Privileged and Confidential

Remedial Action Work Plan, Clay Borrow Pit Area
Kurri Kurri NSW

Prepared for:
Hydro Aluminium Kurri Kurri Pty Ltd

Prepared by:
ENVIRON Australia Pty Ltd

Date:
23 December 2014

Project Number:
AS130386

ENVIRON

Prepared by:

Name: Kirsty Greenfield
Title: Environmental Scientist
Phone: + 61 2 4962 5444
Email: kgreenfield@environcorp.com
Signature: Date:23/12/14

Authorised by:

Name: Fiona Robinson
Title: Principal - Hunter
Phone: + 61 2 4962 5444
Email: frobinson@environcorp.com
Signature: Date:23/12/14

VERSION CONTROL RECORD

Document File Name	Date Issued	Version	Author	Reviewer
_386 Clay Borrow Pit RAWP_D1	27 June 2014	Draft 1	S Cadman	F Robinson
_386 Clay Borrow Pit RAWP_FINAL V2	24 July 2014	Final	S Cadman	F Robinson
_386 Clay Borrow Pit RAWP_FINAL V2	17 December 2014	Revised Final	K Greenfield	F Robinson
_386 Clay Borrow Pit RAWP_FINAL V2	23 December 2014	Revised Final	K Greenfield	F Robinson

Contents

List of Figures

List of Tables

List of Appendices

Acronyms and Abbreviations

ACM	Asbestos Containing Materials
AHD	Australian Height Datum
ALS	Australian Laboratory Services
ANZECC	Australian and New Zealand Environment and Conservation Council
B(a)P	Benzo(a)pyrene
BGL	below Ground Level
BTEX	Benzene, Toluene, Ethylbenzene & Xylenes (Monocyclic aromatic Hydrocarbons)
CT	Certificate of Title
DEC	NSW Department of Environment and Conservation, now EPA
DP	Deposited Plan
DQI	Data Quality Indicator
DQO	Data Quality Objective
EIL	Ecological Investigation Level
EPA	NSW Environment Protection Authority
ESA	Environmental Site Assessment
F	Fluoride
GMU	Groundwater Management Unit
GPS	Global Positioning System
Ha	Hectare
HIL	Health Investigation Level
HSL	Health Screening Level
HRA	Health Risk Assessment
km	Kilometres
LOR	Limit of Reporting
m	Metres
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, Se: Selenium
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Litre
m AHD	Metres relative to the Australian Height Datum
m BGL	Metres below ground level
m TOC	Metres below top of casing
ML	Megalitre, one million litres
mg/L	Micrograms per Litre
NATA	National Association of Testing Authorities
NC	Not Calculated
ND	Not Detected
NEHF	National Environmental Health Forum
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NSW	New South Wales
n	Number of Samples
OH&S	Occupational Health & Safety
PAH	Polycyclic Aromatic Hydrocarbons
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/Quality Control
RAWP	Remediation Action and Work Plan
RPD	Relative Percent Difference
TRH	Total Recoverable Hydrocarbons
UCL	Upper Confidence Limit
US EPA	United States Environment Protection Authority
µg/L	Micrograms per Litre
VENM	virgin excavated natural material
-	On tables is "not calculated", "no criteria" or "not applicable"

EXECUTIVE SUMMARY

ENVIRON Australia Ltd (ENVIRON) has been commissioned by Hydro Aluminium Kurri Kurri Pty Limited (Hydro) to prepare this Remedial Action Work Plan (RAWP) for the implementation of remedial works at the site known as the Clay Borrow Pit, Hart Road Loxford, New South Wales, 2320.

The Clay Borrow Pit is owned by Hydro and is situated within the Hydro Aluminium Smelter Buffer Zone, which is a large land area owned and managed by Hydro as part of the smelter operations. Smelter closure was announced in May 2014 and Hydro is now preparing land for future divestment and redevelopment. The Clay Borrow Pit is proposed for commercial/industrial land use and remediation of the land for this purpose is required. The objective of this RAWP is to describe the works necessary to render the site suitable for the future land use.

The Clay Borrow Pit is zoned Rural Landscape (RU2) under the Cessnock Local Environment Plan 2011 and has been used for rural land use and materials storage during and prior to the smelter operations.

Historical records indicate the site was the source of clay materials for capping of the Capped Waste Stockpile located on the eastern side of the Smelter site and undertaken in the 1990's. Since that time, reinstatement of the excavated area using inert materials from the Smelter site, including concrete, refractory brick and bitumen has been undertaken.

An evaluation of soil and surface water identified that impacts to surface water from the filled areas has not occurred. No impacts to soil within the fill were identified. The presence of fill was recognised to represent an impact on visual amenity and safety risk to the proposed future use of the property.

A review of remediation options was undertaken and also included a review of remedial options applicable to all Hydro owned lands (a whole-of-site strategy). 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 are proposed to be coarsely sorted and stockpiled in a designated area of the Smelter site. Materials relocated to the Smelter site will be stockpiled separately for later beneficial reuse where permissible, or incorporated within a whole-of-site remediation strategy.

This RAWP outlines the remedial plan to be implemented at the site to achieve the remediation objective. The RAWP includes a detailed works methodology including validation requirements and environmental controls to be implemented during the works. At the completion of works a validation report will be compiled including a clear statement of the suitability of the site for the proposed future commercial/industrial use.

1 Introduction

The following Remediation Action and Work Plan (RAWP) details site conditions and requirements for remediation of the area of land known as the “Clay Borrow Pit Area”, located immediately west of the Hydro Aluminium Kurri Kurri Pty Ltd (Hydro), Aluminium Smelter (**Figure 1**).

1.1 Background

Hydro is currently evaluating options for the redevelopment and possible divestment of land parcels following closure of the smelter in May 2014. A Preliminary Masterplan was developed that identified land proposed for industrial/commercial rezoning which includes the Clay Borrow Pit, located to the west of the Smelter site.

Low permeability clay was won from the Clay Borrow Pit for the purpose of capping a waste stockpile, now known as the Capped Waste Stockpile, located on the Smelter site. These works were undertaken in the 1990’s. Since that time the resultant void has been progressively filled with inert smelter derived materials originating from plant maintenance and expansion works. These materials typically comprise bake furnace refractory brick and building materials including concrete and asphalt.

