern boundary of the Site. The majority of the eastern boundary was stated to be within bushland and the boundary not easily identifiable on the ground.
Visible signs of contamination	During site visits conducted by the Consultant on 6 and 15 May 2014, visible signs of contamination were noted in the following areas: - The garden bed at the south-western corner of the Carbon Plant (soils discoloured black); - Staining surrounding the hydraulic rooms of the Carbon Plant and Casting Plant; - Staining surrounding the Heating Transfer Medium (HTM) electric heater room and gas heater room in the Carbon Plant; and - Hydraulic oil on the floor of the Butt Crushing Plant.
Visible signs of plant stress	During site visits conducted by the Consultant in 2012 - 2014, visible signs of plant stress were observed down gradient of the Capped Waste Stockpile near the eastern site boundary, as shown in **Figure 2, Appendix A**.
Presence of drums, wastes and fill material	Some 44 gallon drums of Castrol oil were observed by the Consultant at the drum store in the eastern portion of the Smelter Site on 15 May 2014. Smelter wastes were observed at the Anode Waste Pile, where ahead of schedule anodes are stockpiled prior to disposal or reuse and at the Clay Borrow Pit. Refractory bricks and concrete stockpiles were present at the Clay Borrow Pit. A second anode waste pile was also observed by the Consultant immediately east of Pot Line 1, where excess anodes have been stockpiled prior to disposal off-site since the closure of the smelter. Stockpiles of various waste streams were observed on the storage area west of Pot Line 3 during the 2012 site walkover. It was noted that these stockpiles were recycled or disposed of and were not present during the 2014 investigations.
Odours	No odours were noted by the Consultant at the Site during the investigations conducted between 23 June and 2 July 2014. It was noted that the smelter is no longer operational at that time.
Conditions of buildings and roads	Roads at the Site were noted by the Consultant to be in good condition during the investigations undertaken. Since operations ceased in 2012 and the Smelter was put on a care and maintenance mode, rust had developed on the surface of scrubbers and other plant associated with the pot lines. Office buildings were described to be in good condition. The care and maintenance team maintained the condition of the buildings at the Site and the Consultant noted that they had commenced demolition of structures including removal of hazardous materials.

5.3 Auditor's opinion

The Auditor notes that the background water quality data was described to have elevated fluoride concentrations, which indicate that it is impacted by the Site activities and not representative of a background location.

However, further groundwater investigations are to be undertaken following demolition of Site infrastructure. Hence, in the Site Auditor's opinion, the Site condition summary included in the 2018 RAP was appropriate for the purposes of the report and generally in accordance with the requirements of NSW OEH (2011).

5.4 Site History and Operation

5.4.1 History

The Consultant reported that the smelter was built by Alcan Australia Ltd on undeveloped agricultural land in 1969. At the start, it was a one line operation, and by 1985, the smelter had grown to three lines (each line comprised 120 cells). In this time, production reached 170,000 tonnes per annum.

In 2000, the smelter was purchased by VAW Aluminium and by Norsk Hydro in 2002, which is when it became known as Hydro Aluminium Kurri Kurri Pty Ltd.

The first pot line was taken out of production in 2012, and the smelter closure was announced in 2014. Since then the smelter has been under care and maintenance with a team of Hydro employees remaining on Site.

5.4.2 Operation

The Consultant presented the operation details on **Figure 4**, **Appendix A**. The process was described as being undertaken in four main areas of operation:

- **Potrooms:** During the peak of the operation, three pot lines with 120 pots in each reduced alumina to molten aluminium. In very simplified terms, the process involved placing raw alumina and cryolite into the pots and applying electrical current. The aluminium was siphoned from the pots in its molten state and transported to the Casthouse. The Potrooms were located at the western portion of the Site.
- **Casthouse:** Here, the molten aluminium was cast into ingots and billets, often with the addition of alloys should the product specification require it. The process used chlorine gas to avoid oxidation of the product. Wastes from the process included swarf and dross, which were sent for recycling off-site. The casthouse was located near the main entrance, just east of the Potrooms.
- **Carbon plant:** Here, coke, pitch and recycled anode butts were mixed to produce "green anode". The green anode was baked in a ring furnace, cast iron rods were added, and the anode product used in the Potrooms. The furnace was gas fired at the end of the operation, but was previously oil heated. Operation facilities associated with the Carbon Plant were a liquid pitch tank, petroleum coke storage, bake furnace scrubber, a rodding building, a rodding mix storage building, and baked anode storage. The Carbon Plant is located at the northern boundary, east of the Potrooms.
- **Anode plant:** the anode plant was part of the carbon plant and included the green mixing plant, the baking furnace and rodding plant. It was where the carbon anodes were manufactured.

The Consultant further outlined other key infrastructure and areas within the Site as follows:

- **Transformer yard and substations**: at the north-western corner of the Site.
- **Stormwater drainage system**: the system associated with the paved areas of the Site was described to be either drained to the Eastern or the Western Surge Pond. Run-off from the carpark and the administration areas was drained into the Southern Surge Pond. The Surge Ponds overflow into the Northern Surge Pond.
- **Capped Waste Stockpile**: between 1969 and the early 90s, smelter waste (including Spent Pot Lining (SPL)) was placed in an area by the eastern boundary. It was capped in clay in 1995, and

waste materials produced since then have been stockpiled separately or recycled. SPL is now stored in purpose-built sheds, of which there are ten located to the south of the Capped Waste Stockpile.

- **Waste Sheds**: since 1995, SPL has been stored in sheds, built specifically for the storage purpose. The sheds are located south of the Capped Waste Stockpile.
- **Maintenance Compound**: in the centre of the Site, the compound was used for maintenance and storage of spare parts / equipment.
- **Diesel refuelling Area**: an Above-ground Storage Tank (AST) and wash bay is located at the approximate centre of the Site.
- **Diesel Spray Area**: diesel was used to treat rust coatings from cathode rods before reusing them. The area is located on the northern smelter boundary.
- **Offices, gate house, canteen, gym and playing fields**: located across the Site.
- **Storage Area**: located west of the Potrooms.
- **Pot reconditioning Area**: a large building where the pots were reconditioned for reuse, located south of the Potrooms.
- **Clay Borrow Pit**: an area where clay was taken to use as capping for the Capped Waste Stockpile. The excavation was backfilled with inert smelter waste such as refractory brick, concrete and bitumen. The Clay Borrow Pit is located in the western part of the Site. The Clay Borrow Pit was remediated by excavation in 2015 and the material was removed and was at the time of the RAP stockpiled in a storage area west of the Pot Lines.
- **Vegetated Area**: part of the Site is within the vegetated Buffer Zone.

Further details are provided in **Figure 4, Appendix A**.

5.5 Auditor's opinion

The Auditor queried what the storage area west of the Potrooms stored, and the Consultant replied (in the Response Letter included in **Appendix B**):

"*This is the area where soils from buffer zone remediation works are currently stockpiled. Stockpiles are on hard stand, have erosion and sediment controls and stockpiles containing asbestos are covered with HDPE liners. All material is tracked*."

The Site Auditor considers that the Site history and related information was appropriate and consistent with the requirements of NSW OEH (2011).

6.0 Previous Investigations and Associated Reports

The Consultant provided summaries of some of the investigations undertaken for the Site since 2012, as described below. Results from previous reports were included in Appendix 1 of the 2018 RAP (the key result tables are included as **Appendix D** herein). A summary of the key investigations is provided below:

6.1 Stage 1 of the Phase 2 Environmental Site Assessment

The first Phase 2 conducted by the Consultant was in 2012. It involved a Site walkover and review of historical information / background data. Based on the review, 20 PAECs were identified and the analytical schedule of Contaminant of Primary Concern (CoPCs) was defined as: fluoride, aluminium, cyanide, Polycyclic Aromatic Hydrocarbons (PAH) and Total Petroleum Hydrocarbons (TPH).

A Sampling and Analysis Quality Plan (SAQP) was compiled for the field program. The program involved the drilling of 31 boreholes, installation of 21 groundwater monitoring wells, collection of 45 surface soil samples, 14 sediment samples and 28 groundwater samples.

The Consultant compiled a Conceptual Site Model (CSM) based on the results and recommended further investigation in AECs.

Since the report was written in 2012, the guidelines used have been superseded by the *ASC NEPM* (2013). In the Stage 2 Phase 2 (see below), the Consultant re-assessed the results based on the updated guidelines.

Ten (10) AECs were identified by the Consultant within the Smelter Site footprint, being:

- AEC 1: Capped Waste Stockpile – soil and groundwater
- AEC 2: Anode Waste Pile - soil
- AEC 3: Refuelling Area - groundwater
- AEC 4: Diesel Spray Area - soil
- AEC 6: East Surge Pond and associated drainage line - sediments
- AEC 8: Carbon Plant (western end only) - soil
- AEC 11: Washdown Bay – soil
- AEC 12: Pot Lines - soil
- AEC 15: West Surge Pond - sediments
- Groundwater beneath the Project Site.

These AECs are used throughout the subsequent investigations and remedial design.

6.2 Phase 2 Environmental Site Assessment for the Capped Waste Stockpile

The Capped Waste Stockpile was notified to the NSW EPA in 2012, under Section 60 of the *Contaminated Land Management Act (*1997). The EPA required further investigations into the contamination status of the area to identify if regulation was needed.

The Consultant undertook an ESA in 2013 specifically for the Capped Waste Stockpile (formerly known as the Alcan Mound) and in the surrounding area, where the waste stockpile groundwater contaminant “plume” was identified. The investigation involved a review of history, pumping tests, water quality sampling of 14 groundwater wells before and after the pumping test, and identification of data gaps for the area. The investigations recommended in a data gap analysis were subsequently filled (see reports referenced below).

The Ecological and Human Health Risk Assessments are summarised below, and the following documentation was also part of the process (and included in this Audit):

- ENVIRON, 2012a, "*Section 60 Notification Supporting Information*", dated 12 August 2012;
- ENVIRON, 2012b, "*Environmental Site Assessment, Alcan Mound, Kurri Kurri Aluminium Smelter*", dated 13 December 2012;
- ENVIRON, 2013a, "*Tier 2 Ecological Risk Assessment, Kurri Kurri Aluminium Smelter*", dated March 2013;
- ENVIRON, 2013b, "*Preliminary Screening Level, Health Risk Assessment for Fluoride and Aluminium, Part of the Kurri Kurri Aluminium Smelter, Hart Road, Loxford*", dated 2 April 2013; and
- ENVIRON, 2013c, "*Plume Delineation Report, Alcan Mound*", dated 11 October 2013.

Following the additional information, the NSW EPA responded that the Capped Waste Stockpile could be managed through Hydro's Environmental Protection Licence (EPL). A copy of the NSW EPA response letter is attached in **Appendix C**.

6.3 Ecological Risk Assessment

The Consultant undertook a Tier 2 Ecological Risk Assessment (ERA) in 2013 to derive ecological assessment guidelines for fluoride and aluminium. The Consultant focused on:

- Impacts of the ecology in surface water downstream of the Capped Waste Stockpile / plume; and
- The levels of fluoride and aluminium upgradient and downgradient of the Capped waste Stockpile.

The Consultant concluded that there had been no significant impact to the surface water ecology downstream (at Swamp Creek) from fluoride and aluminium.

Site-specific ecological threshold levels were developed and are provided in **Section 14** of this SAR.

6.4 Health Risk Assessment

The Consultant undertook a Health Risk Assessment (HRA) in 2013 to derive preliminary human health based criteria for fluoride and aluminium. Values were derived for soil, surface water and groundwater.

Site-specific human health threshold levels were developed and are provided in **Section 14** of this SAR.

6.5 Phase 1 Environmental Site Assessment

Because only a high level desktop review had been undertaken previously as part of the Stage 1 Phase 2 ESA, the Consultant undertook a Phase 1 ESA in 2013. As an outcome of this report, an Environmental Issues Register was presented for the Smelter (and also for the Buffer Land).

The Consultant noted that there was no Dangerous Goods search included in the Phase 1. The Consultant referred to a Hazardous Materials Audit and Register, a still live document maintained by Hydro, used for information relating to the current storage of dangerous goods. This Register was stated to be intended as a guide during demolition and remediation, and the information is also to be used in the validation program.

6.6 Stage 2 of Phase 2 Environmental Site Assessment

The second stage of the Phase 2 was undertaken in 2015. This stage involved a data gap review, sampling of five identified AECs, and five PAEC, installation of seven new wells, sampling and analysis of the new plus the existing (17) wells, assessment against generic criteria and refinement of the CSM including defining areas in need of remediation.

The CSM was compiled based on a commercial / industrial landuse, and it considered key downgradient receptors. The Consultant defined areas in need of further investigations, which were:

- the West Surge Pond,
- the Transformer Yard and Sub-Stations and
- a filled area east of the Clay Borrow Pit.

The areas in need of remediation identified by the Consultant are presented in **Table 4**.

Table 4 Areas in need of remediation as identified in the Stage 2 Phase 2 ESA.

AEC	Description
AEC 1: Capped Waste Stockpile	The Consultant stated that the migration of leachate from the stockpile and impacted soils beneath the stockpile could be an unacceptable risk to future commercial / industrial land use. Remediation was considered needed in this area.
AEC 2: Anode Waste Pile	PAH contamination was identified in surface soils to 0.2 m bgs. The Consultant also stated that delineation and remediation of a PAH hot spot at MW103 was considered needed.
AEC 4: Diesel Spray Area	PAH contamination was identified in fill material at 0.4 to 0.6 m bgs. The Consultant considered delineation and remediation needed for this area.
AEC 6: East Surge Pond and associated drainage line	PAH contamination was identified in sediments.
AEC 8: Carbon Plant	PAH contamination was identified in shallow soils to 0.4 m bgs in grassed areas and gardens beds at the western end of the Carbon Plant.
AEC 26: Bake Furnace Scrubber	PAH contamination was identified in shallow soils to 0.3 m bgs in grassed areas below the scrubber duct work. The Consultant considered delineation and remediation of PAH hot spot at HA115 needed.
AEC 28: Area east of the Playing Fields	Buried wastes were considered to need remediation for aesthetic reasons. Delineation and remediation of PAH hot spot identified in south east corner at TP117 was also considered needed.

In the Stage 2 Phase 2, the Consultant also identified three previous AECs that were no longer considered in need of remediation or management based on the following:

- AEC 3: Refuelling Area - Installation of additional groundwater wells and sampling of the new and existing wells did not identify contaminants in groundwater at concentrations requiring remediation or further assessment.
- AEC 11: Washdown Bay – Re-assessment of soil samples against site-specific criteria for fluoride identified one shallow soil sample (total fluoride) that exceeded the criteria. Additional investigations did not identify soluble fluoride impacts in shallow soil.
- AEC 12: Pot Lines – Re-assessment of soil samples against site-specific criteria for fluoride identified shallow soil samples (total fluoride) that exceeded the criteria. Additional investigations did not identify soluble fluoride impacts in shallow soil.

The Consultant stated that vertical delineation was undertaken as part of the Stage 2 Phase 2 (apart from under the Capped Waste Stockpile where vertical delineation of contamination would be needed following its removal). The main Contaminant of Concern (CoC) relating to AEC1 was PAH including B(a)P, which, according to the Consultant, did not appear to have migrated into natural soil or groundwater. Lateral delineation of contamination was undertaken as far as possible with buildings and infrastructure on Site restricting access to some areas.

6.7 Remedial Action Work Plan for the Clay Borrow Pit

6.7.1 Background

The Consultant reported that the Clay Borrow Pit was used to source clay for capping of the Capped Waste Stockpile in the 1990's. The void remaining was filled with inert materials such as bake furnace refractory, concrete and asphalt.

Sampling of soil, stockpiled materials and groundwater indicated that the CoPCs were present at levels below the LORs or below relevant guidelines. However, fluoride was found to be elevated in groundwater, and the area was considered to have visual impacts and potential safety risks for the future landuse. Hence, remediation was suggested and the Remedial Action Work Plan (RAWP) was developed.

The Consultant stated that remediation options for the Clay Borrow Pit were assessed based on cost, risk of failure, long term legacy and onsite management, corporate responsibility and sustainability. The method preferred was presented to be excavation, and coarse sorting (some for potential beneficial reuse where appropriate), of the materials. Materials in need of disposal were to be included in the overall strategy for the Site (subsequently presented in the RAP).

Remediation was undertaken between March and August 2015. The Validation Report for the Clay Borrow Pit was completed and indicated that the remediation was sufficient.

6.7.2 Auditor's opinion

The Auditor notes that the previous investigations were reviewed as part of the overall Audit, including the remediation and the Validation Report for the Clay Borrow Pit.

It is the Auditor's opinion that the previous investigations summary provided in the 2018 RAP was in general accordance with NSW OEH (2011).

6.8 Ramboll Plume Delineation and Management

6.8.1 Auditor's opinion

6.8.1.1 Background

In July 2012, Hydro provided a formal notification to NSWEPA under Section 60 of the CLM Act; describing leachate impacted groundwater, surface water and impacted vegetation down-gradient of an ageing smelter waste stockpile located near the eastern boundary of the smelter Site. The waste stockpile was formed as a SPL associated with the early smelter operations (1969 to 1992). In 1995 the stockpile was capped with clay and the surface was grassed. The stockpile has approximate dimensions of about 170m by 130m by up to 11 m, with an estimated volume of about 159,000 cubic metres. Impacts from the stockpile have been estimated to extend much further, especially in the down gradient direction, to at least

The original uncapped SPL waste stockpile led to the generation of leachate for a period of nearly 25 years. As noted above, the waste stockpile was capped in 1995 but the stockpile had no base liner and the wastes were likely to be in direct contact with fluctuating shallow groundwater nominally at 14.5m AHD.

Ramboll environmental investigations between 2010 and 2013 concluded that groundwater in the vicinity of the stockpile occurred through two aquifers comprising a shallow (near surface) aquifer and a deeper, separate confined aquifer.

Ramboll was commissioned by Hydro to undertake a staged assessment of the leachate impacted groundwater, surface water and impacted vegetation down-gradient of an ageing smelter waste stockpile and identify possible remedial responses to the identified plume.

Ramboll (2013) concluded that mechanisms to intercept the impacted groundwater could be implemented to remove of reduce leachate migration with intercepted leachate managed through existing evaporation and irrigation processes. Ramboll (2013) recommended, inter alia, the construction of a leachate interception trench at the toe of the stockpile.

The interception trench was subsequently constructed in April 2014 with performance monitoring undertaken for approximately four years. This monitoring concluded that the contaminated leachate plume was stable or declining and, if the "source" (i.e. the SPL wastes) were removed to a new containment cell, then active management of the plume would not be required, as long as an appropriate ongoing long term management plan was designed and implemented to ensure no unacceptable human health or environmental risks were posed by the residual groundwater contamination.

6.8.2 Auditor's Opinion

In relation to this Part B Site Audit, it is my opinion that the plume delineation was consistent with the requirements of OEH (2011) in relation to the development of remedial action plans.

The proposal for passive management of the residual plume following "source removal" is considered to be a sustainable remedial response, provided the proposed Long-Term Management Plan is appropriately developed and implemented on a site-specific basis following the "source removal". This approach will be reviewed in light of supplementary information obtained during the construction of the containment cell.

6.9 Ramboll Remedial Options and Sustainability Assessment Memo 22 July 2016

6.9.1 Background

Ramboll, in its 2018 Remedial Action Plan (RAP) for the Kurri Kurri smelter site[3], outlined its assessment of remedial options and its subsequent "sustainability consideration" of the preferred sustainable remediation for the smelter Site.

The 2018 RAP considered seven (7) generic remedial responses, being:

1. Do Nothing
2. Encapsulate in-situ
3. Move to specifically designed landfill adjacent to the capped waste stockpile
4. Encapsulate in purpose built containment cell
5. Treat and encapsulate in purpose built containment cell
6. Excavate, sort and dispose off-site
7. On-site treatment to achieve complete destruction

Using a conventional multi-criteria analysis technique, these generic options were scored against the conventional factors of time, cost and risk, as well as against seven (7) "sustainability factors, being:

- Ecological
- Aboriginal
- Greenhouse Gas / Energy
- Climate Change
- Local community Impacts
- Community Perception; and
- Ethics and Equity.

The unweighted scoring from this multi-criteria evaluation resulted in option 4 (Encapsulate in purpose built containment cell) receiving preferred status.

[3] Ramboll (2018) "*Remedial Action Plan Hydro Aluminium Smelter Kurri Kurri*", dated 02 July 2018 (Reference AS130349)

In its review of the 2018 RAP, the Site Auditor requested further justification of the Sustainability Assessment, and in July 2016, Ramboll provided a technical memorandum outlining the basis of the Sustainability Assessment summarised in the 2018 RAP.

In its technical memorandum, Ramboll advised that:

"Sustainability has been a key element of options evaluation, including consideration of:

- Energy requirements associated with remedial works, including further carbon footprint considerations and long-term management demands;
- Beneficial reuse of materials in waste management; and
- Key stakeholder expectations."

The AIA on the 2018 RAP concluded, in relation to the sustainability assessment that:

> **"**While it is likely that the preferred remedial response will remain unchanged, a more detailed "sustainable remediation" evaluation, such as by reference to the 2013 ASTM E2893-13e1 (Standard Guide for Greener Cleanups) would have enhanced the adequacy of the 2018 RAP.**"**

6.9.2 Auditor's opinion

In relation to this Part B Site Audit, it is my opinion that the remedial technology selection and sustainability assessment was consistent with the requirements of OEH (2011) for the development of remedial action plans.

6.10 Containment Cell and Long Term Management Plan

6.10.1 Background

Ramboll, in its RAP for the Kurri Kurri smelter site[4], identified the preferred remedial response for contaminated solids/soils associated with the Smelter Site and for the contents of the related "Capped Waste Stockpile" to be by relocating and consolidating these materials into an on-site Containment Cell.

The location of the proposed Containment Cell was nominated to be the nominal footprint of the "Clay Borrow Pit" (recently remediated) and the nominal containment cell design was stated to be "using best demonstrated available technology" to contain contaminated soils and smelter wastes in perpetuity. The specifications of the design are to be provided by Hydro's consultant in a separate document.

The conceptual cell design[5] was described as comprising a triple base liner combining compacted clay and with high density polyethylene liners. Leachate drainage layers and leachate collection was included in the nominal design for the base liner. The nominal cell cap design was described to comprise a double liner system with clay and geo-synthetic high density polyethylene liners. Gas venting, drainage layers, fauna protection and vegetation layers were all included in the nominal cap design. Also, as a contingency, the RAP reported that the proposed containment cell was designed to allow the accommodation of additional waste/soil volumes by being able to increase its nominal height, if required.

As noted above, the proposed containment cell design was prepared to ensure contaminated soils and smelter wastes were managed in an environmentally responsible manner, "in perpetuity". The successful "in perpetuity" integrity of the containment cell would, by its nature, have to rely upon long term and ongoing management to ensure its ongoing integrity was maintained. Current regulatory and industry practice used to achieve this "in perpetuity integrity" is by the publication of an approved **Long Term Management Plan (LTMP)** for the ongoing maintenance, management and stakeholder reporting of such a containment cell.

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[55] Ramboll (2018) "*Remedial Action Plan Hydro Aluminium Smelter Kurri Kurri*", dated 02 July 2018 (Reference AS130349)
[5] The final cell design will be subject to independent verification which will be considered as part of this Site Audit.
[5] Ramboll (2017) "*Containment Cell Long Term Management Plan*", Revision 5, dated 19 December 2017.

On behalf of Hydro, Ramboll has prepared a LTMP[6] which contains the following key components:

- Management controls (licences, planning instruments, covenants, financial mechanisms, etc.)
- Roles and Responsibilities for ongoing management and reporting;
- Inspection, monitoring and auditing protocols; and
- Contingency responses.
- It is noted that the following appendices for the LTMP are currently incomplete:
- Containment Cell As Built Design Drawings (to be provided when designs have been completed and approved);
- Approvals and Licences (to be included upon granting);
- Containment Cell Planning and Property Mechanisms (to be developed);
- Containment Cell Funding Mechanisms (to be developed);
- Leachate Monitoring Procedure (to be developed);
- Groundwater Sump Monitoring (to be developed); and
- Gas Sampling Procedure (to be developed).

As noted, many of these appendices will not be able to be finalised until further detailed design and permitting has been completed in consultation with the Appropriate Regulatory Agencies (ARAs).

For the purposes of negotiating with potential future custodians of the Site, Hydro requested AECOM to provide an Auditor Interim Advice (AIA)[7] on the suitability of the LTMP for "perpetual management" of the Containment Cell. To assess its suitability, the Site Auditor considered the LTMP in light of the following key guidance:

- Relevant guidelines referenced in Section 105 of Contaminated Land Management Act (http://www.epa.nsw.gov.au/your-environment/contaminated-land/managing-contaminated-land/statutory-guidelines);
- **ANZECC (1999)** Guidelines for the Assessment of On-Site Containment of Contaminated Soil, September 1999 (http://nepc.gov.au/system/files/resources/378b7018-8f2a-8174-3928-2056b44bf9b0/files/anzecc-gl-assessment-site-containment-contaminated-soil.pdf)
- **Victorian EPA (2015)** Siting, Design, Operation and Rehabilitation of landfills, EPAV No.788.3, especially in relation not after care management (Section 8) (http://www.epa.vic.gov.au/~/media/Publications/788%203.pdf);
- **QLD Department of Environment and Heritage Protection (2013)** "landfill Siting, Design, Operation and Rehabilitation", December 2013 (https://www.ehp.qld.gov.au/assets/documents/regulation/pr-gl-landfill-siting.pdf)
- **CRC CARE (2013)** Safe on-site Retention of Contaminants (Parts 1 and 2) Technical Report No.16 (http://nepc.gov.au/system/files/resources/378b7018-8f2a-8174-3928-2056b44bf9b0/files/anzecc-gl-assessment-site-containment-contaminated-soil.pdf)
- **CRC CARE National Remediation Framework** as it relates to long-term management, closure and monitoring. See: (http://www.crccare.com/files/dmfile/FINALNRFSG-ValidationandClosureNOV16.pdf and http://www.crccare.com/files/dmfile/FINALNRFSGLongTermMonitoring_NOV16docx.pdf).

[6] Ramboll (2017) "*Containment Cell Long Term Management Plan*", Revision 5, dated 19 December 2017.
[7] AECOM (2017) "Auditor Interim Advice on Suitability of Long-Term Management Plan *Hydro Aluminium Kurri Kurri Pty Ltd, 21 December 2017.*

The AIA on the LTMP concluded:

> *"While the Draft Containment Cell Long Term Management Plan (LMTP) is a dynamic document and is subject to further revision, in my opinion, the plan is consistent with the key regulatory and industry guidance noted above, and is conceptually appropriate for the purpose of developing the broader long term management response for the remediation of the Kurri Kurri Site. The final LMTP will inform my independent Site Audit of the containment cell."*

6.10.2 Auditor's Opinion

In relation to this Part B Site Audit, it is my opinion that the principles outlined for the design of the containment cell as are adequate, noting that a separate Audit will be completed to confirm the suitability of the detailed Containment Cell Design.

Also, in relation to this Part B Site Audit, it is my opinion that the Draft LTMP is an adequate framework for the preparation of the final LTMP, noting that much of the key information required for its finalisation will not become available until final design, proposed licences and related matters are resolved with the Appropriate Regulatory Agencies (ARAs).

This need for finalisation of the LTMP does not adversely impact on the provision of this Part B Audit as the remedial works may proceed while the LTMP is being negotiated and finalised.

7.0 Site Contamination

7.1 Introduction

The Consultant provided a summary of the contamination status based on the previous investigations. The Capped Waste Stockpile was identified as the main AEC, and specific details are provided in **Section 7.2**. A groundwater plume was identified in association with the Capped Waste Stockpile, extending north approximately 300 m from the north-eastern corner of the stockpile.

The main CoPC was defined as “carcinogenic PAHs”. This CoPC was generally found in shallow soils (generally less than 0.6 m bgs), within fill. The Consultant reported that its investigation results indicated that the natural materials underlying the fill were not significantly impacted.

7.2 Capped Waste Stockpile

In consultation with the NSW EPA[8], the Consultant provided a waste characterisation and classification of the materials in the Capped Waste Stockpile. A list of the key materials present in the stockpile was provided as follows:

- Cryolite and alumina;
- Spent pot lining;
- Carbon Plant shot blast refuse, including grit and dust;
- Carbon Plant dust collector product;
- Collar mix (coke, pitch) spillage;
- Carbon Plant floor sweepings (comprising alumina, cryolite and carbon);
- Packing coke oversize;
- Contaminated bath;
- Rotary breaker oversize;
- Pot lining mix (hot ramming paste);
- Rodding mix (coke, graphite, pitch and anthracene oil);
- Stud joining mix;
- Pitch spills/ pencil pitch;
- Aluminium swarf;
- Scrap aluminium billets;
- Anode cover material;
- Butt from spent anodes;
- Ahead of schedule anodes;
- Dross;
- Pot bottom aluminium;
- Consumable gaskets and insulation material (Synthetic mineral fibre and presumably asbestos); and
- General rubbish, including plastic, wood and steel.

[8] Excerpt from RAP: “*In consultation with the NSW EPA Waste Group, the inclusion of the Capped Waste Stockpile in a remediation strategy must consider the contents of the Capped Waste Stockpile as ‘waste’ and thereby classify the materials in accordance with the NSW EPA Waste Classification Guidelines*”.

The Consultant stated that the majority of the materials were associated with the Carbon Plant, and the main CoPC for those was PAH. PAH associated with pitch, coke and anodes were not considered by the Consultant to leach readily, as they were reported to have low solubility in water.

7.3 Spent Pot Lining

The Consultant described Spent Pot Lining (SPL) as a waste product of the aluminium smelting process when using the "Hall-Heroult reduction process". Electrolytic cells or pots are used in this process. The pots are made of a steel container lined with refractory brick and an inner lining of carbon, which protects the steel against corrosion. Chemicals from the electrolytic bath, such as cryolite (Na_3AlF_6) and other fluoride salts, are taken up in the pot lining during its service life. As such, SPL is associated with elevated concentrations of leachable fluoride and sodium, and also contains cyanide-forming materials.

The Pot Lining is "spent" when the molten bath and metal breach the carbon and refractory lining. The SPL is then extracted from the steel shell in pieces for recycling/disposal.

The Consultant provided information for the typical components of SPL retrieved from a Material Safety Data Sheet (then "MSDS"), being:

- Carbon 26-72%
- Alumina 11-22%
- Fluorides 7-22%
- Total sodium 13-17%
- Aluminium 5-20%
- Silicates <10%
- Calcium oxide <3%
- Iron oxide <1.4%
- Cyanides <0.7%
- Magnesium oxide <0.35%
- Total sulphur <0.2%

Chemical characterisation was undertaken for the SPL, both for "first cut" and "second cut" materials, and was summarised in a table by the Consultant. The information is provided in below.

Table 5 Chemical Characterisation of Spent Pot Lining at the Site (from Table 5-5 of the RAP)

Analyte	Waste Classification				First Cut Range (%)		Second Cut range (%)	
	CT1 (%)	CT2 (%)	SCC1 (%)	SCC2 (%)	Lower Value	Higher Value	Lower Value	Higher Value
Carbon					41	70	5	10
Silicon Dioxide					0.9	7	25	40
Calcium Oxide					2	3	0.06	7
Sulphur					0.45	0.63	0.1	1.07
Vanadium Pentoxide					0.06	0.09	0.06	0.09
Phosphorus Pentoxide					0.01	0.02	0.06	0.08
Sodium Oxide					14.1	18	12.9	14.9
Aluminium Oxide					4	11	17	21
Fluoride	0.3	1.2	1	4	7.5	8	3.7	6.5
Iron Oxide					1	3	3	4
Potassium Oxide					0.1	4	0.8	2
Manganese Oxide					0.07	0.08	0.1	0.1
Titanium Dioxide					0.01	0.08	0.02	0.04
Cyanide (Total)	0.0320	0.1280	0.059	2.36	0.0164	0.0311	0.0004	0.0178
Aluminium carbide					0.5	3	Not present	Not present
Aluminium Nitride					0.05	1.5	Not present	Not present
Al Metal					0.05	3	0.05	1
Na Metal					0.005	0.1	0.005	0.01

The Consultant reported that the (then) MSDS identified that SPL in contact with water can create ammonia, hydrogen and methane. Further, when SPL experience high temperatures or is in contact with acids, it can create fluorides, hydrogen cyanide and oxides of sulphur.

7.4 Leachate

The Consultant reported that the leachate from the Capped Waste Stockpile was impacting on groundwater in a localised area of the Stockpile. **Figure 13** in **Appendix A** shows the Fluoride concentrations at two locations near the Stockpile over time. Results from sampling conducted at the toe of the stockpile, where an active intercepting trench had been constructed, and from sampling in in the early 90s by Dames and Moore, were presented in the RAP (included in **Table 6** below).

Table 6 Analytical results from leachate in the Capped Waste Stockpile (primarily from Table5-7 of RAP).

Analyte	LT01 (mg/L) (3/6/2015)	LT02 (mg/L) (4/6/2015)	Dames and Moore (1992) Result Range (mg/L)
pH (pH units)	9.7	9.7	-
Electrical Conductivity (µS/cm)	15,000	16,000	-
Aluminium	46	42	-
Iron	33	31	-
Fluoride	480	490	1,100 to 3,420
Total Cyanide	79	85	70 to 200
Mercury	<0.00005	<0.00005	-
Calcium	7	<5	-
Potassium	18	13	-
Sodium	5,600	5,600	4,800 to 15,300
Magnesium	3.6	2.4	-
Hydroxide Alkalinity as $CaCO_3$	<5	<5	-
Bicarbonate Alkalinity as $CaCO_3$	3,300	3,500	-
Carbonate Alkalinity as $CaCO_3$	4,600	4,700	-
Total Alkalinity as $CaCO_3$	7,900	8,200	-
Sulphate	1,900	2,000	4,000 to 6,740
Chloride	160	150	-
TRH C6-C10	<0.01	<0.01	-
TRH C10-40	<0.1	<0.1	-
BTEX	<0.002	<0.002	-
Benzo(a)pyrene	<0.001	<0.001	-
Total PAHs	<0.002	<0.002	-
PCBs	<0.002	<0.002	-

7.5 Gas

Due to the potential for SPL to generate hazardous gases, gas monitoring has been undertaken since 1996. Samples were collected from gas vents in the cap, and were analysed for carbon dioxide, oxygen, methane, carbon monoxide, hydrogen and nitrogen. Kitagawa detection tubes were also sampled for ammonia, phosphine / arsine, hydrogen cyanide and hydrogen sulphide.

Results from the monitoring program were presented in graphs on the Consultant's **Figures 14** and **15** (included in **Appendix A**). The Consultant reported that the levels of methane peaked early (in the first year of sampling). Ammonia had low concentrations initially, followed by peaks in 2002 – 2007 and again between 2010 and 2012. Phosphine/ arsine, hydrogen cyanide and hydrogen sulphide concentrations were not detected above the LOR in any sample collected.

The Consultant identified that water had been used to soak the pot lining to cool it and minimise dust generation during removal. The practise caused the production of sodium carbonate, hydrogen, methane and ammonia. Based on information from Dames and Moore (1992), the Consultant stated that the gas generation was rapid for hydrogen, methane and ammonia initially, and that hydrogen and methane liberation probably ceased within hours of the removal process.

The Consultant also concluded that the use of water to soak pot lining, and the subsequent placement of the material in a stockpile where it was in contact with water is likely to have exhausted much of the material's hazardous gas production potential. The Consultant further concluded that hydrogen cyanide and hydrogen sulphide was not detected since it would require high temperatures to be produced.

7.6 Preliminary Waste Classification of SPL

The Consultant referred to NSW EPA (2014), "*Waste Classification Guidelines, Part 1: Classifying wastes*" and used the steps included in the guidelines to conduct a preliminary waste classification on SPL. A summary is included in **Table 7**.

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Table 7 Preliminary Waste Classification of SPL

Step	Consultant's Assessment
Step 1: Is the waste Special Waste?	The Consultant stated that the waste was Special Waste as it was known to contain asbestos. The Consultant also noted that where waste is characterised as special waste, but is mixed with other waste materials both classifications are to be included.
Step 2: Is the waste Liquid Waste?	The Consultant stated that the material was not liquid waste.
Step 3: Is the waste pre-classified?	The Consultant stated that there were two types of common wastes in the Stockpile that would need consideration in accordance with this step. A discussion was included regarding those materials: "*containers, having previously contained a substance of Class 1, 3, 4, 5 or 8 within the meaning of the Transport of Dangerous Goods Code, or a substance to which Division 6.1 of the Transport of Dangerous Goods Code applies, from which residues have not been removed by washing or vacuuming*": the Consultant stated that aluminium dross, aluminium skimmings, spent cathodes, spent pot lining, and aluminium salt slags were present in the Stockpile, which is Dangerous Goods Class 4.3. However, the materials were directly disposed in the stockpile and no containers previously containing the materials were included in the Stockpile. "*coal tar or coal tar pitch waste (being the tarry residue from the heating, processing or burning of coal or coke) comprising of more than 1% (by weight) of coal tar or coal tar pitch waste*": The Consultant stated that coal tar pitch was used in anode making. The anodes were heat treated prior to disposal. The Consultant further stated that there could be some untreated pitch in the capped waste stockpile, but if so, it would be expected to be very small amounts.
Step 4: Does the waste possess hazardous characteristics?	The Consultant stated that SPL is classified as a Dangerous Goods 4.3, UN code 3170, since it is a substance which in contact with water emit flammable gases that are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities. The Consultant further stated that investigations indicated that the aluminium smelter waste was weathered and had already reacted due to pre-lining procedures in the past. Hence, the Consultant stated that the material would no longer emit flammable gases in dangerous quantities and referred to their Figures 14 – 15 (**Appendix A**). Regardless of this argument, the material was still classified as Dangerous Goods, and as such pre-classified as Hazardous Waste. According to the Consultant, the Smelter Waste was also regulated under the *Environmental Hazardous Chemicals Act 1985.* In the Chemical Control Order for Aluminium by-products, cyanide and leachable concentrations are required to be below 150 mg/L and 10mg/L for disposal (see further clarification regarding this statement in "*Auditor's opinion*" below. According to the Consultant, this was meant to read: "*The Chemical Control Order for Aluminium Smelter Wastes Containing Fluoride and / or Cyanide requires leachable concentrations to be below 150 mg/L and 10 mg/L respectively before disposal.*"). The Consultant presented data (included in **Table 6** herein) showing that the concentrations in SPL exceeded the requirements. Hence, the material would need to be regulated under an immobilisation approval.
Step 5: determining a waste's classification using chemical assessment	The Consultant summarised the information from the tables provided for the purpose of waste classification. As identified in **Table 5**, the fluoride concentrations were above CT1, CT2 and the SCC2 criteria, and would therefore be classified as hazardous waste based on the total concentrations of fluoride. The Consultant had also compared leachate from the toe drain to the TCLP2 concentrations, noting that it was not directly comparable since the TCLP are conducted using an acid solution. The Consultant argued that fluoride was more mobile above neutral pH, and that an acid solution would therefore result in a less conservative assessment. They considered the comparison valid based on this argument.

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The Consultant concluded that the waste was classified “special” and “hazardous waste”, and that the material would need treatment (in accordance with current Chemical Control Order for Aluminium By-products), and an agreement with the NSW EPA would be required, before disposal.

7.7 Immobilisation

The NSW EPA has provided correspondence to Ramboll (dated 6th December 2017) that states “*the EPA advises that as the material is not moving offsite, it does not trigger any waste related regulatory requirements including an immobilised contaminants approval*.”

7.8 Emerging Contaminants

The Consultant provides a section in the 2018 RAP on emerging contaminants (Section 5.12), which specifically focuses on the smelter’s use of AFFF in its firefighting infrastructure. Other potential emerging contaminants are not discussed.

It is noted that the 2018 National Environmental Management Plan for PFAS (NEMP) specifically includes aluminium production as any activity that may be associated with PFAS contamination.

7.9 Auditor's opinion in relation to Contaminant Characterisations

The Auditor notes that the conventional contaminants of primary concern have been appropriately identified in a manner consistent with the 2013 ASC NEPM methodologies, focusing on site history and literature reviews.

However, the potential for emerging contaminants has not been fully addressed. Discussion of fire-fighting infrastructure has not considered the potential for PFAS-contamination arising from non-fire-fighting activities, or from the use of PFAS in aluminium production process.

The Auditor notes that the details of water and leachate treatment will be provided by the Consultant in a detailed Validation Plan were requested but not provided at the time of the submission of the 2018 RAP for planning purposes. This was confirmed by the Consultant in the Response Letter (included in **Appendix B**).

The Consultant's statement that gas generation would be minimal based on the data from the current location where the material has been weathered for 20 years will be confirmed during the Site Auditor's containment cell review including an independent review of the suitability of the cell for the material being contained therein.

Notwithstanding the above, it is the Auditor's opinion that the Section was adequate for the purpose of this RAP suitability Audit and reported in general accordance with NSW OEH (2011). Consideration of emerging contaminants will be reviewed by the Auditor in consideration of the adequacy of the Validation Plan.

8.0 Media of Environmental Concern

8.1 Soil

The Consultant provided a summary of the soil contamination for each of the identified AECs in two tables, with the information compiled in **Table 8** below.

Table 8 Summary of Soil Contamination (from Table 5-3 and 5-4 of the RAP)

Site Activity	Site Area	Description	CoC	No. of Samples	Maximum Concentration (mg/kg)	Minimum Concentration (mg/kg)	Average Concentration (mg/kg)	Exceedances			
								Sample identification	B(a)P TEQ Exceedance of HILD (mg/kg)[A]	B(a)P Exceedance of EIL C/I (mg/kg)[B]	Depth of Soil Impact (m bgs)
Waste Stockpiling	Capped Waste Stockpile (AEC 1, **Figure 5, Appendix A**)	Long term stockpiling of spent pot lining and other wastes.	Fluoride cyanide PAHs asbestos TPH/BTEX Heavy metals	NA	NA	NA	NA	NA	NA	NA	NA
	Anode Waste Pile (**AEC 2, Figure 6, Appendix A**)	Long term stockpiling of 'ahead of schedule anodes' in low lying ground adjacent to the Capped Waste Stockpile.	B(a)P	13	160	0.05	27.8	MW12	56.9	-	0-0.4, Fill extends to 0.9
								SB105	55	-	
			B(a)P TEQ	13	250	0.5	46.5	MW103	42	-	
								MW103	**250**	160	
Fill Importation	Diesel Spray Area (AEC 4, **Figure 7, Appendix A**)	Likely that impacted fill material was used to level this portion of the Site.	B(a)P	13	101	0.5	15.8	SB18	70.1	-	0.4-0.6
								MW19	**150.2**	101	
			B(a)P TEQ	13	150.2	0.5	24.3	SB112	55	-	
Site Operation	Carbon Plant (AEC 8, **Figure 9, Appendix A**)	Impacts in the vicinity are likely due to the accumulation of dust from the Carbon Plant. Impacts in garden beds and grassed areas.	B(a)P	30	180	0.05	19.1	MW18	58.5	-	0-0.4
								HA107	**140**	98	
								HA107	**260**	180	
								HA110	82	-	
								HA111	75	-	
			B(a)P TEQ	30	260	0.5	28	HA111	67	-	
	Bake Furnace Scrubber (PAEC 26, **Figure 10, Appendix A**)	Impacts associated with the accumulation of black sandy material likely to be spilt Ring Furnace Reacted Alumina. Impacts to shallow surface soil beneath the scrubber duct work.	B(a)P	16	230	0.26	26.3	HA115	**440**	230	>0.3
								HA115	94	-	
								HA116	90	-	
			B(a)P TEQ	16	440	0.5	50.1	HA117	120	-	

Site Activity	Site Area	Description	CoC	No. of Samples	Maximum Concentration (mg/kg)	Minimum Concentration (mg/kg)	Average Concentration (mg/kg)	Exceedances			
								Sample Identification	B(a)P TEQ Exceedance of HILD (mg/kg)[A]	B(a)P Exceedance of EIL C/I (mg/kg)[B]	Depth of Soil Impact (m bgs)
Burial of Waste	Area East of Playing Fields (PAEC 29, **Figure 11, Appendix A**)	Waste materials, including concrete, refractory brick, metal sheeting, metal reinforcement, plastic sheeting, timber, fence posts, broken glass, electrical wire, steel posts and old cable.	B(a)P	10	220	0.06	22.3	TP117	**310**	220	0.5, Fill extends to 1.6
			B(a)P TEQ	10	310	0.5	31.7				
Drainage	Drainage Lines (AEC 5, **Figure 8, Appendix A**)	PAH contaminated sediments have accumulated in the drainage line adjacent to the Anode Waste Pile.	B(a)P	7	85.6	0.5	31.6	D6	149.6	85.6	0-0.3
								D7	96.3	-	
			B(a)P TEQ	7	149.6	1.6	63.4	D8	102	-	
	East Surge Pond (AEC 6, **Figure 8, Appendix A**)	PAH contaminated sediments have accumulated within the East Surge Pond, which is immediately down gradient of the drainage lines near the Anode Waste Pile.	B(a)P	4	21.7	0.9	12.9	D11	56.2	-	0-0.2
			B(a)P TEQ	4	56.1	1.9	28.7				

NA = Not Applicable: Soil sampling had not been undertaken in the Capped Waste Stockpile.

A = ASC NEPM (2013) HILD (Commercial / Industrial) guideline for Benzo(a)pyrene TEQ = 40 mg/kg

B = Canadian Council of Ministries of the Environment (2010) Canadian Soil Quality Guidelines Carcinogenic and other Polycyclic Aromatic Hydrocarbons (PAHs) (Environmental and Human Health Effects) guideline value = 72 mg/kg

Bold = >2.5 times the guideline, which was considered by the Consultant as a “hotspot”.

8.2 Groundwater

The Consultant stated that groundwater sampling was conducted in areas within the Site that had the highest risk from contamination, such as upgradient of the Capped Waste Stockpile (this statement was clarified to be "downgradient" as discussed in the "*Auditor's opinion*" below), the Anode Waste Pile, Carbon Plant, Wash Bay, the Diesel Spray Area, Refuelling Area, Pot Rebuild Area and Flammable Liquids Store. Up-gradient and down-gradient locations have also been sampled, as well as other areas of the site such as the Clay Borrow Pit (see comment under "*Auditor's opinion*" in relation to this as the sentence in the RAP was incomplete) . The Consultant reported that the sampling program was considered to adequately represent and characterise the groundwater impacts at the Site.

According to the Consultant, groundwater was encountered at 1 to 5 m bgs under the Smelter Site. The aquifer was considered limited in extent and with a low yield. The main impacts found were from fluoride (between 0.22 mg/L and 43 mg/L) and aluminium (up to 13.6 mg/L) from the two sampling event undertaken, not including the plume at the Capped Waste Stockpile. Free Cyanide was detected in 2012 at one occasion at one location but was below the SAC guidelines and as such the analyte was excluded by the Consultant from further monitoring.

Hydrocarbons were detected at low levels in groundwater at the Carbon Plant and down gradient of the Refuelling Area. However, further assessment confirmed the levels to be low and the Consultant stated that the concentrations were isolated.

The Consultant found a leachate plume extending approximately 350 m north-east of the eastern toe of the Capped Waste Stockpile, characterised by elevated fluoride, cyanide and sodium concentrations and by a high pH (>9). The material in the Capped Waste Stockpile was considered to have leached prior to the Stockpile being capped, when it was in contact with shallow groundwater. The impacted aquifer was stated to be ephemeral, with low yield, situated within unconsolidated estuarine sediments close to the surface at around 0.3 to 2.5 m bgs. The contamination was considered to move in coarse grained sand lenses surrounded by high plasticity clays, which had not allowed migration due to low porosity. The Consultant did not include any Figures of the plume in the RAP. Figures from the Plume Delineation Report (Environ, 2016) showing extent and details of the plume have been included in **Appendix A** of this SAR.

8.3 Auditor's opinion in relation to Environmental Media

The Areas of Environmental Concern section was reported in general accordance with the NSW OEH (2011) and is considered adequate for the purpose of the Audit.

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9.0 Conceptual Site Model

9.1 Consultant's CSM

The Consultant included a CSM for the proposed future industrial / commercial use, also considering the downgradient receptors. The CSM is included in **Table 9**.

Table 9 Conceptual Site Model (from Table 5-10 of the RAP)

Pathway	Potentially Complete Source-Pathway-Receptor Link? (Y/N)				Justification
	Current & future On-site Employees (non-intrusive)	Current & future on-site Intrusive Maintenance and Construction Workers	Recreational users of Kurri Kurri Speedway	Buffer Zone Ecological Receptors	
Shallow Surface Soil					
Dermal contact with soil & dust	N	Y	N	N	Shallow (0-0.4m bgs) impacted soil reported on-site.
Incidental ingestion of dust/soil	N	Y	N	N	
Dermal contact with dust only	Y	N	N	N	Shallow (0-0.4m bgs) impacted soil reported on-site in unpaved areas – potential for dust generation. The source of aerial dust deposition to off-site areas no longer present as Smelter is closed and soil impacts not identified in previous studies in the Buffer Zone.
Outdoor dust inhalation	Y	Y	N	N	
Indoor dust inhalation	Y	N	N	N	Outdoor dust can be transported indoors.
BaP Impacts to Buried Fill at the Diesel Spray Area (0.4-0.6m bgs)					
Dermal contact with soil and dust	N	Y	N	N	Impacted fill material identified at a depth of 0.4- 0.6m bgs at the Diesel Spray Area.
Incidental ingestion of dust/soil	N	Y	N	N	
Groundwater					
Dermal contact	N	Y	N	Y	Shallow (~0.5-5mbgs) fluoride and aluminium impacted groundwater detected on-site. Shallow (0.5-2.5mbgs) leachate plume identified down-gradient of Capped Waste Stockpile. During times of high rainfall, groundwater exflitrates to the surface in the Buffer Zone and can flow to surface water bodies. Studies have shown that concentrations of fluoride and aluminium in surface waters in the Buffer Zone have not impacted on ecology at the downgradient receptor, Swamp Creek. On this basis, concentrations of fluoride and aluminium in groundwater at the site are not considered to represent an ecological risk under the current site use.
Incidental ingestion	N	Y	N	Y	
Sediment					
Dermal contact	N	Y	NA	NA	Impacted sediments detected in the East Surge Pond and associated drainage lines on-site
Incidental ingestion	N	Y	NA	NA	

9.2 Auditor's opinion on Consultant's CSM

It is the Auditor's opinion that the Section was adequate for the purpose of the Audit and was reported in general accordance with NSW OEH (2011), noting that the data gaps that were identified are addressed further below.

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9.3 Data Gaps identified by the CSM

The Consultant used the CSM to identify data gaps due to inaccessible areas (infrastructure on the Site and water covering ponds). The Consultant stated that these areas will be investigated once the infrastructure has been removed. The key uncertainties are presented below.

9.3.1 Soil Uncertainty

The Consultant stated that the following areas require further investigation:

Table 10 Areas Requiring Further Investigation

Area	Data Gaps
AEC 15: West Surge Pond	The Consultant stated that the sediment from the Western Surge Pond should be excavated and stockpiled, and subsequently sampled for soluble fluoride.
PAEC 27: Transformer Yard and Substations	The Consultant stated that once the Transformer Yard and Substations are isolated, the areas will be assessed for Polychlorinated Biphenyls (PCBs) and TPH.
PAEC 30: Area East of the Clay Borrow Pit	Virgin Excavated Natural Material (VENM) from the construction of the Hunter Expressway was placed in this area. Once removed, the Consultant stated that the fill material underneath is to be assessed.
AEC 4: Diesel Spray Area	Underground utilities have prevented lateral delineation of the contamination. The Consultant stated that the lateral extent was to be assessed once it was safe to do so, which later in the document was defined as the underground utilities being switched off.
AEC 2: Anode Waste Pile	According to the Consultant, the lateral and vertical extent of contamination will be assessed once the stockpiled material is removed.

Example characterisation reports has been provided for one of the transformer substations (i.e. PAEC 27) and for the diesel spray area (PAEC 4) but these have not been specifically considered by the Site Auditor as part of this 2018 RAP review. These and other reports will be reviewed as part of the Auditor's consideration of the Validation Plan.

9.3.2 Groundwater Uncertainty

The Consultant noted an uncertainty in relation to groundwater risk and recommended that a Health Risk Assessment should be undertaken; including derivation of a site-specific criterion for fluoride specifically for maintenance and construction workers (defines as a receptor in the CSM).

The Consultant further noted a groundwater risk that may be posed to the environment and subsequently recommended that an ERA be undertaken for fluoride and aluminium. The Consultant also stated that previous ERAs conducted needed to be broadened to include all relevant receptors.

9.4 Auditor's opinion

In the Auditor's review comments on the 2018 RAP, the Auditor questioned the Consultant's statement that if, after their proposed groundwater HRA, the risks from groundwater for maintenance / construction workers were acceptable, then the derived soil criterion would be considered to be protective of human health risks associated with groundwater as well.

The Auditor commented that HRA derived threshold levels for soils may not be protective of groundwater. The Consultant advised that a further risk assessment for groundwater and soil addressing all receptors will be provided for auditor review.

With this clarification, the Auditor considers that the pre-remediation CSM is appropriate for the purposes of the Audit and was generally in accordance with the requirements of NSW OEH (2011).

However, because of some data gaps that will only be addressed following demolition of some structures at the Smelter Site to enable access, this Audit has identified the following comment to the Part B2 Audit: **That Environmental Management Plans consistent with the 2018 RAP be prepared for these portions of the Site be provided to the Site Auditor for endorsement prior to their implementation** (See Section 28 of this Audit Report).

10.0 Remediation

10.1 Remediation Goal

The Consultant stated that the goal of the remediation was to make the Site suitable for the proposed landuses identified in the Masterplan, which were stated to be General Industrial (IN1), Heavy Industrial (IN3) and Environmental Conservation (E2).

10.2 Remediation Extent

The estimated volumes and masses of material in need of remediation from the AECs identified were summarised in a table, provided in **Table 11** below. The Consultant noted that additional materials could potentially be added following the additional investigations proposed.

Table 11 Estimated Volumes in need of Remediation from each AEC (from Table 7-1 of the RAP)

AEC / PAEC	Estimated Volume (m^3)			Bulk Density T/m^3	Estimated Mass (T)	
	Estimate	Range			Range	
		Low	High		Low	High
AEC1: Capped Waste Stockpile including potentially impacted soils beneath the stockpile	133000	105000	160000	2	210000	320000
AEC 2: Anode Waste Pile	1500	1100	2000	1.8	1980	3600
PAEC 29: Area East of Playing Fields	10000	8000	15000	0.3-1.8	2400	4500
AEC 8: Carbon Plant	1000	800	1250	1.8	1440	2250
PAEC 26: Bake Furnace Scrubber	1000	800	1250	1.8	1440	2250
AEC 4: Diesel Spray Area*	unknown	-	-	-	-	-
AEC 5: Drainage Lines	200	100	400	1.8	180	720
AEC 6: East Surge Pond	2500	2000	4000	1.8	3600	7200

* lateral delineation required

The Consultant did not anticipate that contamination would have migrated vertically, but did state that it would be tested through validation sampling. The volume and mass estimates provided were noted to be preliminary in nature, and the remediation extent was stated to be as per the Principal's, or their representatives, requirements.

Remediation of the leachate plume was stated by the Consultant to be required. No estimated volumes for this work were provided for this area, assuming the remediation use "in-situ" techniques (see below).

10.3 Remedial Options Assessment

The Consultant stated (Section 7.3) that a Remediation Option Assessment was undertaken in accordance with DECC (2006), "*Guidelines for the NSW Site Auditor Scheme*" (2nd Edition[9]). The assessment was divided into soil contamination and groundwater contamination (leachate plume). In the 2018 RAP, the Consultant outlined how the evaluation criteria from the original Remediation Options Study had been reviewed and amended in collaboration with Hydro. The following items were discussed:

- **Approval Likelihood**: The Consultant stated that this was originally based on key regulations, legislation and policies. The assessment also considered the potential need for an extended approval process due to the complex nature of the project.
- **Legacy management and Cost**: The Consultant described the two key elements as 1) the ongoing management and monitoring required, and 2) contingency for events, such as needing to repair the cell following potential pollution events. The Consultant noted that the funding for on-going management is a requirement from the Regulator (eg. A bond, trust or similar). The financial model was not complete at the time of the 2016 RAP, but the financial objectives expected by the Consultant were that the financial allocation would need to:
    - Provide sufficient funding to cover the management and monitoring costs in perpetuity;
    - Be attached to the property rather than to the property owner; and
    - Be available only for the purpose of management and monitoring activities.
- **Risk rating**: The Consultant stated that this was a qualitative evaluation of risks to the projects during the physical works. The Consultant presented a calculation methodology which considered likelihood of an event, and the environmental as well as the commercial consequences. The methodology is provided in **Appendix E** herein.
- **Sustainability Analysis**: The Consultant presented the factors that were equally weighed to obtain a sustainability score (lower score equals a more sustainable option) as follows:
    - **Ecological**: Area of native vegetation clearance.
    - **Aboriginal**: Disturbance of known Aboriginal heritage relics.
    - **Greenhouse Gas / Energy**: Potential sources assessment, i.e. vehicle movements, machinery operation including destruction facilities, vegetation clearance, and landfill gas generation.
    - **Climate Change**: Potential impacts from climate change on the method
    - **Local Community Impact**: Potential impacts on the local community from dust, noise and traffic.
    - **Community Perception**: perception or concerns in the local community about the remedial option.
    - **Ethics and Equity**: Geographical and generational displacement of the responsibilities and issues associated with the remediation option.
- **Project Timeline**: the overall project timeline was determined in this step.

[9] Note the NSWEPA's Auditor Scheme guidance is now in its 3rd Edition – see Auditor opinion for further discussion.

The Consultant stated that only the qualitative items were presented in the summary included in the 2018 RAP as the remedial and ongoing management costs were regarded as confidential information. The Remedial Options Summary is included in **Appendix F** herein.

10.4 Preferred Remedial Option

The Consultant stated that the preferred option of on-site containment was considered the most favourable in terms of all the factors outlined in **Section 10.3**. A study (Environ, 2013) was undertaken to evaluate potential locations for the cell, and the Clay Borrow Pit was considered the most suitable as it is situated more than 3 m above groundwater, is located within bedrock, and the closest surface water (ephemeral) is 200 m away.

The Consultant advised that "Best demonstrated technology available" would be selected to construct the cell, and the Consultant presented a conceptual design, included in **Appendix G** herein. The Consultant noted that the cell design would be separately reviewed by an expert group approved by NSWEPA.

Cell Design Outline:

The Consultant stated the following design concepts relating the cell construction:

> "*The cell comprises a triple base liner combining compacted clay and with high density polyethylene liners. Leachate drainage layers and leachate collection capability is included in the base liner. Materials placed within the cell are not putrescible and therefore leachate generation is expected to be minimal.*
>
> *"The cell cap comprises a double liner system comprising clay and geo-synthetic high density polyethylene liners. Gas venting, drainage layers, fauna protection and vegetation layers are included in the cap design.*
>
> *"Cap slopes are designed to promote surface water diversion and surface water runoff as well as ensure stability of the Containment Cell.*
>
> *"Detailed design of the Containment Cell will be undertaken to determine a final cap and liner system that maximises infiltration reduction. The system will be evaluated in terms of long term performance and compatibility with the leachate present.*
>
> *"The cell will be constructed to hold a volume of 415000 cum to a height of approximately 10m above ground cell over an area of approximately 6ha. The cell is designed to accommodate additional volume by increasing height*."

Plume:

For the plume, the Consultant presented a combination of leachate interception, source removal to the extent practicable and monitored natural attenuation (Option 6) as the preferred option (Refer to the Consultant's table 7-3 in **Appendix F**). Conceptual design concepts were outlined as follows:

> *"A leachate interception system, pumping leachate from the Capped Waste Stockpile to the East Surge Pond, was installed in 2014. Source removal is to be undertaken during remediation when the material in the Capped Waste Stockpile is to be relocated into the containment cell.*
>
> *"At the time of removal, the material will be drained into a sump in the Capped Waste Stockpile bund. The leachate in the sump would be treated in the water treatment plant, then discharged into the North Dam. The North Dam is irrigated through an EPL.*
>
> *"The Consultant further stated that the sump / treatment system will remain active until there are no visible signs of leachate in the upper sand aquifer, and the remaining pit would then be backfilled. The natural attenuation was described to be achieved through dispersion, diffusion and sorption. On-going monitoring will be in place to assess the impact of the remediation on the plume."*
>
> *"The sump will be clay or HDPE lined and will be at a low point in the cell to allow gravity drainage. The sump was present during the filling of the cell and will be re-excavated during excavation and re-location. The constructability review may identify the need for two sumps."*

"both visual and chemical analysis would be adopted to validate the removal of leachate from the sand aquifer. A detailed Validation Plan will be provided to the Auditor for review including the methodology of validation."

"In relation to natural attenuation of contamination in the plume, the Auditor noted in the comments on the final RAP that the Consultant identified the intent to measure the potential for site conditions to reduce the contaminant levels by natural attenuation, which the Consultant described to be achieved through a combination of dispersion, diffusion and sorption."

"Mass reduction is described by the RAP, whereby the source and entrained leachate (secondary source) is removed. Sorption is also a form of mass reduction. Natural attenuation is considered appropriate as the plume has been shown to be stable or reducing and risk assessment has shown no risks to current receptors. Monitoring is proposed both during and post remediation, to evaluate plume behaviour. Monitoring will continue until the plume is shown to be stable or decreasing."

"Alkaline groundwater conditions occur in conjunction with site contaminants of F and CN. Free CN readily binds to semi stable complexes and free and WAD CN can be include in validation sampling to assess the potential for free CN ion release under decreasing pH. Similarly further evaluation of the F complexations can be undertaken to assess behaviours under changing pH conditions. This study can also form part of the validation plan." The Auditor notes that aluminium is expected to be included in this discussion in the Validation Plan.

"The modelled concentration is 3 times greater than the guideline value of 1.5 mg/L. The concentration, whilst above the guideline, is considered to represent a low risk on the basis of: Modelling assumed not source reduction, which will not be the case; Modelling assumed no transformation of the contaminant, so attenuation occurs due to mechanical means only, and no chemical attenuation has been included which is likely to occur; Dilution at the receptor (Swamp creek) has not been considered and is likely to also occur. Monitoring at the point of receptor discharge is routinely completed as part of the surface water monitoring program required under the EPL. A contingency trigger will be included in the Validation Plan for unacceptable results at this monitoring point."

"the fate and transport model estimated a fluoride concentration of 4.3 mg/L at the receptor distance (1000 m) compared to a guideline of 1.5 mg/L. Removal of the source and leachate interception was stated to further reduce the potential fluoride concentration at the nearest receptor. This estimated concentration at the receptor is substantially higher than the criteria and the Auditor requested further justification as to why it is acceptable, and contingencies at the point of discharge to the receptor."

The Consultant concluded that:

"*This combination of remedial strategies is considered to be a suitable option, as the ENVIRON (2015) Groundwater Fate And Transport Modelling Report concluded that based on existing hydrogeological conditions and the presence of an on-going source from the Capped Waste Stockpile, the model estimated a fluoride concentration of 4.3 mg/L at the receptor distance (1000 m) compared to a guideline of 1.5 mg/L. Removal of the source and leachate interception will further reduce this potential fluoride concentration at the nearest receptor*."

10.5 Auditor's opinion

The report referred to by the Consultant in relation to the location of the proposed containment cell was also provided to the Auditor (Environ, 2013, "*Preliminary Containment Cell Study Hydro Aluminium Kurri Kurri NSW*"), and the Auditor agrees that this is a suitable location for the containment cell.

However, it is the Auditor's view that processes that lead to mass reduction are considered necessary for implementation of any natural attenuation considerations. By itself, simple dilution in a groundwater or surface water is not generally considered to be "natural attenuation", in the regulatory context, although it may be a relevant consideration in the wider risk assessment process."

The Auditor notes that further discussion is warranted in relation to the groundwater concentrations as the area becomes less alkaline, as a result of source removal. Discussions as to what are the potential impacts on bioavailability, solubility, toxicity etc with a pH change are warranted, as well as whether there may be a risk that the remediation may unintentionally result in increasing levels / mobilisation of the CoCs in groundwater.

Overall (with the clarifications provided) the information is considered to be sufficient for the purpose of the Audit and is in general accordance with NSW OEH (2011).

However, because of some data gaps that will only be addressed following demolition of some structures at the Smelter Site to enable access, this Audit has identified the following comment to the Part B2 Audit: **That a comprehensive Validation Plan for the AEC and PAEC be developed and endorsed by a Site Auditor.** (See Section 28 of this Audit Report).

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11.0 Contingency Plan

11.1 Overview

The Consultant developed a contingency plan for various potential scenarios. The plan is summarised in **Table 12**.

Table 12 Contingency Plan (from Table 7-4 of the RAP).

