Intended for
Hydro Aluminium Kurri Kurri Pty Ltd

Document type
Remedial Action Plan

Date
July 2016

Hydro Smelter Kurri Kurri

REMEDIAL ACTION PLAN
HYDRO ALUMINIUM SMELTER KURRI KURRI

REMEDIAL ACTION PLAN
HYDRO ALUMINIUM SMELTER KURRI KURRI

Revision	**FINAL V2**
Date	**12/07/2016**
Made by	**Kirsty Greenfield**
Checked by	**Fiona Robinson**
Approved by	**Fiona Robinson**
Description	**Ramboll Environ has prepared a remediation strategy for contaminated soils at the former Hydro Aluminium Kurri Kurri Smelter. The strategy is presented in this Remedial Action Plan.**

Ref AS130349
AS130349_Remedial_Action Plan_F1.docx Version FINAL V2

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

Z:\Projects\Hydro Australia\AS130349 Remediation and Preliminary Planning\RAP\Updated with Auditor comments\AS130349_Remedial_Action Plan_FINAL_July 2016.docx

CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

ACM	Asbestos Containing Materials
AEC	Area of Environmental Concern
AHD	Australian Height Datum
ALS	Australian Laboratory Services
ASET	Australian Safer Environment and Technology Pty Ltd. (Laboratory)
ANZECC	Australian and New Zealand Environment and Conservation Council
B(a)P	Benzo(a)pyrene
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes (Monocyclic aromatic Hydrocarbons)
CN	Cyanide (total or free)
CT	Certificate of Title
DP	Deposited Plan
DQO	Data Quality Objective
EIL	Ecological Investigation Level
EPA	Environment Protection Authority
ESA	Environmental Site Assessment
Ha	Hectare
km	Kilometres
LOR	Limit of Reporting
m	Metres
MAH	Monocyclic Aromatic Hydrocarbons
Mercury	Inorganic mercury unless noted otherwise
Metals	As: Arsenic, Cd: Cadmium, Cr: Chromium, Cu: Copper, Fe: Iron, Ni: Nickel, Pb: Lead, Zn: Zinc, Hg: Mercury
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Litre
m BGL	Metres below ground level
mg/L	Micrograms per Litre
MW	Monitoring well
NATA	National Association of Testing Authorities
NC	Not Calculated
ND	Not Detected
NEHF	National Environmental Health Forum
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
OCPs	Organochlorine Pesticides
OH&S	Occupational Health & Safety
OPPs	Organophosphorus Pesticides
PAEC	Potential Area of Environmental Concern
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PQL	Practical Quantitation Limit
pH	a measure of acidity, hydrogen ion activity
QA/QC	Quality Assurance/Quality Control
RPD	Relative Percent Difference
SILs	Soil Investigation Levels
SVOCs	Semi Volatile Organic Compounds

TPHs	Total Petroleum Hydrocarbons
UCL	Upper Confidence Limit
VENM	Virgin Excavated Natural Material
VOCs	Volatile Organic Compounds
µg/L	Micrograms per Litre
-	On tables is "not calculated", "no criteria" or "not applicable”

1. EXECUTIVE SUMMARY

Ramboll Environ was engaged by Hydro Aluminium Kurri Kurri Pty Ltd (Hydro) to prepare a Remedial Action Plan (RAP) for the remediation of approximately 140ha comprised of the Hydro Kurri Kurri Aluminium Smelter (the Smelter) and an area known as the Clay Borrow Pit.

The Smelter and the Clay Borrow Pit form the location of the proposed demolition, remediation and waste management project proposed by Hydro (the Project). The Project site is located at Hart Road, Loxford, New South Wales (NSW).

A Masterplan has been developed that identifies land proposed for General Industrial (IN1) and Heavy Industrial (IN3) landuse at the Project site. A Development Application for approval of a State Significant Development (supported by an Environmental Impact Statement) has been prepared for: the demolition of remaining redundant Smelter buildings; remediation of the Project site; and design, construction and operation of a Containment Cell. The Environmental Impact Statement (EIS) must address the Secretary's Environmental Assessment Requirements (SEARs).

The SEARs require preparation of a RAP. The SEARs also require an independent audit of the RAP and preparation of a Site Audit Report and Site Audit Statement indicating that the site can be made suitable for its future landuse.

Previous investigations at the Project site have identified contamination associated with waste stockpiling at the Capped Waste Stockpile and the Anode Waste Pile; with fill importation at the Diesel Spray Area; with site operations at the Carbon Plant and Bake Furnace Scrubber; with burial of wastes at the Area East of the Playing Fields; and with drainage at the Drainage Lines and at the East Surge Pond. Groundwater impacts (leachate plume) have also been identified down gradient of the Capped Waste Stockpile.

Additional investigations are required to delineate the extent of soil contamination at the Anode Waste Pile and the Diesel Spray Area. Investigations are also required at areas that have not been previously accessible, including investigation of sediments in the West Surge Pond and investigation of soil at the substations and the Area East of the Clay Borrow Pit. The additional investigation areas are not expected to present material contamination issues.

The RAP was commissioned by Hydro to detail the preferred methodology to remediate the impacted soils at each Area of Concern, which involves excavation and on-site containment; the requirement for the treatment of groundwater at the Capped Waste Stockpile; and to detail the required validation.

Ramboll Environ considers that following implementation of the remedial measures and associated validation activities documented in the RAP and provision of a Validation Report, the Project Site can be made suitable for the proposed landuse outlined in the Masterplan.

2. INTRODUCTION

Ramboll Environ Pty Ltd (Ramboll Environ) was engaged by Hydro Aluminium Kurri Kurri Pty Ltd (Hydro) to prepare a Remedial Action Plan (RAP) for the remediation of approximately 140ha comprised of the Hydro Kurri Kurri Aluminium Smelter (the Smelter) and an area known as the Clay Borrow Pit.

The Smelter and the Clay Borrow Pit form the location of the proposed demolition, remediation and waste management project proposed by Hydro (the Project). The Project site is located at Hart Road, Loxford, New South Wales (NSW) as shown in **Figure 1.**

The RAP details site conditions and requirements for remediation of the Project Site. The Project Site is shown on **Figure 2**.

2.1 Background

The Kurri Kurri Aluminium Smelter produced 180,000 tonnes of aluminium metal per annum. The Smelter commenced production in 1969 with a single pot line. A second pot line was commissioned in 1979, and a third added in 1985. In 2002, Hydro undertook an upgrade program, which increased production capacity to 180,000 tonnes. The Smelter is surrounded by a 2,000ha buffer zone (Hydro Land), part of which is used for agricultural purposes.

Hydro suspended operations at the Kurri Kurri Smelter in 2012 and following a two year period of care and maintenance, closure was announced in May 2014.

Two Phase 2 Environmental Assessments have been completed (ENVIRON 2012 and 2015). These investigations identified seven Areas of Environmental Concern (AECs) within the Project site that require surface soil and sediment remediation. These AECs have been delineated vertically and in the majority of cases laterally, however some require additional lateral investigation in areas of contamination prior to remediation. In addition, three AECs or potential AECs (PAECs) were not investigated due to access issues from existing buildings or services during 2014 Phase 2 ESA and will require further investigation to determine the potential risk of harm to human health or the environment.

A Masterplan has been developed that identifies land proposed for General Industrial (IN1), Heavy Industrial (IN3) and Environmental Conservation (E2) landuse at the Project Site.

A Development Application for approval of a State Significant Development (supported by an Environmental Impact Statement) has been prepared for: the demolition of remaining redundant Smelter buildings; remediation of the Project site; and design, construction and operation of a Containment Cell. The Environmental Impact Statement (EIS) must address the Secretary’s Environmental Assessment Requirements (SEARs).

The SEARs require preparation of a RAP. The SEARs also require an independent audit of the RAP and preparation of a Site Audit Report and Site Audit Statement indicating that the site can be made suitable for its future land use.

2.2 Objective

The objective of the RAP is to provide a detailed plan of the works required to remediate the Project Site to a level suitable for the proposed commercial and industrial land uses. Additional objectives of the remediation works are:

- To ensure the remediation of the Project Site is protective of the human health and environment;
- Facilitate the completion of remedial works relevant to National and State regulatory requirements.

This RAP identifies the nature and extent of identified surface soil and sediment contamination, outlines the options for the remediation required, and provides detail of the required remediation and validation works. In addition, demolition of the Smelter infrastructure will be undertaken concurrently with remediation, and in some instances is required to facilitate remediation. Smelter demolition will result in the generation of demolition materials and smelter wastes that are not able to be recycled or reuse on the site, or off site. The necessity to manage these materials will be incorporated in the remediation evaluation.

2.3 Scope of Work

To meet the objective, Ramboll Environ has completed the following scope of work:

- Review all previous reports prepared for the Project Site including:
  - ENVIRON (October 2013) Phase 1 Environmental Site Assessment, Hydro Kurri Kurri Aluminium Smelter
  - ENVIRON (November 2012) Phase 2 Environmental Site Assessment, Kurri Kurri Aluminium Smelter
  - ENVIRON (December 2012) Environmental Site Assessment, Capped Waste Stockpile, Kurri Kurri Aluminium Smelter
  - ENVIRON (March 2013) Tier 2 Ecological Risk Assessment, Kurri Kurri Aluminium Smelter
  - ENVIRON (April 2013) Preliminary Screening Level, Health Risk Assessment for Fluoride and Aluminium, Part of the Kurri Kurri Aluminium Smelter, Hart Road, Loxford
  - ENVIRON (June 2013) Stage 2 Aquatic Assessment – Ecological Risk Assessment, Kurri Kurri Aluminium Smelter
  - ENVIRON (October 213) Plume Delineation Report, Capped Waste Stockpile
  - ENVIRON (January 2015) Phase 2 Environmental Site Assessment, Project Site, Additional Investigations
  - ENVIRON (February 2015) Hydro Aluminium Smelter, Capped Waste Stockpile, 12 Month Groundwater Monitoring Report
- Outline a Sampling Plan for the three AEC/PAECs that have been identified requiring further investigation or any other AEC that requires lateral delineation of contamination;
- Identify and evaluate possible remedial options for each AEC including consultation with Hydro personnel in order to determine the most appropriate remedial option;
- Identify and evaluate possible remedial options for the leachate plume associated with the Capped Waste Stockpile;
- Consultation with regulatory guidelines;
- Outline how the remedial options will be undertaken to meet the remediation objective;
- Establish Data Quality Objectives (DQOs) for the development of the validation plan;
- Develop a validation plan to validate completion of the site remediation and confirm the suitability of the site for the proposed use.

2.4 Regulatory Framework and Guidelines

This document has been prepared in reference to the following regulations:

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

The SEARs issued by the Department of Planning and Environment to be addressed in preparation of the EIS for the Project included requirements regarding the RAP. **Table 2-1** lists the SEARs and where they are addressed in this RAP.

Table 2-1: SEARs for the RAP and Where Addressed

SEARS Condition	Where Addressed in the RAP
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	**Section 5**
• detail the proposed remediation process, including treatment methodologies and processes	**Section 8**
• 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	Refer to the Human Health Risk Assessment, Appendix 11 of the EIS
• detail the proposed remediation management measures including the management of excavated material, stockpiles and wastewater	**Section 8**
• include a site validation plan	**Section 9**
• detail the final landform/use following remediation and the suitability of any fill material	**Section 8.6.10**
• identify any on-going management of the site following remediation works	**Section 17**

3. SITE IDENTIFICATION

3.1 Site Location

The Project Site is located approximately 30km west of the town of Newcastle and 150km north of Sydney in New South Wales, Australia.

For the purpose of the RAP, the 'Smelter site' comprises the whole of the lots that cover the smelter footprint. This 'Smelter site' was identified as a Land Parcel in the Masterplan completed in 2013.

Table 3-1 presents Project Site identification and location details.

Table 3-1: Site Identification

Item	Description
Site Owner	Hydro Aluminium Kurri Kurri Pty Limited (subject to Deed of Company Arrangement)
Street Address	Hart Road, Loxford, New South Wales, Australia , 2326
Local Government Area	Cessnock City Council
Parish	Heddon
County	Northumberland
Distance from Nearest CBD	Approximately 3.5km northwest of Kurri Kurri, and 30km northwest 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, 776 in DP 755231, Lot 16 in DP 1082775 Pt 1, Lot 1 and Lot 2 in DP 456769 and Part Lot 3 in DP 456769
Site Area	Approximately 140 ha.
Zoning (current)	RU2 – Rural Landscape
Site Elevation	RL 20 to 30 m in the centre and north of the lot to RL 10 mAHD to 15 mAHD in the south and south east
Site Map	**Figure 1**

3.2 Site Boundaries

The Project Site is located within the following boundaries:

- East: Bushland within the Buffer Zone owned by Hydro (herewith described as the Hydro Land);
- North: Bushland within the Hydro Land;
- 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 Hydro Land; and
- South: The Hunter Expressway then bushland within the Hydro Land.

The boundary of the Project Site is shown on **Figure 2**. The layout of the Smelter and the location of Areas of Environmental Concern (AECs) and Potential Areas of Environmental Concern (PAECs) is shown in **Figure 3**.

4. SITE HISTORY

4.1 General Operations History

The Project site encompasses a three pot-line aluminium smelter (the Smelter) with 360 pots and a capacity of up to 180,000 tonnes of aluminium per annum. The Smelter was built on previously undeveloped agricultural land. A buffer zone (the Hydro Land) of predominately rural land was progressively purchased around the planned facility as required in the planning approval for the Smelter.

The Smelter was developed in 1969 by Alcan Australia Ltd., later Capral Aluminium, with pot-lines commissioned in 1969. Line 1 was initially commissioned and comprised 120 cells and producing 50,000 tonnes per annum by 1973. Line 2 was commissioned in 1979 and comprised of 120 cells. Line 3 was commissioned in 1985 comprising 120 cells and reaching a final capacity for the plant of 180,000 tonnes per annum.

The Smelter and Hydro Land were purchased by VAW Aluminium in 2000, and became Hydro Aluminium Kurri Kurri Pty Ltd with the Norsk Hydro purchase of VAW Aluminium in 2002.

Pot Line 1 was taken out of active production in January 2012 reducing the capacity by 120 pots. The remaining two pot lines were taken out of active production in September 2012 and the closure of the Smelter was announced in May 2014. The Smelter and Hydro Land are currently maintained by a team of Hydro employees.

4.2 Overview of Former Site Operations

The Smelter layout is shown in **Figure 3**. The overall operational process at the Smelter was comprised of four main operational areas:

- Pot Lines, where alumina was reduced to molten aluminium in three pot-lines. Pot Lines 1, 2 and 3 are located on the western portion of the Smelter. Alumina and cryolite were placed within pots and an electrical current applied. Molten aluminium was siphoned from each pot and taken to the Cast House;
- Casthouse, where molten metal was cast into ingots and billets. The Cast House is located immediately east of Pot Line 1 near the main entrance. The Cast House produced cast aluminium products to product specifications often including the addition of alloys. The Cast Houses utilised chlorine gas to avoid oxidation during the casting process. The gas was captured when the casting chamber was filled. Wastes from the Cast House included dross and swarf, which have a high aluminium content and were sent for recycling off-site;
- Carbon Plant, where a ring furnace was used to bake anodes. The Carbon Plant is located near the northern Smelter boundary to the east of the potlines. The Carbon Plant produced anodes from a mixture of coke, pitch and recycled anode butts to produce a green anode. This green anode was then baked within a bake furnace prior to the addition of a cast iron rod, and dispatched to the Pot Lines. The bake furnace was gas fired however it was previously oil heated. Ancillary facilities associated with the Carbon Plant included a liquid pitch tank, petroleum coke storage, the bake furnace scrubber, the rodding building, rodding mix storage building, baked anode storage. The Anode Plant was included in the Carbon Plant; and
- Anode Plant, where carbon anodes were manufactured. The anode plant included the Greenmix Plant, the Baking Furnace and the Rodding Plant.

Infrastructure and ancillary structures at the Project Site include:

- A transformer yard and substation are located in the north western corner of the Project Site;
- Stormwater on the Smelter's paved areas is directed via conduits to either the West Surge Pond, which is located on the western boundary of the Smelter or the East Surge Pond, which is located on the eastern boundary of the Smelter. Surface water runoff from the car park and administration areas is directed to the South Surge Pond. All ponds flow to the North Dam, located to the north of the Carbon Plant;

- Smelter wastes including spent pot lining was initially stockpiled on a low lying area of the Smelter near the eastern plant boundary between 1969 and the early 1990s. The Smelter waste mound (known as the Capped Waste Stockpile) was capped with clay in 1995. Since this time smelter wastes have been stockpiled separately or recycled. Spent pot lining is now stored in purpose-built sheds, of which there are ten located to the south of the Capped Waste Stockpile. Eight of these sheds contain spent pot lining, the remaining two sheds contain other aluminium smelter wastes;
- A maintenance compound is located in the centre of the Smelter, south of the Carbon Plant. The compound is used for maintenance activities as well as storage of equipment and spare parts;
- A diesel refuelling area is located in the centre of the Smelter. The diesel refuelling area contains one above ground storage tank (AST) and a wash bay;
- A diesel spray area is located at the rear of the Carbon Plant on the northern Smelter boundary, which was used to treat rust coatings from cathode rods prior to reuse;
- Offices, a security gate house, canteen, two playing fields and a former gym building are located within the Project Site;
- Storage area west of the Pot Lines;
- A pot reconditioning area was located to the south of Pot Line 1. The pot reconditioning area contains one large building where pots were reconditioned for re-use.
- The Clay Borrow Pit, an area to the west of the Smelter from which clay material was won to cap the Capped Waste Stockpile. This excavation was subsequently backfilled with inert smelter wastes including refractory brick, concrete and bitumen. This material was removed in 2015 and is currently stockpiled in the Storage area west of the Pot Lines; and
- Small areas of native vegetation are located within the boundaries of the Project Site, which adjoin larger areas of native vegetation outside the Project Site.

5. PREVIOUS INVESTIGATIONS

Ramboll Environ has completed a number of investigations at the Project Site since operations were suspended in 2012. These investigations included a historical review of the Project Site, identification of Potential Areas of Concern (PAECs) and Areas of Concern (AECs), intrusive investigations for soil and groundwater and delineation of contaminated AECs.

Investigations completed by Ramboll Environ that are relevant to this RAP are outlined below.

- 'Stage 1 Phase 2 Environmental Site Assessment, Hydro Kurri Kurri Aluminium Smelter', November 2012, ENVIRON
- 'Tier 2 Ecological Risk Assessment Hydro Kurri Kurri Aluminium Smelter', March 2013, ENVIRON
- 'Preliminary Screening Level for Human Health Risk Assessment Hydro Kurri Kurri Aluminium Smelter', April 2013, ENVIRON
- 'Phase 1 Environmental Site Assessment, Hydro Kurri Kurri Aluminium Smelter', October 2013, ENVIRON
- 'Stage 2 Phase 2 Environmental Site Assessment, Hydro Kurri Kurri Aluminium Smelter', January 2015, ENVIRON

In addition, a Remedial Action Works Plan for the Clay Borrow Pit have also been completed and a summary of these are provided below for general context.

- 'Remedial Action Works Plan Clay Borrow Pit Area, Hydro Kurri Kurri Aluminium Smelter', July 2014, (ENVIRON, 2014b) ENVIRON.

5.1 Stage 1 of the Phase 2 ESA

Ramboll Environ completed Stage 1 of the staged Phase 2 ESA in 2012. Stage 1 included the following documents:

- 'Sampling, Analysis and Quality Plan, Kurri Kurri Aluminium Smelter', March 2012, ENVIRON
- 'Phase 2 Environmental Site Assessment, Kurri Kurri Aluminium Smelter', 1 November 2012, ENVIRON

Stage 1 involved the following tasks:

- A desktop study, including a review of historical information and background data and a site walkover;
- The identification of 20 PAECs and five potential contaminants of concern relating to the production of aluminium and the ancillary operations (fluoride, aluminium, cyanide, PAHs, TPH);
- The development of an sampling and analytical quality plan (SAQP) to assess the PAECs and chemicals of concern;
- Field investigations, including the drilling of 31 boreholes, installation of 21 groundwater monitoring wells, collection of 45 surface soil samples, 14 sediment samples and 28 groundwater samples;
- Analysis of soil, groundwater and sediment samples for a range of potential contaminants of concern;
- The development of a conceptual site model including sources of contamination, receptors and pathways between the sources and receptors; and
- Recommendations for further investigations.

These results are compared against the most relevant guidelines available in 2012, as follows:

- NSW DEC (2006) *Guidelines for the NSW Site Auditor Scheme* (Second Edition);
- NSW EPA (1994) *Guidelines for Assessing Service Station Sites*; and
- NEPC (1999) *National Environmental Protection (Assessment of Site Contamination) Measure* (NEPM).

As the NEPM (1999) guidelines were updated in 2013, the 2012 soil results were re-assessed using the NEPM (2013) guidelines as part of Stage 2 Phase 2 investigation. Soil results from the 2012 investigation for all AECs compared against NEPM (2013) are included in **Appendix 1**.

The Phase 2 ESA identified ten areas of concern that require further evaluation, as follows:

- 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.

5.2 Capped Waste Stockpile

Following the Phase 2 ESA, the Capped Waste Stockpile was notified as potentially contaminated land to the NSW EPA under Section 60 of the *Contaminated Land Management Act 1997*. In response, the EPA requested further information regarding the contamination status of the notified area. Ramboll Environ completed an Environmental Site Assessment on the notified area in 2013, which included the following tasks:

- Review and collation of relevant historical information pertaining to the Capped Waste Stockpile and the surrounding leachate impact area;
- Field sampling of 14 groundwater monitoring wells;
- Completion of a pumping test to assess aquifer behaviour;
- Water quality sampling of 14 wells following pumping to assess variations in response to changes in the aquifer; and
- Completion of a report identifying known information, data gaps and recommendations for further investigations to address the data gaps.

The recommended further investigations were undertaken, including a Preliminary Screening Level human health risk assessment to identify guidelines for fluoride in soil and water at the site for human health; a Tier 2 ecological risk assessment to assess impact from leachate migration on the local ecology; delineation of the plume using a combination of existing data and further field investigations and commencement of a quarterly monitoring regime to monitor the leachate plume.

The following documents were prepared for the Capped Waste Stockpile, noting the groundwater monitoring is currently on-going:

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

Following submission of these reports to NSW EPA, the EPA advised that the notified area could be managed through Hydro's Environmental Protection Licence. A copy of the correspondence from NSW EPA is included in **Appendix 2**.

5.3 Ecological Risk Assessment

A Tier 2 Ecological Risk Assessment was completed in March 2013 (2013a) as there are no ecological assessment guidelines in Australia for fluoride and aluminium. The ecological risk assessment assessed surface water quality down gradient of the Capped Waste Stockpile and was to assess if impacts to the downgradient ecological receptors were occurring as a result of leachate migration. The ecological risk assessment included an assessment of surface water quality at locations upstream and downstream of the Project Site in relation to fluoride and aluminium. The ecological risk assessment identified that the fluoride and aluminium concentrations present at the Capped Waste Stockpile have not impacted on the aquatic species at the receptor point at Swamp Creek.

5.4 Health Risk Assessment

A Health Risk Assessment was completed in April 2013 (ENVIRON, 2013b) as there are no human health assessment guidelines in Australia for fluoride and aluminium. The human health risk assessment allowed for the development of site-specific preliminary guidelines for fluoride and aluminium concentrations in soils, groundwater and surface water at the Project Site.

5.5 Phase 1 ESA

A Phase 1 ESA was completed in October 2013 (ENVIRON, 2013c) to identify any potential areas of concern that were not identified in the high level review completed as part of the Stage 1 Phase 2 ESA. The Phase 1 ESA included the following tasks:

- A review of historical reports relating to land use and operations at the Project Site and Hydro Land to assess the potential for soil and groundwater or surface water contamination arising from historical and current uses;
- A review of published geological, hydrogeological and hydrological data associated with the Project Site and Hydro Land to establish the environmental setting and sensitivity;
- Detailed review of historical aerial photographs from 1951 (earliest available aerial photo), 1957, 1961, 1966, 1975, 1978, 1987, 1994, 2001, 2006 and 2013;
- Detailed site walkover;
- Interview with Hydro Environmental Manager Mr Kerry McNaughton; and
- Review of previous investigations undertaken by Ramboll Environ and others.

An Environmental Issues Register was developed for both the Project Site and Hydro Land, detailing the development on each deposited plan and potential environmental issues relating to the development.

The Phase 1 ESA did not complete a Dangerous Goods Database search. Hydro have maintained current records of all dangerous goods retained on site including those retained prior to ownership of the site by Hydro. In 2013 a review of these records, service plans, building plans and a detailed site inspection was completed. This information was documented in a Hazardous Materials Audit and Register, which is a live document maintained by Hydro. The register includes information on lead based paints; asbestos containing materials; synthetic mineral fibre; sumps; liquid wastes; dusts; transformers; fluorescent lighting and chemicals. The register will be used as a guide during demolition and remediation and will inform the validation program.

5.6 Stage 2 of the Phase 2 ESA

Stage 2 of the Phase 2 ESA was completed in January 2015. The objective of the Stage 2 investigations was to build upon the results of the Stage 1 investigations in understanding the potential for soil and groundwater contamination to impact on the Project Site for commercial/ industrial landuse.

Stage 2 comprised the following documents:

- *Sampling, Analysis and Quality Plan, Kurri Kurri Aluminium Smelter*, June 2014, ENVIRON
- *Phase 2 Environmental Site Assessment, Kurri Kurri Aluminium Smelter*, January 2015, ENVIRON

The scope of work for the Stage 2 investigations included the following:

- Review of previous investigations and identification of data gaps;
- Development of a Sampling, Analysis and Quality plan (SAQP);
- Soil sampling at five AECs identified from the Stage 1 investigations and five new PAECs;
- The installation of seven new groundwater wells at three of the AECs;
- Groundwater sampling of the seven new and seventeen existing wells;
- Laboratory analysis for soil and groundwater samples;
- Assessment of laboratory results against site criteria;
- Refinement of the conceptual site model (CSM);
- Identification of additional site investigation works to refine the CSM; and
- Assessment of areas requiring remediation.

The CSM assumed a future commercial/industrial landuse at the Project Site, and considered off-site receptors in the down-hydraulic gradient area. The following complete source-pathway-receptor linkages were identified in the CSM:

- Inhalation of dust generated from surface soil impacts by current and future on-site commercial/industrial adult employees;
- Direct contact with impacted soil and groundwater by current and future on-site intrusive maintenance workers;
- Direct contact with impacted sediment by current and future on-site commercial/industrial employees.

In order to further refine the CSM, a number of targeted investigations are required to be performed at the West Surge Pond, the Transformer Yard and Sub-Stations and a filled area East of the Clay Borrow Pit.

Based upon the source-pathway-receptor linkages identified in the refined CSM, remediation of surface soil and sediment at the following AECs is required:

- AEC 1: Capped Waste Stockpile: Whilst not identified to represent a risk to downgradient ecology, the ongoing migration of leachate from the stockpile and impacted soils beneath the stockpile may present an unacceptable risk to future development of the site for industrial land use. Remediation to reduce this risk is considered necessary;
- AEC 2: Anode Waste Pile: PAH contamination in surface soils to 0.2m bgs. Delineation and remediation of PAH hot spot at MW103;
- AEC 4: Diesel Spray Area: PAH contamination of fill material at 0.4m to 0.6m bgs. Delineation and remediation required;
- AEC 6: East Surge Pond and associated drainage line: PAH contamination of sediments;
- AEC 8: Carbon Plant: PAH contamination of shallow soils to 0.4m bgs in grassed areas and gardens beds at the western end of the Carbon Plant;
- AEC 26: Bake Furnace Scrubber: PAH contamination in shallow soils to 0.3m bgs in grassed areas below the scrubber duct work. Delineation of remediation of PAH hot spot at HA115; and
- AEC 28: Area east of the Playing Fields: Buried wastes to be remediated for aesthetic reasons. Delineation and remediation of PAH hot spot identified in south east corner at TP117.

The following AECs identified in the 2012 Stage 1 Phase 2 ESA were not considered to require remediation following further assessment in the 2014 Stage 2 Phase 2 ESA:

- 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.

Vertical delineation of the soil contamination at each AEC was completed as part of the Stage 2 Phase 2 investigations. The soil contamination identified was PAH (primarily benzo(a)pyrene) contamination in fill, which has not extended into the underlying alluvial sands and has not impacted groundwater. Lateral delineation of soil contamination has been completed to the extent practicable at this time given buildings, stockpiles, roads and services limit potential sampling locations. Lateral delineation of soil contamination and hotspots will be required at some AECs prior to remediation. Preliminary vertical delineation beneath the Capped Waste Stockpile indicates minor impacts to residual soils beneath the stockpile.

Soil results for each AEC are included in **Appendix 3**.

5.7 Remedial Action Work Plan for Clay Borrow Pit

The Clay Borrow Pit was assessed as an AEC in the Stage 1 Phase 2 ESA. Historical records indicate the Clay Borrow Pit was the source of clay materials for capping of the Capped Waste Stockpile located on the eastern side of the Project Site and undertaken in the 1990's. The resultant void was later filled with inert materials from the Smelter primarily comprising bake furnace refractory, concrete and asphalt. Filling reinstated the excavation to ground level. Subsequent filling resulted in above ground stockpiling of these smelter materials in this area. Soil and groundwater samples were analysed for total petroleum hydrocarbons, pesticides, heavy metals, fluoride, and a range of semi-volatile hydrocarbons including PAHs, and chlorinated hydrocarbons.