As part of the pre-closure due diligence assessment, a site wide Phase 2 Environmental Assessment was undertaken (ENVIRON 2012). This investigation identified the presence of smelter derived materials and included a visual assessment of the materials by excavation, and assessment of impacts to soil and groundwater from the presence of these materials. Materials stockpiled at the Clay Borrow Pit include above and below ground stockpiles.

A preliminary characterisation of bake furnace refractory brick was completed in 2012 as part of an application for a resource recovery exemption. Detailed characterisation sampling was completed in 2014 following the provision of the draft ‘The Hydro Aluminium Kurri Kurri bake ovens refractory brick exemption 2012’. Characterisation sampling indicated the majority of the refractory bricks are suitable for re-use under the draft exemption.

Environmental investigations of these materials found a low risk to human health and the environment. The materials were identified to represent a visual impact under future commercial/industrial land use.

1.2 Objective

The objective of the works is to remediate the Clay Borrow Pit to a level suitable for the proposed commercial/industrial land use. This RAWP forms part of those works and provides a description of the impacted areas requiring remediation and the methodology to remediate and validate those areas in order to meet the project objective.

1.3 Regulatory Framework and Guidelines

This document has been prepared in, light of the following guidelines:

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

2 Scope of Work

To meet the objective ENVIRON have completed the following scope of work.

- Review of all previous reports prepared for the Clay Borrow Pit including:
  - ENVIRON Australia Pty Ltd (ENVIRON 2012a) Application for Exemption – Refractory Brick, Hydro Aluminium Pty Ltd, August 2012.
  - ENVIRON Australia Pty Ltd (ENVIRON 2012b) Sampling, Analysis and Quality Plan, Refractory Brick Characterisation, December 2012.
  - ENVIRON, Phase 1 Environmental Site Assessment, Hydro Kurri Kurri Aluminium Smelter, prepared for Hydro Aluminium Kurri Kurri Pty Ltd, October 2013.
  - ENVIRON, Phase 2 Environmental Site Assessment, Kurri Kurri Aluminium Smelter, prepared for Norsk Hydro ASA, November 2012.
- Sampling of the refractory brick for characterization in accordance with ENVIRON (2012) Sampling, Analysis and Quality Plan, Refractory Brick Characterisation.
- Identification and evaluation of possible remedial options including consultation with Hydro personnel in order to determine the most appropriate remedial option.
- Consultation with regulatory guidelines.
- Presenting the selected remedial option, and the basis for that option, in this RAWP.

3 Site Identification

3.1 Site Details

Table 3.1 presents site identification and location details.

Table 3.1: Site Identification	
Site Owner	Hydro Aluminum 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 north-west of Kurri Kurri, and 30km north-west of Newcastle.
Geographical Coordinates	Latitude 32 78 53 S, Longitude 151 4735 E
Lot and DP Numbers	Part of Lot 319 DP 755231
Site Area	Approximately 6 ha. Lot 319 comprises 52.1 ha.
Zoning (current)	RU2 – Rural Landscape
Site Elevation	RL 20 to 30 m in the centre and north of the lot to RL 10-15m in the south and south east.
Site Map	Figure 1

3.2 Site Boundaries

The site is located within the following boundaries:

- in the east by the western side of the Smelter site;
- in the north by vegetated land owned by Hydro;
- to the west by the former Bishops Bridge Road (now defunct due to the construction of the new Hunter Expressway) and vegetated land owned by Hydro; and
- to the south by bushland, with an Ausgrid easement and the Hunter Expressway further south.

The location of the Clay Borrow Pit is shown on **Figure 1**.

4 Site History

The Clay Borrow Pit is located approximately 400m to the west of the Smelter. Site history investigations included in the Phase 1 ESA for the Hydro Aluminium Kurri Kurri Smelter, dated 26 August 2013 indicate that the Clay Borrow Pit was the location of a hobby farm until approximately 1967. The land was unused from then until the early 1990's when a proposal to cap a waste stockpile located on the Smelter main site was approved. The clay capping comprised low permeability clay which was won from the area now known as the Clay Borrow Pit. The resultant void was later filled with inert materials from the Smelter site primarily comprising bake furnace refractory, concrete and asphalt. Filling has reinstated the excavation to ground level. Subsequent filling has resulted in above ground stockpiling of these smelter materials in this area.

Historical photographs of the Clay Borrow Pit are included in **Appendix A**.

4.1 Potential Areas of Concern

Based on the site history review potential areas of concern were identified to be:

- Presence of smelter derived materials for use in filling and later as stockpiles;
- Potential for dust deposition of the site due to the proximity of the Smelter.

5 Site Conditions

5.1 Topography

The Clay Borrow Pit is located on slightly elevated land to the west of the main Smelter plant site on a north-south trending ridge, at approximately 25 mAHD. The land generally slopes towards the south-east and the small southern tributary of Black Waterholes Creek. The creek conveys surface water to the north towards Wentworth Swamp.

The main entrance to the site is an unsurfaced four wheel drive access road from the western side of the Smelter plant site.

5.2 Geology

According to the review of the regional geology described on the Sydney Basin Geological Sheet, the Clay Borrow Pit Area is underlain by siltstone, marl and minor sandstone from the Permian aged Rutherford Formation (Dalwood Group) in the Sydney Basin.

Undifferentiated Quaternary alluvium occurs to the south-east of the site associated with surface water bodies. Quaternary sediments which are associated with Black Waterholes Creek and Wentworth Swamp consist of gravel, sand, silt and clay.

5.3 Hydrogeology

Regional groundwater is expected to follow topography and flow northeast towards the surface water bodies that discharge to the Hunter River. Locally, groundwater beneath the Clay Borrow Pit Area is expected to generally flow south-east and east to the adjacent Black Waterholes Creek and more distant Wentworth Swamp.

According to the NSW Office of Environment and Heritage (Natural Resource Atlas), there are 31 licensed groundwater abstractions (bores) located approximately 9km north east of the Clay Borrow Pit.

The groundwater bores are located within the coal measures or Quaternary Alluvium associated with Wentworth Swamp and other associated surface water bodies.

Information for seven bores located in a 5km radius from the Clay Borrow Pit indicated the bores are used for domestic, recreation, monitoring, irrigation and stock watering purposes.