Scenario	Contingency Plan
Volumes of contaminated material greater than expected	The Consultant stated that the Containment Cell design allows for additional volumes up to 50% of the estimate by increasing the cell height. The materials excavated would be tracked on-site.
All foreign materials cannot be excavated due to safety or other risks	The Consultant planned to evaluate the Situation and conduct Site Specific Risk Assessment if needed, or implement a management plan if materials would be left in place.
Asbestos Containing Material (ACM) is identified	The Consultant stated that work would cease should asbestos be encountered. Controls would be implemented in accordance with NSW WorkCover the NSW Occupational Health & Safety Regulation Act (2001) and the requirements of the NSW Occupational Health and Safety Commission (NOHSC) Asbestos Code of Practice and Guidance Notes. The areas would be both visually assessed by a licenced (Class A) contractor, and samples would be collected and analysed in accordance with the validation sample methodology.
Unexpected materials (excluding ACM) encountered	The Consultant stated that the Principal's representative would be contacted should unexpected materials be encountered. The material would be sorted into separate stockpiles and options would be discussed. The Consultant further stated that a methodology is yet to be developed for the potential event that reactive materials from the Capped Waste Stockpile are encountered. The methodology needs to be approved by the NSW EPA.
Leachate treatment for the Capped Waste Stockpile is unable to remove visible signs of leachate	The Consultant stated that the concentrations would be assessed, and the fate and transport assessed for the potential impacts on the receptors. The Consultant further stated that it would be determined if the concentrations would pose a risk of harm and as such require long-term management.
On-going monitoring indicates that concentrations of fluoride and cyanide in the leachate plume are not reducing following source removal.	The Consultant stated that in such event, risks to receptors would be assessed. Remediation options would then be identified, for example interception. Potential management options mentioned were long-term restrictions on use through a management plan.

11.2 Auditor's opinion

In relation to the leachate treatment and the possibility that the treatment is unable to remove the visible signs of contamination, the Auditor asked for clarification relating to the potential that the plume would need remediation should the proposed measures fail.

It is the Auditor's opinion that the Validation Plan could include more details of contingencies beyond long term management, and that a trigger protocol could be included in the Validation Plan for appropriate contingency methods.

The Auditor further commented that the use of restriction on the groundwater use would have to be approved by the NSW EPA, which the Consultant noted in the Response Letter.

As such, the Auditor considers the Section to be adequate for the purpose of the Audit and in general accordance with NSW OEH (2011).

12.0 Remedial Works Discussion

12.1 Background

The Consultant stated that the remediation will be supervised by a suitable Remediation Contractor, supported by a suitable Environmental Representative. According to the Consultant, the Remediation Contractor needs to provide a remediation works methodology to the Principal and receive written approval for the document, which is to contain the following detail:

- "*Mobilisation and site facilities required;*
- *Methods of excavation, sorting, materials tracking and backfilling;*
- *Compaction specification for backfilled areas;*
- *Quality control procedures that demonstrate how the requirements of the RAP, including validation, will be met and documented*."

According to the Consultant, the remediation personnel will then be mobilised to Site where they will set up environmental and safety controls around each remediation AEC. The Consultant stated that these controls needed to include the following as a minimum:

- "*Locate and isolate all overhead and underground services in the proximity of the works;*
- *Assess traffic control requirements around the Project Site, cognisant of other site activities;*
- *Work area security fencing;*
- *Sediment fencing;*
- *Implement stormwater runoff and sediment controls*."

12.2 Supplementary Investigations Associated with Remedial Works

12.2.1 Background

As presented earlier, the Consultant identified some PAECs in need of assessment. According to the Consultant, it is presumed that access to the PAECs is to be achieved prior to remediation by demolition and decommissioning of the infrastructure blocking access. The PAECs and the issues needing investigation are presented in **Table 13**.

Table 13 PAECs in need of Investigation prior to Remediation

PAEC	Issues to Investigate
West Surge Pond	According to the Consultant the sediments from this PAEC are to be excavated and stockpiled. Since the sediments had elevated levels of fluoride in the Phase 2, samples will be collected and analysed for soluble fluoride (stated to be the bioavailable portion of fluoride) once the sediments have dried out. Results are to be compared to the Site-specific criterion, which was derived at 17,000 mg/kg for commercial / industrial landuse in the HRA conducted by the Consultant. Should concentrations be above the criterion, sediments will be placed in the containment cell. If below the criterion, the Consultant advised that they can be reused on Site.
Substations	The Consultant identified 16 substations and one transformer yard at the Site: Buildings 3AN, 3AS, 3BN, 3BS, 3CN, 3CS and 3CC: Pot Room Substations. Buildings 4A and 4B Substations. Building 5A/ 8A Substation. Building 8B: Rodding Building Substation. Building 26A: Substation. Building 26C: Substation. Building 29A/C: Pot Room Electrical Control Buildings and Substation. Building 65C: Butt Cleaning Station Substation. Building 78A: Pot Rebuild Substation. Transformer Yard: Includes Substations 1A, 1B and 1C. The Consultant stated that the location for the samples to be collected in these PAECs were to be based on the Hazardous Materials Audit undertaken in 2014. The Audit identified bunds, pits, tanks odours and surface staining. The CoCs associated with the PAECs were identified to be petroleum hydrocarbons, polychlorinated biphenyls (PCBs) and PAHs. The Consultant stated that results from the investigations were to be compared to the *ASC NEPM* (2013) health investigation levels and ecological investigation levels. If contamination is in excess of the adopted criteria, the material is to be placed in the containment cell.
Area East of the Clay Borrow Pit	The Consultant stated that stockpiled ENM derived from the construction of the Hunter Expressway is currently placed here. Once the material is removed, the area will be assessed for potential buried waste using test pits for the assessment.
Diesel Spray Area	According to the Consultant there are currently buildings and underground services (including an 11 kV power line) at this PAEC. Once buildings are removed and the powerline disabled, delineation of the PAH contaminated fill encountered will be undertaken.
Anode Waste Pile	Once the anodes and concrete slabs have been removed from this PAEC, delineation of the PAH contaminated fill encountered will be undertaken.

12.2.2 Auditor's opinion on proposed supplementary works

The Auditor notes that the details of the intent to analyse the sediments and the associated drained water from the sediments needs to be clarified further. The Consultant responded (in the Response Letter included in **Appendix B**) that this was to be addressed in the next stages of works.

It is the Auditor's opinion that this section was adequate for the purpose of the Audit and in general accordance with NSW OEH (2011).

The outstanding site characterisation that is planned to be addressed by these supplementary investigations is certainly warranted.

However, because of the robust and conservative nature of the proposed RAP, these outstanding characterisation issues do not adversely impact on this “Part B” Site Audit.

12.3 Demolition relating to remediation

12.3.1 Background

According to the Consultant the decommissioning and demolition of buildings will be undertaken at the same time as the remediation. Since the demolition can cause additional contamination, the Consultant included a Site walkover after the remediation / demolition is finalised.

Visual validation is proposed by the Consultant to be undertaken noting where:

- Staining is present;
- Residues are present;
- Asbestos Containing Material (ACM) fragments are present; and
- Former sumps or pits were located.

Visually contaminated material is to be placed in the containment cell. ACM was proposed to be removed through hen picking if found.

A demolition and remediation schedule has been developed for the project. Sequence of material placement within the Containment Cell is also being prepared as part of the Detailed Design works. This remediation program can be provided for the Auditor’s review.

12.3.2 Auditor’s opinion on proposed demolition

In the Auditor’s comments on the 2018 RAP, the remediation, demolition and additional investigation (including any treatment trials needed) sequencing and schedule was queried as there appears to be some inconsistency in the 2018 RAP.

A detailed schedule will be reviewed as part of the next stages of the Audit.

12.4 Survey

12.4.1 Background

The Consultant stated that each AEC will be surveyed by a registered surveyor as follows:

- Pre-remediation surface survey;
- Following excavation, but prior to backfilling of the excavations; and
- Post-remediation after backfilling, topsoiling and landscaping / hardscaping.

The Consultant explained that the survey would be part of a 3D model that could potentially be attached to the land title.

12.4.2 Auditor’s opinion on proposed Survey

The Auditor considers this section to be adequate for the purpose of the Audit.

12.5 Remedial Methodology

12.5.1 Background

The Consultant outlined the remedial methodology for soil as follows:

- "*Identify the extent of contaminated surface soils at each AEC using site plans and GPS information provided in the Phase 2 ESA reports;*
- *Excavate contaminated surface soils from each AEC;*
- *Transport contaminated soils to a stockpiled location within the Project Site or directly to the Containment Cell;*
- *Relocate contaminated soils from the stockpile location or excavation to the Containment Cell;*
- *Validate soils remaining at each AEC;*
- *Re-instate each AEC with imported VENM or ENM or with appropriate demolition materials (concrete or refractory brick) to appropriate site levels*."

The Consultant then outlined specific information for each AEC, presented in **Table 14**.

Table 14 Remedial Methodology for each AEC

AEC	Remedial Methodology
Capped Waste Stockpile (**Figure 5**, **Appendix A**)	The Consultant stated that the capping from the Capped Waste Stockpile removed and stockpiled for re-use, and provided the following structural details relating to the capping design: 150mm vegetation layer comprising imported topsoil; 450mm drainage layer comprising imported clean river sand with less than 10% fines and a permeability of not less than 1x10-3cm/sec; 900mm hydraulic barrier consisting of clay material from the Clay Borrow Pit; 150mm buffer / gas control layer comprising unbound gravel with less than 5% fines and a permeability of less than 1x10-3cm/sec. The Consultant presented an approach where capping and stockpiled material is removed in stages to reduce the time materials are exposed to potential rainfall. The Contractor is to be responsible for a removal plan, which should include the following according to the Consultant: "*Opportunistic recycling of spent pot lining. Where spent pot lining is identified to be reactive by visible emission of gas, the Contractor will segregate this material to a treatment area. Treatment will be completed following a predetermined and EPA approved methodology prior to placement within the Containment Cell;* *Segregation of any recyclable materials that can practically be recycled. The Contractor will establish a work pad for the temporary stockpiling of recyclable materials. These materials will be transported of site to a licensed recycling facility.* *There is potential for the wastes within the Capped Waste Stockpile to include ACM. In the event that ACM is identified during the removal of wastes, the asbestos management protocol… shall be followed*".
Anode Waste Pile (**Figure 6**, **Appendix A**)	The Consultant stated that the PAH contamination encountered in this area was due to ahead of schedule anodes being combined with the fill material. Concentrations of carcinogenic PAH at more than 2.5 times the criteria were found at one location at a depth of 0.3 – 0.4 m bgs. Since the contamination has not been delineated, the Consultant stated that investigation would occur prior to removal of contamination for disposal in the containment cell.
Area East of Playing Field (**Figure 11**, **Appendix A**)	The Consultant stated that waste materials buried in this location would be excavated and sorted into various material and size types. Coarser materials will be sorted into: fragments of concrete; broken / whole refractory bricks; and "other" including metal, plastic, timber and other inert materials. The Consultant argued that fine materials would be sorted by size rather than type by necessity. Al fine materials, including soils, are to be disposed of to the containment cell since one sample collected from the in the south-east corner of the paddock contained levels of carcinogenic PAH more than 2.5 times the adopted criteria. The materials will be transported for recycling, storage or directly to the containment cell. No asbestos was encountered during investigation, but the Consultant stated that an asbestos protocol was to be implemented during the remediation.
Carbon Plant (**Figure** 9, **Appendix A**)	The Consultant stated that surface soils, contaminated with PAH, will be excavated to a depth of 0.3mbgs, stockpiled and disposed of to the containment cell.

AEC	Remedial Methodology
Bake Furnace Scrubber (**Figure 10**, **Appendix A**)	The Consultant stated that surface soils, contaminated with carcinogenic PAH, will be excavated to a depth of 0.3 m bgs, stockpiled and disposed of to the containment cell. In this AEC, the surface comprised black ash / gravel, which the Consultant considered likely to be spilt Ring Furnace Reacted Alumina, containing unburnt coal tar pitch. All this material is to be removed and disposed of in the containment cell.
Diesel Spray Area (**Figure 7**, **Appendix A**)	The Consultant stated that PAH impacted material was present at a depth of 0.4 – 0.6 m bgs in fill. Prior to removal and disposal in the containment cell, the lateral extent will be delineated.
Drainage Lines (**Figure 8**, **Appendix A**)	The Consultant stated that the PAH contaminated sediments in the drainage lines will be removed and stockpiled. They will be dewatered and the water will be drained into stormwater system on-site. Sediments will then be placed into the containment cell.
East Surge Pond (**Figure 8**, **Appendix A**)	The Consultant stated that the PAH contaminated sediments in this AEC will be scraped to 0.2 m and stockpiled. They will be dewatered and the water will be drained into stormwater system on-site. Sediments will then be placed into the containment cell.

12.5.2 Auditor's opinion on Remedial Methodology

The Auditor notes that the figure references in this section were incorrect. However, the correct references were added in **Table 14** above.

The Auditor further notes that the Consultant needs to confirm if the water from the sediment dewatering process is of adequate quality for discharge into the on-site stormwater system prior to discharge. Details relating to this are expected in the Validation plan. This omission is not considered to adversely impact on findings of this Part B Site Audit.

Overall, the Auditor considers this section adequate for the purpose of the Audit and in general accordance with NSW OEH (2011).

12.6 Material Tracking

12.6.1 Background

According to the Consultant, all materials are to be tracked from the AEC to the stockpiles. The Consultant stated that the Contractor is responsible for:

- "*Logging of material destinations from each AEC to its stockpile location;*
- *Tracking of each stockpile in the stockpile area;*
- *Provide a weekly Materials Tracking Report;*
- *If any material is taken off-site to landfill, all waste facility tipping dockets will be retained on file by the Contractor's Environmental Representative and be correlated to the truck logging sheets in a weekly Materials Tracking Report*."

12.6.2 Auditor's opinion on Material Tracking

It is the Auditor's opinion that this section is sufficient for the purpose of the Audit. However, details relating to the material tracking process must be provided to the Auditor prior to remediation. The Consultant confirmed that detail would be included in the Validation Plan (see the 2016 Response Letter in **Appendix B**).

This omission is not considered to adversely impact on findings of this Part B Site Audit.

12.7 Reinstatement

12.7.1 Background

The Consultant stated that backfilling was not anticipated to be needed. Instead, the surfaces at the remediated AECs will be reshaped with the aim to achieve:

- "*A final landform that is consistent with the surrounding topography without steep slopes or abrupt changes in shape;*
- *The levels and grades of the finished landform shall be such that it encourages the shedding of incident stormwater but at grades that will not result in erosion;*
- *The finished landform shall comprise a surface layer that is acceptable to the Principal.*"

Further, the Consultant stated that if infilling was needed, inert material from the Site validated as appropriate for the purpose, would be used. Topsoil would then be used to avoid aesthetical issues.

12.7.2 Auditor's opinion on proposed Reinstatement

The Auditor considers this section to be adequate for the purpose of the Audit.

12.8 Remediation of Secondary Source ("Leachate Plume") – Groundwater at the Capped Waste Stockpile

12.8.1 Background

The Consultant stated that the remedial method for the leachate plume associated with the Capped Waste Stockpile was:

- *"Set up water treatment plant at the Capped Waste Stockpile;*
- *Construct a sump following the removal of the capping layers of the Capped Waste Stockpile;*
- *Drain leachate into the sump and pump to the water treatment plant during removal of stockpiled wastes from the Capped Waste Stockpile;*
- *Once all wastes and contaminated soil are removed from the Capped Waste Stockpile, maintain the sump or inject spear points into footprint of the Capped Waste Stockpile and continue to remove leachate for treatment;*
- *Once the bulk of the leachate from beneath the Capped Waste Stockpile has been removed for treatment and disposal via on-site irrigation, decommission the water treatment plant;*
- *Continue quarterly on-going monitoring of groundwater wells down-gradient of the Capped Waste Stockpile in accordance with the EPL;*
- *Following 2 years of quarterly monitoring, complete trend analysis to evaluate plume stability and determine if source removal of stockpiled wastes and secondary removal of leachate has resulted in lowering of fluoride and cyanide concentrations immediately down-gradient of the Capped Waste Stockpile."*

12.8.2 Auditor's opinion

It is the Auditor's opinion that this section is sufficient for the purpose of the Audit and in general accordance with NSW OEH (2011).

However, to address any potential for long-term adverse human health or environmental impacts arising from the "secondary source" once the "Primary Source" has been removed, a supplementary human health and environmental risk assessment has been required as a comment of this Part B2 Audit (see **Section 28** of this Audit Report).

13.0 Validation Planning

13.1 Background

The Consultant stated that the Site validation had two components:

1. Validation that contamination has been adequately removed from the source zones; and
2. Validation that the cell is constructed in accordance with the design, and that materials have been appropriately placed.

The validation requirements for the cell are to be established in a separate document by the contractor employed to build the cell. The Consultant stated that the Site Auditor is to review the validation specifications and the validation for a "landuse suitability" (Part A) Site Audit Statement for the Cell.

The Validation requirements for component 1 were outlined in the RAP by the Consultant. The validation was reported to include validation sampling of the identified AECs and PAECs, as well a broader validation on a grid over the entire Site following completion of demolition and contamination removal. This validation is reported to include areas in between the AECs and PAECs.

13.2 Auditor's opinion

The Auditor notes that there is uncertainty remaining relating to the areas yet to be investigated, and that the potential additional volumes of material for remediation / disposal in the containment cell will need to be updated following the investigations.

The requirement for a comprehensive validation plan for auditor review and Auditor acceptance is a comment to the Site Audit Report (see Section 28 of this Audit Report).

13.3 Validation Data Quality Objectives

The Consultant stated (Section 9.3 and 9.6) that the Data Quality Objective (DQO) process was followed in accordance with DEC, 2006, "*Guidelines for the NSW Site Auditor Scheme*" (3rd Edition)[10]. The DQOs are summarised in **Table 15**.

[10] As noted earlier, the NSWEPA's Auditor guidance was revised in 2017. However, the DQO components appear to use of superceded guidance. This use of the second edition guidelines by the Consultant is not considered to adversely impact on the findings of this Part B Site Audit.

Table 15 Validation Data Quality Objectives

Step	Consultant's Plan
Step 1: State the Problem	The Consultant stated that the former Smelter Site is to be redeveloped for commercial / industrial / ecological landuse and that investigations has identified AECs requiring remediation to make the Site suitable for the propose landuse. Following remediation and demolition of buildings and infrastructure, validation is needed to ensure the identified risks to human health and the environment are remediated adequately for the proposed landuse.
Step 2: Identify the Decisions	The Consultant stated that the validation SAQP is to ensure all CoC for the AECs have been identified, and that the contamination has been successfully removed. The Consultant outlined criteria to be met for the remediation to be deemed successful as follows: "*All contaminated soils have been excavated from each AEC and relocated to the Containment Cell;* *Validation sampling at each AEC has found that concentrations in soil for all contaminants of concern are below remediation acceptance criteria;* *Validation sampling has found that the 95%UCL avg of the mean concentrations for all COCs in soil is below the remediation acceptance criteria and no analyte concentration is in excess of 250% of the remediation acceptance criteria or where the above criteria cannot be achieved due to site or project constraints, such as practical or economical limits, a risk based assessment of the contaminant may be required;* *Groundwater (leachate) at the capped waste stockpile has been extracted and treated and monitoring of the down gradient well network indicates that concentrations of fluoride and cyanide in the leachate; and* *Excavations have been reinstated with suitable materials to an accepted landform*."
Step 3: Identify Inputs to the Decision	The Consultant outlined inputs into the decision making process as follows: A comprehensive soil evaluation program following remediation. Material tracking documentation that demonstrates all materials have been appropriately relocated. Survey to demonstrate landforms have been reinstated in accordance with the objectives.
Step 4: Define the Study Boundary	The Consultant referred to Figure 2 for Site boundaries, and Figure 3 for the study boundaries. Figure 12 provides an overview of AECs and PAECs, while individual AECs are shown in Figures 5 – 11 (**Appendix A**), as well as definitions included in **Table 2**. The Consultant

Step	Consultant's Plan
	further stated that there are no temporal boundaries for this project.
Step 5: Development of Decision Rules	The Consultant listed the following decision rules: "*If the results of the analytical data quality control assessment are acceptable, then the data will be deemed suitable for the purpose of the project. In this regard, data will be assessed against completeness, comparability, representativeness, precision and accuracy; and* *If the reported assessment and validation results are below relevant assessment thresholds provided within applicable regulatory guidelines, then the site soils will be considered suitable for the proposed land use.* *If visual observations indicate that all anthropogenic materials have been removed from the footprint of the Capped Waste Stockpile, then source removal will be considered to have been achieved for the leachate plume in groundwater.* *If quarterly monitoring of the leachate plume indicates that the concentrations of fluoride and cyanide are stable or reducing within 2 years then groundwater an evaluation of the groundwater monitoring program will be undertaken.* *Monitoring of the leachate impacted groundwater is currently undertaken under EPL and consultation and reporting to the EPA will be required.* *If the site surveys of each AEC are conducted by an appropriately qualified surveyor, then the survey will be deemed suitable for the purposes of the project."*
Step 6: Specific Limits of Decision Error	The Consultant outlined the PARCC parameters (Precision, accuracy, representativeness, completeness and Comparability) as Data Quality Indicators (DQIs) in this step. A summary of the Consultant's DQIs are presented in **Table 16**. The Consultant also discussed rectifying non-conformances in this step. Non-conformances are to be assessed based on their significance by the Contractor's Environmental Consultant, who will discuss their proposed rectification with the Site Auditor. A Decision Error Protocol was also discussed by the Consultant in this step, as follows: *"If the data received is not in accordance with the defined acceptable limits outlined in Steps 5 and 6, it may be considered to be an estimate or be rejected. Determination of whether this data may be used or if re-sampling is required will be based on the following considerations:* *Closeness of the result to the guideline concentrations.* *Specific contaminant of concern (e.g. response to carcinogens may be more conservative).*

Step	Consultant's Plan
	The area of site and the potential lateral and vertical extent of questionable information. Whether the uncertainty can be effectively incorporated into site management controls."
Step 7: Optimise the Design for Obtaining Data – Soil Validation	The Consultant stated that the validation samples were to be collected in accordance with the DQOs and methodology outlined in the RAP. The objective of the sampling pattern was to demonstrate that sample density is suitable for the proposed commercial / industrial landuse. The Consultant referred to later Sections describing locations, analytes and justifications.

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Table 16 Validation Data Quality Indicators

Parameter	Definition	How Consultant will Address the Parameter	Criteria
Accuracy:	The Consultant defined accuracy as the nearness of a result to the true value, where all random errors have been statistically removed.	The Consultant stated that internal accuracy will be measured using percent recovery (%R) and external accuracy will be measured using the Relative Percent Difference (%RPD). internal accuracy would be addressed by the following: "*Surrogates: Surrogates are QC monitoring spikes, which are added to all field and QA/QC samples at the beginning of the sample extraction process in the laboratory, where applicable. Surrogates are closely related to the organic target analytes being measured, are to be spiked at similar concentrations, and are not normally found in the natural environment;* *Laboratory control samples: An externally prepared and supplied reference material containing representative analytes under investigation. These will be undertaken at a frequency of one per analytical batch;* *Matrix spikes: Field samples which are injected with a known concentration of contaminant and then tested to determine the potential for adsorption onto the matrix. These will be undertaken at a frequency of 5%."* The Consultant further stated that the external accuracy would be determined by the submission of interlaboratory duplicates at a frequency of 5%.	The Consultant stated that the data would be categorised into one of the following for internal accuracy: - *"70%-130%R confirming acceptable data, note that there are some larger %R for intractable substances;* - *69%-20%R indicates discussion required. May be considered acceptable data, or may be regarded with uncertainty;* - *10-19 %R indicating that the data should be treated as an estimate result;* - *<10 %R indicating that the data should be rejected."* For external accuracy, the Consultant stated that the following limits apply: - *"60% RPD at concentration levels greater than ten times the PQL.* - *85% RPD at concentrations between five to ten times the PQL.* - *100% RPD at concentration levels between two and five times the PQL.* *Where concentration levels are less than two times the PQL, the Absolute Difference (AD) shall be calculated. Data will be considered acceptable if the AD <2.5 times the PQL.* *Any data which does not conform to these acceptance criteria will be examined for determination of suitability for the purpose of site characterisation."*
Precision	The Consultant defined precision as the degree to which data generated from replicate or repetitive measurements differ from one another due to random errors.	The Consultant stated that precision is measured using the standard deviation 'SD' or Relative Percent Difference '%RPD'. The Consultant defined the method for addressing internal precision as the analysis of laboratory duplicates, i.e. where the laboratory analyses two sub-samples form a primary sample collected. Laboratory duplicates will be analysed at a frequency of 10% for internal precision. For measurement of external precision, the Consultant stated that intra-laboratory duplicates would be submitted at a frequency of 5% of the primary samples. The samples will be obtained by mixing and splitting the primary sample into two subsamples. The Consultant also highlighted the need for labelling the duplicate in a way that does not reveal its association with the primary sample to the laboratory. Blank samples will also be submitted to measure precision at a rate of one per matrix type / batch / day. Method blanks will be analysed by the laboratory at a rate of at least one per batch.	The Consultant presented the following limits for internal precision: - *"50% RPD at concentration levels greater than ten times the PQL.* - *75% RPD at concentrations between five to ten times the PQL.* - *100% RPD at concentration levels between two and five times the PQL.* *Where concentration levels are less than two times the PQL, the Absolute Difference (AD) shall be calculated. Data will be considered acceptable if the: AD <2.5 times the PQL.* *Any data which does not conform to these acceptance criteria will be examined for determination of suitability for the purpose of site characterisation."* For external precision, the Consultant outlined the following limits: - *"50% RPD at concentration levels greater than ten times the PQL.* - *75% RPD at concentrations between five to ten times the PQL.* - *100% RPD at concentration levels between two and five times the PQL.* *Where concentration levels are less than two times the PQL, the Absolute Difference (AD) shall be calculated. Data will be considered acceptable if the: AD <2.5 times the PQL.* *Any data which does not conform to these acceptance criteria will be examined for determination of suitability for the purpose of site characterisation."* The Consultant did not specify any limits for blank samples. For the laboratory method blanks, the following was stated: *"Laboratory method blank analyses are to be below the PQLs. Results shall be examined and any positive results shall be examined. Positive blank results may not be subtracted from sample results.* *Positive results may be acceptable if sample analyte concentrations are*

Parameter	Definition	How Consultant will Address the Parameter	Criteria
			significantly greater than the amount reported in the blank (ten times for laboratory reagents such as methylene chloride, chloroform, and acetone etc., and five times for all other analytes). Alternatively, the laboratory PQL may be raised to accommodate blank anomalies provided that regulatory guidelines are not compromised by any adjustment made to the PQL."
Representativeness	The Consultant did not present a definition of representativeness.	The Consultant stated that a sufficient number of samples must be collected to be representative of each stratum assessed, and that the samples must be appropriately collected and preserved in accordance with the methodology outlined in the RAP.	The Consultant stated that the number of samples for soil will be calculated using Procedure B, NSW EPA, 1995, "*Sampling Design Guidelines*"
Comparability	The Consultant did not define comparability.	The Consultant stated that the data "*…must show little to no inconsistencies with results and field observations*."	The Consultant stated that the data needed to include likely associates such as TPH C_6-C_9 and BTEX.
Completeness	The Consultant did not define completeness.	The Consultant stated that the completeness of the data set will be judged as the percentage of data retrieved from the field compared to the proposed scope of works.	The Consultant stated that the acceptable completeness is 95%, and is based on the data deemed acceptable based on the other DQIs. The Consultant further stated that: "*Where two or more data quality objectives indicate less reliability than what the acceptance criteria dictates, the data will be considered with uncertainty.*"

13.4 Auditor's opinion on DQO's and DQI's

The Consultant agreed that further detail would be provided in the Validation Plan including determination of the final contaminants of concern and justification of the sampling density.

In the Validation Plan provided for the Auditor's review, the DQI Section would also be more detailed and targeted to the program.

The Auditor considers the section adequate for the purpose of the Part B Audit with the note that further details are to be provided in the Validation Plan (See Section 28 of this Audit Report).

13.5 Validation Sampling Specifics

The Consultant presented the specifics for the validation sampling program in tables, summarised below in **Table 17**.

Table 17 Validation of Remediation

Validation Method	Validation Requirement	Chemical Analysis
Capped Waste Stockpile		
Visual Validation – Soil	The Consultant stated that visual inspection will be undertaken to confirm removal of all waste materials in the Capped Waste Stockpile. A photographic log is to be included in the Validation Report.	NA
Chemical Validation - Soil	The Consultant defined the validation sampling program for the remaining pit as follows: The excavation base is to be sampled on a 30 m grid, which was stated to be in accordance with the NSW EPA, 1995, "*Sampling Design Guidelines*". The walls of the excavation will be sampled for each soil type per 10 lineal metres.	Fluoride, cyanide, PAHs, TRH, BTEX, Heavy Metals, Asbestos (if encountered during excavation works)
Chemical Validation – Capping Material	The Consultant stated that samples will be collected at a rate of 1 sample per 1000 m^3 to assess the reuse suitability of the material. The sampling frequency was based on the Consultant considering the likelihood of contamination low in the clay material. Statistics will be used to assess if the sampling density is sufficient.	Fluoride, cyanide, PAHs, TRH, BTEX, Heavy Metals, Asbestos (if encountered during excavation works)
Visual validation – Leachate impacted groundwater	The Consultant stated that the impacted leachate is identifiable by brown staining. Leachate is to be removed from the remaining pit until impacted leachate is no longer visible.	NA
Chemical validation – leachate impacted groundwater	The Consultant stated that the groundwater wells included in the EPL will be monitored quarterly for two years initially to assess if the source removal has achieved its objectives. If the remediation goal had not been met after the two years, the Consultant referred to the contingency plan outlined in **Table 12**.	Fluoride, cyanide, aluminium, pH
Area East of Playing Fields		
Visual Validation	The Consultant stated that the validation of this AEC would be visual only to ensure all waste material is removed. A photographic log is to be included in the Validation Report.	NA
Anode Waste Pile, Carbon Plant, Diesel Spray Area, Bake Furnace Scrubber, East Surge Pond, Area East of Playing Fields		
Chemical Validation	The Consultant defined the validation sampling program for the AECs as follows:	PAH

Validation Method	Validation Requirement	Chemical Analysis
	The excavation base is to be sampled on a 30 m grid, which was stated to be in accordance with the NSW EPA, 1995, "*Sampling Design Guidelines*". The walls of the excavation will be sampled for each soil type per 10 lineal metres. The Consultant concluded that the sampling density is adequate to confirm the absence of a contaminated hot spot greater than 5 m in diameter.	
Demolition Areas		
Not Identified by the Consultant	The Consultant stated that demolition may cause impacts due to dust deposition, or subsurface sump / tank removal.	CoCs to be identified based on the source.
Stockpile Areas		
Visual Assessment and Chemical Analysis	Once stockpiled material are removed to a disposal location, the area under is to be visually assessed and sampled for chemical analysis. The area is to be sampled on a 30 m grid, which was stated to be in accordance with the NSW EPA, 1995, "*Sampling Design Guidelines*".	CoCs to be identified based on the material stockpiled in the area.
Entire Site		
Chemical Validation and Visual Assessment	Following the remediation and demolition activities, the entire Site is to be samples on a grid system. Sampling density was stated to be dependent on material homogeneity, but initially is intended to be on a 30 m grid, and where walls are present (deeper than 0.2 m), one sample per soil type and 10 linear metre. Visual assessment of materials will be undertaken to assess the variability and the density will increase should the material variability justify it. The Consultant stated that the final densities and justifications were to be outlined in the Validation Report. Sampling is to be undertaken with disposable gloves, using steel trowels or grab samples. Decontamination between samples will be undertaken using Decon 90 / Xtran and potable water.	PAH

13.6 Contingencies for Validation Sampling

The Consultant included a list of contingencies for the validation sampling as follows:

- *"In the event that visually impacted (including ACM) or odorous soils are excavated as part of the remedial works, validation sampling of the base of the excavation in the vicinity of the visually impacted or odorous soils will be completed;*
- *The analytical suite for the validation samples will vary and will depend on the visual impact or odour. Soils impacted with an oily sheen or hydrocarbon odour will result in validation sampling for hydrocarbons. Discoloured soils will result in validation sampling for a suite of analytes, including heavy metals, fluoride and cyanide. Material with ACM fragments will result in validation sampling for asbestos (as well as the implementation of the Asbestos Management Protocol in Section 14.1* [of the 2018 RAP]*).*
- *In the event that ACM fragments are identified during the excavation works, an asbestos clearance certificate will be required by a suitably qualified and experienced person at the completion of the remedial works.*
- *Discrete sampling will be undertaken by collecting surface soil using a steel trowel or collection directly from the soil surface by hand. Discrete samples will be spaced in a 30 m grid formation across the area to ensure that an even coverage of the site is achieved.*
- *Decontamination of sampling equipment will be undertaken before sampling and between samples by cleaning with "Decon 90/Xtran" and potable water.*
- *Disposable gloves will be worn for all sample collection.*
- *Where walls of excavations are present and are not proposed to be excavated and are deeper than 0.2 m, discrete sampling will be undertaken from each soil type present every 10 lineal metres.*
- *Where walls of excavations are present and are not proposed to be excavated and are deeper than 0.2 m, discrete sampling will be undertaken from each soil type present every 10 lineal metres.*
- *All samples will be given a unique identifier and marked on a plan."*

13.7 Auditor's opinion on Validation Plan

As defined above, the Consultant agreed that further detail would be provided in the Validation Plan relating to how, statistically, it would be demonstrated that the sampling density is suitable for the proposed landuse as presented in Table 17. The intent to sample the Site on a 30 m grid was also queried, and the Consultant responded (Response Letter included in Appendix B) that the final sampling methodology would be confirmed in the Validation Plan. The list of CoCs also needs to be justified and more detailed in the Validation Plan.

In the comments on the 2018 RAP, the Auditor noted that the low frequency of samples for the capping material needed to be further justified. The Consultant agreed and stated that the sampling frequency would be higher initially, and a detailed plan will be included in the Validation Plan.

With the clarification provided, the Auditor considers the section adequate for the purpose of the Audit.

The Auditor notes that the contingencies identified were sampling methodologies rather than contingencies. The Consultant responded (Response Letter included in **Appendix B**) that this would be corrected in the Validation Plan. As such, the Auditor considers this section to be sufficient for the purpose of the Audit.

However, because of some data gaps that will only be addressed following demolition of some structures at the Smelter Site to enable access, this Audit has identified the following comment to the Part B2 Audit: **that a comprehensive Validation Plan be submitted for Auditor endorsement** (see **Section 28** of this Audit Report).

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14.0 Site-Specific Assessment and Validation Criteria

14.1 Imported Fill

The Consultant stated that any material brought onto the Site needs to be VENM or ENM. Source history and laboratory results need to be obtained, and the material source needs to be visually assessed. VENM is to have a VENM certificate, and the ENM criteria need to be met in accordance with the Protection of the Environment Operations (Waste) Regulation 2005, General Exemption under Part 6, Clause 51 and 51A, the Excavated Natural Material Exemption 2012.

Auditor's opinion

The Auditor considers this section to be adequate for the purpose of the Audit.

14.2 Adopted Soil Criteria

The Consultant stated that the CoCs included in the validation were those identified above the adopted guidelines in previous investigations, which were stated to be PAH. For the Capped Waste Stockpile where investigations have not yet been undertaken, the CoCs were considered to be fluoride and cyanide. The Consultant also stated that other potential CoCs were PAHs, TRH, BTEX, heavy metals and asbestos.

The Consultant stated that the adopted guidelines for the validation are from *ASC NEPM* (2013) as follows:

- *"HIL D – Health investigation level for commercial / industrial such as shops, offices, factories and industrial sites. The HILs are applicable for assessing human health risk via all relevant pathways of exposure. The HILs are generic to all soil types and apply generally to a depth of 3 m below the surface for industrial use.*
- *EIL for commercial/ industrial use – ecological investigations levels applicable for assessing risk to terrestrial ecosystems. EILs depend on specific soil physicochemical properties and generally apply to the top 2 m of soil.*
- *ESLs for commercial/ industrial use – ecological screening levels developed for selected petroleum hydrocarbon compounds and fractions and are applicable for assessing risk to terrestrial ecosystems. These are also generally applicable to the top 2 m of soil."*

The Consultant also identified that HILs were not present for aluminium and fluoride in soil, and that a HRA was undertaken to derive Site specific values, which were adopted as remediation criteria.

The Consultant stated that the adopted guidelines would be used in accordance with *ASC NEPM* (2013) by first comparing individual concentrations against the adopted criteria. If the concentrations exceed the criteria, then the 95% upper confidence limit (UCL) will be compared to the criteria, noting that the standard deviation of the results needs to be less than 50% of the criteria, and no single value exceeds 250% of the criteria.

The criteria tables provided in the RAP are replicated in **Table 18** to **Table 20**.

Table 18 Adopted Soil HILs and EILs (from Table 9-4 in the RAP)

Analyte	HIL D (mg/kg)	EIL (mg/kg)
Aluminium	NL (site-specific)[3]	-
Arsenic	3000	160
Cadmium	900	-
Chromium (VI)	3600	-
Chromium (III)	-	320 (1% clay)
Copper	240 000	210[1]
Lead	1500	1800
Nickel	6000	140[1]
Zinc	400 000	440[1]
Mercury (inorganic)	730	-
Fluoride	17,000 (site-specific)[2]	-
Cyanide (free)	1500	-
Carcinogenic PAHs (as BaP TEQ)	40	-
Total PAHs	4000	-
Naphthalene	-	370

1 EILs were calculated using the average CEC (7.26 meq/100g), soil pH (5.5) and total organic carbon (1.3%) values from eight soil samples collected in the Buffer Zone during the March 2014 investigations. The NEPM (2013) EIL calculator spreadsheet was used to generate the numbers and a site-specific ambient background concentration (ABC) was not included (rather a default ABC was used as calculated in the EIL calculator).

2 Site-specific industrial fluoride value calculated in the Preliminary Screening Level Health Risk Assessment for Fluoride and Aluminium (ENVIRON 2013)

NL: indicates that the site-specific risk-based aluminium screening criteria for industrial soil is a concentration greater than physically possible in soil, and therefore the criteria is defined as 'Non-Limiting' or NL (ENVIRON 2013).

Table 19 Adopted Criteria for Vapour Intrusion from Soil (from Table 9-5 of the RAP)

Analyte	Sand, mg/kg			
	0 to <1 m	1 to <2 m	2 to <4 m	4m+
Toluene	NL	NL	NL	NL
Ethylbenzene	NL	NL	NL	NL
Xylenes	230	NL	NL	NL
Naphthalene	NL	NL	NL	NL
Benzene	3	3	3	3
F1(4)	260	370	630	NL
F2(5)	NL	NL	NL	NL

1 The soil saturation concentration (Csat) is defined as the soil concentration at which the porewater phase cannot dissolve any more of an individual chemical. The soil vapour that is in equilibrium with the porewater will be at its maximum. If the derived soil HSL exceeds Csat, a soil vapour source concentration for a petroleum mixture could not exceed a level that would result in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limiting' or 'NL'.

2 (For soil texture classification undertaken in accord with AS 1726, the classifications of sand, silt and clay may be applied as coarse, fine with liquid limit <50% and fine with liquid limit >50% respectively, as the underlying properties to develop the HSLs may reasonably be selected to be similar. Where there is uncertainty, either a conservative approach may be adopted or laboratory analysis should be carried out.

3 To obtain F1 subtract the sum of BTEX concentrations from the C_6-C_{10} fraction.

4 To obtain F2 subtract naphthalene from the >C_{10}-C_{16} fraction.

Table 20 Adopted ESLs and Management Limits for Hydrocarbons in Soil (from Table 9-5 of the RAP)

TRH Fraction	Soil Structure	ESL (mg/kg dry soil) Commercial / Industrial	Management Limits[1] (mg/kg dry soil) Commercial / Industrial
F1 C6- C10	Fine	215*	800
F2 >C10-C16	Fine	170*	1000
F3 >C16-C34	Fine	2500	5000
F4 >C34-C40	Fine	6600	10 000
Benzene	Fine	95	-
Toluene	Fine	135	-
Ethylbenzene	Fine	185	-
Xylenes	Fine	95	-
Benzo(a)pyrene	Fine	72[5]	-

1 Management limits are applied after consideration of relevant ESLs and HSLs.

2 Separate management limits for BTEX and naphthalene are not available hence these should not be subtracted from the relevant fractions to obtain F1 and F2.

3 ESLs are of low reliability except where indicated by * which indicates that the ESL is of moderate reliability.

4 To obtain F1, subtract the sum of BTEX from C6-C10 fraction.

5 Benzo(a)pyrene ESL criteria from Canadian Council of Ministries of the Environment (2010) Canadian Soil Quality Guidelines Carcinogenic and Other Polycyclic Aromatic Hydrocarbons (PAHs) (Environmental and Human Health Effects) Scientific Criteria Document (revised).

The Consultant added to the information in the adopted B(a)P ESL by stating that the *ASC NEPM* (2013) value was based on the previous Environment Canada value that has been updated since the NEPM Value was adopted. Hence, the Consultant adopted the updated value rather than the *ASC NEPM* (2013) criterion.

14.3 Auditor's opinion on soil criteria

Generally, the Auditor considers the section adequate for the purpose of the Audit and in general accordance with NSW OEH (2011).

However, because of some uncertainties identified by the Site Auditor in review of the 2018 RAP, this Audit has identified the following comment to the Part B2 Audit: **that a comprehensive Validation Plan is submitted for Auditor endorsement** (see **Section 28** of this Audit Report).

15.0 Adopted Water Criteria

15.1 Background

The Consultant stated that the CoCs for groundwater were those found in groundwater at the Capped Waste Stockpile, i.e. cyanide, fluoride, sodium and elevated pH.

The Consultant referred to the following guidelines for the assessment of groundwater:

- NSW DEC, 2007, "*Guidelines for the Assessment and Management of Groundwater Contamination*";
- ANZECC & ARMCANZ, 2000, "*Australian and New Zealand Guidelines for Fresh and Marine Water Quality*"; and
- ENVIRON, 2013, "*Tier 2 Ecological Risk Assessment, Kurri Kurri Aluminium Smelter*".

The Consultant identified potential groundwater and surface water receptors and their potential beneficial uses.

The closest surface water receptor was a dam and then Swamp Creek. This drainage area discharges into Wentworth Swamp, which in turn discharges to the Hunter River. For swamp Creek, the Consultant identified potential beneficial uses as freshwater ecosystems, recreational fishing and possible stock watering and / or irrigation. It was noted that drinking water was not considered as it is supplied from Chichester Dam, and also because the Kurri Waste Water Treatment Works has a discharge point into Swamp Creek.

Groundwater is expected by the Consultant to flow north-east. Apart from the bores associated with the Capped Waste Stockpile there were no licenced bores found by the Consultant during a search of the Office of Industry and Investment data bases. The Consultant described the shallow estuarine aquifer under the Site as ephemeral with low yield, and concluded that it is therefore not viable as a drinking water source or for stock watering and / or irrigation.

The Consultant stated that since there were no beneficial uses identified for the groundwater aquifer, there will be no criteria adopted, but rather a monitoring program which should show that levels are stable or reducing for fluoride, cyanide and pH to meet the remediation goals.

Based on the beneficial uses of surface water, the Consultant adopted guidelines for protection of aquatic ecosystems, irrigation, stock watering and recreational use from ANZECC (2000). The Consultant noted that ANZECC (2000) provided trigger values above which further action is needed such as further site-specific investigations to assess potential contamination or management and remedial actions.

Various levels of species protection is associated with the aquatic toxicity guidelines, and the Consultant adopted the 95% species protection level based on information from the Hunter Catchment Management Trust regarding the anthropogenic impacts in the catchment.

The Consultant presented the adopted surface water guidelines in a table, replicated in **Table 21**.

Table 21 Adopted Surface Water Criteria (from Table 9-7 of the RAP)

Contaminant	95% Species Protection Trigger Level for aquatic Freshwater Ecosystems	Irrigation	Stock Watering	Recreational
Aluminium	0.055	5	5	9
Fluoride	No guideline	1	2	1.5
Free Cyanide	0.007	No guideline	No guideline	0.1
pH	6.5 - 8*	No guideline	No guideline	5 - 9
Electrical conductivity (µS/cm)	No guideline	4500 - 7700** >12,200***	No guideline	No guideline

* Values for lowland rivers from Table 3.3.2 in ANZECC (2000)

** Values for tolerant crops from Table 4.2.4 in ANZECC (2000)

*** Value from Table 4.2.4 in ANZECC (2000) for where electrical conductivity is 'generally too saline' for plant growth

15.2 Auditor's opinion on water criteria

It is the Auditor's opinion that the criteria for groundwater will need to be justified and addressed through the further stages of works, including the Risk Assessments. Further, aluminium should be included in the analytical schedule, and the risk assessment process. The Consultant agreed that this would be addressed with a sampling and assessment plan included in the Validation Plan (see the Response Letter included in **Appendix B**). As such, the Auditor considers this section is generally adequate for the purpose of the Audit.

However, because of some uncertainties identified by the Site Auditor in review of the 2018 RAP, this Audit has identified the following comment to the Part B2 Audit: **that a comprehensive Validation Plan is submitted for Auditor endorsement** (see **Section 28** of this Audit Report).

16.0 Validation Reporting

16.1 Background

The Consultant stated (Section 9.6) that a Validation Report is to be compiled following the remediation and validation in accordance with NSW OEH, 2011, "*Guidelines for Consultants Reporting on Contaminated Sites*" and DEC, 2006, "*Guidelines for the NSW Site Auditor Scheme*" 3rd Edition[11]. The Validation Report was specified to have the following included:

- *"Executive summary;*
- *Scope of work;*
- *Site Description;*
- *Summary of site history and previous investigations;*
- *Additional investigations completed at PAECs and AECs with access restrictions;*
- *Description of observations recorded following demolition of buildings, in relation to areas of staining, residues, pits and sumps and ACM fragments;*
- *Remediation activities undertaken, including the extent of the excavation works at each AEC (survey information) and observations made during excavation works;*
- *Supporting factual evidence of the remediation work including photographic and field records and materials tracking data;*
- *Validation sampling and analysis results for each AEC;*
- *Information relating to the water treatment plant at the Capped Waste Stockpile, including volume of leachate extracted and treated, concentrations of the main contaminants following treatment and the volume of treated water disposed of via on-site irrigation;*
- *Quarterly monitoring results for those wells required to be monitored under the EPL for a minimum of 2 years;*
- *Quality assurance/ quality control (QA/QC) protocols for field work and laboratory analysis;*
- *Health Risk Assessment for fluoride in groundwater for maintenance and construction employees at the Smelter site;*
- *A statement indicating the suitability of the Project Site for the proposed landuse."*

16.2 Auditor's opinion on Validation Reporting

In the final comments on the RAP, the Auditor commented on this section and requested that an updated schedule be provided in the Validation Plan including consideration of sequencing of works, and inclusion of pilot trials for treatments if needed.

As such, the Auditor considers the information provided sufficient for the purpose of the Audit, noting that a final Validation Report will be submitted separately for Auditor approval (see **Section 28** of this Audit Report).

[11] As noted in previous sections of this SAR, the Consultant's use of the superceded Site Auditor Scheme guidance is not considered to adversely impact on the findings of this Part B Audit.

17.0 Construction Environmental Management Plan

17.1 Background

The Consultant stated that a Construction Environmental Management Plan (CEMP) is needed for the remediation phase, and referred to NSW Department of Infrastructure, Planning and Natural Resources, 2004 "*Guideline for the Preparation of Environmental Management Plans*". The Consultant then outlined the items to include in the EMP as follows:

- **Site Access**: The Consultant stated that the Contractor is to control Site access, which is to be through established access roads, and must ensure there is signage at the gates to identifying the nature of the works, the Contractor's and the Project Manager's contact details. All workers must be inducted to the environmental and health and safety controls implemented. Any visitors must be accompanied with an inducted person. Any additional access tracks needed must be approved by the Principal's Representative.
- Hours of Operation: The following standard hours of operation were presented for any work that could create audible noise at the closest residential receptor:
  - 7.00 am to 6.00 pm Monday to Friday;
  - 7.00 am to 1:00 pm on Saturdays; and
  - At no time on Sundays or public holidays.
- **Dust Control**: The Consultant stated that the CEMP will include the following dust controls:
  - Covering all loads entering or exiting the site.
  - Use of water carts on unsealed surfaces.
  - Use of water sprays on stockpiles.
  - Vehicles to travel only on designated access roads.
  - If dust is generated at a level that impacts on a receptor, the activity is to temporarily cease.
- **Odour Control**: The Consultant stated that there is little risk for odours. However, should a complaint be received, the following measures were outlined:
  - Covering (for example with plastic) of the area causing the odour.
  - Apply fine mist sprays.
  - Equipment and machinery need maintenance in accordance with manufacturer's requirements to minimise exhaust emissions.
  - Records of any measures implemented will be kept by the Project Manager.
- **Noise Control**: The Consultant referred to DECCW, 2009, "*Interim Construction Noise Guideline*", and stated that the following noise controls should be considered in the CEMP:
  - Vehicles and machinery to be selected with consideration of noise levels, be maintained in accordance with the manufacturer's requirements, and if needed fitted with silencers. Where more than the typical level of noise is experienced, the vehicle / machinery should be replaced or repaired.
  - Vehicles and machinery to be turned off or throttled down when not in use, if possible.
  - The induction is to include the requirement from all staff to minimise noise.
- **Erosion and Sediment Control**: The Consultant referred to the requirements in Landcom, 2004, "*Managing Urban Stormwater: Soils and Construction*", 4th Edition as a minimum for the CEMP. The Clay Borrow Pit and the Stockpile locations were specifically mentioned as areas needing erosion and sediment control plans. The following was outlined to be included in the CEMP:
  - Silt fences to be installed in drainage channels downgradient of the remediation work areas and any stockpile areas.

  - Materials trapped in the silt fences should be managed with the excavated fill material.
  - Inspection of the control measures to take place once a week and following rain events, and repairs undertaken as needed.

- **Surface Water Controls**: The Consultant stated that the main concern was PAH in soils, which have low solubility. Therefore the main concern was particles in surface water with the potential to migrate. The following measures were identified for inclusion in the CEMP:
  - Surface water is not to discharge from the Site, but should be incorporated in the on-site surface water management system, which discharges through irrigation under an EPL.
  - Erosion and sediment controls would capture particles in surface water. If surface water is pumped from excavations, the Consultant stated that it needs to be treated through sediment controls prior to discharge into the on-site management system.
  - Surface water is to be diverted from excavations and stockpile areas, and the stockpile areas are to be placed away from drainage lines and on flat areas where possible.
  - The Contractor is to keep updated on weather conditions and the potential for rain events and manage the Site accordingly.
- **Groundwater Controls**: Groundwater is expected in the excavation pit at the Capped Waste Stockpile. The water will be pumped out and treated in a groundwater treatment system intended to be designed during the detailed design process. Water would then be discharged to the North Dam and irrigated under the EPL.
- **Traffic Controls**: The Consultant anticipated all haulage routes to be within the Site and stated that the traffic control plan will include all internal haulage routes. However, the Consultant stated that a traffic control plan for the Hart Road Site access point is needed as per Cessnock City Council guidelines. If this plan includes the placement of signage or other traffic controls within the Hart Road road-reserve, the Contractor needs to consult with Cessnock Council and gain approvals or permits as needed. For any off-site haulage routes, the following was to be included in the CEMP:
  - Compliance with road traffic rules.
  - Noise, vibration and odour minimisation.
  - Avoid use of local roads to the extent possible.
  - Delivery of materials to take place within the Hours of Operation.
  - All loads to be covered.
  - Measures will be in place to ensure vehicles do not tack soil / materials onto the roads.
- **Spill Response**: The Consultant stated that a Spill Response Protocol is to be included in the CEMP, and presented a couple of examples of potential spills; loss of contaminated load during transport on private or public property (including Hydro Land), and fuel spills during machinery use / refuelling.
- **Hazardous Materials**: The Consultant stated that the CEMP will include measures for storing, transporting, and using any dangerous goods during remediation. Safe Data Sheets (SDS) need to be kept for each substance prior to bringing it onto the Site. The substance needs to be included in the SDS register, and the Environmental Manager needs to maintain the register, and also ensure receipt is kept for all substances in accordance with the Hazardous Substances Regulation, the Dangerous Goods Act and the Dangerous Goods Regulations. The Consultant further stated that the measures are to be included in the CEMP with reference to the requirements in the following documents:
  - Protection of the Environment Operations Act 1997 and associated regulations;
  - Work Health and Safety Act 2011 and the Work Health and Safety Regulation 2011;
  - Australian Standard (AS1216) Class Labels for Dangerous Goods;

- Australian Standard (AS1940-2004) The storage and handling of flammable and combustible liquids; and
- Australian Standard (AS3833): The Storage and Handling of mixed classes of dangerous goods in packages and intermediate bulk containers.

- **Waste Materials**: The Consultant reasoned that although asbestos had not been encountered during investigations, the Capped Waste Stockpile, and other stockpiles, could contain asbestos. As such, the Consultant stated that an Asbestos Removal Control Plan is to be implemented.
- **Flora and Fauna**: The Consultant stated that the CEMP is to include procedures for vegetation clearance, which should include the following:
  - Strategies for minimising vegetation clearance and measures to protect vegetated areas adjacent to the work areas.
  - Weed control measures.
  - Measures for management and disposal of vegetation.
  - Restriction on storing materials below the drip line of a tree.

17.2 Auditor's opinion

The Auditor notes that the surface water management also needs to include chemical analysis to assess impact from soluble contaminants, in addition to the proposed sediment control to remove particles. This will be further discussed in the review of the CEMP / Validation Plan (see below).

Because of some uncertainties identified by the Site Auditor in review of the 2018 RAP, this Audit has identified the following comment to the Part B2 Audit: **that a comprehensive EMP that addresses any data derived from supplementary investigations following demolition works is submitted for Auditor endorsement** (see **Section 28** of this Audit Report).

18.0 Health and Safety

The Consultant stated that a Health and Safety Plan needs to be compiled, in accordance with Hydro Aluminium's Contractor Occupational Health Safety and Environment Requirements Version 3 2014, *Work Health and Safety Act 2011*, and *Work Health and Safety Regulation 2011* and applicable state and federal regulations, legislation and codes of practice. The plan is to address as a minimum the following:

- Application of standard procedures to reduce risks associated with the works;
- that employees get adequate training, equipment and support to ensure they can perform their duties in a safe manner;
- Implement procedures to protect site workers and the general public;
- Assignment of responsibilities;
- Hazard evaluation;
- Implement personal protection standards and safety practices and procedures;
- Provision for contingencies that may arise while operations are being conducted at the site;
- Stability of excavations;
- Presence of services;
- Presence of livestock and wildlife;
- Presence of CoCs; and
- Presence of other site personnel, work and traffic.

Auditor's opinion

The Auditor considers this section to be adequate for the purpose of the Audit.

19.0 Remediation Schedule

19.1 Background

The Consultant included a preliminary schedule (noting the final schedule will be discussed with the Contractor), replicated in **Table 22**.

Table 22 Estimated Remediation Schedule (from Table 12-1 of the RAP)

Task	Estimated Duration
State Significant Development Project Approval	18 – 24 months
Contractor Procurement	2 – 4 months
Preliminaries (documentation)	2 months
Site establishment and mobilisation	2 weeks
Containment Cell Base Establishment and construction	18 months
Capped Waste Stockpile Removal and Placement in Containment Cell	12 months
Contaminated Soils Removal and Placement in Containment Cell Containment Cell Capping	6 months
Capped Waste Stockpile Footprint Restoration	12 months
Completion of Surface Restoration and Regrading	12 months
Demobilisation and final laboratory results	2 months
Groundwater and Leachate Treatment	24 months
Validation reporting	2 months
Final Site Auditor sign-off	2 months

19.2 Auditor's opinion

The Auditor considers this section to be adequate for the purpose of the Audit, and notes that the schedule is a rough estimate of timing to be refined in the remediation stage of the project.

20.0 Environmental Controls Contingency Plan

20.1 Background

The Consultant stated that the contingencies previously outlined in the 2018 RAP were controls for the normal range of Site conditions. The contingencies presented by the Consultant in this section were stated to be for unexpected Site conditions and circumstances. The controls were presented in a table included in **Table 23** herein.

Table 23 Environmental Controls Contingency Plan (from Table 13-1 of the RAP)

Event	Contingency	Responsibility
Discovery of unexpected materials excluding ACM	"Contact the Principal's representative, then sort materials to a segregated stockpile and discuss possible disposal options with the Principal or the Principal's representative."	Principal following notification from the Remediation Contractor.
Unexpected discovery of ACM	"*Stop work and implement the Asbestos Removal Control Plan*." The Consultant referred to information relating to the Asbestos Management Protocol, presented below.	Remediation Contractor
Noise complaint	"Identify noise source and implement noise control measures"	Remediation Contractor
Dust or odour complaint	"Identify odour or dust source and implement control measures"	Remediation Contractor
Flooding event/sediment laden discharge	"Assess and improve sediment and erosion control measures and stockpile management."	Remediation Contractor

20.2 Auditor's opinion

The Auditor considers this section to be adequate for the purpose of the Part B2 Audit.

21.0 Asbestos Management Protocol

21.1 Background

The Consultant stated that the purpose of an Asbestos Management Protocol is outline the permits and approvals needed for removal of ACM, and the procedures to be followed if ACM is encountered.

The Consultant stated that to remove ACM, the Contractor needs a Class A friable asbestos removal licence which is issued by WorkCover NSW or the equivalent in other Australian jurisdictions. Five days prior to any ACM removal works, the Contractor needs to notify WorkCover NSW. The Contractor is also to compile an Asbestos Removal Control Plan, in accordance with the protocol outlined in the RAP, and with WorkCover NSW, 2011, "*How to Safely Remove Asbestos: Code of Practice*" (referred to herein as "the Code"). The Consultant stated that the Plan is to include:

- "*Delineation of and installation of warning signage around the asbestos removal area as appropriate as described in Section 4.2 of the Code.*
- *Provision of the appropriate personal protective equipment to all asbestos removal personnel as described in Section 4.5 of the Code.*
- *Removal and containment of asbestos fragments as described in Section 4.8 of the Code.*
- *Disposal of disposable personal protective equipment in accordance with Section 3.9 of the Code.*
- *Notification of the waste management facility of the requirement to dispose of ACM waste (refer to previous section).*
- *Transportation of the contained ACM waste to the licensed waste management facility (including defining the route to be travelled by the disposal vehicle), disposal in accordance with facility requirements, and a disposal docket attained and presented to the Contractors Environmental Consultant.*
- *The requirement for a clearance inspection to be undertaken by an appropriate person as described in Section 3.10 of the Code upon completion of the ACM removal.*
- *The procedures to be implemented in the event that unexpected ACM is uncovered."*

Prior to off-site transport, the Contractor needs to notify the licenced facility, and following disposal, obtain a docket confirming the ACM has been appropriately disposed of. The docket is to be included in the Validation Report.

21.2 Auditor's opinion

The Auditor considers this section to be adequate for the purpose of the Part B2 Audit.

22.0 Regulatory Compliance Requirements

22.1 Background

The Consultant included the approvals required under the relevant legislations and regulations. The information is replicated in **Table 24**.

Table 24 Key Legislation and Regulation (from Table 14-1 of the RAP)

Legislation / Regulation	Relevance
State Environmental Planning Policy (State and Regional Development) 2011	Schedule 1 of the State Environmental Planning Policy (State and Regional Development) 2011 identifies 'waste and resource management facilities' as a category of State Significant Development, including: "(5) Development for the purpose of hazardous waste facilities that transfer, store or dispose of solid or liquid waste classified in the Australian Dangerous Goods Code or medical, cytotoxic or quarantine waste that handles more than 1,000 tonnes per year of waste."
Protection of the Environment Operations Act 1997 (POEO Act)	The POEO Act is the primary legislation for the management and control of pollution of the environment. This includes the licensing of premises that are listed as scheduled premises under Schedule 1 of the POEO Act. Hydro currently possesses EPL No. 1548. The scheduled activity "contaminated soil treatment" would be added to the EPL to regulate the remediation activities and management of the Containment Cell.
Protection of the Environment Operations (Waste) Regulation 2014	A Specific Immobilised Contaminants Approval issued under the Regulation would be required for immobilisation of the contents of the Capped Waste Stockpile.
Hazardous Chemicals Act 1985	A licence for the storage of aluminium smelter waste applies to the Smelter and would continue to apply to the Site.

22.2 Auditor's opinion

It is the Auditor's opinion that this section is adequate for the purpose of the Audit and in general accordance with NSW OEH (2011).

However, further discussions between the Consultant and NSWEPA will be required to confirm that the remedial plan, for on-site containment of all of the wastes identified by the 2018 RAP, is specifically consistent with current Chemical Control Orders.

This need for clarification of the CCO does not adversely impact on the findings of this Part B2 Audit.

23.0 Key Personnel

23.1 Background

The Consultant presented the intended roles and responsibilities in a Table, replicated in **Table 25**, noting it would be updated as needed.

Table 25 Roles and Responsibilities (from Table 15-1 of the RAP)

Stakeholder	Name and Contact Details	Role / Responsibility
"Principal	*Hydro Aluminium Kurri Kurri Pty Ltd*	*Owner of the Project Site and ultimately responsible for all works on the site. Will engage/contract all other parties.*
Principal's Environmental Representative	*TBA*	*Person employed by or sub-contracted to Hydro to oversee/provide technical advice on remediation works and ensure works are completed in association with relevant guidelines.*
Remediation Contractor	*TBA*	*Company contracted to undertake remediation works. Will supply all plant and personnel to conduct works as outlined in this RAP and as required under local, state and federal legislation.*
Remediation Supervisor or Project Manager	*TBA*	*Responsible Person appointed by Contractor to supervise/coordinate all aspects of remedial works on behalf of the Contractor.* *Is the primary point of contact for the project.*
Contractor's Environmental Representative	*TBA*	*Responsible for implementation, monitoring and management of the RAP.*
Contractor's Environmental Consultant	*TBA*	*Appropriately qualified environmental consulting company/person appointed to validate the implementation of the RAP. The Contractor's Environmental Consultant will supervise the works, conduct validation sampling and undertake all activities necessary to prepare validation report that documents the implementation of the RAP for submission and review by the Principal.*
Contaminated Land Auditor	*TBA*	*The Contaminated Land Audit will be prepared for the site in accordance with the Contaminated Land Management Act 1997. The Contaminated Land Auditor will be appointed by Hydro."*

23.2 Auditor's opinion

The Auditor considers this section to be adequate for the purpose of the Audit and notes that details will be provided in the remediation stages of the project.

24.0 Community Relations Plan

24.1 Background

The Consultant stated that Hydro has been managing community relations since the Smelter closed, and that a Community Reference Group was established in 2012. Open days were held at the Site in 2015 to discuss issues such as the remediation. The plan includes consultation with a Community Reference Group on a monthly basis, newsletter drops, meetings with council, internet articles and drop in sessions. The proposed remediation strategy has been presented on two occasions to the CRG, two occasions to Council and has been subject of two drop in sessions. Further information is provided on the eGrowth Kurri website."

The Consultant stated that this type of Community Relation would continue until completion of the remediation.

24.2 Auditor's opinion

It is noted that the Consultant refers to "eGrowth Kurri website" in the 2018 RAP whereas the correct reference is "Regrowth" with the link being: https://www.hydro.com/en/press-room/regrowth-kurri-kurri/

Given that the 2018 RAP is also considered by the planning process with its extensive consultation and engagement protocols, the Auditor considers this information appropriate for the purpose of the Part B Audit.

25.0 Ongoing Environmental Management Plan

The Consultant stated that apart from the Containment Cell and the Leachate Plume, the remainder of the Site was not anticipated to need an On-going Environmental Management Plan (OEMP).

25.1 Containment Cell

The Consultant stated that an OEMP would be needed for the Containment Cell in perpetuity. The OEMP is to be developed with NSW Department of Planning and Environment and the EPA before the cell capping is places on top. The OEMP is to be part of the development consent according to the Consultant, and was considered likely to include:

- The Site included and the construction details of the cell;
- Identify who is responsible for implementing the OEMP and when it applies;
- Any constraints on the use of the site;
- Health and safety requirements for workers;
- Management activities including:
  - Inspections of surface cap;
  - Inspections of leachate sump;
  - Repair procedures for of cap; and
  - Disposal procedures for of leachate;
- Monitoring and reporting requirements in accordance with the EPLs;
- Potential restrictions to be placed on the land to prevent unacceptable development over the Containment Cell, such as by way of positive covenant;
- Definition of a mechanism by which finances are available to secure performance of the ongoing monitoring and management. The Consultant argued that this could be incorporated as conditions of the Development Consent or EPL; and
- Definition of mechanisms to bind any future owners / occupiers of the Site to comply with the EMP. The Consultant stated that this includes any Consultant engaged to undertake the on-going environmental management of the Containment Cell. The Consultant also presented options for this; conditions of the Development Consent or the EPL, positive covenants or a voluntary planning agreement. It was also stated that Hydro will remain responsible for the long term environmental performance of the Containment Cell.

25.2 Leachate Plume

The Consultant stated that the need for an OEMP would be assessed after the two years of monitoring proposed. At that stage, an evaluation of the assumptions, and potential need for an update of the ERA and the Fate and Transport Modelling Report would be undertaken.

The Consultant developed Plume Delineation Report and this report is discussed in **Section 6.10** of this Site Audit Report.