Sampling of the soil matrix identified potential contaminants either below detectable limits or below guideline concentrations. However, the presence of fill represents an impact on visual amenity and safety risk to the proposed future commercial and industrial landuses of the Project Site.

Evaluation of groundwater quality from within the in-filled borrow pit (MW05) found concentrations of fluoride (15,000 µg/L). The fluoride concentration, compared to a background concentration of 1000 µg/L in MW06, is considered to be elevated.

A Remedial Action Works Plan (RAWP) was completed by Ramboll Environ during December 2014 (2014b) in order to describe the works necessary to render the site suitable for the future commercial/industrial land use.

Remediation options were considered in terms of cost, risk of failure, long term legacy and onsite management, corporate responsibility and sustainability. The preferred strategy was excavation of the filled materials to remove all contaminant management requirements from The Clay Borrow Pit and reshaping of the resultant land surface. Excavated materials were proposed to be coarsely sorted and stockpiled in a designated area of the Smelter. Materials relocated to the Smelter will be stockpiled separately for later beneficial reuse where permissible, or incorporated within a whole-of-site remediation strategy.

The RAWP outlined the remedial plan to be implemented at the site to achieve the remediation objective. The RAWP included a detailed works methodology including validation requirements and environmental controls to be implemented during the works. Remediation was undertaken between March and August 2015. A Remediation and Validation Report has been completed for the Clay Borrow Pit and presents the successful remediation of the area.

5.8 Condition and Surrounding Environment

Table 5-1 provides a summary of the site conditions and surrounding environment. Further information is outlined in Phase 2 ESA (2012) and Stage 2 Phase 2 ESA (2015).

Table 5-1: Summary of Site Conditions and Surrounding Environment

Item	Description
Topography	The Project Site is located between low residual hills to the west and low lying swampy land to the north and east. The Smelter is relatively flat with a gentle slope from west to east, from the plant area towards the surrounding water courses in the east and northeast. Low lying areas were filled to create a flat, elevated platform at approximately 14m AHD for construction. The Project Site increases in elevation to the west in the vicinity of the Clay Borrow Pit, which is at an elevation of 25m AHD.
Boundary Conditions	The boundary of the Project Site is shown in Figure 2. The western, northern and southern boundaries are identifiable by roads or tracks, including the recently completed Hunter Expressway on the southern boundary of the Project Site. The majority of the eastern boundary is within bushland and is not easily identifiable on the ground.
Visible Signs of Contamination	During site visits conducted by Ramboll Environ 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. • Hydraulic oil on the floor of the Butt Crushing Plant.
Visible Signs of Plant Stress	During site visits conducted by Ramboll Environ throughout 2012, 2013 and 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**.
Presence of Drums, Wastes and Fill Material	Some 44 gallon drums of Castrol oil were observed by Ramboll Environ at the drum store in the eastern portion of the Project 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, where refractory bricks and concrete are stockpiled. A second anode waste pile was also observed 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 is noted that these stockpiles were recycled or disposed of and were not present during the 2014 investigations.
Odours	No odours were noted at the Smelter during the investigations conducted between 23 June and 2 July 2014. It is noted that the Smelter is no longer operational.

Table 5-1: Summary of Site Conditions and Surrounding Environment

Item	Description
Conditions of Buildings and Roads	Roads at the Project Site were noted to be in good condition during the investigations undertaken between 23 June and 2 July 2014. Since operations ceased in 2012 and the Smelter was put on a care and maintenance mode, rust has developed on the surface of scrubbers and other plant associated with the pot lines. Office buildings remain in good condition. The care and maintenance team maintain the condition of the buildings at the Project Site and additionally are commencing demolition of structures including removal of hazardous materials.
Quality of Surface Water	There are five storage ponds located at the Smelter as shown on Figure 3. Surface water from the Smelter is directed to these storage ponds via open channels and some concrete subsurface drainage lines. Surface water ponds known as 'East', 'West' and 'South' are pumped to two North dams where excess surface water is 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. Surface water quality at the East Surge Pond and North Dams are monitored and fluoride concentrations are elevated compared to background levels. This is likely due to flow from site sources such as the anode pile which was not covered for some time.
Flood Potential	The majority of the Project Site is located on low lying swampy ground that has been filled. Low lying areas of the Project Site remain susceptible to flooding. The western portion of the Project Site is located on ground at a higher elevation and not likely to flood.
Local Sensitive Environment	Sensitive environments including a two creeks and a wetland swamp are located in the vicinity of the Project Site. Swamp Creek is located approximately 400m to the south and east of the Project Site, flowing in a northerly direction. Swamp Creek flows north into Wentworth Swamp, a large wetland located approximately 1.6km north of the Project Site. Swamp Creek is the receptor for groundwater from the eastern portion of the Project Site. The location of Swamp Creek is shown on Figure 2. An unnamed creek passes through the Project Site between the Smelter site and the Clay Borrow Pit. This creek originally passed through the Smelter site and was relocated during Smelter construction. Black Waterholes Creek is located approximately 700m to the north of the Project Site, flowing in a northerly direction. Black Waterholes Creek flows north into the western portion of Wentworth Swamp. Black Waterholes Creek is the receptor for groundwater from the western portion of the Project Site.

5.9 Geology and Hydrogeology

Table 5-2 provides a summary of the site conditions and surrounding environment. Further information is outlined in Phase 2 ESA (2012) and Stage 2 Phase 2 ESA (2015).

Table 5-2: Summary of Geology and Hydrogeology

Item	Description
Geology	According to the review of the regional geology described on the Sydney Basin Geological Sheet, the Project Site and Hydro Land are underlain by siltstone, marl and minor sandstone from the Permian aged Rutherford Formation (Dalwood Group) in the Sydney Basin.
Location and Extent of Fill	The Smelter is located in low lying land that was filled to create a level area for the construction of the Smelter. The fill material is generally 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. A portion of the Project Site between the north-western fence line and the Clay Borrow Pit was also filled with material likely to include refractory bricks and concrete waste. This area was recently filled with excess Excavated Natural Material (ENM) from the construction of the Hunter Expressway immediately south of the Project Site. A classification of this material was completed by Environ (Classification for Stockpiled Soil, Grahams Lane, dated 8 April 2014) under the Excavated Natural Material Exemption 2012.
Borehole Logs	During the Phase 2 ESA, Ramboll Environ supervised the drilling of 52 boreholes across the Project Site. These boreholes extended to a maximum depth of 16m bgs. The subsurface conditions varied across the Project 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, Ramboll Environ supervised the installation of 21 monitoring wells at the Project 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 Table	Groundwater in the east of the Project Site was identified at shallow depths within the estuarine sands, between 1m and 5m bgs during the Phase 2 ESA. At the Clay Borrow Pit in the west of the Project Site, groundwater was identified within residual clay at depths ranging between 8m and 9m bgs.
Aquifers present	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 a number of licensed groundwater bores located within the shallow alluvium immediately east of the Project 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 3km from the Project Site.

Table 5-2: Summary of Geology and Hydrogeology

Item	Description
Direction and Rate of Groundwater Flow	During the Phase 2 ESA, groundwater was identified flowing north to north east across the Project Site. Douglas Partners (2002) measured permeability within the fill of 5x10**-6** m/s and in the sand of 8x10**-6** m/s. At the Clay Borrow Pit, groundwater is expected to be towards the north east following topography.
Direction of Surface Water Runoff	Stormwater water runoff is managed at the Project Site via a series of drainage channels and three surge ponds. Surge ponds discharge to the two North Dams, from which excess stormwater is spray irrigated over an adjacent paddock in accordance with EPL1548. There are no other surface water bodies located on the Project 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 Project Site. This well was installed in an up-gradient 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 (78µg/L) marginally exceeded the ANZECC (2000) hardness modified trigger value of 70µg/L.
Preferential Water Courses	The 1951 historical aerial photograph shows a former water course extending in a northeast/ southwest direction towards Wentworth Swamp in the west of the Project Site. It is understood this 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 is now an ephemeral unnamed creek situated on the sites western boundary.
Summary of Local Meteorology	Median, daily highest and lowest hourly average temperatures have been collected over the past 20 years. AECOM (2013) indicate that the 2012 temperatures were above average for summer days and nights. AECOM (2013) indicates annual rainfall in 2012 was 515mm, which is below the 20 year average of 619mm. AECOM (2013) indicates quarterly wind roses show the usual pattern of strongest winds from the northwest in winter, moderate winds from the south and southwest in spring and autumn and moderate to strong southeast winds in summer.

5.10 Nature and Extent of Soil Contamination

Ramboll Environ conducted a Phase 2 Environmental Site Assessment at the Project Site in 2012 followed by additional investigations in 2014 to delineate identified soil contamination and to assess areas that were previously inaccessible. These investigations identified all key contaminants at the Smelter site, including aluminium smelter-specific contaminants of fluoride, cyanide, aluminium and PAHs; contaminants associated with industrial sites including the use of petroleum hydrocarbons (mainly diesel), solvents, heavy metals in building materials and paints, transformer oils containing polychlorinated biphenyls (PCBs) and potential use of Aqueous Film Forming Foams (AFFF) fire water. These investigations also identified all key Areas of Concern (AECs) and Potential Areas of Concern (PAECs) across the Smelter site. The locations of all AECs and PAECs identified at the Smelter site are marked out in **Figure 16**.

The main AEC was the Capped Waste Stockpile, used to stockpile spent pot lining and other wastes associated with aluminium smelting, including cryolite, alumina, floor sweepings (alumina, cryolite and carbon), shot blast dust (carbon, steel shot), cement, potlining mix and small amounts of materials including plastics, wood, bonded and friable asbestos and steel. The spent pot lining has leached fluoride and cyanide into shallow groundwater beneath the Stockpile and a leachate plume has been identified extending approximately 300m from the north-east corner of the Stockpile.

Soil impacts identified at the Project Site are primarily associated with PAH impacts, in particular carcinogenic PAHs (Benzo(a)Pyrene Toxicity Equivalence Quotient (BaP TEQ). PAH impacts to soil were observed to be shallow, within the fill material and generally less than 0.6m below ground surface (bgs). PAH contamination is limited in vertical extent and has not impacted underlying natural soils.

Seven AECs were identified as requiring remediation due to PAH impacts in shallow surface soils. Each AEC and the associated contaminant concentrations are shown in **Table 5-3** and a summary of soil concentrations are shown in **Table 5-4**. Each sample location for each AEC are shown on **Figures 4 to 10**. Photographs of the AECs are included in **Appendix 5**.

One AEC, Area East of the Playing Fields, included aesthetic issues with fill material and buried wastes to a depth of 1.0m bgs.

Table 5-3: Summary of Site Soil Contamination

Site Activity	Site Area	Description	CoC	Sample Identification	Sample Concentration in excess of HIL 'D' [A] (mg/kg)	Sample Concentration in excess of EIL 'C/I' [B] (mg/kg)	Depth of Soil Impact (m bgs)
Waste stockpiling	Capped Waste Stockpile (AEC 1) **Figure 4**	Long term stockpiling of spent pot lining and other wastes.	Fluoride cyanide PAHs asbestos TPH/BTEX Heavy metals	NA	NA	NA	NA
	Anode Waste Pile (AEC 2) **Figure 5**	Long term stockpiling of 'ahead of schedule anodes' in low lying ground adjacent to the Capped Waste Stockpile.	BaP TEQ	MW12	56.9	--	0-0.4, fill extends to 0.9
				SB105	55	--	
				MW103	42	--	
				MW103	**250**	160	
Fill Importation	Diesel Spray Area (AEC 4) **Figure 6**	Likely that impacted fill material was used to level this portion of the site.	BaP TEQ	SB18	70.1	--	0.4-0.6
				MW19	**150.2**	101	
				SB112	55	--	
Site Operations	Carbon Plant (AEC 8) **Figure 7**	Impacts in the vicinity are likely due to the accumulation of dust from the Carbon Plant. Impacts in garden beds and grassed areas.	BaP TEQ	MW18	58.5	--	0-0.4
				HA107	**140**	98	
				HA107	**260**	180	
				HA110	82	--	
				HA111	75	--	
				HA111	67	--	
	Bake Furnace	Impacts associated with the accumulation of black sandy	BaP TEQ	HA115	**440**	230	>0.3

Table 5-3: Summary of Site Soil Contamination

Site Activity	Site Area	Description	CoC	Sample Identification	Sample Concentration in excess of HIL 'D' [A] (mg/kg)	Sample Concentration in excess of EIL 'C/I' [B] (mg/kg)	Depth of Soil Impact (m bgs)
	Scrubber (PAEC 26) **Figure 8**	material likely to be spilt Ring Furnace Reacted Alumina. Impacts to shallow surface soil beneath the scrubber duct work.		HA115	94	--	0-0.3
				HA116	90	--	
				HA117	**120**	--	
Burial of Waste	Area East of Playing Fields (PAEC 29) **Figure 9**	Waste materials, including concrete, refractory brick, metal sheeting, metal reinforcement, plastic sheeting, timber, fence posts, broken glass, electrical wire, steel posts and old cable.	BaP TEQ	TP117	**310**	220	0.5, fill extends to 1.6
Drainage	Drainage Lines (AEC 5) **Figure 10**	PAH contaminated sediments have accumulated in the drainage line adjacent to the Anode Waste Pile.	BaP TEQ	D6	149.6	85.6	0-0.3
				D7	96.3	--	
				D8	102	--	
	East Surge Pond (AEC 6) **Figure 10**	PAH contaminated sediments have accumulated within the East Surge Pond, which is immediately down gradient of the drainage lines near the Anode Waste Pile.	BaP TEQ	D11	56.2	**--**	0-0.2

NA Not Applicable - Soil sampling has not been undertaken at the Capped Waste Stockpile
A NEPM (2013) Health Investigation Level 'D' (Commercial/ Industrial) guideline value for Benzo(a)Pyrene TEQ = 40mg/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 = 72mg/kg
Results shown in bold are considered a 'hotspot' of contamination i.e. >2.5 times the guideline value.

Table 5-4 Summary of Soil Results

CoC	No. of Sample	Maximum Concentration (mg/kg)	Minimum Concentration (mg/kg)	Average Concentration (mg/kg)	No. exceeding Site Criteria	Criteria Exceeded (mg/kg)
AEC 2: Anode Waste Stockpile						
B(a)P	13	160	0.05	27.8	1	72 (EIL)
B(a)P TEQ	13	250	0.5	46.5	4	40 (HIL)
AEC 4: Diesel Spray Area						
B(a)P	13	101	0.5	15.8	1	72 (EIL)
B(a)P TEQ	13	150.2	0.5	24.3	3	40 (HIL)
AEC 8: Carbon Plant						
B(a)P	30	180	0.05	19.1	1	72 (EIL)
B(a)P TEQ	30	260	0.5	28	6	40 (HIL)
PAEC 26: Ring Furnace Scrubber						
BaP	16	230	0.26	26.3	1	72 (EIL)
BaP TEQ	16	440	0.5	50.1	4	40 (HIL)
PAEC 29: Area East of Playing Fields						
B(a)P	10	220	0.06	22.3	1	72 (EIL)
B(a)P TEQ	10	310	0.5	31.7	1	40 (HIL)
AEC5: Drainage Lines						
B(a)P	7	85.6	0.5	31.6	1	72 (EIL)
B(a)P TEQ	7	149.6	1.6	63.4	3	40 (HIL)
AEC 6: East Surge Pond						
B(a)P	4	21.7	0.9	12.9	0	72 (EIL)
B(a)P TEQ	4	56.1	1.9	28.7	1	40 (HIL)

5.11 Characterisation of the Capped Waste Stockpile

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* (2014). This evaluation has been completed in this section, and is discussed in **Section 8**.

5.11.1 Waste content

The following materials are understood to be contained within the Capped Waste Stockpile:

- 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;
- 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 asbestos); and
- General rubbish, including plastic, wood and steel.

With the exception of spent pot lining, the majority of these materials are associated with the Carbon Plant, which produced carbon anodes from liquid pitch and petroleum coke. The main chemicals of concern for these materials are Polycyclic Aromatic Hydrocarbons (PAHs). PAHs associated with pitch, coke and anodes have a low solubility in water and are unlikely to generate leachable concentrations.

Spent pot lining is a waste produced during aluminium smelting using the Hall-Heroult reduction process. The process of aluminium smelting takes place in electrolytic cells or pots. The pots consist of a steel container lined with refractory brick with an inner lining of carbon that protects the steel container against corrosion. The pot lining continuously uptakes electrolytic bath and other chemicals during its service life. Pot failure occurs when the molten bath and metal breach the carbon and refractory lining. When pot failure occurs, the spent pot lining, comprising refractory brick and carbon, is broken up and extracted from the steel shell for disposal.

The electrolytic bath, which the pot lining is in contact with, comprises cryolite (Na_3AlF_6) and other fluoride salts. Subsequently, the spent pot lining contains high concentrations of leachable fluoride and sodium. The spent pot lining also contains cyanide-forming materials.

The Materials Safety Data Sheet (MSDS) indicates that the composition of spent pot lining is typically as follows:

- 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%

For the Smelter, both first and second cut spent pot lining have been chemically characterised as shown in **Table 5-5**.

Table 5-5: Analysis of Spent Pot Lining

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
Phosphorous 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

5.11.2 Leachate

Leachate from the Capped Waste Stockpile impacts groundwater in a localised area. Dames and Moore (1992) presents the quality of leachate pond effluent within the Capped Waste Stockpile prior to capping to comprise:

Sodium	4800 to 15300mg/L
Fluoride	1100 to 3420 mg/L
Sulphate	4000 to 6740 mg/L
Total Cyanide	70 to 200 mg/L

Two leachate samples were collected on 3 and 4 June 2015 to evaluate concentrations in leachate at the toe of the mound, where leachate is intercepted by an active trench. Results are included in **Table 5-6.**

Table 5-6: Capped Waste Stockpile Leachate Concentrations (mg/L)

Chemical	TCLP1[1] Solid waste	TCLP2[1] Restricted Solid Waste	LT01 (3/6/2015)	LT02 (4/6/15)
pH (pH units)	--	--	9.7	9.7
Electrical Conductivity (µS/cm)	--	--	15,000	16,000
Aluminium	--	--	46	42
Iron	--	--	33	31
Fluoride	150	600	480	490
Total Cyanide	--[3]	--[3]	79	85
Mercury	0.2	0.8	<0.00005	<0.00005
Calcium	--	--	7	<5
Potassium	--	--	18	13
Sodium	--	--	5,600	5,600
Magnesium	--	--	3.6	2.4
Hydroxide Alkalinity as CaCO3	--	--	<5	<5
Bicarbonate Alkalinity as CaCO3	--	--	3,300	3,500
Carbonate Alkalinity as CaCO3	--	--	4,600	4,700
Total Alkalinity as CaCO3	--	--	7,900	8,200
Sulphate	--	--	1,900	2,000
Chloride	--	--	160	150
TRH C6-C10	N/A	N/A	<0.01	<0.01
TRH C10-40	N/A	N/A	<0.1	<0.1
BTEX	0.5[2]	2[2]	<0.002	<0.002
Benzo(a)pyrene	0.04	0.16	<0.001	<0.001
Total PAHs	N/A	N/A	<0.002	<0.002
PCBs	--	--	<0.002	<0.002

1. TCLP data taken from the NSWEPA Guidelines for Classifying Wastes, Table 2.
2. Guideline for Benzene provided.
3. Not relevant as Cyanide lower than CT1.

– No guideline

Leachate has additionally been monitored since 1992 in groundwater in the immediate vicinity of the site for fluoride. Concentrations are presented in **Figure 12** and show the concentration decline in the aquifer since capping in 1995.

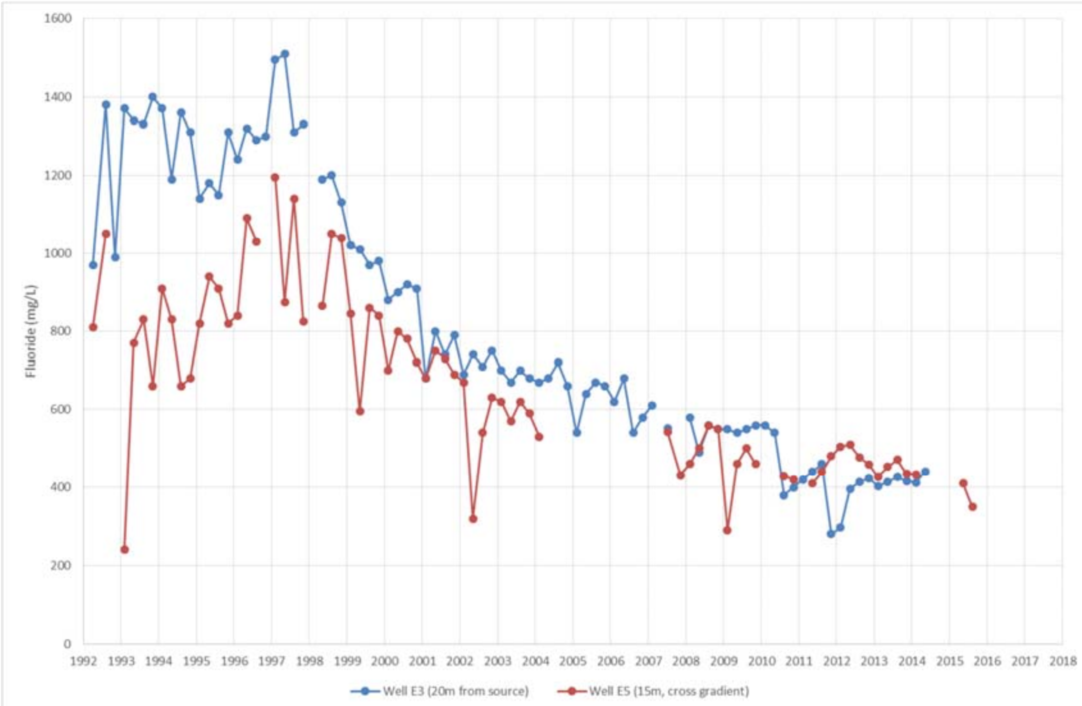


Figure 12 Fluoride concentrations in groundwater

5.11.3 Gas

The MSDS indicates that hazardous decomposition can occur with the interaction of spent pot lining with water, which creates ammonia, hydrogen and methane, and interaction with high temperatures or acids, which can release fluorides, hydrogen cyanide and oxides of sulphur.

Between 1969 and 1992, the process used to remove spent pot lining from a pot involved the use of water to soak the pot linings to cool the lining and minimise dust during demolition. The use of water also created a reaction between the sodium, carbides and nitrides in the spent pot lining to form sodium carbonate, hydrogen, methane and ammonia. Information from the *Environmental Impact Statement*, *Upgrades to Waste Storage Facilities at the Alcan Australia Limited Kurri Kurri Smelter* (Dames and Moore, 1992) indicates that the gas generation rate is initially rapid for the three major gases of ammonia, hydrogen and methane, with the liberation of hydrogen and methane ceasing within a matter of hours. Ammonia continues to be generated for a longer time period. Hydrogen fluoride is not produced and requires a high temperature heat source.

The use of water in the breakup of the pot linings, the subsequent storage in a stockpile open to rain water and the rapid gas generation rate suggests that the spent pot lining stored in the Capped Waste Stockpile is likely to have exhausted much of its flammable gas generation potential.

Gas monitoring has been undertaken from gas vents installed within the cap of the Capped Waste Stockpile since its construction in 1995. Gas sampling was initially completed three to four times per year between 1996 and 1998. No sampling was completed in 1999. From 2000, gas sampling was completed annually.

Gas samples were analysed at a NATA accredited laboratory for carbon dioxide, oxygen, methane, carbon monoxide, hydrogen and nitrogen. During the collection of gas samples, Kitagawa detection tubes were also used to collect samples for ammonia, phosphine/ arsine, hydrogen cyanide and hydrogen sulphide.

Methane peaked at 6.4% in February 1996, with methane varying between a maximum of 3.25% and 6.1% until November 1997. The maximum percentage of methane in 1998 was 2.3%, with maximum percentages declining to 0.21% in 2012. Methane concentrations over time in Standpipes 5 and 7 are presented in **Figure 13**, including comparison to the methane Lower Explosive Limit (LEL) of 5%. These two standpipes have the highest methane concentrations.

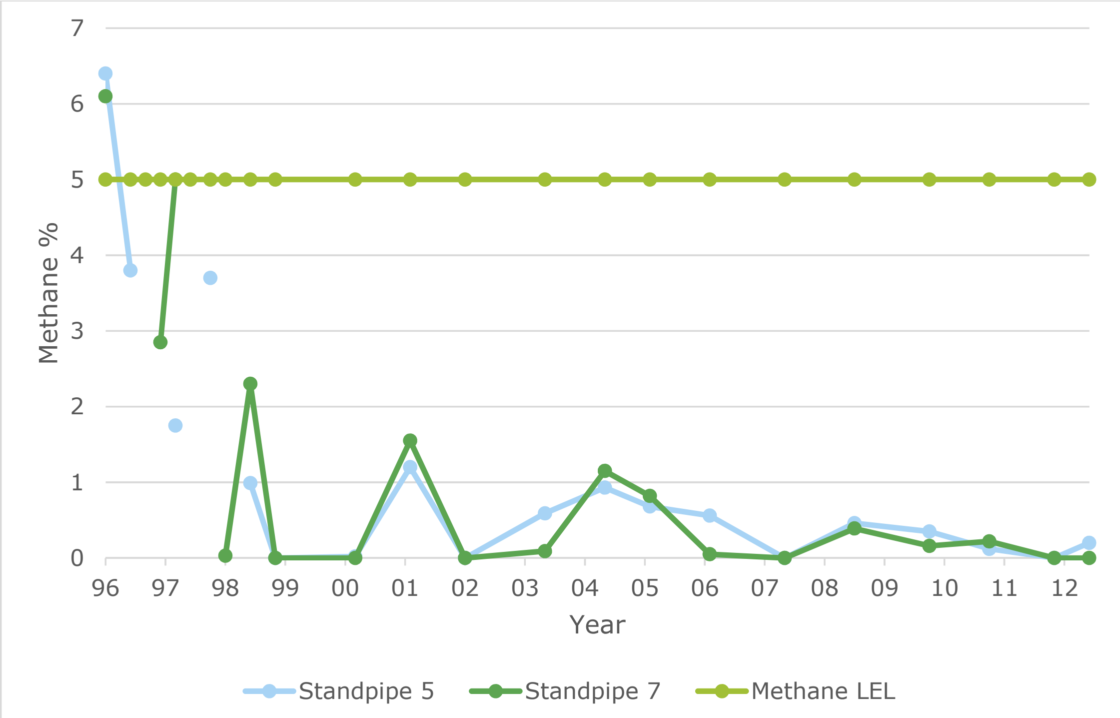


Figure 13 Methane concentrations over time

Ammonia results indicate ammonia generation occurred at low concentrations initially, followed by a period of higher concentrations in a number of standpipes between 2002 and 2007. Ammonia concentrations in other standpipes have increased recently. Results for Standpipes 1 and 4 are included in **Figure 14**, which show ammonia generation between 2000 and 2007 and between 2010 and 2012. **Figure 14** includes comparison to the ammonia Time Weighted Average (TWA) exposure of 25ppm for an 8 hour day.

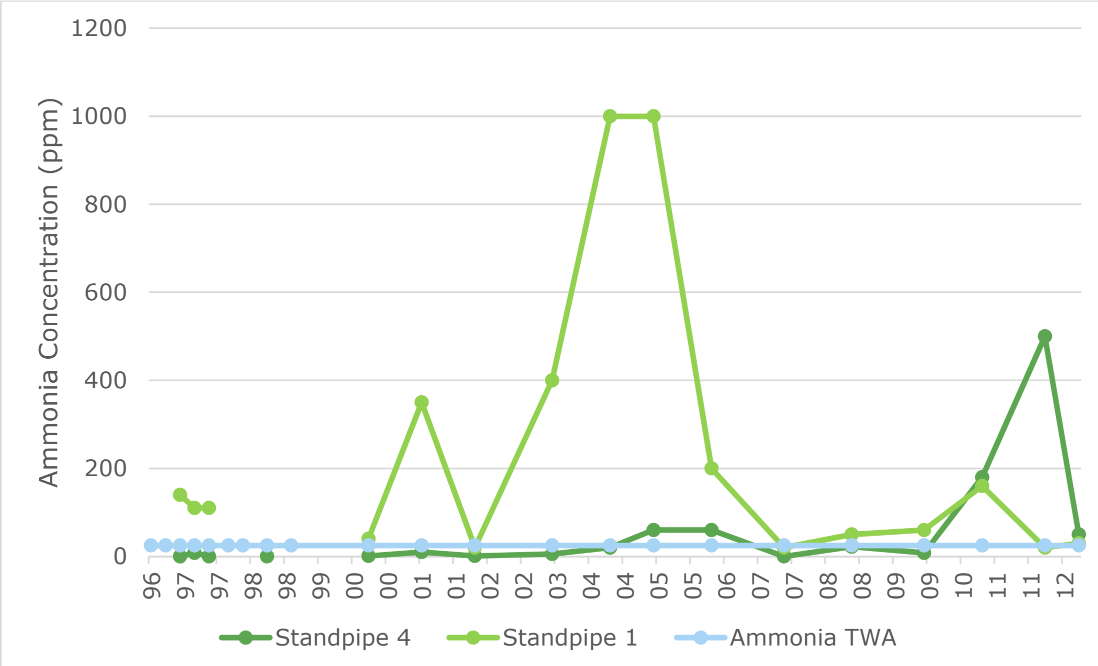


Figure 14 Ammonia concentrations over time

Phosphine/ arsine, hydrogen cyanide and hydrogen sulphide concentrations have not been recorded above the limit of detection since 1996. The hydrogen cyanide and hydrogen sulphide concentrations are as expected based on the information in the MSDS, which indicates release of these gases is only likely if the spent pot lining comes in to contact with high temperatures.