The Hunter River Alluvium Groundwater Management Unit (GMU) is an important groundwater resource to the region. Groundwater extraction for irrigation, urban supply, drought supply, stock, domestic and commercial/ industrial use occurs, with volumes in excess of 10,000ML per annum extracted from the Hunter River Alluvium GMU. Aquifer storage and recovery is also an important use of this GMU. It is noted that the Hunter River GMU is not the primary drinking water supply in the region, although the protection of drinking water is a water quality objective for the Hunter River (NSW Water Quality and River Flow Objectives) (www.environment.gov.au/ieo./Hunter/index.htm).

5.4 Hydrology

Surface water from the Clay Borrow Pit discharges via natural drainage lines to the south-east site boundaries. The north western portion of the site drains toward the northern tributary of Black Waterholes Creek which flows into the Wentworth Swamp wetlands system, approximately 2.5km to the north-east.

The Wentworth Swamp system is within the Fishery Creek Catchment, where declining stream water quality and a reduction in diversity of native plants and animals has occurred due to population growth and development pressures in the last ten years (Hunter-Central Rivers Catchment Management Authority).

5.5 Site Sensitivity

The sensitivity of the Clay Borrow Pit with respect to surface water and groundwater is considered to be moderate based on the following:

- Surface water and groundwater discharge into Wentworth Swamp located approximately 2.5km north-east of the Clay Borrow Pit and discharges to the Hunter River within the Fishery Creek Catchment, approximately 12km north-east of the Clay Borrow Pit near Maitland.
- Declining stream water quality and a reduction in diversity of native plants and animals has occurred within the Fishery Creek Catchment and water quality down gradient of the Clay Borrow Pit has been impacted by historical coal mining;
- The Hunter River GMU is used for irrigation, urban supply, drought supply, stock, domestic and commercial/ industrial use but it is not the main drinking water supply in the region.

6 Soil and Surface Water Assessment Criteria

6.1 Potential Contaminants of Concern

Potential Contaminants of concern associated with the burial and stockpiling of smelter materials and smelter stack particulate fallout were considered to include the following:

- fluoride and cyanide;;
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Heavy Metals;
- Asbestos, from disposal of building materials.

6.2 Soil

The guidelines proposed for the assessment of soil contamination at the Clay Borrow Pit were sourced from the following references:

- NEPC (1999) National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1) (NEPM); and
- Site specific derivation of a guideline for fluoride.

The variation to the NEPM was approved on 19 June 2013 by the NSWEPA under the *Contaminated Land Management Act 1997*. The NEPM amendment 2013 provide revised health-based soil investigation levels (HILs), health based screening levels (HSLs), ecological-based investigation levels (EILs) and ecological based screening levels (ESLs) for various land uses. A summary of the applicability of these guidelines follows.

- The HILs are applicable for assessing human health risk via all relevant pathways of exposure and have been developed for four main land use categories. The HILs are generic to all soil types and apply generally to a depth of 3m below the surface for residential use.
- HSLs for soil vapour intrusion from petroleum hydrocarbons are guidelines that prevent accumulation of vapours at concentrations that may represent a health risk. The HSLs are derived for various depths and are for the same generic land uses as for the HILs. The guidelines are relevant were soils are beneath building or structures such as confined spaces.
- EILs have been developed for commercial/ industrial landuse and are applicable for assessing risk to terrestrial ecosystems. EILs depend on specific soil physicochemical properties and generally apply to the top 2m of soil. Site-specific EILs were developed using pH and Cation Exchange Capacity data from topsoil samples collected from across the entire Buffer Zone. The EIL site-specific calculations using the NEPM Toolbox are included in **Appendix B**.
- ESLs have been developed for commercial/ industrial landuse and are 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.

- Management Limits where concentrations above these limits may indicate poor aesthetics, high odour and potentially explosive vapour. Management limits are to be applied after consideration of relevant ESLs and HSLs.

The applicable assessment criteria for site soils are presented in **Table 6.1.**

Table 6.1: Soil Guidelines (mg/kg) – Health and Ecological Investigation Levels

	HIL D	EIL
Arsenic	3000	160[1]
Cadmium	900	-
Chromium (VI)	3600	-
Chromium (III)		320[2] (1% clay)
Copper	240 000	300[2]
Lead	1500	1800[1]
Nickel	6000	310[2]
Zinc	400 000	700[2]
Mercury (inorganic)	730	-
Cyanide (free)	1500	-
Naphthalene	NL	370[1]
Carcinogenic PAHs (as BaP TEQ)	40	-
Total PAHs	4000	-

1 EILs represent the most conservative value possible as the lowest value for added contaminant limit (ACL) was used and the ambient background concentration (ABC) was not added,

2. Chromium III, nickel, zinc and copper EILs were calculated by adding the ACL with the estimated ABC using the NEPM (2013) EIL Calculation Spreadsheet for aged contamination under commercial/ industrial landuse.

The applicable assessment criteria for volatile PAHs in soil are presented in **Table 6.2 and Table 6.3.**

Table 6.2: Soil Assessment Guidelines for Vapour Intrusion - HSL D (mg/kg) - Sand

	0 to <1m	1m to <2m	2m to <4m	4m+
Naphthalene	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 F2 subtract naphthalene from the >C10-C16 fraction.

Table 6.3: ESLs and Management Limits for Petroleum Hydrocarbons in Soil			
TPH fraction	**Soil texture**	**ESLs (mg/kg dry soil)**	**Management Limits[1] (mg/kg dry soil)**
		Commercial and Industrial	**Commercial and Industrial**
Benzo(a)pyrene	Fine	1.4	-

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 for ESLs, subtract the sum of BTEX from C6-C10 fraction. For F2, naphthalene should not be subtracted as there is no separate ESL for naphthalene.

The HSLs for asbestos are applicable for assessing human health risk via the exposure pathway of inhalation of airborne asbestos and are presented in **Table 6.4**. The HSLs are generic to all soil types.

Table 6.4: Health screening levels for asbestos contamination in soil Health Screening Level (w/w)				
Form of asbestos	**Residential A[1]**	**Residential B[2]**	**Recreational C[3]**	**Commercial/ Industrial D[4]**
Bonded ACM	0.01%	0.04%	0.02%	0.05%
FA and AF[1] (friable asbestos)	0.001%			
All forms of asbestos	No visible asbestos for surface soil			

1. The screening level of 0.001% w/w asbestos in soil for FA and AF (i.e. non-bonded/friable asbestos) only applies where the FA and AF are able to be quantified by gravimetric procedures. This screening level is not applicable to free fibres.