25.3 Enforceability

The Consultant stated that the main regulatory mechanisms to ensure the OEMP is implemented are the Development Consent (which is needed since the remediation of the Site triggers the State Significant Development Criteria) and the EPL. According to the Consultant, Hydro proposed that the OEMP would be part of the Development Consent, and that the OEMP would be submitted for approval of the Department of Planning and Environment and the EPA.

The Consultant listed a number of conditions that would be included in the Development Consent for the Site under Section 80A(1)(a) of the EP&A Act:

- "*Prevent, minimise and/or offset adverse environmental impacts;*
- *Set standards and performance measures for acceptable environmental performance;*
- *Require regular monitoring and reporting; and*
- *Provide for the ongoing environmental management of the Project*."

The Development Consent would then be attached to the land and as such be enforceable by any person to the person responsible for implementing the OEMP. This person was stated to be for example the Containment cell Manager (person employed to carry out the OEMP), and the landowner or occupier.

The Consultant also presented the idea of enforcing the long term management of the cell by a restrictive covenant attached to the Containment Cell Land, which could be enforceable to the Containment Cell Manager and the owner / occupier of the land. The mechanisms included could be to restrict the use of the land so that any development that would risk the integrity of the cell is prohibited. Also, the covenant could require the implementation of the OEMP/LTMP (See **Section 6.9** of this Audit report).

The final EMP control mechanisms are currently being developed between Hydro, the EPA and the Department of Planning and Infrastructure. Further details on possible mechanisms were included in the Ramboll EIS. This further information will be provided to the Auditor once resolved.

25.4 Environment Protection Licence

The Consultant also discussed use and requirements of an EPL, which would include conditions to prevent / minimise / mitigate environmental impacts from the Containment Cell, and ensure long term funding and resourcing for the program. The amount and method of funding was suggested to be established with the Department of Planning and Environment and the NSW EPA, and the Consultant referred to the following matters outlined in the POEO Act:

"*i. The degree of risk of environmental harm associated with the Containment Cell;*

ii. The remediation work that may be required because of activities under the licence;

iii. The environmental record of the holder or former holder of the licence or proposed holder of the licence; and

iv. Other matters prescribed in the regulations."

The Consultant further stated that the EPA may require environmental insurance (section 72 of the POEO Act) and positive covenants (section 74 of the POEO Act) in the EPL, and proposed that such requirements would be agreed with Department of Planning and Environment and the NSW EPA during the process of finalising the OEMP.

According to the Consultant, the POEO Act requires that a person holding the licence satisfies the requirements of a "*fit and proper person test*", which is to ensure that they have the technical and financial capacity to undertake the on-going management of the Containment Cell. The Consultant also stated that the EPL cannot be surrendered or transferred to another person without consent of the NSW EPA.

25.5 Auditor's opinion

The proposed Site's Ongoing Environmental Management Plan is referenced by the Consultant as the "Long Term Management Plan". This plan has been provided as a working draft and is subject to further revisions in light of comments from EPA, the Department of Planning and the Site's Developer. The finalised ongoing EMP will need to dove-tail with the Site's subsequent redevelopment.

As noted in Section 17.2, because of some uncertainties identified by the Site Auditor in review of the 2016 RAP, this Audit has identified the following comment to the Part B2 Audit: **that a comprehensive OEMP that addresses any data derived from supplementary investigations following demolition works, and follow further negotiations with the Regulatory Agencies and the future Site Developer, is submitted for Auditor endorsement** (see **Section 28** of this Audit Report).

26.0 Conclusions

26.1 Consultants Conclusions

The Consultant stated that they had been engaged by Hydro to prepare the 2018 RAP for the Smelter Site and the Clay Borrow Pit, with the aim to render the Site suitable for General Industrial (IN1) and Heavy Industrial (IN3) landuse in accordance with a masterplan developed for the former Smelter.

A Development Application was prepared for the demolition of smelter buildings, remediation of contaminated areas, and for the design, construction and operation of Containment Cell. The Project is considered a State Significant Development and is supported by an EIS. The EIS is to address the Secretary's Environmental Assessment Requirements (SEARs) in which the 2018 RAP and associated SAR / SAS stating that the Site can be made suitable for its proposed landuse was required.

Previous Investigations identified contamination in the following areas:

- Capped Waste Stockpile;
- Anode Waste Pile;
- Diesel Spray Area;
- Carbon Plant;
- Bake Furnace Scrubber;
- Area East of the Playing Fields;
- Drainage Lines;
- East Surge Pond; and
- Leachate Plume down gradient of the Capped Waste Stockpile.

Additional investigation was stated to be needed at the Anode Waste Pile, the Diesel Spray Area, sediments in the West Surge Pond, soil at the substations, and the Area East of the Clay Borrow Pit. The investigations are, according to the Consultant, not expected to present material contamination issues.

The 2018 RAP was to detail the remediation methodology for each AEC (excavation and on-site containment), treatment of groundwater at the Capped Waste Stockpile, and the requirements of validation.

The Consultant concluded that in their opinion, the Site can be made suitable for its proposed landuse, as outlined in the Masterplan, by the successful implementation of the 2018 RAP.

26.2 Auditor's opinion

The Auditor considers this section adequate for the purpose of the Audit and in general accordance with NSW OEH (2011).

27.0 Audit Conclusions

The Site Auditor has reviewed the 2018 RAP and previous investigations and relevant documents for the Site (as outlined in **Section 1.3**), and considers the land can be made suitable for its intended landuse as General Industrial (IN1), Heavy Industrial (IN3) and Environmental Conservation (E2) with the implementation of the RAP, subject to the following:

- As noted by the Consultant, further supplementary investigations are proposed in the PAECs not yet able to be assessed due to access issues. The final landuse suitability Audit will require the entire Site to be characterised and, if necessary, remediated for the proposed landuse. This supplementary characterisation and remediation would need to include the parts of the buffer land that are associated with the Audit, and areas between the AECs, to ensure that the whole of the Site (as defined) is able to be certified as suitable for the proposed uses and ongoing protection of the environment is achieved. As such, this Auditor sign-off is subject to the outcome of the additional investigations.
- Further consideration should be given to ensure that Contaminant of Potential Concern, including that any emerging contaminants, are adequately considered during the proposed supplementary investigations, remedial works and validation processes.
- It will be essential that a suitable monitoring program for Site's groundwater is implemented in a manner consistent with NSW EPA guidelines, since the 2018 RAP does not anticipate active remediation of the residual plume.
- The Consultant has advised that further confirmatory investigations are proposed for Human Health and Ecological Risks Assessment (HHERA) and associated management contingencies have been identified in the event that the proposed soil and waste remediation is not successful. The Auditor's sign-off on this 2018 RAP is subject to the outcome of the monitoring program and the HHERA.
- The Consultant stated that specific future documents, relating to the Site's detailed Validation Plan, the details of the containment cell, and water treatment system, would be provided to the Auditor for review prior to commencement of remedial works. These documents are essential to ensure the continued appropriateness of the Site's remediation, as well as being key to ultimately confirming the Site's final landuse suitability. As such, this Auditor sign-off is subject to the review and approval of those documents.
- The Consultant stated that the Site's long-term management, in the form of a Long Term Management Plan (LTMP) has been presented in principle in the 2018 RAP and associated documentation but this Plan is the subject to further discussions and negotiations with relevant stakeholders and the final long term management plan will not be available until the Site's remediation has been completed.

To address uncertainties identified in the 2018 RAP, the Site Auditor has developed specific comments as discussed in Section 28, below.

28.0 Auditor Comments

28.1 Background

Under the provisions of the CLM Act, a "Part B2 Site Audit Statement" provides an opportunity for a Site Auditor to include comments that may be warranted to ensure that the Auditor's opinion in relation to the appropriateness of a plan remains valid.

It is noted that the Ramboll 2016 RAP was primarily prepared to satisfy a planning requirement and there was some urgency in meeting the planning agency's deadline. As a result of this tight delivery, the Site Auditor's technical review comments associated with the 2106 RAP were not able to be included in the version of the RAP that was published to meet the planning agency requirements. The revised 2018 RAP has addressed the issues raised by the Auditor, except as where specifically noted in this Site Audit Report.

Given the ability of the Part B2 Site Audit Statement to include comments, a number of comments have been provided below in the Auditor's Opinion.

28.2 Site Auditor's Opinion on Comments relating to the 2018 RAP

The following comments (Table 26) have been developed to address uncertainties identified by this Part B2 Site Audit Statement

Table 26 Site Audit Part B2 Comments and their Basis

Item	Comment	Purpose
1	That a comprehensive Validation Plan for the AECs and PAECs will be developed and endorsed by a Site Auditor prior to implementation of the remedial works.	Supplementary investigations following gaining access after the proposed demolition works will confirm the type, nature and extent of contamination within AECs and PAECS and a detailed validation plan for each area will then be possible to develop. This is a standard requirement as per Part IV (Explanatory Notes) to the Site Audit Statement Form.
2	That a further Site Audit will be completed to verify the successful implementation of the RAP and confirm the landuse suitability.	This is a standard requirement as per Part IV (Explanatory Notes) to the Site Audit Statement Form.
3	That the validation plan and associated reporting will consider emerging contaminants such as PFAS.	The successful completion of the Smelter Site's remediation is contingent upon ensuring that the emerging contaminants are adequately addressed during the validation reporting. This is a standard requirement as per Part IV (Explanatory Notes) to the Site Audit Statement Form.
4	That a final Environmental Management Plan (EMP) for AEC/PAEC consistent with the 2018 RAP will be provided for Site Auditor Endorsement prior to their implementation.	Some parts of the Smelter Site are subject to supplementary investigations once access is provided as a result of the staged demolition program. Once the supplementary investigations have been completed, an EMP for the remedial works may be prepared. This is a standard requirement as per Part IV (Explanatory Notes) to the Site Audit Statement Form.
5	That a final risk assessment will be performed at the completion of the remedial works and monitoring that is currently proposed, to	The RAP concludes that the remedial approach should result in a Site that does not pose any unacceptable risk to human health and the environment, but notes an uncertainty in the potential groundwater risk following "source removal". The Consultant concludes that a final risk assessment would be warranted to confirm that no unacceptable risk remained. This is a standard requirement as per Part IV (Explanatory Notes)

Item	Comment	Purpose
	ensure that human health and environmental risks have been adequately addressed.	to the Site Audit Statement Form.
6	That the suitability of the containment cell design will be independently verified.	This condition has been identified by NSWEPA to ensure the proposed containment cell meets current best practice and is appropriate for the degree and extent of contamination identified in the material to be placed in the containment cell.

This Part B2 Audit Report and associated Site Audit Statement on the appropriateness of a plan of remediation should be read in association with the Consultant's Reports nominated above and should not be considered in isolation.

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Appendix A

Figures from the RAP

Appendix A Figures from the RAP

Hydro Aluminium Kurri Kurri: Remedial Action Plan

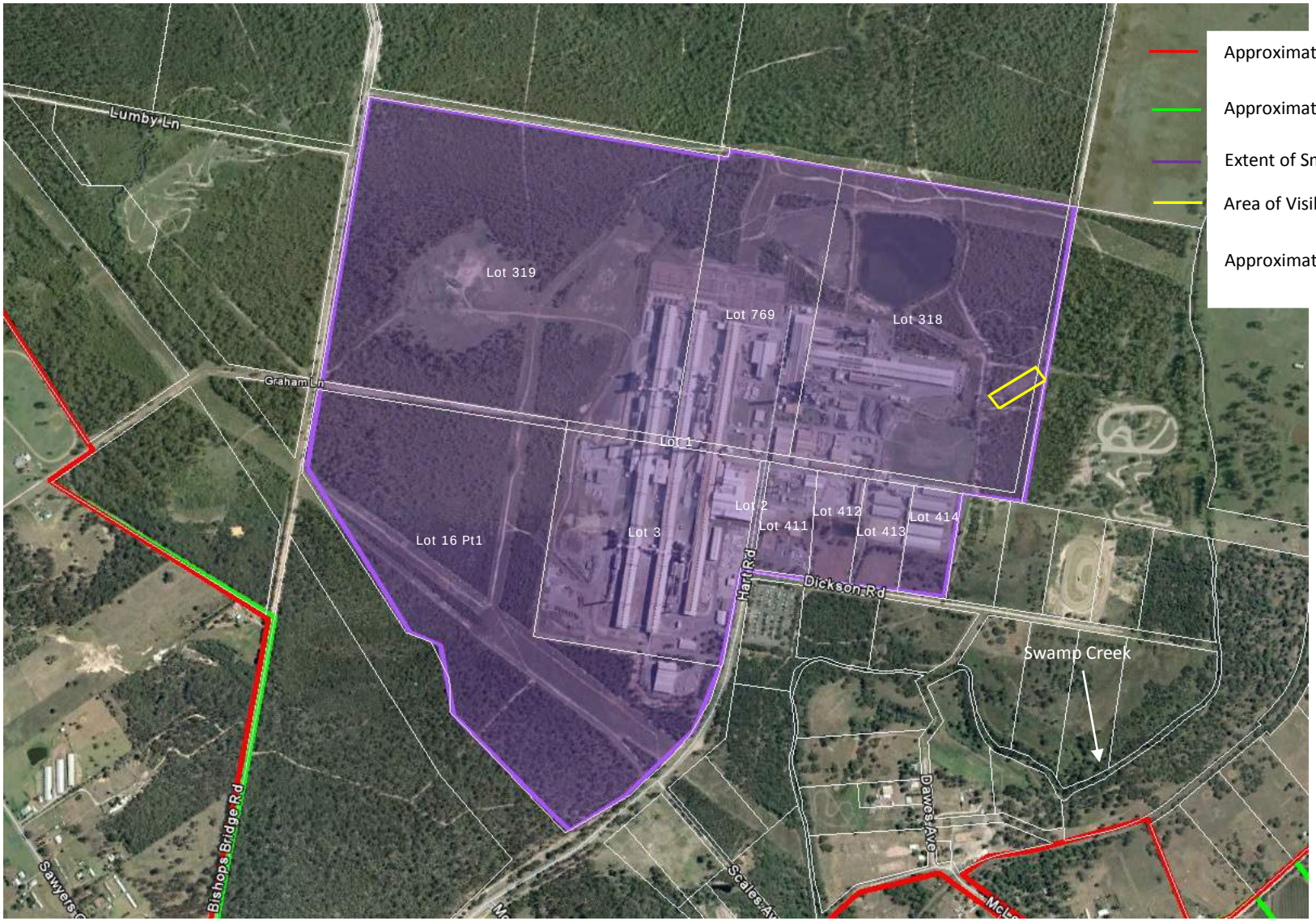
Site Location

RAMBOLL

JOB NO: AS130349

DATE: July 2016

FIGURE 1



Hydro Aluminium Kurri Kurri: Remedial Action Plan

Smelter Site Plan

RAMBOLL

JOB NO: AS130349

DATE: July 2016

FIGURE 2

Hydro Aluminium Kurri Kurri: Smelter Validation Plan

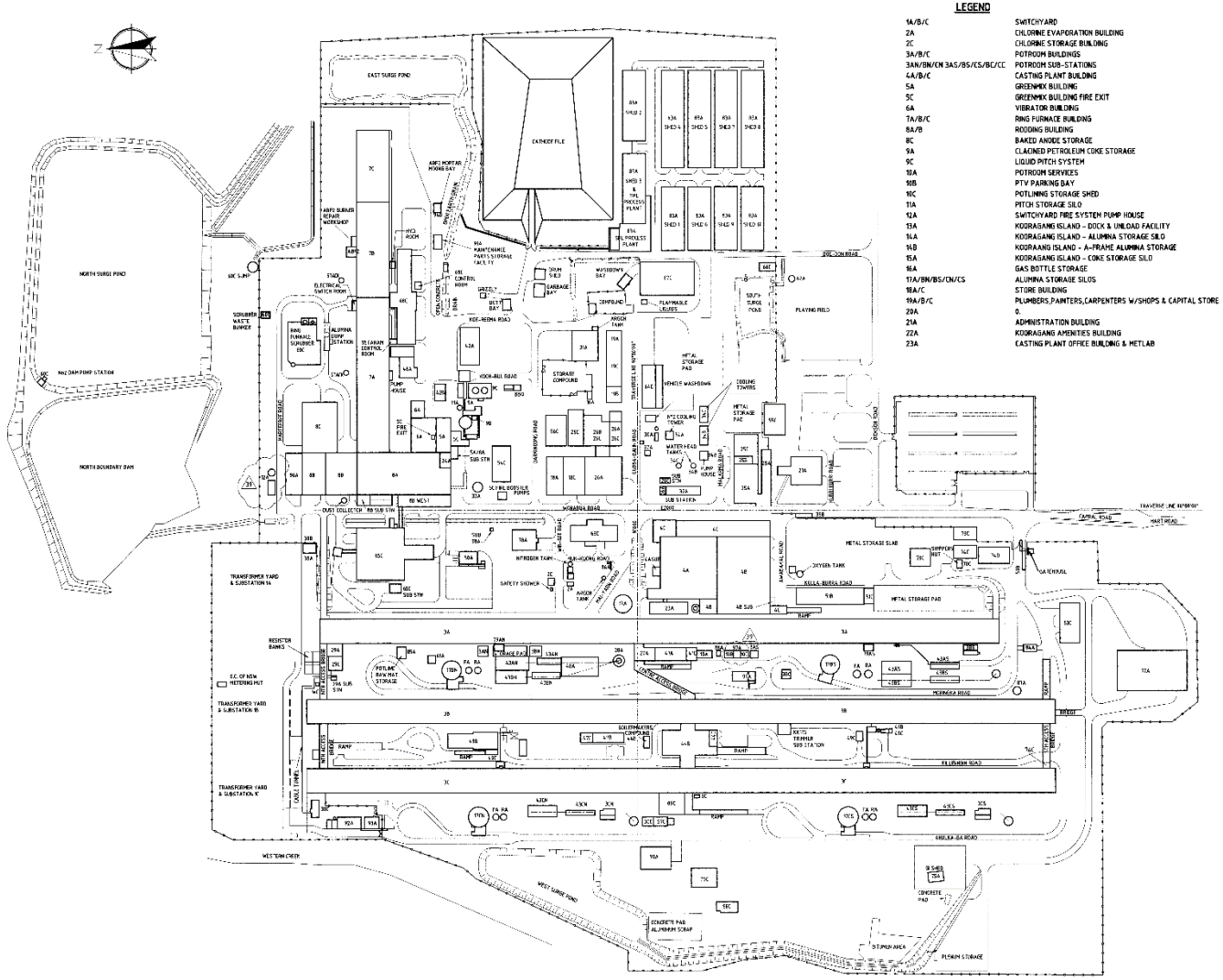
Study Boundary

RAMBOLL

JOB NO: 318000301

DATE: March 2018

FIGURE 3



LEGEND

1A/B/C	SWITCHYARD
2A	CHLORINE EVAPORATION BUILDING
2C	CHLORINE STORAGE BUILDING
3A/B/C	POTROOM BUILDINGS
3AN/BN/CN 3AS/BS/CS/BC/CC	POTROOM SUB-STATIONS
4A/B/C	CASTING PLANT BUILDING
5A	GREENMIX BUILDING
5C	GREENMIX BUILDING FIRE EXIT
6A	VIBRATOR BUILDING
7A/B/C	RING FURNACE BUILDING
8A/B	RODDING BUILDING
8C	BAKED ANODE STORAGE
9A	CLACINED PETROLEUM COKE STORAGE
9C	LIQUID PITCH SYSTEM
10A	POTROOM SERVICES
10B	PTV PARKING BAY
10C	POTLINING STORAGE SHED
11A	PITCH STORAGE SILO
12A	SWITCHYARD FIRE SYSTEM PUMP HOUSE
13A	KOORAGANG ISLAND – DOCK & UNLOAD FACILITY
14A	KOORAGANG ISLAND – ALUMINA STORAGE SILO
14B	KOORAANG ISLAND – A-FRAME ALUMINA STORAGE
15A	KOORAGANG ISLAND – COKE STORAGE SILO
16A	GAS BOTTLE STORAGE
17A/BN/BS/CN/CS	ALUMINA STORAGE SILOS
18A/C	STORE BUILDING
19A/B/C	PLUMBERS,PAINTERS,CARPENTERS W/SHOPS & CAPITAL STORE
20A	0.
21A	ADMINISTRATION BUILDING
22A	KOORAGANG AMENITIES BUILDING
23A	CASTING PLANT OFFICE BUILDING & METLAB
24A	CARBON PLANT OFFICE BUILDING
25A/B/C	GATEHOUSE,MEDICAL CENTRE,PERSONNEL & BATHHOUSE
26A/B/C	ENG. BLDG/APPRENTICE W/SHOP & MAINT W/SHOP,BOILERMAKERS SHOP
27A	POTROOM SERVICES WORKSHOP
28A	MAIN STACK & DUCTWORK
29A/C	POTROOM ELECTRICAL CONTROL BUILDINGS – SUBSTATION
29B	SWITCHYARD SWITCHROOM
30A	FUEL OIL SYSTEM
31A	CROSS STORAGE BUILDING
32A	COMPRESSOR HOUSE
33A	WATER STORAGE AND PUMPHOUSE
34A/B/C	COOLING TOWERS AND PUMPHOUSE
35B	WEIGHBRIDGE
36A	SWITCHYARD WORKSHOP – DEMOLISHED 2009
37A	SEWERAGE PUMPHOUSE
38A/B/C	11KV SWITCHROOMS
39A	SWITCHYARD COMPRESSOR ROOM – DEMOLISHED 2009
40A	CATHODE RODDING BUILDING
41A/B/C	POTROOM OFFICE BUILDING
42A/B	RODDING MIX STORAGE BUILDING
43A/AS/BN/BS/CN/CS	DRY SCRUBBER PLANTS
44B/C	PTA MAINTENANCE BUILDING & OFFICES
45A	SWITCHYARD STOREROOM – DEMOLISHED 2009
46A	CARBON PLANT WORKSHOP & OFFICE
47B/C	POTROOM LUNCHROOM & TOILET BLOCK
49B/C	BATH CRUSHING PLANT,CRUST FEED BATH DUMP
50A	SWITCHYARD UPGRADE PROJECT OFFICE
51B/C	CASTING PLANT SERVICES BUILDING
53C	POT REBUILD WORKSHOP
54C	CARBON PLANT AMENITIES & OFFICE BUILDING
55C	PERSONNEL TRAINING CENTRE
56C	MAINTENANCE OFFICE BUILDING & INSTRUMENT FITTERS WORKSHOP
57C	COMPRESSOR HOUSE – WEST
58C	REFRACTORY STORAGE
59B	WEIGHBRIDGE AND GATEHOUSE
60C	RING FURNACE SCRUBBER
61A	DRY SCRUBBER LUNCHROOM
62A	METEOROLOGICAL TOWER
63C	EDMS BUILDING
64C	MOBILE VEHICLE WORKSHOP
65C	BUTT CLEANING BUILDING – SUBSTATION
66C	NATURAL GAS METER STATION
67C	CATHODE DISPOSAL BUILDING
68C	GREEN & BAKED ANODE STORAGE BUILDING – SUBSTATION
70C	TRUCK LOADING SHELTER / SHIPPERS HUT
72A	SWITCHYARD AMENITIES BUILDING – DEMOLISHED 2009
73C	CASTING MAINTENANCE STORAGE SHED
74C	CASTING ALLOY STORAGE SHED
74D	CASTING ALLOY STORAGE SHED
75A	SLAB REPAIR SHED
75C	POTLINING BRICK STORAGE
76C	TIP CLEANING STATION
77A	POT REBUILD
78A	COMPUTER CENTRE
79AN	NORTH EQUIPMENT ROOM
79AS	SOUTH EQUIPMENT ROOM
81A	POTLINING CENTRE – NOT INSTALLED
82A	DELINING ROOM – NOT INSTALLED
83A	SPL STORAGE & PROCESS PLANT
84A	BROCHOT RAMMING MACHINE STORAGE BLDG
85A	POTLINE RAW MATERIAL STORAGE
86A	LPG GAS BOTTLE FILL STATION
87A	ELECTROLYTE TRUCK LOADING STATION
88A	POT SERVICES STORAGE SHED
89C	CRUCIBLE CLEANING FACILITY
90A	BULK BAG STORAGE FACILITY
91A	MAINTENANCE SPARES STORAGE FACILITY
92A	SWITCHYARD STORAGE/WORKSHOP
93A	SWITCHYARD OFFICE BUILDINGS
94A	(FUTURE) REFRACTORIES AMENITIES & OFFICE BUILDING
94B	(FUTURE) MORTAR MIXING BAY T.B.C (HOLD)
95A	VEHICLE WASHDOWN & PARKING STORAGE
96A	ANODE STORAGE BUILDING
97A	BATTERY EXCHANGE BAY

Hydro Aluminium Kurri Kurri: Remedial Action Plan

Smelter Layout

RAMBOLL

JOB NO: AS130349

DATE: July 2016

FIGURE 4

Capped Waste Stockpile

Approximate Scale 1cm:15m

N

Hydro Aluminium Kurri Kurri: Remedial Action Plan

Capped Waste Stockpile

RAMBOLL

JOB NO: AS130349

DATE: July 2016

FIGURE 5

Hydro Aluminium Kurri Kurri: Remedial Action Plan

AEC 2 – Anode Waste Pile

RAMBOLL

JOB NO: AS130349

DATE: July 2016

FIGURE 6

▲ 2015 soil sampling locations

▲ 2014 soil sampling locations

▲ 2012 groundwater well locations

▲ 2012 soil sampling locations

SB18 Soil sampling locations with PAHs > guidelines

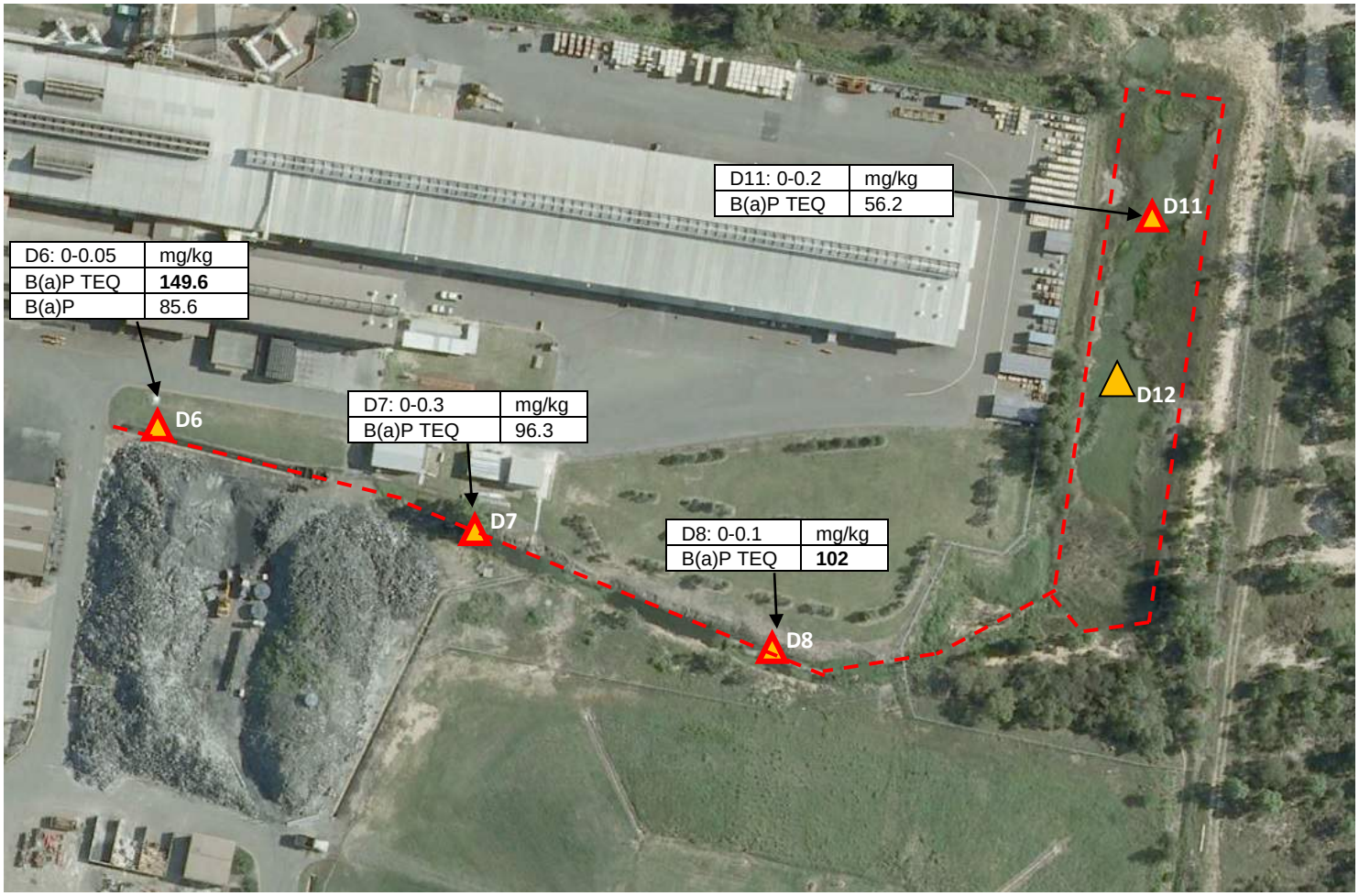
Likely Contamination Extent

Potential Contamination Extent

Approximate Scale is 1cm: 5m

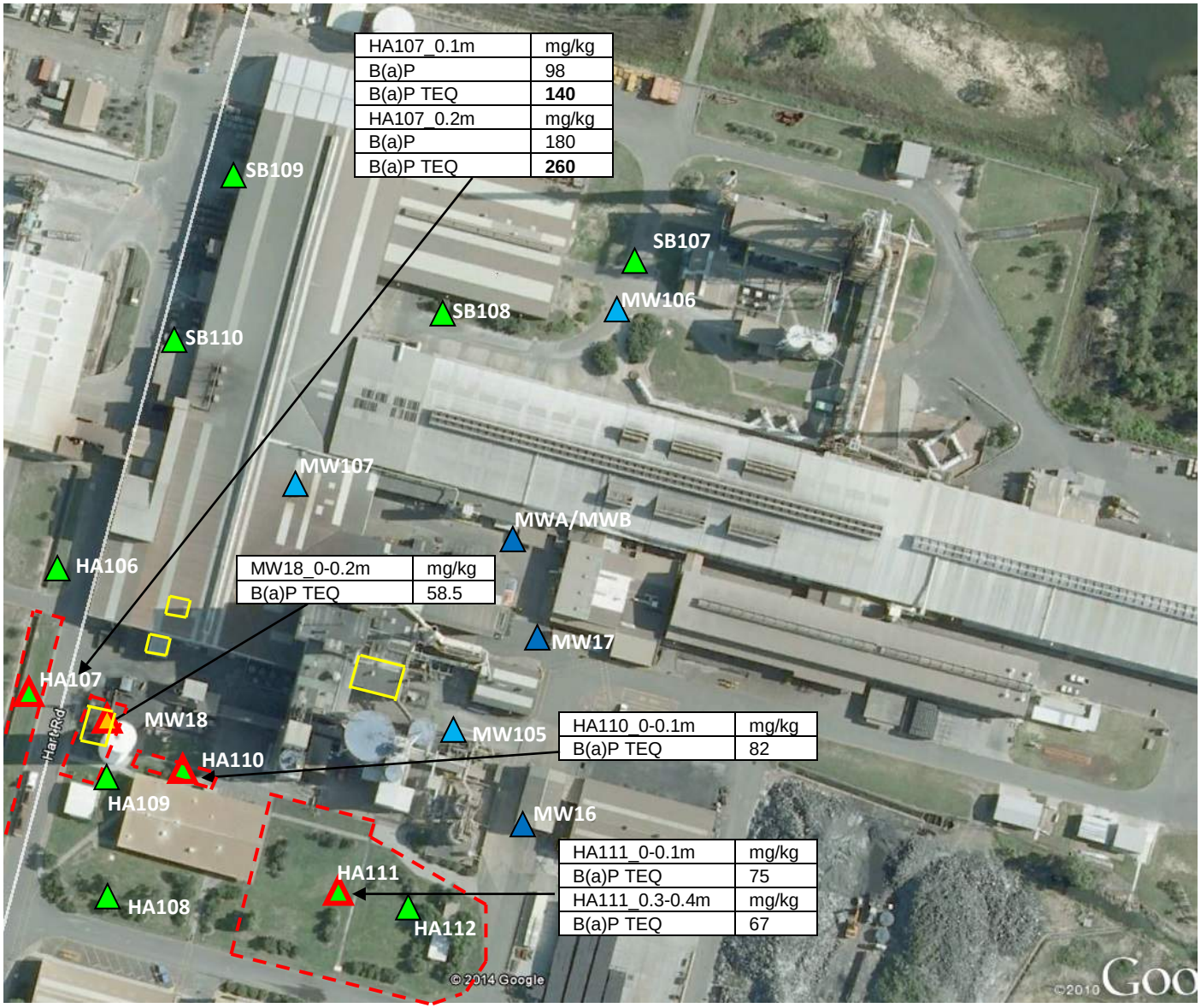
N

Hydro Aluminium Kurri Kurri Remedial Action Plan		AEC 4 - Diesel Spray Area Plan
RAMBOLL	JOB NO: AS130349	DATE: March 2018	FIGURE 7



Hydro Aluminium Kurri Kurri: Remedial Action Plan	AEC 6: East Surge Pond and Associated Drainage Line

RAMBOLL JOB NO: AS130349 DATE: July 2016 FIGURE 8



Hydro Aluminium Kurri Kurri: Remedial Action Plan

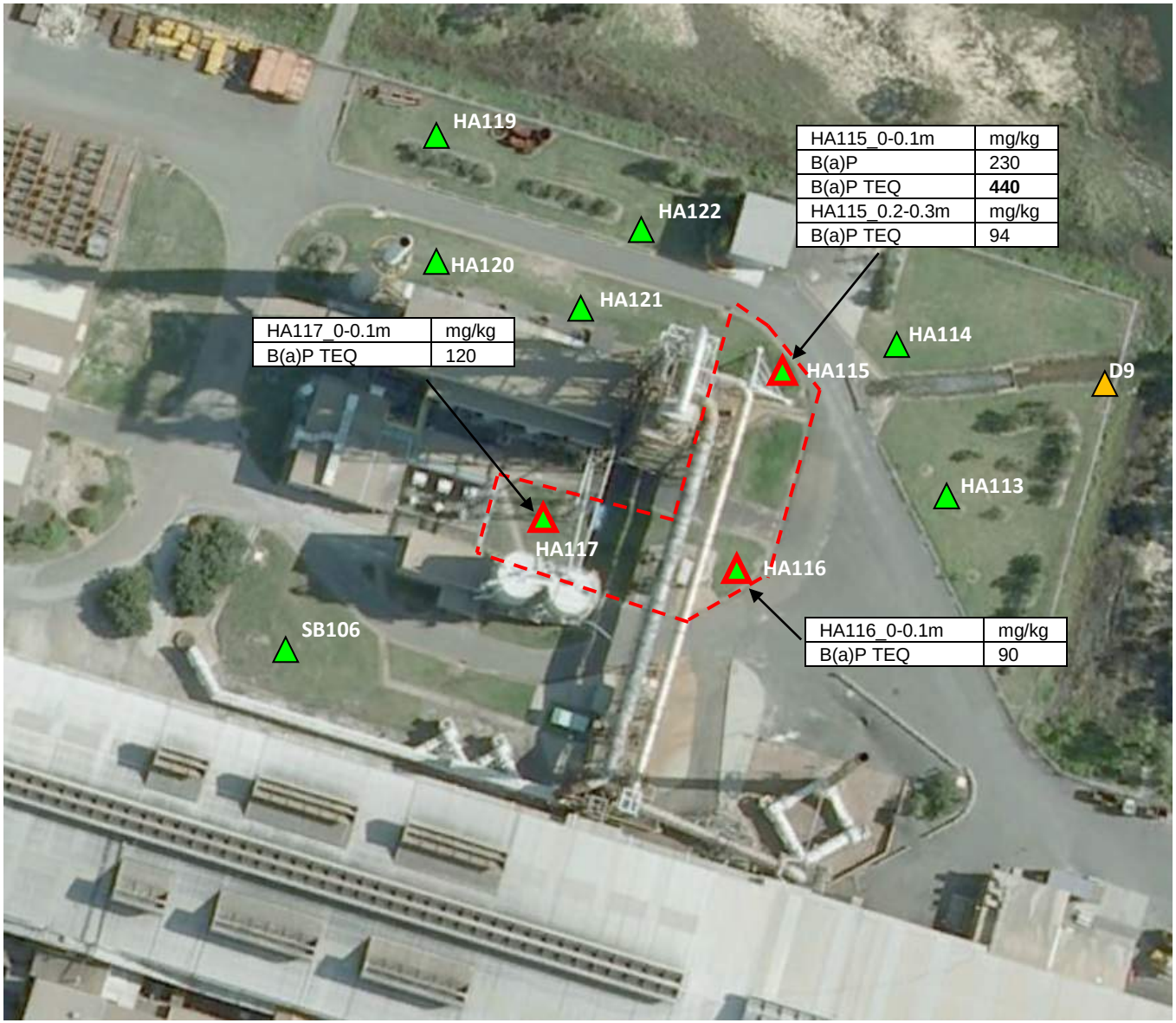
AEC 8 - Carbon Plant (western end)

RAMBOLL

JOB NO: AS130349

DATE: July 2016

FIGURE 9



Hydro Aluminium Kurri Kurri: Remedial Action Plan

AEC 26 – Bake Furnace Scrubber

RAMBOLL

JOB NO: AS130349

DATE: July 2016

FIGURE 10

2014 soil sampling locations

Soil sampling location with PAHs > guidelines

Approximate extent of buried fill

Approximate Scale 1cm:9m

N

Hydro Aluminium Kurri Kurri: Remedial Action Plan

AEC 28 – Area East of Playing Fields

RAMBOLL

JOB NO: AS130349

DATE: July 2016

FIGURE 11

Key

AEC 1: Capped Waste Stockpile
AEC 2: Anode Waste Pile
AEC 3: Refuelling Area
AEC 4: Diesel Spray Area
AEC 5: Drainage Lines
AEC 6: East Surge Pond
AEC 7: North Dams 1 and 2
AEC 8: Carbon Plant
AEC 9: Cathode Bar Washdown Area
AEC 10: Flammable Liquids Store
AEC 11: Washdown Bay
AEC 12: Pot Lines
AEC 13: SPL Storage Sheds
AEC 14: South Surge Pond
AEC 15: West Surge Pond
AEC 16: Transformer Yard
AEC 17: Contractor's Storage Compound
AEC 18: Pot Rebuild Area
AEC 19: Clay Borrow Pit
AEC 20: Glen Ayr Drift Infilling (off-site, not shown)
AEC 21: Irrigation Area (off-site, not shown)
AEC 22: General Buffer Zone (off-site, not shown)
AEC 23: Background Well
AEC 24: -
AEC 25: Dry Scrubbers
AEC 26: Bake Furnace Scrubber
AEC 27: Substations (not shown, too small)
AEC 28: Playing Fields
AEC 29: Area East of Playing Fields
AEC 30: Area East of Clay Borrow Pit
AEC 31: Storage Area West of Pot Lines
AEC 32: Garden Beds

Areas of Concern
Areas not considered for further investigations
Areas not assessed yet due to restrictions

Hydro Aluminium Kurri Kurri: Remedial Action Plan

Smelter Site with AECs and PAECs

RAMBOLL

JOB NO: AS130349

DATE: Sept 2015

FIGURE 12

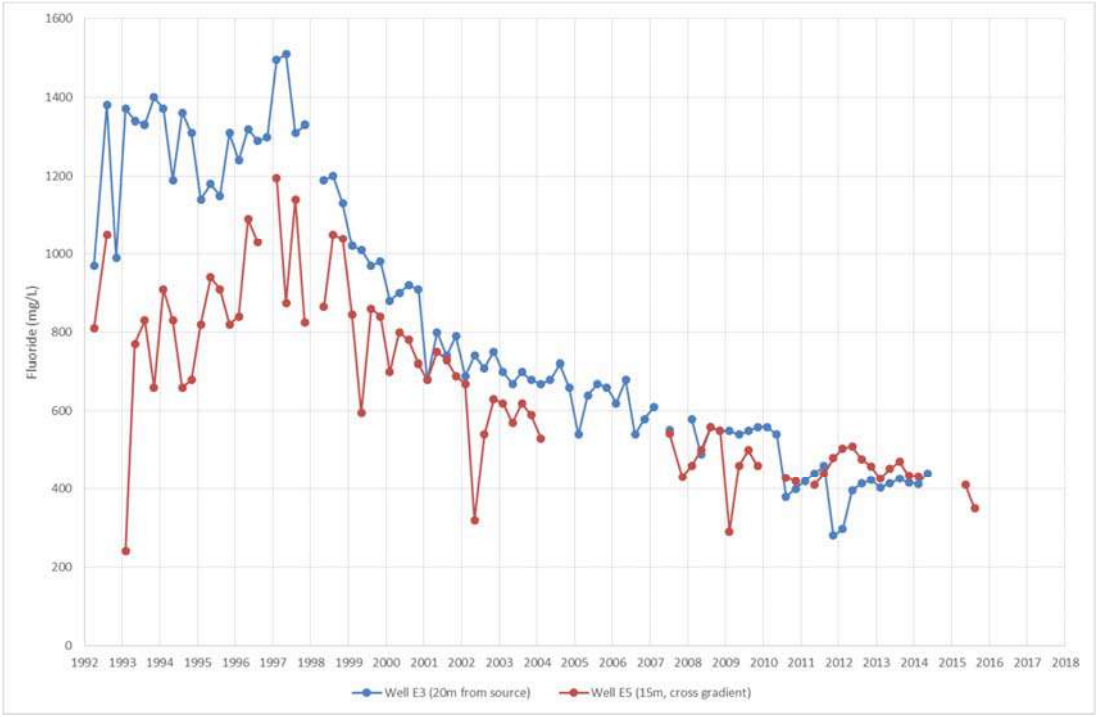


Figure 13 Fluoride concentrations in groundwater

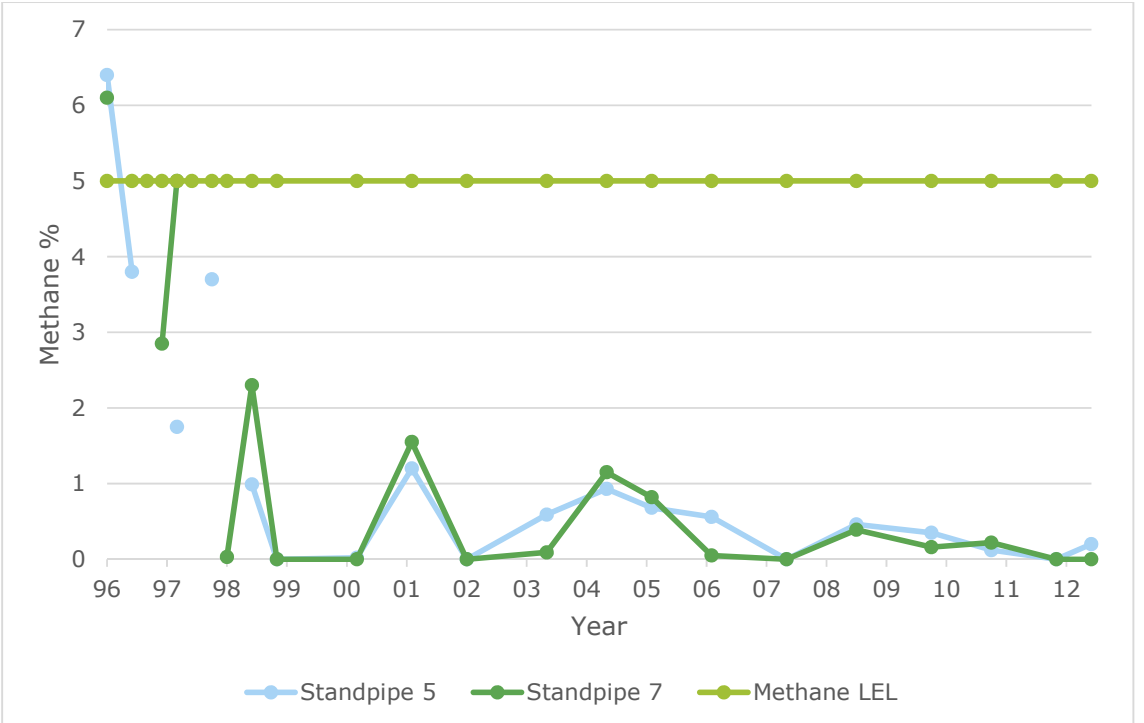


Figure 14 Methane concentrations over time

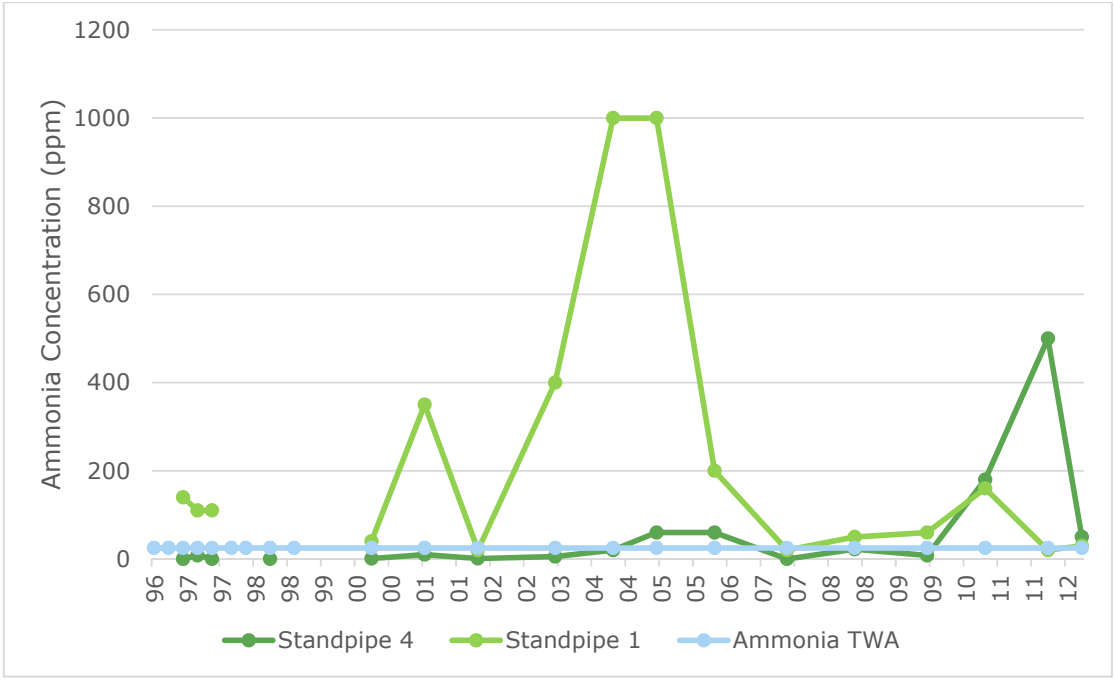
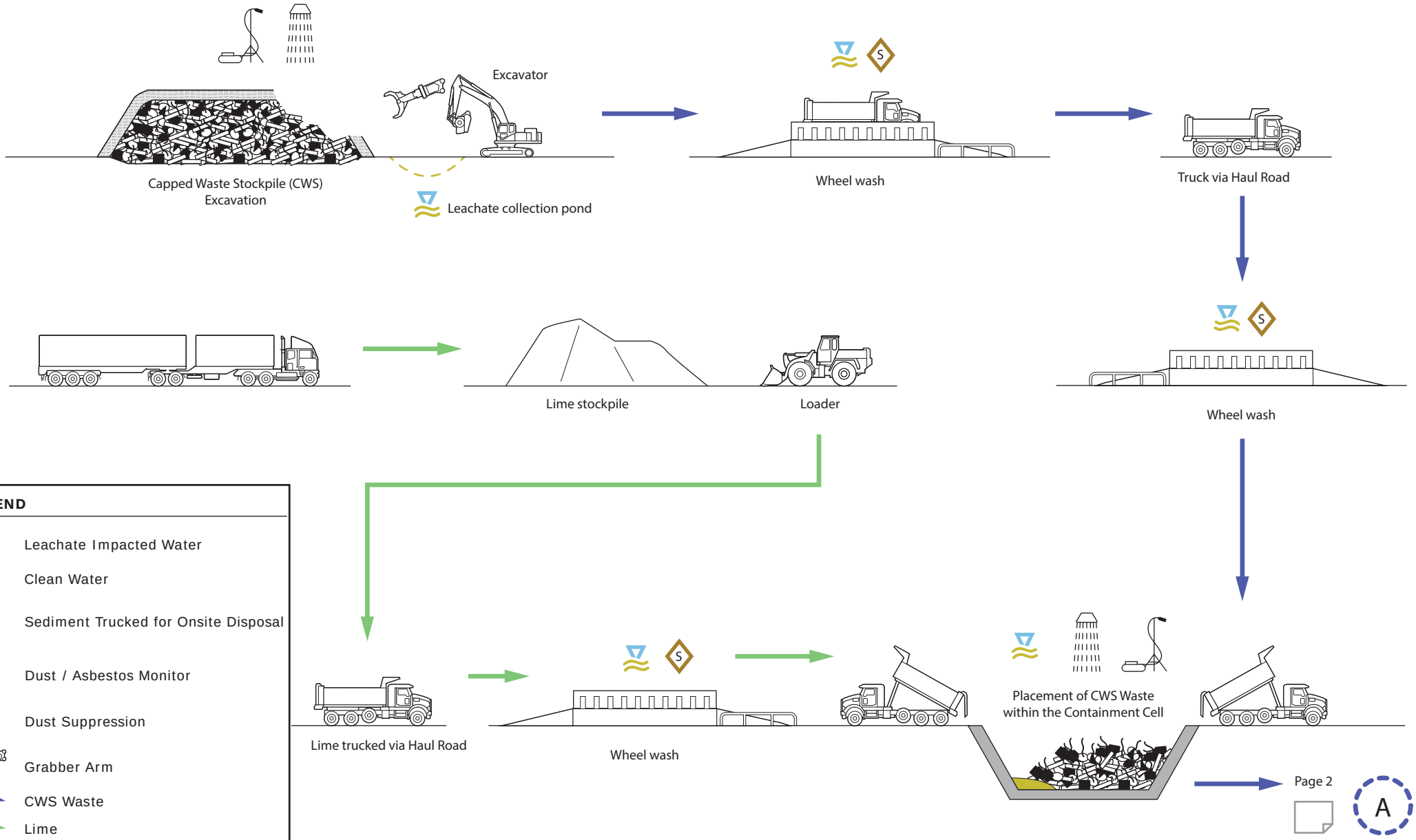


Figure 15 Ammonia concentrations over time



RAMBOLL ENVIRON HYDRO

Date: 23/06/2017

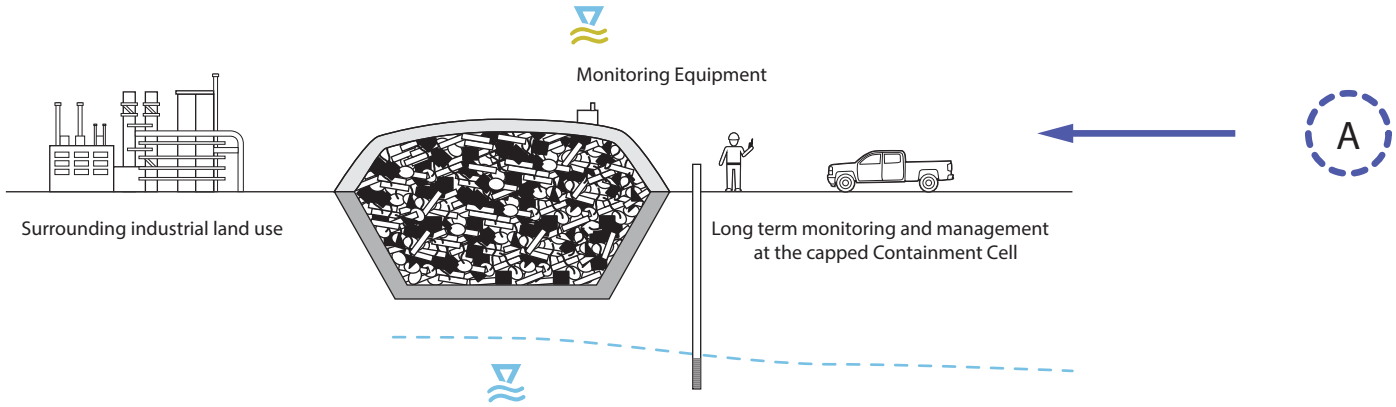
Drafted by: KK

OPTION 4 - Page 1

Onsite Containment Cell With Lime Application

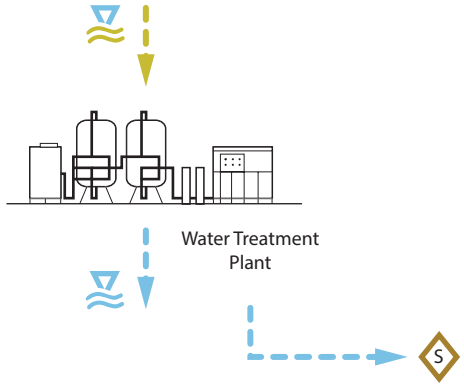
FIGURE **16**

AS13505



LEGEND

- Leachate Impacted Water
- Clean Water
- Sediment Trucked for Onsite Disposal
- Dust / Asbestos Monitor
- Dust Suppression
- Grabber Arm
- CWS Waste
- Lime



RAMBOLL ENVIRON HYDRO

Date: 23/06/2017

Drafted by: KK

OPTION 4 - Page 2

Onsite Containment Cell with Lime Application

FIGURE

17

AS13505

Appendix B

Ramboll's Response Letter for the Final Comments on the RAP

Appendix B Ramboll's Response Letter for the Final Comments on the RAP

AECOM
17 Warabrook Boulevard
Warabrook
NSW 2310

CHANGE LOG FOR AUDITOR COMMENTS ON THE FINAL RAP 28TH JULY 2016

Dear Ross

Ramboll Environ has reviewed your comments provided in your letter dates 28th July 2016. Reponses to these comments are provided in the following table. It is not our intention to update the Final RAP but to address the comments either by responses presented below, or in the Validation Plan which is currently being prepared.

Date 16/09/2016

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Ref AS130328

Ramboll Environ Australia Pty Ltd
ACN 095 437 442
ABN 49 095 437 442

Ref	Auditor Comment	Response
1	The Consultant added a discussion about comparing results from leachate samples collected from the toe drain to the TCLP2 concentrations, noting that it was not directly comparable since the TCLP test protocols are conducted using an acid solution. The Consultant argued that fluoride was more mobile above neutral pH, and that an acid solution would therefore result in a less conservative assessment. The Consultant considered the comparison valid based on this argument. However, the TCLP2 criteria are based on a certain amount of soil with a certain amount of liquid and can therefore not be compared to leachate from a toe drain. The leachate sample result is, of course, useful in itself, but comparing it with TCLP2 criteria is not valid.	Noted and agreed.
2	The RAP proposed that water from various sources of the Site be diverted to the North Dam, which is used for irrigation purposes under an EPL. It needs to be confirmed that these changes in the input to the North Dam, and hence to the water management on Site, have been approved by the EPA and as such is acceptable under the EPL.	Noted. Water treatment forms part of the EIS. Once approved, the EPL will be modified to reflect the site activities. Irrigation from the North Dam is currently subject to an EPL.
3	The Consultant also stated that if, after their proposed groundwater HRA, the risks from groundwater for maintenance / construction workers were acceptable, then the derived soil criterion would be considered to be protective of human health risks associated with groundwater as well. The Auditor notes that HRA derived threshold levels for soils are not protective of groundwater. This needs further consideration by the Consultant.	Noted. Currently the RAP states that there will be a risk assessment for groundwater and soil addressing all receptors and that this is a remaining data gap. The risk assessment will cover the intent described by the auditor. This will be a piece of further work.
4	A remedial options summary was included in the RAP, but the sections of the RAP that follow do not describe the details of the steps that were proposed. Hence, the outcome of the remedial options summary is not supported within the current RAP. I understand that a separate Remedial Options Report has been developed and it may be prudent for this report to be provided to the Auditor for information, and in support of the summarised outcomes presented in the RAP.	Remedial options study now provided.
5	It is unclear how the material from the Capped Waste Stockpile will be drained into the sump before it is placed in the containment cell, nor how the sump will be constructed and if it will be lined.	Further information is being developed in the constructability review. The sump will be clay or HDPE lined and will be at a low point in the cell to allow gravity drainage. The sump was present during the filling of the cell and will be re-excavated during excavation and re-location. The constructability review may identify the need for two sumps.

Ref	Auditor Comment	Response
6	Following the proposed "source removal" of the leachate plume, the Consultant propose to monitor the levels in the plume over time. One factor stated in the Consultant's proposed monitoring design outline was to monitor the potential for site conditions to reduce the contaminant levels by natural attenuation, which the Consultant described to be achieved through a combination of dispersion, diffusion and sorption. However, it is the Auditor's view that processes that lead to mass reduction are considered necessary for implementation of any natural attenuation considerations. By itself, simple dilution in a groundwater or surface water is not generally considered to be "natural attenuation", in the regulatory context, although it may be a relevant consideration in the wider risk assessment process.	Mass reduction is described by the RAP, whereby the source and entrained leachate (secondary source) is removed. Sorption is also a form of mass reduction. Natural attenuation is considered appropriate as the plume has been shown to be stable or reducing and risk assessment has shown no risks to current receptors. Monitoring is proposed both during and post remediation, to evaluate plume behaviour. Monitoring will continue until the plume is shown to be stable or decreasing.
7	Discussion is warranted in relation to the groundwater concentrations as the area becomes less alkaline, as a result of source removal. Discussions as to what are the potential impacts on bioavailability, solubility, toxicity etc with a pH change are warranted, as well as whether there may be a risk that the remediation may unintentionally result in increasing levels / mobilisation of the CoCs in groundwater.	Alkaline groundwater conditions occur in conjunction with site contaminants of F and CN. Free CN readily binds to semi stable complexes and free and WAD CN can be include in validation sampling to assess the potential for free CN ion release under decreasing pH. Similarly further evaluation of the F complexations can be undertaken to assess behaviours under changing pH conditions. This study can also form part of the validation plan.
8	According to the Consultant, "*ENVIRON (2015) Groundwater Fate And Transport Modelling Report concluded that based on existing hydrogeological conditions and the presence of an on-going source from the Capped Waste Stockpile, the model estimated a fluoride concentration of 4.3mg/L at the receptor distance (1000m) compared to a guideline of 1.5mg/L. Removal of the source and leachate interception will further reduce this potental fluoride concentration at the nearest receptor*". This estimated concentration at the receptor is significantly higher than the criteria and requires further justification as to why it is acceptable, and contingencies at the point of discharge to the receptor.	The modelled concentration is 3 times greater than the guideline value of 1.5mg/L. The concentration, whilst above the guideline, is considered to represent a low risk on the basis of: Modelling assumed not source reduction, which will not be the case; Modelling assumed no transformation of the contaminant, so attenuation occurs due to mechanical means only, and no chemical attenuation has been included which is likely to occur; Dilution at the receptor (Swamp creek) has not been considered and is likely to also occur. Monitoring at the point of receptor discharge is routinely completed as part of the surface water monitoring program required under the EPL. A contingency trigger will be included in the Validation Plan for unacceptable results at this monitoring point.

Ref	Auditor Comment	Response
9	The Consultant stated that the leachate encountered in the excavation of the Capped Waste Stockpile would be removed and treated until all visible signs of contamination are removed. As a contingency in case the visible signs are not going away, the Consultant stated that the concentrations would be assessed, and the key contaminants' fate and transport would also be assessed for the potential impacts on the receptors. The Consultant further stated that a subsequent assessment would be performed to determine if the concentrations would pose a risk of harm and as such if the "remediated" Capped Waste Stockpile would require long-term management. It would be prudent for the Consultant to also consider the possibility that the plume may need further remediation rather than simply management, as a contingency.	The Validation Plan can be include to include contingencies beyond long term management and a trigger protocol for the circumstances under which contingencies are required.
10	Another contingency nominated by the Consultant for the plume is a restriction on use of groundwater. This contingency needs to be accepted by the NSWEPA and associated regulatory agencies (also see my comment 25).	Noted.
11	The Consultant notes that the sediments from the West Surge Pond are to be investigated once the water has been drained. The sediments are proposed to be excavated and stockpiled. Since the sediments reported elevated levels of fluoride in the Phase 2 investigations, samples are planned to be collected and analysed for soluble fluoride (stated to be the "bioavailable" portion of fluoride) once the sediments have dried out. The overall management and assessment of water and sediment is not clear from the outline provided in the RAP and further details are warranted to ensure that this significant environmental risk is adequately addressed.	Proposed to be completed in the next phase of works.
12	The proposed landuses are currently nominated as General Industrial (IN1), Heavy Industrial (IN3) and Environmental Conservation (E2). A more detailed figure showing these proposed landuse areas is warranted to allow for a statement regarding the suitability of the RAP. It is noted that the masterplan is referred to, but since the masterplan is evolving, a finalised landuse (masterplan) will be needed for preparation of the Auditor's SAR.	Noted and can be included as part of the Validation Plan.
13	A treatment system for leachate is proposed to be constructed on Site for potential leachate from the containment cell, but the Consultant stated that the system may not be needed over time as the leachate is expected to be minimal. If so, a pump-out system was suggested as an option. It is assumed that the details	Forms part of the detailed containment cell design. The detailed containment cell design also includes a water balance so that volumes are understood.

Ref	Auditor Comment	Response
	of such system would be included in the proposed plan for the water treatment system.	
14	The Consultant advises that decommissioning and demolition of buildings will be undertaken at the same time as the remediation. However, the Consultant also stated that the additional investigations would be undertaken after the demolition of buildings. In the proposed remediation schedule, the additional investigations, the proposed HRA / ERA, and the on-going monitoring have not been identified and it would be prudent for a more comprehensive integrated schedule (with key milestones identified) to be provided in the RAP so it can be referenced by the Site Auditor in the SAR. In such an updated schedule the Auditor would expect adequate time is provided to assess water treatment methods and the design (including treatability trials if required) of the proposed water treatment system (also see my comment 13).	A demolition and remediation schedule has been developed for the project that recognizes this requirement. Sequence of material placement within the Containment Cell is also being prepared as part of the Detailed Design works. This remediation program can be provided for the Auditor's review.
15	Although it is stated in the Validation section of the RAP that chemical validation will occur at the Capped Waste Stockpile, other sections, such as the Data Quality Objectives (DQOs), appear to indicate that only visual assessment is to be undertaken: For example: the RAP notes "*If visual observations indicate that all anthropogenic materials have been removed from the footprint of the Capped Waste Stockpile, then source removal will be considered to have been achieved for the leachate plume in groundwater".* The Consultant needs to confirm that the validation process for this area will include chemical analysis.	This will be a combination of laboratory and visual analysis. This will be further detailed in the validation plan, to be developed.
16	In the Validation DQOs, the Consultant stated that the objective of the sampling pattern was to demonstrate that sample density is suitable for the proposed commercial / industrial landuse. The Consultant needs to present the details of this validation, including any proposed statistical methodology.	Agreed, this will be shortly provided.
17	The ESL for B(a)P was included as 72**5** mg / kg. It is assumed that the number 5 is intended to be a footnote. This needs to be confirmed and updated to avoid confusion.	Noted. It is 72.
18	In Validation Reporting, the Consultant advised that the results of the HRA on groundwater for maintenance and construction workers will be included. However, the RAP is silent in relation to the proposed ERA, also proposed to be undertaken. Further clarification is warranted.	Noted and will be incorporated in the Validation Plan.
19	Under the Section relating to "OEMP", the Consultant referred to it as ongoing EMP, operational EMP, longterm EMP, and just EMP. The terminology needs to be consistent, to avoid confusion.	Noted. This is just EMP.