Maximum and average concentrations of these gases are presented in **Table 5-7**.

Table 5-7: Capped Waste Stockpile Gas Concentrations (ppm)

Chemical	Maximum Concentration (ppm)	Average Concentration (ppm)	LEL (ppm)
Ammonia	>800	55.6	150000
Phosphine / Arsine	<0.1	<0.1	18000
Hydrogen cyanide (HCN)	<1	<1	56000
Hydrogen sulfide (H2S)	<1	<1	40000
Hydrogen	2.3%	0.45%	4%
Methane	6.4%	0.67%	5%

5.11.4 Summary of preliminary waste classification

Following the NSWEPA Waste Classification Guidelines, Part 1: Classifying wastes, wastes are classified following a stepwise process.

Step 1 – Is the waste Special Waste?

The waste is known to contain asbestos in either bonded or friable form.

Where waste is characterised as special waste, but is mixed with restricted solid or hazardous waste, the waste must be classified as both special waste and restricted solid or hazardous (as applicable).

Step 2 – Is the waste Liquid Waste?

No, the waste does not met the definition of liquid waste.

Step 3 – Is the waste pre-classified?

Two commonly generated waste types are potentially included within the capped waste stockpiles. These have been discussed in **Table 5-8.**

Table 5-8: Capped Waste Stockpile Gas Concentrations (ppm)

Pre-classified Waste Type	Comment
"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";	Dangerous goods Class 4.3 material within capped waste stockpile is present. This includes aluminium dross, aluminium skimmings, spent cathodes, spent pot lining, and aluminium salt slags. These materials were disposed directly and not contained. Therefore there are no containers that previously contained Class 4.3 within 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"	Coal tar pitch is used in the making of anodes used in the smelting process. These anodes are heat treated prior to disposal. Some untreated pitch may be present in the capped waste stockpile, however these are expected to be very small amounts.

Step 4 – Does the waste possess hazardous characteristics?

The waste contains spent pot lining which is classified as a Dangerous Goods 4.3, UN code 3170 applying to aluminium smelting by-products. The definition of Dangerous Goods code 4.3 is substances 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 Dangerous Goods classification applies to aluminium smelter wastes within the Capped Waste Stockpile. Investigations indicate that the aluminium smelter waste has been weathered and/or 'pre-reacted' due to historical de-lining procedures and no longer emitting flammable gases at ignitable levels or in dangerous quantities. This is evidenced by **Figure 13** and **Figure 14**.

Despite exhibiting these characteristics, the Capped Waste Stockpile material still contains material that is classified as a Dangerous Good and therefore is pre-classified as a hazardous waste.

The waste contains aluminium smelter waste which is regulated under the *Environmental Hazardous Chemicals Act 1985*. The Chemical Control Order for Aluminium Smelter Wastes Containing Fluoride and/ or Cyanide requires cyanide and leachable concentrations to be below 150mg/L and 10mg/L before disposal. **Table 5-6** shows that the concentrations of these analytes in leachate exceed the Chemical Control Order requirements. The waste from the Capped Waste Stockpile placed in the Containment Cell would be regulated in accordance with a specific immobilised contaminants approval (as described in **Section 14**).

Step 5 determining a waste's classification using chemical assessment

Where wastes are not characterised by steps 1 to 4, chemical characterisation is required. The first component is to classify the waste using a contaminant threshold.

Table 5-5: Analysis of Spent Pot Lining

Table 5-5 shows that the fluoride concentrations are above the CT1 and CT2 values, meaning the waste does not meet the classification of solid or restricted solid waste.

Table 5-5 also shows that that the fluoride concentrations are above the SCC2 values, meaning the waste does not meet the classification of solid or restricted solid waste and would therefore be classified as hazardous on the basis of total fluoride concentrations.

Table 5-6 shows that fluoride concentrations in leachate from the capped waste stockpile are below the TCLP2 concentrations. Leachate concentrations from the toe drain are not directly comparable to the waste classification TCLP concentrations as the later are obtained using an acidic leach solution. As fluoride is more mobile at above neutral pH, an acidic leach solution will provide a less conservative assessment. The comparison is therefore considered valid for this purpose.

On the basis of the classification completed the waste is considered to be special and hazardous waste. Additionally, disposal of the waste without treatment is contrary to the requirements of the Chemical Control Order for Aluminium Smelter Wastes Containing Fluoride and/ or Cyanide. Treatment and agreement for disposal from the EPA is required prior to disposal.

5.12 Immobilisation

Methods of immobilisation were considered for the capped waste stockpile. Due to the presence of bonded and friable asbestos, treatment by chemical fixation and micro-encapsulation are not viable and has not been considered further. Application of an Immobilisation Approval to the EPA is required to allow landfilling of the Capped Waste Stockpile. This application is being prepared and a summary of the approach is in **Table 5-9.**

Table 5-9: Capped Waste Stockpile Gas Concentrations (ppm)

Immobilisation Method	Comment
Natural Immobilisation	PAHs are naturally immobilised due to the low solubility of the carbon source, and the heating undertaken on most carbon waste. The low solubility is supported by the absence of PAHs in leachate. Fluoride concentrations, whilst not naturally immobilised, are significantly reduced as a consequence of weathering. Leachable concentrations are below the TCLP2 criteria.
Chemical fixation	Not viable due to presence of asbestos
Micro-encapsulation	Not viable due to presence of asbestos
Macro-encapsulation	A suitable cell can be designed to manage elevated concentrations of fluoride. This option is considered the most appropriate for the capped waste stockpile as the presence of friable asbestos and chemical variability mean treatment is difficult to achieve and will require special handling health and safety precautions. World's best practice landfill design using proven multi-liner liner components will be utilised to provide the best possible containment. As the waste is non-putrescible, a cell can be designed to incorporate the waste with minimal leachate generation, thereby mitigating leachate impacts to the surrounding environment. Leak detection layers combined with leachate collection systems allow for collection and management of leachate. A water treatment system will be established on site to allow for leachate treatment, however if leachate volumes prove to be significantly reduced with time, as is the expectation, then a pump out system or similar may be adopted. The proposed cell location within the Clay Borrow Pit area of the site is situated within deep residual clays overlying tight massive bedrock.

Table 5-9: Capped Waste Stockpile Gas Concentrations (ppm)

Immobilisation Method	Comment
	Investigations show the depth to groundwater as 8 to 9m below ground surface. This site represents an ideal location for a containment cell providing a natural barrier in the event of liner breach. Waste is significantly reduced in reactivity as a consequence of weathering and a period of 20 years of previous containment. Gas venting will be incorporated however gas emissions of the existing containment area are recorded to be low and significant gas generation is not expected. The remediation requirements and Containment Cell design are further discussed further in **Section 8**.

5.13 Site-Wide Assessment of Groundwater

Groundwater beneath the Project Site was identified at shallow depths between 1m and 5mbgs within shallow sands. This aquifer is limited in extent and has a low yield. Groundwater has been impacted primarily due to the leaching of fluoride and aluminium from smelter materials into groundwater. Fluoride concentrations ranged between 0.22 and 43mg/L, and aluminium concentrations ranged between 0.08 and 13.6mg/L over two sampling rounds, excluding the leachate plume at the Capped Waste Stockpile.

Free cyanide was not detected above the laboratory detection limit, aside from a concentration of 7µg/L in a well at the Anode Waste Pile. As concentrations of free cyanide were below the site guidelines in the 2012 sampling round, further assessment of cyanide in groundwater was not considered to be required.

Low level hydrocarbons were detected in groundwater at the Carbon Plant and down gradient of the Refuelling Area. Further assessment found concentrations to be low and isolated.

Groundwater sampling has been undertaken at locations within the Smelter site that have the highest risk from contamination, including 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. Up-gradient and down-gradient locations have also been sampled, as well as other areas of the site such as. The concentrations identified in groundwater are considered to accurately represent the potential impacts to groundwater at the site and the groundwater conditions are considered to be adequately characterised.

Groundwater immediately down gradient of the Capped Waste Stockpile has been impacted by leachate generated from contact of wastes in the stockpile with shallow groundwater and from the infiltration of water through the Capped Waste Stockpile (prior to capping). The leachate plume is characterised by elevated fluoride, cyanide and sodium concentrations and by a high pH (>9). The leachate plume extends approximately 350m north-east of the eastern toe of the Capped Waste Stockpile. The extent of the leachate plume is limited by the geology of this area, with the leachate moving through coarse grained sand lenses surrounded by high plasticity clays. The leachate has not moved laterally or vertically through the high plasticity clays due to low porosity. The aquifer impacted by the leachate is close to the ground surface (0.3m to 2.5mbgs) within unconsolidated estuarine sediments, is ephemeral in nature and has a low yield.

5.14 Conceptual Site Model

A conceptual site model (CSM) is a site-specific qualitative description of the source(s) of contamination, the pathway(s) by which contaminants may migrate through the environmental media, and the populations (human or ecological) that may potentially be exposed. This relationship is commonly known as a Source-Pathway-Receptor (SPR) linkage. Where one or more elements of the SPR linkage are missing, the exposure pathway is considered to be incomplete and no further assessment is required.

The sources of contamination are outlined in **Table 5-3**.

5.15 Assessment of Exposure Routes and Potential Receptors

Human and ecological receptors are presented in **Table 5-10**, together with identified exposure routes from contaminated soil and sediment and groundwater in the context of future industrial/commercial use as well as the acknowledgement of down gradient receptors.

Table 5-10: Exposure Pathways Assessment

Pathways	Potentially Complete Source-Pathway-Receptor Link ? (Y/N)				Justification
	Current and future on-site employees (non-intrusive)	Current and future on-site Intrusive Maintenance and Construction Workers	Recreational users of Kurri Kurri Speedway	Hydro Land Ecological Receptors	
Shallow Surface Soil					
Dermal contact with soil and 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 – potenital 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 Hydro Land (ENVIRON, 2014c-l).
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	

Table 5-10: Exposure Pathways Assessment

Pathways	Potentially Complete Source-Pathway-Receptor Link ? (Y/N)				Justification
	Current and future on-site employees (non-intrusive)	Current and future on-site Intrusive Maintenance and Construction Workers	Recreational users of Kurri Kurri Speedway	Hydro Land Ecological Receptors	
Groundwater					
Dermal contact	N	Y	N	N	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 Hydro Land have not impacted on ecology at the downgradient receptor, Swamp Creek (ENVIRON, 2013a and 2013d). On this basis, concentrations of fluoride and aluminium in groundwater at the site are not considered to represent an ecological risk under tha current site use.
Incidental ingestion	N	Y	N	N	
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	

6. REMAINING CSM DATA GAPS

6.1 Soil

The data gaps that currently exist are limited to areas inaccessible during the previous investigations due to existing infrastructure or presence of water within drains and ponds. Following infrastructure removal, additional investigation works will be undertaken in areas beneath and in the immediate vicinity of areas not previously investigated.

The following AECs and PAECs require investigation in the future:

- AEC 15 West Surge Pond: Sampling of the sediment for soluble fluoride should be completed once the sediment is excavated and stockpiled.
- PAEC 27 Transformer Yard and Substations: The Transformer Yard and Substations are currently live and in use and cannot be assessed until they are isolated. Assessment of each substation for Polychlorinated Biphenyls (PCBs) and Total Petroleum Hydrocarbons (TPH) should be completed once safe to proceed.
- PAEC 30 Area East of the Clay Borrow Pit: The area has been covered with excess Virgin Excavated Natural Material (VENM) from the construction of the Hunter Expressway. Assessment of buried fill material in this area cannot be completed until the VENM has been removed.
- AEC 4 Diesel Spray Area: the lateral extent of contamination has not been completely defined due to the presence of subsurface utilities. Further investigations can be completed once safe to do so.
- AEC 2 Anode Waste Pile: the lateral and vertical extent of contamination has not been completely defined as anode waste remains stockpiled in this area. Further investigations can be completed once anode wastes have been removed.

6.2 Groundwater

As illustrated in **Table 5-10** groundwater beneath the Smelter site impacted with fluoride was identified as a concern for on-site maintenance and construction employees. Fluoride concentrations in groundwater (excluding the leachate plume) ranged between 0.22 and 43mg/L over two groundwater monitoring rounds, exceeding the (2013) site-specific preliminary screening criteria of 1.5mg/L for recreational use. As the screening criterion is for recreational use, a health risk assessment and derivation of site-specific criterion for fluoride for maintenance and construction employees is recommended.

The health risk assessment is recommended for groundwater beneath the Smelter site, excluding the leachate plume, which requires remediation and as discussed in the Remedial Action Plan. If the groundwater risk assessment indicates that the risk to on-site maintenance and construction employees is acceptable, then the soil remediation criteria are considered protective of human risks associated with groundwater.

An ecological risk assessment is also recommended in conjunction with the health risk assessment to assess the risk of fluoride and aluminium concentrations in groundwater to ecological receptors. The Ecological Risk Assessments (2013a and 2013d) undertaken did not identify an unacceptable risk, however the risk assessment should be broadened to assess impacts to all relevant receptors.

7. REMEDIAL OPTIONS

7.1 Remediation Goal

The goal of this remediation project is to render the Project Site suitable for commercial /industrial land use.

7.2 Extent of Remediation Required

Based on the surface and subsurface contamination identified in **Table 5-3**, remediation is required across these areas. The approximate remediation volume for each AEC is defined below in **Table 7-1**. The volume calculations were determined from an estimation of the lateral and vertical extent determined during site investigations, noting that further lateral delineation is necessary at some AECs. Tonnages were calculated from the anticipated bulk density as shown for each material present. There is inherent uncertainty in the volume estimates.

Table 7-1: Contaminated Soils Quantity Estimates

Type	Volume Estimate (m^3)			Bulk Density (T/m^3)	Mass estimates (T)	
		Range [1]			Range	
	Estimate	Low	High		Low	High
Capped Waste Stockpile (AEC1) including potentially impacted soils beneath the stockpile	159000	145000	206700	2	290000	413400
Anode Waste Pile (AEC 2)	1500	1370	1950	1.8	2470	3510
Area East of Playing Fields (PAEC 29)	7500	6820	9750	0.3-1.8	6820	9750
Carbon Plant (AEC 8)	940	860	1230	1.8	1548	2220
Bake Furnace Scrubber (PAEC 26)	510	470	670	1.8	850	1210
Diesel Spray Area (AEC 4)**2**	450	395	730	1.8	720	1320
Drainage Lines (AEC 5)	220	200	290	1.8	360	530
East Surge Pond (AEC 6)	2300	2100	2990	1.8	3780	5390
West surge pond (AEC 15)	2700	2460	3510	1.8	4430	6320
Area East of Clay Borrow Pit (PAEC 30)	2600	2370	3380	1.8	4270	6090
Transformer yard (PAEC 27)	15500	14100	20150	1.8	25380	36270

1. Low/high -10%, +30%
2. Low/high based on field observations

Additional volumes of contaminated material may be identified at the PAECs yet to be assessed due to access limitations, including the Transformer Yard and Substations, Area to the East of the Clay Borrow Pit and West Surge Pond.

Migration of contaminants vertically through the soil profile is not anticipated however validation of the natural materials within the exposed excavations will be required.

Remediation of the leachate and impacted groundwater within the Capped Waste Stockpile and within shallow natural underlying soils also forms part of the remediation requirements.

In general, **Table 7-1** is a preliminary guide to the extent of remediation required however remediation will be undertaken to the final satisfaction of the Principal or Principal's representative.

7.3 Remedial Options Assessment

Based on the site characterisation presented in **Table 7-1** a review of potential remediation options for the Project Site was undertaken in general accordance with the *Guidelines for the NSW Site Auditor Scheme* (2nd Edition) (DECC 2006). The remedial options assessment has been separated into soil contamination and groundwater contamination, where groundwater contamination is a secondary source comprising groundwater impacted by the Capped Waste Stockpile.

7.3.1 Review of Evaluation Criteria Definitions

Ramboll Environ and Hydro undertook a review of the evaluation criteria used in the original Remedial Options Study to determine if they accurately assess the option and the differences between alternatives. The following sections discuss how the definitions of the evaluation have been amended for the purpose of this review.

7.3.2 Approval Likelihood

Likelihood of approval was originally evaluated following a review of key legislation, regulations and policies. Other key regulations or policies are considered where it is critical to the approval of a particular option.

The likelihood of approval rating in this review also considers the potential for an extended approval process due to the project complexity of potential government agency issues and/or the need to modify the project to attain approval.

7.3.3 Legacy Management and Costs

Legacy costs are based on two key elements:

1. Long term management and monitoring activities.
2. Contingent events, such as a pollution event that may require a level of cell reconstruction.

Financial provisioning for long term management and monitoring costs is a requirement of the regulator. Financial provision can be in the form of a bond or trust or other financial instrument. At this stage the details of the provision are not finalised however it is expecting that the funding model adopted will need to meet the following objectives:

- Provide sufficient funding to cover the management and monitoring costs in perpetuity;
- Be attached to the property, rather than to the property owner;
- Be available only for the purpose of management and monitoring activities.

7.3.4 Risk Rating

The risk rating evaluates risks to the project during the undertaking of the physical works. Post completion risks are captured in the evaluation of legacy costs.

The risk rating is qualitative and evaluates potential risks to the project physical works following the Risk Rating calculation methodology described in **Figure 15**.

	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

7.3.5 Sustainability Analysis

The Sustainability Analysis definition has been reviewed and included a combination of quantitative and qualitative assessments for a range of environmental, social, climatic and cultural factors. **Table 7-2** identifies these factors and how they are assessed.

Table 7-2: Sustainability Factors

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
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.

Each of these factors was considered with equal weighting to generate an overall sustainability score (out of 35). Options with a greater overall sustainability have a lower score.

7.3.6 Project Time

Elements of each project that occur in series were summed to determine the overall project timeline.

7.3.7 Qualitative Assessment Summary

Whilst the above remedial options review was completed following both the qualitative and quantitative process outline above, only a summary of the qualitative review is presented in the following. Information regarding remedial costs and ongoing management costs is regarded as confidential information.

Table 7-3: Assessment of Remedial Options

Option	Description	Advantages	Disadvantages
SOIL			
1. Do Nothing	Leave contamination onsite without treatment	Cost effective solution. Only acceptable if a risk assessment for PAHs demonstrates that the concentrations present do not represent an unacceptable risk to human or ecological health. May not require an EMP registered with Council. Has a low carbon footprint compared to other options.	Does not address the aesthetic issues. Planning approval may be required. Impacts on land value and sale ability. Retains potential long term liability for Hydro.
2.Encapsulate in-situ	Encapsulation barriers could include surface filling, hardstands, roads and buildings. It has been assumed that the barrier is formed by the placement of 0.5m of clean soil over the contaminant footprint. Improvements to the Capped Waste Stockpile could be incorporated in-situ comprising a subsurface cut-off wall to control groundwater migration. The current cap surface has been shown to be effective.	Material remains in-situ and removes health and safety risks from excavation. Cost effective. Has a low carbon footprint compared to other options.	Requires long term management of disconnected land parcels and registration of an Environmental Management Plan with Council. May reduce property value. Exclusion of wastes may be required or preferred. (i.e. remove and dispose of these separately to landfill off site). Retains Capped Waste Stockpile in close proximity to a sensitive receptor and shallow groundwater.
3.Move to specifically designed landfill adjacent to the capped waste stockpile	The material would be placed in a cell adjacent and adjoining the capped waste stockpile.	Relocates long term management requirements to a centralised area. Improves land value for Project Site. Has a moderate carbon footprint compared to other options.	Remaining excavations need rehabilitation with clean fill. Environmental Management Plan with Council. Planning approval for disposal site will be required.
4.Encapsulate in purpose built containment cell	Encapsulation on site within a purpose built containment cell. This would involve excavation of contaminated soil, sorting and transfer to cell. Any municipal waste will be disposed offsite to a licensed waste facility.	Consolidation of all wastes and contaminated soils in one location, in a cell that includes segregated compartments Has a moderate carbon footprint compared to other options.	Liability associated with keeping material onsite

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.

7.4 Proposed Remediation Strategy

The disposal of site materials during decommissioning and demolition was also considered when evaluating remediation options. The preferred option identified for soil from **Table 7.3** is the relocation and consolidation of all contaminated soils and the contents of the Capped Waste Stockpile in one specifically designed Containment Cell. This option was considered most favourable when compared to other options in terms of cost, risk of failure, long term legacy and onsite management, corporate responsibility and sustainability.

The Containment Cell will be constructed at the location of the Clay Borrow Pit and will be constructed using best demonstrated available technology to contain contaminated soils and smelter wastes in perpetuity. The Clay Borrow Pit has been identified as a suitable location based on a Preliminary Containment Cell Study (ENVIRON 2013c) which evaluated possible cell locations. The site is situated more than three metres above the groundwater table level and within competent bedrock. The cell would be situated approximately 200m from the closest ephemeral surface water body.

A conceptual Containment Cell design is included in **Appendix 4** and details the components of the cell. The cell design comprises a base liner combining compacted clay and with high density polyethylene liners. Leachate drainage layers and leachate collection capability is included in the liner. Materials placed within the cell are not putrescible and therefore leachate generation is expected to be minimal.

The cell cap design comprises a liner system comprising clay and geosynthetic 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 is currently being prepared. The detailed design will be consistent with the performance standard of the concept design. The system will be designed to maximise infiltration reduction and 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 266,000 m^3 over an area of approximately six hectares. The cell is designed to accommodate additional volume (if required) by increasing height.

The preferred option identified for the leachate plume in groundwater at the Capped Waste Stockpile from **Table 7-3** is Option 6, a combination of leachate interception, source removal to the extent practicable and monitored natural attenuation. Leachate interception was employed in April 2014 with the installation of a leachate interception trench that collects leachate and pumps to the East Surge Pond. Source removal to the extent practicable will be achieved during the soil remediation works by the relocation 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 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.

Monitored natural attenuation will be achieved via physical processes, such as dispersion, diffusion and sorption. On-going monitoring will be used to determine the success of leachate interception and source removal as a remedial strategy for the leachate plume.

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 4.3mg/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 potential fluoride concentration at the nearest receptor.

7.5 Contingency Plan

Table 7-4 outlines the potential failure scenarios that could occur and the contingency mechanisms that will be implemented to achieve the overall remediation objective.

Table 7-4: Remediation Contingency Planning

Failure Scenario	Contingency Response
Increased volumes of contaminated material	Excavated materials will be managed onsite via a tracking system, controlled by the contract. The Containment Cell design allows for increased capacity by increasing the cell height. The detailed cell design will include a capacity for an additional 50% of estimate material.
All foreign materials cannot be excavated due to safety or other risks	While all efforts will be undertaken to remove identified wastes/contamination, if a situation arises where it becomes impractical to completely remove fill/soil to meet the remediation objectives, (e.g. physical constraints or safety), alternative strategies may be employed to justify leaving contamination in place (e.g. specific risk assessment and/ or long term management requirements). Such alternatives will not proceed without consultation and full written approval of Hydro.
Identification of Asbestos Containing Material (ACM)	In the event that ACM is identified during the remedial works, works in the vicinigty of the material will cease until such time as sufficient controls are put in place and remedial works are completed in accordance with NSW WorkCover the NSW *Work Health and Safety Act 2011* and the requirements of the NSW Occupational Health and Safety Commission (NOHSC) *Asbestos Code of Practice and Guidance Notes*. A visual inspection by a qualified person capable of undertaking and providing clearance inspections (Class A) will be undertaken to confirm that the location is free of visible ACM. All validation samples will be collected for asbestos in areas identified to contain asbestos at the rate defined in **Section 10.5**. These measures would be implemented through an Unexpected Hazardous Materials Protocol that would be developed as an appendix to the EMP.
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. Reactive materials within the Capped Waste Stockpile are a not expected however could occur. Prior to commencement of works a methodology for the treatment of potentially reactive materials will be developed and approved by the NSW EPA.
Treatment of leachate within the Capped Waste Stockpile is unable to remove visible signs of leachate	Evaluate the remaining concentrations and assess fate and transport to the receptor. Determine if the concentrations remaining represent a risk of harm and the requirement for long term management.
On-going monitoring indicates that concentrations of fluoride and cyanide in the leachate plume are not	Evalute the risk to receptors from the remaining concentrations. Identify suitable active remedial options, such as further interception, that would further intercept/remove fluoride and cyanide impacted groundwater. Investigate other possible options

Table 7-4: Remediation Contingency Planning

Failure Scenario	Contingency Response
reducing following source removal.	for treatment and/ or management e.g. long term restrictions to groundwater use through a long term management plan.

7.6 Interim Site Management Plan

The Project Site is located within the Hydro site boundaries and is not accessible to the public. On this basis, there is not considered to be a requirement for interim site management.

8. REMEDIAL ACTION PLAN

8.1 Preliminaries

The remedial works will be undertaken by an appropriately qualified and experienced Contractor with support from an appropriately qualified and experienced Contractor's Environmental Representative.

Prior to commencing works, the Remediation Contractor would provide a proposed remediation works methodology to the Principal for written approval. The methodology is to describe:

- Mobilisation and site facilities required;
- Methods of excavation, sorting, materials tracking and backfilling;
- Compaction specification for backfilled areas;
- Environmental control procedures consistent with the Works Environmental Management Plan (the EMP) (refer to **Section 10**), supporting specialist management plans and the RAP; and
- Quality control procedures that demonstrate how the requirements of the RAP, including validation, will be met and documented.

It should be noted that the remedial works form part of the activities at the Smelter defined as the "Works", which includes the following key activities:

- Demolition of remaining Smelter buildings (known as Stage 2 Demolition);
- Management of demolition waste, including temporary stockpiling before:
  - Processing for reuse on site (concrete and bricks);
  - Transportation off-site for recycling (scrap metal);
  - On site disposal of non-recyclable waste;
- Remediation activities (as described in this RAP);
- Construction of the Containment Cell;
- Placement of contaminated soils and non-recyclable wastes in the Containment Cell; and
- Leachate and groundwater treatment.

8.2 Site Establishment

The required personnel and plant are to be mobilised to site, define the boundaries of each area of concern and set up work controls including environmental and safety systems and controls in accordance with the Works EMP. These controls will include, but are not limited to:

- 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 (consistent with the Smelter Access Plan);
- Work area security fencing; and
- Implement stormwater runoff and sediment controls (consistent with the Works Soil and Water Management Plan).

8.3 Prior to Remediation Works

In order to allow access to areas previously not characterised due to access issues, all decommissioning and demolition works of existing infrastructure and associated services will be undertaken prior to remediation works. The areas that decommissioning and demolition works will provide access to are:

- AEC 15: West Surge Pond;
- PAEC 27: Substations;
- PAEC 30: Area East of the Clay Borrow Pit;
- AEC 4: Diesel Spray Area; and
- AEC 2: Anode Waste Pile.

8.3.1 West Surge Pond

Sediments in the West Surge Pond contained elevated concentrations of fluoride in the 2012 Phase 2 ESA. Total fluoride concentrations exceeded the criteria used during this investigation. Subsequently a site-specific criteria was developed in the 2013 Health Risk Assessment, which relates to soluble fluoride, the bio-available portion of this contaminant. Sediments from the West Surge Pond are to be excavated and stockpiled. Once the sediments have dried out, sampling shall be completed and analysis undertaken for soluble fluoride. Analytical results shall be compared against the site-specific criterion of 17,000mg/kg for commercial/ industrial landuse.

In the event that soluble fluoride concentrations are below the site-specific criteria, the sediments can be reused on the Project Site. In the event that the soluble fluoride concentrations exceed the site-specific criteria, the sediments shall be relocated to the Containment Cell.

8.3.2 Substations

There are 16 substations and one transformer yard at the Project Site. The substations are identified as:

- 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.

A Hazardous Materials Audit was completed on the transformer yard and substations in October 2014, which included the identification of bunds, pits, tanks and odours and surface staining. The information compiled in the Hazardous Materials Audit shall be used to inform the location of soil samples at the transformer yard and at each substation. Representative soil samples shall be collected and analysed for chemicals of concern associated with substations, such as petroleum hydrocarbons, polychlorinated biphenyls (PCBs) and PAHs.

Analytical results shall be compared against NEPM (2013) health investigation levels and ecological investigation levels. Where contamination is identified, the lateral and vertical extent shall be delineated and contaminated materials shall be excavated for relocation to the Containment Cell.

8.3.3 Area East of the Clay Borrow Pit

The Area East of the Clay Borrow Pit is currently covered by a stockpile of Excavated Natural Material (ENM) derived from the construction of the Hunter Expressway immediately south of the Project Site.

Access to this area will not be available until the ENM stockpile has been removed. Assessment of the potential for buried wastes should be completed via test pitting at this time.

8.3.4 Diesel Spray Area

The Diesel Spray Area is located in the central northern portion of the Project Site and intrusive investigations are currently limited by the location of buildings and underground services, including an 11kV power line.

Access to this area will not be available until the buildings have been removed and the underground services disabled. Delineation of the lateral extent of PAH contamination in fill at 0.5m bgs should be completed at this time.

8.3.5 Anode Waste Pile

The majority of the Anode Waste Pile is currently covered by ahead of schedule anodes and concrete slabs.

Access to this area will not be available until the remaining anodes and concrete slabs have been removed. Delineation of the lateral and vertical extent of shallow PAH contamination in surface fill material should be completed at this time.