NEPM (2013) do not provide criteria for fluoride in soils in Australia. Therefore, ENVIRON (2013) conducted a preliminary level Human Health Risk Assessment (HRA) specific to fluoride in order to derive a specific preliminary screening level for soluble fluoride for the Hydro Aluminium Kurri Kurri Smelter. The screening levels are protective of the range of human receptors and are provided in **Table 6.5**.

Table 6.5: Site Specific Soil Assessment Guidelines (mg/kg) for Soluble Fluoride	
Land Use	**Preliminary screening level**
Commercial/ industrial - soil	F 17000mg/kg

6.3 Water

The assessment criteria for the assessment of surface water were sourced from the following references:

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

- ENVIRON (2013) Preliminary Screening Level, Health Risk Assessment for Fluoride and Aluminium, Part of the Kurri Kurri Aluminium Smelter, Hart Road, Loxford.

6.3.1 Potential Beneficial Uses

Potential beneficial uses of surface water on site and down gradient of the Clay Borrow Pit include:

- Flow to Black Waterholes Creek and ultimately discharge to Wentworth Swamp, which supports aquatic ecosystems, and potentially flows into the Hunter River;
- Extraction of water from Wentworth Swamp may also be used for stock watering and/ or irrigation.
- Discharge into groundwater, which is used by local communities for domestic, recreation, monitoring, irrigation and stock watering purposes, as described in **Section 5.3**.

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

- Drinking water supply to the local communities is reticulated and originates from Chichester Dam located on the Chichester River;
- The Kurri Kurri Waste Water Treatment Works is located up gradient of the Clay Borrow Pit. The Works has a licensed discharge point into Swamp Creek, which flows into Wentworth Swamp. Extraction of surface water for drinking water downgradient of this discharge point is therefore not undertaken.

6.3.2 Appropriate Criteria for Surface Water

Based on the review of potential beneficial uses of groundwater and surface water, the criteria for protection of aquatic ecosystems, irrigation and stock watering will be used. Additionally, site specific preliminary screening levels for fluoride and aluminium in surface water have been developed for the Hydro Aluminium Kurri Kurri Smelter (ENVIRON 2013). These are protective of human health and are as follows:

- Surface water (recreational use): Fluoride – 1.5mg/L, Aluminium – 9mg/L.

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/ remedial action.

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-Central Rivers Catchment Management Authority that declining stream water quality and a reduction in diversity of native plants and animals has occurred in the last ten years.

ANZECC (2000) indicates there is currently insufficient data to derive a high reliability trigger value for TRH but propose a low reliability trigger value of 7µg/L. This guideline is considered by industry to be overly conservative and is below the TRH detection limit that most laboratories can achieve. Therefore the limit of reporting (LOR) will be adopted as a screening trigger for TRH.

Trigger values for cadmium, copper, nickel, lead and zinc can be modified for hardness, as the bioavailability of these heavy metals decreases with increasing hardness. Total hardness was calculated for the receiving waters of Wentworth Swamp using calcium and magnesium concentrations, with results indicating hard water (236mg/L CaCO3). Trigger values modified for hard waters have been used, as per Table 3.4.3 of ANZECC (2000).

Surface water results will also be compared against trigger values for irrigation and stock watering. Section 4.3.4 of ANZECC (2000) indicates that stock watering trigger values for heavy metals and metalloids are for total concentrations, irrespective of whether the constituent is dissolved, complexed with an organic compound or bound to suspended solids. Fluoride is included in this section.

Investigation levels for livestock drinking water are not available for organic contaminants, such as TRH and PAHs. In the absence of available investigation levels, the limit of reporting (LOR) will be adopted as a screening trigger for TRH and PAHs.

The long term trigger value has been used for irrigation guidelines. Section 9.2.5.11 of ANZECC (2000) indicates that the long term trigger value for fluoride is based on the assumption that the irrigation water could potentially be phytotoxic to sensitive plant species or could contaminate stock drinking water. As stock watering guidelines are for total metal and metalloid concentrations, total fluoride concentrations will be used.

7 Site Characterisation

7.1 Assessment of Contamination

ENVIRON conducted a site assessment of the Clay Borrow Pit in 2012 as part of a Hydro-wide preliminary investigation to addressing the potential for soil and groundwater contamination (ENVIRON 2012).

Materials placed to reinstate the void following the winning of clay included concrete, bitumen/asphalt slabs (assumed to be from internal roads at the smelter), bake furnace refractory brick. These materials were found to be both buried and stockpiled at the surface. Buried materials were mixed with soils. No asbestos containing materials were identified during the investigations.

The Phase 2 investigation undertaken in 2012 included the excavation of five test pits, the drilling of six boreholes and the installation of four groundwater monitoring wells to assess the extent and nature of the fill materials and any impacts to surrounding soils or groundwater. The sampling locations are shown in **Figure 3**. Copies of the borehole and test pit logs are included in **Appendix B**.

Investigations found the depth of fill material to extend up to 4.2m with the greatest depth occurring at the eastern extent of the filled area. Fill materials comprised refractory bricks, broken concrete slabs, metal and rubble within a sandy clay matrix. Three of the five test pits were terminated at depths between 1.2m and 2.0m due to instability from water ingress. Refractory bricks were not identified within test pits TP3, TP4 and TP5. In some areas of the Clay Borrow Pit, refractory bricks were identified beneath approximately 1m of overlying sand and clay fill (e.g. test pit TP1 and borehole MW05). Fill materials were underlain by red / grey residual clay to depths of approximately 8m to 10m, underlain by extremely weathered siltstone.

Soil samples were analysed for hydrocarbons, heavy metals, total fluoride, and a range of semi-volatile hydrocarbon including PAHs, pesticide, and chlorinated hydrocarbons. Soil matrix samples detected potential contaminants of concern either below detectable limits or below guideline concentrations.

Groundwater samples were also analysed for hydrocarbons, heavy metals, fluoride, cyanide, and a range of semi-volatile hydrocarbon including PAHs, pesticide, and chlorinated hydrocarbons. Evaluation of groundwater quality from within the in-filled borrow pit (MW05) found elevated concentrations of fluoride (15,000µg/L). The fluoride concentration, compared to a background concentration of 1000µg/L in MW06, is considered to be elevated.