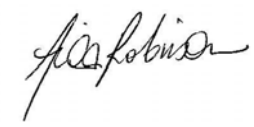
Ref	Auditor Comment	Response
20	It should be noted that a clear mechanism for enforceability of the OEMP must be provided to the Auditor and it needs to be demonstrated that it meets EPA requirements and is “future-proof” in term of its ongoing implementation.	The EMP control mechanisms are currently being developed between Hydro, the EPA and the Department of Planning and Infrastructure. Further details on possible mechanisms are included in the EIS. This information will be provided to the Auditor once resolved.
21	In the checklist review for the Draft RAP checklist, The Auditor asked why “Aluminium” is not included in CoCs. The Consultant stated that it was “not-limiting” in soil. This statement appears to relate to human contact risks and not ecological risks or risk for migration to groundwater / surface water. Further justification is warranted.	Aluminium has not been included in the CoC as it is nto the driver for toxicity. Toxicity is driven by the presence of Na and F. Al complexes readily with F to form less toxic compounds.
22	It is assumed that details relating to material tracking will be provided to the Auditor in a Construction Environmental Management Plan (CEMP) prior to remediation.	Yes, that is correct. The required documentation for material tracking will also be outlined in the Validation Plan.
23	Prior to the proposed investigation across the Site in a grid pattern, a Sampling, Analysis and Quality Plan (SAQP) clearly justifying the CoCs intended for analysis should be provided for the Auditor’s verification prior to implementation.	Agreed. This will be detailed in the Validation plan
24	Soil specific values from the buffer zone were used to derive EILs for the Smelter Site. It should be noted that these need to be updated with samples from the Smelter Site prior to / during Validation.	Noted, this will be incorporated in the validation plan.
25	In relation to the groundwater plume, the Consultant stated that the since there were no beneficial uses identified for the groundwater aquifer, there will be no criteria adopted, but rather a monitoring program which should show that levels are stable or reducing fluoride, cyanide and pH to meet the remediation goals. The Auditor notes that groundwater resources belong to the State and that the relevant water agencies as well as the NSW EPA need to accept the proposed method. Further, the Consultant needs to include Aluminium in the analytical schedule for the groundwater plume. The Consultant also needs to consider the impacted aquifer itself a receptor, which is clearly impacted, and discuss the implications of leaving it in place. See also my comment 10.	Noted. The EIS process, which discusses the remediation of the plume, is subject to approval from the relevant departments. The impacted aquifer was subject to the ERA which identified that localized flora impacts had occurred but that fauna impacts were negligible due to the mobility of the communities present. Since completing the ERA activities at the site have been completed to minimise impacts to the aquifer. These works have resulted in improvements to the flora and fauna based on visual evidence. A revised ERA can form part of the validation plan. Aluminium will be included in the validation suite and documented in the validation plan.

Ref	Auditor Comment	Response
26	The Community Relations Plan Section did not include a plan, and as such is not in accordance with the Guidelines and further details or reference to the broader community works being undertaken by Hydro are warranted.	Community consultation for the project is managed through a Community Consultation Plan developed by GHD for the site redevelopment. The plan includes consultation with a Community Reference Group on a monthly basis, newletter drops, meetings with council internet articles and drop in sessions. The proposed remediation strategy has been presented on two occasions to the CRG, two occasions to Council and has been subject of two drop in sessions. Further information is provided on the ReGrowth Kurri website.
27	The low frequency of sampling; 1 sample per 1000 m3, for the clay capping material from the capped waste stockpiled was justified by stating contamination of the high plasticity clays are not anticipated. The Auditor notes that further justification is needed such as by earlier sampling with presumably low standard deviation.	Agreed. A sampling approach that incorporates an initial high frequency sampling plan will be incorporated in the validation plan.
28	In the Section about Site Operation, the Consultant stated that there is a storage area west of the pot rooms. It is unclear what is / was stored here.	This is the area where soils from buffer zone remediation works are currently stockpiles. Stockpiles are on hard stand, have erosion and sediment controls and stockpiles containing asbestos are covered with HDPE liners. All material is tracked.
29	When discussing waste classification of SPL, the Consultant stated that: "*cyanide and leachable concentrations are required to be below 150mg/L and 10mg/L for disposal*" it is unclear what analyte "leachable concentrations" refers to.	The sentence should read Cyanide The Chemical Control Order for Aluminium Smelter Wastes Containing Fluoride and/ or Cyanide requires leachable concentrations to be below 150mg/L and 10mg/L respectively before disposal.
30	In relation to groundwater, the Consultant stated that groundwater sampling was conducted in areas within the Site that had the highest risk from contamination, such as upgradient of the Capped Waste Stockpile, the Anode Waste Pile, Carbon Plant, wash bay, the Diesel Spray Area, Refuelling Area, Pot Rebuild Area and Flammable Liquids Store. Should this be "downgradient"?	Yes.
31	Incomplete sentence in Section 5-13: "*Up-gradient and down-gradient locations have also been sampled, as well as other areas of the site such as."* – the Consultant needs to confirm what was intended here.	The sentence should read, Up-gradient and down-gradient locations have also been sampled, as well as other areas of the site such as the Clay Borrow Pit.
32	The landuses were stated to include General Industrial (IN1), Heavy Industrial (IN3) and Environmental	No, these are the proposed land uses.

Ref	Auditor Comment	Response
	Conservation (E2). The Consultant needs to confirm if there are other uses as is implied when using the word “include”.	
33	In Table 7-1, the “volume” and “Mass” are swapped around the wrong way in the title of the table.	This was corrected in the Final version of the RAP (which is the basis of these latest comments).
34	There is no proper reference to the Hazardous Materials Audit undertaken in 2014 included in the RAP.	This document has now been provided to the Auditor. The reference is ‘Hazardous Materials Audit, Stages 1 to 6, Hydro Aluminium Kurri Kurri, NSW, prepared by Environ Australia Pty Ltd, 2014’.
35	For further investigations of the substations the Consultant stated that they had identified associated CoCs such as petroleum hydrocarbons, polychlorinated biphenyls (PCBs) and PAHs. The Consultant needs to confirm if there are other CoCs as is implied when using the words “such as”.	There are no other COCs being considered.
36	It is unclear if the grid sampling intended to be undertaken across the entire Site following remediation is on a 30 m grid. The Consultant needs to confirm.	Further details will be provided in the Validation Plan.
37	Most points identified under Validation Sampling Contingencies are sampling methodologies rather than contingencies.	Noted. This will be corrected in the validation plan.
38	Under “Spill Response” the consultant stated that it applies “*anywhere including private or public property*”. It needs to be confirmed if this includes the Site.	Yes, this includes the site.

We trust that the information provided in our responses is sufficient for you to complete the audit. Please let us know if you require any further information.

Yours sincerely



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Appendix C

Relevant Correspondence

Appendix C Relevant Correspondence

DOC17/602948

Mr Richard Brown
Managing Director
Hydro Aluminium Kurri Kurri Pty Ltd
PO Box 1
KURRI KURRI NSW 2327

By email: Richard.Brown@hydro.com

Dear Mr Brown

EPA advice on Hydro Aluminium Kurri Kurri Pty Ltd – Capped Waste Stockpile Waste Management Options Evaluation Study

The EPA's advice with respect to the Capped Waste Stockpile Waste Management Options Evaluation Study for the Capped Waste Stockpile (CWS) at Hydro Aluminium Kurri Kurri (Ramboll-Environ, 30 October 2017) (the Study / Hydro Aluminium) is as follows.

The EPA's preferred option is Option 4 not Option 2

The EPA notes the methodologies used in the Study to screen, evaluate and select the options presented in the Study are generally sound.

The Study identifies the placement of the CWS material untreated within an on-site containment cell (Option 2) as the most appropriate management option. However, the EPA's preferred option is Option 4, which includes the co-placement of lime to reduce fluoride in leachate, where leaching of fluoride from the waste occurs, in addition to the management requirements in Option 2.

In support of Option 4, the EPA notes:

a. Increased certainty that the approach does not contravene the Chemical Control Order (CCO);
b. The net benefit/impact analysis for Option 4 has only a slightly larger impact profile than Option 2, due to slightly increased greenhouse gas emissions and safety risks; and
c. Option 4 offers a relatively simple and generally robust means to effectively capture fluoride in leachate generated by the waste, thus potentially reducing leachate treatment and management requirements.

The EPA notes however additional investigation of Option 4 will be required, if this option is agreed to be the preferred option to remediate the CWS. For example, it is unclear if the co-placement of lime may potentially increase the leaching of cyanide which is also present within the CWS material. In addition, detailed design and management information associated with Option 4 will be required.

The EPA also notes Hydro must be certain that the treatment process will result in leachable fluoride and cyanide concentrations being below the CCO specified concentrations because otherwise, option 4 would likely contravene the CCO. However, Hydro may seek its own legal advice on this matter.

Advice requested by Hydro Aluminium

In response to Hydro Aluminium's request for written advice from the EPA:

- as above, the EPA advises that based on its review of the Study, the placement of the CWS material, with co-placement of lime, within an on-site Containment Cell (Option 4) is an appropriate management option
- the EPA agrees that Option 4 may be able to be lawfully implemented under the current regulatory framework relevant to the remediation of the CWS;
- the EPA agrees that the Environment Protection Licence for the facility (#1548) will need to be varied to include contaminated soil treatment and chemical storage as additional scheduled activities at the site;
- the EPA advises that as the material is not moving offsite, it does not trigger any waste related regulatory requirements including an immobilised contaminants approval; and
- the EPA refers Hydro to the Department of Planning and Environment who can provide advice on issues related to the *Environmental Planning and Assessment Act 1997*.

The EPA looks forward to continuing to work co-operatively with Hydro to progress lawful disposal of the CWS waste.

If you have any questions please contact me on 49086803 or by email to hunter.region@epa.nsw.gov.au.

Yours sincerely

6.12.17

KAREN MARLER
Director Hunter
Environment Protection Authority

Cc: Shaun Taylor by email: staylor@ramboll.com

EPA 1997 Reporting Guidelines Compliance Checklist – Validation

Client	**Hydro Aluminium Krurri Kurri Pty Ltd**
Site Name	**Clay Borrow Pit Area, Hydro Kurri Kurri Aluminium Smelter, Hart Road, Loxford, New South Wales (2321)**
Report Title	**Automotive Waste Removal Validation**
Report Date / Version / Reference	**June 2015 / R00 / DLH1155_H00457**
Report Author / Consultant	**Author Not Identified / DLA Environmental Services**
AECOM Auditor Assistant	**Erla Hafsteinsdottir**
AECOM Auditor Reviewed (initials / date)	**Ross McFarland 25 August 2016**

Background:

The NSW EPA guidance on preparing a site remedial action plan (RAP) states:

*Where remedial action has been carried out, the site must be **'validated'** to ensure that the objectives stated in the RAP have been achieved. A report detailing the results of the site validation is required.*

The extent of validation required will depend on:

- *the degree of contamination originally present*
- *the type of remediation processes that have been carried out*
- *the proposed land use.*

Validation must confirm statistically that the remediated site complies with the clean-up criteria set for the site. For guidance, see the NSW EPA's Contaminated Sites Sampling Design Guidelines. Where applicable, the US EPA's Methods for Evaluating the Attainment of Cleanup Standards (1989) can also be used.

The validation report must assess the results of the post-remediation testing against the clean-up criteria stated in the RAP. Where targets have not been achieved, reasons must be stated and additional site work proposed to achieve the original RAP objectives.

The validation report should also include information confirming that all EPA and other regulatory authorities' licence conditions and approvals have been met. In particular, documentary evidence is needed to confirm that any disposal of soil off-site is done in accorance with the RAP.

The following checklist is based on that provided by the NSW EPA. The code system is:

- ✓ Include this section
- (S) A summary is adequate if detailed information was included in an available referenced previous report
- (N) Include only if there is to be no further site investigation
- (N/A) Not applicable

EPA 1997 Reporting Guidelines Compliance Checklist – Validation

Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
Executive Summary ✓	**-**	-	Please provide an executive summary	
• Background	-	-		
• Objectives of the Investigation	-	-		
• Scope of work	-	-		
• (Where appropriate) a summary of sampling results in tabulated format containing minimum, maximum, arithmetic average and 95% upper-confidence limit on arithmetic average for each analyte	-	-		As the report is an appendix to the DLA (October 2015) Validation Report, Clay Borrow Pit Area, Hart Road Loxford, New South Wales, Australia, 2326, the report will not be amended.
• Summary of conclusions and recommendations	-	-		
Scope of Work and Objectives ✓	**-**	-	Overall comments: • Although this report is presented in an appendix for the CBP validation report, it has been reviewed separately as it is a validation report in itself. • Referring to the CBP validation report for certain section is justifiable and only a summary needed for this report The introduction to this report is unclear and needs to be clarified to include: • Why this report was written and why it was written separately from the CBP validation report; • A referral to the CBP validation report, i.e. that it forms part of the overall validation works for the CBP area; • What monitoring is being referred to in the second paragraph; • Consistency in terms of how the area of interest is being referred to (e.g. make sure a capital letter is always used). The second sentence in the second paragraph of the Introduction sounds more like a statement that should be made in the conclusions – please amend/provide a comment.	
• A clear statement of the scope of work	-	The scope of work, which is provided after the DQOs and Limitations, is more a method section (i.e. how the work was carried out). Scope of work should be presented just after the objectives in dot points, outlining how the work is to be carried out – please amend. Section 1.4, please clarify where Area 5 is and provide a map showing its location.		
• A clear statement of the objectives.	✓	-		It would have been preferable that this report was not written separately to the CBP Validation Report, as the automotive waste pit was identified as an unexpected find during the CBP remediation. It should have been included in the CBP Validation Report, rather than reported separately. Monitoring is incorrect terminology and should read 'Results from the validation sampling indicate…'
Site Identification ✓	**-**	-	Site identification/description would provide a clearer understanding of the work if presented after the objectives (and the scope of works - see comment above) – please amend.	
• Street number, street name and suburb	✓	Include the street name.		Refer to CBP Validation Report.
• Lot number and Deposited Plan number	-	Please provide or refer to the CBP validation report		Refer to CBP Validation Report.
• Geographic coordinates related to a nearby cadastral corner of a State Survey Control Mark	-	Please include or refer to the CBP validation report		Refer to CBP Validation Report.
• Locality map	✓	Include a scale bar and a north arrow for all maps.		Noted
• Current site plan with scale bar, showing north, local water drainage and other local environmentally significant features	✓	Include a scale bar and a north arrow for all maps. Include local water drainage and other environmentally significant features.		Noted
Site History ✓ (S)	**-**	-	This section is missing from the report. Please provide a summary section, that includes a referral to the CBP validation report	Refer to CBP Validation Report.
• Summary of previous investigations	-	-		
• Zoning-previous, present and proposed	-	-		
• Land use-previous, present and proposed	-	-		
• Summary of Council rezoning and relevant development and building approvals records	-	-		
• Chronological list of site uses, indicating information gaps and unoccupied periods	-	-		
• Review of aerial photographs	-	-		

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Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
• Site photographs (with date and location indicated on site maps)	-	-		
• Inventory of chemicals and wastes associated with site use and their on-site storage location	-	-		
• Possible contaminant sources and potential off-site effects including potential issues associated with migration of contaminants	-	-		
• Site layout plans showing present and past industrial processes	-	-		
• Sewer and service plans	-	-		
• Description of manufacturing processes	-	-		
• Details and locations of current and former underground and aboveground storage tanks	-	There is a brief mention of a possible UST in section 1.12 Laboratory Analysis. However, this does not provide sufficient information – see right hand column for further instructions on required action.		Reference to a UST is in error. It should read 'Samples were analysed for contaminants indicators that may be associated with past and present land uses i.e. burial of vehicles'.
• Product spill and loss history	-	-		
• Discharges to land, water and air	-	-		
• Disposal locations	-	-		
• Relevant complaint history	-	-		
• Local site knowledge of residents and staff-both present and former	-	-		
• Summary of local literature about the site, including newspaper articles	-	-		
• Details of building and related permits, licences, approvals and trade waste agreements	-	-		
• Historical use of adjacent land	-	-		
• Local usage of ground/surface waters, and locations of bores/pumps	-	-		
• Integrity assessment (assessment of the accuracy of information)	-	-		
Site Condition and Surrounding Environment ✓ (S)	-	-	Please provide a summary and refer to the CBP validation report. Section 1.2 refers to some chapters that might contain this information. However, it is unclear where those chapters are – please clarify.	
• Topography	✓	Further to the information provided in section 1.6, please provide a greater detail or a referral to the CBP validation report.		Refer to CBP Validation Report.
• Conditions at site boundary such as type and condition of fencing, soil stability and erosion	-	-		
• Visible signs of contamination such as discolouration or staining of soil, bare soil patches-both on-site, and off-site adjacent to Site boundary	-	-		
• List potential contaminants of concern at or near the site	✓	-		
• Visible signs of plant stress	-	-		
• Presence of drums, wastes and fill materials	-	-		
• Odours	✓	-		
• Condition of buildings and roads	-	-		
• Quality of surface water	-	-		
• Flood potential	-	-		
• Details of relevant local sensitive environment-e.g Rivers, lakes, creeks, wetlands, local habitat areas, endangered flora and fauna.	-	-		
• Identification of sensitive receptors, e.g. kindergarten, parks, etc.	-	-		

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Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
Geology and Hydrogeology ✓(S)	-	-	Please provide a summary and refer to the CBP validation report.	
• Soil stratigraphy using recognised classification methods, e.g. Australian Standard 1726, Unified Soil classification Table	-	-		
• Location and extent of imported and locally derived fill	-	-		
• Site borehole logs or test pit logs showing stratigraphy	-	-		
• Detailed description of the location, design and construction of on-site wells.	-	-		
• Description and location of springs and wells in the vicinity	-	-		
• Depth to groundwater table	-	-		
• Direction and rate of groundwater flow	-	-		
• Direction of surface water run-off	-	-		
• Background water quality	-	-		
• Preferential water courses	-	-		
• Summary of local meteorology	-	-		
Acid Sulphate Soils ✓(S)	-	-	Please provide a summary and refer to the CBP validation report.	Refer to CBP Validation Report.
• Identification of extent and potential for ASS	-	-		
• Assessment of management and remedial strategies to work with ASS	-	-		
Sampling and Analysis Plan and Sampling Methodology ✓	-	-	Overall, the SAQP needs to be clarified in the sections that form part of the planning process. Section *Remediation Validation Plan* is a combination of a sampling plan and the actual work undertaken. For a better understanding of the report, these two should be in separate sections.	
• Sampling, analysis and data quality objectives (DQOS)	✓	The seven step DQO process is provided. However, the following needs to be clarified in order for the auditor to provide an appropriate assessment: • It is unclear where the chapters are that are being referred to – please clarify. • Unless the chapters that are being referred to contain all the required information, most of the steps provided in the text should be expanded to include more information as per the guidelines.		Reference to a Chapter 2 has been made in error and should be ignored.
• Rationale for the selection of:	-	-		
– sampling pattern	✓	-		
– sampling density including an estimated size of the residual hot spots that may remain undetected	-	Provide a comment		Section 1.5.1 indicates validation samples were collected from the base and walls of the automotive pit in accordance with the methodology outlined in NSW EPA Guidelines for Assessing Service Station Sites.
– sampling locations including locations shown on a site map	✓	Include locations on map. Also, clarify on a site map where SP23 is that is being referred to in the text.		
– sampling depth	✓	-		
– samples for analysis and samples not analysed	✓	Results section		
– sampling of relevant environmental media (soil, air, water)	✓	-		
– analytical methods	-	Provide a comment		See CBP Validation Report.
– analytes for samples	✓	-		

EPA 1997 Reporting Guidelines Compliance Checklist – Validation

Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
• Detailed description of the sampling methods including:	-	-		
– sample containers and type of seal used	-	Provide a comment		Appendix M of the CBP Validation Report indicates soil samples were collected into laboratory prepared glass jars with Teflon lid inserts. All samples were packed into an esky with ice from the time of collection. Soil samples were forwarded to the laboratories under chain of custody conditions.
– sampling devices and equipment e.g. auger type	-	Provide a comment		Appendix M of the CBP Validation Report indicates sampling methods included a hand auger and spades, although it is considered that validation samples from the walls and base of the automotive pits would have been collected from the excavator bucket.
– equipment decontamination procedures	-	Provide a comment		Decontamination was not required as samples would have been collected from the centre of the excavator bucket.
– sample handling and transport procedures		Provide a comment		Appendix M of the CBP Validation Report indicates samples were packed into an esky with ice from the time of collection. Soil samples were forwarded to the laboratories under chain of custody conditions.
– sample preservation methods and reference to recognised protocols, e.g. APHA or US EPA SW 846	-	Provide a comment		Appendix M of the CBP Validation Report indicates soil samples were collected into laboratory prepared glass jars with Teflon lid inserts.
• Detailed description of field screening protocols and validation of field measurements	-	Provide a comment		
Field Quality Assurance and Quality Control (QA/QC) ✓	-	-		
• Details of sampling team	✓	-		
• Decontamination procedures carried out between sampling events	-	Provide a comment		Decontamination of sampling equipment was not required as samples were collected from the centre of the excavator bucket.
• Logs for each sample collected—including time, location, initials of sampler, duplicate locations, duplicate type, chemical analyses to be performed, site observations and weather conditions.	-	Please include		
• Chain of custody fully identifying—for each sample—the sampler, nature of the sample, collection date, analyses to be performed, sample preservation method, departure time from the site and dispatch courier(s).	-	Please include all COCs		See attached.
• Sample splitting techniques	-	Provide a comment		Appendix M of the CBP Validation Report indicates that a larger than normal quantity of soil is recovered from the sample locations, placed in a stainless steel bowl, mixed and then divided into two equal parts.
• Statement of duplicate frequency	-	Please clarify		One intra-laboratory duplicate was collected for 12 primary samples at the

EPA 1997 Reporting Guidelines Compliance Checklist – Validation

Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
				Automotive Pit.
• Field blank results	-	Provide a comment		Field blank samples were not collected as part of the remediation and validation works as the main validation method was visual removal of waste materials.
• Background sample results	-	Provide a comment		Background samples were not collected as part of the remediation and validation works as the main validation method was visual removal of waste materials.
• Rinsate sample results	-	Provide a comment		Rinsate samples were not required as no sampling equipment required decontamination.
• Laboratory-prepared trip spike results for volatile analytes	-	Provide a comment		The collection of soil validation samples was not expected to be required and trip blank samples and trip spike samples were not arranged in advance for validation soil sampling of unexpected finds.
• Trip blank results	-	Provide a comment		
• Field instrument calibrations (when used).	-	Provide a comment		No field instruments were used.
• Acceptance limit for each calibration standard	-	Provide a comment		Not applicable.
Laboratory QA/QC ✓	**-**	-		
• A copy of signed chain-of-custody forms acknowledging receipt date and time, and identity of samples included in shipments	-	Please include all COCs		See attached.
• Record of holding times and a comparison with method specifications	-	Provide a comment and include all laboratory reports.		Laboratory report relating to the validation sampling of the Automotive Pit is 128345. The COC indicates that samples were collected on 20 May 2015 and laboratory analysis was completed on 25 May 2015, which is within holding times for TPH and BTEX.
• Analytical methods used	✓	-	In order to sufficiently assess this section the auditor requires all laboratory reports, along with the COCs. Please provide these documents.	
• Laboratory accreditation for analytical methods used	✓	-		
• Discussion of non-standard methods used	-	NA		
• Laboratory performance in inter-laboratory trials for the analytical methods used, where available	✓	-		
• Description of surrogates and spikes used	✓	-		
• Per cent recoveries of spikes and surrogates	✓	-		
• Instrument detection limits	-	LOR used		
• Method Detection Limits	-	LOR used		
• Matrix or practical quantification limits	✓	-		
• Standard solution results	-	-		
• Reference sample results	-	-		
• Reference check sample results	-	-		
• Daily check sample results	-	-		
• Laboratory duplicate results	✓	-		
• Laboratory blank results	✓	-		
• Laboratory standard charts.	-	-		
QA/QC Data Evaluation ✓	**-**	-	Typo: Section 1.12.1, “Soil samples **that** were collected…”	
• Evaluation of all QA/QC information listed above against the stated DQIs, including a discussion of:	-	--		
– documentation completeness	✓	COCs are missing – Include all COCs		

EPA 1997 Reporting Guidelines Compliance Checklist – Validation

Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
– data completeness	✓	Provide a comment on why there is no inter-laboratory duplicate Provide a comment on rinsate samples and trip spike samples		It appears that inter-laboratory samples were not collected as part of the completed sampling. The main validation method was visual validation of the removal of waste materials, however where validation soil samples were collected, inter-laboratory duplicate samples should have been collected. Trip spike samples were not collected. Based on the main validation method of visual validation, the collection of soil validation samples was not expected to be required and trip spike samples were not arranged in advance for validation soil sampling of unexpected finds.
– data comparability (see next point)	✓	Include all logs for sample locations. Provide a comment on why a secondary laboratory and inter-laboratory duplicate were not used.		Logs of the sample locations were not provided by DLA, however the photographs indicate that the soil validation samples were collected from natural red/brown clays.
– data representativeness	✓	Provide a comment on trip blanks, rinsate blanks and trip spikes		See comment above.
– precision and accuracy for both sampling and analysis for each analyte in each environmental matrix informing data users of the reliability, unreliability, or qualitative value of the data	-	Provide a comment		Section 1.12.1 indicates that DLA considers that the analytical data generated is of an acceptable degree of accuracy, representativeness, comparability, completeness and precision for the purpose of assessing soil quality.
• Data comparability checks, which should include e.g. bias assessment – which may arise from various sources, including:	-	-		
– collection and analysis of samples by different personnel	✓	-		
– use of different methodologies	✓	-		
– collection and analysis by the same personnel using the same methods but at different times	✓	-		
– spatial and temporal changes (because of the environmental dynamics)	✓	-		
• Relative per cent differences for intra-and inter-laboratory duplicates.	✓	Provide a comment on why there is no inter-laboratory duplicate. Section 1.12.1, please provide a further comment on the RPD values compared to the DQIs.		See comment above.
Basis for Assessment Criteria ✓	**-**	-		
• Table listing all selected assessment criteria and references	✓	In section 1.8, for the dot points, please include that Tables 1A(3) and 1B(7) were also used. Table 4a: clarify that chromium is chromium **VI** and mercury is **inorganic**		Confirmed chromium VI and mercury (inorganic).
• Rationale for and appropriateness of the selection of criteria	✓	Note, *NSW EPA Guidelines for Assessing Service Station Sites (1994)* has been replaced with *Technical Note: Investigation of Service Station Sites (2014), NSW EPA*. Please amend in report. Provide a clarification why fine soil texture was used for Table 4c.	For a more logical order of the sections, the section on Assessment Criteria should follow the DQO section. Please amend.	Noted
• Assumptions and limitations of criteria.	-	Please provide a comment		
• Compliance with Guidelines for Consultants Reporting on Contaminated Sites (2011)	✓	-		
Results ✓	**-**	-		
• Summary of previous results, if appropriate	-	-		
• Summary of all results, in a table that:	✓	✓		

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Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
– shows all essential details such as sample numbers and sampling depth	✓	Include sampling depth		Section 1.11 indicates that samples were collected from the north, south, east and west walls at depths of 1-2m bgl and 2-4m bgl.
– shows assessment criteria	-	Include assessment criteria		Refer to CBP Validation Report
– highlights all results exceeding the assessment criteria	-	No exceedances		
• Site plan showing all sample locations, sample identification numbers and sampling depths	-	Please provide		Refer to CBP Validation Report
• Site plan showing the extent of soil and groundwater contamination exceeding selected assessment criteria for each sampling depth.	-	No exceedances		
Site Characterisation and Risk Assessment ✓	**-**	-	No risk assessment is provided, although step 1 in the DQO process states that …to evaluate the likely human health and environmental risks associated… Please provide a comment.	
• Assessment of type of all environmental contamination, particularly soil and groundwater	-	-		
• Assessment of extent of soil and groundwater contamination, including off-site effects	-	-		
• Assessment of the chemical degradation products	-	-		
• Assessment of possible exposure routes and exposed populations (human, ecological).	-	-		
• Assessment of type of risks particularly to human health and the environment	-	-		Assessment of risk was not required as the validation analytical results were below the site criteria.
• Assessment of mathematical modelling or other method to justify conclusions of risk assessment	-	-		
• Detection limits for each chemical appropriate for risk assessment process	-	-		
• Appropriateness of site specific risk assessment	-	-		
• Compliance with requirements in Human Health Risk Assessment checklist	-	-		
Remedial Action Plan ✓(S)	**-**	-	There is some mention of the remediation work and its goal throughout the document. However, the information is unclear and therefore, this section requires clarification. A summary of the ENVIRON 2014 RAWP and referencing it is sufficient – Please provide.	
• Remediation goal	✓	Clarify what the proposed land use is (see section 1.1)		
• Remediation category under SEPP55 (where applicable)	-	See comment in the right hand column		
• Discussion of the extent of remediation required	✓	-		
• Discussion of possible remedial options and how risk can be reduced including consideration of vertical soil mixing and capping	-	See comment in the right hand column		
• Where cap and contain is to be used:	-	NA		
– Maximises long term engineering security of the works	-	-		
– Minimises leachate formation and volatilisation	-	-		
– Notification mechanism to ensure protection of capped material	-	-		
– Structures built n capped area will not pose a future significant risk of harm	-	-		
• Where bioremediation option is used:	-	NA		
– Consideration of local rather than foreign species	-	-		
– Quarantine license and laboratory identification for foreign organisms	-	-		
– Potential risks from release of organisms	-	-		
– Monitoring and contingency measures	-	-		
• Consideration of chemical wastes subject to a	-	See comment in the right hand column		

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Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
Chemical Control Order (CCO) and compliance				
• Rationale for the selection of recommended remedial option including reference to ANZECC/ NHMRC preferred order of options for remediation	-	See comment in the right hand column		Refer to CBP Validation Report. Noted.
• Proposed testing to validate the site after remediation	-	See comment in the right hand column		
• Contingency plan if the selected remedial strategy fails	-	See comment in the right hand column		
• Interim site management plan (before remediation), including e.g. fencing, erection of warning signs, stormwater diversion	-	See comment in the right hand column		
• Boundary conditions and extent of remediation	-	See comment in the right hand column		
• Site management plan (operational phase):	-	See comment in the right hand column		
– site stormwater management plan	-	See comment in the right hand column		
– soil management plan	-	See comment in the right hand column		
– noise control plan	-	See comment in the right hand column		
– dust control plan, including wheel wash (where applicable)	-	See comment in the right hand column		
– odour control plan	-	See comment in the right hand column		
– occupational health and safety plan	-	See comment in the right hand column		
• Compliance with Part A in checklist (C1) for the EMP	-	See comment in the right hand column		
• Remediation schedule	-	See comment in the right hand column		
• Hour of operation	-	See comment in the right hand column		
• Contingency plans to respond to site incidents, to obviate potential effects on surrounding environment and community	-	See comment in the right hand column		
• Identification of regulatory compliance requirements such as licenses and approvals	-	See comment in the right hand column		
• Names and phone numbers of appropriate personnel to contact during remediation	-	See comment in the right hand column		
• Community relations plans, where applicable	-	See comment in the right hand column		
• Staged progress reporting, where applicable	-	See comment in the right hand column		
• Long-term site management plan	-	See comment in the right hand column		
Validation ✓	-	-		
Rationale and justification for the validation strategy including:	✓	-		
– clean-up criteria and statistically based decision-making methodology	✓	Provide a comment on statistics		
– validation sampling and analysis plan	✓	See comments above for the SAQP		
• Details of a statistical analysis of validation results and evaluation against the clean-up criteria	✓	Provide a comment on statistics		
• Verification of compliance with regulatory requirements set forth by the EPA, WorkCover and local government	✓	Provide a comment on WorkCover and local government.		
Ongoing site monitoring ✓	-	-	Although ongoing site monitoring is not required as per the CBP Validation Report, please provide a comment stating this and a rational for it.	
• Scope of ongoing site monitoring requirements (if any), including monitoring parameters, targets and frequency	-	-		
• Results of monitoring analyses including all relevant QA/QC reporting requirements stated above	-	-		
• Corrective/preventative action taken (where monitoring has indicated that performance targets have not been met)	-	-		Ongoing site monitoring is not required as per the CBP Validation Report as all wastes have been removed from the site and remedial works were successfully validated.

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Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
• Ongoing site/equipment maintenance, e.g. containment cap integrity	-	-		
• Details of party(ies) responsible for maintenance and monitoring program	-	-		
• Maintenance records for plant and equipment	-	-		
• Data management – indicate where, for how long and by whom, monitoring and maintenance records will be kept	-	-		
• Regulatory compliance for ongoing monitoring	-	-		
Conclusions and Recommendations ✓	**-**	-		
• Brief summary of all findings	✓	-		
• Assumptions used in reaching the conclusions	-	Provide a comment		
• Extent of uncertainties in the results	-	Provide a comment		
• Where remedial action has been taken, a list summarising the activities and physical changes to the site	-	Please provide		Noted.
• A clear statement that the consultant considers the subject site to be suitable for the proposed use (where applicable)	✓			Noted.
• A statement detailing all limitations and constraints on the use of the site (where applicable)	✓			
• Recommendations for further work, if appropriate.		Provide a comment		

Second paragraph:

- Update the NSW EPA Service Station Guidelines, 1994, to the *Technical Note: Investigation of Service Station Sites (2014), NSW EPA*
- Include the other tables that are used for the assessment criteria (Table 1A(3) and Table 1B(7))

EPA 1997 Reporting Guidelines Compliance Checklist – Validation

Client	**Hydro Aluminium Krurri Kurri Pty Ltd**
Site Name	**Clay Borrow Pit Area, Hydro Kurri Kurri Aluminium Smelter, Hart Road, Loxford, New South Wales (2321)**
Report Title	**Validation Report**
Report Date / Version / Reference	**29 October 2015 / Final / DLH1155_H000638**
Report Author / Consultant	**Jon Mansfield / DLA Environmental Services**
AECOM Auditor Assistant	**Erla Hafsteinsdottir**
AECOM Auditor Reviewed (initials / date)	**Ross McFarland / 25 August 2016**

Background:

The NSW EPA guidance on preparing a site remedial action plan (RAP) states:

*Where remedial action has been carried out, the site must be **'validated'** to ensure that the objectives stated in the RAP have been achieved. A report detailing the results of the site validation is required.*

The extent of validation required will depend on:

- *the degree of contamination originally present*
- *the type of remediation processes that have been carried out*
- *the proposed land use.*

Validation must confirm statistically that the remediated site complies with the clean-up criteria set for the site. For guidance, see the NSW EPA's Contaminated Sites Sampling Design Guidelines. Where applicable, the US EPA's Methods for Evaluating the Attainment of Cleanup Standards (1989) can also be used.

The validation report must assess the results of the post-remediation testing against the clean-up criteria stated in the RAP. Where targets have not been achieved, reasons must be stated and additional site work proposed to achieve the original RAP objectives.

The validation report should also include information confirming that all EPA and other regulatory authorities' licence conditions and approvals have been met. In particular, documentary evidence is needed to confirm that any disposal of soil off-site is done in accorance with the RAP.

The following checklist is based on that provided by the NSW EPA. The code system is:

- ✓ Include this section
- (S) A summary is adequate if detailed information was included in an available referenced previous report
- (N) Include only if there is to be no further site investigation
- (N/A) Not applicable

EPA 1997 Reporting Guidelines Compliance Checklist – Validation

Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
Executive Summary ✓	**-**	-		
• Background	✓	-		
• Objectives of the Investigation	✓	-		
• Scope of work	-	Provide information.		The scope of work included: • Supervision of remedial works to achieve remediation in accordance with the RAWP. • Complete validation photography in accordance with the RAWP.
• (Where appropriate) a summary of sampling results in tabulated format containing minimum, maximum, arithmetic average and 95% upper-confidence limit on arithmetic average for each analyte	-	-		
• Summary of conclusions and recommendations	✓	-		
Scope of Work and Objectives ✓	**-**	-		
• A clear statement of the scope of work	✓	-		
• A clear statement of the objectives.	✓	-		
Site Identification ✓	**-**	-		
• Street number, street name and suburb	✓	-		
• Lot number and Deposited Plan number	✓	-		
• Geographic coordinates related to a nearby cadastral corner of a State Survey Control Mark	✓	-	Minor edits required	
• Locality map	✓	Include scale bar and north arrow		
• Current site plan with scale bar, showing north, local water drainage and other local environmentally significant features	✓	Include a site plan showing local water drainage and other local environmentally significant features (e.g. Black Waterholes Creek, Wentworth Swamp wetlands) Identify the Unexpected Finds Area 3 (UFA3) on a map (see p. 3).		
Site History ✓ (S)	**-**	-		
• Summary of previous investigations	✓	-		
• Zoning-previous, present and proposed	✓	Include previous and proposed zoning		The previous zoning is the same as the current zoning. The proposed zoning is IN3 Heavy Industrial.
• Land use-previous, present and proposed	✓	-		
• Summary of Council rezoning and relevant development and building approvals records	-	Provide a comment		No rezoning has occurred at the site. Currently, there is a proposal to rezone the land IN3 Heavy Industrial.
• Chronological list of site uses, indicating information gaps and unoccupied periods	✓	In section 2.8, clarify what year the Smelter closure occurred.	Minor edits required.	The Smelter ceased production in September 2012 and was formally closed in May 2014.
• Review of aerial photographs	-	No aerial photographs provided. Please provide a comment – can refer to a relevant report where they might already have been provided.		Review of aerial photographs was completed as part of the site history review in ENVIRON (2013) Phase 1 ESA, Hydro Kurri Kurri Aluminium Smelter.
• Site photographs (with date and location indicated on site maps)	✓	Dates are missing on a number of photographs, also the location of the photographs (e.g. in which direction it is taken)		
• Inventory of chemicals and wastes associated with site use and their on-site storage location	-	Provide a comment		The site was used for the storage of refractory bricks and waste concrete.
• Possible contaminant sources and potential off-site effects including potential issues associated with migration of contaminants	✓	-		
• Site layout plans showing present and past industrial processes	-	Please provide		No industrial processes occurred at the site. The site was used for the storage of

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Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
				refractory bricks and waste concrete.
• Sewer and service plans	-	Please provide		
• Description of manufacturing processes	✓	-		
• Details and locations of current and former underground and aboveground storage tanks	-	Provide a comment		No underground or aboveground storage tanks were located on the site.
• Product spill and loss history	-	Provide a comment		No products were stored on the site.
• Discharges to land, water and air	✓	-		
• Disposal locations	✓	-		
• Relevant complaint history	-	Provide a comment		It is understood there is no history of complaints relating to the site.
• Local site knowledge of residents and staff-both present and former	-	Provide a comment		The Hydro Environmental Manager, Mr McNaughton, provided local site knowledge, which was included in ENVIRON (2013) Phase 1 ESA, Hydro Kurri Kurri Aluminium Smelter.
• Summary of local literature about the site, including newspaper articles	-	Provide a comment		No information available that is applicable to the site.
• Details of building and related permits, licences, approvals and trade waste agreements	-	Provide a comment		Information on the adjacent Smelter is included in ENVIRON (2013) Phase 1 ESA, Hydro Kurri Kurri Aluminium Smelter.
• Historical use of adjacent land	✓	Present surrounding land use is provided – please also provide a comment on the historical use.		Historical use is the same as the present use. No major changes have occurred to the historical use of surrounding land since the 1960s.
• Local usage of ground/surface waters, and locations of bores/pumps	✓	-		
• Integrity assessment (assessment of the accuracy of information)	-	Provide a comment		
Site Condition and Surrounding Environment ✓ (S)	**-**	-	Minor edits required.	
• Topography	✓	-		
• Conditions at site boundary such as type and condition of fencing, soil stability and erosion	-	Provide a comment		The Clay Borrow Pit is a portion of land to the west of the Smelter that was used to excavate clay for capping material to cap the Capped Waste Stockpile. The edge of the site is identifiable as the tree line between densely vegetated natural bushland and the grassed area of the Clay Borrow Pit.
• Visible signs of contamination such as discolouration or staining of soil, bare soil patches-both on-site, and off-site adjacent to Site boundary	✓	-		
• List potential contaminants of concern at or near the site	✓	-		
• Visible signs of plant stress				
• Presence of drums, wastes and fill materials	✓	Provide a comment on presence of drums		There were no drums present at the site prior to and during the remedial works.
• Odours	✓	-		
• Condition of buildings and roads	-	Provide a comment		There are no buildings at the Clay Borrow Pit. The access road to the Clay Borrow Pit was constructed from refractory brick for stability.
• Quality of surface water	✓	-		

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Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
• Flood potential	-	Provide a comment		
• Details of relevant local sensitive environment-e.g Rivers, lakes, creeks, wetlands, local habitat areas, endangered flora and fauna.	✓	-		
• Identification of sensitive receptors, e.g. kindergarten, parks, etc.	✓	-		
Geology and Hydrogeology ✓(S)	-	-		
• Soil stratigraphy using recognised classification methods, e.g. Australian Standard 1726, Unified Soil classification Table	✓	-		
• Location and extent of imported and locally derived fill	✓	-		
• Site borehole logs or test pit logs showing stratigraphy	✓	-		
• Detailed description of the location, design and construction of on-site wells.	-	Include a comment.		On-site wells were installed to assess groundwater conditions during the Environ 2012 Phase 2 Environmental Site Assessment. Information regarding the location, design and construction is included in ENVIRON (2012) Phase 2 Environmental Site Assessment, Kurri Kurri Aluminium Smelter.
• Description and location of springs and wells in the vicinity	✓	-		
• Depth to groundwater table	-	Provide information.		A perched groundwater table was identified at depths of 1 to 4mbgs within fill materials. A permanent bedrock aquifer is present within the underlying siltstone at depths of approximately 9 mbgs.
• Direction and rate of groundwater flow	✓	Provide information on flow rate.		Groundwater within the bedrock aquifer flows to the north east, with groundwater flowing within rock defects and joints confined by the overlying clays. Groundwater flow rates are considered to be low.
• Direction of surface water run-off	✓	-		
• Background water quality	✓	One sentence comment is made in section 3.7.1 – please provide a further comment		Background water quality was assessed via well MW06, installed to the west of the Smelter. Background water quality was assessed in ENVIRON (May 2015) Phase 2 Environmental Site Assessment, Smelter Site, Additional Investigations, which indicated that heavy metal, fluoride, cyanide, PAHs and SVOC concentrations were below the site criteria aside from zinc concentrations of 78µg/L exceeded the ANZECC (2000) hardness modified trigger value of 70µg/L.
• Preferential water courses	✓	-		
• Summary of local meteorology	✓	-		
Acid Sulphate Soils ✓(S)	-	-		
• Identification of extent and potential for ASS	✓	-		
• Assessment of management and remedial strategies to work with ASS	NA	ASS not identified		

Minor edits required.

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Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
Sampling and Analysis Plan and Sampling Methodology ✓	-	-	The SAQP is unclear because the sections are not provided in the correct sequence, i.e. planning/preparation → work undertaken. See further comment below: This section should be presented prior to Section 5 Remediation Works. It forms part of the planning stage and sets the requirements of the work before presenting the work that was undertaken. Although the consultant's main objective was the validation work by visual assessment, sample collection was required as the remediation works progressed. In particular, the DQOs should be presented before Section 6.1 for a clear understanding of the sequence of works (i.e. present before outlining the sampling work undertaken). Typo: • Section 6.3, …the DQOs have been summarised **in** the table below… • Table 6b, Step 7, the second last point is a repetition of the one above it. • Appendix M, change o "Appendix **M**1 – Field Quality Control" o "Appendix **M**2 – Laboratory Analytical and Quality Plan" Table 6a – Sample Collection and Analysis: please expand this table to clarify the SAQP (or provide a new table), including Sample IDs, sample depths	
• Sampling, analysis and data quality objectives (DQOS)	✓	Table 6b, Step 4 in DQO, provide a comment on the temporal boundaries.		The temporal boundary is limited to the data collected during the remediation and validation works.
• Rationale for the selection of:	-	-		
– sampling pattern	✓	-		
– sampling density including an estimated size of the residual hot spots that may remain undetected	✓	-		
– sampling locations including locations shown on a site map	✓	Include a site map showing sampling locations (soil and asbestos)		
– sampling depth	-	Sampling depths are provided in results table in Appendix H. However, please provide a comment on the rational		Soil validation samples were collected from pits excavated due to the identification of unexpected finds, such as a former well and car bodies. Soil validation samples were collected from the walls and base of each individual pit at a depth where the unexpected find occurred. As the walls and base of most pits were within natural sandy clay with no change in lithology, one sample was collected per pit wall. Two wall samples were collected from depth of 1-2m bgl and 2-4m bgl at the Automotive Pit, which extended to a depth of 4m bgl..
– samples for analysis and samples not analysed	✓	Provide a comment whether or not all samples were analysed, and a rational.		All collected validation samples were sent for laboratory analysis.
– sampling of relevant environmental media (soil, air, water)	✓	-		
– analytical methods	✓	Provided in laboratory reports		
– analytes for samples	✓	-		
• Detailed description of the sampling methods including:	-	This is provided in part in the main body of text and then in more detail in Appendix M1. However, the information should be provided as part of the SAQP and then assessed in Appendix M1. Please amend accordingly.		Noted
– sample containers and type of seal used	✓	-		
– sampling devices and equipment e.g. auger type	✓	See above comment regarding amendment		
– equipment decontamination procedures	✓	See above comment regarding amendment		
– sample handling and transport procedures	✓	-		
– sample preservation methods and reference to recognised protocols, e.g. APHA or US EPA SW 846	-	Provide a comment		Appendix M indicates soil samples were collected into laboratory prepared glass jars with Teflon lid inserts. All samples were packed into an esky with ice from the time of collection. Soil samples were forwarded to the laboratories under chain of custody conditions.
• Detailed description of field screening protocols and validation of field measurements	✓	-		
Field Quality Assurance and Quality Control (QA/QC) ✓	-	-	Please provide all COCs and laboratory reports – the auditor is unable to assess the QA/QC section without it (holding times, recoveries etc.) Appendix M1 – Field Quality Control:	
• Details of sampling team	✓	-		
• Decontamination procedures carried out between sampling events	✓	-		

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Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
• Logs for each sample collected—including time, location, initials of sampler, duplicate locations, duplicate type, chemical analyses to be performed, site observations and weather conditions.	-	Please provide information	• Clarify which second lab was used (ASET and/or SGS) • Text indicates that 12 soil samples were collected. However, there are 17 samples in Appendix H – Clarify the number of samples collected • Table C3: include the comparison with HIL concentration for a clear comparison (less than 5%)	
• Chain of custody fully identifying—for each sample—the sampler, nature of the sample, collection date, analyses to be performed, sample preservation method, departure time from the site and dispatch courier(s).	-	Provide all COCs		Envirolab was the primary laboratory for heavy metals, TRH, BTEX, PAH and fluoride analysis. ASET was the primary laboratory for asbestos analysis. No samples were sent to a secondary laboratory.
• Sample splitting techniques	✓	-		12 soil validation samples were collected from the Automotive Pit unexpected find. A further 5 samples were collected from other unexpected finds, as follows: • Hotspot 1: 2 samples for TRH/BTEX; • Packing Coke: 1 sample for PAHs; • Sediment Scrapings: 2 samples for fluoride and cadmium.
• Statement of duplicate frequency	✓	-		
• Field blank results	-	Provide a comment		Field blank samples were not collected as part of the remediation and validation works as the main validation method was visual removal of waste materials.
• Background sample results	-	Provide a comment		Background samples were not collected as part of the remediation and validation works as the main validation method was visual removal of waste materials.
• Rinsate sample results	-	Provide a comment		Rinsate samples were not collected although Appendix M indicates that a hand auger, spades and a mixing bowl were used for sampling.
• Laboratory-prepared trip spike results for volatile analytes	✓	However, the auditor requires all laboratory reports to be able to confirm the information in Appendix M meets criteria.		Laboratory reports have been provided as follows: • Hotspot 1: Envirolab Report 124662 • Well 1: ASET Report 43437/46617 • Well 2: ASET Report 43615/46795 • SMF: ASET Report 43345/46525 • Packing Coke: Envirolab Report 128665 • Automotive Waste: Envirolab Report 128345 • Sediment Scrapings: Envirolab Report 131590 Stockpile containing ACM: ASET Report 43669/ 46849
• Trip blank results	-	Provide a comment		No trip blank samples were collected as part of the validation of the unexpected finds. Based on the main validation method of visual validation, the collection of soil validation samples was not expected to be required and trip blank samples were not arranged in advance for validation soil sampling of unexpected finds.

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Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
• Field instrument calibrations (when used).	-	-		
• Acceptance limit for each calibration standard	-	-		
Laboratory QA/QC ✓				
• A copy of signed chain-of-custody forms acknowledging receipt date and time, and identity of samples included in shipments	-	Not all COCs were provided		COCs are attached.
• Record of holding times and a comparison with method specifications	-	Please provide all laboratory reports		Laboratory reports have been provided as follows: • Hotspot 1: Envirolab Report 124662 • Well 1: ASET Report 43437/46617 • Well 2: ASET Report 43615/46795 • SMF: ASET Report 43345/46525 • Packing Coke: Envirolab Report 128665 • Automotive Waste: Envirolab Report 128345 • Sediment Scrapings: Envirolab Report 131590 • Stockpile containing ACM: ASET Report 43669/ 46849
• Analytical methods used	✓	-		
• Laboratory accreditation for analytical methods used	✓	-		
• Discussion of non-standard methods used	✓	-		
• Laboratory performance in inter-laboratory trials for the analytical methods used, where available	-	Provide a comment on inter-laboratory samples	Some missing information is required. Minor edits / comments required.	It appears that inter-laboratory samples were not collected as part of the completed sampling. The main validation method was visual validation of the removal of waste materials, however where validation soil samples were collected, inter-laboratory duplicate samples should have been collected.
• Description of surrogates and spikes used	✓	-		
• Per cent recoveries of spikes and surrogates	✓	Provide information for surrogates		DLA indicate in Appendix M that surrogate recoveries for soil samples were all within recommended control limits, indicating there was an acceptable degree of accuracy in analysing for organic compounds.
• Instrument detection limits	-	LOR provided		
• Method Detection Limits	-	LOR provided		
• Matrix or practical quantification limits	✓	-		
• Standard solution results	-	Provide a comment		
• Reference sample results	-	Provide a comment		
• Reference check sample results	-	Provide a comment		Envirolab used laboratory control samples in their QA/QC and assessed spike recoveries. Spike recoveries were within acceptable control limits.
• Daily check sample results	-	Provide a comment		
• Laboratory duplicate results	✓	-		
• Laboratory blank results	✓	-		
• Laboratory standard charts.	-	-		
QA/QC Data Evaluation ✓	**-**	-		
• Evaluation of all QA/QC information listed above against the stated DQIs, including a discussion of:	-	-	Some missing information is required. Minor edits / comments required.	
– documentation completeness	✓	COCs not included in report – see above		

EPA 1997 Reporting Guidelines Compliance Checklist – Validation

Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
– data completeness	✓	Provide a comment regarding a secondary duplicate (inter-laboratory). NEPM states 1:20, which is the same as for intra-laboratory duplicates. Provide a comment regarding trip spikesIn		Inter-laboratory duplicate samples were not collected – see comment above. Trip spike samples were not collected. Based on the main validation method of visual validation, the collection of soil validation samples was not expected to be required and trip spike samples were not arranged in advance for validation soil sampling of unexpected finds.
– data comparability (see next point)	✓	However, see comments below and also, provide: • Detailed logs of all sample locations • A comment on primary and secondary laboratory (rational for not using a secondary laboratory)		Logs of the sample locations were not provided by DLA, however the photographs indicate that the soil validation samples were collected from natural red/brown clays.
– data representativeness	✓	Please provide a comment on Trip Blanks and Trip Spikes		Trip blank and trip spike samples were not arranged in advance for validation soil sampling of unexpected finds.
– precision and accuracy for both sampling and analysis for each analyte in each environmental matrix informing data users of the reliability, unreliability, or qualitative value of the data	✓	-		
• Data comparability checks, which should include e.g. bias assessment – which may arise from various sources, including:	-	Please provide a comment for the following points:		
– collection and analysis of samples by different personnel	-	+		DLA had two personnel inducted on site. Validation soil sampling would have been completed by one of these two personnel.
– use of different methodologies	-	+		Appendix M indicates that sampling equipment included a hand auger, spades and a mixing bowl.
– collection and analysis by the same personnel using the same methods but at different times	-	+		The collection of validation soil samples from each of the unexpected finds occurred at different times throughout the remediation and validation works.
– spatial and temporal changes (because of the environmental dynamics)	-	+		There were no spatial or temporal changes that are likely to have altered the outcome of the validation sampling of the unexpected finds.
• Relative per cent differences for intra-and inter-laboratory duplicates.	✓	+		One intra-laboratory duplicate was analysed as part of the validation of the Automotive Pit. RPDs for heavy metals exceeded 50% for copper, nickel and zinc. DLA indicated that the concentrations for the primary and intra-lab duplicate pair were less than 5% of the relevant HIL concentration.
Basis for Assessment Criteria ✓	**-**	-	Typos: • Section 6.4, fourth paragraph: o Singular or plural? …during the excavation works, **an** asbestos clearance certificate **have** been provided as **appendices** in this… o This paragraph should be presented as part of the SAQP (apart from the first sentence which belongs to the results section)	
• Table listing all selected assessment criteria and references	✓	Table 6d, provide an explanation for “NL” Table 6f, value for ESL is **0.7** mg/kg not 1.4 mg/kg – correct table. Table 6g, amend table to clarify that 0.001% for FA and AF is for all (A, B, C and D) not just A.		“NL” is non-limiting. Noted. Noted.
• Rationale for and appropriateness of the selection of criteria	✓	Section 6.4.1, in the summary of the applicability of the guidelines; expand on the first point for HILs how they are applicable for commercial/industrial sites.		

EPA 1997 Reporting Guidelines Compliance Checklist – Validation

Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
		Table 6f, provide the rational for using fine soil texture.	• Section 6.4.4, second paragraph …on such factors as local biological **e**ffects data…	Natural soils at the site are clays.
• Assumptions and limitations of criteria.	✓	-		
• Compliance with Guidelines for Consultants Reporting on Contaminated Sites (2011)	✓	-		
Results ✓	-	-		
• Summary of previous results, if appropriate	✓	-		
• Summary of all results, in a table that:	-	-		
– shows all essential details such as sample numbers and sampling depth	✓	-		Appendix M indicates sampling methods included a hand auger and spades.
– shows assessment criteria	✓	Clarify the assessment criteria for PAH total and metals in Appendix H Data Summary Table		
– highlights all results exceeding the assessment criteria	✓	-		
• Site plan showing all sample locations, sample identification numbers and sampling depths	-	Appendix H – Data Summary Table: need an explanation of where these samples were collected from – provide a site plan with their locations, IDs and depths	Section 7, please include a comment referring to the results table in Appendix H, as appropriate, and clarify sample IDs for each section. As per comments above, sampling methods are unclear in the main body of the text – please amend as per instructions above. Section 7.1.2, first paragraph, add "bgl" …Fill materials were observed from 1.0 m**bgl** to 4.0 m**bg**l across… Section 7.2.6 refers to Appendix L Automotive Waste Find Validation Report – this report will be reviewed separately and another audit report provided to the consultant. Section 7.5 refers to 12 samples. However, Appendix H data summary table includes 17 samples – please clarify. Section 7.5, clarify sentence "When validation sampling was conducted of the Automotive Pit which included a Laboratory Duplicate." Appendix H Data Summary Table: • Provide a comment on all the asbestos results (as presented in Table 6a). • Clarify what analyte is in the last column ("Fl")	Seventeen primary soil samples for collected in four batches from four different unexpected finds, as follows: • Hotspot 1: 2 samples for TRH/BTEX; • Packing Coke: 1 sample for PAHs; • Automotive Pit: 12 samples for heavy metals, TRH, BTEX; • Sediment Scrapings: 2 samples for fluoride and cadmium. Given the low number of samples collected per batch, duplicate samples were not collected aside from one duplicate sample collected during the sampling of the Automotive Pit. One inter-laboratory duplicate soil sample was collected for the 12 primary validation samples from the Automotive Pit. As Asbestos Clearance Certificate was provided in Appendix I of the report, which concludes that the five areas have have been cleared of asbestos based on visual inspection and asbestos soil sampling. A suspected ACM fragment from Well 1 was confirmed by laboratory testing to contain asbestos. FL is fluoride.
• Site plan showing the extent of soil and groundwater contamination exceeding selected assessment criteria for each sampling depth.	-	No exceedances		
Site Characterisation and Risk Assessment ✓	-	-	Minor edits / comments required	
• Assessment of type of all environmental contamination, particularly soil and groundwater	✓	-		
• Assessment of extent of soil and groundwater contamination, including off-site effects	✓	-		
• Assessment of the chemical degradation products	-	Provide a comment		There are no chemical degradation

EPA 1997 Reporting Guidelines Compliance Checklist – Validation

Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
				products associated with the chemicals of concern for each unexpected find, including heavy metals, TRH, BTEX, PAHs, fluoride and asbestos.
• Assessment of possible exposure routes and exposed populations (human, ecological).	✓	-		
• Assessment of type of risks particularly to human health and the environment	✓	-		
• Assessment of mathematical modelling or other method to justify conclusions of risk assessment	-	Please provide a comment		Risk assessment was not required to be undertaken as part of the remediation and validation works.
• Detection limits for each chemical appropriate for risk assessment process	NA	NA		
• Appropriateness of site specific risk assessment	NA	NA		
• Compliance with requirements in Human Health Risk Assessment checklist	NA	NA		
Remedial Action Plan ✓(S)	**-**	-		
• Remediation goal	✓	-		
• Remediation category under SEPP55 (where applicable)	✓	-		
• Discussion of the extent of remediation required	✓	-		
• Discussion of possible remedial options and how risk can be reduced including consideration of vertical soil mixing and capping	✓	Provide a comment on vertical soil mixing and capping.		
• Where cap and contain is to be used:	-	-		
– Maximises long term engineering security of the works	-	-		
– Minimises leachate formation and volatilisation	-	-		
– Notification mechanism to ensure protection of capped material	-	-		
– Structures built n capped area will not pose a future significant risk of harm	-	-		
• Where bioremediation option is used:	-	-		
– Consideration of local rather than foreign species	-	-		
– Quarantine license and laboratory identification for foreign organisms	-	-		
– Potential risks from release of organisms	-	-		
– Monitoring and contingency measures	-	-		
• Consideration of chemical wastes subject to a Chemical Control Order (CCO) and compliance	✓	-		
• Rationale for the selection of recommended remedial option including reference to ANZECC/ NHMRC preferred order of options for remediation	✓	Provide a comment in the right hand column on a reference to ANZECC/NHMRC preferred order of options for remediation.		
• Proposed testing to validate the site after remediation	✓	-		
• Contingency plan if the selected remedial strategy fails	✓	-		
• Interim site management plan (before remediation),	✓	-		

In section 5 Remediation Works, clarify what the **MOXY** incident is, especially if it impacted on the remedial works.
Section 5.4.2, provide a comment on the use of ENM/VENM for the imported materials.

Typos:
Section 5.2.6, …1.5 m – 2.5 m depth with a 1.0 **m** capping layer…
Section 5.3, …Fines and oversized **??** are stockpiled in the main…
Section 5.4.4., …requirements as the Site **is** encapsulated by either…

The MOXY is the name of the dump trucks used to transport waste material to the stockpile area at the Smelter Site. A hydraulic line on one of the MOXYs leaked hydraulic oil onto the ground on one day of the works. The visually stained soil was excavated and stockpiled with other waste soils at the Smelter Site stockpile area.

EPA 1997 Reporting Guidelines Compliance Checklist – Validation

Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
including e.g. fencing, erection of warning signs, stormwater diversion				
• Boundary conditions and extent of remediation	✓	-		
• Site management plan (operational phase):	✓	-		
– site stormwater management plan	✓			
– soil management plan	✓	-		
– noise control plan	✓	-		
– dust control plan, including wheel wash (where applicable)	✓	Provide a comment on wheel wash		All works were undertaken within the Smelter site. A wheel wash was not required for works within the Smelter Site, however heavy vehicles were washed down prior to leaving site.
– odour control plan	✓	-		
– occupational health and safety plan	✓	-		
• Compliance with Part A in checklist (C1) for the EMP	-	Confirm the CEMP was produced		The Remediation Contractor, EnviroPacific Services, developed a site-specific CEMP for the remedial works.
• Remediation schedule	✓	-		
• Hour of operation	✓	-		
• Contingency plans to respond to site incidents, to obviate potential effects on surrounding environment and community	✓	-		
• Identification of regulatory compliance requirements such as licenses and approvals	✓	-		
• Names and phone numbers of appropriate personnel to contact during remediation	✓	Provide a comment on phone numbers		Phone number of specific members of the remedial team were not available at the time the RAWP was completed.
• Community relations plans, where applicable	✓	-		
• Staged progress reporting, where applicable	-	Provide a comment in the right hand column		Staged progress reporting was not required.
• Long-term site management plan	✓	-		
Validation ✓	-	-		
Rationale and justification for the validation strategy including:	✓	-		
– clean-up criteria and statistically based decision-making methodology				
– validation sampling and analysis plan	✓	See comments above regarding the SAQP		Noted.
• Details of a statistical analysis of validation results and evaluation against the clean-up criteria				
• Verification of compliance with regulatory requirements set forth by the EPA, WorkCover and local government	✓	-		
Ongoing site monitoring ✓	-	-	Note: The aesthetic impacts were negated and therefore no further management was deemed a requirement. Additionally, samples that were collected during the remediation works were either below LOR or criteria. Materials left in stockpiles on the Hydro site remain there for future use in the “whole of site” remediation.	
• Scope of ongoing site monitoring requirements (if any), including monitoring parameters, targets and frequency	-	-		
• Results of monitoring analyses including all relevant QA/QC reporting requirements stated above	-	-		
• Corrective/preventative action taken (where monitoring has indicated that performance targets have not been met)	-	-		
• Ongoing site/equipment maintenance, e.g. containment cap integrity	-	-		

EPA 1997 Reporting Guidelines Compliance Checklist – Validation

Section	Ref / Sec in Report	Comments on Specific Information to be Included	Overall Conclusion for this Section	Consultants Reply / Section Amended
• Details of party(ies) responsible for maintenance and monitoring program	-	-		
• Maintenance records for plant and equipment	-	-		
• Data management – indicate where, for how long and by whom, monitoring and maintenance records will be kept	-	-		
• Regulatory compliance for ongoing monitoring	-	-		
Conclusions and Recommendations ✓	**-**	-		
• Brief summary of all findings	✓	-		
• Assumptions used in reaching the conclusions	✓	-		
• Extent of uncertainties in the results	-	Please provide a comment		Validation of the remedial works was based on a visual assessment of the removal of all fill material. There is no uncertainty in the results of the visual validation of the removal of all fill material from the Clay Borrow Pit.
• Where remedial action has been taken, a list summarising the activities and physical changes to the site	✓	Provided as text in section 8, which is sufficient.		
• A clear statement that the consultant considers the subject site to be suitable for the proposed use (where applicable)	✓	-		
• A statement detailing all limitations and constraints on the use of the site (where applicable)	-	Provide a comment.		
• Recommendations for further work, if appropriate.	-	No further work deemed necessary.		

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26 July 2016

Richard Brown

Managing Director
Hydro Aluminium Kurri Kurri Pty Limited
PO Box 1 Kurri Kurri
New South Wales, Australia, 2327

Dear Richard,

Auditor's Interim Opinion relating to the Remedial Action Plan for the Smelter Site, Hydro Kurri Kurri, NSW

1.0 Introduction

Ross McFarland was engaged by Hydro Aluminium Kurri Kurri Pty Ltd ("Hydro") as the Site Auditor, accredited by the NSW Environment Protection Authority (NSW EPA) under the Contaminated Land Management Act 1997, (Accreditation No. 9819) to audit the assessment, remediation and validation works conducted on the former Hydro Aluminium Smelter, Kurri Kurri, NSW. The part of the former smelter area this Interim Opinion (IO) refers to is the former Smelter, which is referred to herein as "the Site". The Site is presented on the Consultant's Figure 2 attached to this Interim Opinion (IO).

This letter contains the Auditor's IO of the following document:

- Ramboll, 2016, "*Remedial Action Plan Hydro Aluminium Smelter Kurri Kurri*", dated 12 July 2016 (herein referred to as "the RAP"); and
- Ramboll, 2016, "*Hydro Aluminium Smelter Kurri Kurri Remedial Action Plan Sustainability Analysis Results"*, dated 22 July, 2016.

This IO is based on comparison of the RAP primarily against the guidelines endorsed by NSW EPA in Section 105 of the CLM Act, as amended, as well as NSW EPA Technical Practice Notes, as may be appropriate.

1.1 Purpose of the Audit

The demolition and remediation of the Site is considered State Significant, and the Audit of the 140ha Site is statutory as it is a requirement by the Department of Planning and Infrastructure in response to a Preliminary Environment Assessment (PEA). The Secretary's Environmental Assessment Requirements requested that an RAP was to be prepared and that the RAP *"…be accompanied by a Site Audit Statement from an Environment Protection Authority (EPA) accredited site auditor and prepared in accordance with the contaminated land planning guidelines under section 145C of the EP&A Act and relevant guidelines produced or approved under section 105 of the* Contaminated Land Management Act 1997".

The purpose of the Audit is to determine if the land can be made suitable for General Industrial (IN1), Heavy Industrial (IN3) and Environmental Conservation (E2) by implementation of the RAP (i.e. it is a Part B(iii) Audit).

2.0 Background

The former Aluminium Smelter was active from 1969 until it ceased operations in 2012, and closed down in 2014 after two years of care and maintenance. The smelter operated a single pot line until 1979, when a second pot line was commissioned. A third pot line was added in 1985, and upgrades were undertaken in 2002, resulting in a production of 180,000 tonnes of aluminium per annum.

Hydro has produced a master plan for the proposed re-zoning of the Site, which includes General Industrial (IN1), Heavy Industrial (IN3) and Environmental Conservation (E2).

Ramboll (formerly Environ) undertook several ESAs (reviewed by the Auditor) and identified Areas of Environmental Concern (AECs) that need remediation and management, and further areas that need to be investigated when access is obtained following removal of buildings / services. The AECs and associated Contaminant of Concern (CoC) identified by Ramboll are provided in **Table 1** below.