8.4 Potential for Contamination due to Demolition

Decommissioning and demolition works will be completed concurrently with remediation. Demolition of the Smelter buildings has the potential to cause contamination to surface soils. Following demolition and prior to closure of the Containment Cell, a site walkover shall be conducted to identify any areas of the Project Site to validate these areas. The following observations should be recorded:

- Areas where staining is present;
- Areas where residues are present;
- Areas where asbestos containing material (ACM) fragments are present; and
- Areas where former sumps or pits were located.

Remediation via excavation and relocation to the Containment Cell may be required for stained areas or residues. Areas of former pits and sumps will be inspected for staining and soil surrounding the sump or pit remediation if required.

ACM fragments will be collected via hen picking for disposal at the Containment Cell. An asbestos management protocol is outlined in **Section 13.1**.

8.5 Survey

A survey of each contaminated area will be undertaken by a registered surveyor. The survey will involve:

- Pre-remediation survey on the surface of each AEC;
- Following excavation of contaminated soils, but prior to backfilling and completion of the remediation; and
- Post-remediation, following backfilling, topsoiling and landscaping or hardscaping.

The survey should be conducted such that a 3D model of each AEC can be located laterally and vertically on a registered survey plan, suitable for potential attachment to a land title.

This survey forms part of the validation requirements described in **Section 9**.

8.6 Remedial Methodology

In general, the remedial methodology is 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 the designated stockpile area or directly to the Containment Cell;
- Relocate contaminated soils from the stockpile area to the Containment Cell;
- Validate soils remaining at each AEC; and
- Where required, re-instate each AEC with validated crushed concrete or refractory brick to appropriate site levels.

Specific information for each AEC is provided below.

8.6.1 Capped Waste Stockpile

The extent of the Capped Waste Stockpile is shown in **Figure 4**. The Capped Waste Stockpile contains spent pot lining and other wastes associated with aluminium smelting which was capped with clay to prevent human contact and infiltration of precipitation in the mid-1990s. The capping from the Stockpile needs to be removed, with separation of the capping layers and stockpiling for later reuse. The capping layers include the following:

- 150mm vegetation layer: imported topsoil;
- 450mm drainage layer: imported clean river sand containing less than 10% fines and having a permeability of not less than $1x10^{-3}$cm/sec;
- 900mm hydraulic barrier: clay material obtained from the Clay Borrow Pit; and
- 150mm buffer/ gas control layer: imported, clean, unbound gravel containing less than 5% fines and having a permeability of less than $1x10^{-3}$cm/sec.

The capping layers will be removed in stages to minimise the surface area of waste exposed to rainfall. Once the capping layer is removed from a stage, the waste will be excavated directly to truck and removed to the Containment Cell. This removal will be undertaken following an excavation plan developed by the Contractor. The excavation plan would include details on:

- 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.
- Potentially recyclable (scrap metals) materials would be removed from materials by excavator (where possible) and transported to the Capped Waste Stockpile recyclable materials storage area. Materials that can be recycled would be stockpiled for cleaning (to the standard agreed with the off-site recycling facility). Cleaned materials would then be transported to the main stockpile area prior to transportation for recycling at an off-site facility.
- Material that cannot be recycled would be loaded into articulated trucks for transportation to the Containment Cell.
- 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 outlined in **Section 13.1** shall be followed.

Leachate within the Capped Waste Stockpile will be drained to a sump and treated through a water treatment plant established on site. The water treatment plant will be designed to treat water to a level suitable for discharge to site water management system. Treatment will continue until the contents of the Capped Waste Stockpile are removed from the area.

Impacts to natural soils beneath the Capped Waste Stockpile have occurred to depths of less than 1.0m below the waste/natural soil interface. Excavation of these soils for relocation to the Containment Cell will also be required. Treatment of groundwater from this excavation will also be undertaken by draining groundwater to a sump. Where groundwater within the excavation is treated (removed), remediation of groundwater will be considered complete.

8.6.2 Anode Waste Pile

The extent of the Anode Waste Pile is shown in **Figure 5.** PAH contamination was identified in surface soils, associated with the compaction of ahead-of-schedule anodes into fill material in this area. Carcinogenic PAHs were identified in one borehole MW103 at the mid-northern boundary of the Anode Waste Pile at a concentration more than 2.5 times the site criteria (considered to be a 'hot spot') at a depth of 0.3-0.4mbgl.

Shallow PAH contamination has not been adequately delineated vertically or laterally due to the presence of ahead of schedule anodes and concrete slabs. Additional delineation works are outlined in **Section 8.3.5**. Following delineation, surface soils are to be excavated and stockpiled for relocation to the Containment Cell.

8.6.3 Area East of Playing Field

Waste materials including concrete, refractory brick, metal sheeting, metal reinforcement, plastic sheeting, timber, fence posts, broken glass, electrical wire, steel posts and old cables have been buried to a depth of 1mbgl in the paddock east of the playing fields, as shown on **Figure 9**.

The dumped waste materials are to be excavated and sorted for disposal. Coarse high level sorting is to be conducted so that fill materials are sorted on both a size and composition basis. Coarser materials will be split in to:

- Concrete fragments;
- Broken/ whole refractory bricks;
- "other" including metal, plastic, timber and other inert materials; and
- Fine materials including soil and below a 'sortable' size, materials will necessarily be mixed and include soil-sized materials.

All materials will be transported to identified recycling areas, identified temporary storage areas, or directly to the Containment Cell.

Although the site assessment did not identify asbestos containing materials, a protocol detailing actions where unexpected materials (including ACM) are encountered during the excavation works is required.

Carcinogenic PAHs were identified in shallow soil (0.5mbgs) at test pit TP117 at a concentration more than 2.5 times the site criteria (considered to be a 'hot spot'). Test pit TP117 is located in the south-east corner of the paddock. Due to the presence of this 'hot spot', all soil that is sorted into the fine materials stockpile will be relocated to the Containment Cell.

8.6.4 Carbon Plant

The extent of the grassed areas and garden beds where surface soils have been impacted by PAHs at the western end of the Carbon Plant are shown in **Figure 7**. Surface soils to a depth of 0.3mbgs are to be excavated and stockpiled for relocation into the Containment Cell.

8.6.5 Bake Furnace Scrubber

The extent of grassed areas where surface soils have been impacted by PAHs at the Bake Furnace Scrubber are shown in **Figure 8**. Surface soils to a depth of 0.3mbgs are to be excavated and stockpiled for relocation into the Containment Cell.

Carcinogenic PAHs were identified in surface soil (0-0.1mbgs) at hand auger hole HA115 at a concentration more than 2.5 times the guideline (considered to be a 'hot spot'). The surface soils comprised black ash/ gravel material, likely to be spilt Ring Furnace Reacted Alumina, which contains unburnt coal tar pitch. This material was not vertically delineated during the previous investigations. Excavation works in the northern portion of grassed area should extend both vertically and laterally until all black ash/ gravel material has been removed.

8.6.6 Diesel Spray Area

Fill material at depths of 0.4m to 0.6mbgs has been impacted by PAHs. There is no visual indicator of the contamination within the fill material. The lateral extent of this contamination has not been delineated however will be delineated prior to commencing excavation works. The PAHs have not impacted underlying estuarine sediments.

The fill material is to be excavated and stockpiled prior to relocation to the Containment Cell.

8.6.7 Drainage Lines

The extent of sediments impacted by PAHs in the drainage lines associated with the East Surge Pond are shown on **Figure 7**. Sediments from these drainage lines are to be excavated and stockpiled for dewatering prior to relocation into the Containment Cell.

Sediments are to be stockpiled to allow retained water to drain to the site stormwater management system.

8.6.8 East Surge Pond

Sediments to a depth of 0.2m in the East Surge Pond have been impacted by PAHs. The East Surge Pond is to be drained, then surface sediment to a depth of 0.2m are to be scraped from the pond and stockpiled prior to relocation into the Containment Cell.

Sediments are to be stockpiled to allow retained water to drain to the site stormwater management system.

8.6.9 Materials Tracking

All materials excavated from each AEC shall be tracked from the AEC to the stockpile location within the Project Site. The Remediation Contractor shall implement a procedure that includes:

- 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; and
- 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.

8.6.10 Backfilling and Final Landform

AECs will be backfilled where required 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; and
- The finished landform shall comprise a surface layer that is acceptable to the Principal.

Materials such as crushed concrete and crushed brick validated as suitable for use on the site will be used. Use of these materials should be covered with soil or similar to remove any aesthetic impacts.

8.7 Remediation of Secondary Source, Groundwater - Capped Waste Stockpile

The remedial methodology for leachate impacted groundwater at the Capped Waste Stockpile is as follows:

- 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 within the residual clay soils and drain groundwater from residual soils during soil removal;
- Once the bulk of the leachate from beneath the Capped Waste Stockpile has been removed for treatment, backfill the sump and reinstate the ground surface as required for development;
- 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.

9. VALIDATION PLAN

Validation of the remediation works includes two primary components. Firstly, validation that all source zones have been effectively remediated. Secondly, validating that the cell is constructed in accordance with the design and that contaminated materials are appropriately placed.

Validation requirements for the construction of the Containment Cell will form part of the detailed Cell Design. Validation requirements will be described in a standalone validation specification that will form part of the technical specification for the Containment Cell Contractor. The Validation Specification will be review by the Site Auditor to ensure that the final validation report is sufficiently comprehensive to allow Site Auditor provision of a Part A Site Audit Statement. In development of the Containment Cell Validation Specification, the principles outlined below will be followed.

Information required to demonstrate that the source areas have been remediated is outlined in this sampling, analysis and quality plan (SAQP). Validation activities will be required at each AEC:

- AEC 1: Capped Waste Stockpile, including soil and leachate impacted groundwater;
- AEC 2: Anode Waste Pile;
- AEC 4: Diesel Spray Area;
- AEC 6: Drainage Lines;
- AEC 6: East Surge Pond;
- AEC 8: Carbon Plant;
- AEC 26: Bake Furnace Scrubber;
- AEC 28: Area East of the Playing Field.

In addition to the identified AECs, validation of areas following structure demolition will be required. These include sumps and drainage lines, transformers. Broad validation of the entire site will also be undertaken on a systematic grid following the completion of all demolition and remedial works. This will include the densely vegetated portion of the site in the west and south-west that has previously had limited assessment and those areas of the site between AECs and PAECs that have had limited assessment.

9.1 Validation Data Quality Objectives

In order to achieve the objectives and purpose of the validation program, both the field and laboratory programs must be representative of the actual extent of contamination in soil. As such, specific Data Quality Objectives (DQOs) have been developed for the validation of field and analytical data obtained during the remediation. The DQO process is a systemic, seven step process that defines the criteria that the validation sampling should satisfy in accordance with the requirements of DEC (2006) *Guidelines for the NSW Site Auditor Scheme* (2^{nd} Edition). The DQOs are as follows:

9.1.1 Step 1: State the Problem

The Project Site has historically been used as an aluminium smelter and is proposed to be redeveloped for commercial and industrial landuse. Previous investigations, as outlined in **Section 5**, have identified seven AECs that require remediation in order to make the Project site suitable for the proposed landuse. In addition, the demolition of the Smelter and temporary stockpiling of materials at the Project Site will require validation following completion.

Validation of demolition and remedial works is required to demonstrate that the identified health-based and environmental risks to future users of the Project Site have been adequately remediated to render the site suitable for the proposed development.

9.1.2 Step 2: Identify the Decisions

The validation SAQP is to ensure that all relevant contamination has been identified at each AEC and that remediation has been carried out successfully. To validate the effectiveness of the remediation strategy, validation sampling and analysis at each AEC is required. The site will be considered remediated when the remediation and validation program has been carried out successfully. Remediation is deemed to be successful when:

- 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 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 groundwater are below the remediation criteria; and
- Excavations have been reinstated with suitable materials to an accepted landform.

9.1.3 Step 3: Identify Inputs to the Decision

For each Area of Concern at the Project Site, the following inputs into the decision making process are required:

- A comprehensive evaluation of soil contaminant concentrations is required following remediation. It is proposed that the evaluation will comprise sampling and analysis as described in **Table 9-1**, **Table 9-2** and **Table 9-3**.
- Documented material tracking that demonstrates all materials have been appropriately relocated as described in **Section 7.1**.
- Final survey that demonstrates the landform has been reinstated to achieve the objectives of the final landform as described in **Section 7.1.**

9.1.4 Step 4: Define the Study Boundary

The Project Site boundaries have been outlined in **Figure 3** and defined in **Section 2**. The boundaries of each AEC are outlined in **Figures 4** to **10**. There is no temporal boundary to this project.

9.1.5 Step 5: Development of Decision Rules

The decision rules for the project will be as follows:

- 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.

9.1.6 Step 6: Specific Limits of Decision Error

Acceptable limits and the manner of addressing possible decision errors are outlined in the sections below:

Accuracy: Accuracy is defined as the nearness of a result to the true value, where all random errors have been statistically removed. Internal accuracy is measured using percent recovery '%R' and external accuracy is measured using the Relative Percent Difference '%RPD'.

Internal accuracy will be tested utilising:

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%.

Recovery data shall be categorised into one of the following control limits:

- 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; and
- <10 %R indicating that the data should be rejected.

External accuracy will be determined by the submission of interlaboratory duplicates at a frequency of 5%. Data will be analysed in accordance with the following control limits:

- 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 degree to which data generated from replicate or repetitive measurements differ from one another due to random errors. Precision is measured using the standard deviation 'SD' or Relative Percent Difference '%RPD'.

Internal precision will be determined by the undertaking of laboratory duplicates, where two sub samples from a submitted sample are analysed. These will be undertaken at a frequency of 10%. A RPD analysis is calculated and results compared to:

- 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.

External precision will be determined by the submission of intralaboratory duplicates at a frequency of 5%. The external duplicate samples are to be obtained by mixing and then splitting the primary sample to create two identical sub samples. Field duplicate samples are to be labelled with a unique identification that does not reveal the association between the primary and duplicate samples e.g., QA1.

It must be noted that significant variation in duplicate results is often observed (particularly for solid matrix samples) due to sample heterogeneity or concentrations reported near the Practical Quantification Limit (PQL).

Data will be analysed in accordance with the following control 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.

Blank samples will be submitted with the analytical samples and analysed for the contaminants of concern:

- Field Blank One per matrix type each batch samples/each day;

The laboratory will additionally undertake a method blank with each analytical batch of samples. 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 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.

Completeness: The completeness of the data set shall be judged as:

- The percentage of data retrieved from the field compared to the proposed scope of works. The acceptance criterion is 95%.
- The percentage of data regarded as acceptable based on the above data quality objectives. 95% of the retrieved data must be reliable.
- The reliability of data based on cumulative sub-standard performance of data quality objectives.

Where two or more data quality objectives indicate less reliability than what the acceptance criteria dictates, the data will be considered with uncertainty.

Representativeness: Sufficient samples must have been collected from the soil present at the site. This will be calculated for soil samples by Procedure B, NSWEPA Sampling Design Guidelines, 1995.

Samples must be collected and preserved in accordance with the sampling methodology proposed in Step 7 to ensure that the sample is representative of the assessed stratum.

Comparability: The data must show little to no inconsistencies with results and field observations and include likely associates e.g. TPH C6-C9 and BTEX.

Decision Error Protocol

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).
- 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.

Rectifying Non-conformances

If any of the validation procedures or criteria identified are not followed or met, this will constitute a non- conformance. The significance of the non-conformance will determine if rectification is required after discussion with the site auditor. In order to address any non-conformances, the Contractor's Environmental Consultant must assess the significance of each non-conformance and put their conclusion and recommendation to the auditor for approval.

9.1.7 Step 7: Optimise the Design for Obtaining Data – Soil Validation

All validation samples are to be collected in accordance with the DQOs outlined in this Section.

The sampling methodology for the site remediation work is outlined below.

The objective of the sampling pattern is to demonstrate that the adopted sample density and total number of samples collected is suitable for the proposed commercial/industrial land use. The excavations will be validated following removal of the materials and potential contaminants of concern.

Validation samples, frequency of collection, the analysis required, and justification presented in **Table 9-1** for the Capped Waste Stockpile and **Table 9-2** in for the remaining AECs. **Table 9-3** outlines the validation requirements for the remainder of the Project Site.

Table 9-1: Validation of the Capped Waste Stockpile

Validation Method	Validation Requirements	Chemical Analysis
Visual validation - soil	Visual documentation of the removal of all waste materials will be completed at the Capped Waste Stockpile. Excavations are to be photographed showing the complete removal of all buried waste materials. A photographic log shall be maintained and included in the Validation Report.	NA

Table 9-1: Validation of the Capped Waste Stockpile

Validation Method	Validation Requirements	Chemical Analysis
Chemical validation - soil	Sampling and analysis to demonstrate the removal of wastes. The walls and base of the Capped Waste Stockpile excavation shall be sampled as follows: • Excavated Base: Sampling across each area is to be undertaken on 30m grid spacing. This sampling program is in accordance with NSW EPA (1995) *Sampling Design Guidelines*. • Excavation Walls: One sample for each soil type present within the face of the excavation per 10 lineal metres.	Fluoride, cyanide, PAHs, TRH, BTEX, Heavy Metals, Asbestos (if encountered during excavation works)
	Sampling and analysis of capping soils to demonstrate suitability for reuse will be undertaken from soil stockpiles. Samples will be collected at rates of: • 1 per 1000m3. This rate is based on the low likelihood of contamination of the capping soils, which are high plasticity clays excavated from the Clay Borrow Pit. A statistical analysis of the data set will be undertake to assess data set variability and determine if additional sampling is required to further evaluate contaminant concentration.	Fluoride, cyanide, PAHs, TRH, BTEX, Heavy Metals, Asbestos (if encountered during excavation works)
Visual validation – leachate impacted groundwater	Leachate impacted groundwater is readily identified by brown staining. Leachate will be removed from the footprint of the Capped Waste Stockpile until it is no longer visually observed to be present.	
Chemical validation – leachate impacted groundwater	Validation that source removal (excavation of stockpiled wastes and contaminated soil) and secondary removal (extraction and treatment of leachate within the shallow residual soil profile of the Capped Waste Stockpile footprint) has been successful in reducing fluoride and cyanide concentrations within the down gradient plume will be completed via at least 2 years of quarterly monitoring of those wells required to be monitored under the EPL. In the event that fluoride and cyanide concentrations in the down gradient plume have not reduced following 2 years of monitoring, the contingency plan in **Table 7.3** will be enacted.	Fluoride, cyanide, aluminium, pH

Table 9-2: Validation of Remaining AECs

Validation Method	Validation Requirements	Chemical Analysis
Visual validation: Area East of Playing Fields	Visual documentation of the removal of all waste materials will be completed at the Area East of the Playing Fields. Excavations are to be photographed showing the complete removal of all buried waste materials. A photographic log shall be maintained and included in the Validation Report.	NA
Chemical validation: **Anode Waste Pile** **Carbon Plant** **Diesel Spray Area** **Bake Furnace Scrubber** **East Surge Pond** **Area East of Playing Fields**	Sampling and analysis to demonstrate the removal of wastes. The walls and base of the excavations shall be sampled as follows: • Excavated Base: Sampling across each area is to be undertaken on 30m grid spacing. This sampling program is in accordance with NSW EPA (1995) Sampling Design Guidelines. • Excavation Walls: One sample for each soil type present within the face of the excavation per 10 lineal metres. This sampling density is considered sufficient to confirm the absence of a contaminant hot spot greater than 5m in diameter.	PAHs

Table 9-3: Validation of Stockpiling and Demolition Areas

Validation Method	Validation Requirements	Chemical Analysis
Demolition areas	Potential impacts to ground may occur during demolition. Such activities are: • Dust deposition; and • Subsurface sump and tank removal.	Identified contaminants of concern based on source information.
Stockpile areas	Materials, including waste materials, may be temporarily stockpiled on site prior to placement in the Containment Cell. Validation of these areas following removal of the materials will be required. Validation will include both visual assessment and chemical evaluation of surface soils. Surface soil sampling across each area is to be undertaken on 30m grid spacing. This sampling program is in accordance with NSW EPA (1995) Sampling Design Guidelines.	Identified contaminants of concern based on stockpile contents.

Validation of the entire Smelter site following all demolition and remedial activities will be undertaken by sampling the surface of the Smelter site on a systematic grid, with analysis for PAHs.

- The sampling density is dependent on the homogeneity of the soil material sampled. All surfaces to be validated will be inspected visually before sampling and a determination of variability of the media will be made. Should the visual inspection show significant variability, an increased sampling density will be determined and a justification will be outlined within the Validation Report.
- 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 30m grid formation across the area to ensure that an even coverage of the excavation base 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 0.2m, discrete sampling will be undertaken from each soil type present every 10 lineal metres.

Contingency for validation sampling:

- 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).
- 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 30m 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 0.2m, 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 0.2m, 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.

9.1.7.1 Imported Fill Sampling

Any imported fill that is proposed to be brought to the site during the remediation project is to be VENM or ENM. The history of the source site and accompanying laboratory certification must show that the site has not been previously contaminated and a visual inspection of the source material is to be conducted. VENM material must be accompanied by a VENM certificate as outlined by the EPA. Refer to http://www.epa.nsw.gov.au/wr/venm.htm.

Imported ENM is to meet the criteria outlined in the ENM exemption issued under the Protection of the Environment Operations (Waste) Regulation 2005 – General Exemption Under Part 6, Clause 51 and 51A, The excavated natural material exemption 2012.

9.2 Soil Validation Criteria

9.2.1 Contaminants of Concern

Contaminants of Concern (CoCs) are those contaminants that have been found to be present in soil and sediments at the Project Site at concentrations which exceed the adopted screening criteria:

- Polycyclic Aromatic Hydrocarbons (PAHs).

Intrusive investigations have not been undertaken at the Capped Waste Stockpile. Contaminants of Concern at the Capped Waste Stockpile are known to include the following:

- Fluoride and cyanide.
- Other potential contaminants of concern include:
  - PAHs, TRH, BTEX, heavy metals and asbestos.

9.2.2 Soil Criteria

The guidelines proposed as remediation acceptance criteria at the Project Site are sourced from the following references:

- NEPC (1999) National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1) (NEPM).

The variation to the National Environmental Protection (Assessment of Site Contamination) Measure (NEPM 2013) was approved on 19 June 2013 by the NSWEPA under the *Contaminated Land Management Act 1997*. NEPM (2013) provide revised health-based soil investigation levels (HILs) and ecological-based investigation levels (EILs) for various land uses.

The remediation acceptance criteria adopted for the Project Site from the NEPM are 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 2m of soil.

NEPM (2013) do not provide criteria for fluoride and aluminium in soils in Australia. Therefore, Ramboll Environ (2013) conducted a preliminary level Human Health Risk Assessment (HRA) specific to fluoride and aluminium in order to derive a specific preliminary screening level for fluoride for the Hydro Aluminium Kurri Kurri Smelter. The screening levels are protective of the range of human receptors.

The applicable remediation assessment criteria for heavy metals and PAHs in soil are presented in **Table 9-4**.

Table 9-4: Remediation Assessment Criteria (mg/kg) – Health and Ecological Investigation Levels

Analyte	HIL D	EIL
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 (7.26meq/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)
[3] 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).

The applicable remediation assessment criteria for petroleum hydrocarbons in soil are presented in **Table 9-5** and **Table 9-6**.

Table 9-5: Soil Assessment Criteria for Vapour Intrusion - HSL D (mg/kg) - Sand

Analyte	0 to <1m	1m to <2m	2m to <4m	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 C6-C10 fraction.

[4] To obtain F2 subtract naphthalene from the >C10-C16 fraction.

Table 9-6: ESLs and Management Limits for Petroleum Hydrocarbons in Soil

TPH fraction	Soil texture	ESLs (mg/kg dry soil) Commercial and Industrial	Management Limits[1] (mg/kg dry soil) Commercial and 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	725	-

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)

NEPM (2013) includes a low reliability ecological screening criterion for benzo(a)pyrene of 1.4mg/kg for commercial/industrial land use. This criterion has been adopted from Environment Canada (1999) benzo(a)pyrene soil quality guideline, which is based on toxicity data for a single invertebrate species (an earthworm). Environment Canada revised their benzo(a)pyrene soil quality guideline in 2010 using the Species Sensitivity Distribution method, which is the preferred method for the derivation of ecological investigation levels and can only be used where sufficient toxicity data are available that adhere to rigorous quality control requirements. Ramboll Environ has elected to use the revised Environment Canada soil quality guideline of 72mg/kg, for commercial/industrial land use, as the most relevant ecological investigation level for benzo(a)pyrene at the Project Site as this guideline has been derived from a larger and more up-to-date toxicity database than the NEPM (2013) low reliability criterion.

Consistent with the guidance provided in the NEPM, the data will be assessed against the above adopted site guidelines by:

- Comparing individual concentrations against the relevant guidelines and if discrete samples are in excess of the relevant guideline then;
- Comparing the 95% upper confidence limit of mean against the relevant guideline also ensuring that:
  - the standard deviation of the results is less than 50% of the relevant investigation or screening level; and
  - no single value exceeds 250% of the relevant investigation or screening level.

9.3 Groundwater and Surface Water Validation Criteria

9.3.1 Contaminants of Concern

Contaminants of Concern (CoCs) are those contaminants that have been found to be present in groundwater in the vicinity of the Capped Waste Stockpile:

- Cyanide.
- Fluoride.
- Sodium.
- Elevated pH.

9.3.2 Groundwater Criteria

The guidelines proposed for the assessment of groundwater contamination at the Capped Waste Stockpile are sourced from the following references:

- 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 (March 2013) Tier 2 Ecological Risk Assessment, Kurri Kurri Aluminium Smelter.

9.3.2.1 Potential Beneficial Uses

NSW DEC (2007) indicates that for assessing groundwater quality, it is first necessary to assess the beneficial uses of groundwater and surface water down gradient of the site.

The closest surface water receptor to the site is a dam and then Swamp Creek located approximately 1.5km to the north-east of the site within an area of the buffer zone used for farming. This drainage area discharges into Wentworth Swamp, which in turn discharges to the Hunter River approximately 15km north-east of the site near Maitland.

Surface water within Swamp Creek is described generally neutral, ranging between pH 7.0 and 7.8 and conductivity was generally fresh, ranging from 626μS/cm to 1520μS/cm. This surface water body is considered to be a fresh water receptor and supports the following beneficial uses:

- Fresh water aquatic ecosystems;
- Recreational fishing;
- Possible stock watering and/ or irrigation.

It is noted that drinking water has not been included as a potential beneficial use of water from Swamp Creek for the following reasons:

- Drinking water supply to the local communities is reticulated and originates from Chichester Dam on the Chichester River;
- The Kurri Waste Water Treatment Works is located up gradient of the site. The works has a licensed discharge point into Swamp Creek.

Groundwater is expected to follow the topography and flow north-east towards the dam and Swamp Creek. Water level gauging completed during previous investigations confirmed the groundwater flow direction to the north-east.

According to the Office of Industry and Investment, NSW, there are 17 licensed groundwater abstractions (bores) located within the Smelter site, which are known to be associated with monitoring of groundwater impact at the Capped Waste Stockpile. There are no other licensed groundwater bores within 2km of the site.

The shallow estuarine aquifer beneath the Smelter site is ephemeral in nature with a low yield and as such, this aquifer is not viable for beneficial uses such as drinking water, stock watering or irrigation.

9.3.2.2 Appropriate Criteria for Groundwater

The review of potential beneficial uses of the shallow estuarine groundwater aquifer did not identify any potential beneficial uses. As such, validation criteria for demonstrating successful source removal (excavation of stockpiled wastes and contaminated soil) and secondary removal (extraction and treatment of leachate within the footprint of the Capped Waste Stockpile) will be as follows:

- Trend analysis following a minimum of 2 years of quarterly monitoring of those wells required to be monitored under the EPL. Wells to show stable or reducing trends in the concentrations of fluoride, cyanide and pH.

9.3.2.3 Appropriate Criteria for Surface Water

Based on the review of potential beneficial uses of surface water within the closest receptor, the criteria for protection of aquatic ecosystems, irrigation, stock watering and recreational use will be used for evaluating surface water quality.

The investigation levels presented in ANZECC and ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality are considered applicable for the protection of aquatic ecosystems of receiving waters. ANZECC (2000) advocates a site-specific approach to developing guideline trigger values based on such factors as local biological affects data and the current levels of disturbance of the ecosystem. The guidelines present 'low risk trigger values' which are defined as concentrations of key performance parameters below which there is a low risk of adverse biological effects. If these trigger values are exceeded, then further action is required which may include further site-specific investigations to assess potential contamination or management and remedial actions.

Low risk trigger values are presented in Table 3.4.1 of ANZECC (2000) for the protection of 80-99% of species in fresh and marine waters, with trigger values depending on the health of the receiving waters.

Surface water results will be compared against trigger values for the protection of 95% of freshwater species. A 95% protection of fresh water species was selected due to the indication from the Hunter Catchment Management Trust that declining stream water quality and a reduction in diversity of native plants and animals has occurred in the last ten years.

A summary of the remediation acceptance criteria for surface water are provided in **Table 9-7**.

Table 9-7: Surface Water Assessment Criteria (mg/L).

Contaminant	95% Protection for Aquatic 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

9.4 Validation Reporting

At the completion of the remediation and validation works, a Validation Report will be prepared in general accordance with the relevant sections of NSW OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites*. The Validation Report will include:

- 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.

The Validation report will be prepared in accordance with the NSWEPA Guidelines for Consultants Reporting on Contaminated Sites (NSWEPA 1997) and the Department of Environment and Conservation Guidelines for the NSW Site Auditor Scheme 2nd Edition (DEC 2006).