Groundwater wells surrounding the Clay Borrow Pit (MW03 and MW04) identified concentrations of aluminium (maximum 2530µg/L), fluoride (maximum 5500µg/L), cadmium (maximum 3.1µg/L), nickel (maximum 938µg/L) and zinc (1840µg/L) exceeding the criteria and above concentrations found in MW05. Wells MW03 and MW04 are situated in residual soils and upgradient of the Borrow Pit. A second round of sampling was completed in August 2012, which confirmed the results of the initial sampling. The concentrations of the analytes detected are above levels considered to be natural occurring however, given the upgradient location of the wells the elevated metals concentrations are not considered to be associated with activities at the site or from the placement of fill in the Clay Borrow Pit. It is noted that

the surrounding land consists of virgin bushland of the buffer zone and there are no identified industrial facilities up gradient of the Clay Borrow Pit that could provide a source for the elevated metals concentrations.

Summary tables presenting analytical results compared to adopted site guidelines and the location of soil and water sampling points are presented in **Appendix C.**

Remediation of the clay borrow pit is required to removal aesthetic impact from the presence of these materials and to mitigate possible impacts to groundwater.

7.2 Refractory Brick Exemption Sampling 2012

It was recognised that concrete, asphalt and bake furnace refractory materials within the Clay Borrow Pit may be suitable for reuse under existing and specific exemptions in accordance with the Protection of the Environment Operations (Waste) Regulation 2005 – General Exemption under Part 6, Clause 51 and 51A.

Chemical analysis of bake furnace refractory was undertaken as part of a submission for beneficial reuse of these materials. The chemical composition determined as part of that exemption is tabulated in **Table 7.1**.

Table 7.1: Summary Chemical Characteristics of Refractory Brick (2012)

Analyte	PQL	Summary statistics			
		Minimum	Average	Maximum	Standard Deviation
Moisture Content		<0.5	0.5	7.5	2.3
Metals					
Arsenic	4	<4	-	<4	0
Beryllium	1	<1	-	<1	0
Boron	3	<3	26	98	25
Cadmium	0.5	<0.5	0.5	4	1
Chromium	1	2	12	38	8
Lead	1	<1	5	45	10
Molybdenum	1	<1	1	2	0
Nickel	1	2	5	7	2
Selenium	2	<2	-	<2	0
Tin	1	<1	1	2	0
Mercury	0.1	<0.1	-	<0.1	0
Silver	1	<1	-	<1	0
Copper	1	8	12	23	7
Zinc	1	3	7	12	4
Vanadium	0.5	8	20	46	10
Non Metallic Inorganics					
Total Fluoride	50	<50	191	920	276
Total Cyanide	0.5	<0.5	-	<0.5	0
Sulphur	1	110	1871	9100	2624
Total Organic Carbon	1	1100	1910	5600	1125

Chloride	1	<100	-	<100	0
Electrical Conductivity	1	42	902	2500	825
pH	1	7	9	11	2
Polycyclic Aromatic Hydrocarbons					
Sum of reported PAH	0.1	<0.1	-	-	-

All units are mg/kg on a dry weight basis.

Concentrations presented in **Table 7.1** are below the site guidelines for soils. This supports the conclusion that the risk associated with the presence of these materials is associated with visual amenity. Also, the data further supports that metals identified in groundwater are not likely to be resulting from the presence of these materials. The exception is the concentration of fluoride identified at MW5 which may be attributed to the presence of these materials, noting that groundwater sampled at MW5 is a perched water table present within the filled materials.

This preliminary characterisation data was used in the application for the resource recovery exemption.

7.3 Refractory Brick Exemption Sampling 2014

The Draft Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption 2012 was granted by NSW EPA in October 2012. In a letter dated 21 December 2012, NSW EPA requested a detailed characterisation of the refractory bricks be completed as per ENVIRON (December 2012) Sampling, Analysis and Quality Plan (SAQP). This detailed characterization sampling was undertaken in August 2014.

The detailed characterisation sampling was completed as per the sampling locations outlined in Figure 1 of the SAQP on an approximate 20m grid (see **Figure 4**). Brick samples were collected from both stockpiled and buried material .Twelve brick samples were collected from 25 test pits and 24 brick samples were collected from above-ground stockpiles. Each sample comprised five brick chips that were crushed and composited to form one sample. As per the SAQP, each sample was analysed for Heavy Metals, fluoride (total), cyanide (total) and 20% of the samples were analysed for PAHs.

The analytical results were compared against Table 2 of the Draft 'The Hydro Aluminium Kurri Kurri base ovens refractory brick exemption 2012', with average concentrations compared against Column 2 and maximum concentrations compared against Column 4, as outlined in **Table 7.2**. A full laboratory summary is presented in **Appendix D**.

Table 7.2: Summary Chemical Characteristics of Refractory Brick (2014)

Analyte	No. of Samples	Summary statistics (mg/kg)			
		Average	Maximum Average[1]	Maximum	Absolute Maximum[2]
Metals					
Arsenic	36	2	15	2	30
Cadmium	36	0.2	0.5	**2**	1
Chromium	36	2.7	40	20	80
Copper	36	2.1	40	9	80
Nickel	36	2	25	8	50
Lead	36	1.1	50	10	100

Zinc	36	2	150	25	300
Mercury	36	0.05	0.5	0.05	1
Non Metallic Inorganics					
Total Fluoride	36	86.8	300	**730**	600
Total Cyanide	36	0	-	0	1
Polycyclic Aromatic Hydrocarbons					
Benzo(a)pyrene	7	<0.05	-	0.39	1
Sum of reported PAH	7	<0.0.5	-	4	40

1 Maximum Average Concentration for Characterisation, from Column 2 of Table 2 from the Draft Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption 2012

2 Absolute Maximum Concentration, from Column 4 of Table 2 from the Draft Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption 2012

As shown in **Table 7.2**, the absolute maximum concentration of cadmium and fluoride were exceeded. The cadmium concentration in one sample, RB18, was 2mg/kg exceeding the absolute maximum concentration of 1mg/kg. The total fluoride concentration in one sample, RB14, was 730mg/kg exceeding the absolute maximum concentration of 600mg/kg. Both RB14 and RB18 are samples of buried bricks. The segregation of these two exceedences is discussed further in **Section 9.5**.

No bricks were found within 13 of the 25 test pits excavated into the eastern portion of the Clay Borrow Pit. Where no bricks were found, the test pits generally comprised brown/ red gravelly sandy clay fill material. The anticipated extent of the buried bricks is outlined in **Figure 3**.

It is noted that the laboratory results from the characterisation sampling are below the HILs for commercial/ industrial landuse and below the EILs and no asbestos containing materials were identified during this investigation.