Table 1 Areas of Environmental Concern at the Smelter Site

Site Activity	Site Area	Description	CoC
Waste Stockpiling	Capped Waste Stockpile (AEC 1)	Long term stockpiling of spent pot lining and other wastes.	Fluoride cyanide Polycyclic Aromatic Hydrocarbons (PAH) including B(a)P asbestos Total Petroleum Hydrocarbons and Benzene, Toluene, Ethylbenzene and Xylenes (TPH/BTEX) Heavy metals
	Anode Waste Pile (AEC 2)	Long term stockpiling of 'ahead of schedule anodes' in low lying ground adjacent to the Capped Waste Stockpile.	B(a)P
Fill Importation	Diesel Spray Area (AEC 4)	Likely that impacted fill material was used to level this portion of the Site.	B(a)P
Site Operation	Carbon Plant (AEC 8)	Impacts in the vicinity are likely due to the accumulation of dust from the Carbon Plant. Impacts in garden beds and grassed areas.	B(a)P
	Bake Furnace Scrubber (PAEC 26)	Impacts associated with the accumulation of black sandy material likely to be spilt Ring Furnace Reacted Alumina. Impacts to shallow surface soil beneath the scrubber duct work.	B(a)P
Burial of Waste	Area East of Playing Fields (PAEC 29)	Waste materials, including concrete, refractory brick, metal sheeting, metal reinforcement, plastic sheeting, timber, fence posts, broken glass, electrical wire, steel posts and old cable.	B(a)P
Drainage	Drainage Lines (AEC 5)	PAH contaminated sediments have accumulated in the drainage line adjacent to the Anode Waste Pile.	B(a)P
	East Surge Pond (AEC 6)	PAH contaminated sediments have accumulated within the East Surge Pond, which is immediately down gradient of the drainage lines near the Anode Waste Pile.	B(a)P

The Capped Waste Stockpile was identified as the main AEC. A groundwater plume was identified in association with the Capped Waste Stockpile, extending north approximately 300m from the north-eastern corner.

The main CoC was defined as carcinogenic certain PAHs. This CoC was found in shallow soils (generally less than 0.6 m below ground surface (m bgs), within fill. Investigation results indicated that the natural materials underlying the fill were not significantly impacted.

2.1 Spent Pot Lining

Ramboll described Spent Pot Lining (SPL) as a waste product of main concern, stored in the Capped Waste Stockpile. It's associated with aluminium smelting when using the "Hall-Heroult reduction process". In this process, electrolytic cells or pots are used. The pots are made of a steel container lined with refractory brick and an inner lining of carbon, which protects the steel against corrosion.

Chemicals from the electrolytic bath, such as cryolite (Na_3AlF_6) and other fluoride salts, are taken up in the pot lining during its service life. As such, SPL is associated with elevated concentrations of leachable fluoride and sodium, and also contains cyanide-forming materials. The Pot Lining is spent when the molten bath and metal breach the carbon and refractory lining. The SPL is then extracted from the steel shell in pieces for disposal.

3.0 Remedial Strategy Summary

Ramboll outlined remedial options and presented the preferred option in the RAP, noting that some areas are yet to be investigated when access is obtained. A brief summary of the remediation method is provided below.

3.1 Soil and Waste Material

Ramboll identified the preferred option as relocating / consolidating all contaminated soils and the contents of the Capped Waste Stockpile into a Containment Cell. The location of the Containment Cell is to be the Clay Borrow Pit (currently being remediated) and the design was stated to be using best demonstrated available technology to contain contaminated soils and smelter wastes in perpetuity. The specifications of the design are to be provided in a separate document.

The cell design was described as comprising a triple base liner combining compacted clay and with high density polyethylene liners. Leachate drainage layers and leachate collection is included in the design for the base liner. The cell cap was described to comprise a double liner system with clay and geo-synthetic high density polyethylene liners. Gas venting, drainage layers, fauna protection and vegetation layers were all included in the cap design. As a contingency, the cell was designed to accommodate additional volume by increasing height if needed.

3.2 Groundwater

Ramboll defined the preferred option for the leachate plume in groundwater at the Capped Waste Stockpile as a combination of leachate interception, source removal and on-going monitoring. The leachate interception is already in place (since April 2014) and pumps leachate to the East Surge Pond.

Source removal is intended by removing the material stored in the Capped Waste Stockpile and placing it in the containment cell. Source removal is also intended by draining the leachate contained within the wastes into a sump within the Capped Waste Stockpile bund.

The leachate is to be extracted and treated through a water treatment plant (specifications for the water treatment plant is to be provided in a separate document to be reviewed by the Auditor). The treated water is to be discharge to the North Dam, which is irrigated under EPL.

Following the removal of the stockpiled material, the sump will remain and water will be treated until visible signs of leachate are removed. On-going monitoring was presented as a means of determining the success of the remediation.

4.0 Auditor's Interim Opinion

In my opinion, the land can be made suitable for General Industrial (IN1), Heavy Industrial (IN3) and Environmental Conservation (E2) by implementation of the RAP as outlined in the remedial action plan (RAP), and if successfully implemented, the proposed works should result in remediation of the Site, to enable the proposed landuses to proceed. However, the appropriateness of the RAP is subject to the following comments and clarifications:

1. As noted by the Consultant, further supplementary investigations are proposed in the AECs not yet able to be assessed due to access issues. The final landuse suitability Audit will require the entire Site to be characterised and, if necessary, remediated for the proposed landuses. This supplementary characterisation and remediation would need to include the parts of the buffer land that are associated with the Audit, and

areas between the AECs, to ensure that the whole of the Site (as defined) is able to be certified as suitable for the proposed uses and ongoing protection of the environment is achieved.

2. Consideration should be given to ensuring that contaminants of concern, including any emerging contaminants, are adequately considered during the proposed supplementary investigations, remedial works and validation processes.

3. It will be essential that a suitable monitoring program for Site's groundwater is implemented in a manner consistent with NSW EPA guidelines, since the proposed RAP does not anticipate active remediation of the residual plume. The Consultant has advised that further confirmatory investigations are proposed for human health and ecological risks assessment and associated management contingencies have been identified in the event that the proposed soil and waste remediation is not successful.

4. The Consultant stated that specific future documents, relating to the Site's detailed validation plan, and the details of the containment cell and water treatment system, would be provided to the Auditor for review prior to commencement of remedial works. These documents are essential to ensure the continued appropriateness of the Site's remediation, as well as being key to ultimately confirming the Site's final and continued landuse suitability.

5. The Consultant discussed immobilisation and presented the immobilisation options considered. At the time of reporting, an application was being prepared for the NSW EPA, and the Consultant included a summary of the approach. This IO is subject to an approved approach for immobilisation of the material.

6. The Consultant stated that a methodology is yet to be developed for the potential event that reactive materials from the Capped Waste Stockpile are encountered. According to the Consultant, the methodology needs to be approved by the NSW EPA. This IO is subject to an approved approach being established.

7. The NSWEPA has commissioned an independent specialist to review the containment cell design, including relevant quality assurance and maintenance/monitoring protocols and therefore this IO does not consider containment cell's design or implementation.

8. A number of items to be clarified and / or amended in relation to the RAP were provided to Hydro and the Consultant. Further, the final responses to comments for three reports relating to the Smelter Site are yet to be received. These outstanding items do not change the Auditor's opinion provided herein. However, the IO is subject to the Consultant responding to the comments in a satisfactory manner.

5.0 Closure

Consistent with EPA requirements for staged "signoff" of sites that are the subject of progressive assessment, remediation and validation, the Auditor is required to advise that:

- This IO does not constitute a Site Audit Report and Site Audit Statement (SAR / SAS) but it does advise on my opinion of the documents reviewed.
- This IO is consistent with OEH / NSW EPA guidelines and policies.
- In the final SAR / SAS and associated documentation, this IO will be documented.
- At the completion of the reporting process, an SAR / SAS will be prepared.

I trust these comments are found to be constructive. Please do not hesitate to contact us if you have any questions or comments.

Yours faithfully

Ross McFarland
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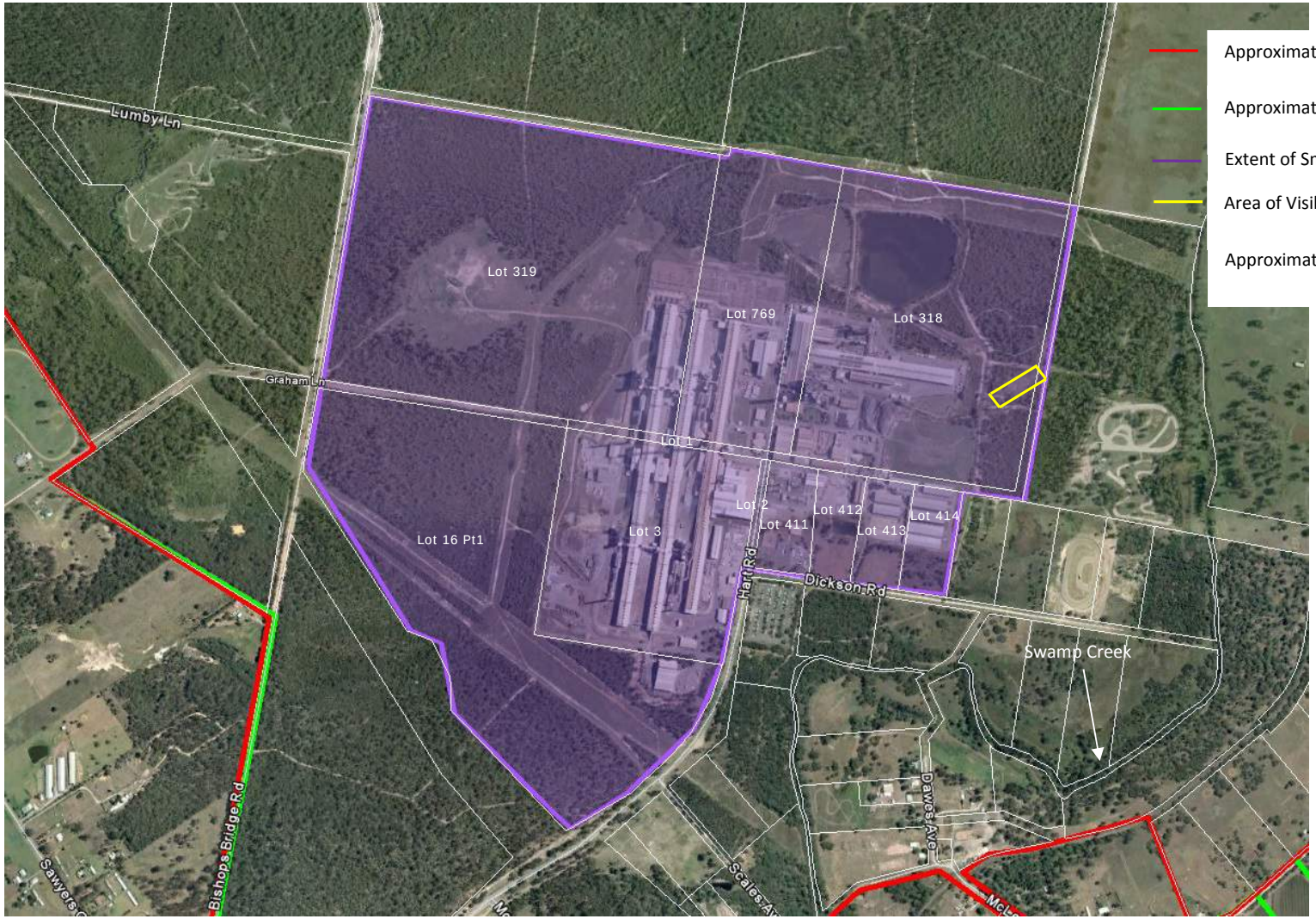

Hydro Aluminium Kurri Kurri: Remedial Action Plan	Smelter Site Plan
RAMBOLL ENVIRON JOB NO: AS130349 DATE: July 2016	FIGURE 2

RAMBOLL ENVIRON

AECOM
PO Box 73
Warabrook NSW 2304
Attention: Ross McFarland

HYDRO ALUMINIUM SMELTER KURRI KURRI REMEDIAL ACTION PLAN SUSTAINABILITY ANALYSIS RESULTS

Date 22/07/2016

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Ref AS130349
AS130349 RAP Sustainability Advice 2016_07_22

The purpose of this letter is to provide information on the evaluation of sustainability factors in relation to the remediation options described in the *Hydro Aluminium Smelter Kurri Kurri Remedial Action Plan* (Ramboll Environ, 2016), as requested in Point 1 of Section 4 of the Interim Opinion to Hydro Aluminium Kurri Kurri Pty Ltd (Hydro) dated 21 July 2016.

Remediation Options Sustainability Evaluation

Table 7-3 of the Remedial Action Plan (RAP) describes the remedial options that were considered, and describes the advantages and disadvantages of these options. This table provides a summary of the outcomes of the remediation options analysis that Hydro and Ramboll Environ have undertaken.

As discussed Section 7.3.5 of the RAP a Sustainability Analysis was undertaken of the remediation options. The factors listed in Table 7-2 of the RAP (and reproduced below) were each given an unweighted score out of five (1 the best, 5 the worst), to calculate a total Sustainability score out of 35.

Table 7-2: Sustainability Factors (reproduced from the RAP)

Factor	Definition
Ecological	Area of native vegetation clearance
Aboriginal	Disturbance of known Aboriginal heritage relics Extent of disturbance of areas potentially containing Aboriginal heritage relics
Greenhouse Gas/ Energy	Subjective assessment of potential energy consumption/ greenhouse gas generation sources: Vehicle movements Machinery (including destruction facilities) operation Vegetation clearance Landfill gas generation
Climate Change	Susceptibility of the option to climate change impacts

Ramboll Environ Australia Pty Ltd
ACN 095 437 442
ABN 49 095 437 442

Factor	Definition
Local community impacts	Subjective assessment of the potential impacts on the local community from: Air quality (dust generation) Noise Traffic
Community Perception	Likely perception of/ concern about the option in the local community
Ethics and Equity	Displacement (geographical, generational) of potential environmental issues and responsibilities.

In calculating the scores, the following information was considered:

Ecological

The ecological mapping undertaken for the Demolition and Remediation Environmental Impact Statement (EIS) and the rezoning of the Hydro Land. This allowed quantification of vegetation clearance.

Aboriginal

The Aboriginal heritage assessments undertaken for the Demolition and Remediation Environmental Impact Statement (EIS) allowed the potential impacts on Aboriginal heritage to be quantified.

Greenhouse Gas/ Energy

Analysis of the likely remediation methodology to undertake a qualitative assessment was undertaken of the energy demands and greenhouse gas generation of each option. This considered factors such as:

- Vehicle movements
- Machinery (including destruction facilities) operation
- Vegetation clearance
- Landfill gas generation

Climate Change

Consideration of key factors that could influence the options susceptibility to climate change, such as:

- Topography (with regard to flooding and hydrology).
- Hydrogeology (relationship to groundwater levels)
- Bushfire

Local community impacts

Analysis of the likely remediation methodology to undertake a qualitative assessment of the potential impacts on the local community from:

- Air quality (dust generation)
- Noise
- Traffic

Community Perception

Hydro has undertaken extensive community consultation regarding remediation of the Project Site. The results of this consultation (such as feedback regarding specific remediation options), and a qualitative assessment of the likely response to some remediation options, were considered.

Ethics and Equity	Analysis of the likely remediation methodology to undertake a qualitative assessment of the displacement (such as geographical (local, regional, national and international) and generational) of potential environmental issues and responsibilities.

Table 1 (see attached) provides the scores from the Sustainability Analysis against the remediation options. As the results show there is very little difference between the options (ranging between 17 and 20 out of a possible range between 7 and 35), with the adopted option being one of three with a score of 17.

In addition to the description of the remediation options evaluation provided in the RAP, Section 5 of the EIS (Consideration of Alternatives) (refer to attached) includes further detail on the remediation options evaluation process (including sustainability). This includes consideration of the management options for each of the material streams, as well as integrated materials management.

Preferred Option Sustainability

The potential environmental impacts (and the development of the associated management measures) and sustainability of the preferred remediation option (the Containment Cell) have been considered throughout the EIS.

- Section 4 of the EIS identifies the issues of the key stakeholders (Section 4.2 identifies community issues and Section 4.3 government agency issues) and where these issues have been addressed in the EIS.
- Section 5.3.6 of the EIS describes how the proposed Containment Cell location was evaluated, and how it minimises potential environmental impacts.
- Section 8 of the EIS describes the demolition and remediation methodology (including the Containment Cell construction)
  This includes environmental management measures that form and inherent part of the methodology. This also identifies the potential for beneficial reuse of waste materials (such as crushed concrete and refractory).
- Section 9 of the EIS describes how the Containment Cell would be managed and monitored in the long term to minimise potential environmental impacts.
- Section 11 and Appendix 6 of the EIS assess the potential air quality (primarily dust) and odour impacts, and describes how these would be managed to minimise impacts.
  The Air Quality Impact Assessment concluded that through the proposed Works methodology and the additional management measures the Project would not adversely impact nearby residents.
- Section 12 and Appendix 7 of the EIS assess the potential noise and vibration impacts, and describes how these would be managed to minimise impacts.
  The Noise and Vibration Impact Assessment concluded that through the proposed Works methodology and the additional management measures the Project would not adversely impact nearby residents.

- Section 13 and Appendix 9 of the EIS assess the potential impacts on surface water, groundwater and soil, and describes how these would be managed to minimise impacts.
  The EIS concluded that the through the implementation of the erosion and sediment control measures, water management measures and materials handling procedures described in Section 8 (as part of the demolition and remediation methodology) potential impacts would be minimised.
- Section 16 and Appendix 10 of the EIS describes the Aboriginal heritage within the Project site, and describes how potential impacts would be avoided or managed.
  The Aboriginal Heritage Impact Assessment identified one Aboriginal relic (deemed of low significance) and one Potential Archaeological Deposit (PAD) were located within the Project site. The identified relic would be removed in consultation with Aboriginal stakeholders, and the PAD would be avoided. Other management measures would be implemented in the event an unexpected find was identified.
- Section 18 and Appendix 11 of the EIS describe the biodiversity of the Project site, how much vegetation clearance is required, and describes the mitigation measures to be implemented.
  The Biodiversity Assessment calculated that approximately 2.5 hectares of native vegetation would be cleared as part of the Project. The vegetation clearance would be offset as part of the Biocertification agreement for the Hydro Land, and other management measures would be implemented to restrict vegetation clearance to the approved area.
- Section 20 and Appendix 12 of the EIS present the findings of a greenhouse gas assessment undertaken on the Project.
  The Greenhouse Gas Assessment quantified the predicted greenhouse gas emissions based on the demolition and remediation methodology, and identifies measures to reduce greenhouse gas emissions.
- Section 21 of the EIS describes the waste streams to be generated by the Project. Section 5.3 of the EIS identifies those materials that are readily recyclable or reusable (such as concrete and metals) and considers the potential management options for those waste streams that are not readily recyclable or reusable t.

Consideration of sustainable design and practices, and minimisation of the potential environmental impacts, would continue through the development of the detailed design, the detailed demolition, remediation and Containment Cell construction methodology, and the Containment Cell Long Term Management.

Conclusion

As this letter presents, through the RAP and EIS development process Hydro and Ramboll Environ sustainability has been a key element of options evaluation, including consideration of:

- Energy requirements associated with remedial works, including further carbon footprint considerations and long-term management demands;
- Beneficial reuse of materials in waste management; and
- Key stakeholder expectations.

As such, Hydro and Ramboll Environ concludes that it has undertaken an extensive assessment of the sustainability and potential environmental issues associated with potential remediation options. Through this process the proposed Containment Cell and remediation methodology proposed as part of the Project was deemed to be the most sustainable remediation option.

Please feel free to give me a call to discuss.

Yours sincerely

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Table 1 Remediation Options Sustainability Analysis

Option	Ecological	Aboriginal	GHG / Energy	Climate Change	Local Community	Community Perception	Ethics & Equity	TOTAL (out of 35)
1. Do Nothing	1	1	3	3	3	5	4	20
2.Encapsulate in-situ	2	3	3	3	2	4	2	19
3.Move to specifically designed landfill adjacent to the capped waste stockpile	2	3	3	3	2	4	2	19
4.Encapsulate in purpose built containment cell	**3**	**3**	**3**	**1**	**2**	**3**	**2**	**17**
5.Treat and encapsulate in purpose built containment cell	3	3	3	1	2	3	2	17
7.Excavate, sort and dispose off-site	1	1	4	2	3	2	4	17
8. On-site treatment to achieve complete destruction	1	1	4	2	4	3	3	18

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5. CONSIDERATION OF ALTERNATIVES

5.1 Introduction

This section assesses alternative options for the Project as required by the Secretary's Environmental Assessment Requirements.

Table 5.1 outlines the Secretary's Environmental Assessment Requirements relating to the assessment of alternatives for the Project, and where those requirements are addressed in the EIS. Assessing and comparing the Project against alternatives is integral to the Project justification.

Table 5.1: Secretary's Environmental Assessment Requirements

Requirement	Where Addressed
General Requirements. The EIS must include detailed description of the development, including: need and justification for the proposed development.	**Section 5.2, Section 6, Section 7, Section 8** and **Section 9**
Waste Containment Cell including: clearly explain and provide detailed justification for the preferred treatment technology.	**Section 5.3** and **Section 6.4**

5.2 Project Outline

5.2.1 The Works

The demolition, remediation and waste management activities (the Works) are the required to make the Project Site suitable for future use. The key element of the Works is the construction of a waste management facility, comprising a Containment Cell (the Containment Cell).

Other ancillary elements of the Works are:

- Demolition of the remaining Smelter buildings and structures.
- Site remediation, including leachate and groundwater treatment.

5.2.2 Containment Cell Management

Following completion of the Works, the Containment Cell would be subject to a monitoring and management program.

These activities are further discussed in **Section 7**, **Section 8** and **Section 9**.

5.3 Assessment of Alternatives to the Project

In determining the preferred approach for the Project, Hydro assessed alternative options for each the following key elements:

Future Land Use:	The future land use for the Hydro Land would be the key driver for determining the objective of the Project, and the criteria to be applied and achieved. As part of this, the options available for the former smelter buildings and remediation of the Project Site were considered.
Smelter Buildings and Demolition:	Demolition of Smelter infrastructure.
Remediation, including Waste Management:	An options evaluation for remediation of all material streams was undertaken. Each material stream was evaluated in isolation against relevant criteria and then considered together to develop a whole of site remediation strategy.

Containment Cell Location: When the materials stream management options were considered and it was determined that an on-site Containment Cell was the preferred option, the best location for the Containment Cell was examined.

5.3.1 Future Land Use

As discussed in **Section 1.1** Hydro is committed to meeting its corporate environmental and social responsibilities, managing its environmental legacies and leaving a positive social and environmental legacy for the local community.

As such, doing the minimum required for compliance with existing approvals and licences would not meet Hydro's commitment and therefore was not considered an option.

To fulfil its commitment, Hydro aims to facilitate the rezoning of the Hydro Land to allow for development of significant employment, residential, rural and biodiversity conservation purposes. The Project would render the Hydro Land suitable for these future uses.

A land use master plan has been prepared for the Hydro Land. The master plan was developed to inform the proposed rezoning for the Hydro Land, based on a consideration of a number of aspects, including environmental, social, economic, engineering and regulatory requirements. These investigations concluded that the Project Site was best suited for use as employment land.

5.3.2 Smelter Buildings and Demolition

In examining the market demand for the proposed employment land, the master plan process also reviewed the opportunities for retaining Smelter buildings. The review concluded that due to the specific purpose of the majority of buildings at the Smelter, there would be limited demand and opportunity for their viable refitting and retention for an alternative use. Therefore, Hydro has determined that Smelter buildings would be demolished. As discussed in **Section 3.4.3.2** Development Consent has been granted by Cessnock City Council for the demolition of the majority of the Smelter buildings.

In addition, the retention of many of the buildings and structures, especially the stacks, would present a safety risk and would not be economically viable for future developers of the Project Site. Retention of such structures would involve significant maintenance costs, and could impose restrictions on future development. Demolition of these structures once redevelopment of the Project Site has commenced would pose significant difficulties. As described in **Section 3.4.3.2** the demolition of the stacks and remaining Smelter buildings and structures not included in the Development Consent granted by Cessnock City Council forms part of the Project.

The majority of demolition material from the Smelter buildings would be recyclable and reusable. This includes metal (steel, aluminium and copper), concrete, bricks and refractory bricks. Recycling and reuse are the only options considered for these materials.

Section 5.3.3.4 describes the options considered for management of non-recyclable demolition material.

5.3.3 Remediation and Waste Management

The Capped Waste Stockpile and areas of soils within the Project Site require remediation so that the site can be made suitable for use as employment land. This section describes the remediation and waste management options considered.

5.3.3.1 Outline of Demolition and Remediation Material Streams

Hydro undertook a detailed assessment of alternative management options for demolition materials, aluminium smelter production wastes and contaminated soils at the Smelter.

The objective of the assessment was to identify the most appropriate option (based on social, environmental and economic grounds) to achieve the objectives of the Project. The primary objective of the Project is to render the Hydro Land suitable for the future land use described in **Section 5.3.1**.

The key material streams that would be generated by the Project are described in **Table 5.2**. The assessment of alternative options for management of these material streams is contained in the following sections.

Table 5.2: Material Streams Description

Material type	Description
Capped Waste Stockpile	Mixed smelter wastes were stockpiled in the eastern portion of the Smelter for the period 1969 to 1995. These mixed wastes comprised spent pot lining and to an equal extent amounts of other solid wastes generated at the smelter including cryolite, alumina, floor sweepings (alumina, cryolite, carbon), shot blast dust (carbon, steel shot), cement, pot lining mix and small amounts of other materials including plastic, wood, steel and asbestos including friable and bonded. The Capped Waste Stockpile is expected to include a wide range of unwanted site materials that are differing in size and composition. Cross contamination is likely to have occurred between material types which restricts the possibility of recycling and would require special handling. The contents of the Capped Waste Stockpile are non-putrescible. The stockpile is currently capped but is situated on sandy strata in a low lying area of the Smelter and within close proximity of the groundwater table.
Contaminated soils, smelter wastes and other municipal wastes derived from other Hydro owned land	Contaminated soils and materials within the buffer zone that have arisen during the operations of the Smelter. This includes soil contamination and wastes (including asbestos). Municipal wastes are sourced from non-smelter related activities and are able to be sorted from mixed wastes.
Contaminated soils on the smelter site	Soils within the Smelter footprint that have been impacted by contaminants during site operations. This includes soil and sediments impacted with fluoride and polycyclic aromatic hydrocarbons.
Smelter demolition wastes	These are non-recyclable/ non-reusable wastes generated during the Smelter demolition and include asbestos containing materials, contaminated sludge and dusts and contaminated building materials. Recyclable materials (such as metals, concrete and bricks) would be separated for recycling.

Each material stream was evaluated against the criteria described in **Table 5.3**.

Table 5.3: Remedial Option Evaluation Criteria

Criteria	Description
Regulatory and Statutory Compliance	Regulatory and statutory compliance is evaluated following a review of key legislation, regulations and policies. In the event that any element of an option is not permissible or has a low likelihood of approval, this option was ruled out of further investigation.
Timeframe to complete	The evaluation of timeframe is quantitative and incorporates estimates of times based on professional experiences for each section of the project.

Table 5.3: Remedial Option Evaluation Criteria

Criteria	Description
Risk	The evaluation considered the risk of events occurring in the future post-remediation stage that may require investigation, and possibly restoration or upgrading of controls or management measures. Risk is evaluated in terms of technological, environmental and financial consequence and the likelihood of the consequence occurring.
Social impacts	The potential social impacts associated with undertaking the waste management option and the ongoing operations of the option were evaluated.
Environmental impacts	The potential environmental impacts associated with constructing/ undertaking the material management option (including ecological and heritage disturbance; noise and vibration; air quality; and waste management principles) and the ongoing operations of the option were evaluated.
Climate change	The energy usage and greenhouse gas emissions associated with undertaking the waste management option and the ongoing operations of the option were evaluated.
Economic viability	Remediation costs were determined for each option on the basis of the option description and a set of assumptions made about the option.
Legacy, legal liability and required contingencies	Legacy is defined as the potential long term liability that may be incurred by Hydro for the life of the project. Legacy relates to both future management costs and liability provisioning represented by occurrence of a future event. Future management and monitoring costs and the likelihood of these occurring can reasonably be evaluated for most remediation strategies.

Options were considered by comparing the actual value of each of the criteria for each option. However, this makes it difficult to identify a preferred option, as the significance of each of the criteria is not considered.

To provide a comparison between the criteria, data was normalized on a scale where increasing numbers reflected worsening performance.

To develop the relationship between the data for each criteria, the data was weighted using weightings which were then used to rate the options. Where a number of options performed similarly the same methodology was used to allow comparison of this smaller number of options to provide a more accurate comparison.

5.3.3.2 Capped Waste Stockpile

The options considered for remediation and management of the Capped Waste Stockpile are presented in **Table 5.4**.

Table 5.4: Capped Waste Stockpile Options

Management Option	Option Description	Options Assessment
Retention of the existing Capped Waste Stockpile	This would be the retention of the existing Capped Waste Stockpile with implementation of the existing management measures.	This option is cost effective and represents the lowest health and environmental risks during the remedial works program. The Ecological Risk Assessment indicated that leachate migration from the Capped Waste Stockpile has not and is not likely to impact off-site receivers including Swamp Creek and Wentworth Swamp. The stockpile is currently capped in accordance with a planning approval and environment protection licence, with testing showing that the cap is performing and reducing infiltration. However, localised impact to vegetation is evident within the Hydro Land that is unacceptable to Hydro and steps to intercept and treat leachate in groundwater were considered. Retention of the existing Capped Waste Stockpile would limit the extent to which capture of leachate impacted groundwater could be achieved due to the presence of the stockpile itself and the ongoing generation of leachate. Additionally, long term management requirements and uncertainty of the long term performance were considered to be unacceptable due to the absence of a base liner and the unconsolidated nature of the stockpile potentially resulting in a reduction in cap performance over time.
Upgrade of the existing Capped Waste Stockpile	Low permeability residual clay is present at depths of around 10 metres beneath the current Capped Waste Stockpile. The migration of leachate could be reduced through the placement of a vertical subsurface low permeability wall constructed and keyed into the underlying clays. Cap upgrades to key into the wall would then create an effective barrier to leachate migration.	This option was cost effective and represented low health and environmental risks. An Ecological Risk Assessment indicated that leachate migration from the Capped Waste Stockpile has not and is not likely to impact off-site receivers including Swamp Creek and Wentworth Swamp. The stockpile is currently capped in accordance with a planning approval and environment protection licence, with testing showing that the cap is performing and reducing infiltration.

Table 5.4: Capped Waste Stockpile Options

Management Option	Option Description	Options Assessment
		Barrier wall construction has inherent risk due to the subsurface method of emplacement. It was also recognised that, in the event of failure, the stockpile remains in close proximity to the groundwater system and could result in ongoing environmental harm.
Sorting of the Capped Waste Stockpile for reuse	Investigations were undertaken to evaluate the ability to segregate all of the materials for reuse, or treatment and reuse.	While examples of mechanical and optical sorting of the Capped Waste Stockpile materials into various streams were considered, this evaluation identified the significant risk of the resultant material streams being contaminated by the presence of the spent pot lining (sodium, fluoride and cyanide) and asbestos, and therefore would be unsuitable for reuse including recycling without treatment.
	Coarser level sorting by mechanical means was also considered for the purpose of recycling metal, concrete, bake furnace refractory bricks, anodes, spent pot lining and possibly other materials.	The risk of contamination of material streams as described previously and the potential environmental and human health risk posed by the potential presence of unknown hazardous materials (such as asbestos containing materials) meant that it would require significant time and effort to sort uncontaminated recyclable material, and that hand sorting would likely be required. The limitation with any sorting approach is the cross contamination of these materials that has likely occurred during the period of time when the stockpile was uncapped. It was therefore considered that only metals may be effectively recycled due to the ability to clean these materials. Where practical metals would be removed and made available for recycling. However due to stringent requirements that exist for recycling of other materials, these materials could not be recycled. Additionally, if recycling is possible, a suitable end market or end use has not currently been identified.

Table 5.4: Capped Waste Stockpile Options

Management Option	Option Description	Options Assessment
	Sorting of spent pot lining.	As noted in the consideration of sorting all materials within the Capped Waste Stockpile, due to cross contamination, the specific requirements of the processing facilities required for spent pot lining and end product quality requirements, this option was considered to have a high risk of failure. In addition, the potential environmental and human health risk posed by the potential presence of unknown hazardous materials meant that it would require significant time and effort to sort uncontaminated recyclable material, and that hand sorting would likely be required. In the event that portions of spent pot lining are encountered in the Capped Waste Stockpile and can be feasibly and safely separated these would be removed and made available for recycling at a licensed off-site recycling facility.
Off-site disposal	This would involve the excavation of the Capped Waste Stockpile material and transportation to a licensed waste management facility or facilities. Some of this material could be transported to the Cessnock Waste and Reuse Centre, while other materials would be transported to a licensed facility in Sydney.	Environmental impacts would be transferred from the Project Site to the receiving location rather than being managed at the Project Site. It could also adversely impact on the landfilling capacity at the receiving waste management facilities. This option also has significantly higher costs. In addition, this option has a significant carbon footprint due to the transportation requirements and has an adverse impact on the local community (there would be a significant number of trucks travelling between the Project Site and the disposal location).

Table 5.4: Capped Waste Stockpile Options

Management Option	Option Description	Options Assessment
High temperature treatment	Processing of the Capped Waste Stockpile materials to remove fluorides and cyanides, in conjunction with carbon value capitalisation in a waste to energy process.	The risk associated with this option is a technological risk from the unproven technology and the possibility that an alternate remediation solution would require implementation. There is high potential for this technology not being able to treat the mixed materials in the Capped Waste Stockpile economically or technically into a condition that can be re-used without additional treatment (and therefore needing to landfill). The material generated from previous trials is currently not qualified as inert and therefore it cannot be used without limitation as fill material. Also, no technical specification of material strength has been determined. If it cannot be utilised as inert fill material, an alternative management measure would still be required. In addition, there are no known estimates of the difference between input volume / weight, and volume / weight of the vitrified material (it is unknown how much of the processed material would be generated).
Encapsulation in a purpose built Containment Cell	This is the option that forms part of the Project.	A Containment Cell would be designed and constructed to incorporate best practice technology specifically designed to macro-encapsulate the expected contents of the Capped Waste Stockpile and to mitigate and manage risks. It also allows remediation of the contaminated groundwater below the Capped Waste Stockpile. The Capped Waste Stockpile is a large area of land identified within an area proposed for future employment land. Its removal and relocation to a Containment Cell would allow this area to be remediated and made available for employment land. Justification of the option is described in **Section 6.4**.

5.3.3.3 Contaminated Soils

The options considered for remediation and management of contaminated soils are presented in **Table 5.5**.

Table 5.5: Contaminated Soils Management Options

Management Option	Option Description	Option Assessment
Cap and contain in-situ	This would involve contaminated soils remaining in their current location and being capped. This would require ongoing management so that future activities (such as excavations for building construction or services installation) do not intercept the contaminated soils.	As the Hydro Land would potentially be owned and / or occupied by numerous parties, the management of multiple capped contaminated sites imposes development restrictions and management requirements on a larger land holding. This is considered to have a greater likelihood of inefficient or inappropriate management and a greater potential for environmental or human health risk.
Off-site disposal	This would involve the excavation of contaminated soils and transportation to a licensed waste management facility. This could include the Cessnock Waste and Reuse Centre.	Environmental impacts would be transferred from the Project Site to the receiving location rather than being managed. It could also adversely impact on the landfilling capacity at the Cessnock Waste and Reuse Centre. This option also has significantly higher costs. In addition, this option has a significant carbon footprint due to the transportation requirements and has an adverse impact on the local community (there would be a significant number of trucks travelling between the Project Site and the disposal location).
High temperature treatment	Processing of the contaminated soils to remove fluorides and polycyclic aromatic hydrocarbons.	The risk associated with this option is a technological risk from the unproven technology with the particular contaminants and the possibility that an alternate remediation solution would require implementation. There is high potential for this technology not being able to treat the mixed materials economically or technically into a condition that can be re-used without additional treatment (and therefore needing to landfill).

Table 5.5: Contaminated Soils Management Options

Management Option	Option Description	Option Assessment
Encapsulation in purpose built Containment Cell	This is the option that forms part of the Project.	A Containment Cell would be designed and constructed to incorporate best practice technology specifically designed to macro-encapsulate contaminated soils and to mitigate and manage risks. Placement of the contaminated soils in a Containment Cell provides Hydro with a definitive timeframe, allowing Hydro to achieve its objective for the Smelter and Hydro Land. Placement of the contaminated soils in the Containment Cell provides a cost effective strategy for achieving site remediation objectives that avoids the potential environmental and social impacts associated with capping and containing in-situ and off-site disposal. Justification of the option is described in **Section 6.4**.

5.3.3.4 Non-Recyclable Demolition Waste

As discussed in **Table 5.2** this refers to non-recyclable/ non-reusable wastes generated during the Smelter demolition and include asbestos containing materials, contaminated sludge and dusts and contaminated building materials.

Recyclable demolition waste has been excluded from the options evaluation. Recyclable demolition waste (such as concrete, refractory bricks and metal) would either be reused on-site or made available for reuse and recycling at a licensed waste management facility.

The disposal options for the non-recyclable demolition materials are presented in **Table 5.6**.

Table 5.6: Non-Recyclable Demolition Waste Management Options

Management Option	Option Description	Option Assessment
Disposal off-site	This would involve the transportation of non-recyclable demolition wastes to a licensed waste management facility. This could include the Cessnock Waste and Reuse Centre.	This option has a significant carbon footprint due to the transportation requirements and has an adverse impact on the local community (there would be a significant number of trucks travelling between the Project Site and the disposal location). Environmental impacts would be transferred from the Project Site to the receiving location rather than being managed. It could also adversely impact on the landfilling capacity at the Cessnock Waste and Reuse Centre. This option also has significantly higher costs than any other option.
High temperature treatment	Processing of the non-recyclable demolition wastes through establishment of a high temperature incinerator or similar	This option is technologically sound, however was neither cost nor time effective when compared to off-site landfill disposal. The option was not considered further.
Encapsulation in purpose built Containment Cell	This is the option that forms part of the Project.	A Containment Cell would be designed and constructed to incorporate best practice technology specifically designed to macro-encapsulate demolition wastes and to mitigate and manage risks. Placement of the contaminated soils in a Containment Cell provides Hydro with a definitive timeframe, allowing Hydro to achieve its objective for the Smelter and Hydro Land. Placement of the demolition wastes in the Containment Cell provides a cost effective strategy for achieving site remediation objectives that avoids the potential environmental and social impacts associated with off-site disposal, such as the adverse impact on the landfilling capacity Cessnock Waste and Reuse Centre. Justification of the option is described in **Section 6.4**.

5.3.3.5 Integrated Waste Management

Following examination of the individual material streams, an evaluation against the criteria in **Table 5.2** was undertaken of a range of integrated in-situ and ex-situ management and remediation options for all site materials.

These options are presented and discussed in **Table 5.7**.

Table 5.7: Integrated Waste Management Options

Management Option	Option Description	Option Assessment
Upgrading the Capped Waste Stockpile and combining this with a new Containment Cell	Several options were considered with the variations including a new Containment Cell located either adjacent to or separated from the Capped Waste Stockpile; and a new Containment Cell containing all remaining material streams.	This option is cost effective and represented low health and environmental risks. The Capped Waste Stockpile would remain and could be upgraded with a low permeability wall constructed and keyed into the underlying clays. Cap upgrades to key into the wall would then create an effective barrier to leachate migration. However, retention of the existing Capped Waste Stockpile would limit the extent to which capture of leachate impacted groundwater could be achieved due to the presence of the stockpile itself and the ongoing generation of leachate. Additionally, long term management requirements and uncertainty of the long term performance of the Capped Waste Stockpile were considered to be unacceptable due to the absence of a landfill base and the unconsolidated nature of the stockpile potentially resulting in a reduction in cap performance over time. When considered in combination with a Containment Cell in a second location, it was recognised that long term management and monitoring requirements were increased and a larger land footprint would require development restrictions. The ongoing management requirements and the risk of failure (relating to the Capped Waste Stockpile) were not acceptable and this option was not further considered.

Table 5.7: Integrated Waste Management Options

Management Option	Option Description	Option Assessment
Off-site disposal	This option would require all material to be transported from the Project Site. Some of the materials could be disposed of to the Cessnock Waste and Reuse Centre or another local licensed waste management facility. The remainder of the material streams would be transported to an appropriately licensed landfill facility in Sydney, interstate or internationally.	This option has a significant carbon footprint due to the transportation requirements and has an adverse impact on the local community (there would be a significant number of trucks travelling between the Project Site and the disposal location). Environmental impacts would be transferred from the Project Site to the receiving location rather than being managed. It could also adversely impact on the landfilling capacity at the Cessnock Waste and Reuse Centre and other licensed facilities. This option also has significantly higher costs than any other option.
High temperature treatment	Potential treatment technologies applicable for the all material streams were assessed. This assessment identified high temperature (such as plasma arc treatment) as a potential alternative to achieve removal of hazardous components including fluorides, cyanides, hydrocarbons and asbestos from all material streams.	The risk associated with this option is a technological risk from the unproven technology and the possibility that an alternate remediation solution would require implementation. There is high potential for this technology not being able to treat the mixed materials economically or technically into a condition that can be re-used without additional treatment (and therefore needing to landfill).
Construction of a purpose built Containment Cell	This is the option that forms part of the Project.	A Containment Cell would be designed and constructed to incorporate best practice technology specifically designed to macro-encapsulate all the material streams and to mitigate and manage risks. Managing the material streams at the Smelter does not transfer the potential environmental impacts and risks to another location: the responsibility for management of the materials remains with Hydro. Placement of the material streams in the Containment Cell provides a cost effective strategy for achieving site remediation objectives that avoids the potential environmental and social impacts associated with off-site management options.

Table 5.7: Integrated Waste Management Options

Management Option	Option Description	Option Assessment
		All material streams generated by demolition and remediation would be managed in one location, minimising potential environmental impacts and allowing for more efficient and effective management. It also maximises the area available for the employment land proposed for the Smelter. Justification of this option is described in **Section 6.4**

5.3.4 Containment Cell Characteristics

The key characteristics of a Containment Cell are:

- It is a facility that is built in an appropriate geological and environmental location.
- It is designed and built to contain its contents, specifically addressing the known characteristics of those contents.
- It is designed and built to minimise leachate generation: leachate management is only provided as a contingency.

Table 5.8 provides a comparison of the type of Containment Cell proposed as part of the Project with a typical traditional landfill and a typical modern landfill (such as those operated by a local council or private operator).

Table 5.8: Comparison Between Containment Cell and Landfills

Criteria	Typical Historic Landfill (+20 years old)	Typical Modern Landfill (less than 20 years old)	Hydro Containment Cell
Cell location/ siting	Typically constructed on low value land, for example swampy low lying areas and therefore either within the groundwater table or in very close proximity.	Modern landfills are built in areas of stable geology that are at an acceptable distance (typically around three metres or more) above the permanent groundwater table.	The proposed Containment Cell site: • Is considered to be geotechnically stable. • Has a depth to groundwater in excess of three metres. • Is at a suitable distance from a surface water body. • Is in an area not prone to flooding or containing erosive or unstable soils. The Containment Cell site selection process is described in **Section 5.3.6**. **Key difference: the cell would be appropriately located to minimise human health and environmental risk.**
Cell construction	Typically historical landfills do not have a leachate barrier system or leachate collection/control capability. Historical landfills do not have base liners and often not properly constructed capping liners. Landfills had no gas venting capability.	The NSWEPA *Solid Waste Landfill Guidelines* (1996) recommended a single liner system comprising a 90cm compacted clay layer achieving a permeability of less than 10^{-9} m/s. Modern landfills generally adopt a dual layer system with one layer comprising compacted clay and a second layer comprising a geocomposite clay layer (GCL) or high density polyethylene layer (HDPE). Where compacted clay is not locally available the dual layer system can be achieved by using a GCL in combination with a HDPE. An example is the Newcastle City Council Summerhill waste management facility.	The Hydro Containment Cell liner system concept design has been developed in accordance with the EPA *Environmental Guidelines: Solid Waste landfills* (2016). This is a multiple layer system comprising a one metre compacted clay layer of permeability less than 1 x 10^{-9} m/s, overlain by a composite geomembrane/geosynthetic clay liner Drainage layers and protection layers separate the liners. The Containment Cell would be constructed to allow segregation of the materials and allow enhanced monitoring precision. A gas collection layer and venting system would be implemented for the spent pot lining. Though testing shows flammable gas generation to be lower than typical municipal landfills. All materials proposed to be used in the cell liner system would be subject to compatibility testing. Due to the purpose built nature of this cell, it is possible to undertake compatibility testing.

Table 5.8: Comparison Between Containment Cell and Landfills

Criteria	Typical Historic Landfill (+20 years old)	Typical Modern Landfill (less than 20 years old)	Hydro Containment Cell
		Monocells (discrete cells within the overall cell) are generally constructed to minimize the exposed/uncapped surface area but not to segregate waste.	**Key difference: materials to be contained are known and quantified and therefore specific testing for compatibility and design for purpose would be achieved.**
Leachate management	Typically no leachate control or collection. High volumes of leachate are generated from both the breakdown of the wastes themselves and rainfall to the landfill prior to closure. Due to the absence of a base liner, groundwater can be permanently or periodically in contact with wastes creating an ongoing source of leachate. Inadequate final capping layers can also contribute to increased infiltration and leachate generation.	The base liners include a leachate detection and capture system where leachate can be collected and treated. Putrescible landfills typically have a leachate treatment system. Leachate in these systems can be increased from organic matter breakdown and infiltration both during and following operations.	The design objective is for the Containment Cell to not generate any leachate. The capping layer is designed to minimise the infiltration to the Containment Cell. Leachate generation from the waste itself is not expected as no breakdown of the wastes would occur. However, as a contingency, systems would be implemented for leachate monitoring and collection in the event that leachate is identified. Where leachate does occur, a contingent leachate treatment system is proposed (refer to **Section 8.8.2** of the EIS). **Key difference: avoidance of leachate generation is a key design objective: any leachate generated would be very small volumes. A leachate contingency system is proposed.**
Operation	In regular use, usually permanently open or with daily cover for a long period of time. Require operational controls to minimise infiltration, surface water management, vermin, dust, odour and litter.	In regularly use, open or with daily cover for a long period of time. Require operational controls to minimize infiltration, surface water management, vermin, dust, odour and litter.	Constructed and operational for a short period whilst receiving the designated materials. Therefore infiltration and dust can be carefully controlled and minimised. The materials would not result in issues regarding litter and vermin. **Key difference: Controlled and short duration of filling. Reduces environmental management requirements and leachate.**

Table 5.8: Comparison Between Containment Cell and Landfills

Criteria	Typical Historic Landfill (+20 years old)	Typical Modern Landfill (less than 20 years old)	Hydro Containment Cell
Materials deposited	Municipal landfills include putrescible (degradable) wastes along with mixed wastes.	Municipal landfills include putrescible (degradable) wastes along with mixed wastes. Licensed industrial waste landfills are privately operated (e.g. SITA) and can receive a range of industrial wastes.	Materials placed in the Containment Cell would be limited to: non-recyclable and non-reusable site demolition wastes, soils impacted by asbestos containing materials, other contaminated soils and dried sludges, mixed smelter wastes from the Capped Waste Stockpile including mixed and degraded first and second cut spent pot lining, contaminated bricks and concrete, contaminated anode wastes. Hydro would divert recyclable materials (concrete, bricks and metals) for recycling and reuse. Organic matter would not be deposited in the Containment Cell. **Key difference: Materials would only be generated from the Smelter. All materials are known. Compatibility with each other and with cell construction materials form part of the design.**
Capping layer construction	Minimum 0.9m of compacted clay with overlying protection and vegetation layers.	The NSW EPA *Solid Waste Landfill Guidelines* (1996) capping system comprises a seal bearing surface (trafficable layer to minimize waste consolidation); gas collection layer; sealing layer comprising a 0.5m of compacted clay to achieve a permeability less than 1 x 10^{-8} m/s; a drainage layer; and a 1m thick vegetation layer. Surface slopes are to be 5% following consolidation.	The proposed capping concept design has been developed in accordance with the EPA *Environmental Guidelines: Solid Waste landfills* (2016). The cap design would be comprised of a 0.6m compacted clay of permeability less than 1 x 10^{-9} m/s; overlain by a HDPE or LLDPE liner; drainage layer; fauna barrier; and the revegetation layer (including the vegetation cover). Site slopes would be sufficient to promote surface water runoff as determined by modelling. Waste consolidation would not occur due to the absence of organic matter. Materials would be placed to an engineered specification.

Table 5.8: Comparison Between Containment Cell and Landfills

Criteria	Typical Historic Landfill (+20 years old)	Typical Modern Landfill (less than 20 years old)	Hydro Containment Cell
		Industrial waste landfills (NSW *Draft Environmental Guidelines for Industrial Waste Landfilling* 1998) recommended a dual capping system of a 0.6m compacted clay of permeability less than 1 x 10^{-9} m/s; overlain by a HDPE liner; drainage layer and 1m thick vegetation layer. Site slopes are to be 3 to 5% following consolidation.	**Key difference: fauna barrier included. Vegetation layer/ vegetation cover includes plant species with high water demands to further reduce infiltration. Settlement not likely due to non-degradable nature of waste materials therefore surface slope and water shedding can be maintained in the long term.**
Gas management	Methane generated from the breakdown of organic components.	Due to the breakdown of organics, landfills containing organics produce gases that must be captured and treated.	Methane, hydrogen and ammonia generation from spent pot lining in contact with water can occur. Concentrations from the existing capped wastes stockpile are low and below the NSW EPA trigger for capture of methane (1.25%v/v) and are lower than typical municipal landfills. **Key difference: fugitive gas emissions would be controlled by installing gas collection within the necessary cell, with controlled venting to the atmosphere.**

5.3.5 Examples of Containment Cells in Australia

Containment Cells have been, and continue to be, used in Australia for a number of industrial wastes and contaminated soils.

5.3.5.1 Former Pasminco Smelter, Boolaroo NSW

Remediation of the former Pasminco Smelter at Boolaroo, New South Wales has included consolidation of soils impacted with lead and other contaminants within an on-site containment cell. The cell is situated on natural soils including clay strata and features a leachate collection and treatment system. The cell contains approximately 1.8 million cubic metres of contaminated soils that are capped with a low permeability material.

5.3.5.2 Former BHP Steelworks, Newcastle NSW

Containment of subsurface hydrocarbon impacted soils and fill by a containment cell formed an integral part of the remediation design for the former steelworks site. The cell comprised excavation to underlying sediments or residual clays and construction of a vertical barrier wall comprising low permeability slurry on three sides. The wall effected a hydraulic barrier to groundwater, and therefore contaminant migration, with the Hunter River comprising a fourth side. The site was then capped with a low permeability surface. The site is now proposed for redevelopment and managed under a long term management plan.

In parallel with the Mayfield site remediation was the remediation of 800,000 cubic metres of contaminated sediment dredged from the Hunter River. Sediments were treated prior to placement within a purpose built Containment Cell at Kooragang Island. The cell was situated above the highest groundwater level and fully lined with a leachate collection system. The cell was capped with low permeability materials and is now considered compatible with industrial land use.

5.3.5.3 Sydney Olympic Park

Remediation of Sydney Olympic Park included excavation and consolidation of wastes. Treatment by thermal desorption of approximately 400 tonnes of waste was undertaken, followed by consolidation of all wastes in containment mounds. Approximately nine million cubic metres of waste has been contained on-site and has been capped, landscaped and turned in to parklands. Leachate collection systems have been installed on the site to prevent leachate escape.

5.3.5.4 Evaluation

Most of these options cap and partially contain the contaminated materials: while the design for these options includes engineered, low permeability capping systems, they do not include an engineered containment cell base (the exception being the containment cell on Kooragang Island) and therefore are not fully contained. These facilities are required to include a leachate collection and management system as a key element of the design, rather than as a contingency to be triggered in the event that leachate is generated.

In addition, the location of the cells at the former BHP Steelworks and the Sydney Olympic Park were not able to be built in locations with preferable geological and hydrogeological conditions.

The benefit of the Smelter Site is that a containment cell can be constructed in a location with preferable geological and hydrogeological conditions, with an engineered base. It would also include leachate management as a contingency rather than as a key element of the containment cell.

5.3.6 Containment Cell Location

Following determination that a purpose built Containment Cell was the preferred materials management approach, Hydro undertook investigations to identify the best location for a Containment Cell.

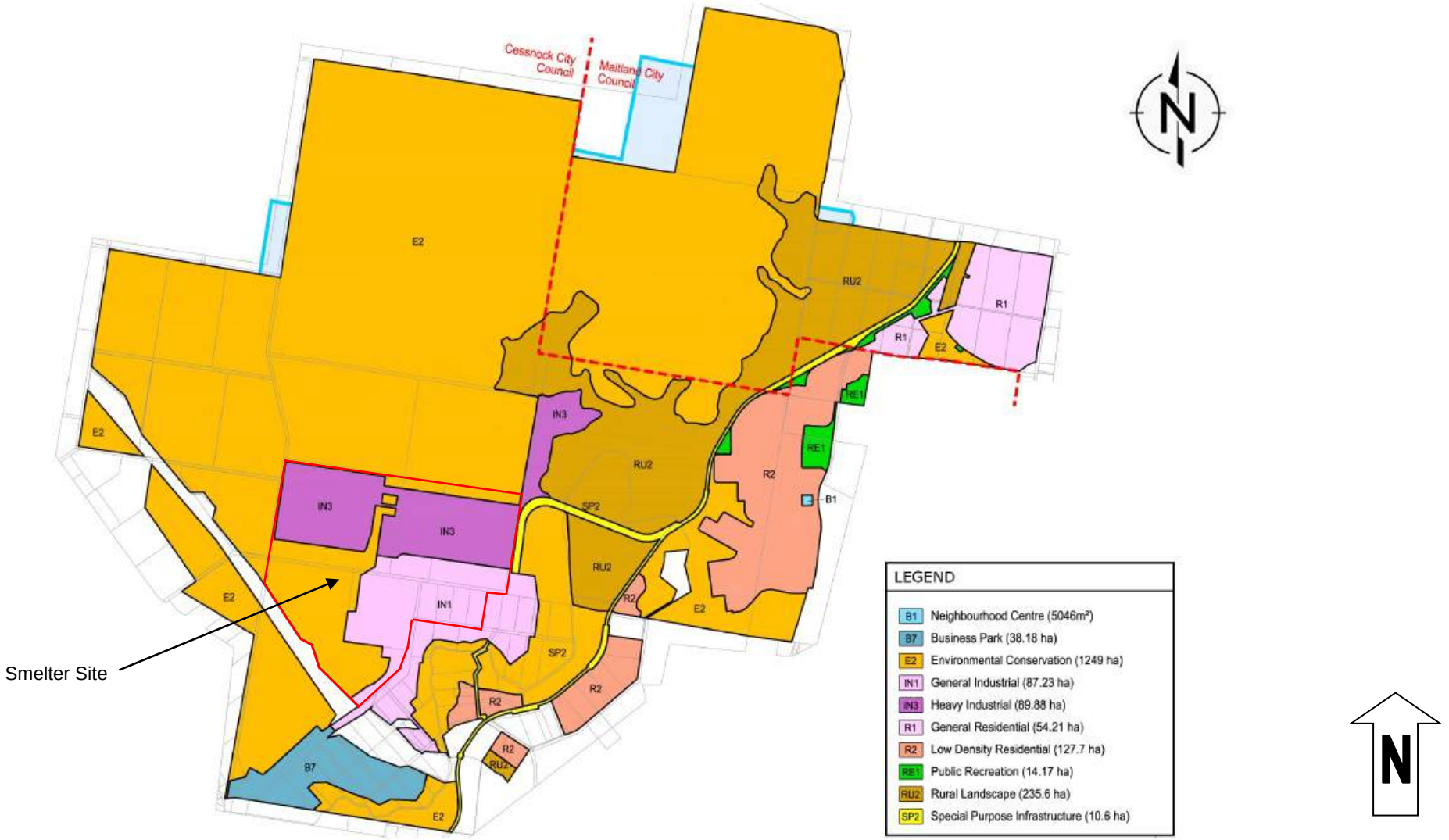
Locating the Containment Cell outside of the Hydro Land was not consistent with Hydro's commitment to corporate responsibility: it would have a significant carbon footprint due to the transportation requirements and the significant number of trucks travelling between the Project Site and the disposal location may present an adverse impact on the local community; and it

would have transferred the environmental legacies to another property. Locating it on land owned by Hydro allows for mechanisms to be implemented to ensure the long term ongoing management of the Containment Cell, and its integration into the land use master planning for the Hydro Land.

The key criteria in determining the preferred location were:

Geological:	An area underlain by suitable soils comprising low permeability residual clays and bedrock, and avoiding alluvial soils. Bedrock to be massive with minimal defects and fractures.
Hydrogeological:	An acceptable distance above the highest observed groundwater level.
Environmental:	Avoids/ minimises vegetation clearance.
Hydrological:	It is located: • Above the 1% Annual Exceedence Probability (AEP) flood level. • More than 100 metres from a watercourse.
Existing Land Uses:	It is located: • A minimum of 500 metres from the nearest residence. • Within 500 metres of the Smelter and on the northern side of the Hunter Expressway. • A minimum of 20 metres from power line easements.

Using the above criteria Hydro commissioned a study of the 2,000 hectares of Hydro Land to identify suitable sites. Whilst a number of sites were identified, the proposed Containment Cell location (currently known as the Clay Borrow Pit) best addresses these criteria and was preferred as the site was already cleared and within proximity of the Smelter.



Hydro Aluminium Kurri Kurri: Smelter Site	Smelter Site showing Proposed Landuses

RAMBOLL ENVIRON JOB NO: AS130328 DATE: Sept 2016 FIGURE

Tiedeman, Mark

From: Kirsty Greenfield <kgreenfield@ramboll.com>
Sent: Tuesday, 26 July 2016 1:31 PM
To: McFarland, Ross
Cc: Lundmark, Anna
Subject: FW: Sustainability Memo - two more references?
Attachments: Hydro Remediation and Demolition EIS Final Rev 2 2016_07_14A.pdf

Hi Ross,

Please find attached the text of the EIS, without the figures or appendices. Please let me know if you need any further info.

Yours sincerely
Kirsty Greenfield

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From: Shaun Taylor
Sent: Tuesday, 26 July 2016 1:26 PM
To: Kirsty Greenfield
Subject: RE: Sustainability Memo - two more references?

Here it is (a little quicker). PDF of the EIS without figures.

Shaun Taylor

Senior Environmental Scientist

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From: Kirsty Greenfield
Sent: Tuesday, 26 July 2016 1:22 PM
To: Shaun Taylor; Fiona Robinson
Subject: FW: Sustainability Memo - two more references?
Importance: High

FYI

Yours sincerely
Kirsty Greenfield

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From: McFarland, Ross [mailto:Ross.McFarland@aecom.com]
Sent: Tuesday, 26 July 2016 12:24 PM
To: Kirsty Greenfield
Cc: Lundmark, Anna
Subject: RE: Sustainability Memo - two more references?
Importance: High

Dear Kirsty,

Hmmm. The problem with an “integrated report” like an EIS, is that it refers the reader to other parts of that EIS Report.

As I read Section 5, it refers me to Section 6, In Section 6 (thanks for providing this morning) there is cross-reference to Section 6.4.1 (which is a short paragraph and associated Table 6.2 you provided - thanks) as well as reference to **Section 8.8 and Section 9** – do these references (Section 8.8 and 9.) provide further justification and if so, can you provide, please? I would be remiss if I didn’t request these referenced sections from you as part of my audit.

Perhaps the fully EIS might be a prudent way forward – is there a problem in providing me with the full EIS as there seems to be a lot of “justification” of RAP issues within that EIS?

I am still expecting to send my revised IO today so your timely response to this email would be appreciated.

Call me on my mobile if you prefer.

Regards,

Ross McFarland
Chief Environmental Scientist – ANZ
NSWEPA Site Auditor (No.9819)
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From: Kirsty Greenfield [mailto:kgreenfield@ramboll.com]
Sent: Tuesday, 26 July 2016 8:19 AM
To: McFarland, Ross; Lundmark, Anna
Cc: Fiona Robinson; Richard Brown
Subject: RE: Sustainability Memo

Hi Ross,

Thanks for your quick response. Please find attached Section 6 of the EIS.

Yours sincerely
Kirsty Greenfield

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From: McFarland, Ross [mailto:Ross.McFarland@aecom.com]
Sent: Monday, 25 July 2016 7:42 PM
To: Kirsty Greenfield; Lundmark, Anna
Cc: Fiona Robinson; Richard Brown
Subject: Re: Sustainability Memo

Thanks Kirsty.

In your memo, there is frequent reference to section 6.4 where "justification is provided" (i assume this is section 6.4 of the EIS?). Can you please provide this section?

I have reviewed the memo you have provided and, subject to your provision of section 6.4, it seems to be adequate information for me to remove my comment in relation the need for further consideration of sustainable remediation in your RAP.

I should be able to preview my revised interim opinion shortly.

Regards

Ross McFarland
AECOM Chief Environmental Scientist
Australia and New Zealand
M: +61413833811

-------- Original message --------
From: Kirsty Greenfield <kgreenfield@ramboll.com>
Date: 22/07/2016 14:19 (GMT+10:00)
To: "McFarland, Ross" <Ross.McFarland@aecom.com>, "Lundmark, Anna" <Anna.Lundmark@aecom.com>
Cc: Fiona Robinson <frobinson@ramboll.com>, Richard Brown <Richard.Brown@hydro.com>
Subject: Sustainability Memo

Hi Ross and Anna,

As discussed this morning, please find attached our memo regarding the sustainability analysis results in relation to the Hydro RAP.

Yours sincerely
Kirsty Greenfield

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RESPONSE TO AUDIOR COMMENTS, HYDRO ALUMINIUM SMELTER, KURRI KURRI

Date 6/05/2016

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Ref AS130328

Dear Ross

Ramboll Environ, as the environmental consultant for Hydro Aluminium Kurri Kurri, has provided a number of environmental reports for your review as part of your audit of these works. In return, you have provided comments via several letters, as follows:

- 'Auditor's Review of the Tier 2 Ecological Risk Assessment, Hydro, Kurri Kurri, NSW' dated 28 April 2015;
- 'Auditor's Review of the Stage 2 Aquatic Assessment – Ecological Risk Assessment for Hydro, Kurri Kurri, NSW' dated 28 April 2015;
- 'Auditor's Review of the Preliminary Screening Level, Health Risk Assessment for Fluoride and Aluminium for Hydro, Kurri Kurri, NSW' dated 28 April 2015.

Ramboll Environ will address the comments provided in these letters below.

Auditor's Review of the Tier 2 Ecological Risk Assessment

Comment No. 1: Clear definition of the terms groundwater, exfiltrated groundwater, leachate plume, surface water and ephemeral soaks is required throughout the report to make sure it is clear what environmental media is being discussed and what exposure pathways/ receptors are relevant. Please provide clear distinctions throughout the report as to which media is being discussed to enable an understanding of the completeness of the conceptual site model.
Ramboll Environ Response: Figure 1, attached, shows the locations of the leachate plume, the exfiltrated groundwater (Northern Vegetation Impact Area and Southern Vegetation Impact Area), surface water (semi-permanent dam and Swamp Creek) and ephemeral soaks (ephemeral dam). This figure should assist with interpretation of the conceptual site model.

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Comment No. 2: Please include consideration of exposure to impacts in groundwater (e.g. via discharge to surface water or as a result of extraction (i.e. livestock watering)).
Ramboll Environ Response: There are no extractive uses of groundwater within 4km down gradient of the aluminium smelter. This area includes the smelter buffer zone, which is used for agistment of cattle. Stock watering occurs via the use of water from Swamp Creek. There are no groundwater extraction bores in the buffer zone down gradient of the smelter.

Comment No. 3: Section 3.4 identifies terrestrial fauna to be exposed to COPEC via ingestion of drinking water only. Figure 3.1 also lists ingestion of soil incomplete for mammals and birds. Please provide an explanation as to why these receptors would not be exposed via direct contact with soil and incidental ingestion of soil?
Ramboll Environ Response: These potential pathways were not considered in detail because, as stated in the final paragraph of Section 3.4, "*dermal exposure is assumed to be negligible for birds and mammals since feathers and fur limit the contact of skin and contaminated media (Sample & Suter 1994). Furthermore, the focus for this risk assessment is on risks from contaminated surface water and therefore the main exposure pathway investigated for birds and mammals is via consumption of drinking water.*" In addition, in Section 4.5.3 it states that "*Soil ingestion is considered to be insignificant for the range of species being investigated and is not considered further.*"

Comment No. 4: Section 4.5.3 states that 'The main food items within the investigation area that could potentially influence the daily dose of fluoride for the selected ROIs are fish, which are considered in the exposure assessment for the white-faced heron only.' Food intake exposure pathways have not been included in the CSM and no data has been presented to indicate how food intakes have been included in the food web modelling presented in Table 6.2. Please clarify how food intakes have been assessed in the report?
Ramboll Environ Response: Throughout the report there is reference to the calculation of food intake exposures for the white-faced heron, as indicated below.