10. WORKS ENVIRONMENTAL MANAGEMENT PLAN

10.1 Works Environmental Management Plan

The contractor is to prepare a Works Environmental Management Plan (EMP) consistent with the "Guideline for the Preparation of Environmental Management Plans" (NSW Department of Infrastructure, Planning and Natural Resources, 2004). The EMP is to include the controls presented in **Sections 10.2** to **10.11.**

10.2 Site Access

During remediation works access to the site is to be strictly controlled by the Contractor. The contractor should include signage at the entry to the work area identifying the nature of the works, the contractor details and the Remediation Project Manager's details.

Only authorized persons who have been inducted into the safety and environmental controls on the site will be permitted to work on the site. Visitors to the site will be accompanied by such inducted personnel.

Vehicle access to the site will be along established access roads where possible.

If the construction of additional access tracks is required, these shall be detailed for approval from the Principal's Representative prior to commencement of any construction works.

10.3 Hours of Operation

The Contractor shall only undertake works associated with the Project that may generate an audible noise at the closest residential receptor during the following hours unless under direction from a relevant authority for safety reasons or in the event of an emergency:

- 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.

10.4 Air Controls

10.4.1 Dust Control

Dust emissions shall be managed to avoid dust generation that could impact on a sensitive receiver. The CEMP is to identify the dust control measures the contractor will implement to meet this objective.

The following dust control procedures would be implemented:

- Securely covering all loads entering or exiting the site.
- Use of water carts on unsealed roads, parking and other trafficable areas.
- Control of dust from all stockpiles by water sprays.
- All vehicles to travel on designated access roads.
- Temporarily ceasing an activity that generates dust that could affect a sensitive receiver.

10.4.2 Odour

Given the nature and extent of the stockpiled and buried fill identified at the site, there is a low potential for odours to be emitted.

Should a complaint be received by the Remediation Project Manager regarding odour, the source of the odour is to be located and appropriate control measures identified and implemented.

Control measures could include:

- Use of appropriate covering techniques such as the use of plastic sheeting to cover specific excavation faces or stockpiles.
- Use of fine mist sprays.

- Any equipment and machinery used on site need to have been maintained in accordance with manufacturers' requirements to minimise exhaust emissions.

Records of odours and control measures (if required) shall be kept by the Remediation Project Manager.

10.5 Noise Control

The remediation works shall comply with the "Interim Construction Noise Guideline" (DECCW, 2009). This would include remediation works being restricted to the hours described in **Section 10.3**.

The CEMP is to identify the noise control measures the contractor will implement to comply with the guideline. The following noise control measures should be considered:

- Construction vehicles and machinery would be selected with consideration of noise emissions. Equipment should be fitted with appropriate silencers (where applicable) and be maintained in accordance with manufacturer's requirements. Machines found to produce excessive noise compared to typical noise levels should be removed and replaced, or repaired or modified prior to recommencing works.
- Where possible construction vehicles and machinery would be turned off or throttled down when not in use.
- All site staff would be informed of their obligations to minimise potential noise impacts on residents during the site induction and the need to take reasonable and practical measures to minimise noise.

10.6 Erosion and Sediment Control

The CEMP is to include erosion and sediment control measures consistent with Managing Urban Stormwater: Soils and Construction (4th Ed) (Landcom, 2004).

The erosion and sediment control plan is to be prepared and implemented for the Clay Borrow Pit works area and the Project Site stockpile location.

The following erosion and sediment control measures should be considered:

- Installation of silt fences in drainage channels downgradient of the remediation work areas and any stockpile areas.
- Any material which is collected at the silt fences (or other sediment control measures) should be managed with the soil component of the excavated fill material.

Once a week and following rain events the sediment control measures would be inspected and maintained as required.

10.7 Surface Water and Groundwater Control

10.7.1.1 Surface water

Contaminants in soils are present at the surface however comprise low solubility PAHs. Management of turbidity in surface water is therefore necessary in order to manage the migration of PAHs bound to soils. Additionally, surface water controls are required to manage erosion and sediment control (refer to **Section 10.6**), and surface water collected within excavations.

The CEMP is to identify the measures the contractor will implement to manage surface water quality, including turbidity. The following control measures should be considered:

- No surface water is not to discharge from the site. All surface water will be managed through the site wide surface water management system and discharged to the irrigation area under the EPL.
- Erosion and sediment controls outlined in **Section 10.6** are implemented;
- Diversion of surface water upgradient of the excavation and stockpile areas from the areas of disturbance.
- Stockpile areas are to be on flat land where possible and out of any drainage lines.

- Water collected within excavations would drain from the excavation area through sediment controls (as outlined in **Section 10.6**). Where the water is required to be pumped from the excavation it is to be subjected to the sediment controls outlined in **Section 10.6** prior to discharge to the site surface water management system.
- The Contractor is to keep themselves informed of weather conditions and the potential for rain events and proactively manage the site.

10.7.2 Groundwater

Groundwater will be encountered during removal of the Capped Waste Stockpile. Groundwater will be drained to a sump within the Capped Waste Stockpile bund. From here, groundwater will be pumped to the on-site groundwater treatment system. The system will be designed, during a detailed design process, to treat water to a level suitable for discharge to the North Dam and disposed of via irrigation under the existing Environment Protection Licence.

10.8 Traffic Control

It is envisaged that all haulage routes will be within Hydro property. All haulage routes for trucks transporting soil, materials, equipment or machinery to and from the site shall be selected to meet the following objectives:

- Comply with road traffic rules
- Minimise noise, vibration and odour to adjacent premises; and
- Maximise travel on state and arterial roads and avoid use of local roads.

The CEMP is to include a traffic control plan for the Hart Road site access point as per Cessnock City Council guidelines. The plan should also designate internal material haulage routes.

If the traffic control plan includes the placement of signage or other traffic controls within the Hart Road road reserve, the Contractor is to consult with the Cessnock Council and attain any required approvals or permits prior to placing the signage or controls.

The CEMP should also include the following measures:

- Deliveries of soil, materials, equipment or machinery are to occur during standard construction hours (refer to **Section 10.3**).
- Securely cover all loads to prevent any dust or odour emissions during transportation.
- Vehicles are not to track soil, mud or sediment onto the road.

10.9 Spill Response

The Contractor is to develop a spill response protocol to be implemented in the event that site activities result in a spill.

Examples where spills could occur are:

- Transport of contaminated material from the site, involving loss of load anywhere including private and public property;
- Fuel spill during machinery use or refuelling that occurs anywhere including private or public property.

10.10 Hazardous Materials

The CEMP shall include measures for the storage, transport and use of any hazardous materials and dangerous goods during site activities. This will reference the guidance and requirements in the following:

- 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.

Relevant Safe Data Sheets (SDS) for each material, chemical or hazardous substance used at the workplace is to be obtained from the manufacturer or suppliers of those goods prior to its arrival on site. All substances brought on to site must be registered on the SDS Register. This register must be developed and controlled by the site environmental manager who will be responsible for the receipt of such substances / materials in accordance with the Hazardous Substances Regulation, the Dangerous Goods Act and the Dangerous Goods Regulations.

10.11 Waste Materials

Although no asbestos containing materials were identified during investigations at the Project Site, there is potential for asbestos contamination materials, including friable asbestos, to be present within the Capped Waste Stockpile and within stockpiles proposed to be disposed in the Containment cell.

The Contractor is to develop and implement an Asbestos Removal Control Plan consistent with the Asbestos Management Protocol included in **Section 13.1**.

10.12 Flora and Fauna

The CEMP is to include procedures for the clearance of vegetation (if required). This should include:

- Strategies for minimising vegetation clearance within the worksite and protection of vegetated areas adjoining the work area.
- Weed control measures.
- Measures for the management and disposal of cleared vegetation matter.
- Stockpiles and other materials are not to be stored below the drip line of any tree.

11. HEALTH AND SAFETY

A site specific health and safety plan detailing procedures and requirements that are to be implemented will need to be developed for the remediation works including as a minimum but not limited to, the requirements described below.

The objectives of the health and safety plan are:

- To apply standard procedures that reduce risks resulting from the works;
- To ensure all employees are provided with appropriate training, equipment and support to consistently perform their duties in a safe manner; and
- To have procedures to protect other site workers and the general public.

These objectives will be achieved by:

- Assignment of responsibilities;
- An evaluation of hazards;
- Establishment of personal protection standards and mandatory safety practices and procedures; and
- Provision for contingencies that may arise while operations are being conducted at the site.

Specifically the Health and Safety plan is to address the following identified hazards:

- The stability of excavations;
- The presence of services;
- The presence of livestock, wildlife including snakes;
- The presence of contaminants as described within this document; and
- The presence of other site personnel, work and traffic.

The Contractors Health and Safety plan is to be compliant with:

- Hydro Aluminium's Contractor Occupational Health Safety and Environment Requirements Version 3 2014. This requires the Contractor and all employees and subcontractors to be inducted to the Hydro site and for Hydro work permits to be obtained prior to starting any work.
- *Work Health and Safety Act 2011*.
- Work Health and Safety Regulation 2011.
- Applicable state and federal regulations, legislation and codes of practice.

12. REMEDIATION SCHEDULE

The final remediation schedule will be discussed with the Contractor. A proposed indicative schedule up to the completion of a draft validation report is outlined in **Table 12-1**.

Table 12-1: Remediation Schedule

Task	Estimated Duration
State Significant Development Project Approval	18 – 24 months
Contractor Procurement	2 – 4 months
Preliminaries (documentation)	2 month
Site establishment and mobilisation	2 weeks
Containment Cell Base Establishment and Construction	18 months
Capped Waste Stockpile Removal and Placement in Containment CellSite works	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

13. ENVIRONMENTAL CONTROLS CONTINGENCY PLAN

This section of the RAP describes the contingency plans to respond to site incidents that may occur during remedial works and could impact on the surrounding environment and the community.

The environmental controls described in **Section 10** are designed to be sufficiently protective under the normal range of site conditions. The contingencies presented in **Table 13-1** are to be implemented where unexpected site conditions or circumstances arise.

Table 13-1: Environmental Controls Contingency Plan

Contingency 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. Refer to **Section 13.1**.	Remediation Contractor
Receival of a noise complaint	Identify noise source and implement noise control measures	Remediation Contractor
Receival of a 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

13.1 Asbestos Management Protocol

The purpose of this protocol is to describe:

- The permits and approvals required to be attained prior to the works for the removal and management of potential asbestos containing materials (ACM) if encountered.
- The procedures to be implemented in the event that ACM is encountered.

13.1.1 Asbestos Related Permits and Approvals

The Contractor is required to possess a Class A friable asbestos removal license issued by WorkCover NSW or an equivalent asbestos removal license issued in another Australian jurisdiction.

The Contractor is responsible for notifying WorkCover NSW of the asbestos removal work **five days prior** to the commencement of the works. The Notification of Asbestos Removal Work is to address the removal of ACM that may be encountered below the surface.

The Contractor is required to prepare an Asbestos Removal Control Plan consistent with this Protocol, which is to be amended (as required); in the event that ACM is encountered.

The Contractor must notify a licensed waste management facility of the requirement to dispose of ACM prior to transporting the material to the facility. The Contractor would be required to provide the Contractor's Environmental Consultant with a docket from the facility confirming that the material was appropriately disposed as ACM at the facility and for that docket to be included in the Validation Report, refer to **Section 9.4**.

13.1.2 Management of ACM

The Contractor is to develop and implement an Asbestos Removal Control Plan consistent with *How to Safely Remove Asbestos: Code of Practice* (WorkCover NSW, 2011) ("the Code"), addressing the following:

- 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.

14. REGULATORY COMPLIANCE REQUIREMENTS

Approvals required for the remediation of the Project Site are outlined in **Table 14-1**.

Table 14-1: Key Relevant Legislation and Regulations

Legislation or 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 posses 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 to 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 Project Site.

15. KEY PERSONNEL

The key stakeholders and their roles and responsibilities are outlined in **Table 15-1**.

Table 15-1: Roles and Responsibilities

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.
Contractors 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.

16. COMMUNITY RELATIONS PLAN

Community relations has been managed by Hydro since the closure of the Smelter, primarily through the Community Reference Group which was established in 2012. A series of community open days were also held in 2015 to discuss a range of issues, including the remediation of the Project Site. The consultation process is proposed to continue until completion of demolition and remediation.

17. LONG-TERM SITE MANAGEMENT PLAN

A Containment Cell Operation Environmental Management Plan (OEMP) will be required for the management of the Containment Cell in perpetuity. A number of organisational structures are being investigated to determine the most appropriate long term management vehicle. The OEMP will be a stand-alone document that includes:

- A clear description of the objectives of the EMP;
- A description of the land under management and the as-built construction details;
- Description of when the EMP applies and who is responsible for implementing;
- An outline of the constraints on the use of the site for any purpose;
- An outline of the health and safety requirements for any workers at the site;
- An outline of the specific management activities including:
  - Surface cap inspections;
  - Leachate sump inspections;
  - Procedures for repair of cap;
  - Procedures for disposal of leachate;
- An outline of the monitoring and reporting requirements. These will be in accordance with the varied Hydro EPL.
- details of any restrictions to be placed on the land (such as by way of positive covenant) to prevent unacceptable development over the Containment Cell;
- financial assurance mechanisms to secure performance of the long term monitoring and management obligation (which could be incorporated as conditions of the Development Consent or EPL); and
- mechanisms to bind any future owners/occupiers of the Project Site, including any suitably qualified consultant engaged to undertake the long term environmental management of the Containment Cell, to comply with the OEMP (such as by way of conditions of the Development Consent or the EPL, positive covenants or a voluntary planning agreement). Hydro will retain overarching responsibility for the long term environmental performance of the Containment Cell.

The remainder of the Project Site will not require on-going management following remediation and validation works.

17.1 Leachate Plume

With regard to the residual leachate plume at the Capped Waste Stockpile, the need for a Long Term Management Plan will be assessed following 2 years of quarterly monitoring and assessment of groundwater results at this time. This would include an evaluation of the assumptions made in the ENVIRON (2013) Stage 2 Aquatic Assessment – Ecological Risk Assessment and in the ENVIRON (2015) Groundwater Fate and Transport Modelling report. The need for a further ecological risk assessment or fate and transport modelling will be assessed at this time.

17.2 Enforceability of the LTEMP

The key regulatory mechanisms available to ensure the long term environmental management of the Containment Cell are the Development Consent and the EPL. Project Consent is required from the Department of Planning as the remediation triggers State Significant Development criteria.

17.2.1 Development Consent

Any development consent granted for the Project will include a suite of conditions under Section 80A(1)(a) of the EP&A Act to:

- 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.

Hydro proposes that the Development Consent requires the preparation and implementation of an OEMP. The OEMP would be submitted for approval of the Department of Planning and Environment and the EPA.

Under the EP&A Act the Development Consent would remain with the land and bind, and be enforceable by any person against, the person responsible for carrying out the long term environmental management of the Containment Cell. This could include, for example, the suitably qualified expert that is proposed to be engaged to carry out the long term environmental management of the Containment Cell (Containment Cell Manager) and the owner or occupier of the Containment Cell land.

The Development Consent could also require the registration of restrictive covenants against the Containment Cell land. The covenant could implement a number of mechanisms to enforce the long term environmental management of the Containment Cell including:

i. Constraining the use of the Containment Cell land so that, for example, any development that presents a risk to the integrity of the Containment Cell is prohibited;
ii. Requiring the implementation of the OEMP. The restrictive covenant could be registered against the title to the land and bind, and be enforceable against, the Containment Cell Manager and the owner or occupier of the Containment Cell land.

17.2.2 Environment Protection Licence

The occupier of the Containment Cell land would be required to hold an EPL under the POEO Act to authorise the proposed scheduled activity to be carried out on that land. The holder would be required to satisfy the fit and proper person test prescribed in the POEO Act. This test includes, among other matters, satisfying the EPA that they are technically competent and have the financial capacity to undertake the long term environmental management of the Containment Cell.

The EPL is likely to contain a suite of conditions to prevent, minimise and mitigate the environmental impacts of the Containment Cell. The POEO Act also enables the EPA to implement a number of specific mechanisms to ensure the long term funding and resourcing of long term environmental management activities. For example, the EPL could include a condition requiring the holder to provide financial assurance to secure the performance of the environmental obligations set out in the EPL (section 70 of the POEO Act). The amount and form of any financial assurance is proposed to be agreed with the Department of Planning and Environment and the PA having regard to the following prescribed matters 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.

Other relevant conditions that may be inserted by the EPA into the EPL include requirements in respect of environmental insurance (section 72 of the POEO Act) and positive covenants (section 74 of the POEO Act). The nature and extent of such mechanisms are proposed to be agreed with the Department of Planning and Environment and the EPA as part of the finalisation and approval of the OEMP. The EPL could not be surrendered, or transferred to another person, except with the consent of the EPA in accordance with the POEO Act. The conditions of the EPL (including maintaining the financial assurance) would remain binding and enforceable against the holder of the EPL.

18. CONCLUSIONS

Ramboll Environ was engaged by Hydro Aluminium Kurri Kurri Pty Ltd (Hydro) to prepare a Remedial Action Plan (RAP) for the remediation the Hydro Kurri Kurri Aluminium Smelter (the Smelter) and an area known as the Clay Borrow Pit Cell, comprising approximately 140 ha. The Smelter and the Clay Borrow Pit form the location of the proposed demolition, remediation and waste management project proposed by Hydro (the Project). The Project Site is located at Hart Road, Loxford, New South Wales (NSW).

A Masterplan has been developed that identifies land proposed for General Industrial (IN1) and Heavy Industrial (IN3) landuse at the Project Site. A Development Application for approval of a State Significant Development (supported by an Environmental Impact Statement) has been prepared for the demolition of redundant smelter buildings, remediation of the site and design, construction and operation of containment cell. The Environmental Impact Statement must address the Secretary’s Environmental Assessment Requirements (SEARs).

The SEARS require preparation of a RAP. The SEARs also require an independent audit of the RAP and preparation of a Site Audit Report and Site Audit Statement indicating that the site can be made suitable for its future landuse.

Previous investigations at the Project Site have identified contamination associated with waste stockpiling at the Capped Waste Stockpile and the Anode Waste Pile; with fill importation at the Diesel Spray Area; with site operations at the Carbon Plant and Bake Furnace Scrubber; with burial of wastes at the Area East of the Playing Fields; and with drainage at the Drainage Lines and at the East Surge Pond. Secondary impacts to groundwater have also been identified beneath and down gradient of the Capped Waste Stockpile.

Additional investigations are required to delineate the extent of soil contamination at the Anode Waste Pile and the Diesel Spray Area. Investigations are also required at areas that have not been previously accessible, including investigation of sediments in the West Surge Pond and investigation of soil at the substations and the Area East of the Clay Borrow Pit. The additional investigation areas are not expected to present material contamination issues.

The RAP was commissioned by Hydro to detail the preferred methodology to remediate the impacted soils at each Area of Concern, which involves excavation and on-site containment; the requirement for the treatment of groundwater at the Capped Waste Stockpile; and to detail the required validation.

Ramboll Environ considers that following implementation of the remedial measures and associated validation activities documented in the RAP and provision of a Validation Report, the Project Site can be made suitable for the proposed landuse outlined in the Masterplan.

19. REFERENCES

ANZECC & ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality

Canadian Council of Ministries of the Environment (2010) Candian Soil Quality Guidelines, Carcinogenic and Other Polycyclic Aromatic Hydrocarbons (PAHs) (Environmental and Human Health Effects) Scientific Criteria Document (revised)

National Environment Protection Council (1999) National Environmental Protection (Assessment of Site Contamination) Measure (NEPM 1999)

National Environment Protection Council (2013) National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1) (NEPM 2013)

National Health and Medical Research Council (2008) Guidelines for Managing Risks in Recreational Water

National Health and Medical Research Council (2011) Australian Drinking Water Guidelines

NSW DEC (2006) Guidelines for the NSW Site Auditor Scheme (Second Edition)

NSW DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination.

19.1 Previous Ramboll Environ Reports

ENVIRON, Stage 1 Phase 2 Environmental Site Assessment, Hydro Kurri Kurri Aluminium Smelter, prepared for Hydro Aluminium Kurri Kurri Pty Ltd, November 2012. (ENVIRON, 2012)

ENVIRON, Tier 2 Ecological Risk Assessment Hydro Kurri Kurri Aluminium Smelter, prepared for Hydro Aluminium Kurri Kurri Pty Ltd, March 2013. (ENVIRON, 2013a)

ENVIRON, Preliminary Screening Level for Human Health Risk Assessment Hydro Kurri Kurri Aluminium Smelter, prepared for Hydro Aluminium Kurri Kurri Pty Ltd, April 2013. (ENVIRON, 2013b)

ENVIRON, Preliminary Containment Cell Study, Hydro Aluminium Kurri Kurri NSW, prepared for Hydro Aluminium Kurri Kurri Pty Ltd, April 2013. (ENVIRON, 2013c)

ENVIRON, Stage 2 Aquatic Assessment – Ecological Risk Assessment, Kurri Kurri Aluminium Smelter, June 2013. (ENVIRON 2013d)

ENVIRON, Phase 1 Environmental Site Assessment, Hydro Kurri Kurri Aluminium Smelter, prepared for Hydro Aluminium Kurri Kurri Pty Ltd, October 2013. (ENVIRON, 2013e)

ENVIRON, Stage 2 Phase 2 Environmental Site Assessment, Hydro Kurri Kurri Aluminium Smelter, prepared for Hydro Aluminium Kurri Kurri Pty Ltd, January 2015. (ENVIRON, 2015)

ENVIRON, Remedial Options Study, Hydro Kurri Kurri Aluminium Smelter, prepared for Hydro Aluminium Kurri Kurri Pty Ltd, May 2014. (ENVIRON, 2014a)

ENVIRON, Remedial Action Works Plan Clay Borrow Pit Area, Hydro Kurri Kurri Aluminium Smelter, prepared for Hydro Aluminium Kurri Kurri Pty Ltd, December 2014. (ENVIRON, 2014b).

ENVIRON, Groundwater Fate and Transport Modelling, Leachate Plume – Capped Waste Stockpile, Hydro Aluminium Smelter Kurri Kurri NSW (ENVIRON, 2015).

20. LIMITATIONS

Ramboll Environ Australia Pty Ltd prepared this report in accordance with the scope of work as outlined in our proposal to Hydro Aluminium Pty Ltd and in accordance with our understanding and interpretation of current regulatory standards.

A representative program of sampling and laboratory analyses was undertaken as part of this investigation, based on past and present known uses of the site. While every care has been taken, concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. We cannot therefore preclude the presence of materials that may be hazardous.

Site conditions may change over time. This report is based on conditions encountered at the site at the time of the report and Ramboll Environ disclaims responsibility for any changes that may have occurred after this time.

The conclusions presented in this report represent Ramboll Environ's professional judgment based on information made available during the course of this assignment and are true and correct to the best of ENVIRON's knowledge as at the date of the assessment.

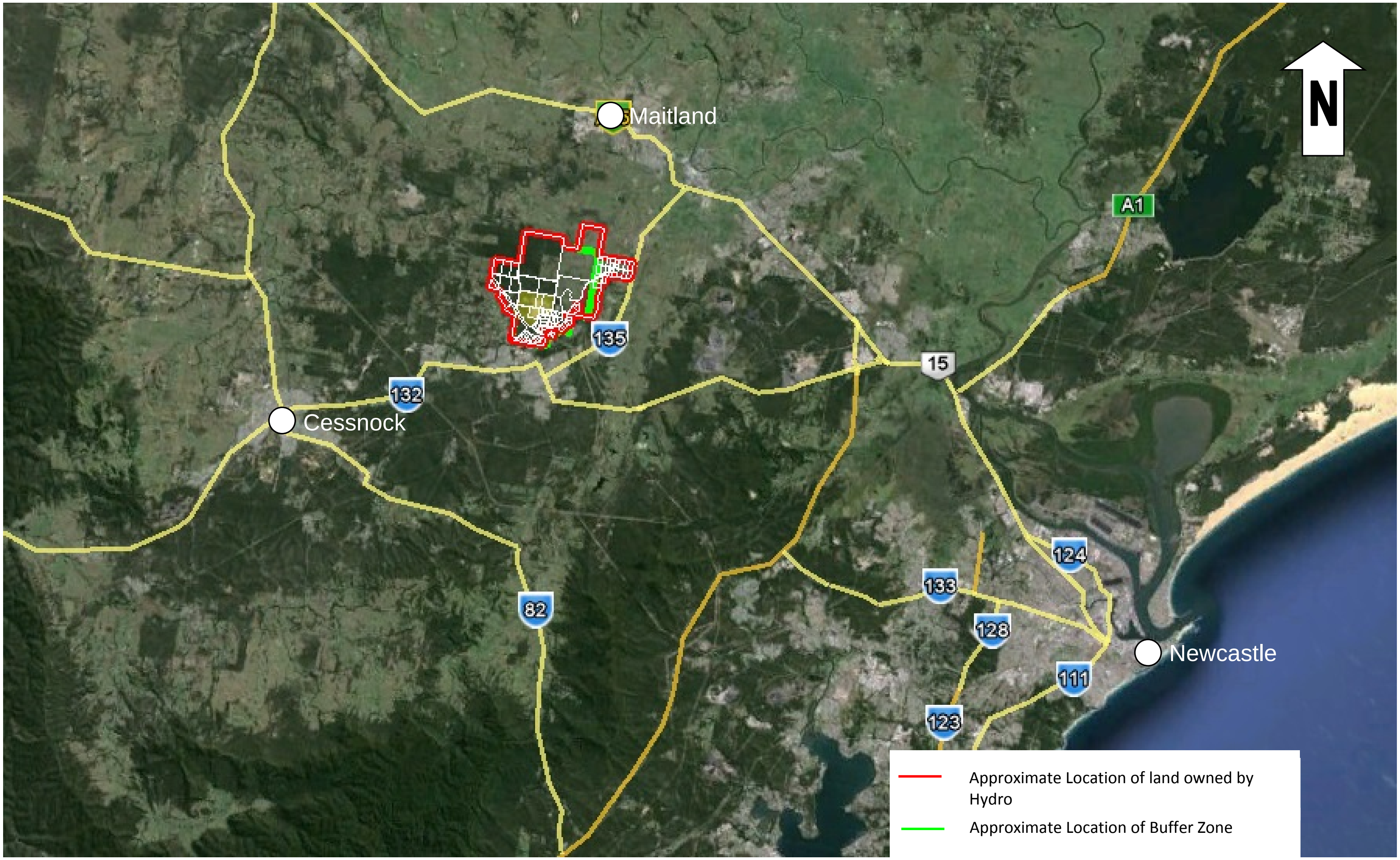
Ramboll Environ did not independently verify all of the written or oral information provided to ENVIRON during the course of this investigation. While Ramboll Environ has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to Ramboll Environ was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

20.1 User Reliance

This report has been prepared exclusively for Hydro Aluminium Pty Ltd and may not be relied upon by any other person or entity without Ramboll Environ's express written permission.