7.4 Assessment of Exposure Routes and Potential Receptors

The Clay Borrow Pit forms part of the Hydro smelter buffer zone and is a temporary stockpiling area for site demolition wastes. As such the site is rarely frequented and presents no impact on visual amenity, as the appearance is directly related to the Hydro purpose of use.

Impacts to surrounding surface water and groundwater are inconclusive. However, if impacts occur the primary receptors would include the ecological community of Black Waterholes Creek and Wentworth Swamp under both the current and future land use scenarios.

For the proposed future commercial/industrial land use the site in its current state is considered to represent an impact on visual amenity.

7.5 Statement of Suitability for Existing and Proposed Site Use

The site is suitable for the current land use although further assessment of impacts to groundwater should be undertaken if management or remediation is not proposed. The site is not considered suitable for the proposed commercial/industrial land use due to the impacts on visual amenity and the potential for impacts to groundwater and surface water.

8 Remedial Action Plan

8.1 Remediation Goal

The goal of this remediation project is to remediate and validate those areas of the Clay Borrow Pit identified as being unsuitable for commercial/industrial development due to impacts to visual amenity from stockpiled and buried fill material.

8.2 Extent of the Remediation Required

Aesthetic impacts from stockpiled and buried smelter demolition materials including refractory brick, concrete and bitumen within a soil matrix requires remediation across the area on Lot 319 DP755231, shown in **Figure 2** and known as the Clay Borrow Pit.

The impacts to visual amenity identified comprise a former excavation being reinstated with smelter derived construction materials and subsequently stockpiling of these materials across an area adjacent to the filled excavation.

Estimated volumes of materials are shown on **Figure 5**.

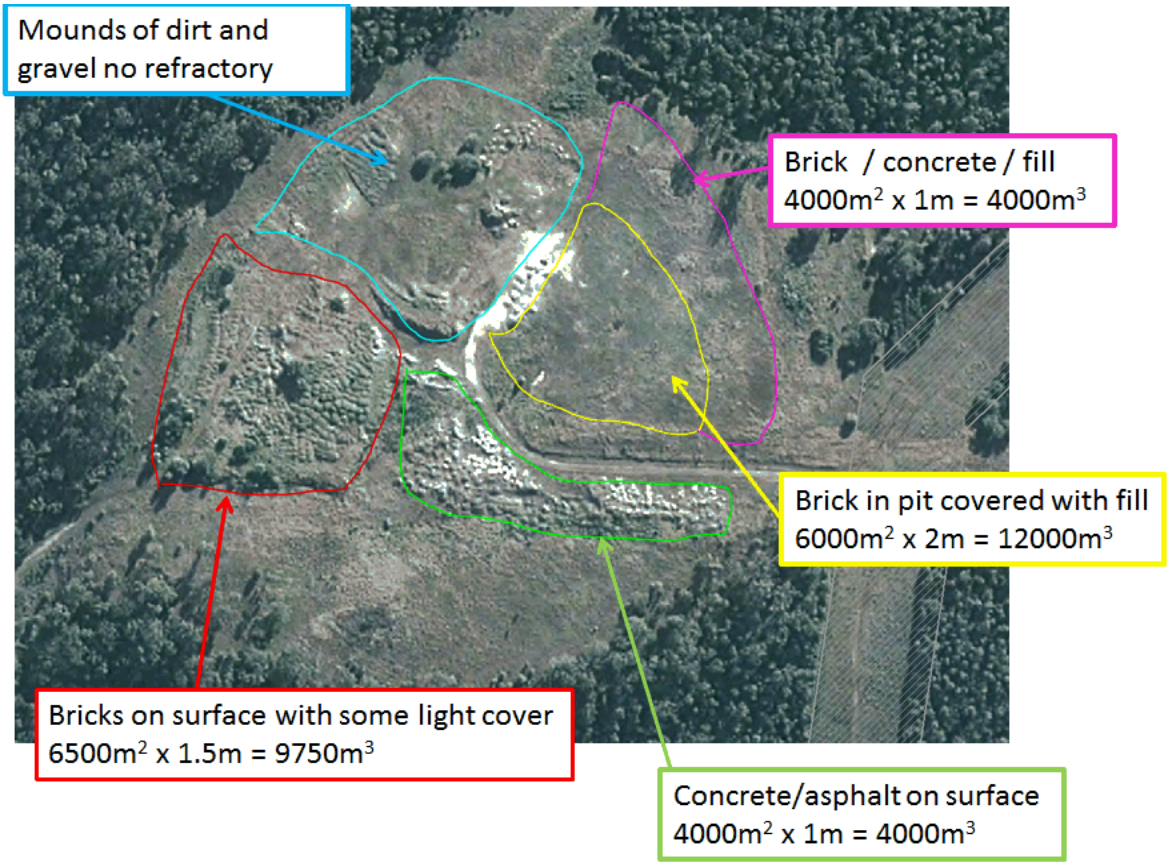


Figure 5: Estimated Material Volumes

Potential contaminants of concern, including heavy metals and fluoride, were detected within the soil matrix at concentrations below the site criteria. PAHs and SVOCs were not detected above the laboratory limits of reporting. As the stockpiled and buried materials are inert (concrete, refractory brick and bitumen) and the soil matrix shows no impact, it considered there is no risk of impact to the underlying clay, therefore the extent of remediation is to extend to the top of the underlying clay. In general, **Figure 5** will serve as 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.

8.3 Remediation Options

Based on the site characterisation presented in **Section 7**, a review of potential remediation options for the Clay Borrow Pit was undertaken.

Table 8.1 presents a summary of the available remedial options considered for the site and the contaminants present.

Table 8.1: Assessment of Remediation Options

Option	Description	Advantages	Disadvantages
1	Do nothing	Cost effective solution. An EMP may not be required.	Does not address the aesthetic issues or potential risks to groundwater from the presence of filled materials. Planning approval may be an issue. May require an Environment Protection Licence. Reduction of land values.
2	Excavate and dispose to landfill.	Removes long term management requirement from site, leaving no legacy issues. Improves land value. Planning approval requirements straightforward.	Consumes off site landfill space. Disposal costs are very high. Remaining void may need rehabilitation with clean fill.
3	Re-use smelter derived materials in-situ and establish capping layers	Long term management risk low. Costs mitigated by a combination approach and relatively easy to achieve	May reduce property value. Development may be restricted due to potential presence of unsuitable materials due to geotechnical/foundation properties of placed materials. May require management into future (including monitoring)
4	Excavation and combined encapsulation of all materials at another location within Hydro owned land	Relocates long term management requirements. Improves land value for Clay Borrow Pit.	Planning approval may be an issue. Timeline is reliant on whole of site solution.
5	Excavate and removal of smelter derived materials to another location within Hydro owned land for recycling (potential a minor component will not be able to be	Relocates long term management requirements. Improves land value for Clay Borrow Pit. Offers most sustainable solution. Allows for an immediate improvement in aesthetics.	Requires additional costs for testing (to obtain resource recovery exemption).