Section 4.1 states "*When a receptor is exposed by more than one pathway (e.g. drinking water and food), the HQs for each exposure pathway are added to provide a "Total HQ" for each COPEC.*"

Section 4.5.3 states "*The total oral exposure experienced by white-faced heron in the investigation area therefore equals the sum of exposures from drinking water and fish in the diet.*

$$Exposure = AUF \times \left[\frac{IR\ water\ x\ C\ water + IR\ food \times \sum(FIR\ food\ item \times C\ food\ item)}{BW}\right]$$

Where:

Exposure = Oral intake of COPEC in diet (mg/kg body weight/day)
AUF = Area Use Factor (percentage) (literature)
IR water = Ingestion rate of water (L of water/individual/day) (literature)

C water = Concentration of COPEC in water (mg/L water) (measured)
IR food = Ingestion rate of food (kg fresh weight of food/individual/day) (literature)
FIR food item = Fractional ingestion rate of food item (percentage) (literature)
C food item = Concentration of COPEC in a food item (mg/kg fresh weight) (calculated)
BW = Body Weight (kg) (literature)

The assessment of food-based dose for the white-faced heron provides an estimated intake of constituents via food to the constituent concentration in fish consumed. The dietary component of fish is weighted by its relative contribution to the total diet (as a percentage). The concentration of COPECs in fish is estimated using COPEC concentrations in surface water and literature-derived bioaccumulation factors (BAFs). Species-specific water ingestion rates and body weights were obtained from published literature.

Section 6.2.4 (Semi-permanent Dam) states "*Note that in addition to the risk assessment based on consumption of drinking water described above, the potential dose of fluoride obtained from prey items was assessed for the white-faced heron since this species relies heavily on fish for food. The resultant HQ based on potential fluoride intake in food and water was less than 1* ***(Table 6.2b)****, indicating no unacceptable risk. Risk calculations are believed to be conservative considering that calculations were based on consumption of 90% of their daily food requirement from the dam alone, and in reality, the dam is unlikely to support sufficient fish numbers to support continuous feeding throughout the year."*

Section 6.2.5 (Swamp Creek) states "*Note that in addition to the risk assessment based on consumption of drinking water described above, the potential dose of fluoride obtained from prey items was assessed for the white-faced heron since this species relies heavily on fish for food. The resultant HQ based on potential fluoride intake in food and water was less than 1* ***(Table 6.2b)****, indicating no unacceptable risk. Risk calculations are believed to be conservative considering that calculations were based on consumption of 90% of their daily food requirement from the same reach of the creek (where fish are exposed to the specified fluoride concentrations), and in reality, the birds would also forage in other reaches of the river where the concentration of fluoride in fish is likely to be lower."*

The CSM diagram (Figure 3.1) indicates a complete SPR linkage for water birds associated with the 'semi-permanent dam' and 'Swamp Creek' via 'ingestion'. This exposure is inclusive of ingestion of water and food with respect to the white-faced heron.

Additional table showing data used to calculate hazard quotients for total fluoride uptake (in food and water) for the white-faced heron is provided (**Table 6.2b)** with reference inserted as shown in bold shading in above two paragraphs.

Comment No. 5: Section 5.4 states that toxicity benchmarks of 1mg/kg/day for aluminium and 0.4mg/kg/day for fluoride were adopted based on back calculation from ANZECC (2000) livestock drinking water criteria. Please include the assumptions of average weight and water consumption referred to in this section to provide clarity on how these benchmarks were derived?

Ramboll Environ Response: We used an average weight of 600kg and water consumption rate of 120L/day. The consumption rate is at the upper (most conservative) limit of the range, based on NSW DPI Prime Fact guidance on *Water Requirement for Sheep and Cattle* (https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/96273/Water-requirements-for-sheep-and-cattle.pdf).

Comment No. 6: Toxicity benchmarks for all receptors discussed in Section 5.0 have not been included in Table 5.1 or 5.2. For the completeness and ease of cross checking, please include all adopted toxicity benchmarks in the Tables section.
Ramboll Environ Response: Table 5.3 has been added to provide terrestrial toxicity benchmarks, and reference to Table 5.3 has been added to Section 5.1.

Comment No. 7: Section 7.1 discusses mapping of the groundwater plume, please provide a figure within the report which illustrates where the groundwater plume is relative to identified exfiltration areas and ecological receptors.
Ramboll Environ Response: A figure showing the extent of the groundwater plume relative to identified exfiltration areas (Northern Vegetation Impact Area and Southern Vegetation Impact Area) and ecological receptors (semi-permanent dam and Swamp Creek) is attached.

Comment No. 8: Figure 3.1 indicates that ingestion of sediments is not a complete exposure pathway for birds in the semi-permanent dam and Swamp Creek. Section 3.4 states that the drinking water pathway is considered to be the main exposure pathway for birds and mammals. Is it considered likely that birds may incidentally ingest sediment during collection of aquatic organisms. Please provide more details explanation as to why this exposure pathway is not considered complete for these receptors?
Ramboll Environ Response: Sediment ingestion is considered to represent minimal exposure potential for the bird and mammal species considered in the risk assessment. None of the species forage within sediments for food and incidental ingestion of minor amounts of sediment attached to prey items, e.g., fish consumed by herons, is not considered to be of concern since most prey targeted by these predators are actively mobile species living amongst the aquatic vegetation where sediment exposure is low.

Comment No. 9: Table 2.1 – 2.4 lists soil assessment criteria adopted which are not based on ecological endpoints. Please discuss the appropriateness of using human health based screening criteria for screening of soil results?
Ramboll Environ Response: Ecological endpoints are a better option but in their absence for the COPECs assessed in this report, the adoption of human-health screening criteria was deemed to represent a conservative approach.

Comment No. 10: Data presented within Table 4.1 could not be cross checked due to lack of source references. Please provide references for all data presented in Table 4.1, including the reasoning behind the exposure area assumptions? Please define AUF within Table 4.1?
Ramboll Environ Response: Reference to source of data for Table 4.1 is discussed in Section 4.5; it is not appropriate to include all source information within Table 4.1. The concept of AUF is clearly defined in Section 4.5, "*AUFs are the estimation of dose to account for the possibility that some wildlife ROIs may*

obtain some drinking water from outside of the investigation area. An AUF is the ratio of the area of potential exposure (e.g. pond area) divided by the species' home range." The reasoning behind using the area assumptions is to acknowledge that most of the larger receptors of interest (ROI) forage across a wider area than the impacted zone and hence are not totally relying on water/food intake that is potentially contaminated with COPECs.

Comment No. 11: US Benchmark Species for each ROI have been included in Table 4.2, however no explanation as to the reasoning for selection of each of the US benchmark Species has been included in the report. Please provide an explanation as to why each US Benchmark Species is considered appropriate relative to the Australian ROI?
Ramboll Environ Response: Section 4.5 states "*TRVs for Australian ROIs are lacking and therefore the exposure assessment for birds and mammals is based on published wildlife toxicity benchmarks from the US, using data for species that, as far as possible, are from similar taxonomic groups, trophic levels and body size. The selection of suitable proxy species is restricted by the availability of benchmark data and it is acknowledged that much of the "species-specific" US data are extrapolated from laboratory test animals. Table 4.2 lists the species identified as ROIs for the investigation area and the proxy US species used for wildlife toxicity benchmarks" and "Where appropriate, the total exposures for species are based on calculated COPEC doses in drinking water and food. Average daily food consumption rates are based on the proxy US species, as derived from published literature (Sample et al. 1996). Note however, that species-specific data for mean body sizes and daily water consumption rates are used for the Australian marsupial ROIs (antechinus, possum and kangaroo) since it has been suggested that marsupial water consumption is lower than for equivalent sized placental mammals (Hume 1999).*"

Similarly, Section 5.2 states that "*Toxicity benchmarks are unavailable for most Australian species but are available for a range of North American terrestrial bird and mammal species (Sample et al. 1996). However, reliance on these benchmarks is deemed acceptable if using data for species that are taxonomically similar, with similar body size, habits and trophic levels to Australian species. In this assessment, toxicity data for appropriate US species were used for calculation of risk to a selection of Australian species known to occur within the investigation area. US-based toxicity data were supplemented with specific data on body sizes, home ranges and ingestion rates wherever Australian data were available.*"

As stated, the US benchmark species have been selected on the basis of being taxonomically similar, with similar body size, habits and trophic levels to Australian species. Table 4.2 provides a clear comparison of trophic level, habitat and mean body weights for Australian ROI and the US proxies.

Comment No. 12: Table 6.1 presents a fluoride criterion for microbes/ water of 30mg/L, and a fluoride criterion for plants/ water of 5mg/L, however there is no information included in the report as to the source of these values. Please clarify?
Ramboll Environ Response: Section 6 states that "*No appropriate benchmark was located for toxicity to soil microbes from fluoride in the exfiltrated groundwater although the benchmark used for soils was based on data from experiments where soils were 'wetted' with solutions containing fluoride. Therefore this benchmark may also be appropriate for the exfiltrated groundwater. Using data from the wetted soils, HQ values were 11.7 and 5.43 for the southern and northern vegetation impact areas, respectively.*"

As stated in Section 2.4.2.1, "*A guideline for fluoride that is protective of the environment has not been developed for Australia. Anecdotal information indicates that 5 mg/L has been 'regulator-approved' and adopted as a trigger concentration for fluoride in groundwater at a nearby aluminium smelter. This guideline value was adopted in the screening level evaluation; however, its applicability for the investigation area requires further consideration*."

Comment No. 13: Table 6.4 lists the fluoride criterion for invertebrates at 0.54mg/L, however the criterion listed in Table 5.2 is 3.706mg/L. Please cross check and amend where required. For the purpose of clarity, please also include units in Table 6.4 and 6.5.
Ramboll Environ Response: Agreed. The stated value of 0.54mg/L is incorrect as it is the criterion for aluminium. This was an error and fluoride criteria in Table 6.4 should be 3.706mg/L to match Table 5.2. The fluoride criteria in Table 6.4 has been updated and the HQs for fluoride are consequently lower than reported, i.e. risks are less than first calculated.

Comment No. 14: Table 6.7 lists no unacceptable risks identified for aluminium in surface and sub-surface soils for terrestrial plants and soil microbes in the southern and northern vegetation impact areas. However the is no table which presents HQ risk estimates for aluminium in soils. Please clarify?
Ramboll Environ Response: As stated in Section 3.3.2, since "*At pH values greater than 5.5, naturally occurring aluminium compounds exist predominantly in an undissolved form*" and in Section 5.1, since "*USEPA have adopted a policy whereby aluminium is identified as a COPEC only for soils with a pH less than 5.5 (USEPA 2003) and since the pH of surface water samples collected within the vegetation impact areas had pH ranging from 8.8 to 9.7, the conditions are clearly unsuitable for mobilisation of aluminium from soil. Therefore, aluminium is not considered to be a COPEC in soils within the investigation area (Table 5.3).*"

Auditor's Review of the Stage 2 Aquatic Assessment

Comment No. 1: Section 3.1 and Section 3.2 discuss sediment and water quality parameters in Dam 03 which are 'significantly higher than the reference dams'. The use of the word significant in these sections (and through the report) indicates that a statistical analysis has been conducted. It is understood based on the information presented (e.g. no discussion of statistical analysis has been included) and the limited number of sampled collected that no statistical analysis has been conducted. Please clarify and amend the text accordingly.
Ramboll Environ Response: Agreed. The terms 'significant' and 'significantly' should not have been used to avoid confusion in the absence of statistical significance.

Comment No. 2: There is a comment in Section 4.0, which states 'Guidelines for aluminium in sediment indicate that concentrations are not likely to cause significant issues until they reach percentage values (i.e. greater than one million mg/kg)'. Please specify the guidelines to which this statement refers and the source of these guidelines?
Ramboll Environ Response: Our statement is incorrect in that percentage values are equivalent to greater than 10,000 mg/kg – the error has been fixed in the revised report. The underlying basis for this statement is that natural concentrations of aluminium in freshwater sediments have often been reported at

percentage levels. For example, in 541 streambed samples collected from a wide variety of freshwater streams in the US, aluminium concentrations ranged from 14 – 140 g/kg (1.4 – 14%); similar results were reported for sediments from Canada and Antarctica, as discussed in the ATSDR's 2008 Toxicological Profile for Aluminium.
We acknowledge that the statement 'Guidelines for aluminium…' is misleading and clarify that the wording 'Natural concentrations of aluminium in sediments are often at percentage levels…' should have been used.

Comment No. 3: Section 5.0 states that 'the results of the Stage 2 Aquatic Assessment indicate that there is no discernible impact to the aquatic ecology within the semi-permanent dam as a result of elevated concentrations of fluoride in surface water and sediments.' Based on the limited investigation undertaken to assess the potential for ecological impacts, it is considered unlikely that the reported conditions in Dam 03 have the potential to result in unacceptable ecological risks. The above wording from the current conditions in the report implies a level of certainty which cannot be achieved by the sampling conducted to date. Therefore consideration should be given to softening the wording of this conclusion and outlining the uncertainties and limitations to the investigation conducted to date to give appropriate context to the conclusions provided.
Ramboll Environ Response: We agree that the wording of the conclusions associated with the current study should be softened and a statement of uncertainty and limitation included as recommended.

Auditor's Review of the Preliminary Screening Level, Health Risk Assessment

Comment No. 1: The Conceptual Site Model in Section 3.0 does not include consideration of extractive uses of groundwater (including for watering of livestock which is also not included in the ecological risk assessment (ENIRON, 2013)). Please provide consideration of the potential for exposure via groundwater extraction pathways.
Ramboll Environ Response: There are no extractive uses of groundwater within 4km down gradient of the aluminium smelter. This area includes the smelter buffer zone, which is used for agistment of cattle. Stock watering occurs via the use of water from Swamp Creek. There are no groundwater extraction bores in the buffer zone down gradient of the smelter.

Comment No. 2: Please include references for the information presented in Section 4.2.1, Section 4.2.2, Section 4.2.4 and Section 4.3.1.
Ramboll Environ Response: The references reviewed to provide information regarding the health effects of fluoride and aluminium were as follows:
'Inorganic Fluorides, Canadian Environment Protection Act, Priority Substances List, Assessment Report, Environment Canada', 1993, Health Canada CEPA.
'Aluminium Chloride, Aluminium Nitrate and Aluminium Sulphate, Priority Substances List Assessment Report, Follow-up to the State of Science Report 2000, Canadian Environmental Protection Act 1999', 2010 CEPA.
'Aluminium and aluminium compounds, The Hague: Health Council of the Netherlands', 2009, HCN.
'Australian Drinking Water Guidelines, National Water Quality Management Strategy, Canberra: National Health and Medical Research Council and Natural Resource Management Ministerial Council, Commonwealth of Australia', 2011, NHMRC.
'Air Quality Guidelines for Europe, Second Edition, WHO regional publications, Copenhagen', 2000 WHO

'Fluoride in Drinking Water, London: IWA Publishing', 2006, WHO.

Comment No. 3: Please provide details as to how the plant uptake factor presented in Attachment A has been derived.
Ramboll Environ Response: The plant uptake factor presented in Attachment A was $7.0x10^{-5}$kg/day. Information in Section 4.2.4 indicates '*Review of fluorides by OEHHA (2012) derived a range of soil to plant uptake factors, where the higher uptake factors related to the uptake of fluoride from deposited soluble salts on the leaf surface. In the assessment presented, this mechanism is not expected to be significant (as smelter emissions have ceased and the fluorides are bound with soil and dust generation is not expected to be significant). Hence for the purpose of deriving a soil guideline, the plant uptake factors for root crops of 0.009 (mg/kg plant per mg/kg soil) and protected (from dust deposition) aboveground crops of 0.004 (mg/kg plant per mg/kg soil) has been considered.'* The plant uptake factor in kg/day has been derived from the uptake factors in mg/kg plant per mg/kg soil.

Comment No. 4: The source of the TRV (inhalation) value of 0.14mg/m^3 for fluoride and 3.5mg/m^3 for aluminium presented in the Attachment A tables has not been provided in the report text. Please provide a reference/ discussion as to the source and the suitability of these values for use in the risk assessment.
Ramboll Environ Response: An oral TRV was identified and discussed in the report. For the purpose of deriving a soil guideline value, dust inhalation is an exposure pathway that is included. No inhalation-specific TRVs are available for fluoride or aluminum and hence, in accordance with NEPM (2013) and USEPA (2009) guidance the oral value has been used to assess inhalation exposures. The inhalation TRV is calculated by converting the oral value to an inhalation value assuming inhalation of 20m^3 air per day and a body weight of 70kg, as outlined by USEPA (2009). For fluoride the oral TRV is 0.04 mg/kg/day, which converts to and inhalation TRV of 0.14 mg/m^3. For aluminum the oral TRV is 1 mg/kg/day, which converts to an inhalation TRV of 3.5 mg/m^3.

Comment No. 5: The report does not outline why 90% background intake (inhalation) has been assumed for aluminium (Attachment A tables). Please clarify?
Ramboll Environ Response: The background intake for inhalation should be 30%, not 90% as outlined in Section 4.3.2 of the report. When this error is corrected the relevant soil criteria for aluminum is unchanged from that presented in the report, as the dust inhalation pathway is not the driving pathway. The revised Appendix A is attached.

We trust that the information provided in our responses has is sufficient for you to complete the audit. Please let us know if you require any further information.
Yours sincerely

Kirsty Greenfield
Senior Environmental Consultant

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Tiedeman, Mark

From:	Kirsty Greenfield <kgreenfield@ramboll.com>
Sent:	Friday, 16 September 2016 3:15 PM
To:	Lundmark, Anna
Cc:	McFarland, Ross; Hafsteinsdottir, Erla; Richard.Brown@hydro.com; Fiona Robinson
Subject:	RE: Hydro Audit: Finalisation of the Smelter SAR
Attachments:	60342271_Audit_reporting_guidelines Validation_Automotive Waste Removal_25 Aug16_RE Responses.pdf; 60342271_Audit_reporting_guidelines Validation_Clay Borrow Pit Area_25Aug16_RE Response.pdf; 124662-coc.pdf; 128345-coc.pdf; 128665-coc.pdf; 131590-coc.pdf; ASET43345 - COC.PDF; ASET43437 - COC.PDF; ASET43615 AND ASET43616 - COC.PDF; ASET43669 -COC.PDF

Hi Anna,

Please find attached a copy of our responses to your comments on the Clay Borrow Pit Validation Report and the COCs for the laboratory reports, as requested.

Please let me know if you need any further info.

Yours sincerely
Kirsty Greenfield

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From: Lundmark, Anna [mailto:Anna.Lundmark@aecom.com]
Sent: Friday, 9 September 2016 10:35 PM
To: Fiona Robinson
Cc: McFarland, Ross; Hafsteinsdottir, Erla; Richard.Brown@hydro.com; Kirsty Greenfield
Subject: RE: Hydro Audit: Finalisation of the Smelter SAR

Thanks Fiona,

If you provide the remaining documents by the 16th we should be able to deliver the SAR to you before I go on long service leave.

If you could provide the full hazmat report at this stage that would be great. We will look at it for background purposes for the SAR on the RAP, and it will also be a reference for the additional investigations at the Smelter Site eventually.

Cheers,

Anna Lundmark
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From: Fiona Robinson [mailto:frobinson@ramboll.com]
Sent: Friday, 9 September 2016 5:44 PM
To: Lundmark, Anna; Richard.Brown@hydro.com; Kirsty Greenfield
Cc: McFarland, Ross; Hafsteinsdottir, Erla
Subject: RE: Hydro Audit: Finalisation of the Smelter SAR

Anna
Please find attached:

- For background purposes, could you also provide:
  - Remedial Options Report; and
  - Containment Cell Location report.

We do not have a dangerous goods report but we do have a hazardous materials audit – which is a very large document, approx. 6 volumes. Do we need to distill some information from this for you?

For the Clay Borrow Pit Validation we were not planning on providing updated reports and will be responding to the comments made (as we did for Residential Parcel 1). Will this be okay? These will be available by the 16th.
I will send the plume delineation report updated tomorrow and the response to the RAP comments next week. That should give you all responses by the 16th.
How does that sound for completion of your component before you head off on leave?

Yours sincerely
Fiona Robinson

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From: Lundmark, Anna [mailto:Anna.Lundmark@aecom.com]
Sent: Monday, 5 September 2016 10:21 AM
To: Richard.Brown@hydro.com; Fiona Robinson; Kirsty Greenfield
Cc: McFarland, Ross; Hafsteinsdottir, Erla
Subject: Hydro Audit: Finalisation of the Smelter SAR

Hi Richard, Kirsty and Fiona,

In order to finalise the SAR for the Smelter Site, there are still some documents that we need from you, namely:

- Updated Plume Delineation Report or response to the comments provided;
- Response to clarifications needed for the RAP;
- If you wish for us to refer to final versions of the Clay Borrow Pit Validation Reports, we'd need the finals (noting that this is not a landuse suitability audit, so we can still complete the SAR with the draft versions as they will not impact on the suitability of the RAP);
- For background purposes, could you also provide:
  - Remedial Options Report;
  - Containment Cell Location report; and
  - Dangerous good survey report.

Please note that I will be on long service leave from 23 September and am committed to assisting in the delivery of the SAR before then subject to receiving the above documents.

Regards,

Anna

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Tiedeman, Mark

From: Kirsty Greenfield <kgreenfield@ramboll.com>
Sent: Friday, 23 September 2016 1:53 PM
To: Lundmark, Anna
Cc: Hafsteinsdottir, Erla; McFarland, Ross; Fiona Robinson; Richard.Brown@hydro.com
Subject: RE: Hydro Audit: Landuse Figure for the Smelter Site
Attachments: Figure Showing Proposed Landuse.pdf

Hi Anna,

Please see attached.

Thanks,

Yours sincerely
Kirsty Greenfield

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From: Lundmark, Anna [mailto:Anna.Lundmark@aecom.com]
Sent: Friday, 23 September 2016 1:24 PM
To: Fiona Robinson; Richard.Brown@hydro.com; Kirsty Greenfield
Cc: Hafsteinsdottir, Erla; McFarland, Ross
Subject: Hydro Audit: Landuse Figure for the Smelter Site

Hi Fiona, Richard and Kirsty,

Could you please provide a Figure showing the proposed landuses for the Smelter Site so we can attach it to the SAR / SAS (I note you stated in the Response Letter to the Auditor's comments on the final RAP that it would be provided in the Validation Plan, but we do need to included it in the final SAR / SAS).

Cheers,

Anna Lundmark
Principal Environmental Scientist
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Anna.Lundmark@aecom.com

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Tiedeman, Mark

From: Kirsty Greenfield <kgreenfield@ramboll.com>
Sent: Tuesday, 26 July 2016 8:19 AM
To: McFarland, Ross; Lundmark, Anna
Cc: Fiona Robinson; Richard Brown
Subject: RE: Sustainability Memo
Attachments: Section 6.pdf

Hi Ross,

Thanks for your quick response. Please find attached Section 6 of the EIS.

Yours sincerely
Kirsty Greenfield

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From: McFarland, Ross [mailto:Ross.McFarland@aecom.com]
Sent: Monday, 25 July 2016 7:42 PM
To: Kirsty Greenfield; Lundmark, Anna
Cc: Fiona Robinson; Richard Brown
Subject: Re: Sustainability Memo

Thanks Kirsty.

In your memo, there is frequent reference to section 6.4 where "justification is provided" (i assume this is section 6.4 of the EIS?). Can you please provide this section?

I have reviewed the memo you have provided and, subject to your provision of section 6.4, it seems to be adequate information for me to remove my comment in relation the need for further consideration of sustainable remediation in your RAP.

I should be able to preview my revised interim opinion shortly.

Regards

Ross McFarland
AECOM Chief Environmental Scientist
Australia and New Zealand
M: +61413833811

-------- Original message --------
From: Kirsty Greenfield <kgreenfield@ramboll.com>
Date: 22/07/2016 14:19 (GMT+10:00)
To: "McFarland, Ross" <Ross.McFarland@aecom.com>, "Lundmark, Anna" <Anna.Lundmark@aecom.com>
Cc: Fiona Robinson <frobinson@ramboll.com>, Richard Brown <Richard.Brown@hydro.com>
Subject: Sustainability Memo

Hi Ross and Anna,

As discussed this morning, please find attached our memo regarding the sustainability analysis results in relation to the Hydro RAP.

Yours sincerely
Kirsty Greenfield

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Tiedeman, Mark

From:	Kirsty Greenfield <kgreenfield@ramboll.com>
Sent:	Tuesday, 26 July 2016 1:31 PM
To:	McFarland, Ross
Cc:	Lundmark, Anna
Subject:	FW: Sustainability Memo - two more references?
Attachments:	Hydro Remediation and Demolition EIS Final Rev 2 2016_07_14A.pdf

Hi Ross,

Please find attached the text of the EIS, without the figures or appendices. Please let me know if you need any further info.

Yours sincerely
Kirsty Greenfield

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From: Shaun Taylor
Sent: Tuesday, 26 July 2016 1:26 PM
To: Kirsty Greenfield
Subject: RE: Sustainability Memo - two more references?

Here it is (a little quicker). PDF of the EIS without figures.

Shaun Taylor

Senior Environmental Scientist

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From: Kirsty Greenfield
Sent: Tuesday, 26 July 2016 1:22 PM
To: Shaun Taylor; Fiona Robinson
Subject: FW: Sustainability Memo - two more references?
Importance: High

FYI

Yours sincerely
Kirsty Greenfield

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From: McFarland, Ross [mailto:Ross.McFarland@aecom.com]
Sent: Tuesday, 26 July 2016 12:24 PM
To: Kirsty Greenfield
Cc: Lundmark, Anna
Subject: RE: Sustainability Memo - two more references?
Importance: High

Dear Kirsty,

Hmmm. The problem with an “integrated report” like an EIS, is that it refers the reader to other parts of that EIS Report.

As I read Section 5, it refers me to Section 6, In Section 6 (thanks for providing this morning) there is cross-reference to Section 6.4.1 (which is a short paragraph and associated Table 6.2 you provided - thanks) as well as reference to **Section 8.8 and Section 9** – do these references (Section 8.8 and 9.) provide further justification and if so, can you provide, please? I would be remiss if I didn’t request these referenced sections from you as part of my audit.

Perhaps the fully EIS might be a prudent way forward – is there a problem in providing me with the full EIS as there seems to be a lot of “justification” of RAP issues within that EIS?

I am still expecting to send my revised IO today so your timely response to this email would be appreciated.

Call me on my mobile if you prefer.

Regards,

Ross McFarland
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NSWEPA Site Auditor (No.9819)
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From: Kirsty Greenfield [mailto:kgreenfield@ramboll.com]
Sent: Tuesday, 26 July 2016 8:19 AM
To: McFarland, Ross; Lundmark, Anna
Cc: Fiona Robinson; Richard Brown
Subject: RE: Sustainability Memo

Hi Ross,

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Yours sincerely
Kirsty Greenfield

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From: McFarland, Ross [mailto:Ross.McFarland@aecom.com]
Sent: Monday, 25 July 2016 7:42 PM
To: Kirsty Greenfield; Lundmark, Anna
Cc: Fiona Robinson; Richard Brown
Subject: Re: Sustainability Memo

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I have reviewed the memo you have provided and, subject to your provision of section 6.4, it seems to be adequate information for me to remove my comment in relation the need for further consideration of sustainable remediation in your RAP.

I should be able to preview my revised interim opinion shortly.

Regards

Ross McFarland
AECOM Chief Environmental Scientist
Australia and New Zealand
M: +61413833811

-------- Original message --------
From: Kirsty Greenfield <kgreenfield@ramboll.com>
Date: 22/07/2016 14:19 (GMT+10:00)
To: "McFarland, Ross" <Ross.McFarland@aecom.com>, "Lundmark, Anna" <Anna.Lundmark@aecom.com>
Cc: Fiona Robinson <frobinson@ramboll.com>, Richard Brown <Richard.Brown@hydro.com>
Subject: Sustainability Memo

Hi Ross and Anna,

As discussed this morning, please find attached our memo regarding the sustainability analysis results in relation to the Hydro RAP.

Yours sincerely
Kirsty Greenfield

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Certified Practitioner: Site Assessment and Management
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Appendix D

Results from Previous Investigations

Appendix D Results from Previous Investigations

TABLE LR1 Soil Analytical Results for the Site

Sample Identification	PQL	Guideline					MW06	MW06	SB11	SB12	SB13	MW14	MW15	MW16	MW16	MW17	MW17	MW18	MW18	SB15	SB15	SB16	SB16	MW07	MW07	MW08	MW08	SB17	SB18	MW19	MW19
Sample Depth (m)		HIL D[A]	HSL D[B]	EIL C/I[C]	Management Limits[D]	ESL C/I[E]	0-0.1	0.5-0.6	0.2-0.4	1.8-1.9	1.0-1.2	0-0.4	0.1-0.4	0.2-0.4	1.8-2.0	0.2-0.4	0.8-1.0	0-0.2	0.8-1.0	0.3-0.5	1-1.2	0.2-0.4	1-1.2	0-0.2	0.8-1.0	0.15-0.3	0.4-0.6	0.3-0.4	0.5-0.6	FILL 1	FILL 2
Date							13/04/2012	13/04/2012	17/04/2012	18/04/2012	18/04/2012	19/04/2012	19/04/2012	18/04/2012	18/04/2012	18/04/2012	18/04/2012	19/04/2012	19/04/2012	16/04/2012	16/04/2012	16/04/2012	16/04/2012	16/04/2012	16/04/2012	16/04/2012	16/04/2012	18/04/2012	18/04/2012	19/04/2012	19/04/2012
Sample Profile							ALLUVIAL	RESIDUAL	FILL	FILL	FILL	FILL	FILL	FILL	ESTUARINE	FILL	ESTUARINE	FILL	ESTUARINE	ESTUARINE	ESTUARINE	ESTUARINE	ESTUARINE	TOPSOIL	ESTUARINE	FILL	ESTUARINE	FILL	FILL	FILL	FILL
PAEC Sampled							Background	Background	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Refuelling	Refuelling	Refuelling	Refuelling	Refuelling	Refuelling	Refuelling	Refuelling	DSA	DSA	DSA	DSA
Sample collected by							KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG
Metals																															
Aluminium	50	NL*	-	-	-	-	2270	10700	9550	10300	14200	14700	13800	7740	3180	6740	1310	32700	8210	620	12500	3410	1720	7710	5720	690	4280				
Arsenic	1	3000	-	160	-	-	0.9	3.4	10.9	16.5	3.4	6.3	5.1	0.9	1.2	0.8	0.2	12	1.8	0.2	1.2	0.8	0.3	4.4	1.8	<0.1	0.2				
Cadmium	0.1	900	-	-	-	-	<0.1	<0.1	<0.1	<0.1	0.1	0.1	2.4	<0.1	<0.1	<0.1	<0.1	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.2	<0.1				
Chromium (VI)	1	3600	-	320**	-	-	2.5	15.1	7.3	7.9	52.1	25.5	18	5	3.2	5.3	1.4	26.9	6	1.9	26.6	3.9	5.7	10.5	21.2	3.9	3.6				
Copper	2	240,000	-	210**	-	-	0.4	0.6	13.6	14.2	16	15.6	44.5	7.8	0.2	4.2	0.3	21.9	0.3	0.8	5.8	0.5	0.6	32.8	2.2	4.1	0.4				
Nickel	1	6000	-	140**	-	-	1.3	2	11	12.4	34.4	53	27.8	6.4	1.8	2	0.6	51.6	4.6	1.1	11.2	3.3	2.6	8.1	11.9	2.7	5.8				
Lead	2	1500	-	1800	-	-	2.3	8.1	6.3	6.5	25.8	9.2	44.4	3.6	1.8	37	0.6	20.6	3.3	2.5	12.8	4.8	1.2	49.4	4.6	3.6	1.4				
Zinc	5	400,000	-	440**	-	-	5.3	2.9	51.6	53.4	178	70.4	115	18.8	0.6	43.4	0.5	288	1.4	2.6	32.6	2.8	1.3	384	7	59.9	12.1				
Mercury (inorganic)	0.05	730	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
Fluoride	40	17000*	-	-	-	-	150	140	240	150	1960	2350	3950	700	60	200	80	7740	650	830	100	60	280	3240	90	90	130				
Non Metallic Inorganics																															
Total Cyanide	1	1500	-	-	-	-	<1	<1	<1	<1	<1	<1	<1	3	<1	<1	<1	<1	<1												
Polycyclic Aromatic Hydrocarbons (PAH)																															
Naphthalene	0.5	-	-	370	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<4.0	<0.5	
Acenaphthylene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<4.0	<0.5	
Acenaphthene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	1.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.8	8.4	1.6	
Fluorene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.2	4.2	0.8	
Phenanthrene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	<0.5	16.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	30.2	46.7	7.8	
Anthracene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	6.3	9.6	1.6	
Fluoranthene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	0.7	3.8	<0.5	<0.5	<0.5	<0.5	41.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	0.6	<0.5	59.7	137	21.6	
Pyrene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	0.7	3	<0.5	<0.5	<0.5	<0.5	38.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	0.6	<0.5	59.1	133	21.7	
Benz(a)anthracene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	0.7	5.3	<0.5	<0.5	<0.5	<0.5	47.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	0.5	<0.5	46.7	103	24.3	
Chrysene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	8.1	<0.5	<0.5	<0.5	<0.5	50.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	0.6	<0.5	45.6	97.3	23.5	
Benzo(b)&(k)fluoranthene	1	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	1.1	9.6	<0.5	<0.5	<0.5	<0.5	67.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	0.9	<0.5	60.3	140	31	
Benzo(k)fluoranthene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.1	<0.5	<0.5	<0.5	<0.5	20.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	21.2	47.7	10	
Benzo(a) pyrene	0.5	-	-	-	-	72[F]	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	2.1	<0.5	<0.5	<0.5	<0.5	33.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	43.4	101	19.2	
Indeno(1,2,3-c,d)pyrene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.5	<0.5	<0.5	<0.5	<0.5	29.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	41.6	57.5	17.5	
Dibenz(a,h)anthracene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	7.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	8.8	12.8	4.6	
Benzo(g,h,i)perylene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.8	<0.5	<0.5	<0.5	<0.5	28.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	46.1	65	19.9	
Benzo(a)pyrene TEQ		40	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	1.87	4.5	<0.5	<0.5	<0.5	<0.5	58.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	70.1	150.2	31.6	
Sum of reported PAH	--	4000	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	5.8	38.6	0.8	<0.5	<0.5	<0.5	387	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.2	3.2	<0.5	475	963	205	
Total Petroleum Hydrocarbons (TPH)																															
TPH C6-C9	10	-	260	-	800	-														<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	
TPH C10-C14	50	-	NL	-	1000	170														<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	
TPH C15-C28	100	-	-	-	5000	1700														<100	<100	<100	<100	<100	<100	1400	<100	<100	980	1870	400	
TPH C29-C36	100	-	-	-	10,000	3300														<100	<100	<100	<100	120	<100	1960	<100	<100	1040	1890	470	
TPH C10-C36	--	-	-	-	-	-														<50	<50	<50	<50	120	<50	3360	<50	<50	2020	3760	870	
Polychlorinated Biphenyls																															
Total PCBs	1	-	-	-	-	-																									
Semi Volatile Organic Compounds																															
Total PAHs	1	4000	-	-	-	-														<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Total Phenols	1	240,000	-	-	-	-														<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Phthalate Esters	5	-	-	-	-	-														<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Nitrosamines	1	-	-	-	-	-														<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Nitroaromatics and Ketones	1	-	-	-	-	-														<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Haloethers	0.5	-	-	-	-	-														<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Chlorinated Hydrocarbons	1	-	-	-	-	-														<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Anilines and Benzidines	1	-	-	-	-	-														<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Organochlorine Pesticides	1	-	-	-	-	-														<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Organophosphorus Pesticides	0.5	-	-	-	-	-														<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Miscellaneous Compounds	0.5	-	-	-	-	-														<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Volatile Organic Compounds																															
Monocyclic Aromatic Hydrocarbons	5	-	-	-	-	-																									
Oxygenated Compounds	0.5	-	-	-	-	-																									
Sulfonated Compounds	1	-	-	-	-	-																									
Fumigants	0.5	-	-	-	-	-																									
Halogenated Aliphatic Compounds	5	-	-	-	-	-																									
Halogenated Aromatic Compounds	0.5	-	-	-	-	-																									
Trihalomethanes	0.5	-	-	-	-	-																									

All results are in units of mg/kg.

Blank Cell indicates testing was not completed

PQL = Practical Quantitation Limit.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Soil Health Screening Level for Vapour Intrusion 'D' Commercial/ Industrial

[C] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

[D] NEPM (2013) Management Limits for TPH Fractions F1 to F4 in soil - note that the F1 to F4 fractions are different to the fractions reported here

[E] NEPM (2013) Ecological Screening Level for Commercial/ Industrial

[F] Canadian Council of Ministries of the Environment (2010) Canadian Soil Quality Guidelines Carcinogenic and other Polycyclic Aromatic Hydrocarbons (PAHs) (Environmental and Human Health Effects)

* Fluoride (soluble) and aluminium Preliminary Screening Criteria from ENVIRON (2013) 'Preliminary Screening Level Health Risk Assessment for Fluoride and Aluminium'

** EIL values calculated using site-specific CEC (7.26 meq/100g), pH (5.5) and TOC (1.3%) data collected from the Buffer Zone during the March 2014 investigations

Results shown in shading are in excess of the primary health acceptance criteria

Results shown in underline are in excess of the primary ecological acceptance criteria

<LOR = Less than the Limit of Reporting

PAECs

CBP	Clay Borrow Pit
FLS	Flammable Liquids Store
AWP	Anode Waste Pile
DSA	Diesel Spray Area
CBWB	Cathode Bay Washdown Bay
PRA	Pot Rebuild Area

TABLE LR1 Soil Analytical Results for the Site

Sample Identification	PQL	Guideline					SB1	SB2	SB3	SB4	SB5	SB6	SB7	SB8	SB14	SB14	MW09	MW10	SB9	SB9	MW11	SB10	SB10	MW12	MW12	MW13	SB20 (i)	MW01	MW02	MW03A	MW05	MW21
Sample Depth (m)		HIL D[A]	HSL D[B]	EIL C/I[C]	Management Limits[D]	ESL C/I[E]	0-0.05	0-0.05	0-0.05	0-0.05	0-0.05	0-0.05	0-0.05	0-0.05	0-0.4	0.6-0.8	0.1-0.3	0.2-0.4	0.3-0.4	0.6-0.8	0-0.2	0.5-0.6	1-1.2	0-0.2	0.4-0.6	0.2-0.4	0-0.05	0.3-0.4	0-0.05	0.4-0.5	1.8-2.0	0.2-0.4
Date							12/04/2012	12/04/2012	12/04/2012	12/04/2012	12/04/2012	12/04/2012	12/04/2012	12/04/2012	18/04/2012	18/04/2012	17/04/2012	16/04/2012	16/04/2012	16/04/2012	16/04/2012	17/04/2012	17/04/2012	17/04/2012	17/04/2012	17/04/2012	13/04/2012	11/04/2012	11/04/2012	12/04/2012	12/04/2012	16/04/2012
Sample Profile							FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	ESTUARINE	FILL	FILL	FILL	FILL	FILL	FILL	TOPSOIL	FILL	FILL	FILL	TOPSOIL	FILL	FILL	FILL	FILL	FILL
PAEC Sampled							Pot Lines	Pot Lines	Pot Lines	Pot Lines	SPL Sheds	SPL Sheds	SPL Sheds	SPL Sheds	Maintenance	Maintenance	FLS	FLS	Washbay	Washbay	Washbay	CBWB	CBWB	AWP	AWP	AWP	Switchyard	CBP	CBP	CBP	CBP	PRA
Sample collected by							FR	FR	FR	FR	FR	FR	FR	FR	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	FR	KJG	KJG	KJG	KJG	KJG
Metals																																
Aluminium	50	NL*	-	-	-	-	53300	139000	138000	41700	26900	23700	11800	11000	11600	2820	5460	20500	39800	12600	15000	60800	4640	55800	3260	36700		10400	14400	17600	9510	15800
Arsenic	1	3000	-	160	-	-	4.5	28.9	8.8	14.6	5.1	3.4	2.4	1.9	3.6	0.9	6.4	16.4	17.1	23.9	5.8	10.8	1.4	10.1	1	10.5		4.9	7.9	4.1	4.9	1.3
Cadmium	0.1	900	-	-	-	-	0.7	1.8	1.4	0.8	0.2	0.2	0.1	0.1	<0.1	<0.1	0.1	0.8	11.1	0.2	0.2	4	<0.1	1.4	<0.1	<0.1		<0.1	<0.1	1	0.1	<0.1
Chromium (VI)	1	3600	-	320**	-	-	26.8	35	14.8	36	39.6	36.5	21.9	14.2	22.4	3.5	12.8	13.2	59.5	18.8	23.7	51.2	8.7	46.8	4.4	10.9		14.6	22.4	27.9	16.3	44
Copper	2	240,000	-	210**	-	-	21.1	280	18.9	89.8	33.7	28	12.4	11.6	17.8	0.4	21.9	71.4	82	62	36.3	55.2	1.7	41.1	0.3	6.7		7.9	1.8	12.4	11.1	34.6
Nickel	1	6000	-	140**	-	-	98	159	166	65.7	49	39.3	24.1	18.6	69.9	1.9	59.9	14.7	152	29.4	24.5	77.4	6.5	103	3.4	79.9		13.3	4.9	35.4	15.8	27.6
Lead	2	1500	-	1800	-	-	25	430	28.7	247	18.3	39.7	8.6	10.1	8.8	1.9	18	107	185	66.4	48	58	3.3	34.1	2.6	7.5		8.4	11.1	26.2	15	2.8
Zinc	5	400,000	-	440**	-	-	229	5400	444	1210	232	179	65.3	362	90.7	1.1	260	1380	578	621	420	425	4.9	304	1	21.3		31.6	15.4	75.5	76.7	59.2
Mercury (inorganic)	0.05	730	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1
Fluoride	40	17000*	-	-	-	-	13400	26400	41900	20900	1470	680	520	1440	970	70	700	16200	39000	1230	960	10600	190	47100	1010	17700		310	190	2120	1030	190
Non Metallic Inorganics																																
Total Cyanide	1	1500	-	-	-	-											<1	<1			<1	4	<1	<1	1	<1						
Polycyclic Aromatic Hydrocarbons (PAH)																																
Naphthalene	0.5	-	-	370	-	-											<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	
Acenaphthylene	0.5	-	-	-	-	-											<0.5	<0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	
Acenaphthene	0.5	-	-	-	-	-											<0.5	<0.5			<0.5	<0.5	<0.5	1.4	<0.5	0.6		<0.5	<0.5	<0.5	<0.5	
Fluorene	0.5	-	-	-	-	-											<0.5	<0.5			<0.5	<0.5	<0.5	0.9	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	
Phenanthrene	0.5	-	-	-	-	-											<0.5	<0.5			0.6	1.8	<0.5	15.2	<0.5	5		<0.5	<0.5	<0.5	<0.5	
Anthracene	0.5	-	-	-	-	-											<0.5	<0.5			<0.5	0.6	<0.5	4.1	<0.5	1.1		<0.5	<0.5	0.8	<0.5	
Fluoranthene	0.5	-	-	-	-	-											<0.5	1.1			2	10.6	<0.5	56.5	<0.5	20.4		<0.5	<0.5	0.7	<0.5	
Pyrene	0.5	-	-	-	-	-											<0.5	1			1.9	9.4	<0.5	52.2	<0.5	20.5		<0.5	<0.5	<0.5	<0.5	
Benz(a)anthracene	0.5	-	-	-	-	-											<0.5	0.5			1.8	13.8	<0.5	52.6	<0.5	17.3		<0.5	<0.5	0.9	0.6	
Chrysene	0.5	-	-	-	-	-											0.6	0.5			2	24.3	<0.5	74.3	<0.5	17		<0.5	<0.5	2.2	1.4	
Benzo(b)&(k)fluoranthene	1	-	-	-	-	-											1.1	0.8			3.3	39	<0.5	88.6	<0.5	26.6		1	<1	3	3	
Benzo(k)fluoranthene	0.5	-	-	-	-	-											<0.5	<0.5			1.2	10.8	<0.5	31.2	<0.5	11.8		<0.5	<0.5	<0.5	<0.5	
Benzo(a) pyrene	0.5	-	-	-	-	72[F]											<0.5	<0.5			1.7	8.9	<0.5	29.4	<0.5	16.1		0.7	<0.5	1.2	1	
Indeno(1,2,3-c,d)pyrene	0.5	-	-	-	-	-											<0.5	<0.5			1.2	10.3	<0.5	20.7	<0.5	11.4		<0.5	<0.5	<0.5	<0.5	
Dibenz(a,h)anthracene	0.5	-	-	-	-	-											<0.5	<0.5			<0.5	3.1	<0.5	7.2	<0.5	2.5		<0.5	<0.5	0.5	<0.5	
Benzo(g,h,i)perylene	0.5	-	-	-	-	-											<0.5	<0.5			1.5	16	<0.5	24	<0.5	14.5		<0.5	<0.5	<0.5	<0.5	
Benzo(a)pyrene TEQ		40	-	-	-	-											<0.5	<0.5			2.98	19.79	<0.5	56.9	<0.5	25.6		<0.5	<0.5	1.52	1.34	
Sum of reported PAH	--	4000	-	-	-	-											1.7	3.9			17.2	149	<0.5	458	<0.5	165		0.5	<0.5	0.7	<0.5	
Total Petroleum Hydrocarbons (TPH)																																
TPH C6-C9	10	-	260	-	800	-																										
TPH C10-C14	50	-	NL	-	1000	170																										
TPH C15-C28	100	-	-	-	5000	1700																										
TPH C29-C36	100	-	-	-	10,000	3300																										
TPH C10-C36	--	-	-	-	-	-																										
Polychlorinated Biphenyls																																
Total PCBs	1	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01																	<0.1					
Semi Volatile Organic Compounds																																
Total PAHs	1	4000	-	-	-	-									<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Total Phenols	1	240,000	-	-	-	-									<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Phthalate Esters	5	-	-	-	-	-									<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Nitrosamines	1	-	-	-	-	-									<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Nitroaromatics and Ketones	1	-	-	-	-	-									<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Haloethers	0.5	-	-	-	-	-									<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Chlorinated Hydrocarbons	1	-	-	-	-	-									<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Anilines and Benzidines	1	-	-	-	-	-									<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Organochlorine Pesticides	1	-	-	-	-	-									<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Organophosphorus Pesticides	0.5	-	-	-	-	-									<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Miscellaneous Compounds	0.5	-	-	-	-	-									<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Volatile Organic Compounds																																
Monocyclic Aromatic Hydrocarbons	5	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01																	<LOR					
Oxygenated Compounds	0.5	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01																	<LOR					
Sulfonated Compounds	1	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01																	<LOR					
Fumigants	0.5	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01																	<LOR					
Halogenated Aliphatic Compounds	5	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01																	<LOR					
Halogenated Aromatic Compounds	0.5	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01																	<LOR					
Trihalomethanes	0.5	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01																						

All results are in units of mg/kg.

Blank Cell indicates testing was not completed

PQL = Practical Quantitation Limit.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Soil Health Screening Level for Vapour Intrusion 'D' Commercial/ Industrial

[C] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

[D] NEPM (2013) Management Limits for TPH Fractions F1 to F4 in soil - note that the F1 to F4 fractions are different to the fractions reported here

[E] NEPM (2013) Ecological Screening Level for Commercial/ Industrial

[F] Canadian Council of Ministries of the Environment (2010) Canadian Soil Quality Guidelines Carcinogenic and other Polycyclic Aromatic Hydrocarbons (PAHs) (Enviro

* Fluoride (soluble) and aluminium Preliminary Screening Criteria from ENVIRON (2013) 'Preliminary Screening Level Health Risk Assessment for Fluoride and Alumin

** EIL values calculated using site-specific CEC (7.26 meq/100g), pH (5.5) and TOC (1.3%) data collected from the Buffer Zone during the March 2014 investigations

Results shown in shading are in excess of the primary health acceptance criteria

Results shown in underline are in excess of the primary ecological acceptance criteria

<LOR = Less than the Limit of Reporting

PAECs

CBP	Clay Borrow Pit
FLS	Flammable Liquids Store
AWP	Anode Waste Pile
DSA	Diesel Spray Area
CBWB	Cathode Bay Washdown Bay
PRA	Pot Rebuild Area

TABLE LR2 Soil Analytical Results for Drainage Lines and Dams

Sample Identification	PQL	HIL D[A]	HSL D[B]	EIL C/I[C]	Management Limits[D]	ESL C/I[E]	D1	D2	D3	D5	D6	D7	D8	D8-BASE	D9	D10	D11	D11-1	D12	D12-1
Sample Depth (m)							0-0.3	0-0.2	0-0.2	0-0.2	0-0.05	0-0.3	0-0.1	0.1-0.35	0-0.2	0-0.05	0-0.2	0.2-0.4	0-0.2	0.3-0.4
Date							13/04/2012	13/04/2012	13/04/2012	13/04/2012	13/04/2012	13/04/2012	13/04/2012	13/04/2012	13/04/2012	13/04/2012	13/04/2012	13/04/2012	13/04/2012	13/04/2012
Sample Profile							SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	CLAY	RESIDUAL	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	CLAY
PAECs Sampled							Western Dam	Western Dam	Southern Dam	Drain at SPL Sheds	Drain at AWP	Drain at AWP	Drain at Alcan Mound	Drain at Alcan Mound	Drain near Carbon Plant	Drain near DSA	East Surge Dam	East Surge Dam	East Surge Dam	East Surge Dam
Sample collected by							FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR
Metals																				
Aluminium	50	NL*	-	-	-	-	166000	31900	14200	25100	26800	39200	40900	15100	10900	23900	12800	13500	56000	5030
Arsenic	1	3000	-	160	-	-	14.1	9.3	5.9	5.7	9.2	17	16.1	3.2	6.7	4	5.7	3	16	0.6
Cadmium	0.1	900	-	-	-	-	2.6	0.6	0.2	0.6	3	2	4.4	<0.1	<0.1	1.1	1.2	0.3	4.5	<0.1
Chromium	1	3600	-	320**	-	-	25.8	23.2	23.2	27.8	41.4	35.9	49.5	18.8	13.5	15.5	16	13.7	55.4	6.4
Copper	2	240,000	-	210**	-	-	43.6	10.7	12.9	10	40.8	31.4	45.7	3.7	5.4	11.6	3.7	2	35.9	1
Nickel	1	6000	-	140**	-	-	173	78	21.1	22.2	118	87	119	10.7	9	49.6	10.9	6.9	103	3.7
Lead	2	1500	-	1800	-	-	49.9	17.9	24.3	24.7	52.1	71.4	79.6	11.4	12.2	31.8	12.7	7.7	63.2	3.8
Zinc	5	400,000	-	440**	-	-	1290	328	122	132	707	599	955	43	110	197	72.4	28.4	671	5.9
Mercury	0.05	730	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1
Fluoride	40	17000*	-	-	-	-	38500	5850	150	1110	3810	7350	3790	520	750	3330	1480	3010	2510	210
Non Metallic Inorganics																				
Total Cyanide	1	1500	-	-	-	-	2	<1	<1	<1	1	2	24	2	<1		2	2	86	4
Polycyclic Aromatic Hydrocarbons (PAH)																				
Naphthalene	0.5	-	-	370	-	-	<0.5	<0.5	<0.8	<0.8	<8.0	<0.5	<0.8	<0.5	<0.5	<0.5	<4.0	<0.5	<0.8	<0.5
Acenaphthylene	0.5	-	-	-	-	-	<0.5	<0.5	<0.8	<0.8	<8.0	<0.5	<0.8	<0.5	<0.5	<0.5	<4.0	<0.5	<0.8	<0.5
Acenaphthene	0.5	-	-	-	-	-	1.4	<0.5	<0.8	<0.8	<8.0	2.8	2.5	<0.5	<0.5	<0.5	<4.0	<0.5	<0.8	<0.5
Fluorene	0.5	-	-	-	-	-	1.2	<0.5	<0.8	<0.8	<8.0	2.2	1.5	<0.5	<0.5	<0.5	<4.0	<0.5	<0.8	<0.5
Phenanthrene	0.5	-	-	-	-	-	3.4	<0.5	<0.8	<0.8	38.3	20	18.1	1.7	<0.5	0.7	<4.0	<0.5	2.3	<0.5
Anthracene	0.5	-	-	-	-	-	0.7	<0.5	<0.8	<0.8	14.1	5.1	4.6	0.5	<0.5	<0.5	<4.0	<0.5	<0.8	<0.5
Fluoranthene	0.5	-	-	-	-	-	5.5	0.6	2.4	0.9	107	86.4	65.4	7.9	<0.5	3.7	33.1	0.7	12.9	<0.5
Pyrene	0.5	-	-	-	-	-	4.3	0.5	2.1	0.8	102	79.9	60.4	7.9	<0.5	3.6	31.3	0.8	12.5	<0.5
Benz(a)anthracene	0.5	-	-	-	-	-	3.4	0.6	2.6	1.1	109	73.3	63.4	8.5	<0.5	4.4	46.2	1.3	17.8	<0.5
Chrysene	0.5	-	-	-	-	-	3.8	0.8	4.6	1.3	116	84.8	64.9	11.2	<0.5	6.8	91	2.1	23.4	<0.5
Benzo(b)&(k)fluoranthene	1	-	-	-	-	-	6.1	1.6	8.6	2.4	224	145	151	30.1	0.6	11.5	172	3.9	46.5	<0.5
Benzo(k)fluoranthene	0.5	-	-	-	-	-	1.5	<0.5	2	<0.8	61.7	46.2	35.9	7.7	<0.5	3	37.2	0.9	11	<0.5
Benzo(a) pyrene	0.5	-	-	-	-	72[F]	2.4	0.6	2.1	0.8	85.6	57.1	58.8	15.1	<0.5	3.4	21.7	0.9	16	<0.5
Indeno(1,2,3-c,d)pyrene	0.5	-	-	-	-	-	1.4	<0.5	1.5	<0.8	54.6	32.2	46.3	13	<0.5	2.8	16.2	0.6	10.9	<0.5
Dibenz(a,h)anthracene	0.5	-	-	-	-	-	<0.5	<0.5	<0.8	<0.8	17.2	8.3	12.3	3	<0.5	0.9	6.2	<0.5	3.1	<0.5
Benzo(g,h,i)perylene	0.5	-	-	-	-	-	1.9	0.6	2.2	<0.8	66.9	38.2	59.9	16.6	<0.5	3.7	20.4	0.9	14.2	<0.5
Benzo(a)pyrene TEQ		40	-	-	-	-	3.9	1.1	4.0	1.6	149.6	96.3	102.0	24.3	<0.5	6.6	56.2	1.9	28.1	<0.5
Sum of reported PAH	--	4000	-	-	-	-	37	5.3	28.1	7.3	996	682	645	123	0.6	44.5	475	12.1	171	<0.5

All results are in units of mg/kg.

Blank Cell indicates testing was not completed

PQL = Practical Quantitation Limit.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Soil Health Screening Level for Vapour Intrusion 'D' Commercial/ Industrial

[C] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

[D] NEPM (2013) Management Limits for TPH Fractions F1 to F4 in soil - note that the F1 to F4 fractions are different to the fractions reported here

[E] NEPM (2013) Ecological Screening Level for Commercial/ Industrial

[F] Canadian Council of Ministries of the Environment (2010) Canadian Soil Quality Guidelines Carcinogenic and other Polycyclic Aromatic Hydrocarbons (PAHs) (Environmental and Human Health Effects)

* Fluoride (soluble) and aluminium Preliminary Screening Criteria from ENVIRON (2013) 'Preliminary Screening Level Health Risk Assessment for Fluoride and Aluminium'

** EIL values calculated using site-specific CEC (7.26 meq/100g), pH (5.5) and TOC (1.3%) data collected from the Buffer Zone during the March 2014 investigations

Results shown in shading are in excess of the primary health acceptance criteria

Results shown in underline are in excess of the primary ecological acceptance criteria

<LOR = Less than the Limit of Reporting

TABLE LR2 Soil Analytical Results for Drainage Lines and Dams

Sample Identification	PQL						COMPOSITE 1	COMPOSITE 2	COMPOSITE 3	COMPOSITE 4	ND4-BASE	ND7-BASE
Sample Depth (m)		HIL D[A]	HSL D[B]	EIL C/I[C]	Management Limits[D]	ESL C/I[E]					0.25-0.35	0.1-0.15
Date							13/04/2012	13/04/2012	13/04/2012	13/04/2012	13/04/2012	13/04/2012
Sample Profile							SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	CLAY	CLAY
PAECs Sampled							North Dam	North Dam	North Dam	North Dam	North Dam	North Dam
Sample collected by							FR	FR	FR	FR	FR	FR
Metals												
Aluminium	50	NL*	-	-	-	-	26300	24300	22800	8940	10300	15600
Arsenic	1	3000	-	160	-	-	7	6.4	5	2.9	3	4.6
Cadmium	0.1	900	-	-	-	-	5.4	3.7	1.6	0.5	<0.1	0.1
Chromium	1	3600	-	320**	-	-	24.9	19.3	16.4	8.9	13.6	21.2
Copper	2	240,000	-	210**	-	-	7.7	10.2	6.8	4.4	0.7	1.5
Nickel	1	6000	-	140**	-	-	27.4	41.3	70.3	28.6	4.2	7.6
Lead	2	1500	-	1800	-	-	23.8	19.2	10.8	6.2	5.8	9.2
Zinc	5	400,000	-	440**	-	-	308	677	840	184	6.8	46
Mercury	0.05	730	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoride	40	17000*	-	-	-	-	1390	1580	1880	860	340	7350
Non Metallic Inorganics												
Total Cyanide	1	1500	-	-	-	-	<1	<1	<1	<1	<1	<1
Polycyclic Aromatic Hydrocarbons (PAH)												
Naphthalene	0.5	-	-	370	-	-	<0.8	<0.8	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	0.5	-	-	-	-	-	<0.8	<0.8	<0.5	<0.5	<0.5	<0.5
Acenaphthene	0.5	-	-	-	-	-	<0.8	<0.8	<0.5	<0.5	<0.5	<0.5
Fluorene	0.5	-	-	-	-	-	<0.8	<0.8	<0.5	<0.5	<0.5	<0.5
Phenanthrene	0.5	-	-	-	-	-	<0.8	<0.8	<0.5	<0.5	<0.5	<0.5
Anthracene	0.5	-	-	-	-	-	<0.8	<0.8	<0.5	<0.5	<0.5	<0.5
Fluoranthene	0.5	-	-	-	-	-	7.4	<0.8	<0.5	<0.5	<0.5	<0.5
Pyrene	0.5	-	-	-	-	-	6.9	<0.8	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	0.5	-	-	-	-	-	11.4	<0.8	<0.5	<0.5	<0.5	<0.5
Chrysene	0.5	-	-	-	-	-	24	<0.8	0.7	<0.5	<0.5	<0.5
Benzo(b)&(k)fluoranthene	1	-	-	-	-	-	36.9	0.8	1.2	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	0.5	-	-	-	-	-	9.8	<0.8	<0.5	<0.5	<0.5	<0.5
Benzo(a) pyrene	0.5	-	-	-	-	72[F]	7.4	<0.8	<0.5	<0.5	<0.5	<0.5
Indeno(1,2,3-c,d)pyrene	0.5	-	-	-	-	-	6.9	<0.8	<0.5	<0.5	<0.5	<0.5
Dibenz(a,h)anthracene	0.5	-	-	-	-	-	2.6	<0.8	<0.5	<0.5	<0.5	<0.5
Benzo(g,h,i)perylene	0.5	-	-	-	-	-	9.1	<0.8	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ		40	-	-	-	-	16.8	<0.8	<0.5	<0.5	<0.5	<0.5
Sum of reported PAH	--	4000	-	-	-	-	122	0.8	1.9	<0.5	<0.5	<0.5

All results are in units of mg/kg.