FIGURES



Hydro Aluminium Kurri Kurri: Remedial Action Plan

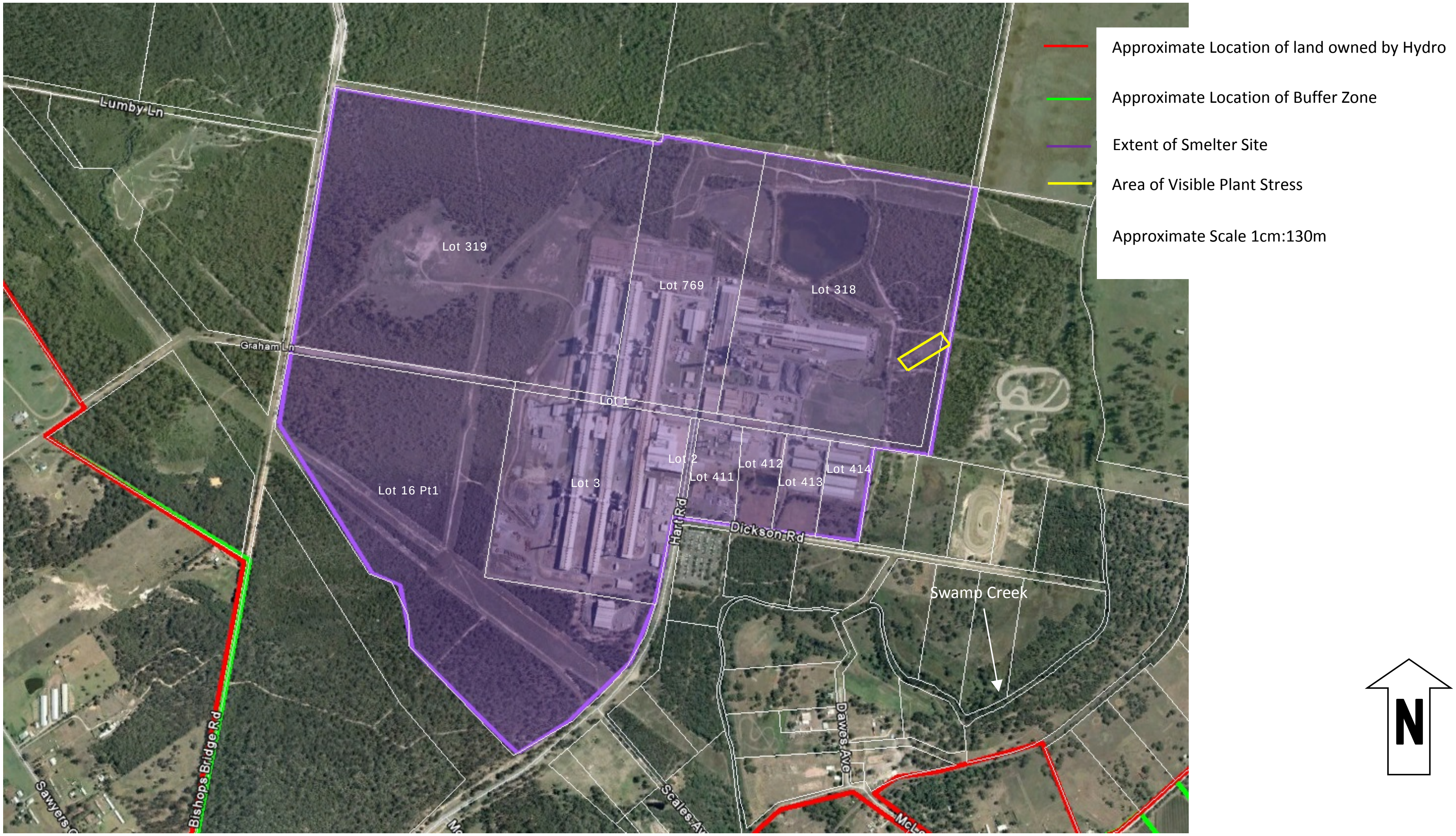
Site Location

RAMBOLL ENVIRON

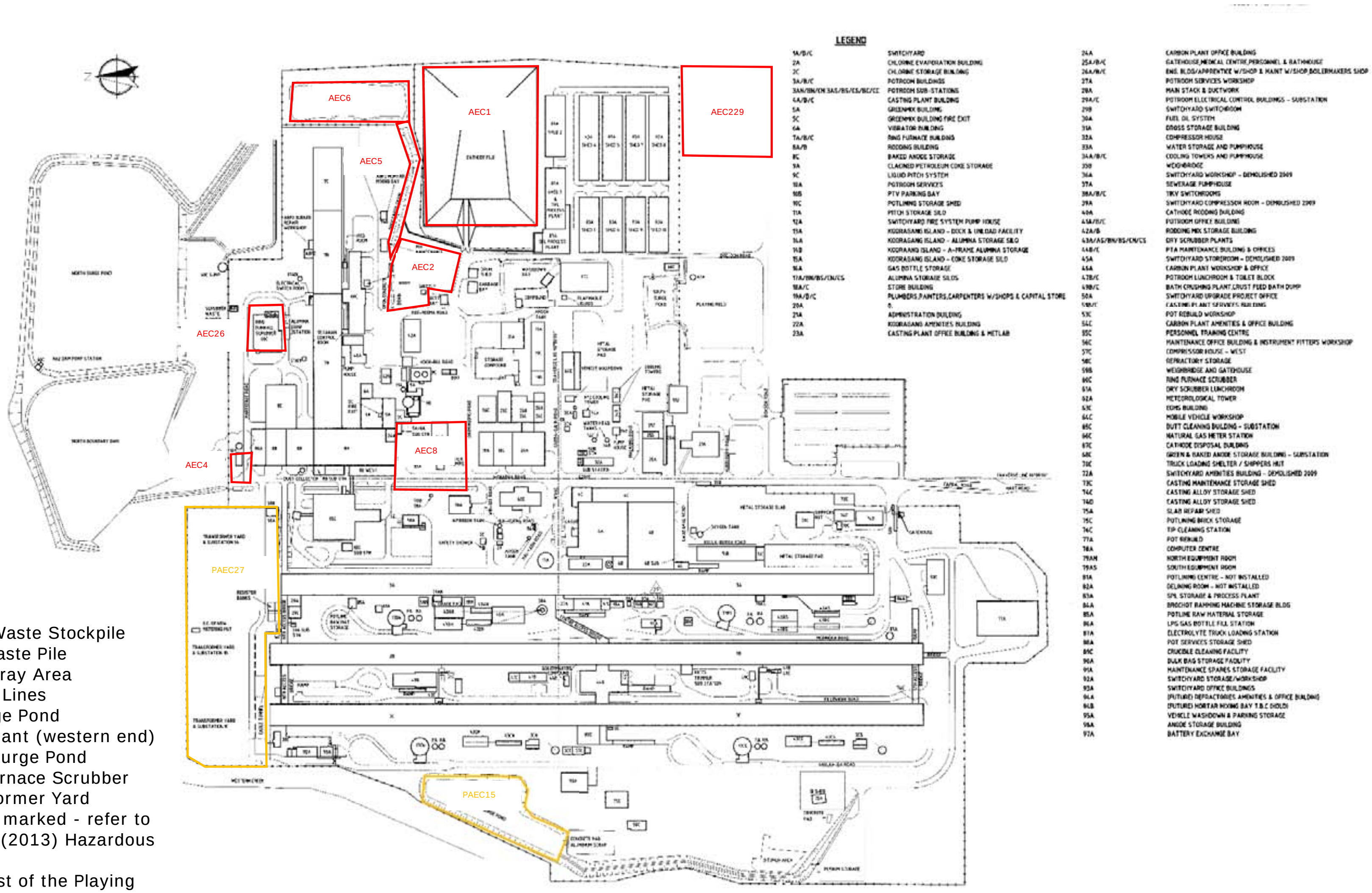
JOB NO: AS130349

DATE: July 2016

FIGURE 1



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



KEY

AEC 1: Capped Waste Stockpile
AEC 2: Anode Waste Pile
AEC 4: Diesel Spray Area
AEC 5: Drainage Lines
AEC 6: East Surge Pond
AEC 8: Carbon Plant (western end)
PAEC 15: West Surge Pond
AEC 26: Bake Furnace Scrubber
PAEC 27: Transformer Yard
(Substations not marked - refer to Ramboll Environ (2013) Hazardous Materials Audit)
AEC 29: Area East of the Playing Fields

Hydro Aluminium Kurri Kurri: Remedial Action Plan	Smelter Layout Showing AECs and PAECs

RAMBOLL ENVIRON | JOB NO: AS130349 | DATE: July 2016 | FIGURE 3

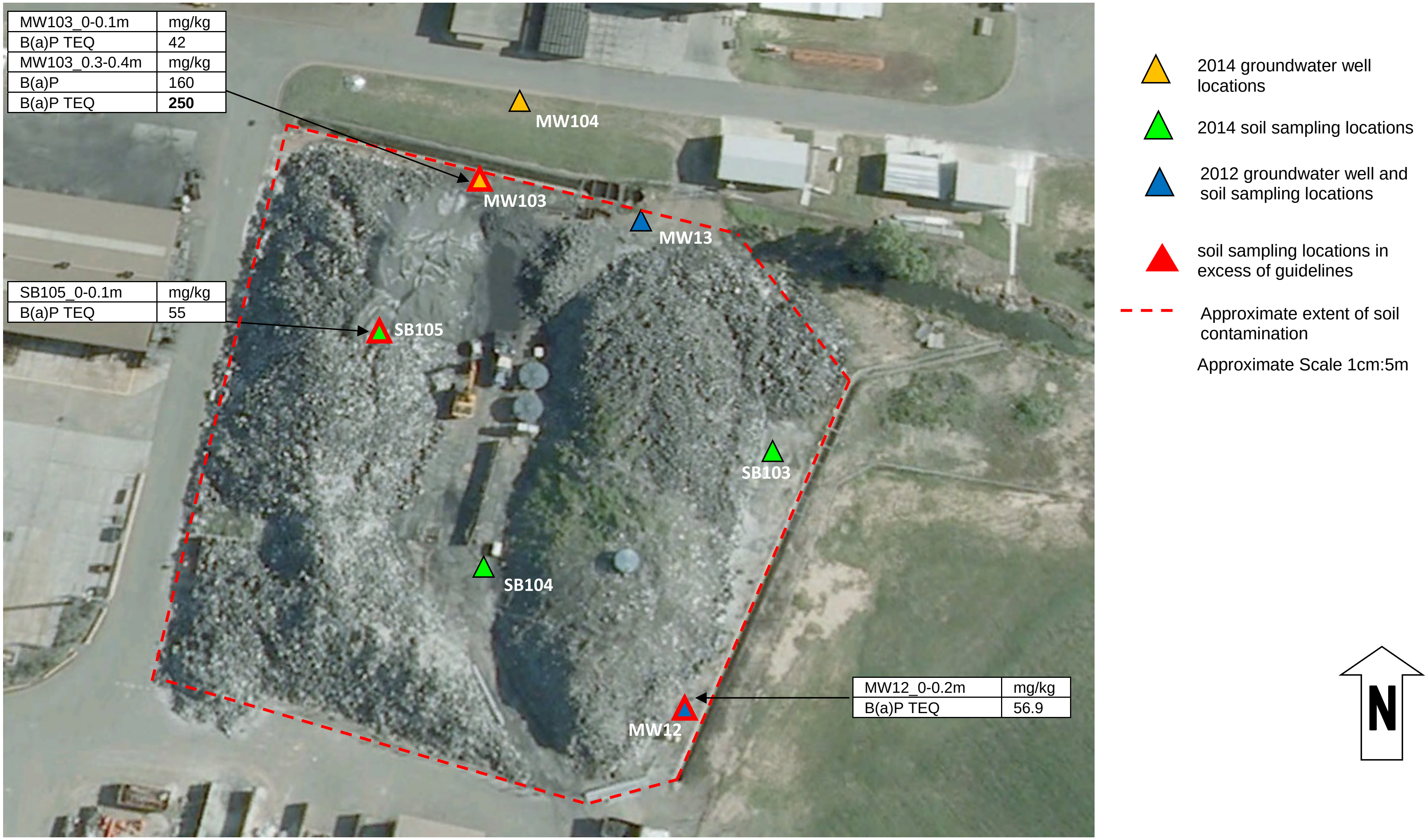
Capped Waste Stockpile

Approximate Scale 1cm:15m

N

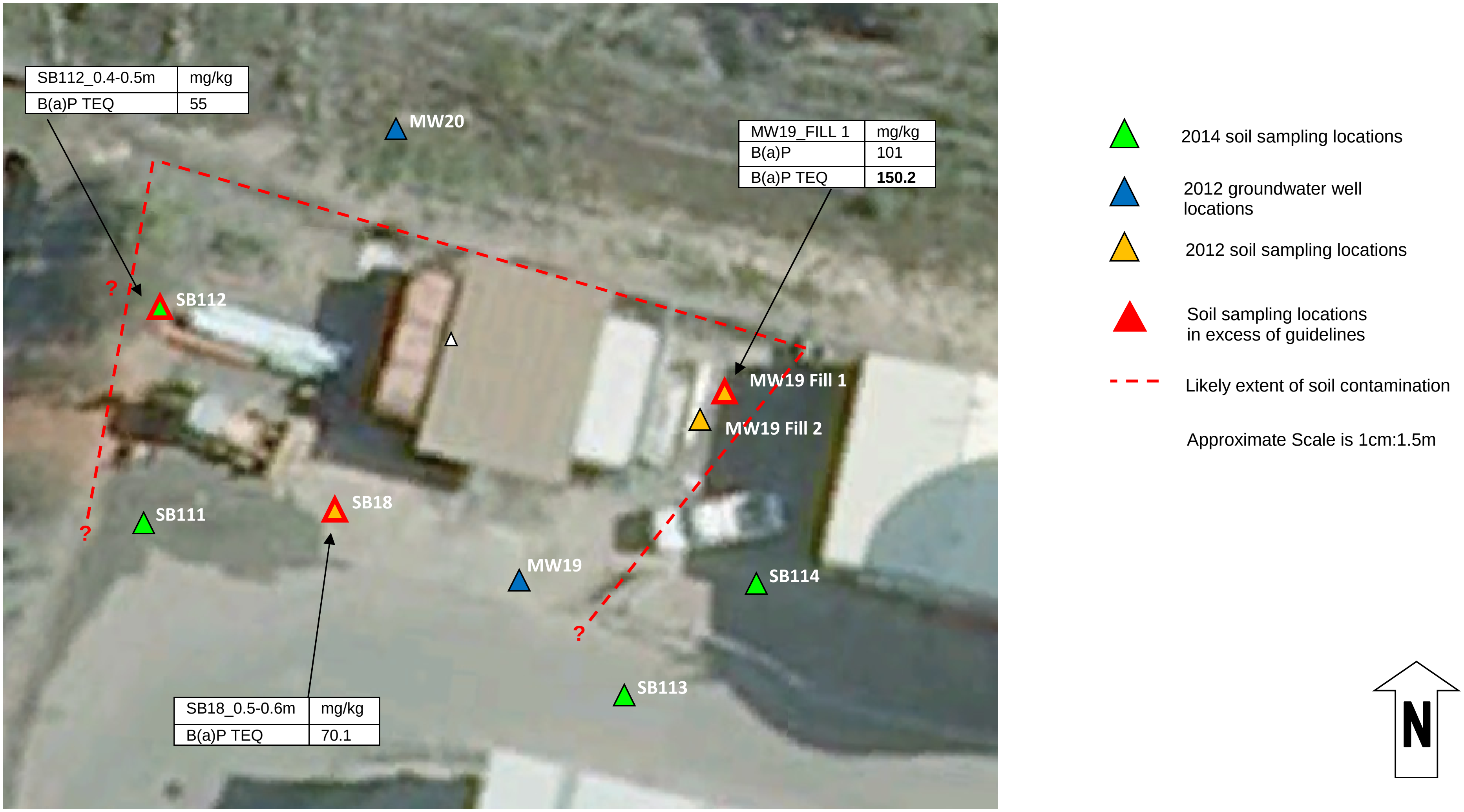
Hydro Aluminium Kurri Kurri: Remedial Action Plan	Capped Waste Stockpile

RAMBOLL ENVIRON JOB NO: AS130349 DATE: July 2016 FIGURE 4



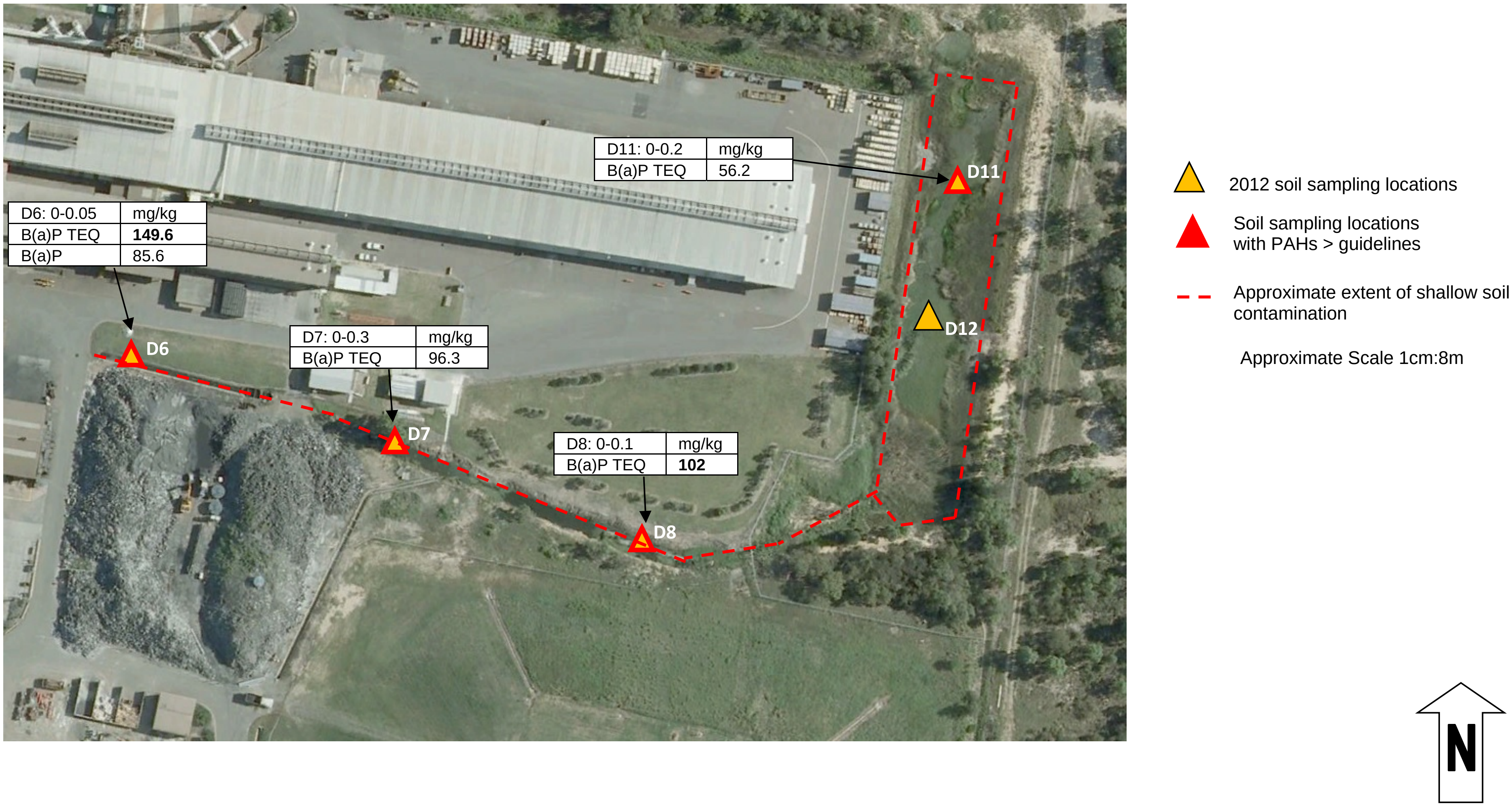
Hydro Aluminium Kurri Kurri: Remedial Action Plan	AEC 2 – Anode Waste Pile

RAMBOLL ENVIRON   JOB NO: AS130349   DATE: July 2016   FIGURE 5



Hydro Aluminium Kurri Kurri: Remedial Action Plan	AEC 4 – Diesel Spray Area

RAMBOLL ENVIRON JOB NO: AS130349 DATE: July 2016 FIGURE 6



Hydro Aluminium Kurri Kurri: Remedial Action Plan

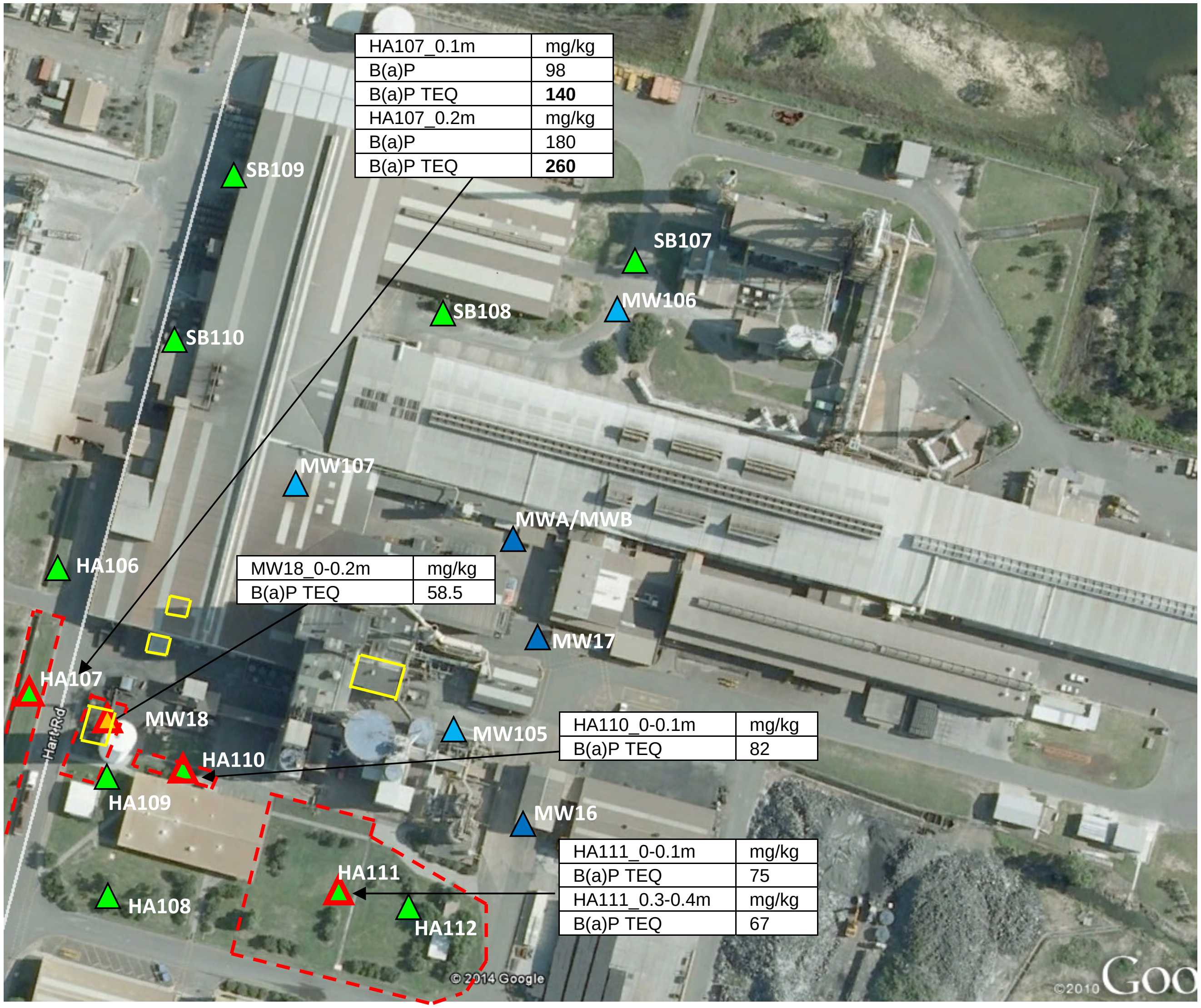
AEC 6: East Surge Pond and Associated Drainage Line

RAMBOLL ENVIRON

JOB NO: AS130349

DATE: July 2016

FIGURE 7



2014 groundwater well locations

2014 soil sampling locations

2012 groundwater well locations

2012 soil sampling locations

Soil sampling locations
with PAHs > guidelines

Areas of visible staining

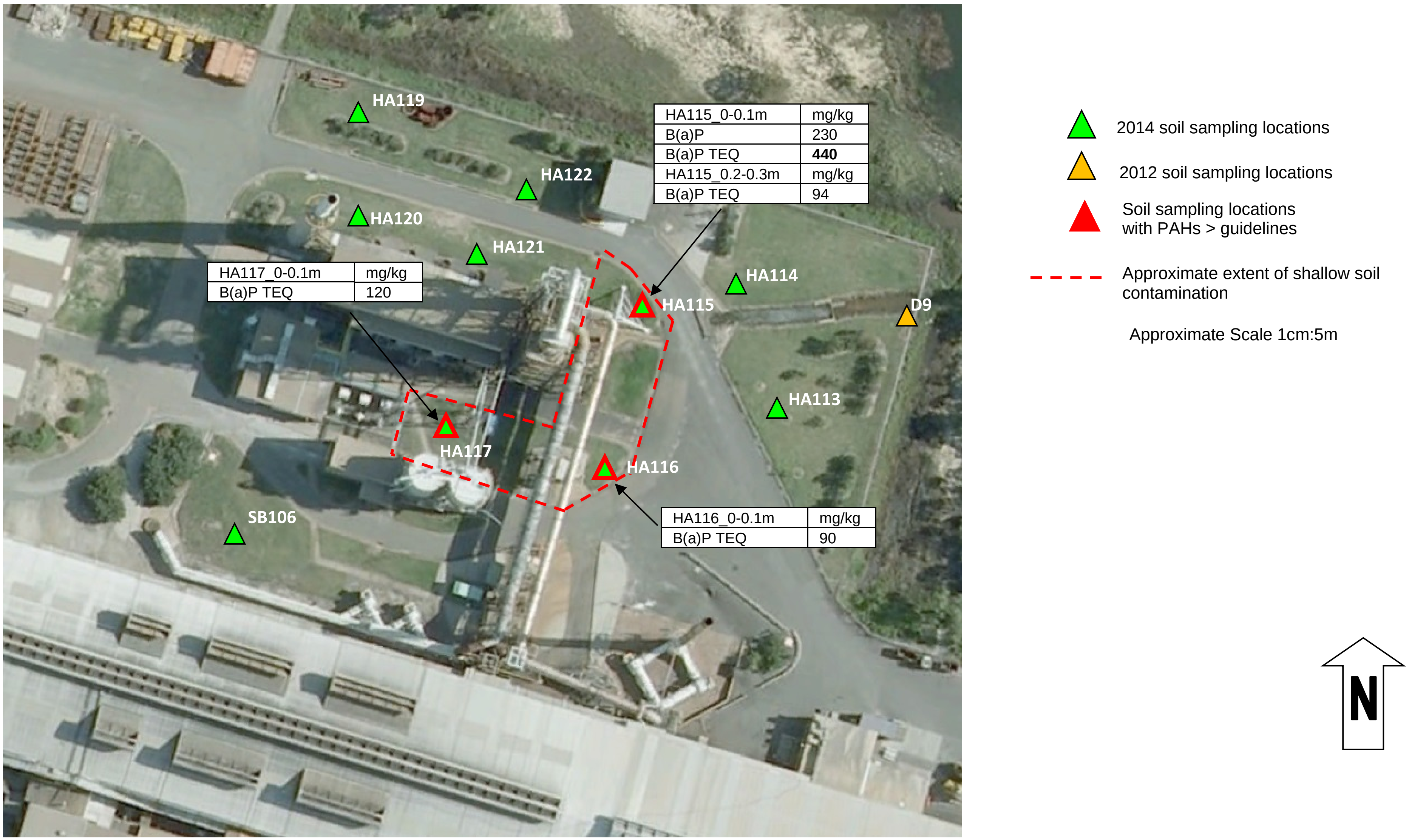
Approximate extent of shallow soil contamination

Approximate Scale 1cm:12m

N

Hydro Aluminium Kurri Kurri: Remedial Action Plan	AEC 8 - Carbon Plant (western end)

RAMBOLL ENVIRON JOB NO: AS130349 DATE: July 2016 FIGURE 8

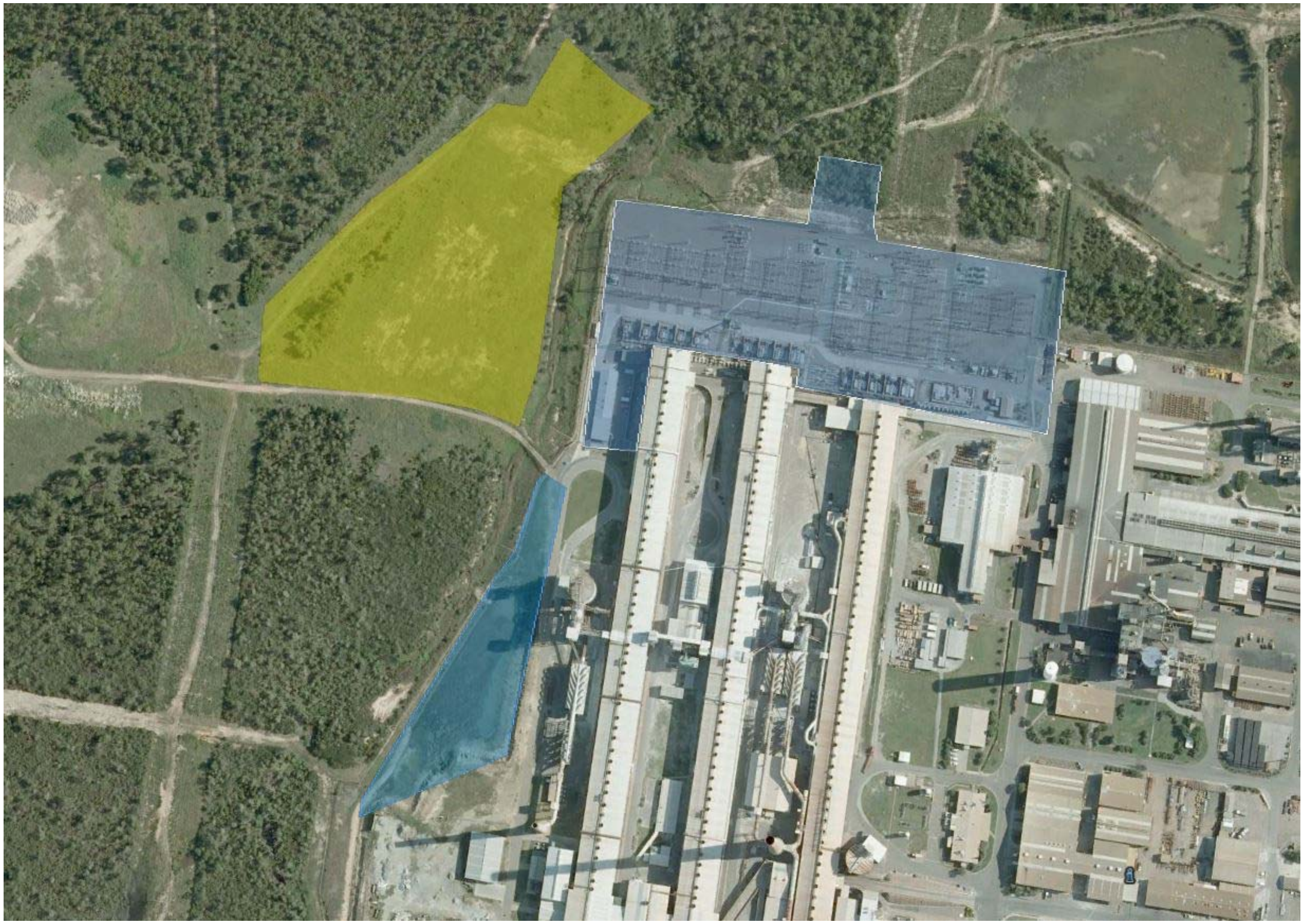


Hydro Aluminium Kurri Kurri: Remedial Action Plan	AEC 26 – Bake Furnace Scrubber

RAMBOLL ENVIRON | JOB NO: AS130349 | DATE: July 2016 | FIGURE 9

Hydro Aluminium Kurri Kurri: Remedial Action Plan	AEC 28 – Area East of Playing Fields