Table 8.1: Assessment of Remediation Options			
Option	**Description**	**Advantages**	**Disadvantages**
	recycled).		

8.4 Rational for the Selection of the Recommended Remedial Option

Remediation options were considered in terms of cost, risk of failure, long term legacy and onsite management, corporate responsibility and sustainability. In terms of these evaluators, Option 5 was preferred. Option 5 provides a sustainable reuse option for concrete, bitumen and refractory brick. These materials will be segregated pending later evaluation for reuse under the NSW EPA resource recovery general and specific exemptions. Any materials that are unable to be reused will be incorporated in a whole-of-site solution allowing consolidation of materials in one location thereby reducing environmental footprint, potential land sterilization, and long term management requirements. Hydro has conducted a whole-of-site remediation options study in 2014 to identify the most appropriate remediation strategy applicable to the issues across all Hydro owned lands. Materials not able to be recycled from the Clay Borrow Pit temporarily stockpiled for incorporation in a whole-of-site strategy.

8.5 Contingency if the remedial strategy fails

Table 8.2 outlines the potential failure scenarios that could occur and the contingency mechanisms that will be implemented to achieve the overall remediation objective.

Table 8.2: Remediation Contingency Planning	
Failure Scenario	**Contingency Response**
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, (eg physical constraints, safety etc), alternative strategies may be employed to justify leaving contamination in place (eg specific risk assessment). Such alternatives will not proceed without consultation and full written approval of the Principal.
Unexpected materials are encountered including significant volumes of highly contaminated soils and/or asbestos-containing materials, not currently allowed for using the proposed methodology	The Principal will be advised and consideration will be given to alternate methods of disposal (eg, off-site to landfill or to temporary storage).
Concrete, bitumen, refractory brick do not meet general or specific exemptions for reuse.	Consider the hierarchy of other preferred options including off site disposal or onsite treatment and disposal.
Material segregation proves not feasible using the proposed methodology	The Principal will consider transport of unsegregated material to the stockpile location for evaluation at a later date.
A whole-of-site strategy is not approved that incorporates the Clay Borrow Pit unusable materials.	Consider the hierarchy of other preferred options including off site disposal or onsite treatment and disposal.

8.6 Interim Site Management Plan

The Clay Borrow Pit is located within the Hydro site boundaries and is not accessed by the public. Soils at the site are stabilised by vegetation and do not represent an erosion

potential. On this basis, there is not considered to be a requirement for interim site management.

9 Remedial Action Works Plan

9.1 HOLD POINT

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

- Mobilisation and site facilities required and proposed locations
- Methods of excavation, sorting, materials tracking, backfilling;
- Compaction specification for reinstatement of the void;
- Final landform design;
- Quality control procedures that demonstrate how the requirements of the RAWP (including validation) will be met and documented.

The general objectives are outlined in the following.

9.2 Mobilisation

Mobilisation and setup on-site of required plant and personnel.

Setup of work controls including environmental and safety systems and controls, both at the Clay Borrow Pit and at the proposed area identified on the main Hydro site and referred to as the Smelter site stockpile area (location to be advised).

Establishment of all controls listed herein and within the CEMP, **Section 11.**

9.3 Survey

Survey, conducted by a registered surveyor, will be undertaken. The survey will involve:

- Pre-remediation survey of the surface, excluding surface stockpiles;
- Following excavation and removal of fill material, but prior to backfilling and completion of the remediation; and
- Post-remediation following backfilling, topsoiling/landscaping.

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

The survey plan forms part of the remediation validation requirements described in **Section 9.9.**

9.4 Remediation Methodology

Excavation and sorting of materials in the Clay Borrow Pit Area (including materials currently stockpiled on the surface and materials buried across the site), identified in **Figure 2** is required. Materials are to be sorted and transported to the stockpile locations, excavations are to be validated and the area is to be reshaped.

9.5 Excavation

The Contractor may schedule excavation works in stages to allow partial excavation and validation before proceeding on to the next stage. If remediation is undertaken in this fashion, the Contractor will still need to comply with the validation and survey requirements as set out in **Section 10** and in **Section 9.3** respectively.

It is noted that bricks were not identified at all sampling locations during the previous investigations. The locations where bricks were not identified are included on **Figure 4**. It is also noted that bricks were identified at some locations below approximately 1m of cover. Excavation works shall extend to a minimum of 1.5m bgs in the area of buried bricks, and extending laterally outwards from the main fill area until natural ground is reached.

Two samples of bricks with exceedences of the absolule maximum concentrations for cadmium and fluoride were identified during characterisation sampling under the Draft Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption 2012. As per ENVIRON (2012b) SAQP, non-conforming materials need to be separately excavated and stockpiled as per the following methodology:

- Where individual sample locations fail on the basis of a non-conforming maximum concentration, the sample will be removed from the data set and the area represented by the sample considered a hotspot.
- The area defined as a hotspot will be that area represented by the closest conforming samples and extending vertically in the profile.
- The volume of material defined as a hotspot can be calculated. This volume of material will be deemed unsuitable and is to be stockpiled separately.
- Where further sampling is required to reduce the volume of material deemed as unsuitable, samples will be collected at the mid-point between the elevated sample(s) and the closet conforming samples. Samples will be collected and analysed in accordance with this SAQP with the exception that samples will be analysed only for the non-conforming analytes(s).

The two sampling locations with exceedences, RB14 and RB18, are shown on **Figure 4**. No refractory bricks were identified within the test pits surrounding the location of RB18. As the bricks within test pit RB18 are isolated, refractory bricks from around the location of RB18 are to be excavated and stockpiled separately. The co-ordinates for RB18 are -32.78545 latitude and 151.47466 longitude.