Blank Cell indicates testing was not completed

PQL = Practical Quantitation Limit.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Soil Health Screening Level for Vapour Intrusion 'D' Commercial/ Industrial

[C] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

[D] NEPM (2013) Management Limits for TPH Fractions F1 to F4 in soil - note that the F1 to F4 fractions are different to the fractions reported

[E] NEPM (2013) Ecological Screening Level for Commercial/ Industrial

[F] Canadian Council of Ministries of the Environment (2010) Canadian Soil Quality Guidelines Carcinogenic and other Polycyclic Aromatic Hy

* Fluoride (soluble) and aluminium Preliminary Screening Criteria from ENVIRON (2013) 'Preliminary Screening Level Health Risk Assessm

** EIL values calculated using site-specific CEC (7.26 meq/100g), pH (5.5) and TOC (1.3%) data collected from the Buffer Zone during the I

Results shown in shading are in excess of the primary health acceptance criteria

Results showin in underline are in excess of the primary ecological acceptance criteria

<LOR = Less than the Limit of Reporting

TABLE LR4 Groundwater Analytical Results

Sample Identification	PQL	Guideline			MW06	MW01	MW01	MW03	MW03	MW04	MW04	MW05	MW05	MW07	MW08	MW09	MW10	MW11	MW12	MW13
Date		95% Fresh [A]	Irrigation	Stock	2/5/12	2/5/12	24/7/12	2/5/12	24/7/12	2/5/12	24/7/12	2/5/12	24/7/12	1/5/12	1/5/12	30/4/12	30/4/12	1/5/12	30/4/12	1/5/12
PAEC Sampled					Background	CBP	CBP	CBP	CBP	CBP	CBP	CBP	CBP	Refuelling	Refuelling	FLS	FLS	Washbay	AWP	AWP
Sample Appearance					Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Cloudy	Turbid	Milky	Brown	Cloudy
Sample collected by					KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG
Metals																				
Aluminium pH>6.5	10	55	5000	5000	10	20		590		2530		30		30	150	10	<10	380	13,600	2,150
Arsenic	1	24	100	500	<10	<10	<1	<10	3	<10	<1	2	2	13	3	3	2	18	16	4
Cadmium	0.1	0.2	10	10	<1	<1	1.1	<1	2	3.1	2.7	0.1	0.2	0.2	<1	<0.1	<0.1	<0.1	2.1	<0.1
Chromium	1	1	100	1000	<10	<10	<1	<10	4	<10	<1	<1	<1	<10	2	<1	<1	2	29	4
Copper	1	1.4	200	1000	<10	<10	5	<10	3	<10	4	3	3	10	<1	2	1	2	88	1
Nickel	1	11	200	1000	22	<10	58	488	420	938	600	15	15	30	2	16	19	5	110	2
Lead	1	3.4	2000	100	<10	<10	<1	<10	3	<10	<1	1	<1	<1	<1	<1	<1	<1	133	<1
Zinc	5	8	2000	20,000	78	<50	64	847	1100	1840	1000	30	9	28	12	9	10	28	699	25
Mercury	0.1	0.6	2	2	<0.1	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoride	100	5000*	1000	2000	1000	1200		2500		5500		15000		1300	4900	1000	1200	3900	1700	43000
Non Metallic Inorganics																				
Free Cyanide	4	7			<4											<8	<4	<4	<8	7
Total Cyanide	4	NA			<4											<8	<4	13	<8	40
Total Petroleum Hydrocarbons (TPH)																				
TPH C6-C9	20													<20	<20					
TPH C10-C14	50													<50	<50					
TPH C15-C28	10													<100	330					
TPH C29-C36	50													<50	<50					
TPH C6-C36		7	LOR	LOR										<50	330					
Polycyclic Aromatic Hydrocarbons (PAH)																				
3-Methylcholanthrene	0.1				<0.1									<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2
2-Methylnaphthalene	0.1				<0.1									<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
7.12-Dimethylbenz(a)anthracene	0.1				<0.1									<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	0.1				<0.1									<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2
Acenaphthylene	0.1				<0.1									<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	0.1	*0.4*			<0.1									<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2
Benz(a)anthracene	0.1				<0.1									<0.1	<0.1	0.3	<0.1	<0.1	0.3	4
Benzo(a)pyrene	0.05	0.2			<0.05									<0.05	<0.05	0.58	<0.05	<0.05	0.4	6.46
Benzo(b)fluoranthene	0.1				<0.1									<0.1	<0.1	1.4	<0.1	<0.1	0.6	8.1
Benzo(e)pyrene	0.1				<0.1									<0.1	<0.1	0.7	<0.1	<0.1	0.3	3.4
Benzo(g.h.i)perylene	0.1				<0.1									<0.1	<0.1	0.4	<0.1	<0.1	0.2	2.6
Benzo(k)fluoranthene	0.1				<0.1									<0.1	<0.1	0.4	<0.1	<0.1	0.2	2.7
Chrysene	0.1				<0.1									<0.1	<0.1	0.6	<0.1	<0.1	0.2	3.6
Coronene	0.1				<0.1									<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5
Dibenz(a.h)anthracene	0.1				<0.1									<0.1	<0.1	0.1	<0.1	<0.1	<0.1	1
Fluoranthene	0.1	1.4			<0.1									<0.1	<0.1	0.2	<0.1	<0.1	0.3	4.8
Fluorene	0.1				<0.1									<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1.2.3.cd)pyrene	0.1				<0.1									<0.1	<0.1	0.2	<0.1	<0.1	0.2	3
N-2-Fluorenyl Acetamide	0.1				<0.1									<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	0.1	16			<0.1									<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Perylene	0.1				<0.1									<0.1	<0.1	0.2	<0.1	<0.1	0.1	1.9
Phenanthrene	0.1	2			<0.1									<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.9
Pyrene	0.1				<0.1									<0.1	<0.1	0.2	<0.1	<0.1	0.3	5
Semivolatile Organic Compounds (SVOCs)																				
Organochlorine Pesticides (OCP)																				
alpha-BHC	2				<2	<2		<2		<2		<2				<2	<2			
HCB	2				<2	<2		<2		<2		<2				<2	<2			
delta-BHC	2				<2	<2		<2		<2		<2				<2	<2			
Heptachlor	2	0.09			<2	<2		<2		<2		<2				<2	<2			
Aldrin	2	*0.001*			<2	<2		<2		<2		<2				<2	<2			
Heptachlor epoxide	2				<2	<2		<2		<2		<2				<2	<2			
Chlordane	2	0.08			<2	<2		<2		<2		<2				<2	<2			
Endosulfan	2	0.2			<2	<2		<2		<2		<2				<2	<2			
Dieldrin	2	*0.01*			<2	<2		<2		<2		<2				<2	<2			
DDE	2	*0.03*			<2	<2		<2		<2		<2				<2	<2			
Endrin	2	0.02			<2	<2		<2		<2		<2				<2	<2			
DDD	2				<2	<2		<2		<2		<2				<2	<2			
Endrin aldehyde	2				<2	<2		<2		<2		<2				<2	<2			
Endosulfan sulfate	2				<2	<2		<2		<2		<2				<2	<2			
DDT	4	0.01			<4	<4		<4		<4		<4				<4	<4			

TABLE LR4 Groundwater Analytical Results

Sample Identification	PQL	Guideline			MW06	MW01	MW01	MW03	MW03	MW04	MW04	MW05	MW05	MW07	MW08	MW09	MW10	MW11	MW12	MW13
Date		95% Fresh [A]	Irrigation	Stock	2/5/12	2/5/12	24/7/12	2/5/12	24/7/12	2/5/12	24/7/12	2/5/12	24/7/12	1/5/12	1/5/12	30/4/12	30/4/12	1/5/12	30/4/12	1/5/12
PAEC Sampled					Background	CBP	CBP	CBP	CBP	CBP	CBP	CBP	CBP	Refuelling	Refuelling	FLS	FLS	Washbay	AWP	AWP
Sample Appearance					Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Cloudy	Turbid	Milky	Brown	Cloudy
Sample collected by					KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG
Organophosphorous Pesticides (OPP)																				
Dichlorvos	2				<2	<2		<2		<2		<2				<2	<2			
Dimethoate	2	0.15			<2	<2		<2		<2		<2				<2	<2			
Diazinon	2	0.01			<2	<2		<2		<2		<2				<2	<2			
Chlorpyrifos-methyl	2				<2	<2		<2		<2		<2				<2	<2			
Malathion	2	0.05			<2	<2		<2		<2		<2				<2	<2			
Fenthion	2	0.2			<2	<2		<2		<2		<2				<2	<2			
Chlorpyrifos	2				<2	<2		<2		<2		<2				<2	<2			
Bromophos-ethyl	2				<2	<2		<2		<2		<2				<2	<2			
Chlorfenvinphos	2				<2	<2		<2		<2		<2				<2	<2			
Prothiofos	2				<2	<2		<2		<2		<2				<2	<2			
Ethion	2				<2	<2		<2		<2		<2				<2	<2			
Polynuclear Aromatic Hydrocarbons																				
Naphthalene	2					<2		3		<2		<2								
2-Methylnaphthalene	2					<2		<2		<2		<2								
2-Chloronaphthalene	2					<2		<2		<2		<2								
Acenaphthylene	2					<2		<2		<2		<2								
Acenaphthene	2					<2		<2		<2		<2								
Fluorene	2					<2		<2		<2		<2								
Phenanthrene	2					<2		<2		<2		<2								
Anthracene	2					<2		<2		<2		<2								
Fluoranthene	2					<2		<2		<2		<2								
Pyrene	2					<2		<2		<2		<2								
N-2-Fluorenyl Acetamide	2					<2		<2		<2		<2								
Benz(a)anthracene	2					<2		<2		<2		<2								
Chrysene	2					<2		<2		<2		<2								
Benzo(b) & Benzo(k)fluoranthene	4					<4		<4		<4		<4								
7.12-Dimethylbenz(a)anthracene	2					<2		<2		<2		<2								
Benzo(a)pyrene	2					<2		<2		<2		<2								
3-Methylcholanthrene	2					<2		<2		<2		<2								
Indeno(1.2.3.cd)pyrene	2					<2		<2		<2		<2								
Dibenz(a.h)anthracene	2					<2		<2		<2		<2								
Benzo(g.h.i)perylene	2					<2		<2		<2		<2								
Phenols																				
Total Phenolics	4	320			<4	<4		<4		<4		<4				<4	<4			
Phthalate Esthers																				
Dimethylphthalate	2	3700			<2	<2		<2		<2		<2				<2	<2			
Diethylephthalate	2	1000			<2	<2		<2		<2		<2				<2	<2			
Nitrosamines																				
Total Nitrosamines	2				<2	<2		<2		<2		<2				<2	<2			
Nitroaromatics and Ketones																				
Total Nitroaromatics and Ketones	2				<2	<2		<2		<2		<2				<2	<2			
Haloethers																				
Total Haloethers	2				<2	<2		<2		<2		<2				<2	<2			
Chlorinated Hydrocarbons																				
Total Chlorinated Hydrocarbons	2				<2	<2		<2		<2		<2				<2	<2			
Anilines and Benzidines																				
Total Anilines and Benzidines	2				<2	<2		<2		<2		<2				<2	<2			
Miscellaneous Compounds																				
Total Misscellaneous Compounds	2				<2	<2		<2		<2		<2				<2	<2			

All results in µg/L

PQL = Practical Quantitation Limit.

[A] ANZECC 2000 95% Protection Level for Receiving Water Type

Guidelines in *italics* are low level reliability guidelines

[B] NHMRC Australian Drinking Water Guidelines, 20110

* 5000µg/L for Fluoride is based on the value used by another Aluminium Smelter

ANZECC arsenic guideline based on As (III) for marine and As (V) for fresh, the lowest of presented guidelines.

NHMRC arsenic guidelines are based on total arsenic

ANZECC and NHMRC guidelines for chromium are based on Cr (VI)

Total Phenolics guideline based on Phenol

ANZECC guidelines for mercury are based on inorganic mercury.

NHMRC guidelines for mercury are based on total mercury.

NHMRC guidelines for total cyanide are based on cyanogen chloride (as cyanide).

Results for TRH have been compared to TPH guidelines.

Results shaded grey are in excess of the primary acceptance criteria: ANZECC 95%, NHMRC

PAECs

CBP	Clay Borrow Pit
FLS	Flammable Liquids Store
AWP	Anode Waste Pile
DSA	Diesel Spray Area
CBWB	Cathode Bay Washdown Bay
PRA	Pot Rebuild Area

TABLE LR4 Groundwater Analytical Results

Sample Identification	PQL	Guideline			MW14	MW15	MW16	MW17	MW18	S3A	S3B	SUMP	MW19	MW20	MW21
Date		95% Fresh [A]	Irrigation	Stock	1/5/12	3/5/12	3/5/12	3/5/12	3/5/12	3/5/12	3/5/12	3/5/12	1/5/12	3/5/12	2/5/12
PAEC Sampled					Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	DSA	DSA	PRA
Sample Appearance					Yellow	Yellow	Clear	Cloudy	Clear	Clear	Clear	Clear	Milky	Cloudy	Clear
Sample collected by					KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG
Metals															
Aluminium pH>6.5	10	55	5000	5000	110	200	100	3,260	3,120	50	270	40			20
Arsenic	1	24	100	500	2	<1	4	12	2	5	2	4			<1
Cadmium	0.1	0.2	10	10	0.3	0.2	<0.1	<0.1	<0.1	0.3	<1	3			<0.1
Chromium	1	1	100	1000	<1	<1	1	<1	3	<1	1	<1			<10
Copper	1	1.4	200	1000	7	2	4	10	2	4	2	5			<10
Nickel	1	11	200	1000	10	7	6	14	3	6	1	8			62
Lead	1	3.4	2000	100	<1	<1	<1	34	<1	<1	<1	<1			<10
Zinc	5	8	2000	20,000	32	37	57	40	50	31	24	38			70
Mercury	0.1	0.6	2	2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1
Fluoride	100	5000*	1000	2000	3600	4500	1500	800	35000	12000	14000	4400			3000
Non Metallic Inorganics															
Free Cyanide	4	7			<4	<4	<8	<8	<4	<4	<4	<4			
Total Cyanide	4	NA			4	<4	<8	<8	<4	<4	<4	<4			
Total Petroleum Hydrocarbons (TPH)															
TPH C6-C9	20												<20	<20	
TPH C10-C14	50												<50	<50	
TPH C15-C28	10												<100	<100	
TPH C29-C36	50												<50	<50	
TPH C6-C36		7	LOR	LOR									<50	<50	
Polycyclic Aromatic Hydrocarbons (PAH)															
3-Methylcholanthrene	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
2-Methylnaphthalene	0.1				<0.1	<0.1	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
7.12-Dimethylbenz(a)anthracene	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Acenaphthene	0.1				<0.1	<0.1	9.4	22.9	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	
Acenaphthylene	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Anthracene	0.1	*0.4*			<0.1	<0.1	0.6	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Benz(a)anthracene	0.1				<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Benzo(a)pyrene	0.05	0.2			0.06	<0.05	0.22	<0.05	0.06	0.14	0.08	<0.05	<0.05	<0.05	
Benzo(b)fluoranthene	0.1				0.1	<0.1	0.2	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	
Benzo(e)pyrene	0.1				<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Benzo(g.h.i)perylene	0.1				<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Benzo(k)fluoranthene	0.1				<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Chrysene	0.1				<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Coronene	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Dibenz(a.h)anthracene	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Fluoranthene	0.1	1.4			0.1	<0.1	1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Fluorene	0.1				<0.1	<0.1	1.1	2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Indeno(1.2.3.cd)pyrene	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
N-2-Fluorenyl Acetamide	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Naphthalene	0.1	16			<0.1	<0.1	5.2	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Perylene	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Phenanthrene	0.1	2			<0.1	<0.1	0.6	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Pyrene	0.1				0.1	<0.1	0.7	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Semivolatile Organic Compounds (SVOCs)															
Organochlorine Pesticides (OCP)															
alpha-BHC	2														<2
HCB	2														<2
delta-BHC	2														<2
Heptachlor	2	0.09													<2
Aldrin	2	*0.001*													<2
Heptachlor epoxide	2														<2
Chlordane	2	0.08													<2
Endosulfan	2	0.2													<2
Dieldrin	2	*0.01*													<2
DDE	2	*0.03*													<2
Endrin	2	0.02													<2
DDD	2														<2
Endrin aldehyde	2														<2
Endosulfan sulfate	2														<2
DDT	4	0.01													<4

TABLE LR4 Groundwater Analytical Results

Sample Identification	PQL	Guideline			MW14	MW15	MW16	MW17	MW18	S3A	S3B	SUMP	MW19	MW20	MW21
Date		95% Fresh [A]	Irrigation	Stock	1/5/12	3/5/12	3/5/12	3/5/12	3/5/12	3/5/12	3/5/12	3/5/12	1/5/12	3/5/12	2/5/12
PAEC Sampled					Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	DSA	DSA	PRA
Sample Appearance					Yellow	Yellow	Clear	Cloudy	Clear	Clear	Clear	Clear	Milky	Cloudy	Clear
Sample collected by					KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG
Organophosphorous Pesticides (OPP)															
Dichlorvos	2														<2
Dimethoate	2	0.15													<2
Diazinon	2	0.01													<2
Chlorpyrifos-methyl	2														<2
Malathion	2	0.05													<2
Fenthion	2	0.2													<2
Chlorpyrifos	2														<2
Bromophos-ethyl	2														<2
Chlorfenvinphos	2														<2
Prothiofos	2														<2
Ethion	2														<2
Polynuclear Aromatic Hydrocarbons															
Naphthalene	2														<2
2-Methylnaphthalene	2														<2
2-Chloronaphthalene	2														<2
Acenaphthylene	2														<2
Acenaphthene	2														<2
Fluorene	2														<2
Phenanthrene	2														<2
Anthracene	2														<2
Fluoranthene	2														<2
Pyrene	2														<2
N-2-Fluorenyl Acetamide	2														<2
Benz(a)anthracene	2														<2
Chrysene	2														<2
Benzo(b) & Benzo(k)fluoranthene	4														<4
7.12-Dimethylbenz(a)anthracene	2														<2
Benzo(a)pyrene	2														<2
3-Methylcholanthrene	2														<2
Indeno(1.2.3.cd)pyrene	2														<2
Dibenz(a.h)anthracene	2														<2
Benzo(g.h.i)perylene	2														<2
Phenols															
Total Phenolics	4	320													<4
Phthalate Esthers															
Dimethylphthalate	2	3700													<2
Diethylephthalate	2	1000													<2
Nitrosamines															
Total Nitrosamines	2														<2
Nitroaromatics and Ketones															
Total Nitroaromatics and Ketones	2														<2
Haloethers															
Total Haloethers	2														<2
Chlorinated Hydrocarbons															
Total Chlorinated Hydrocarbons	2														<2
Anilines and Benzidines															
Total Anilines and Benzidines	2														<2
Miscellaneous Compounds															
Total Misscellaneous Compounds	2														<2

All results in µg/L

PQL = Practical Quantitation Limit.

[A] ANZECC 2000 95% Protection Level for Receiving Water Type

Guidelines in *italics* are low level reliability guidelines

[B] NHMRC Australian Drinking Water Guidelines, 20110

* 5000µg/L for Fluoride is based on the value used by another Aluminium Smelter

ANZECC arsenic guideline based on As (III) for marine and As (V) for fresh, the lowest of presented guidelines.

NHMRC arsenic guidelines are based on total arsenic

ANZECC and NHMRC guidelines for chromium are based on Cr (VI)

Total Phenolics guideline based on Phenol

ANZECC guidelines for mercury are based on inorganic mercury.

NHMRC guidelines for mercury are based on total mercury.

NHMRC guidelines for total cyanide are based on cyanogen chloride (as cyanide).

Results for TRH have been compared to TPH guidelines.

Results shaded grey are in excess of the primary acceptance criteria: ANZECC 95%, NHMRC

TABLE LR1 Soil Analytical Results for AEC 2 Anode Waste Pile (mg/kg)

Sample Identification	PQL				MW12	MW12	MW13	SB103	SB103	SB104	SB104	SB105	SB105	MW103	MW103	MW104	MW104
Sample Depth (m)		HIL D[A]	EIL C/I[B]	ESL C/I	0-0.2	0.4-0.6	0.2-0.4	0-0.1	0.3-0.4	0-0.1	0.3-0.4	0-0.1	0.3-0.4	0-0.1	0.3-0.4	0-0.1	0.3-0.4
Date					17-Apr-12	17-Apr-12	17-Apr-12	30-Jun-14	30-Jun-14	30-Jun-14	30-Jun-14	30-Jun-14	30-Jun-14	30-Jun-14	30-Jun-14	30-Jun-14	30-Jun-14
Sample Profile					FILL	FILL	FILL	FILL	ESTUARINE	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL
PAEC Sampled					AWP	AWP	AWP	AWP	AWP	AWP	AWP	AWP	AWP	AWP	AWP	AWP	AWP
Sample collected by					KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG
Metals																	
Aluminium	50	NL*	-	-	55800	3260	36700	-	-	-	-	-	-	-	-	-	-
Arsenic	1	3000	160	-	10.1	1	10.5	-	-	-	-	-	-	-	-	-	-
Cadmium	0.1	900	-	-	1.4	<0.1	<0.1	-	-	-	-	-	-	-	-	-	-
Chromium	1	3600	320**	-	46.8	4.4	10.9	-	-	-	-	-	-	-	-	-	-
Copper	2	240000	210**	-	41.1	0.3	6.7	-	-	-	-	-	-	-	-	-	-
Nickel	1	6000	140**	-	103	3.4	79.9	-	-	-	-	-	-	-	-	-	-
Lead	2	1500	1800	-	34.1	2.6	7.5	-	-	-	-	-	-	-	-	-	-
Zinc	5	400000	440**	-	304	1	21.3	-	-	-	-	-	-	-	-	-	-
Mercury (inorganic)	0.1	730	-	-	<0.1	<0.1	<0.1	-	-	-	-	-	-	-	-	-	-
Fluoride (soluble)	40	17000*	-	-	-	-	-	890	24	1077	270	970	110	410	430	64	45
Fluoride (total)	40	-	-	-	47100	1010	17700	-	-	-	-	-	-	-	-	-	-
Non Metallic Inorganics																	
Total Cyanide (free)	1	1500	-	-	<1	1	<1	-	-	-	-	-	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons (PAH)																	
Naphthalene	0.5	-	370	-	<0.5	<0.5	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	0.5	-	-	-	<0.5	<0.5	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	0.5	-	-	-	1.4	<0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Fluorene	0.5	-	-	-	0.9	<0.5	<0.5	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Phenanthrene	0.5	-	-	-	15.2	<0.5	5	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Anthracene	0.5	-	-	-	4.1	<0.5	1.1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Fluoranthene	0.5	-	-	-	56.5	<0.5	20.4	13	13	13	13	13	13	13	13	13	13
Pyrene	0.5	-	-	-	52.2	<0.5	20.5	12	12	12	12	12	12	12	12	12	12
Benz(a)anthracene	0.5	-	-	-	52.6	<0.5	17.3	11	11	11	11	11	11	11	11	11	11
Chrysene	0.5	-	-	-	74.3	<0.5	17	11	11	11	11	11	11	11	11	11	11
Benzo(b)&(k)fluoranthene	1	-	-	-	88.6	<0.5	26.6	25	25	25	25	25	25	25	25	25	25
Benzo(k)fluoranthene	0.5	-	-	-	31.2	<0.5	11.8	-	-	-	-	-	-	-	-	-	-
Benzo(a) pyrene	0.5	-	-	72[C]	29.4	<0.5	16.1	15	<0.05	18	21	37	12	28	160	24	0.21
Indeno(1,2,3-c,d)pyrene	0.5	-	-	-	20.7	<0.5	11.4	14	<0.1	16	18	32	8.2	27	120	18	0.2
Dibenz(a,h)anthracene	0.5	-	-	-	7.2	<0.5	2.5	1.4	<0.1	2	1.7	5.2	0.9	4.1	22	2.7	<0.1
Benzo(g,h,i)perylene	0.5	-	-	-	24	<0.5	14.5	12	<0.1	13	16	27	6.6	21	100	15	0.2
Benzo(a) pyrene TEQ		40			56.9	<0.5	25.6	21	<0.5	26	30	55	16	42	250	34	<0.5
Sum of reported PAH	--	4000	--	--	458	<0.5	165	120	NIL (+)VE	140	180	300	85	210	1400	150	1.7

All results are in units of mg/kg.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

[C] Canadian Council of Ministries of the Environment (2010) Canadian Soil Quality Guidelines Carcinogenic and other Polycyclic Aromatic Hydrocarbons (PAHs) (Environmental and Human Health Effects)

Cells with '-' indicates testing was not completed or an appropriate screening criteria was not available

NL: indicates that the site-specific risk-based aluminium screening criteria for industrial soil is at a concentration greater than physically possible in soil, and therefore the criteria is defined as 'Non-Limiting' or NL.

PQL = Practical Quantitation Limit.

Results shown in shading are in excess of the human health criteria

Results shown in underline are in excess of the ecological criteria

<LOR or <value = Less than the laboratory Limit of Reporting

* Site-specific fluoride (soluble) soil criteria derived from 'Preliminary Screening Level Health Risk Assessment for Fluoride and Aluminium (ENVIRON 2013)'

** EIL values calculated using site-specific CEC (7.26 meq/100g), pH (5.5) and TOC (1.3%) data collected from the Buffer Zone during the March 2014 investigations

TABLE LR2 Soil Analytical Results for AEC 4 Diesel Spray Area (mg/kg)

Sample Identification	PQL				SB17	SB18	MW19	MW19	SB111	SB111	SB112	SB112	SB112	SB113	SB113	SB114	SB114
Sample Depth (m)		HIL D[A]	EIL C/I[B]	ESL C/I	0.3-0.4	0.5-0.6	FILL 1	FILL 2	0.0-0.1	0.4-0.5	0.0-0.1	0.4-0.5	0.8-0.9	0.0-0.1	0.4-0.5	0.0-0.1	0.4-0.5
Date					18-Apr-12	18-Apr-12	19-Apr-12	19-Apr-12	01-Jul-14	01-Jul-14	01-Jul-14	01-Jul-14	01-Jul-14	01-Jul-14	01-Jul-14	01-Jul-14	01-Jul-14
Sample Profile					FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL
PAEC Sampled					DSA	DSA	DSA	DSA	DSA	DSA	DSA	DSA	DSA	DSA	DSA	DSA	DSA
Sample collected by					KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG
Polycyclic Aromatic Hydrocarbons (PAH)																	
Naphthalene	0.5	-	370	-	<0.5	<0.5	<4.0	<0.5	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	0.5	-	-	-	<0.5	<0.5	<4.0	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	0.5	-	-	-	<0.5	3.8	8.4	1.6	<0.1	<0.1	<0.1	2	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	0.5	-	-	-	<0.5	2.2	4.2	0.8	<0.1	<0.1	<0.1	0.9	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	0.5	-	-	-	<0.5	30.2	46.7	7.8	<0.1	0.4	<0.1	8.1	<0.1	0.2	<0.1	0.1	<0.1
Anthracene	0.5	-	-	-	<0.5	6.3	9.6	1.6	<0.1	<0.1	<0.1	1.7	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	0.5	-	-	-	<0.5	59.7	137	21.6	0.4	1.5	<0.1	30	<0.1	0.4	0.1	1	0.2
Pyrene	0.5	-	-	-	<0.5	59.1	133	21.7	0.5	1.6	<0.1	32	<0.1	0.4	0.1	1	0.2
Benz(a)anthracene	0.5	-	-	-	<0.5	46.7	103	24.3	0.3	1.2	<0.1	29	<0.1	0.3	<0.1	1.4	0.2
Chrysene	0.5	-	-	-	<0.5	45.6	97.3	23.5	1	1.1	<0.1	29	<0.1	0.6	0.1	2.7	0.2
Benzo(b)&(k)fluoranthene	1	-	-	-	<0.5	60.3	140	31	0.9	2.3	<0.2	64	<0.2	0.9	0.2	4.1	0.5
Benzo(k)fluoranthene	0.5	-	-	-	<0.5	21.2	47.7	10	-	-	-	-	-	-	-	-	-
Benzo(a) pyrene	0.5	-	-	72[C]	<0.5	43.4	<u>101</u>	19.2	0.48	1.5	0.06	38	<0.05	0.42	0.12	0.96	0.16
Indeno(1,2,3-c,d)pyrene	0.5	-	-	-	<0.5	41.6	57.5	17.5	0.3	1.1	<0.1	28	<0.1	0.3	<0.1	0.6	0.1
Dibenz(a,h)anthracene	0.5	-	-	-	<0.5	8.8	12.8	4.6	<0.1	0.1	<0.1	3.8	<0.1	<0.1	<0.1	0.1	<0.1
Benzo(g,h,i)perylene	0.5	-	-	-	<0.5	46.1	65	19.9	0.4	1	<0.1	23	<0.1	0.3	<0.1	0.8	0.1
Benzo(a) pyrene TEQ		40	-	-	<0.5	70.1	150.2	31.6	1	2	<0.5	55	<0.5	1	<0.5	2	<0.5
Sum of reported PAH	-	4000	-	-	<0.5	475	963	205	4.3	12	0.06	290	NIL (+)VE	3.7	0.66	13	1.7

All results are in units of mg/kg.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

[C] Canadian Council of Ministries of the Environment (2010) Canadian Soil Quality Guidelines Carcinogenic and other Polycyclic Aromatic Hydrocarbons (PAHs) (Environmental and Human Health Effects)

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Results shown in shading are in excess of the human health criteria

<u>Results shown in underline are in excess of the ecological criteria</u>

<LOR or <value = Less than the laboratory Limit of Reporting

TABLE LR3 Soil Analytical Results for AEC 8 Carbon Plant

Sample Identification	PQL	HIL D[A]	EIL C/I[B]	ESL C/I	SB11	SB12	SB13	MW14	MW15	MW16	MW16	MW17	MW17	MW18	MW18	SB108	SB109	SB110	MW105	MW105
Sample Depth (m)					0.2-0.4	1.8-1.9	1.0-1.2	0-0.4	0.1-0.4	0.2-0.4	1.8-2.0	0.2-0.4	0.8-1.0	0-0.2	0.8-1.0	0-0.1	0-0.1	0-0.1	0.15-0.25	0.3-0.4
Date					17-Apr-12	18-Apr-12	18-Apr-12	19-Apr-12	19-Apr-12	18-Apr-12	18-Apr-12	18-Apr-12	18-Apr-12	19-Apr-12	19-Apr-12	30-Jun-14	01-Jul-14	01-Jul-14	30-Jun-14	30-Jun-14
Sample Profile					FILL	FILL	FILL	FILL	FILL	FILL	ESTUARINE	FILL	ESTUARINE	FILL	ESTUARINE	FILL	FILL	FILL	FILL	FILL
PAEC Sampled					Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant
Sample collected by					KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG
Metals																				
Aluminium	50	NL*	-	-	9550	10300	14200	14700	13800	7740	3180	6740	1310	32700	8210	-	-	-	-	-
Arsenic	1	3000	160	-	10.9	16.5	3.4	6.3	5.1	0.9	1.2	0.8	0.2	12	1.8	-	-	-	-	-
Cadmium	0.1	900	-	-	<0.1	<0.1	0.1	0.1	2.4	<0.1	<0.1	<0.1	<0.1	0.4	<0.1	-	-	-	-	-
Chromium	1	3600	320**	-	7.3	7.9	52.1	25.5	18	5	3.2	5.3	1.4	26.9	6	-	-	-	-	-
Copper	2	240000	210**	-	13.6	14.2	16	15.6	44.5	7.8	0.2	4.2	0.3	21.9	0.3	-	-	-	-	-
Nickel	1	6000	140**	-	11	12.4	34.4	53	27.8	6.4	1.8	2	0.6	51.6	4.6	-	-	-	-	-
Lead	2	1500	1800	-	6.3	6.5	25.8	9.2	44.4	3.6	1.8	37	0.6	20.6	3.3	-	-	-	-	-
Zinc	5	400000	440**	-	51.6	53.4	178	70.4	115	18.8	0.6	43.4	0.5	288	1.4	-	-	-	-	-
Mercury	0.05	730	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	-
Fluoride (soluble)	40	17000*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoride (total)	40	-	-	-	240	150	1960	2350	3950	700	60	200	80	7740	650	-	-	-	-	-
Non Metallic Inorganics																				
Total Cyanide	1	--	-	-	<1	<1	<1	<1	<1	3	<1	<1	<1	<1	<1	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons (PAH)																				
Naphthalene	0.5	-	370	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.1	<0.1	<0.1	4	0.2
Acenaphthylene	0.5	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	0.5	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	1.9	<0.5	0.1	0.1	<0.1	7.3	0.4
Fluorene	0.5	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.1	<0.5	<0.1	<0.1	<0.1	2.7	0.2
Phenanthrene	0.5	-	-	-	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	<0.5	16.6	<0.5	1.3	0.7	<0.1	3.4	0.2
Anthracene	0.5	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.4	<0.5	0.3	0.3	<0.1	0.9	<0.1
Fluoranthene	0.5	-	-	-	<0.5	<0.5	<0.5	0.7	3.8	<0.5	<0.5	<0.5	<0.5	41.2	<0.5	6	2.2	<0.1	5.9	0.1
Pyrene	0.5	-	-	-	<0.5	<0.5	<0.5	0.7	3	<0.5	<0.5	<0.5	<0.5	38.3	<0.5	6	2	<0.1	4.6	0.1
Benz(a)anthracene	0.5	-	-	-	<0.5	<0.5	<0.5	0.7	5.3	<0.5	<0.5	<0.5	<0.5	47.1	<0.5	3.4	0.8	<0.1	0.8	<0.1
Chrysene	0.5	-	-	-	<0.5	<0.5	<0.5	0.8	8.1	<0.5	<0.5	<0.5	<0.5	50.3	<0.5	3.8	0.8	0.1	0.9	<0.1
Benzo(b)&(k)fluoranthene	1	-	-	-	<0.5	<0.5	<0.5	1.1	9.6	<0.5	<0.5	<0.5	<0.5	67.2	<0.5	10	1.5	<0.2	1.3	<0.2
Benzo(k)fluoranthene	0.5	-	-	-	<0.5	<0.5	<0.5	<0.5	2.1	<0.5	<0.5	<0.5	<0.5	20.4	<0.5	-	-	-	-	-
Benzo(a) pyrene	0.5	-	-	72[C]	<0.5	<0.5	<0.5	0.6	2.1	<0.5	<0.5	<0.5	<0.5	33.6	<0.5	4.9	0.88	<0.05	0.44	<0.05
Indeno(1,2,3-c,d)pyrene	0.5	-	-	-	<0.5	<0.5	<0.5	0.6	1.5	<0.5	<0.5	<0.5	<0.5	29.2	<0.5	4.7	0.6	<0.1	0.4	<0.1
Dibenz(a,h)anthracene	0.5	-	-	-	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	7.7	<0.5	0.5	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	0.5	-	-	-	<0.5	<0.5	<0.5	0.6	1.8	<0.5	<0.5	<0.5	<0.5	28.8	<0.5	4.1	0.6	<0.1	0.3	<0.1
Benzo(a) pyrene TEQ		40	-	-	<0.5	<0.5	<0.5	1.87	4.5	<0.5	<0.5	<0.5	<0.5	58.5	<0.5	7	1	<0.5	1	<0.5
Sum of reported PAH	--	4000	-	-	<0.5	<0.5	<0.5	5.8	38.6	0.8	<0.5	<0.5	<0.5	387	<0.5	46	10	0.1	33	1.2

All results are in units of mg/kg.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

[C] Canadian Council of Ministries of the Environment (2010) Canadian Soil Quality Guidelines Carcinogenic and other Polycyclic Aromatic Hydrocarbons (PAHs) (Environmental and Human Health Effects)

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* Site-specific fluoride (soluble) soil criteria derived from 'Preliminary Screening Level Health Risk Assessment for Fluoride and Aluminium (ENVIRON 2013)'

** EIL values calculated using site-specific CEC (7.26 meq/100g), pH (5.5) and TOC (1.3%) data collected from the Buffer Zone during the March 2014 investigations

TABLE LR3 Soil Analytical Results for AEC 8 Carbon Plant

Sample Identification	PQL	HIL D[A]	EIL C/I[B]	ESL C/I	MW106	MW107	HA106	HA106	HA107	HA107	HA108	HA109	HA109	HA110	HA110	HA111	HA111	HA112
Sample Depth (m)					0.0-0.1	0.15-0.25	0.1	0.15	0.1	0.2	0-0.1	0-0.1	0.3-0.4	0-0.1	0.3-0.4	0-0.1	0.3-0.4	0.1
Date					30-Jun-14	30-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14
Sample Profile					FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL
PAEC Sampled					Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant
Sample collected by					KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG
Metals																		
Aluminium	50	NL*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	1	3000	160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	0.1	900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium	1	3600	320**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	2	240000	210**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel	1	6000	140**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead	2	1500	1800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	5	400000	440**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury	0.05	730	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoride (soluble)	40	17000*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoride (total)	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Non Metallic Inorganics																		
Total Cyanide	1	--	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons (PAH)																		
Naphthalene	0.5	-	370	-	<0.1	<0.1	<0.1	<0.1	1	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	0.5	-	-	-	<0.1	<0.1	<0.1	<0.1	0.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	0.5	-	-	-	<0.1	<0.1	0.6	0.7	4.3	8.3	0.4	0.4	0.2	1.5	0.1	1.2	1.1	0.2
Fluorene	0.5	-	-	-	<0.1	<0.1	0.3	0.3	2.6	3.6	0.2	0.2	<0.1	1	<0.1	0.8	0.4	0.1
Phenanthrene	0.5	-	-	-	0.1	<0.1	5.5	6.3	24	68	3.5	3.4	1.5	15	1.8	12	12	2.4
Anthracene	0.5	-	-	-	<0.1	<0.1	1.2	1.3	5.7	11	0.8	0.9	0.4	3.8	0.5	3.1	3.7	0.6
Fluoranthene	0.5	-	-	-	0.6	<0.1	19	20	76	220	12	11	4.5	43	7.8	37	46	9.3
Pyrene	0.5	-	-	-	0.6	<0.1	19	19	72	220	12	10	4.5	40	7.8	35	46	9
Benz(a)anthracene	0.5	-	-	-	0.7	<0.1	18	14	70	150	9	10	2.6	40	5.5	36	34	9.3
Chrysene	0.5	-	-	-	0.9	<0.1	19	13	70	130	9.3	10	2.5	41	5.5	37	34	9.8
Benzo(b)&(k)fluoranthene	1	-	-	-	2.4	<0.2	46	30	170	290	22	25	5.6	96	13	86	76	25
Benzo(k)fluoranthene	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a) pyrene	0.5	-	-	72[C]	0.72	<0.05	25	18	98	180	13	14	3.7	55	8.1	50	47	14
Indeno(1,2,3-c,d)pyrene	0.5	-	-	-	0.7	<0.1	19	15	63	150	9.1	10	2.4	41	5.8	38	36	10
Dibenz(a,h)anthracene	0.5	-	-	-	0.1	<0.1	2.7	2	15	16	0.9	1.7	0.3	9.4	0.7	8.4	4.4	1.4
Benzo(g,h,i)perylene	0.5	-	-	-	0.7	<0.1	18	14	59	130	8.9	9.7	2.3	37	5.5	33	32	9.2
Benzo(a) pyrene TEQ		40	-	-	1	<0.5	36	26	140	260	18	21	5	82	11	75	67	20
Sum of reported PAH	--	4000	-	-	7.6	NIL (+)VE	190	150	730	1600	100	110	30	420	63	380	370	100

All results are in units of mg/kg.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

[C] Canadian Council of Ministries of the Environment (2010) Canadian Soil Quality Guidelines Carcinoge

Cells with '-' indicates testing was not completed or an appropriate screening criteria was not available

NL: indicates that the site-specific risk-based aluminium screening criteria for industrial soil is at a conc

PQL = Practical Quantitation Limit.

Results shown in shading are in excess of the human health criteria

Results shown in underline are in excess of the ecological criteria

<LOR or <value = Less than the laboratory Limit of Reporting

* Site-specific fluoride (soluble) soil criteria derived from 'Preliminary Screening Level Health Risk Asse

** EIL values calculated using site-specific CEC (7.26 meq/100g), pH (5.5) and TOC (1.3%) data collec

TABLE LR4 Soil Analytical Results for AEC 11 Washdown Bay

Sample Identification	PQL	Guideline		SB9	SB9	MW11	SB101	SB101
Sample Depth (m)		HIL D[A]	EIL C/I[B]	0.3-0.4	0.6-0.8	0-0.2	0.0-0.1	0.3-0.4
Date				16-Apr-12	16-Apr-12	16-Apr-12	30-Jun-14	30-Jun-14
Sample Profile				FILL	FILL	FILL	FILL	FILL
PAEC Sampled				Washbay	Washbay	Washbay	Washbay	Washbay
Sample collected by				KJG	KJG	KJG	KJG	KJG
Metals								
Aluminium	50	NL*	-	39800	12600	15000	-	-
Arsenic	1	3000	160	17.1	23.9	5.8	-	-
Cadmium	0.1	900	-	11.1	0.2	0.2	-	-
Chromium	1	3600	320**	59.5	18.8	23.7	-	-
Copper	2	240000	210**	82	62	36.3	-	-
Nickel	1	6000	140**	152	29.4	24.5	-	-
Lead	2	1500	1800	185	66.4	48	-	-
Zinc	5	400000	440**	578	621	420	-	-
Mercury	0.05	730	-	0.2	<0.1	<0.1	-	-
Fluoride (soluble)	40	17000*	-	-	-	-	94	73
Fluoride (total)	40	-	-	39000	1230	960	-	-
Non Metallic Inorganics								
Total Cyanide	1	1500	-	-	-	<1	-	-

All results are in units of mg/kg.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

Cells with '-' indicates testing was not completed or an appropriate screening criteria was not available

NL: indicates that the site-specific risk-based aluminium screening criteria for industrial soil is at a concentration greater than physically possible in soil, and therefore the criteria is defined as 'Non-Limiting' or NL.

PQL = Practical Quantitation Limit.

Results shown in shading are in excess of the human health criteria

Results shown in underline are in excess of the ecological criteria

<LOR or <value = Less than the laboratory Limit of Reporting

* Site-specific fluoride (soluble) soil criteria derived from 'Preliminary Screening Level Health Risk Assessment for Fluoride and Aluminium (ENVIRON 2013)'

** EIL values calculated using site-specific CEC (7.26 meq/100g), pH (5.5) and TOC (1.3%) data collected from the Buffer Zone during the March 2014 investigations

TABLE LR5 Soil Analytical Results for AEC 12 Pot Lines and PAEC 25 Dry Scrubbers

Sample Identification	PQL	HIL D[A]	EIL C/I[B]	SB1	SB2	SB3	SB4	SB115	SB116	SB116	SB117	SB117	SB118	SB118	SB119	SB119	SB120	SB121
Sample Depth (m)				0-0.05	0-0.05	0-0.05	0-0.05	0.0-0.1	0.0-0.1	0.1-0.2	0.0-0.1	0.1-0.2	0.0-0.1	0.2-0.3	0.0-0.1	0.3-0.4	0.0-0.1	0.0-0.1
Date				12/04/2012	12/04/2012	12/04/2012	12/04/2012	01-Jul-14	01-Jul-14	01-Jul-14	02-Jul-14	02-Jul-14	02-Jul-14	02-Jul-14	01-Jul-14	01-Jul-14	01-Jul-14	01-Jul-14
Sample Profile				FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL
PAEC Sampled				Pot Lines	Pot Lines	Pot Lines	Pot Lines	Pot Lines	Pot Lines	Pot Lines	Pot Lines	Pot Lines	Pot Lines	Pot Lines	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers
Sample collected by				FR	FR	FR	FR	KG	KG	KG	KG	KG	KG	KG	KG	KG	KG	KG
Metals																		
Aluminium	50	NL*	-	53300	139000	138000	41700	-	-	-	-	-	-	-	-	-	-	-
Arsenic	1	3000	160	4.5	28.9	8.8	14.6	-	-	-	-	-	-	-	-	-	-	-
Cadmium	0.1	900	-	0.7	1.8	1.4	0.8	-	-	-	-	-	-	-	-	-	-	-
Chromium	1	3600	320**	26.8	35	14.8	36	-	-	-	-	-	-	-	-	-	-	-
Copper	2	240000	210**	21.1	280	18.9	89.8	-	-	-	-	-	-	-	-	-	-	-
Nickel	1	6000	140**	98	159	166	65.7	-	-	-	-	-	-	-	-	-	-	-
Lead	2	1500	1800	25	430	28.7	247	-	-	-	-	-	-	-	-	-	-	-
Zinc	5	400000	440**	229	5400	444	1210	-	-	-	-	-	-	-	-	-	-	-
Mercury (inorganic)	0.05	730	-	<0.1	<0.1	<0.1	<0.1	-	-	-	-	-	-	-	-	-	-	-
Fluoride (soluble)	40	17000*	-	-	-	-	-	73	140	48	13	24	17	29	55	36	3.1	20
Fluoride (total)	40	-	-	13400	26400	41900	20900	-	-	-	-	-	-	-	-	-	-	-

All results are in units of mg/kg.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

Cells with '-' indicates testing was not completed or an appropriate screening criteria was not available

NL: indicates that the site-specific risk-based aluminium screening criteria for industrial soil is at a concentration greater than physically possible in soil, and therefore the criteria is defined as 'Non-Limiting' or NL.

PQL = Practical Quantitation Limit.

Results shown in shading are in excess of the human health criteria

Results shown in underline are in excess of the ecological criteria

<LOR or <value = Less than the laboratory Limit of Reporting

* Site-specific fluoride (soluble) soil criteria derived from 'Preliminary Screening Level Health Risk Assessment for Fluoride and Aluminium (ENVIRON 2013)'

** EIL values calculated using site-specific CEC (7.26 meq/100g), pH (5.5) and TOC (1.3%) data collected from the Buffer Zone during the March 2014 investigations

TABLE LR5 Soil Analytical Results for AEC 12 Pot Line

Sample Identification	PQL			SB121	SB122	SB123	SB123	SB124	SB125	SB126	SB127	SB127	SB127	SB128	SB129	SB129	SB129	SB131
Sample Depth (m)		HIL D[A]	EIL C/I[B]	0.1-0.2	0.0-0.1	0.0-0.1	0.1-0.2	0.0-0.1	0.0-0.1	0.0-0.1	0.0-0.1	0.1-0.2	0.4-0.6	0.0-0.1	0.0-0.1	0.1-0.2	0.9-1.0	0.0-0.1
Date				01-Jul-14	01-Jul-14	01-Jul-14	01-Jul-14	01-Jul-14	01-Jul-14	01-Jul-14	01-Jul-14	01-Jul-14	01-Jul-14	02-Jul-14	02-Jul-14	02-Jul-14	02-Jul-14	02-Jul-14
Sample Profile				FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	ALLUVIAL	FILL	FILL	FILL	FILL	FILL
PAEC Sampled				Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers
Sample collected by				KG	KG	KG	KG	KG	KG	KG	KG	KG	KG	KG	KG	KG	KG	KG
Metals																		
Aluminium	50	NL*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	1	3000	160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	0.1	900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium	1	3600	320**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	2	240000	210**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel	1	6000	140**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead	2	1500	1800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	5	400000	440**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury (inorganic)	0.05	730	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoride (soluble)	40	17000*	-	7.8	44	87	140	87	210	250	7.5	14	0.6	23	23	16	2.7	10
Fluoride (total)	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

All results are in units of mg/kg.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

Cells with '-' indicates testing was not completed or an appropriate screening crite

NL: indicates that the site-specific risk-based aluminium screening criteria for ind

PQL = Practical Quantitation Limit.

Results shown in shading are in excess of the human health criteria

Results shown in underline are in excess of the ecological criteria

<LOR or <value = Less than the laboratory Limit of Reporting

* Site-specific fluoride (soluble) soil criteria derived from 'Preliminary Screening L

** EIL values calculated using site-specific CEC (7.26 meq/100g), pH (5.5) and T

TABLE LR5 Soil Analytical Results for AEC 12 Pot Line

Sample Identification	PQL			SB131	SB132	SB133	SB133	SB134	SB135	SB135	HA101	HA101	HA101	HA102	HA102	HA102	HA103	HA103	HA104
Sample Depth (m)		HIL D[A]	EIL C/I[B]	0.3-0.4	0.0-0.1	0.2-0.3	0.3-0.4	0-0.1	0-0.1	0.3-0.4	Surface	0.1	0.2	Surface	0.1	0.15	Surface	0.1	Surface
Date				02-Jul-14	02-Jul-14	02-Jul-14	02-Jul-14	02-Jul-14	02-Jul-14	02-Jul-14	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014	26/06/2014
Sample Profile				ALLUVIAL	FILL	ALLUVIAL	ALLUVIAL	FILL	FILL	FILL									
PAEC Sampled				Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Dry Scrubbers	Pot Lines	Pot Lines	Pot Lines	Pot Lines	Pot Lines	Pot Lines	Pot Lines	Pot Lines	Pot Lines
Sample collected by				KG	KG	KG	KG	KG	KG	KG	KW	KW	KW	KW	KW	KW	KW	KW	KW
Metals																			
Aluminium	50	NL*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	1	3000	160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	0.1	900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium	1	3600	320**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	2	240000	210**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel	1	6000	140**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead	2	1500	1800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	5	400000	440**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury (inorganic)	0.05	730	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoride (soluble)	40	17000*	-	52	2.3	5	27	2.3	22	36	28	180	62	53	78	120	140	180	90
Fluoride (total)	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

All results are in units of mg/kg.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

Cells with '-' indicates testing was not completed or an appropriate screening crite

NL: indicates that the site-specific risk-based aluminium screening criteria for ind

PQL = Practical Quantitation Limit.

Results shown in shading are in excess of the human health criteria

Results shown in underline are in excess of the ecological criteria

<LOR or <value = Less than the laboratory Limit of Reporting

* Site-specific fluoride (soluble) soil criteria derived from 'Preliminary Screening L

** EIL values calculated using site-specific CEC (7.26 meq/100g), pH (5.5) and T

TABLE LR5 Soil Analytical Results for AEC 12 Pot Line

Sample Identification	PQL			HA104	HA105	HA105	HA105
Sample Depth (m)		HIL D[A]	EIL C/I[B]	0.1	Surface	0.1	0.2
Date				26/06/2014	26/06/2014	26/06/2014	26/06/2014
Sample Profile							
PAEC Sampled				Pot Lines	Pot Lines	Pot Lines	Pot Lines
Sample collected by				KW	KW	KW	KW
Metals							
Aluminium	50	NL*	-	-	-	-	-
Arsenic	1	3000	160	-	-	-	-
Cadmium	0.1	900	-	-	-	-	-
Chromium	1	3600	320**	-	-	-	-
Copper	2	240000	210**	-	-	-	-
Nickel	1	6000	140**	-	-	-	-
Lead	2	1500	1800	-	-	-	-
Zinc	5	400000	440**	-	-	-	-
Mercury (inorganic)	0.05	730	-	-	-	-	-
Fluoride (soluble)	40	17000*	-	82	100	120	67
Fluoride (total)	40	-	-	-	-	-	-

All results are in units of mg/kg.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

Cells with '-' indicates testing was not completed or an appropriate screening crite

NL: indicates that the site-specific risk-based aluminium screening criteria for ind

PQL = Practical Quantitation Limit.

Results shown in shading are in excess of the human health criteria

Results shown in underline are in excess of the ecological criteria

<LOR or <value = Less than the laboratory Limit of Reporting

* Site-specific fluoride (soluble) soil criteria derived from 'Preliminary Screening L

** EIL values calculated using site-specific CEC (7.26 meq/100g), pH (5.5) and T

TABLE LR6 Soil Analytical Results for PAEC 26 Ring furnace Scrubber

Sample Identification	PQL	HIL D[A]	EIL C/I[B]	ESL C/I	HA113	HA113	HA114	HA115	HA115	HA116	HA116	HA117	HA117	HA119	HA119	HA120	HA121	HA122	HA122	SB106
Sample Depth (m)					0-0.1	0.3-0.4	0-0.1	0-0.1	0.2-0.3	0-0.1	0.3-0.4	0-0.1	0.25-0.35	0-0.1	0.3-0.4	0-0.1	0-0.1	0-0.1	0.3-0.4	0.0-0.1
Date					27-Jun-14	27-Jun-14	27-Jun-14	27-Jun-14	27-Jun-14	27-Jun-14	27-Jun-14	27-Jun-14	27-Jun-14	27-Jun-14	27-Jun-14	27-Jun-14	27-Jun-14	27-Jun-14	27-Jun-14	30-Jun-14
Sample Profile					FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL	FIILL
PAEC Sampled					27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	27/06/2014	30/06/2014
Sample collected by					KW	KW	KW	KW	KW	KW	KW	KW	KW	KW	KW	KW	KW	KW	KW	KG
Metals																				
Fluoride (soluble)	40	17000*		-	40	130	29	7.9	-	28	-	13	-	76	130	13	17	39	68	38
Polycyclic Aromatic Hydrocarbons (PAH)																				
Naphthalene	0.1	-	370	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	0.1	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	0.1	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.9	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	0.1	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	0.1	-	-	-	2.7	0.9	0.4	16	2.2	4.2	0.2	4	<0.1	5.6	1.5	1.4	0.1	0.4	0.7	<0.1
Anthracene	0.1	-	-	-	0.7	0.3	<0.1	3.5	0.6	0.8	<0.1	1.3	<0.1	1	0.4	0.4	<0.1	<0.1	0.2	<0.1
Fluoranthene	0.1	-	-	-	15	3.2	3.1	210	40	41	3.4	38	0.3	17	5.8	12	1.2	2.4	2.6	0.2
Pyrene	0.1	-	-	-	14	3.1	3	240	50	41	3.4	38	0.3	16	5.6	11	1.2	2.3	2.5	0.3
Benz(a)anthracene	0.1	-	-	-	9.5	1.5	4.4	300	61	57	3.1	52	0.2	16	3.2	14	1.5	2.4	1.4	0.3
Chrysene	0.1	-	-	-	12	1.6	8.1	490	110	110	5.8	110	0.3	21	3.3	26	2.8	4.2	1.7	0.3
Benzo(b)&(k)fluoranthene	0.2	-	-	-	28	3.6	18	990	230	240	12	300	0.8	53	7.4	69	7.4	8.8	3.8	0.7
Benzo(a) pyrene	0.05	-	-	72[C]	8.6	1.9	3.7	230	44	42	1.7	47	0.26	19	4.3	12	1.4	2.2	1.7	0.3
Indeno(1,2,3-c,d)pyrene	0.1	-	-	-	7.4	1.3	3.1	190	44	48	2.9	76	0.3	17	3.1	20	2.2	2.1	1.2	0.3
Dibenz(a,h)anthracene	0.1	-	-	-	1.4	0.2	0.8	60	15	12	0.7	25	<0.1	3	0.3	4.9	0.5	0.4	0.2	<0.1
Benzo(g,h,i)perylene	0.1	-	-	-	7.5	1.2	3.3	190	42	53	2.9	81	0.3	16	2.9	21	2.4	2.1	1.3	0.3
Benzo(a) pyrene TEQ	0.5	40	-	-	15	3	7	440	94	90	4	120	<0.5	31	6	28	3	4	3	<0.5
Sum of reported PAH	--	4000	-	-	110	19	47	2900	640	640	37	770	2.8	190	38	190	21	27	17	2.7

All results are in units of mg/kg.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

[C] Canadian Council of Ministries of the Environment (2010) Canadian Soil Quality Guidelines Carcinogenic and other Polycyclic Aromatic Hydrocarbons (PAHs) (Environmental and Human Health Effects)

Cells with '-' indicates testing was not completed or an appropriate screening criteria was not available

NL: indicates that the site-specific risk-based aluminium screening criteria for industrial soil is at a concentration greater than physically possible in soil, and therefore the criteria is defined as 'Non-Limiting' or NL.

PQL = Practical Quantitation Limit.

Results shown in shading are in excess of the human health criteria

Results shown in underline are in excess of the ecological criteria

<LOR or <value = Less than the laboratory Limit of Reporting

* Site-specific fluoride (soluble) soil criteria derived from 'Preliminary Screening Level Health Risk Assessment for Fluoride and Aluminium (ENVIRON 2013)'

** EIL values calculated using site-specific CEC (7.26 meq/100g), pH (5.5) and TOC (1.3%) data collected from the Buffer Zone during the March 2014 investigations

TABLE LR7 Soil Analytical Results for PAEC 28 Playing Fields

Sample Identification	PQL						TP101	TP104	TP107	TP111	TP113	TP115	TP116
Sample Depth (m)		HIL D[A]	HSL D[B]	EIL C/I[C]	Management Limits[D]	ESL C/I[E]	0.2	0-0.2	0.5	0-0.3	0.4-0.5	0.4-0.5	0.1-0.3
Date							23-Jun-14	23-Jun-14	23-Jun-14	23-Jun-14	23-Jun-14	23-Jun-14	23-Jun-14
Sample Profile							Estuarine	Estuarine	Estuarine	Fiill	Estuarine	Estuarine	Fill
PAEC Sampled							Playing Fields	Playing Fields	Playing Fields	Playing Fields	Playing Fields	Playing Fields	Playing Fields
Sample collected by							KW	KW	KW	KW	KW	KW	KW
Metals													
Arsenic	4	3000		160			<4	<4	<4	<4	<4	<4	63
Cadmium	0.4	900		-			<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.5
Chromium	1	3600		320**			3	12	<1	23	17	11	12
Copper	1	240,000		210**			2	2	<1	2	<1	<1	590
Lead	1	1500		1800			5	10	1	12	24	4	1600
Mercury	0.1	730		-			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	1	6000		140**			8	5	1	6	3	1	5
Zinc	1	400,000		440**			32	36	3	35	5	2	5600
Fluoride (soluble)	0.5	17000*		-			45	16	19	22	<0.5	2.1	31
Polycyclic Aromatic Hydrocarbons (PAH)													
Naphthalene	0.1			370			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	0.1						0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	0.1						0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
Benz(a)anthracene	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)&(k)fluoranthene	0.2						<0.2	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a) pyrene	0.05					72[F]	0.07	0.12	<0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenz(a,h)anthracene	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a) pyrene TEQ	0.5	40					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sum of reported PAH	--	4000					0.35	0.69	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE
Total Petroleum Hydrocarbons (TPH)													
TRH C6-C10	25				800		<25	<25	<25	<25	<25	<25	<25
TRH >C10-C16	50				1000	170	<50	<50	<50	<50	<50	<50	<50
TRH >C16-C34	100				5000	2500	<100	<100	<100	<100	<100	<100	<100
TRH >C34-C40	100				10000	6600	<100	<100	<100	<100	<100	<100	<100
TRH C6-C10 - BTEX (F1)	25		260			215	<25	<25	<25	<25	<25	<25	<25
TRH >C10-C36 - Naph (F2)	50		NL				<50	<50	<50	<50	<50	<50	<50
Benzene, Toluene, Ethyl benene, Xylene (BTEX)													
Benzene	0.2		3			75	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	0.5		NL			135	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	2		NL			165	<2	<2	<2	<2	<2	<2	<2
Xylenes	1		230			180	<1	<1	<1	<1	<1	<1	<1

All results are in units of mg/kg.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Soil Health Screening Level for Vapour Intrusion 'D' Commercial/ Industrial

[C] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

[D] NEPM (2013) Management Limits for TPH Fractions F1 to F4 in soil

[E] NEPM (2013) Ecological Screening Level for Commercial/ Industrial

[F] Canadian Council of Ministries of the Environment (2010) Canadian Soil Quality Guidelines Carcinogenic and other Polycyclic Aromatic Hydrocarbons (PAHs) (Environmental and Human Health Effects)

Cells with '-' indicates testing was not completed or an appropriate screening criteria was not available

PQL = Practical Quantitation Limit.

Results shown in shading are in excess of the human health criteria

Results shown in underline are in excess of the ecological criteria

<LOR or <value = Less than the laboratory Limit of Reporting

* Site-specific fluoride (soluble) soil criteria derived from 'Preliminary Screening Level Health Risk Assessment for Fluoride and Aluminium (ENVIRON 2013)'

** EIL values calculated using site-specific CEC (7.26 meq/100g), pH (5.5) and TOC (1.3%) data collected from the Buffer Zone during the March 2014 investigations

NL: If the derived soil HSL exceeds the soil saturation concentration the HSL is shown as 'not limiting' or 'NL'.

TABLE LR8 Soil Analytical Results for PAEC 29 Area East of Playing Fields

Sample Identification	PQL	HIL D[A]	HSL D[B]	EIL C/I[C]	Management Limits[D]	ESL C/I[E]	TP117	TP118	TP119	TP120	TP122	TP123	TP124	TP125	TP126	TP127
Sample Depth (m)							0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Date							25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14
Sample Profile							FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL
PAEC Sampled							EPF	EPF	EPF	EPF	EPF	EPF	EPF	EPF	EPF	EPF
Sample collected by							KW	KW	KW	KW	KW	KW	KW	KW	KW	KW
Metals																
Arsenic	4	3000		160			<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Cadmium	0.4	900		-			<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	1	3600		320**			11	5	3	3	5	7	7	7	5	6
Copper	1	240,000		210**			17	4	3	2	1	2	3	2	5	3
Lead	1	1500		1800			23	7	8	18	6	9	7	8	6	6
Mercury	0.1	730		-			0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	1	6000		140**			18	6	4	4	3	7	5	6	4	4
Zinc	1	400,000		440**			51	41	20	22	14	26	12	57	23	13
Fluoride (soluble)	40	17000*		-			340	22	28	17	26	23	17	27	15	19
Polycyclic Aromatic Hydrocarbons (PAH)																
Naphthalene	0.1			370			1.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	0.1						7.6	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	0.1						2.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	0.1						130	0.2	0.1	<0.1	0.1	0.2	<0.1	0.1	0.1	0.2
Anthracene	0.1						33	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	0.1						390	0.5	0.5	0.2	0.5	0.7	0.1	0.4	0.4	0.6
Pyrene	0.1						380	0.4	0.5	0.2	0.5	0.7	<0.1	0.4	0.4	0.5
Benz(a)anthracene	0.1						180	0.2	0.4	0.1	0.3	0.4	<0.1	0.3	0.2	0.2
Chrysene	0.1						170	0.2	0.4	0.1	0.4	0.4	<0.1	0.3	0.2	0.2
Benzo(b)&(k)fluoranthene	0.2						320	0.4	1.2	0.2	0.8	1	<0.2	0.8	0.4	0.3
Benzo(a) pyrene	0.05					72[F]	220	0.23	0.58	0.13	0.47	0.56	0.06	0.41	0.21	0.17
Indeno(1,2,3-c,d)pyrene	0.1						120	0.2	0.5	0.1	0.4	0.5	<0.1	0.4	0.2	0.1
Dibenz(a,h)anthracene	0.1						26	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	0.1						120	0.2	0.4	0.1	0.4	0.4	<0.1	0.3	0.1	0.1
Benzo(a) pyrene TEQ	0.5	40					310	<0.5	1	<0.5	1	1	<0.5	1	<0.5	<0.5
Sum of reported PAH	--	4000					2100	2.5	4.8	1	4	4.8	0.18	3.5	2.3	2.2
Total Petroleum Hydrocarbons (TPH)																
TRH C6-C10	25				800		<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
TRH >C10-C16	50				1000	170	<50	<50	<50	<50	<50	61	<50	<50	<50	<50
TRH >C16-C34	100				5000	2500	5100	<100	<100	<100	<100	150	<100	<100	<100	<100
TRH >C34-C40	100				10000	6600	1000	<100	<100	<100	<100	<100	<100	<100	<100	<100
TRH C6-C10 - BTEX (F1)	25		260			215	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
TRH >C10-C36 - Naph (F2)	50		NL				<50	<50	<50	<50	<50	61	<50	<50	<50	<50
Benzene, Toluene, Ethyl benene, Xylene (BTEX)																
Benzene	0.2		3			75	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	0.5		NL			135	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	2		NL			165	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Xylenes	1		230			180	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

All results are in units of mg/kg.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Soil Health Screening Level for Vapour Intrusion 'D' Commercial/ Industrial

[C] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

[D] NEPM (2013) Management Limits for TPH Fractions F1 to F4 in soil

[E] NEPM (2013) Ecological Screening Level for Commercial/ Industrial

[F] Canadian Council of Ministries of the Environment (2010) Canadian Soil Quality Guidelines Carcinogenic and other Polycyclic Aromatic Hydrocarbons (PAHs) (Environmental and Human Health Effects)

Cells with '-' indicates testing was not completed or an appropriate screening criteria was not available

PQL = Practical Quantitation Limit.

Results shown in shading are in excess of the human health criteria

TABLE LR9 Soil Analytical Results for PAEC 31 Storage Area west of Pot Line 3

Sample Identification	PQL	HIL D[A]	HSL D[B]	EIL C/I[C]	Management Limits[D]	ESL C/I[E]	TP128	TP128	TP129	TP130	TP130	TP131	TP132	TP132	TP133	TP134	TP135	TP135	TP136	TP137	TP137
Sample Depth (m)							0.1	0.2	0-0.3	0-0.3	0.6-0.7	0.1-0.3	0.1	0.4	0.1-0.2	0.2	0.1	0.4	0.1	0.1	0.4
Date							25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14	25-Jun-14
Sample Profile							FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL
PAEC Sampled							SAPL3	SAPL3	SAPL3	SAPL3	SAPL3	SAPL3	SAPL3	SAPL3	SAPL3	SAPL3	SAPL3	SAPL3	SAPL3	SAPL3	SAPL3
Sample collected by							KW	KW	KW	KW	KW	KW	KW	KW	KW	KW	KW	KW	KW	KW	KW
Metals																					
Arsenic	4	3000		160			30	6	6	<4	<4	7	20	<4	8	7	9	6	6	<4	5
Cadmium	0.4	900		-			<0.4	<0.4	<0.4	<0.4	<0.4	4.3	<0.4	<0.4	<0.4	0.4	0.6	<0.4	<0.4	<0.4	<0.4
Chromium	1	3600		320**			17	8	15	9	29	29	33	15	11	10	19	13	6	20	18
Copper	1	240,000		210**			94	12	8	12	1	48	44	2	22	28	140	12	10	24	<1
Lead	1	1500		1800			120	8	9	11	8	23	13	10	21	47	38	16	7	29	17
Mercury	0.1	730		-			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	1	6000		140**			18	14	47	54	8	130	27	3	16	21	17	6	10	12	4
Zinc	1	400,000		440**			510	48	47	86	15	240	130	8	140	220	210	47	42	76	22
Fluoride (soluble)	40	17000*		-			220	800	200	1463	120	87	58	0.9	1.1	110	110	4.6	13	2.2	7
Polycyclic Aromatic Hydrocarbons (PAH)																					
Naphthalene	0.1			370			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	0.1						<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	0.1						<0.1	<0.1	0.4	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	0.1						<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	0.1						<0.1	<0.1	1	1	<0.1	0.2	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	0.1						<0.1	<0.1	0.9	1	<0.1	0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benz(a)anthracene	0.1						<0.1	<0.1	0.5	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	0.1						<0.1	<0.1	0.5	0.6	<0.1	0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)&(k)fluoranthene	0.2						<0.2	<0.2	1.1	1	<0.2	0.2	<0.2	<0.2	0.3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a) pyrene	0.05					72[F]	0.08	<0.05	0.64	0.56	<0.05	0.11	0.06	<0.05	0.11	<0.05	0.05	<0.05	<0.05	0.08	<0.05
Indeno(1,2,3-c,d)pyrene	0.1						<0.1	<0.1	0.5	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenz(a,h)anthracene	0.1						<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	0.1						<0.1	<0.1	0.5	0.4	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1
Benzo(a) pyrene TEQ	0.5	40					<0.5	<0.5	1	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sum of reported PAH	--	4000					0.08	NIL (+)VE	6.2	5.7	NIL (+)VE	0.76	0.06	0.13	0.84	NIL (+)VE	0.05	NIL (+)VE	NIL (+)VE	0.18	NIL (+)VE
Total Petroleum Hydrocarbons (TPH)																					
TRH C6-C10	25				800		<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
TRH >C10-C16	50				1000	170	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
TRH >C16-C34	100				5000	2500	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	590	<100
TRH >C34-C40	100				10000	6600	<100	<100	<100	<100	<100	<100	<100	<100	120	<100	<100	<100	<100	<100	<100
TRH C6-C10 - BTEX (F1)	25		260			215	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
TRH >C10-C36 - Naph (F2)	50		NL				<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
benzene, Toluene, Ethyl benzene, Xylene (BTEX)																					
Benzene	0.2		3			75	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	0.5		NL			135	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	2		NL			165	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Xylenes	1		230			180	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

All results are in units of mg/kg.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Soil Health Screening Level for Vapour Intrusion 'D' Commercial/ Industrial

[C] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

[D] NEPM (2013) Management Limits for TPH Fractions F1 to F4 in soil

[E] NEPM (2013) Ecological Screening Level for Commercial/ Industrial

[F] Canadian Council of Ministries of the Environment (2010) Canadian Soil Quality Guidelines Carcinogenic and other Polycyclic Aromatic Hydrocarbons (PAHs) (Environmental and Human Health Effects)

Cells with '-' indicates testing was not completed or an appropriate screening criteria was not available

PQL = Practical Quantitation Limit.

Results shown in shading are in excess of the human health criteria

Results shown in underline are in excess of the ecological criteria

<LOR or <value = Less than the laboratory Limit of Reporting

* Site-specific fluoride (soluble) soil criteria derived from 'Preliminary Screening Level Health Risk Assessment for Fluoride and Aluminium (ENVIRON 2013)'

** EIL values calculated using site-specific CEC (7.26 meq/100g), pH (5.5) and TOC (1.3%) data collected from the Buffer Zone during the March 2014 investigations

NL: If the derived soil HSL exceeds the soil saturation concentration the HSL is shown as 'not limiting' or 'NL'.