RAMBOLL ENVIRON JOB NO: AS130349 DATE: July 2016 FIGURE 10



Area East of Clay Borrow Pit

Transformer Yard

West Surge Pond

Approximate Scale 1cm:22m

N

Hydro Aluminium Kurri Kurri: Remedial Action Plan	Additional Investigation Areas

RAMBOLL ENVIRON JOB NO: AS130349 DATE: July 2016 FIGURE 11

APPENDIX 1
2012 SOIL AND GROUNDWATER INVESTIGATION RESULTS TABLES

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
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
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
Sample Profile							ALLUVIAL	RESIDUAL	FILL	FILL	FILL	FILL	FILL	FILL	ESTUARINE	FILL	ESTUARINE	FILL	ESTUARINE
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
Sample collected by							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
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
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
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
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
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
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
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
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
Fluoride	40	17000*	-	-	-	-	150	140	240	150	1960	2350	3950	700	60	200	80	7740	650
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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	-	-	-	-	-													
Semi Volatile Organic Compounds																			
Total PAHs	1	4000	-	-	-	-													
Total Phenols	1	240,000	-	-	-	-													
Phthalate Esters	5	-	-	-	-	-													
Nitrosamines	1	-	-	-	-	-													
Nitroaromatics and Ketones	1	-	-	-	-	-													
Haloethers	0.5	-	-	-	-	-													
Chlorinated Hydrocarbons	1	-	-	-	-	-													
Anilines and Benzidines	1	-	-	-	-	-													
Organochlorine Pesticides	1	-	-	-	-	-													
Organophosphorus Pesticides	0.5	-	-	-	-	-													
Miscellaneous Compounds	0.5	-	-	-	-	-													
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	-	-	-	-	-													

Sample Identification	SB15	SB15	SB16	SB16	MW07	MW07	MW08	MW08	SB17	SB18	MW19	MW19
Sample Depth (m)	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	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	ESTUARINE	ESTUARINE	ESTUARINE	ESTUARINE	TOPSOIL	ESTUARINE	FILL	ESTUARINE	FILL	FILL	FILL	FILL
PAEC Sampled	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
Metals												
Aluminium	620	12500	3410	1720	7710	5720	690	4280				
Arsenic	0.2	1.2	0.8	0.3	4.4	1.8	<0.1	0.2				
Cadmium	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.2	<0.1				
Chromium (VI)	1.9	26.6	3.9	5.7	10.5	21.2	3.9	3.6				
Copper	0.8	5.8	0.5	0.6	32.8	2.2	4.1	0.4				
Nickel	1.1	11.2	3.3	2.6	8.1	11.9	2.7	5.8				
Lead	2.5	12.8	4.8	1.2	49.4	4.6	3.6	1.4				
Zinc	2.6	32.6	2.8	1.3	384	7	59.9	12.1				
Mercury (inorganic)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
Fluoride	830	100	60	280	3240	90	90	130				
Non Metallic Inorganics												
Total Cyanide												
Polycyclic Aromatic Hydrocarbons (PAH)												
Naphthalene	<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	<4.0	<0.5
Acenaphthene	<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	2.2	4.2	0.8
Phenanthrene	<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	6.3	9.6	1.6
Fluoranthene	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	0.6	<0.5	<0.5	59.7	137	21.6
Pyrene	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	0.6	<0.5	<0.5	59.1	133	21.7
Benz(a)anthracene	<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	0.6	<0.5	<0.5	45.6	97.3	23.5
Benzo(b)&(k)fluoranthene	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	0.9	<0.5	<0.5	60.3	140	31
Benzo(k)fluoranthene	<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	<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	<0.5	<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	8.8	12.8	4.6
Benzo(g,h,i)perylene	<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	<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	<0.5	<0.5	<0.5	<0.5	<0.5	2.2	3.2	<0.5	<0.5	475	963	205
Total Petroleum Hydrocarbons (TPH)												
TPH C6-C9	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
TPH C10-C14	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
TPH C15-C28	<100	<100	<100	<100	<100	<100	1400	<100	<100	980	1870	400
TPH C29-C36	<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												
Semi Volatile Organic Compounds												
Total PAHs	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Total Phenols	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Phthalate Esters	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Nitrosamines	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Nitroaromatics and Ketones	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Haloethers	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Chlorinated Hydrocarbons	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Anilines and Benzidines	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Organochlorine Pesticides	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Organophosphorus Pesticides	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Miscellaneous Compounds	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR						
Volatile Organic Compounds												
Monocyclic Aromatic Hydrocarbons												
Oxygenated Compounds												
Sulfonated Compounds												
Fumigants												
Halogenated Aliphatic Compounds												
Halogenated Aromatic Compounds												
Trihalomethanes												

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 showin 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
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
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
Sample Profile							FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL
PAEC Sampled							Pot Lines	Pot Lines	Pot Lines	Pot Lines	SPL Sheds	SPL Sheds	SPL Sheds	SPL Sheds
Sample collected by							FR	FR	FR	FR	FR	FR	FR	FR
Metals														
Aluminium	50	NL*	-	-	-	-	53300	139000	138000	41700	26900	23700	11800	11000
Arsenic	1	3000	-	160	-	-	4.5	28.9	8.8	14.6	5.1	3.4	2.4	1.9
Cadmium	0.1	900	-	-	-	-	0.7	1.8	1.4	0.8	0.2	0.2	0.1	0.1
Chromium (VI)	1	3600	-	320**	-	-	26.8	35	14.8	36	39.6	36.5	21.9	14.2
Copper	2	240,000	-	210**	-	-	21.1	280	18.9	89.8	33.7	28	12.4	11.6
Nickel	1	6000	-	140**	-	-	98	159	166	65.7	49	39.3	24.1	18.6
Lead	2	1500	-	1800	-	-	25	430	28.7	247	18.3	39.7	8.6	10.1
Zinc	5	400,000	-	440**	-	-	229	5400	444	1210	232	179	65.3	362
Mercury (inorganic)	0.05	730	-	-	-	-	<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
Non Metallic Inorganics														
Total Cyanide	1	1500	-	-	-	-								
Polycyclic Aromatic Hydrocarbons (PAH)														
Naphthalene	0.5	-	-	370	-	-								
Acenaphthylene	0.5	-	-	-	-	-								
Acenaphthene	0.5	-	-	-	-	-								
Fluorene	0.5	-	-	-	-	-								
Phenanthrene	0.5	-	-	-	-	-								
Anthracene	0.5	-	-	-	-	-								
Fluoranthene	0.5	-	-	-	-	-								
Pyrene	0.5	-	-	-	-	-								
Benz(a)anthracene	0.5	-	-	-	-	-								
Chrysene	0.5	-	-	-	-	-								
Benzo(b)&(k)fluoranthene	1	-	-	-	-	-								
Benzo(k)fluoranthene	0.5	-	-	-	-	-								
Benzo(a) pyrene	0.5	-	-	-	-	72[F]								
Indeno(1,2,3-c,d)pyrene	0.5	-	-	-	-	-								
Dibenz(a,h)anthracene	0.5	-	-	-	-	-								
Benzo(g,h,i)perylene	0.5	-	-	-	-	-								
Benzo(a)pyrene TEQ		40	-	-	-	-								
Sum of reported PAH	--	4000	-	-	-	-								
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				
Semi Volatile Organic Compounds														
Total PAHs	1	4000	-	-	-	-								
Total Phenols	1	240,000	-	-	-	-								
Phthalate Esters	5	-	-	-	-	-								
Nitrosamines	1	-	-	-	-	-								
Nitroaromatics and Ketones	1	-	-	-	-	-								
Haloethers	0.5	-	-	-	-	-								
Chlorinated Hydrocarbons	1	-	-	-	-	-								
Anilines and Benzidines	1	-	-	-	-	-								
Organochlorine Pesticides	1	-	-	-	-	-								
Organophosphorus Pesticides	0.5	-	-	-	-	-								
Miscellaneous Compounds	0.5	-	-	-	-	-								
Volatile Organic Compounds														
Monocyclic Aromatic Hydrocarbons	5	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01				
Oxygenated Compounds	0.5	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01				
Sulfonated Compounds	1	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01				
Fumigants	0.5	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01				
Halogenated Aliphatic Compounds	5	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01				
Halogenated Aromatic Compounds	0.5	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01				
Trihalomethanes	0.5	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01				

Sample Identification	SB14	SB14	MW09	MW10	SB9	SB9	MW11	SB10	SB10	MW12	MW12	MW13	SB20 (i)	MW01	MW02	MW03A	MW05	MW21
Sample Depth (m)	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	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	ESTUARINE	FILL	FILL	FILL	FILL	FILL	FILL	TOPSOIL	FILL	FILL	FILL	TOPSOIL	FILL	FILL	FILL	FILL	FILL
PAEC Sampled	Maintenance	Maintenance	FLS	FLS	Washbay	Washbay	Washbay	CBWB	CBWB	AWP	AWP	AWP	Switchyard	CBP	CBP	CBP	CBP	PRA
Sample collected by	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG	FR	KJG	KJG	KJG	KJG	KJG
Metals																		
Aluminium	11600	2820	5460	20500	39800	12600	15000	60800	4640	55800	3260	36700		10400	14400	17600	9510	15800
Arsenic	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	<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)	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	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	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	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	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)	<0.1	<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	970	70	700	16200	39000	1230	960	10600	190	47100	1010	17700		310	190	2120	1030	190
Non Metallic Inorganics																		
Total Cyanide			<1	<1			<1	4	<1	<1	1	<1						
Polycyclic Aromatic Hydrocarbons (PAH)																		
Naphthalene			<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	
Acenaphthene			<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	0.9	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	
Phenanthrene			<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	0.6	<0.5	4.1	<0.5	1.1		<0.5	<0.5	0.8	<0.5	
Fluoranthene			<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	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			1.8	13.8	<0.5	52.6	<0.5	17.3		<0.5	<0.5	0.9	0.6	
Chrysene			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	0.8			3.3	39	<0.5	88.6	<0.5	26.6		1	<1	3	3	
Benzo(k)fluoranthene			<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	<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			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	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			1.5	16	<0.5	24	<0.5	14.5		<0.5	<0.5	<0.5	<0.5	
Benzo(a)pyrene TEQ			<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			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																		
TPH C10-C14																		
TPH C15-C28																		
TPH C29-C36																		
TPH C10-C36																		
Polychlorinated Biphenyls																		
Total PCBs													<0.1					
Semi Volatile Organic Compounds																		
Total PAHs	<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Total Phenols	<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Phthalate Esters	<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Nitrosamines	<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Nitroaromatics and Ketones	<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Haloethers	<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Chlorinated Hydrocarbons	<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Anilines and Benzidines	<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Organochlorine Pesticides	<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Organophosphorus Pesticides	<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Miscellaneous Compounds	<LOR	<LOR	<LOR	<LOR										<LOR	<LOR	<LOR	<LOR	<LOR
Volatile Organic Compounds																		
Monocyclic Aromatic Hydrocarbons													<LOR					
Oxygenated Compounds													<LOR					
Sulfonated Compounds													<LOR					
Fumigants													<LOR					
Halogenated Aliphatic Compounds													<LOR					
Halogenated Aromatic Compounds													<LOR					
Trihalomethanes																		

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 showin 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	HIL D[A]	HSL D[B]	EIL C/I[C]	Management Limits[D]	ESL C/I[E]	COMPOSITE 1	COMPOSITE 2	COMPOSITE 3	COMPOSITE 4	ND4-BASE	ND7-BASE
Sample Depth (m)											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

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

APPENDIX 2
NSW EPA CORRESPONDENCE

NSW EPA

Our reference: Doc12/35460

Alex Fry
Aluminium Metal
Primary Production Kurri Kurri
PO Box 1
Kurri Kurri
NSW 2327

Dear Alex Fry

Hydro Aluminium Kurri Kurri
Section 60 Notification under the *Contaminated Land Management Act 1997*

Thank you for the Site Contamination Notification dated 11 July 2012 and supporting information provided in accordance with section 60 of the *Contaminated Land Management Act 1997* (the CLM Act) relating to Hydro Aluminium Kurri Kurri.

The notification and attached documents have been considered and I advise that we are unable to make a determination as to whether the contamination at the site warrants regulation under the CLM Act as insufficient information has been provided. In order to progress our assessment, we require the following information:

- Site plans and tables of results summarising the concentrations of contaminants for each of the groundwater monitoring wells. The site plans should also show the extent of the groundwater contamination which exceeds the adopted assessment criteria;
- The nature and extent of the groundwater contamination arising from the leaching of contaminants from the stockpiles. We understand from your letter that these investigations are currently in progress; and
- An assessment of the risks posed to any nearby receptors (including water bodies, livestock and groundwater users) from the potential off-site migration of the contamination.

Would you please provide the above information within 8 weeks from the date of this letter. We will then review the information and assess whether the contamination at the site warrants regulation under the CLM Act or if the contamination would be more appropriately managed by the existing Environment Protection Licence (EPL No. 1548) under the *Protection of the Environment Operations (POEO) Act* 1997.

The site will be added to the public list of notified sites on the Environment Protection Authority (EPA) website, which can be accessed at: www.environment.nsw.gov.au/clm/publiclist.htm. This list includes all sites notified under section 60 of the CLM Act. The listing provides basic information such as the location of the sites, the category of activity that has caused the contamination and the current status of the sites with respect to site assessment and management. If circumstances relating to your site change, you should advise the EPA in writing so that the listing can be amended as appropriate.

If you have any further queries related to this matter, please contact John Coffey on (02) 99955621.

Yours sincerely

18/10/2012

NIALL JOHNSTON
Manager Contaminated Sites
Environment Protection Authority

Our reference: DOC15/40734

Mr Richard Brown
Managing Director
Hydro Aluminium Kurri Kurri Pty Limited
PO Box 1
Kurri Kurri, NSW, 2327

Email: richard.brown@hydro.com

Dear Mr Brown,

Hydro Aluminium Kurri Kurri
Section 60 Notification under the *Contaminated Land Management Act 1997*

Thank you for the information provided in response to our letter dated 18 October 2012 (attached for your reference) following the notification of the site under the *Contaminated Land Management Act 1997* (CLM Act), as well as the more recent updates after Hydro's announcement of the closure of the smelter in May 2014. We note that the demolition and remediation of the site are to be dealt with as State Significant Development by the NSW Department of Planning and Environment who issued Secretary's Environmental Assessment Requirements (SEARs) on 18 November 2014.

The contaminated sites section of the EPA has reviewed the reports provided on the contamination identified at the site and the assessment of potential risks from the contamination. We concur with the findings of the assessment, that under the existing use of the land and with 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. Changes to either the land use or configuration would require a reassessment of the risks.

The remediation of the land will be performed in accordance with the requirements of 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 land uses. A site auditor accredited under the CLM Act is required as part of this process to oversee the works on site relating to the 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.

We 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*. We do not intend to initiate additional regulation of the remediation work under the CLM Act at this stage and consider that the current and future site issues can be appropriately managed by the existing Environment Protection Licence (EPL No. 1548) under the *Protection of the Environment Operations (POEO) Act* 1997.

The record for the site on the EPA website of sites notified under section 60 of the CLM Act (http://www.epa.nsw.gov.au/clm/publiclist.htm) will be updated to reflect that regulation under the CLM Act is not required.

If you have any further queries related to this matter, please contact John Coffey on (02) 99955621.

Yours sincerely

9th February 2015

NIALL JOHNSTON
Manager Contaminated Sites
Environment Protection Authority

CC: EPA Region – Mr Bill George
Department of Planning and Environment (DPE)

APPENDIX 3
2014 SOIL AND GROUNDWATER INVESTIGATION RESULTS TABLES

TABLE LR1 Soil Analytical Results for AEC 2 Anode Waste Pile (mg/kg)

Sample Identification	PQL	HIL D[A]	EIL C/I[B]	ESL C/I	MW12	MW12	MW13	SB103	SB103	SB104	SB104	SB105	SB105	MW103	MW103	MW104	MW104
Sample Depth (m)					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	HIL D[A]	EIL C/I[B]	ESL C/I	SB17	SB18	MW19	MW19	SB111	SB111	SB112	SB112	SB112	SB113	SB113	SB114	SB114
Sample Depth (m)					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	101	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)

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

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)

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 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 con

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

<u>Results shown in underline are in excess of the ecological criteria</u>

<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	HIL D[A]	EIL C/I[B]	SB121	SB122	SB123	SB123	SB124	SB125	SB126	SB127	SB127	SB127	SB128	SB129	SB129	SB129	SB131
Sample Depth (m)				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	HIL D[A]	EIL C/I[B]	SB131	SB132	SB133	SB133	SB134	SB135	SB135	HA101	HA101	HA101	HA102	HA102	HA102	HA103	HA103	HA104
Sample Depth (m)				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	HIL D[A]	EIL C/I[B]	HA104	HA105	HA105	HA105
Sample Depth (m)				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	HIL D[A]	HSL D[B]	EIL C/I[C]	Management Limits[D]	ESL C/I[E]	TP101	TP104	TP107	TP111	TP113	TP115	TP116
Sample Depth (m)							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	HIL D[A]	HSL D[B]	EIL C/I[C]	Management Limits[D]	ESL C/I[E]	TP138	TP139	TP140
Sample Depth (m)							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

<u>Results shown in underline are in excess of the ecological criteria</u>

<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		<8		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-methyl	2					<2								<2		<2									
Malathion	2	0.05				<2								<2		<2									
Fenthion	2	0.2				<2								<2		<2									
Chlorpyrifos	2					<2								<2		<2									
Bromophos-ethyl	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 Ketones	2					<2								<2		<2									
Haloethers																									
Total Haloethers	2					<2								<2		<2									
Chlorinated Hydrocarbons																									
Total Chlorinated Hydrocarbons	2					<2								<2		<2									
Anilines and Benzidines																									
Total Anilines and Benzidines	2					<2								<2		<2									
Miscellaneous Compounds																									
Total Misscellaneous Compounds	2					<2								<2		<2									

All results in ug/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 Identificatior	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-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
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 ug/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)

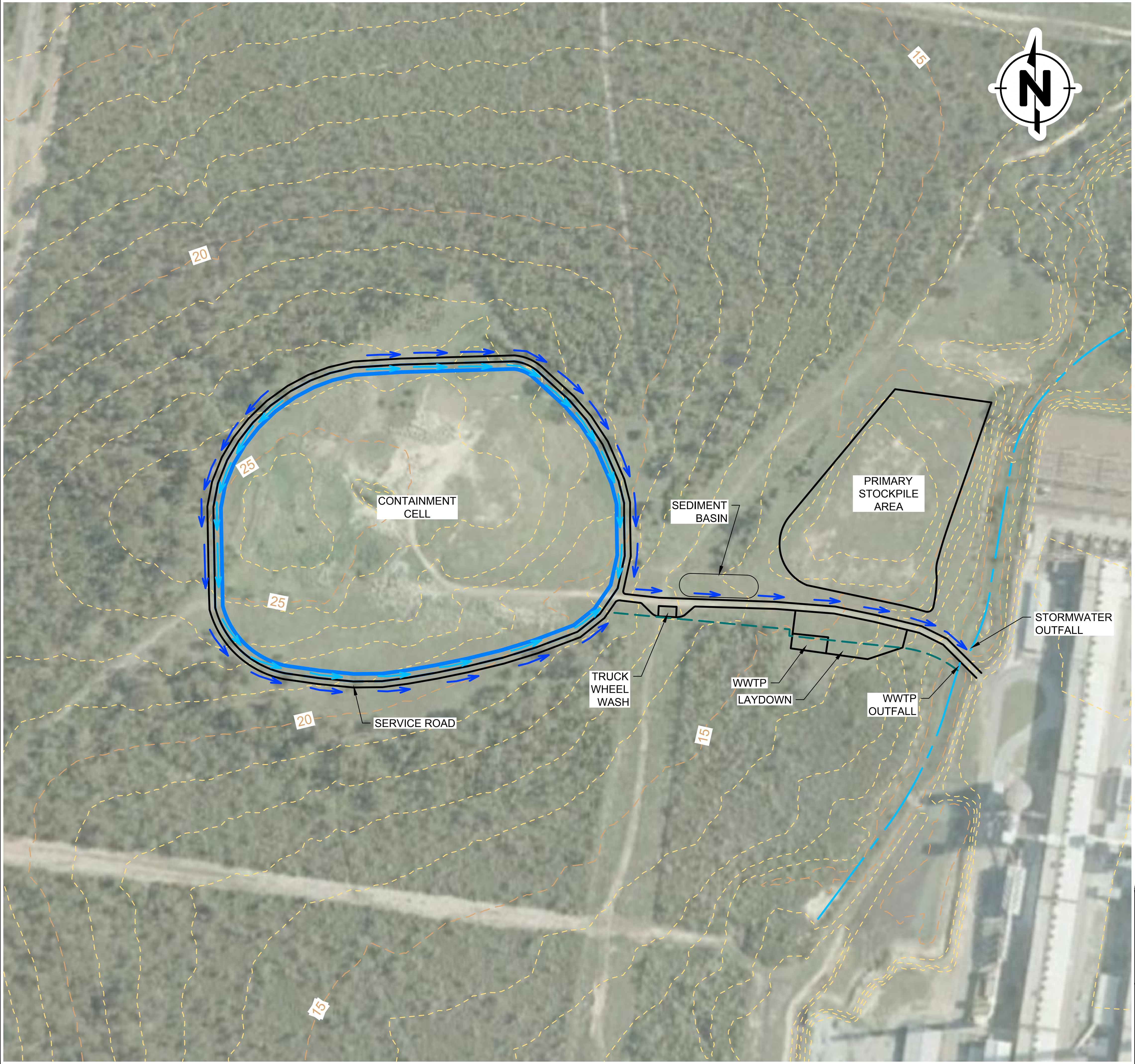
TABLE LR11 Groundwater Analytical Results for VOCs and SVOCs

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 4
CONTAINMENT CELL CONCEPT 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

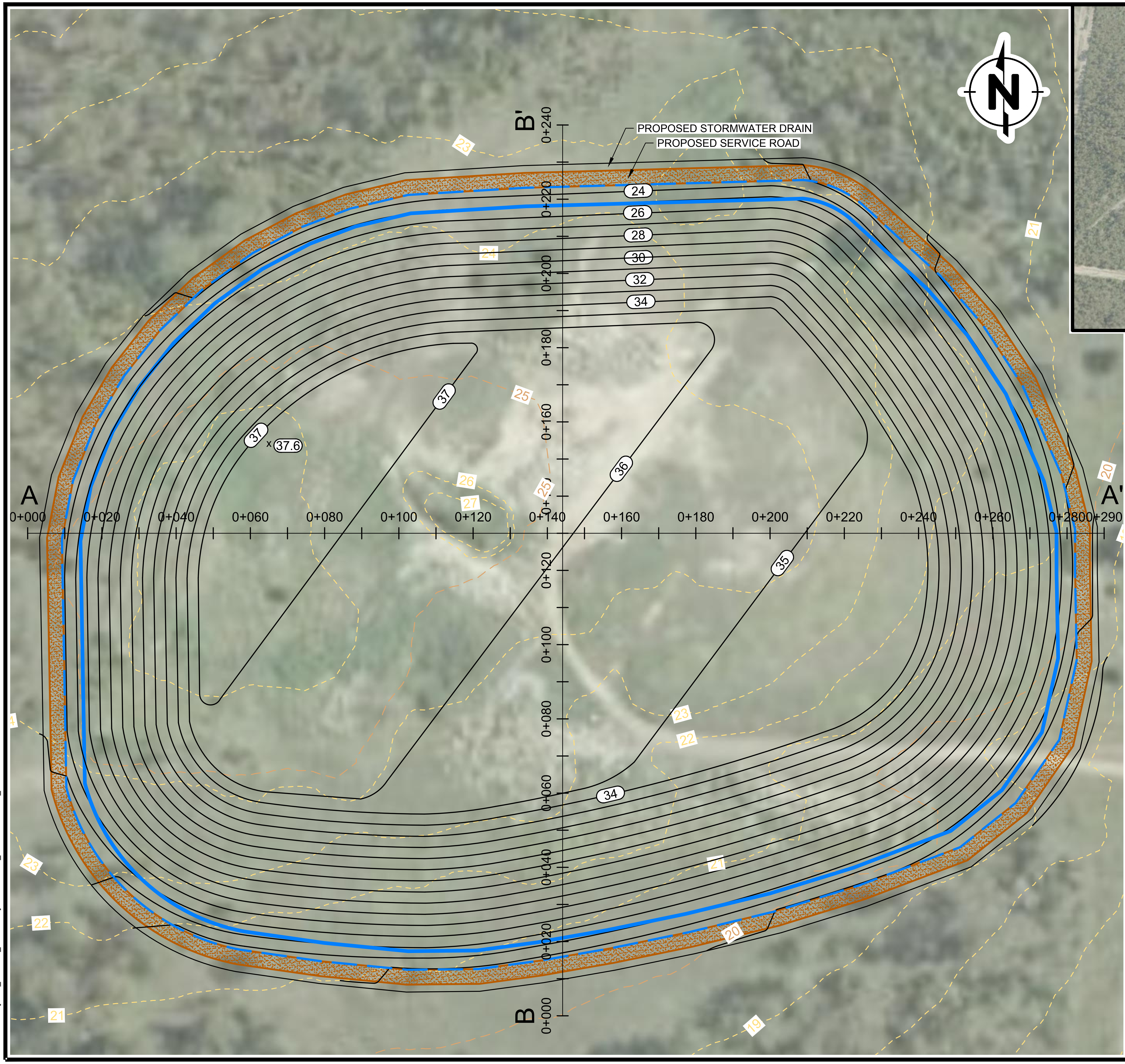
HYDRO ALUMINIUM SMELTER KURRI KURRI
NEW SOUTH WALES, AUSTRALIA

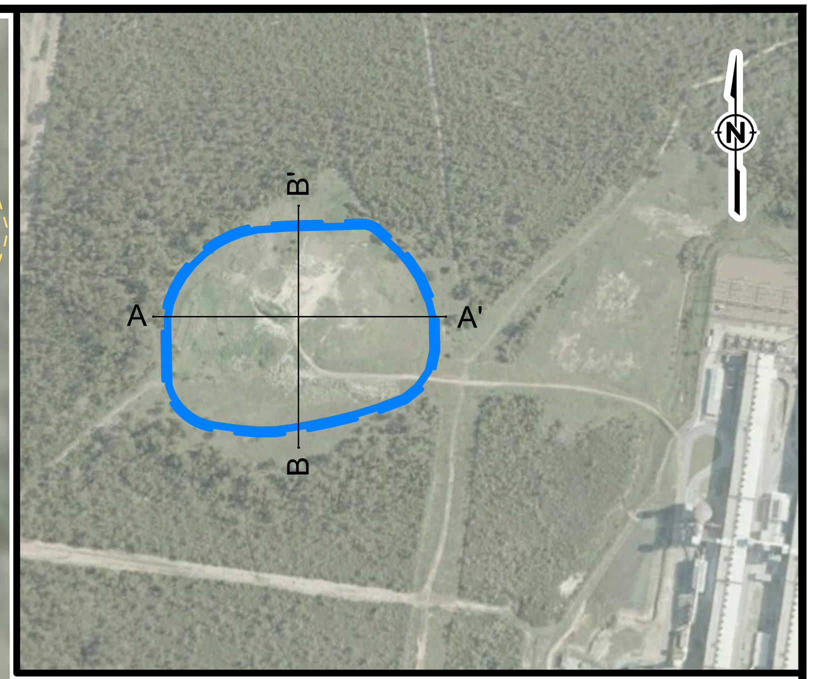
RAMBOLL ENVIRON

FIGURE 1

DRAFTED BY: PRM/MSB | DATE: 07/26/2016 | AS130349

MBLEI 7/26/16 [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 ALUMINIUM SMELTER KURRI KURRI
NEW SOUTH WALES, AUSTRALIA