TABLE LR9 Soil Analytical Results for PAEC 31 Storage Area west of Pot Line 3

Sample Identification	PQL						TP138	TP139	TP140
Sample Depth (m)		HIL D[A]	HSL D[B]	EIL C/I[C]	Management Limits[D]	ESL C/I[E]	0.2	0.1	0.1
Date							25-Jun-14	25-Jun-14	25-Jun-14
Sample Profile							FILL	FILL	FILL
PAEC Sampled							SAPL3	SAPL3	SAPL3
Sample collected by							KW	KW	KW
Metals									
Arsenic	4	3000		160			<4	4	<4
Cadmium	0.4	900		-			<0.4	<0.4	<0.4
Chromium	1	3600		320**			7	17	7
Copper	1	240,000		210**			<1	26	1
Lead	1	1500		1800			8	33	13
Mercury	0.1	730		-			<0.1	<0.1	<0.1
Nickel	1	6000		140**			3	15	5
Zinc	1	400,000		440**			41	280	7
Fluoride (soluble)	40	17000*		-			5.5	79	50
Polycyclic Aromatic Hydrocarbons (PAH)									
Naphthalene	0.1			370			<0.1	0.4	<0.1
Acenaphthylene	0.1						<0.1	<0.1	<0.1
Acenaphthene	0.1						<0.1	0.6	<0.1
Fluorene	0.1						<0.1	0.6	<0.1
Phenanthrene	0.1						<0.1	2.3	<0.1
Anthracene	0.1						<0.1	0.3	<0.1
Fluoranthene	0.1						<0.1	3.8	<0.1
Pyrene	0.1						<0.1	3.4	<0.1
Benz(a)anthracene	0.1						<0.1	2.4	<0.1
Chrysene	0.1						<0.1	2.7	<0.1
Benzo(b)&(k)fluoranthene	0.2						<0.2	5.6	<0.2
Benzo(a) pyrene	0.05					72[F]	<0.05	2.9	<0.05
Indeno(1,2,3-c,d)pyrene	0.1						<0.1	2.1	<0.1
Dibenz(a,h)anthracene	0.1						<0.1	0.3	<0.1
Benzo(g,h,i)perylene	0.1						<0.1	1.9	<0.1
Benzo(a) pyrene TEQ	0.5	40					<0.5	4	<0.5
Sum of reported PAH	--	4000					NIL (+)VE	29	NIL (+)VE
Total Petroleum Hydrocarbons (TPH)									
TRH C6-C10	25				800		<25	<25	<25
TRH >C10-C16	50				1000	170	<50	<50	<50
TRH >C16-C34	100				5000	2500	<100	<100	<100
TRH >C34-C40	100				10000	6600	<100	<100	<100
TRH C6-C10 - BTEX (F1)	25		260			215	<25	<25	<25
TRH >C10-C36 - Naph (F2)	50		NL				<50	<50	<50
benzene, Toluene, Ethyl benzene, Xylene (BTEX)									
Benzene	0.2		3			75	<0.2	<0.2	<0.2
Toluene	0.5		NL			135	<0.5	<0.5	<0.5
Ethylbenzene	2		NL			165	<2	<2	<2
Xylenes	1		230			180	<1	<1	<1

All results are in units of mg/kg.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Soil Health Screening Level for Vapour Intrusion 'D' Commercial/ Industrial

[C] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

[D] NEPM (2013) Management Limits for TPH Fractions F1 to F4 in soil

[E] NEPM (2013) Ecological Screening Level for Commercial/ Industrial

[F] Canadian Council of Ministries of the Environment (2010) Canadian Soil Quality Guidelines Carcinogenic and other Polycyclic Aromatic Hydrocar

Cells with '-' indicates testing was not completed or an appropriate screening criteria was not available

PQL = Practical Quantitation Limit.

Results shown in shading are in excess of the human health criteria

Results shown in underline are in excess of the ecological criteria

<LOR or <value = Less than the laboratory Limit of Reporting

* Site-specific fluoride (soluble) soil criteria derived from 'Preliminary Screening Level Health Risk Assessment for Fluoride and Aluminium (ENVIR

** EIL values calculated using site-specific CEC (7.26 meq/100g), pH (5.5) and TOC (1.3%) data collected from the Buffer Zone during the March 2

NL: If the derived soil HSL exceeds the soil saturation concentration the HSL is shown as 'not limiting' or 'NL'.

TABLE LR10 Groundwater Analytical Results (µg/L)

Sample Identification	PQL	Guideline				MW06	MW06	MW101	MW102	MW07	MW07	MW08	MW08	MW09	MW09	MW10	MW10	MW11	MW11	MW12	MW12	MW13	MW13	MW103	MW104
Date		95% Fresh [A]	Recreational	Irrigation	Stock	2/5/12	10/7/14	9/7/14	9/7/14	1/5/12	9/7/14	1/5/12	9/7/14	30/4/12	9/7/14	30/4/12	9/7/14	1/5/12	9/7/14	30/4/12	9/7/14	1/5/12	9/7/14	9/7/14	9/7/14
PAEC Sampled						Background	Background	Refuelling	Refuelling	Refuelling	Refuelling	Refuelling	Refuelling	FLS	FLS	FLS	FLS	Washbay	Washbay	AWP	AWP	AWP	AWP	AWP	AWP
Sample Appearance						Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Cloudy	Clear	Turbid	Clear	Milky	Clear	Brown	Clear	Cloudy	Brown	Clear	Clear
Sample collected by						KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG
Metals																									
Aluminium pH>6.5	10	55	9000	5000	5000	10	180	<10	<10	30	<10	150	1200	10	30	<10	2900	380	390	13,600	<10	2,150	2,500	7,700	1,300
Arsenic	1	24	100	100	500	<10	1	2	1	13	6	3	<1	3	2	2	3	18	1	16	<1	4	<1	1	2
Cadmium	0.1	2*	20	10	10	<1	<0.1	<0.1	<0.1	0.2	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	2.1	<0.1	<0.1	<0.1	0.2	<0.1
Chromium	1	27*	500	100	1000	<10	<1	<1	<1	<10	<1	2	1	<1	<1	<1	3	2	<1	29	<1	4	6	<1	6
Copper	1	12*	20,000	200	500	<10	1	4	2	10	<1	<1	<1	2	1	1	<1	2	<1	88	<1	1	<1	<1	3
Nickel	1	97*	200	200	1000	22	20	9	2	30	2	2	<1	16	14	19	24	5	6	110	15	2	<1	18	5
Lead	1	87*	100	2000	100	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	133	<1	<1	<1	<1	<1
Zinc	5	70*	30,000	2000	20,000	78	16	10	4	28	3	12	<1	9	1	10	9	28	2	699	8	25	2	92	8
Mercury	0.1	0.6	10	2	2	<0.1	<0.05	<0.05	<0.05	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.05	<0.05
Fluoride	100		1500	1000	2000	1000	220	460	3200	1300	1400	4900	6700	1000	560	1200	2100	3900	8300	1700	220	43000	40000	12000	13000
Non Metallic Inorganics																									
Free Cyanide	4	7	800			<4								<8		<4		<4		<8		7			
Total Cyanide	4	NA				<4								<8		<4		13				40			
Total Petroleum Hydrocarbons (TPH)																									
TPH C6-C9	20							<10	18	<20	<10	<20	<10												
TPH C10-C14	50							<50	<50	<50	<50	<50	<50												
TPH C15-C28	100							<100	<100	<100	<100	330	<100												
TPH C29-C36	100							<100	<100	<50	<100	<50	<100												
TPH C6-C36		LOR		LOR	LOR			<100	18	<50	<100	330	<100												
Polycyclic Aromatic Hydrocarbons (PAH)																									
Naphthalene	0.1	16				<0.1				<0.1		<0.1		<0.1		<0.1		<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	0.1					<0.1				<0.1		<0.1		<0.1		<0.1		<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	0.1					<0.1				<0.1		<0.1		<0.1		<0.1		<0.1		<0.1	<0.1	0.2	<0.1	<0.1	<0.1
Fluorene	0.1					<0.1				<0.1		<0.1		<0.1		<0.1		<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	0.1	*2*				<0.1				<0.1		<0.1		<0.1		<0.1		<0.1		<0.1	<0.1	0.9	<0.1	<0.1	<0.1
Anthracene	0.1	*0.4*				<0.1				<0.1		<0.1		<0.1		<0.1		<0.1		<0.1	<0.1	0.2	<0.1	<0.1	<0.1
Fluoranthene	0.1	*1.4*				<0.1				<0.1		<0.1		0.2		<0.1		<0.1		0.3	<0.1	4.8	<0.1	<0.1	0.1
Pyrene	0.1					<0.1				<0.1		<0.1		0.2		<0.1		<0.1		0.3	<0.1	5	<0.1	<0.1	0.2
Benz(a)anthracene	0.1					<0.1				<0.1		<0.1		0.3		<0.1		<0.1		0.3	<0.1	4	<0.1	<0.1	<0.1
Chrysene	0.1					<0.1				<0.1		<0.1		0.6		<0.1		<0.1		0.2	<0.1	3.6	<0.1	<0.1	0.1
Benzo(b)&(k)fluoranthene	0.2					<0.2				<0.2		<0.2		1.8		<0.2		<0.2		0.8	<0.2	10.8	<0.2	<0.2	<0.2
Benzo(a) pyrene	0.05	*0.2*				<0.05				<0.05		<0.05		<0.05		<0.05		<0.05		0.4	<0.05	6.46	<0.05	<0.05	0.1
Indeno(1,2,3-c,d)pyrene	0.1					<0.1				<0.1		<0.1		0.2		<0.1		<0.1		0.2	<0.1	3	<0.1	<0.1	0.1
Dibenz(a,h)anthracene	0.1					<0.1				<0.1		<0.1		0.1		<0.1		<0.1		<0.1	<0.1	1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	0.1					<0.1				<0.1		<0.1		0.4		<0.1		<0.1		0.2	<0.1	2.6	<0.1	<0.1	0.1
Semivolatile Organic Compounds (SVOCs)																									
Organochlorine Pesticides (OCP)																									
alpha-BHC	2					<2								<2		<2									
HCB	2					<2								<2		<2									
delta-BHC	2					<2								<2		<2									
Heptachlor	2	0.09				<2								<2		<2									
Aldrin	2	*0.001*				<2								<2		<2									
Heptachlor epoxide	2					<2								<2		<2									
Chlordane	2	0.08				<2								<2		<2									
Endosulfan	2	0.2				<2								<2		<2									
Dieldrin	2	*0.01*				<2								<2		<2									
DDE	2	*0.03*				<2								<2		<2									
Endrin	2	0.02				<2								<2		<2									
DDD	2					<2								<2		<2									
Endrin aldehyde	2					<2								<2		<2									
Endosulfan sulfate	2					<2								<2		<2									
DDT	4	0.01				<4								<4		<4									
Organophosphorous Pesticides (OPP)																									
Dichlorvos	2					<2								<2		<2									
Dimethoate	2	0.15				<2								<2		<2									
Diazinon	2	0.01				<2								<2		<2									
Chlorpyrifos-methy	2					<2								<2		<2									
Malathion	2	0.05				<2								<2		<2									
Fenthion	2	0.2				<2								<2		<2									
Chlorpyrifos	2					<2								<2		<2									
Bromophos-ethy	2					<2								<2		<2									
Chlorfenvinphos	2					<2								<2		<2									
Prothiofos	2					<2								<2		<2									
Ethion	2					<2								<2		<2									
Phenols																									
Total Phenolics	4	320				<4								<4		<4									
Phthalate Esthers																									
Dimethylphthalate	2	3700				<2								<2		<2									
Diethylephthalate	2	1000				<2								<2		<2									
Nitrosamines																									
Total Nitrosamines	2					<2								<2		<2									
Nitroaromatics and Ketones																									
Total Nitroaromatics and Ketone	2					<2								<2		<2									
Haloethers																									
Total Haloethers	2					<2								<2		<2									
Chlorinated Hydrocarbons																									
Total Chlorinated Hydrocarbon	2					<2								<2		<2									
Anilines and Benzidines																									
Total Anilines and Benzidine	2					<2								<2		<2									
Miscellaneous Compounds																									
Total Misscellaneous Compound	2					<2								<2		<2									

All results in µg/L

PQL = Practical Quantitation Limit.

[A] ANZECC 2000 95% Protection Level for Receiving Water Type

Guidelines in *italics* are low level reliability guidelines

[B] NHMRC Australian Drinking Water Guidelines, 2011

* Hardness Modified Trigger Values for Cd, Cr (III), Cu, Ni, Pb, Zn

NHMRC arsenic guidelines are based on total arsenic

NHMRC guidelines for chromium are based on Cr (VI)

Total Phenolics guideline based on Phenol

ANZECC guidelines for mercury are based on inorganic mercury.

NHMRC guidelines for mercury are based on total mercury.

NHMRC guidelines for total cyanide are based on cyanogen chloride (as cyanide).

Results for TRH have been compared to TPH guidelines.

Results shaded grey are in excess of the primary acceptance criteria: ANZECC 95%, NHMRC (2011)

TABLE LR10 Groundwater Analytical Results (µg/L)

Sample Identification	PQL	Guideline				MW14	MW14	MW15	MW15	MW16	MW16	MW17	MW17	MW18	MW18	MW105	MW106	MW107	S3A	S3A	S3B	S3B	SUMP	MW19	MW19	MW20	MW20	MW21
Date		95% Fresh [A]	Recreational	Irrigation	Stock	1/5/12	9/7/14	3/5/12	11/7/14	3/5/12	10/7/14	3/5/12	10/7/14	3/5/12	10/7/14	10/7/14	10/7/14	11/7/14	3/5/12	10/7/14	3/5/12	10/7/14	3/5/12	1/5/12	10/7/14	3/5/12	10/7/14	2/5/12
PAEC Sampled						Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	Carbon Plant	DSA	DSA	DSA	DSA	PRA
Sample Appearance						Yellow	Clear	Yellow	Clear	Clear	Clear	Cloudy	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Milky	Clear	Cloudy	Clear	Clear
Sample collected by						KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG
Metals																												
Aluminium pH>6.5	10	55	9000	5000	5000	110	<10	200	180	100	<10	3,260	3,800	3,120	750	20	50	5,000	50	630	270	1400	40	-	8	-	1500	20
Arsenic	1	24	100	100	500	2	2	<1	2	4	<1	12	12	2	<1	1	2	<1	5	1	2	5	4	-	<0.1	-	2	<1
Cadmium	0.1	2*	20	10	10	0.3	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	0.2	<1	0.2	3	-	1	-	<0.1	<0.1
Chromium	1	27*	500	100	1000	<1	<1	<1	<1	1	<1	<1	4	3	<1	2	5	2	<1	1	1	2	<1	-	<1	-	2	<10
Copper	1	12*	20,000	200	500	7	3	2	<1	4	2	10	1	2	<1	1	<1	<1	4	<1	2	3	5	-	<1	-	<1	<10
Nickel	1	97*	200	200	1000	10	7	7	9	6	<1	14	8	3	<1	4	2	3	6	2	1	7	8	-	7	-	4	62
Lead	1	87*	100	2000	100	<1	<1	<1	<1	<1	<1	34	1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1	-	<1	-	<1	<10
Zinc	5	70*	30,000	2000	20,000	32	7	37	2	57	1	40	6	50	4	4	15	7	31	64	24	13	38	-	2	-	6	70
Mercury	0.1	0.6	10	2	2	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.1	<0.05	<0.1	-	<0.05	-	<0.05	<0.1
Fluoride	100		1500	1000	2000	3600	850	4500	2700	1500	2300	800	1100	35000	17000	1100	7400	10000	12000	8200	14000	12000	4400	-	370	-	670	3000
Non Metallic Inorganics																												
Free Cyanide	4	7	800			<4		<4		<8		<8		<4					<4		<4		<4					
Total Cyanide	4	NA				4		<4		<8		<8		<4					<4		<4		<4					
Total Petroleum Hydrocarbons (TPH)																												
TPH C6-C9	20										<10					240								<20		<20		
TPH C10-C14	50										<50					180								<50		<50		
TPH C15-C28	100										<100					1400								<100		<100		
TPH C29-C36	100										<100					<100								<50		<50		
TPH C6-C36		LOR		LOR	LOR						<100					1820								<50		<50		
Polycyclic Aromatic Hydrocarbons (PAH)																												
Naphthalene	0.1	16				<0.1		<0.1		5.2	<0.1	0.2	<0.1	<0.1	<0.1		<0.1		<0.1		<0.1		<0.1	<0.1		<0.1		
Acenaphthylene	0.1					<0.1		<0.1		<0.1	<0.1	22.9	<0.1	<0.1	<0.1		<0.1		<0.1		<0.1		<0.1	<0.1		<0.1		
Acenaphthene	0.1					<0.1		<0.1		9.4	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1		<0.1		<0.1		<0.1	<0.1		<0.1		
Fluorene	0.1					<0.1		<0.1		1.1	<0.1	2	<0.1	<0.1	<0.1		<0.1		<0.1		<0.1		<0.1	<0.1		<0.1		
Phenanthrene	0.1	*2*				<0.1		<0.1		0.6	<0.1	0.4	<0.1	<0.1	<0.1		<0.1		<0.1		<0.1		<0.1	<0.1		<0.1		
Anthracene	0.1	*0.4*				<0.1		<0.1		0.6	<0.1	0.1	<0.1	<0.1	<0.1		<0.1		<0.1		<0.1		<0.1	<0.1		<0.1		
Fluoranthene	0.1	*1.4*				0.1		<0.1		1	<0.1	0.2	<0.1	<0.1	<0.1		<0.1		<0.1		<0.1		<0.1	<0.1		<0.1		
Pyrene	0.1					0.1		<0.1		0.7	<0.1	0.1	<0.1	<0.1	<0.1		<0.1		<0.1		<0.1		<0.1	<0.1		<0.1		
Benz(a)anthracene	0.1					<0.1		<0.1		0.2	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1		<0.1		<0.1		<0.1	<0.1		<0.1		
Chrysene	0.1					<0.1		<0.1		0.2	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1		<0.1		<0.1		<0.1	<0.1		<0.1		
Benzo(b)&(k)fluoranthene	0.2					0.1		<0.2		0.3	<0.2	<0.2	<0.2	<0.2	<0.2		<0.2		0.2		<0.2		<0.2	<0.2		<0.2		
Benzo(a) pyrene	0.05	*0.2*				0.06		<0.05		0.22	<0.05	<0.05	<0.05	0.06	<0.05		<0.05		0.14		0.08		<0.05	<0.05		<0.05		
Indeno(1,2,3-c,d)pyrene	0.1					<0.1		<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1		<0.1		<0.1		<0.1	<0.1		<0.1		
Dibenz(a,h)anthracene	0.1					<0.1		<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1		<0.1		<0.1		<0.1	<0.1		<0.1		
Benzo(g,h,i)perylene	0.1					<0.1		<0.1		0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1		<0.1		<0.1		<0.1	<0.1		<0.1		
Semivolatile Organic Compounds (SVOCs)																												
Organochlorine Pesticides (OCP)																												
alpha-BHC	2																											<2
HCB	2																											<2
delta-BHC	2																											<2
Heptachlor	2	0.09																										<2
Aldrin	2	*0.001*																										<2
Heptachlor epoxide	2																											<2
Chlordane	2	0.08																										<2
Endosulfan	2	0.2																										<2
Dieldrin	2	*0.01*																										<2
DDE	2	*0.03*																										<2
Endrin	2	0.02																										<2
DDD	2																											<2
Endrin aldehyde	2																											<2
Endosulfan sulfate	2																											<2
DDT	4	0.01																										<4
Organophosphorous Pesticides (OPP)																												
Dichlorvos	2																											<2
Dimethoate	2	0.15																										<2
Diazinon	2	0.01																										<2
Chlorpyrifos-methy	2																											<2
Malathion	2	0.05																										<2
Fenthion	2	0.2																										<2
Chlorpyrifos	2																											<2
Bromophos-ethy	2																											<2
Chlorfenvinphos	2																											<2
Prothiofos	2																											<2
Ethion	2																											<2
Phenols																												
Total Phenolics	4	320																										<4
Phthalate Esthers																												
Dimethylphthalate	2	3700																										<2
Diethylephthalate	2	1000																										<2
Nitrosamines																												
Total Nitrosamines	2																											<2
Nitroaromatics and Ketones																												
Total Nitroaromatics and Ketone	2																											<2
Haloethers																												
Total Haloethers	2																											<2
Chlorinated Hydrocarbons																												
Total Chlorinated Hydrocarbon	2																											<2
Anilines and Benzidines																												
Total Anilines and Benzidine	2																											<2
Miscellaneous Compounds																												
Total Misscellaneous Compound	2																											<2

All results in µg/L

PQL = Practical Quantitation Limit.

[A] ANZECC 2000 95% Protection Level for Receiving Water Type

Guidelines in *italics* are low level reliability guidelines

[B] NHMRC Australian Drinking Water Guidelines, 2011

* Hardness Modified Trigger Values for Cd, Cr (III), Cu, Ni, Pb, Zn

NHMRC arsenic guidelines are based on total arsenic

NHMRC guidelines for chromium are based on Cr (VI)

Total Phenolics guideline based on Phenol

ANZECC guidelines for mercury are based on inorganic mercury.

NHMRC guidelines for mercury are based on total mercury.

NHMRC guidelines for total cyanide are based on cyanogen chloride (as cyanide).

Results for TRH have been compared to TPH guidelines.

Results shaded grey are in excess of the primary acceptance criteria: ANZECC 95%, NHMRC (2011)

TABLE LR11 Groundwater Analytical Results for VOCs and SVOCs

Sample Identification	PQL	Guideline			MW06	MW09	MW10	MW105	MW107	MW21
Date		95% Fresh [A]	Irrigation	Stock	2/5/12	30/4/12	30/4/12	10/7/14	11/7/14	2/5/12
PAEC Sampled					Background	FLS	FLS	Carbon Plant	Carbon Plant	PRA
Sample Appearance					Clear	Cloudy	Turbid	Cloudy	Clear	Clear
Sample collected by					KJG	KJG	KJG	KJG	KJG	KJG
Volatile Organic Compounds (VOCs) and Semivolatile Organic Compounds (SVOCs)										
Monocyclic Aromatics										
Benzene					<2	<2	<2	1	<2	<2
Other Monocyclic Aromatics					<2	<2	<2	<2	<2	<2
Chlorinated Hydrocarbons										
Cis-1, 2-dichloroethane					<1	<1	<1	1	<1	<1
Chloroform					<1	<1	<1	5	<1	<1
Chlorobenzene					<1	<1	<1	150	<1	<1
1,4-dichlorobenzene					<1	<1	<1	9	<1	<1
Organochlorine Pesticides (OCP)										
All OCPs	2				<2	<2	<2	<2	<2	<2
Organophosphorous Pesticides (OPP)										
All OPPs	2				<2	<2	<2	<2	<2	<2
Sulfonated Compounds										
Carbon Disulfide	4	320			<4	<4	<4	<4	<4	<4
Fumigants										
Total Fumigants	4	320			<4	<4	<4	<4	<4	<4
Oxygenated Compounds										
Total Oxygenated Compounds	4	320			<4	<4	<4	<4	<4	<4
Phenols										
Total Phenolics	4	320			<4	<4	<4	<4	<4	<4
Phthalate Esthers										
Dimethylphthalate	2	3700			<2	<2	<2	<2	<2	<2
Diethylephthalate	2	1000			<2	<2	<2	<2	<2	<2
Nitrosamines										
Total Nitrosamines	2				<2	<2	<2	<2	<2	<2
Nitroaromatics and Ketones										
Total Nitroaromatics and Ketones	2				<2	<2	<2	<2	<2	<2
Haloethers										
Total Haloethers	2				<2	<2	<2	<2	<2	<2
Anilines and Benzidines										
Total Anilines and Benzidines	2				<2	<2	<2	<2	<2	<2
Miscellaneous Compounds										
Total Misscellaneous Compounds	2				<2	<2	<2	<2	<2	<2

All results in µg/L

PQL = Practical Quantitation Limit.

[A] ANZECC 2000 95% Protection Level for Receiving Water Type

Guidelines in *italics* are low level reliability guidelines

[B] NHMRC Australian Drinking Water Guidelines, 20110

Results shaded grey are in excess of the primary acceptance criteria: ANZECC 95%, NHMRC

FLS - Flammable Liquids Store

PRA - Pot Rebuild Area

Appendix E

Risk Rating Methodology for Remedial Options

Appendix E Risk Rating Methodology for Remedial Options

	Environmental Consequence	Commercial Consequence
Catastrophic	Significant irreversible damage. Significant remediation actions required. Potential for regulatory prosecution.	≥$10mil
Major	Major effect, but long term reversible. Significant remediation actions required.	≥$5mil - <$10mil
Moderate	Serious effect, but short term reversible. Remediation actions required.	≥$0.5mil - <$5mil
Minor	Medium effect	≥$0.1mil - <$0.5mil
Insignificant	Minor effect	<$0.1mil

	Likelihood
Rare	May occur only in exceptional circumstances
Unlikely	Could occur at some time
Possible	Might occur at some time
Likely	Will probably occur in most circumstances
Almost Certain	Is expected to occur in most circumstances

Risk Rating Matrix

Catastrophic	5	10	15	20	25
Major	4	8	12	16	20
Moderate	3	6	9	12	15
Minor	2	4	6	8	10
Insignificant	1	2	3	4	5
	Rare	Unlikely	Possible	Likely	Almost certain

Figure 15 Risk Rating

Appendix F

Remedial Options Summary

Appendix F Remedial Options Summary

Table 7-3: Assessment of Remedial Options

Option	Description	Advantages	Disadvantages
5.Treat and encapsulate in purpose built containment cell	Encapsulation on site within a purpose built containment cell in combination with a pre-treatment step to remove PAHs, cyanides and fluorides from the contaminated soils and capped waste stockpile.	Consolidation of all wastes and contaminated soils in one location, in a cell that includes segregated compartments. Less liability as reduced contaminant concentrations from treatment	Higher cost of treating soil then Option 5. Friable asbestos present in the capped waste stockpile resulting in associated health risks with treatment. Liability associated with keeping material onsite. Capped Waste Stockpile is a highly variable mixed waste and treatment is difficult to achieve in a uniform manner. Has a high carbon footprint compared to other options.
7.Excavate, sort and dispose off-site	Material would be removed and transported to a licensed waste management facility. Soils to be removed off-site would be required to be classified in accordance with the NSW EPA (2008) Waste Classification Guidelines.	This option provides a reduced remediation timeframe, increased confidence in source removal, reduced liability to Hydro and improves land value.	Excavation and disposal of all soils over the criteria to a licensed waste facility is generally considered unsustainable and costly. Reassigns responsibility to a third party. Has a high carbon footprint compared to other options.
8. On-site treatment to achieve complete destruction	Onsite treatment of contaminants so that the contaminant is either destroyed or reduced to an acceptable level.	Complete destruction of contaminants, production of an inert re-useable material.	High costs associated with onsite treatment. Technology not proven. Risk with treated product still requiring landfilling or management. Unlikely to be able to manage variability of the Capped Waste Stockpile contents. Has a high carbon footprint compared to other options, however this could be negated if the treatment plant uses fuel derived from the waste as an energy source.

Table 7-3: Assessment of Remedial Options

Option	Description	Advantages	Disadvantages
LEACHATE PLUME IN GROUNDWATER AT THE CAPPED WASTE STOCKPILE			
1. Do Nothing	Leave leachate plume as is. Current monitoring indicates fluoride concentrations are between 400mg/L and 1200mg/L close to the Capped Waste Stockpile and between 50mg/L and 400mg/L down gradient of the source.	As the leachate plume is constrained by geology, this is a cost effective option. The ENVIRON (2015) Groundwater Fate And Transport Modelling Report concludes that based on existing hydrogeological conditions and the presence of an on-going source from the Capped Waste Stockpile, the model estimated a fluoride concentration of 4.3mg/L at the receptor distance (1000m) compared to a guideline of 1.5mg/L. Has a low carbon footprint.	On-going visual impact of daylighting leachate in down-gradient areas. Recovery of vegetation impacted area likely to be slower than for other options.
2. Leachate Interception	Interception of leachate at the toe of the Capped Waste Stockpile prior to its down-gradient migration. Disposal of captured leachate a designed treatment plant and then through on-site stormwater management.	This option will reduce the volume of leachate moving down-gradient from the toe of the Capped Waste Stockpile. The fluoride concentration at a receptor distance (1000m) would be less than 4.3mg/L, as the ENVIRON (2015) Groundwater Fate and Transport Modelling Report assumed a continuous source of leachate.	Has a high carbon footprint as pumping will be required for a longer timeframe as this option is reliant on rain events to mobilise the plume.
3. Source Removal to the extent practicable	Removal of the source of the leachate – spent potlining and other wastes disposed of in the Capped Waste Stockpile.	Source removal will eliminate the on-going generation of leachate. The fluoride concentration at a receptor distance (1000m) would be less than 4.3mg/L, as the ENVIRON (2015) Groundwater Fate and Transport Modelling Report assumed a continuous source of leachate. Improves land value for Project Site.	Remaining excavations will need rehabilitation with clean fill. Some leachate within the groundwater system will remain. Has a high carbon footprint compared with other options due to source removal.
4.Reactive Barrier Wall	Construction of a reactive barrier wall at the toe of the Capped Waste Stockpile to reduce fluoride and cyanide concentrations in the leachate.	Reduction in concentrations of fluoride and cyanide in leachate down-gradient of the wall.	High costs associated with on-going treatment. Difficult chemistry to achieve required reductions in fluoride and cyanide concentrations. Has a moderate carbon footprint.

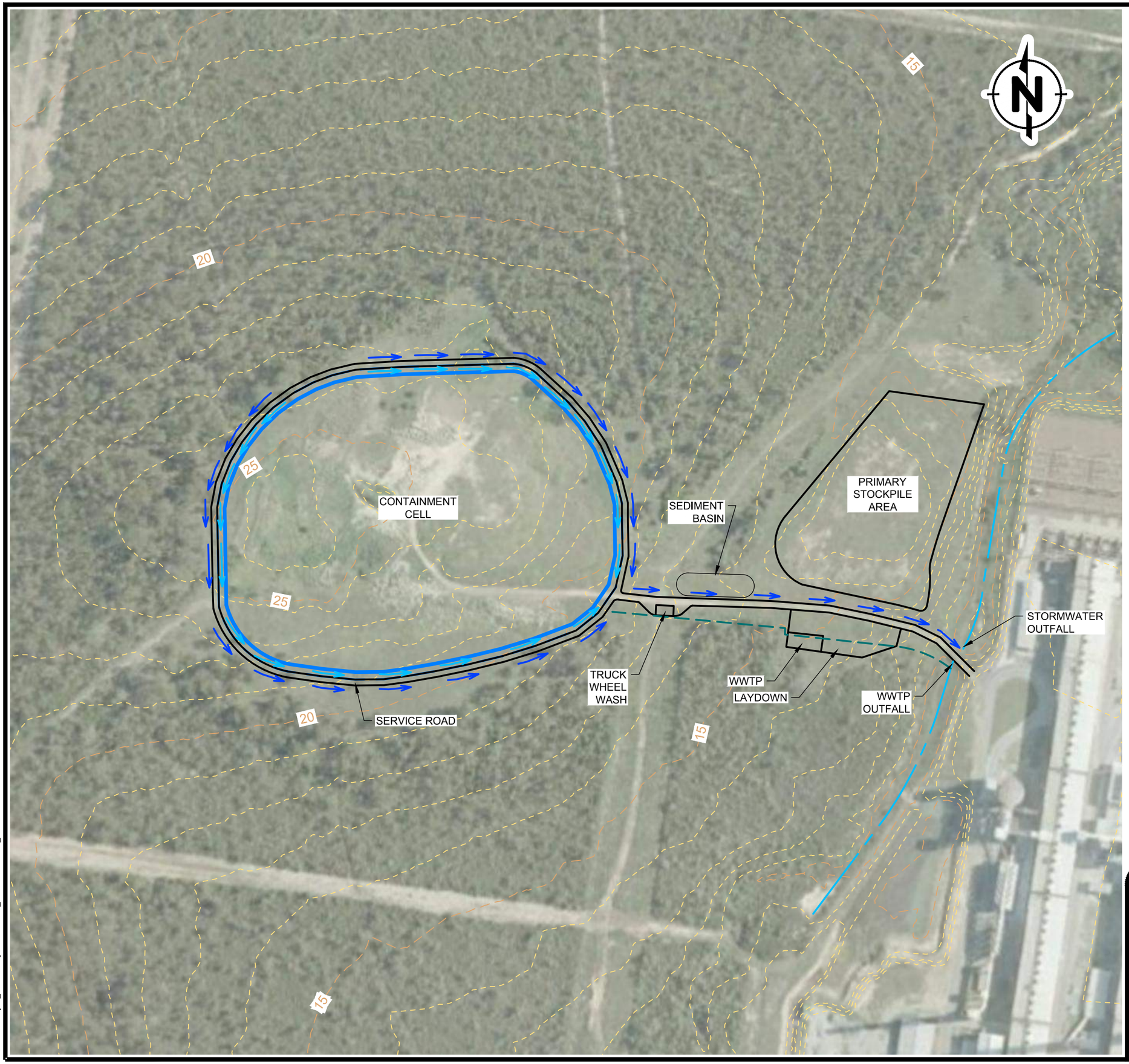
Table 7-3: Assessment of Remedial Options

Option	Description	Advantages	Disadvantages
5. Monitored Natural Attenuation	The leachate plume is constrained in its down-gradient movement by the geology of this area. On-going monitoring to demonstrate that the leachate plume is stable. Attenuation would be achieved through physical processes, such as dispersion, diffusion and sorption.	As the leachate plume is constrained by geology, this is a cost effective option. The fluoride concentration at a receptor distance (1000m) would be less than 4.3mg/L, as the ENVIRON (2015) Groundwater Fate and Transport Modelling Report assumed a continuous source of leachate. Has a low carbon footprint.	On-going visual impact of daylighting leachate in down-gradient areas.
6. Combination of source removal to the extent practicable, leachate removal and monitored natural attenuation	Refer to No. 2, 3 and 5.	Refer to No. 2, 3 and 5.	Refer to No. 2, 3 and 5.

Appendix G

Conceptual Cell Design

Appendix G Conceptual Cell Design



LEGEND

- CONTAINMENT CELL LIMIT (CONCEPTUAL)
- CONTAINMENT CELL CAP LIMIT (CONCEPTUAL)
- 25 — EXISTING CONTOUR MAJOR (5 METRE)
- 24 — EXISTING CONTOUR MINOR (1 METRE)
- STORMWATER DRAINAGE CHANNEL
- TOE DRAIN
- UNDERGROUND LEACHATE / WWTP PIPING
- EPHEMERAL CREEK

NOTES:

1. THE PRIMARY STOCKPILE WILL STORE EXCAVATED CLAY TO BE REUSED IN THE CONTAINMENT CELL LINER AND CAP, AND CRUSHED REFRACTORY/CONCRETE TO BE REUSED IN ACCESS ROADS. IT IS ASSUMED THAT REFRACTORY AND CONCRETE WILL BE CRUSHED IN THE SMELTER BUILDINGS.
2. THE FOOTPRINT OF THE WWTP IS BASED ON THE SYSTEM SPECIFIED IN "STAGE 2 WATER TREATMENT OPTIONS REPORT"' AND IS SUBJECT TO DETAILED DESIGN.
3. THE PROPOSED SUPPORT STRUCTURE DETAILS AND POSITIONING WILL NEED TO BE REASSESSED DURING THE DETAILED DESIGN STAGE.
4. THE ACCESS ROAD CROSSING THE EPHEMERAL CREEK TO BE ASSESSED TO DETERMINE IF UPGRADES ARE NECESSARY TO SUPPORT TRUCK TRAFFIC AND ADDITIONAL HYDRAULIC STRESSES FROM ADDITIONAL FLOW FROM THE PROPOSED STORMWATER OUTFALL.
5. CELL FILLING WILL BE UNDERTAKEN LOGISTICALLY BASED ON SITE SEQUENCING.
6. SEDIMENT BASIN POSITIONING AND DESIGN WILL BE PROVIDED DURING DETAILED DESIGN.

SOURCE:

AERIAL IMAGE: GOOGLE EARTH PRO©

0 75

SCALE IN METRES
1:2500

SITE LAYOUT

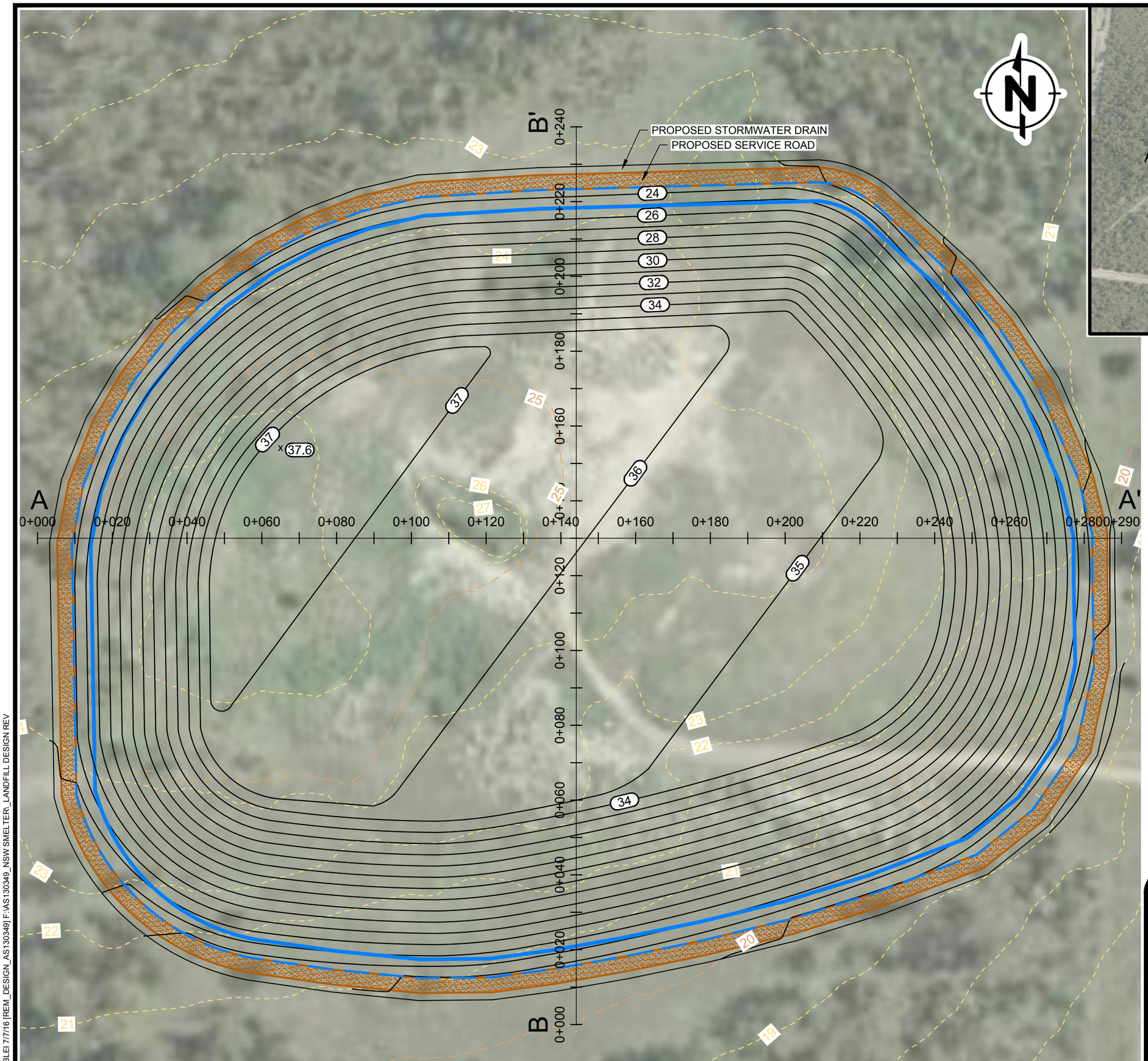
HYDRO ALUMINUM SMELTER KURRI KURRI
NEW SOUTH WALES, AUSTRALIA

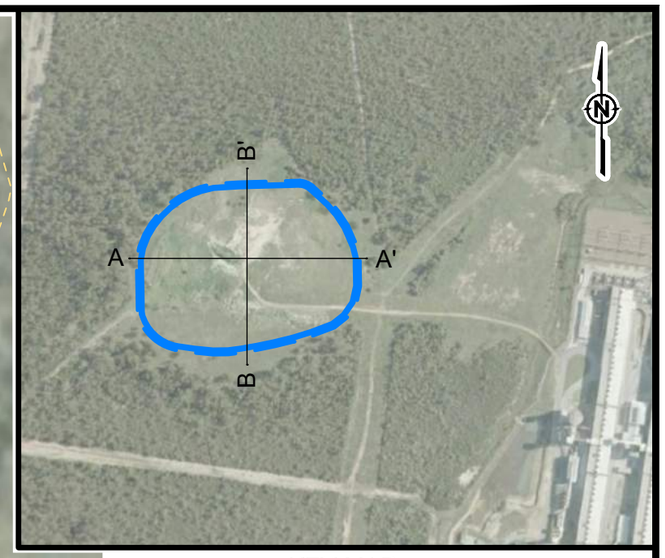
RAMBOLL ENVIRON

FIGURE 1

DRAFTED BY: PRM/MSB | DATE: 07/07/2016 | AS130349

MBLEI 7/7/16 [SL_AS130349] F:\AS130349_NSW SMELTER_LANDFILL DESIGN REV





KEY MAP
1:7,500

LEGEND

- CONTAINMENT CELL LIMIT (CONCEPTUAL)
- CONTAINMENT CELL CAP LIMIT (CONCEPTUAL)
- 25 EXISTING CONTOUR MAJOR (5 METRE)
- 24 EXISTING CONTOUR MINOR (1 METRE)
- 25 PROPOSED CONTOUR MAJOR (5 METRE)
- 24 PROPOSED CONTOUR MINOR (1 METRE)

SOURCE:

AERIAL IMAGE: GOOGLE EARTH PRO©

0 30

SCALE IN METRES
1:1000

CONCEPTUAL CONTAINMENT CELL FINAL GRADING

HYDRO ALUMINUM SMELTER KURRI KURRI
NEW SOUTH WALES, AUSTRALIA

RAMBOLL ENVIRON

FIGURE
2

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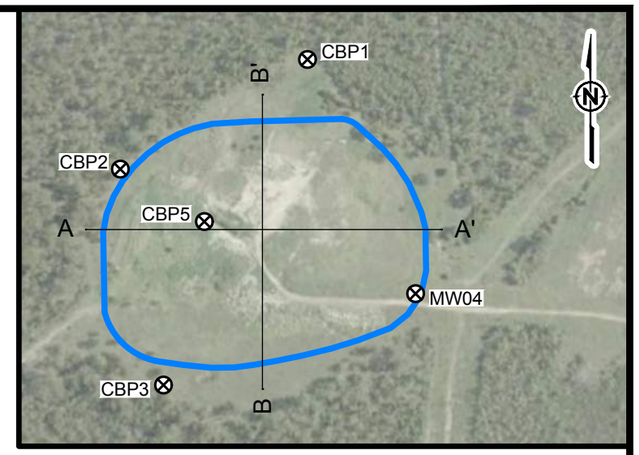
MBLEI 7/7/16 [REM_DESIGN_AS130349] F:\AS130349_NSW SMELTER_LANDFILL DESIGN REV

NOTES:

1. THE PROPOSED CONTAINMENT CELL FOOTPRINT HAS A CAPACITY OF 410,000 CU. M. THE CAPACITY WILL ACCOMODATE THE MAXIMUM VOLUME OF MATERIAL FOR ON-SITE CONTAINMENT PRESENTED IN THE REMEDIAL OPTION STUDY REPORT - 265,000 CU. M - PLUS DAILY COVER. IF NEEDED, ADDITIONAL CAPACITY CAN BE REALIZED BY INCREASING THE HEIGHT OF THE CONTAINMENT CELL WITHOUT ADJUSTING THE FOOTPRINT.
2. CONTAINMENT CELL DIMENSIONS WERE DETERMINED BASED ON EXISTING TEST PIT AND SOILING BORING LOGS, AND ASSUMING 3:1 (H:V) SIDE SLOPES, A 2% GRADE FOR LEACHATE DRAINAGE, AND MAINTAINING 3 M DISTANCE BETWEEN THE BEDROCK AND THE BOTTOM OF THE CONTAINMENT CELL LINER.
3. EXPECT NATIVE MATERIAL TO BE ADEQUATE FOR REUSE FOR CLAY IN THE LINER AND CAP, BUT THIS WILL NEED TO BE VERIFIED BY A LICENSED GEOTECHNICAL ENGINEER.
4. A PERMEABLE MARKER LAYER WILL BE ADDED TO DELINEATE SPENT POTLINING REPOSITORY EXTENT.
5. SURFACE DRAINAGE FOLLOWING CAPPING WILL BE DESIGNED AND IMPLEMENTED TO PROMOTE SURFACE RUNOFF AND PREVENT SCOURING OF THE CAP SURFACE.
6. CELL FILLING WILL BE UNDERTAKEN LOGISTICALLY BASED ON SITE SEQUENCING.



KEY MAP
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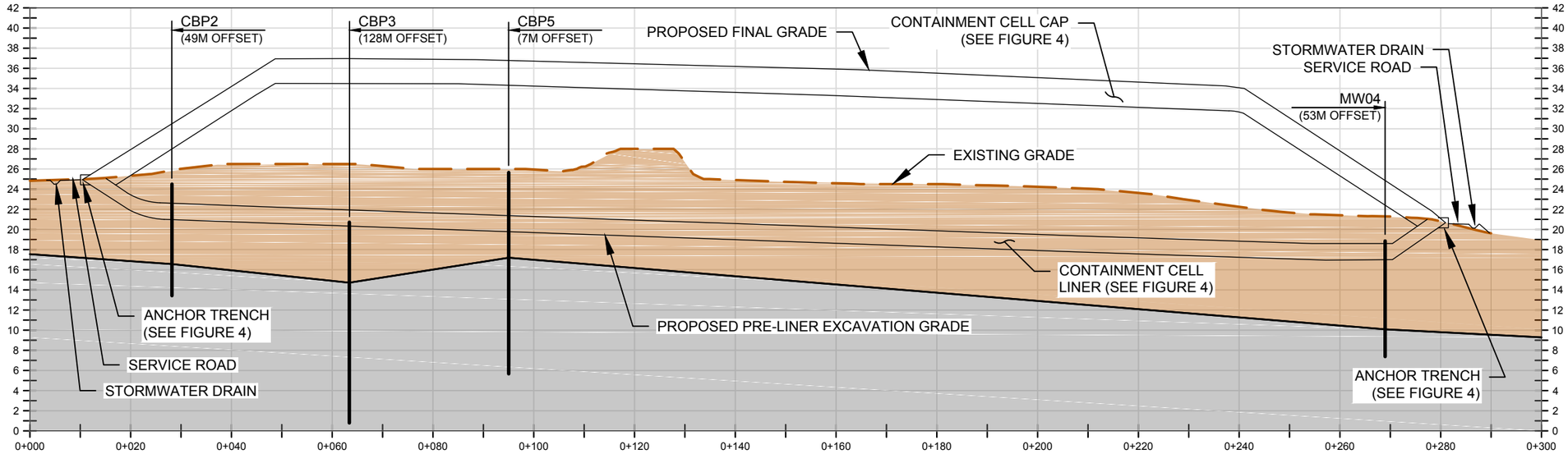
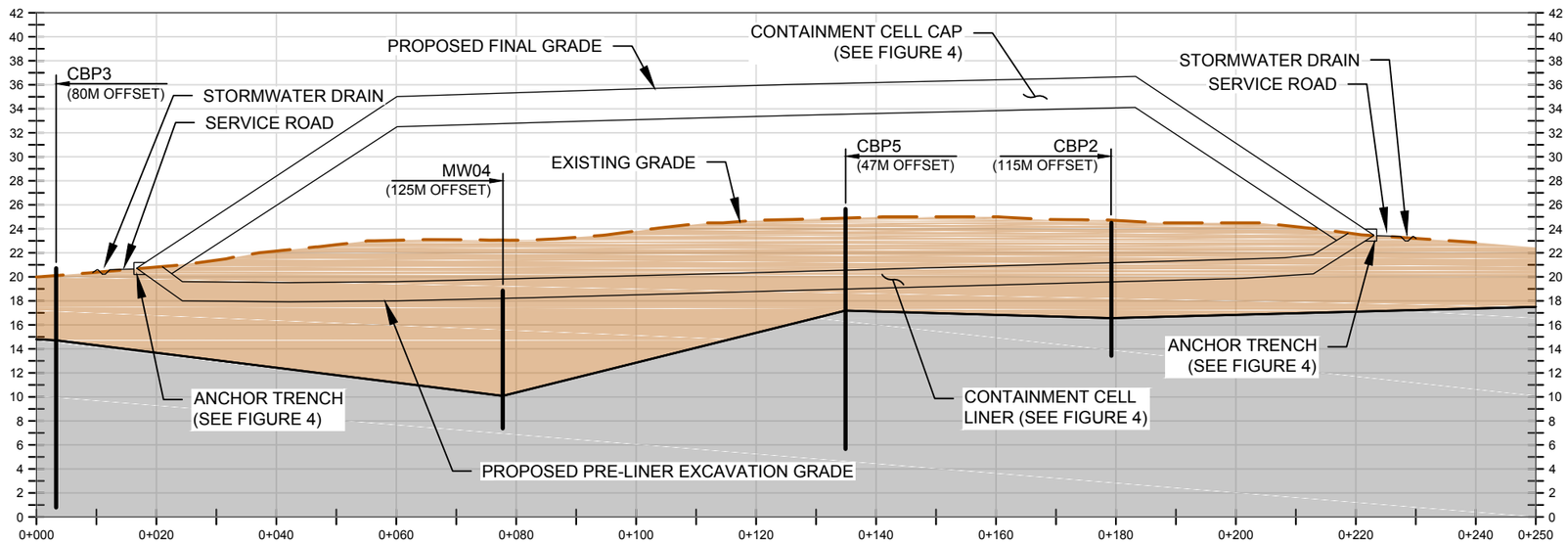


CROSS SECTION A-A'
HORZ: 1:1000
VERT: 1:500 (VERTICAL EXAGGERATION OF 2)



CROSS SECTION B-B'
HORZ: 1:1000
VERT: 1:500 (VERTICAL EXAGGERATION OF 2)

LEGEND

CONTAINMENT CELL LIMIT (CONCEPTUAL)

RESIDUAL CLAY (SANDY/SILTY)

SILTSTONE

SOURCE:

AERIAL IMAGE: GOOGLE EARTH PRO©

0 30

SCALE IN METRES
1:1000

CONCEPTUAL CONTAINMENT CELL CROSS SECTIONS

HYDRO ALUMINUM SMELTER KURRI KURRI
NEW SOUTH WALES, AUSTRALIA

RAMBOLL ENVIRON

FIGURE
3

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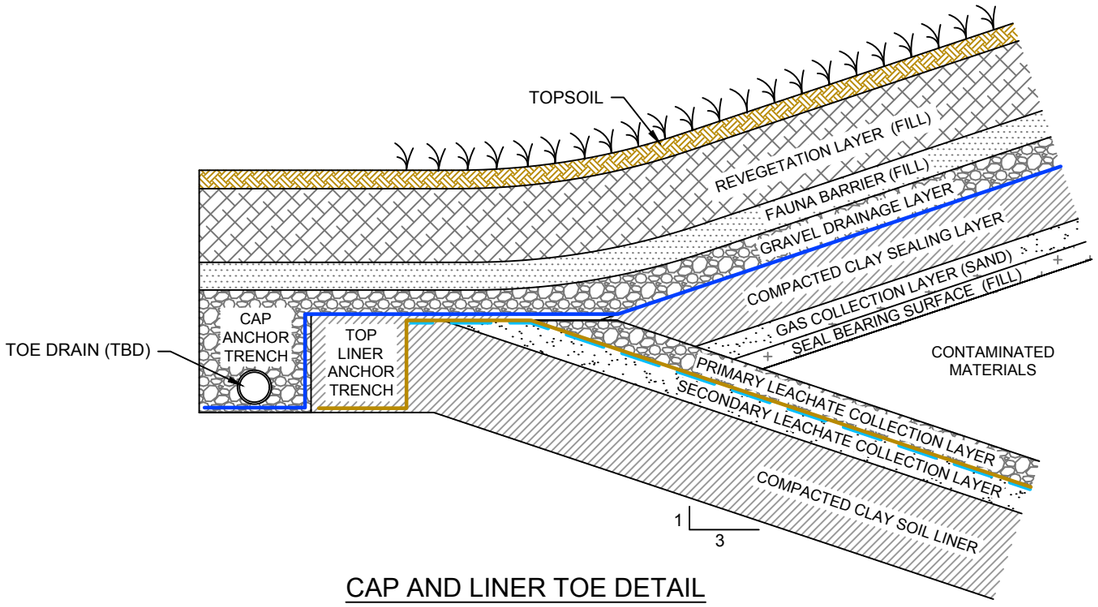
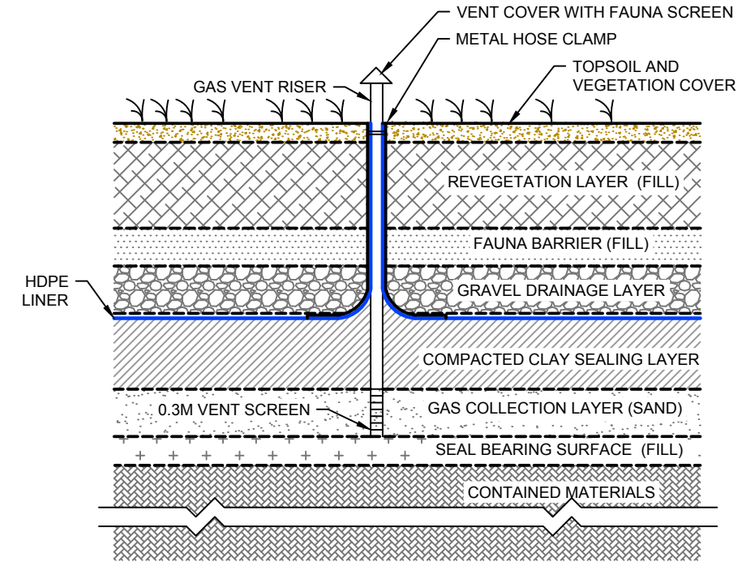
MBLEI 7/7/16 [REM_DESIGN_AS130349] F:\AS130349_NSW SMELTER_LANDFILL DESIGN REV



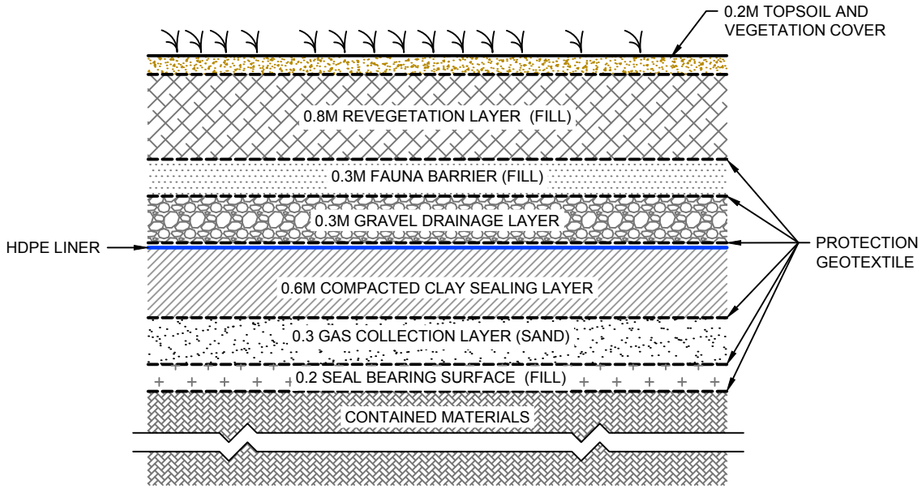
CAP AND LINER TOE DETAIL

N.T.S.



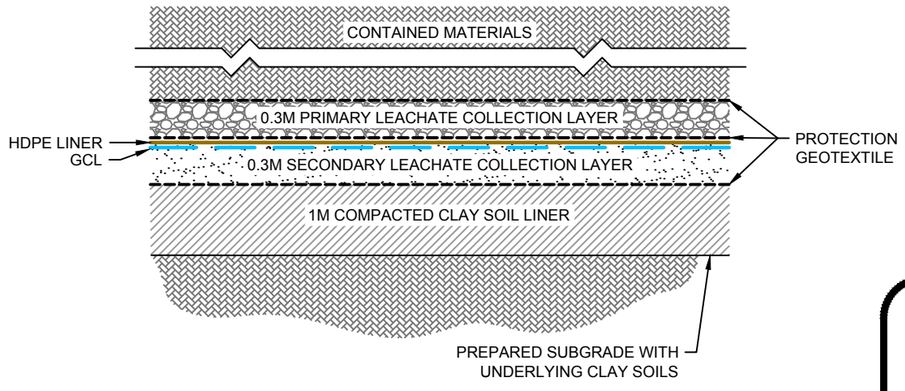
TYPICAL GAS VENT PENETRATION THROUGH CAP DETAIL

N.T.S.



CAP DETAIL

N.T.S.



LINER DETAIL

N.T.S.

NOTES:

1. THE NUMBER AND DIMENSIONS OF THE GAS VENTS TO BE DETERMINED DURING DETAILED DESIGN.
2. THE GAS VENT DETAIL SHOWN IS SUBJECT TO CHANGE DURING DETAILED DESIGN. CONSTRUCTION METHODS WILL FOLLOW THE MANUFACTURER'S RECOMMENDATIONS, THE REQUIREMENTS OF THE QUALITY CONTROL PLAN, AND THE MATERIALS WILL BE BUSHFIRE, CHEMICAL AND CORROSION RESISTANT.
3. HDPE LINER SPECIFICATIONS TO BE DETERMINED DURING DETAILED DESIGN. TYPICAL CONTAINMENT CELL HDPE LINERS ARE SPECIFIED AS 1.5-2.0 MM THICK TEXTURED SURFACE, FORMULATED TO BE RESISTANT TO THE CHEMICALS EXPECTED IN THE LEACHATE, AND CONSTRUCTED PER A SPECIFIC QUALITY CONTROL PLAN.
4. GEOSYNTHETIC CLAY LINER (GCL) OF PERMEABILITY LESS THAN $5x10^{-11}$ M/S, TO MEET SPECIFICATIONS OUTLINED IN NSW EPA SOLID WASTE GUIDELINES 2016.
5. THE LINER AND CAP DETAILS ARE SUBJECT TO CHANGE BASED ON ECONOMIC OR FUNCTIONAL CONSIDERATIONS DURING DETAILED DESIGN.
6. GRAVEL DRAINAGE LAYER IS TO COMPRISE ROUNDED GRAVEL OR ALTERNATE GEOSYNTHETIC MATERIAL COULD BE CONSIDERED, EG/ GEONET OR SIMILAR.

CONCEPTUAL CONTAINMENT CELL DETAIL CAP AND LINER

HYDRO ALUMINUM SMELTER KURRI KURRI
NEW SOUTH WALES, AUSTRALIA

RAMBOLL ENVIRON

FIGURE 4

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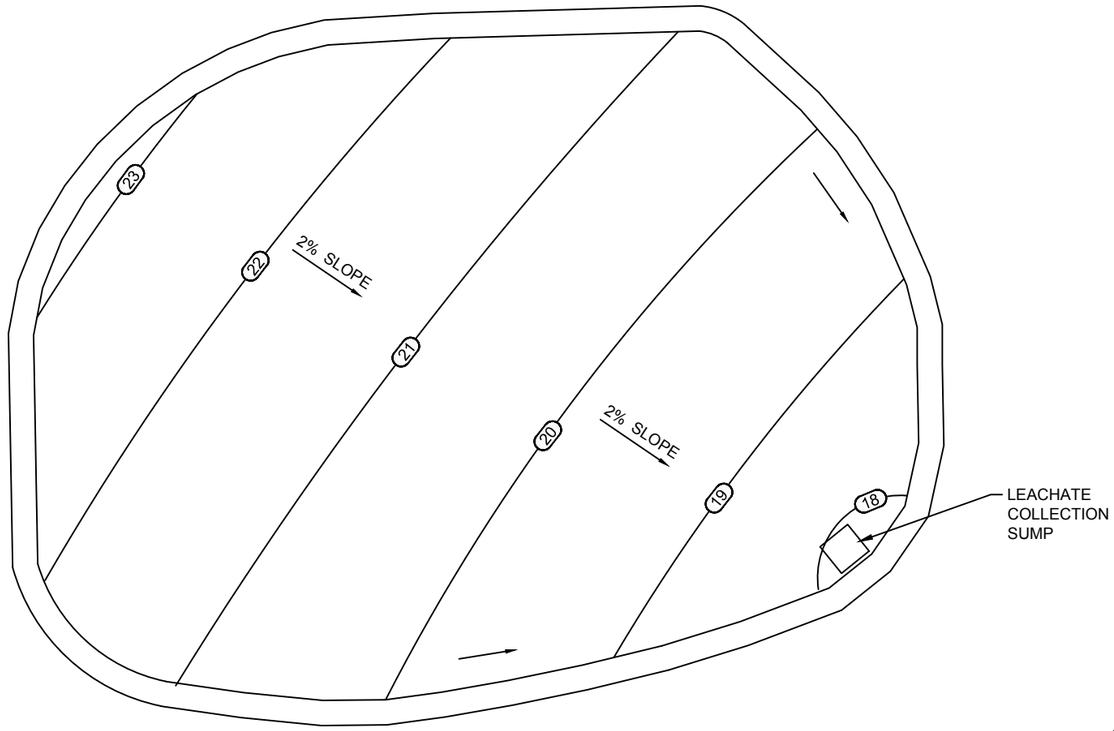
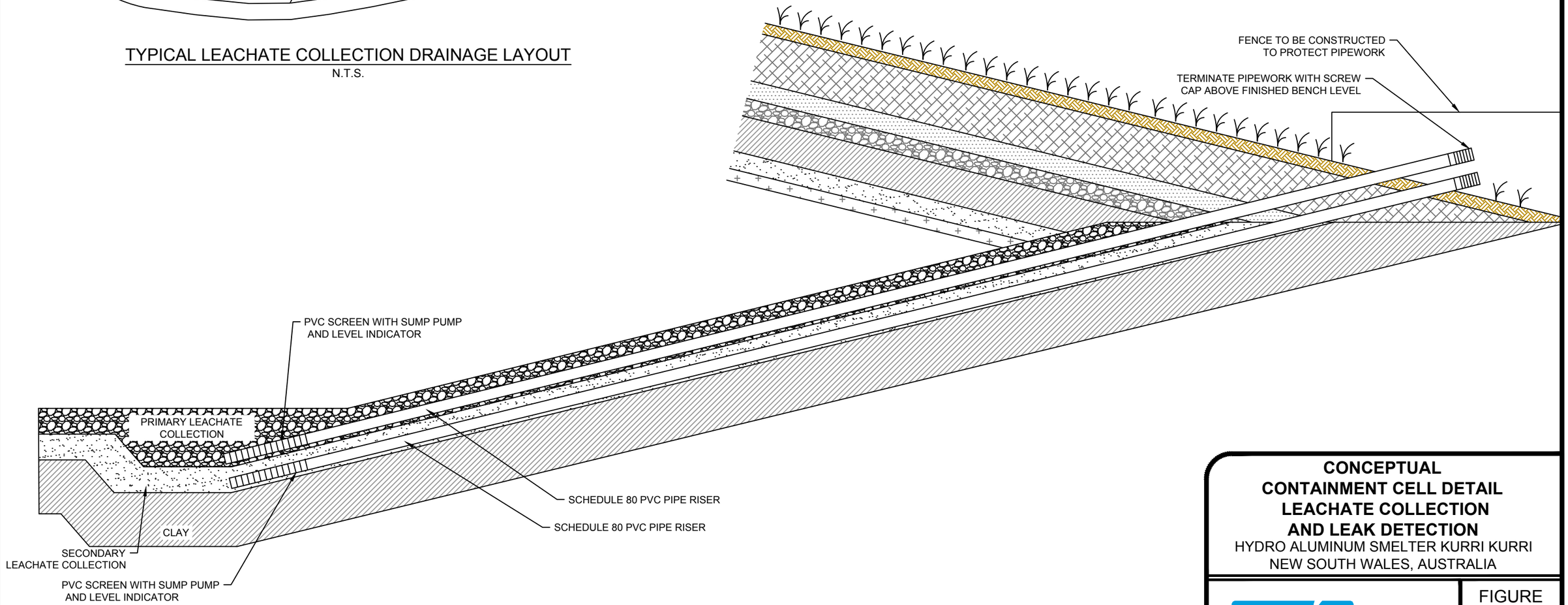


TYPICAL LEACHATE COLLECTION DRAINAGE LAYOUT

N.T.S.

NOTES:

1. LEACHATE COLLECTION SYSTEM MAY INCLUDE PERFORATED COLLECTION PIPING. SPACING AND QUANTITY OF PIPING WILL BE DETERMINED DURING DETAILED DESIGN.
2. WATER MANAGEMENT DURING CONSTRUCTION AND FILLING WILL COMPRISE SEGREGATION OF CLEAN AND DIRTY WATER. THE WATER MANAGEMENT PLAN WILL BE DEVELOPED DURING DETAILED DESIGN.
3. CONTAINMENT CELL LINER ELEVATION AND GRADE SHOWN IS APPROXIMATE AND IS SUBJECT TO CHANGE DURING DETAILED DESIGN.



TYPICAL SUMP AND LEACHATE DETECTION DETAIL

N.T.S.

CONCEPTUAL
CONTAINMENT CELL DETAIL
LEACHATE COLLECTION
AND LEAK DETECTION

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NEW SOUTH WALES, AUSTRALIA

RAMBOLL ENVIRON

FIGURE
5

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