RAMBOLL ENVIRON

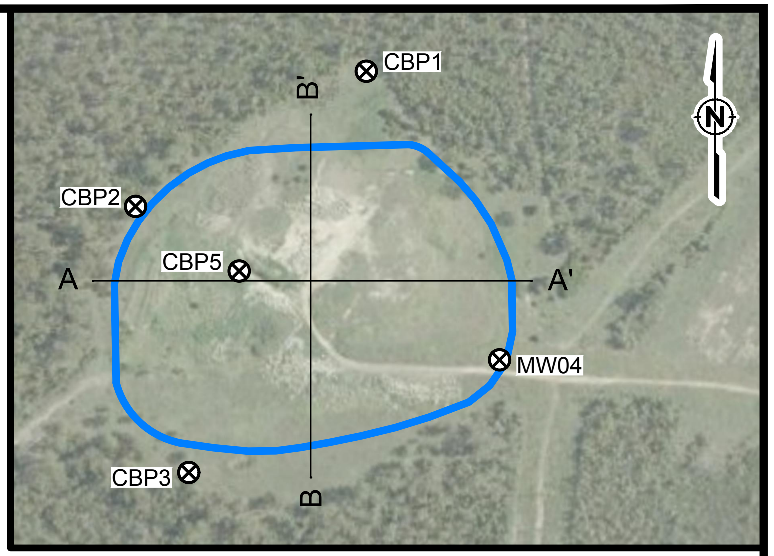
FIGURE 2

DRAFTED BY: PRM/MSB | DATE: 07/26/2016 | AS130349

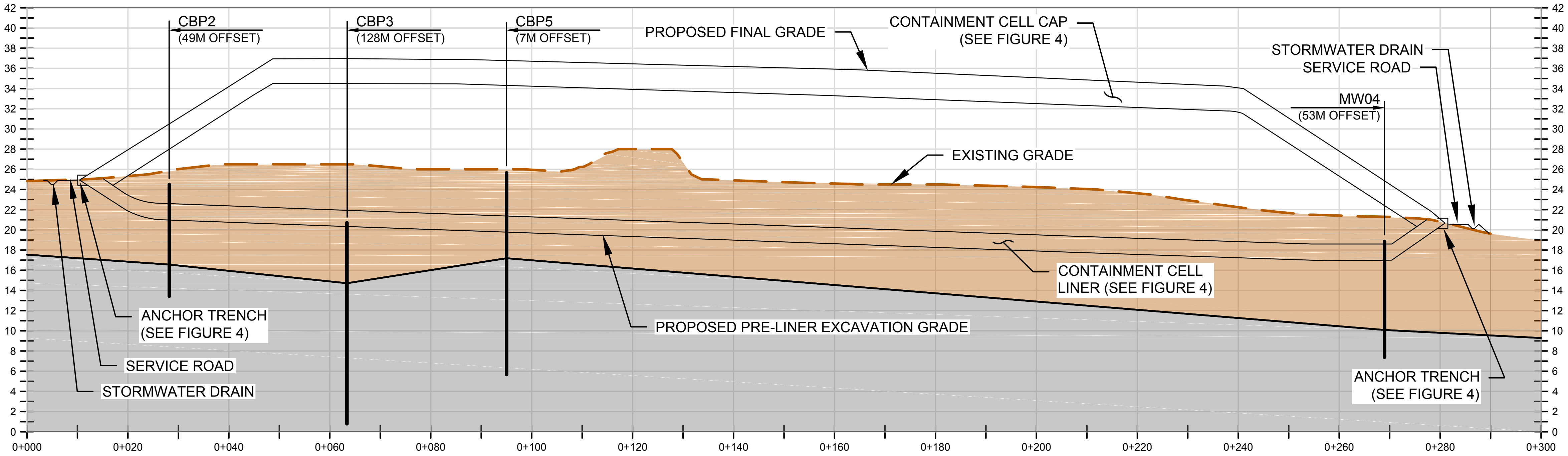
MBLEI 7/26/16 [REM_DESIGN_AS130349] F:\AS130349_NSW SMELTER_LANDFILL DESIGN REV

NOTES:

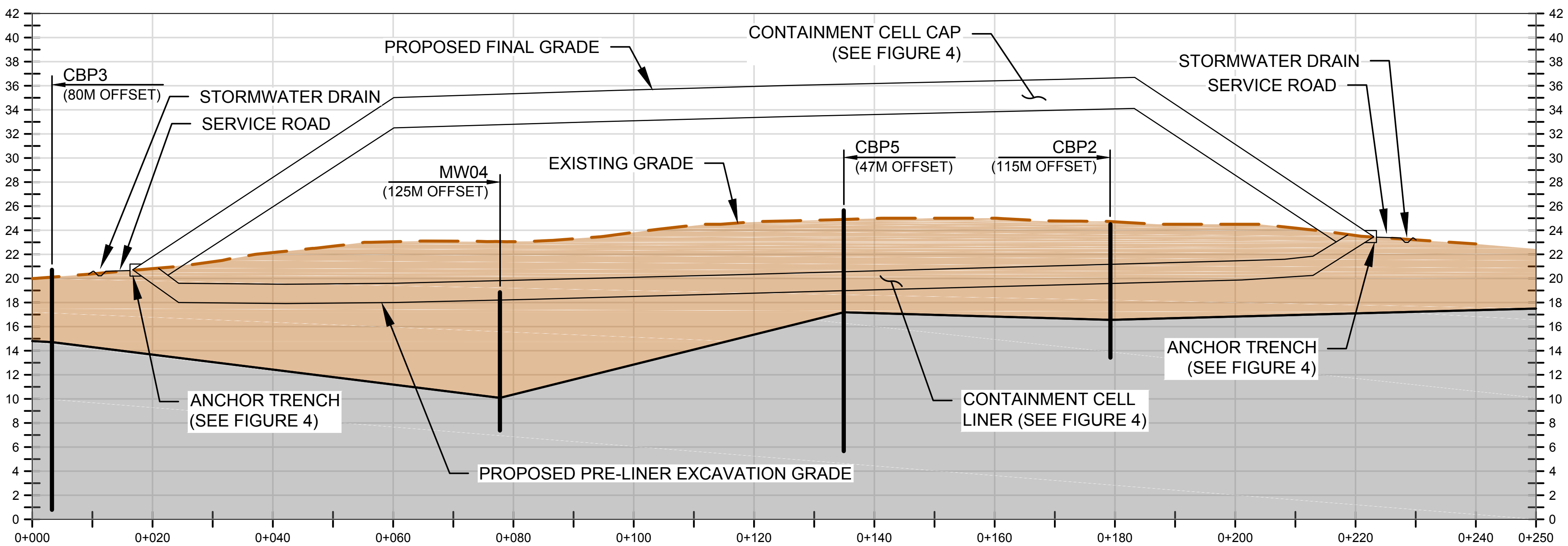
1. THE PROPOSED CONTAINMENT CELL FOOTPRINT HAS A CAPACITY OF 410,000 CU. M. THE CAPACITY WILL ACCOMODATE THE MAXIMUM VOLUME OF MATERIAL FOR ON-SITE CONTAINMENT PRESENTED IN THE REMEDIAL OPTION STUDY REPORT - 265,000 CU. M - PLUS DAILY COVER. IF NEEDED, ADDITIONAL CAPACITY CAN BE REALIZED BY INCREASING 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. SURFACE DRAINAGE FOLLOWING CAPPING WILL BE DESIGNED AND IMPLEMENTED TO PROMOTE SURFACE RUNOFF AND PREVENT SCOURING OF THE CAP SURFACE.
5. CELL FILLING WILL BE UNDERTAKEN LOGISTICALLY BASED ON SITE SEQUENCING.



KEY MAP
1:5,000



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

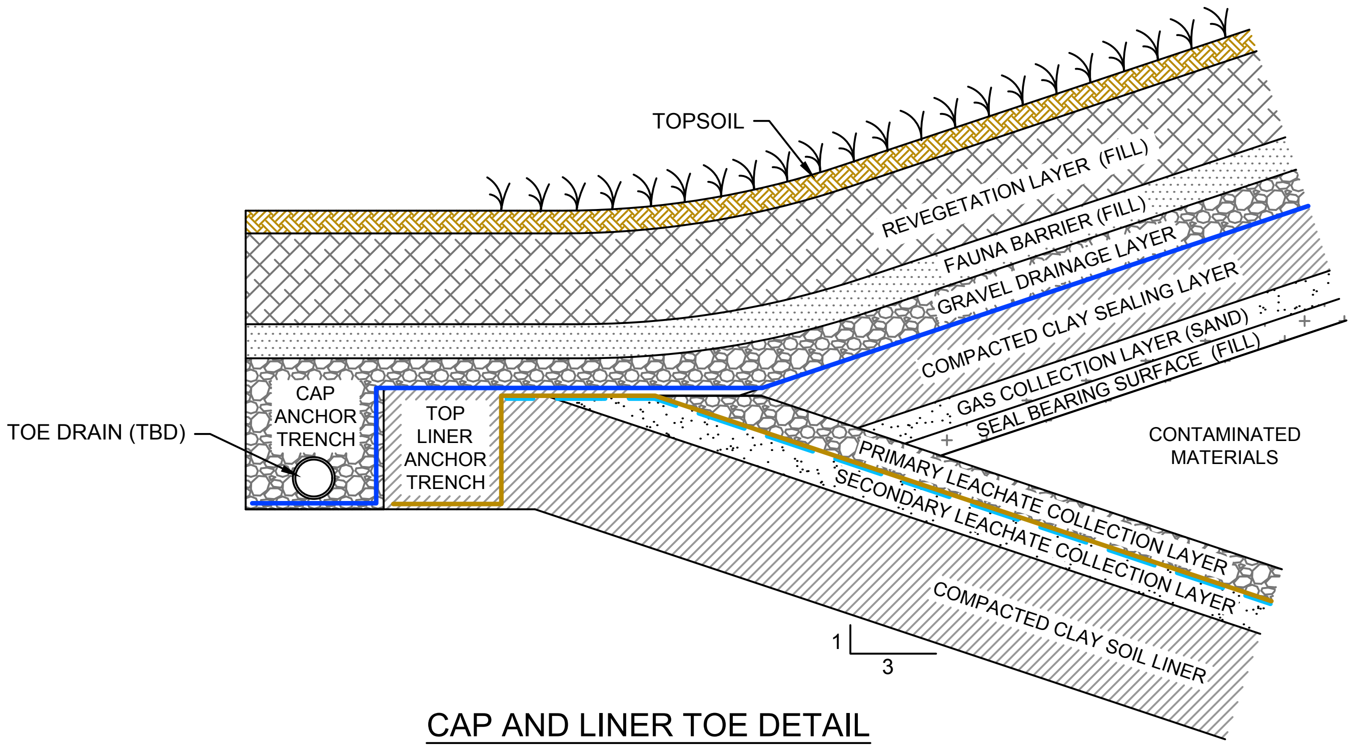
HYDRO ALUMINIUM SMELTER KURRI KURRI
NEW SOUTH WALES, AUSTRALIA

RAMBOLL ENVIRON

FIGURE 3

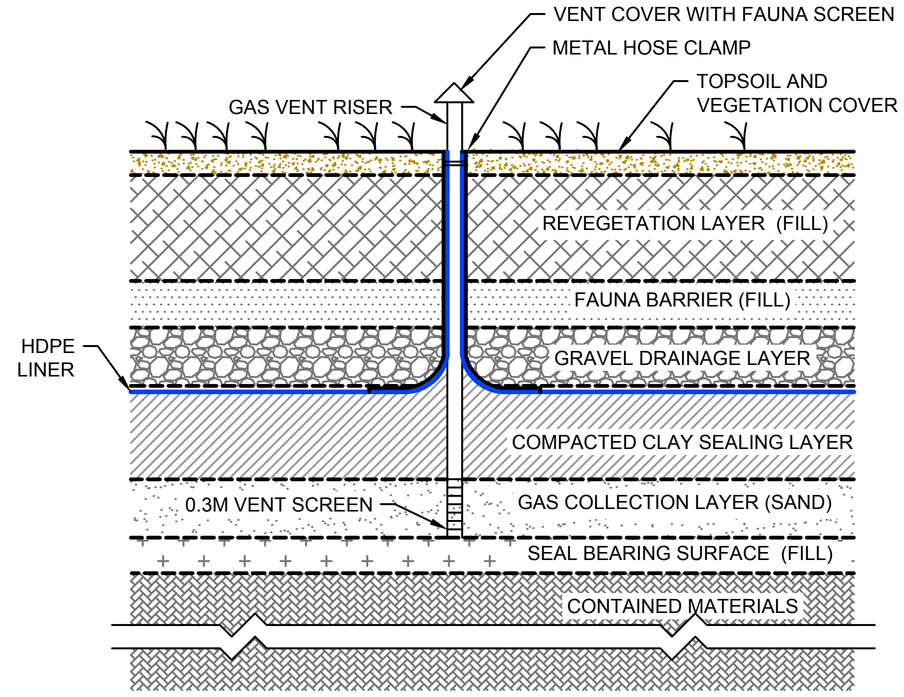
DRAFTED BY: PRM/MSB | DATE: 07/26/2016 | AS130349

MBLEI 7/26/16 [REM_DESIGN_AS130349] F:\AS130349_NSW SMELTER_LANDFILL DESIGN REV



CAP AND LINER TOE DETAIL

N.T.S.

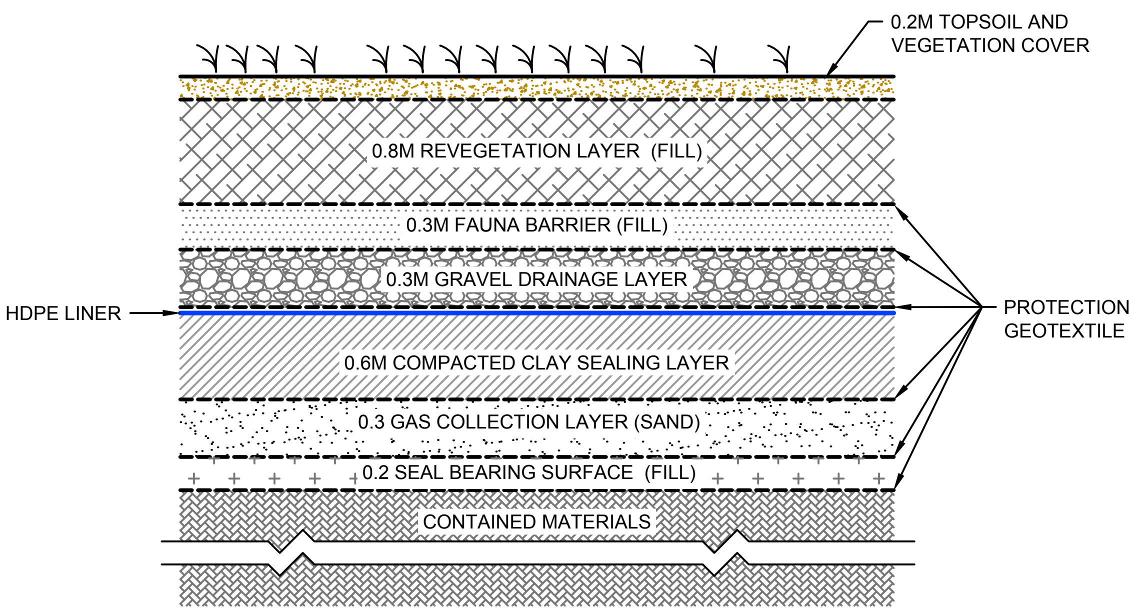


TYPICAL GAS VENT PENETRATION THROUGH CAP DETAIL

N.T.S.

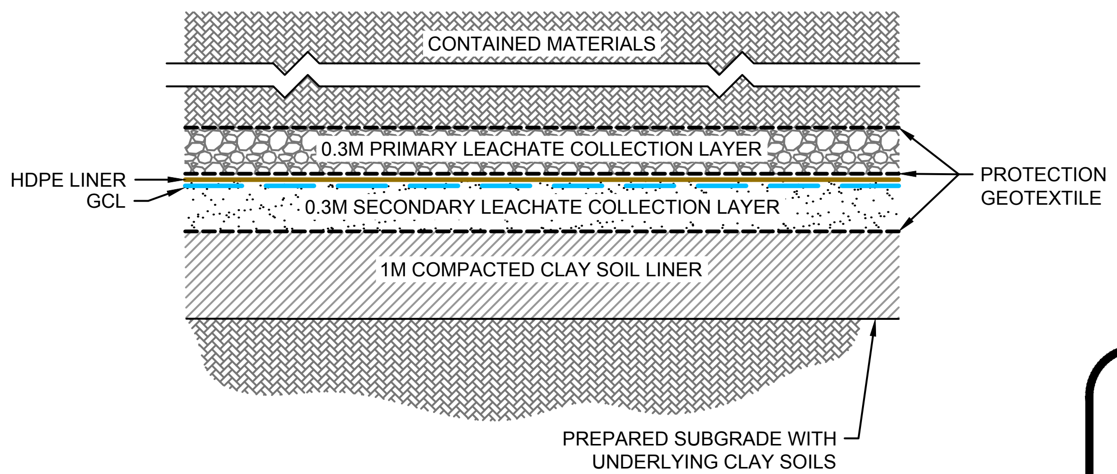
NOTES:

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.



CAP DETAIL

N.T.S.



LINER DETAIL

N.T.S.

CONCEPTUAL CONTAINMENT CELL DETAIL CAP AND LINER

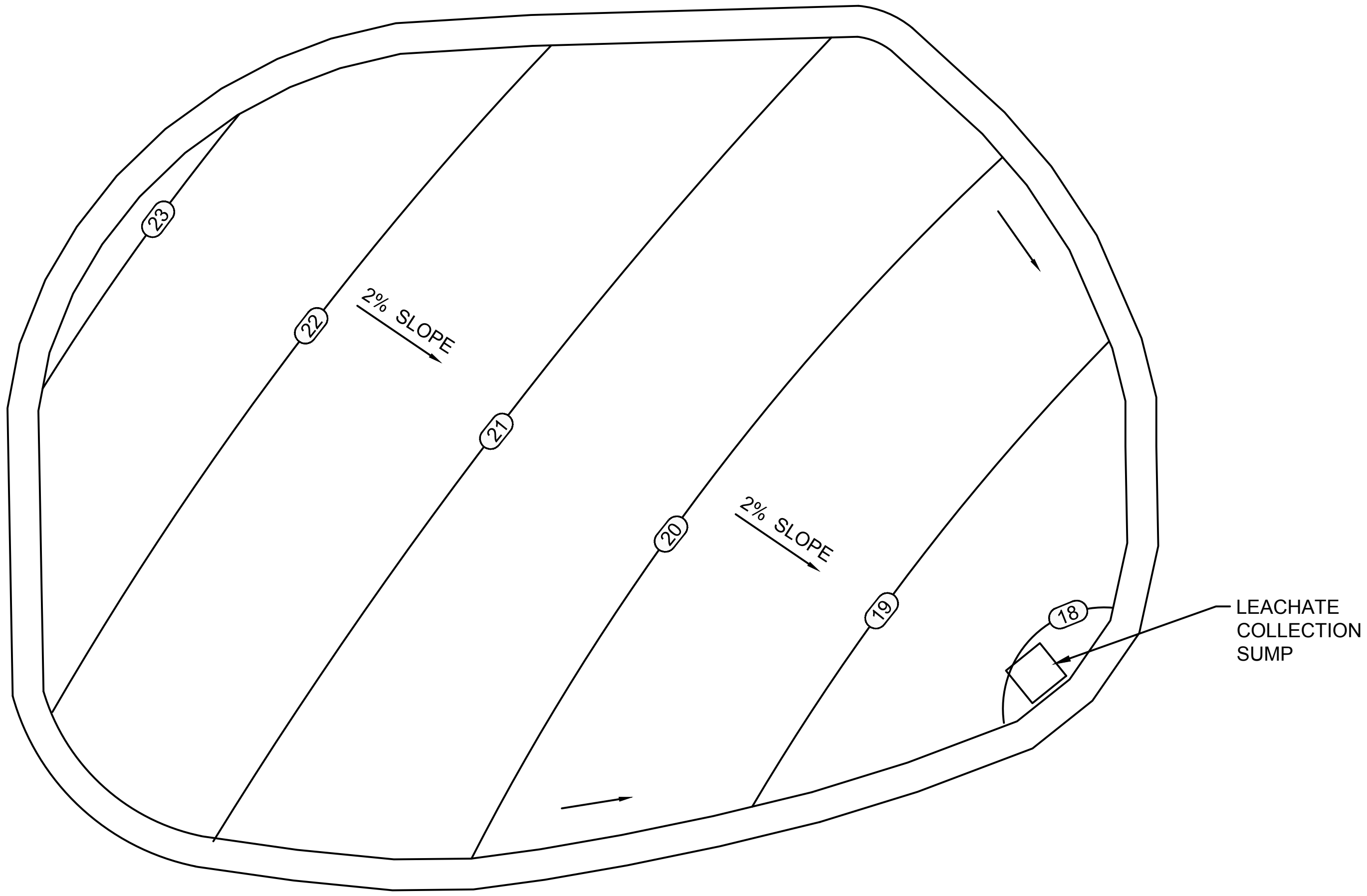
HYDRO ALUMINIUM SMELTER KURRI KURRI
NEW SOUTH WALES, AUSTRALIA

RAMBOLL ENVIRON

FIGURE 4

DRAFTED BY: PRM/MSB | DATE: 07/26/2016 | AS130349

MBLEI 7/26/16 [DETAILS_AS130349] F:\AS130349_NSW SMELTER_LANDFILL DESIGN REV



TYPICAL LEACHATE COLLECTION DRAINAGE LAYOUT

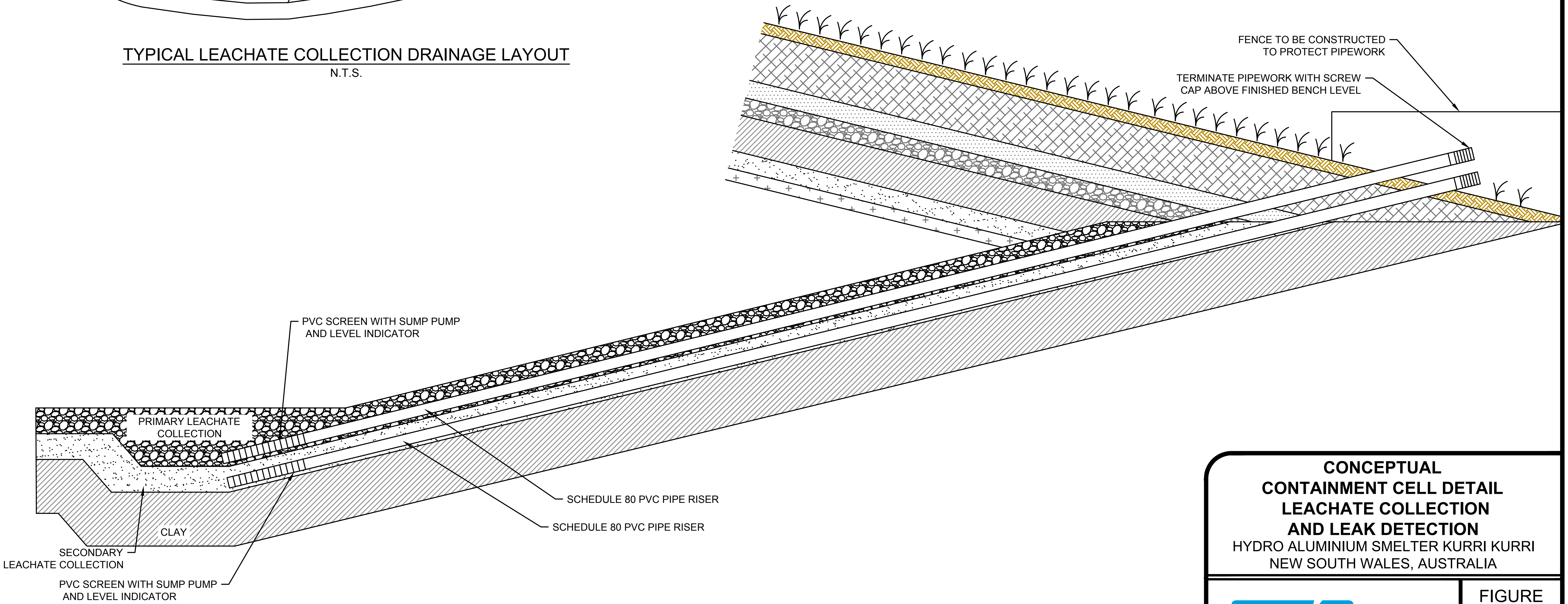
N.T.S.

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

HYDRO ALUMINIUM SMELTER KURRI KURRI
NEW SOUTH WALES, AUSTRALIA

RAMBOLL ENVIRON

FIGURE **5**

DRAFTED BY: PRM/MSB	DATE: 07/26/2016	AS130349

MBLEI 7/26/16 [DETAILS_AS130349] F:\AS130349_NSW SMELTER_LANDFILL DESIGN REV

APPENDIX 5
PHOTOGRAPHS OF AECS REQUIRING REMEDIATION

Plate 1: Capped Waste Stockpile (right-hand side of photo)

Plate 2: Anode Waste Pile

Plate 3: Diesel Spray Area

Plate 4: Drainage Lines near Capped Waste Stockpile and Anode Waste Pile

Plate 5: East Surge Pond

Plate 6: Carbon Plant

Plate 7: Carbon Plant – Western End

Plate 8: Bake Furnace Scrubber

Plate 9: Bake Furnace Scrubber

Plate 10: Area East of Playing Fields

AECOM

AECOM Australia Pty Ltd
17 Warabrook Boulevard
Warabrook NSW 2304
PO Box 73
Hunter Region MC NSW 2310
Australia
www.aecom.com

+61 2 4911 4900 tel
+61 2 4911 4999 fax
ABN 20 093 846 925

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:

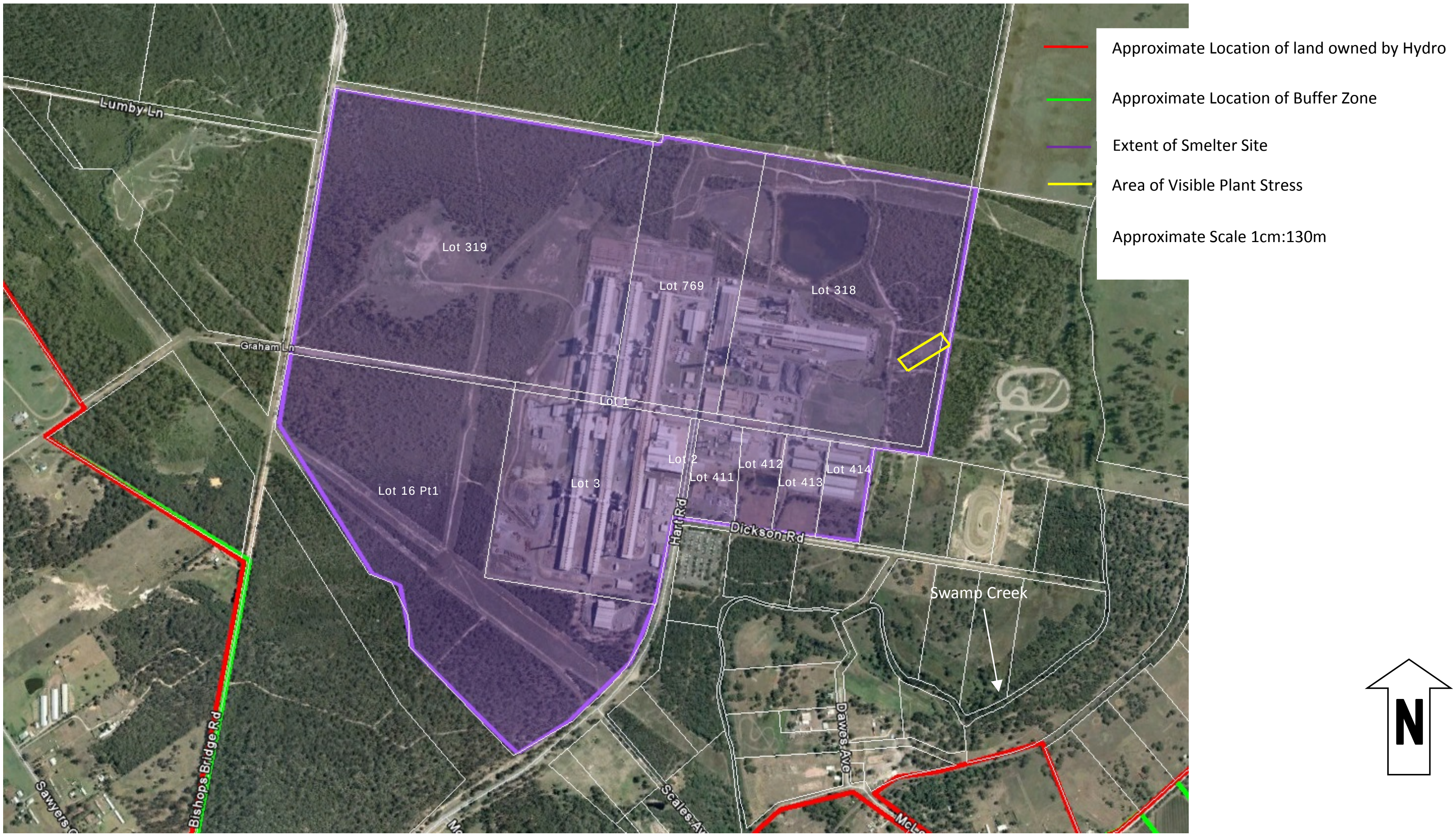
- This IO does not constitute a Site Audit Report and Site Audit Statement (SAR / SAS) but it does advise on my opinion of the documents reviewed.
- This IO is consistent with OEH / NSW EPA guidelines and policies.
- In the final SAR / SAS and associated documentation, this IO will be documented.
- At 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
Technical Director - Environment
Mobile: +61 4 13833811
Direct Dial: +61 2 4911 4982
Direct Fax: +61 2 4911 4999

© AECOM
* This document was prepared for the sole use of the party identified within the address header, and that party is the only intended beneficiary of AECOM Australia Pty Ltd (AECOM) work.
* No other party should rely on the document without the prior written consent of AECOM, and AECOM undertakes no duty to, nor accepts any responsibility to, any third party who may rely upon this document.
* All rights reserved. No section or element of this document may be removed from this document, extracted, reproduced, electronically stored or transmitted in any form without the prior written permission of AECOM



Hydro Aluminium Kurri Kurri: Remedial Action Plan

Smelter Site Plan

RAMBOLL ENVIRON

JOB NO: AS130349

DATE: July 2016

FIGURE 2