Bricks were identified in four of the six test pits surrounding the location of RB14, with no bricks identified in test pits to the east or south east. The closest conforming samples are from test pits RB10, RB11, RB12 and RB13. The latitude and longitudes for these test pits are as follows:

- RB10: -32.78556, 151.47394;
- RB11: -32.78572, 151.47377 ;
- RB12: -32.78593, 151.47382;

- RB13: - 32.78568, 151.47416
- RB14: -32.78582, 151.47398.

9.6 Sorting

Coarse high level sorting is to be conducted on the Clay Borrow Pit and is described below.

It is envisaged that fill materials will be sorted on both a size and composition basis.

Coarser materials will be split into:

- concrete fragments;
- asphalt fragments,
- broken/whole refractory fragments;
- “other”, including metal and other inert materials; and
- Fine material including soil and below a “sortable” size, materials will necessarily be mixed and include soil-sized materials.

All materials will be transported to the area identified for storage on the smelter plant site. Classification in accordance with the NSW EPA resource recovery general and specific exemptions will be undertaken at a later date.

Although the site assessment did not identify contaminated soils or materials such as asbestos containing materials (ACM), a protocol detailing actions where unexpected materials (including ACM) are encountered during the excavation works is addressed in **Section 14.1.**

9.7 Spoil Management

The following general principles should be incorporated into management of stockpiles:

- No stockpiles or other materials shall be placed on steep slopes and will be away from the natural watercourse of Black Waterholes Creek.
- Control of dust from all atockpiles.
- All stockpiles will be placed on a level area as a low elongated mound.

Further erosion and sediment controls in accordance with the CEMP (refer to **Section 11.8**) are to be implemented.

9.8 Materials Tracking

A procedure shall be provided including:

- Truck logging at the site entrances and exits or materials being exported and imported.
- Logging of material destinations from/to the Clay Borrow Pit and the smelter stockpile site.
- If any material is taken offsite 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.

It is not proposed that any contaminated soils will be transported from the site or on public roads. The Hydro Smelter site is considered to be part of the site.

However, in the event that contaminated soils are transported off site, these will need to be controlled as per the NSWEPA requirements of waste tracking and acceptance, where classified as a waste that must be tracked. Waste disposal dockets are to form part of the validation report.

These are as follows based on regulations current at the time of this RAWP:

- Obtain a written consignment authorisation number from a licensed waste disposal or treatment facility before moving waste to the facility.
- Complete a waste data form signed by the consignor before the waste is dispatched.
- The waste consignor, the waste transporters and the waste facility must each keep a copy of the waste data form for up to four years for auditing purposes.
- The waste consignor must give a completed copy of the waste data form to the transporters, who must check that it is completed and then sign it. The driver must carry the waste data form in the vehicle.
- The transporters must give a completed copy of the waste data form to the waste facility on arrival at the destination. The waste facility operator must check the load details on the form. The waste data form must be signed by a representative of the waste facility on receipt of the waste at the destination
- The waste consignor must receive from the waste facility written confirmation of receipt of the waste within 21 days of dispatch. This must be kept for up to four years for auditing purposes.

Imported Fill

All fill imported on to the site shall be tracked including landscaping materials. All soil and landscaping materials shall be validated **PRIOR** to being received at the site to confirm it is ENM or VENM and meets the geotechnical requirements for backfill described in **Section 9.10**.

9.9 Validation of Remediation.

Detailed validation requirements are presented in **Section 10.**

Generally validation will comprise visual inspection identifying that the excavation is free of all impacted materials. The analysis of soil samples from the walls and base of the excavation is not required as there is no risk of impact to the natural soils from the stockpiled and buried material or from the soil matrix.

Visual validation of the exposed excavation shall be undertaken prior to reinstatement of the excavation. Excavation backfilling is not permitted until the Contractors environmental representative is satisfied that visual validation shows the remediation goal has been achieved **or, where the goal has not been achieved then** following written approval from the Principal or Principal's Representative.

9.10 Backfilling and Final Landform

It is not envisaged that the site will be backfilled but that the land will be reshaped to the minimum effort level necessary to achieve;

- A final landform that is consistent with the surrounding topography without steep slopes or abrupt changes in slope;
- The levels and grades of the finished landform shall be such that it encourages the shedding of incident stormwater but are at grades that would not result in erosion;
- The finished landform shall comprise a surface layer not less than 100mm of topsoil and shall be vegetated with native grasses.

In the event that backfill soils are required, all backfilling works shall comply with the following requirements:

- All backfill shall be appropriate soil material complying with either the VENM or EMN exemptions. All materials imported as backfill to the site shall have appropriate documentation to confirm their status (as ENM/VENM). It is the responsibility of the Contractor that material used to reinstate the excavation meets these requirements;
- Acid sulfate soil shall be specifically excluded from use in backfilling;
- Fill material shall be placed and undergo sufficient compaction such that it will not be subject to subsidence or erosion either in the short or long term.

9.11 Demobilisation

At the completion of the works the Contractor is to demobilise. The Contractor is to remove all project infrastructure and wastes unless agreed to remain in writing by the Principal.

9.12 Smelter Site Stockpile Area.

The Contractor will be responsible for the preparation of the Smelter site stockpile area on the smelter plant site.

The Principal shall identify the area to be used on the smelter.

Materials transported from the Clay Borrow Pit will be stored at this location.

The Contractor shall undertake site preparation works, (in the area identified by Hydro) to ensure:

- The layout of the smelter site stockpile area will be suitable for placement of the anticipated material volumes (or as indicated by the Principal), in terms of allowance for space and access;
- During active construction of the stockpiles, appropriate erosion and sediment controls have been installed (refer to **Section 11.8**);
- Upon completion of the stockpiling works, (following the Clay Borrow Pit remediation works), the Contractor shall undertake works to ensure long-term stabilization of the **soil** stockpile. No stabilisation is required for concrete, refractorty brick or bitumen. These are envisaged to include:
  - Placement, shaping and compaction of stockpile landform to encourage runoff but not erosion;

- Placement of a topsoil layer (min 100mm) and vegetation (eg, hydromulch) over the finer materials stockpile; and

- Surface water diversion and erosion control measures as appropriate to divert stormwater away from and around stockpiles, and capture any sediment in runoff from the stockpiles.

10 Validation of Remediation

The following is the validation sampling, analytical and quality plan (SAQP) to be implemented to validate the remediation objective has been achieved for the Clay Borrow Pit.

10.1 Validation Sampling and Analysis

Validation sampling will be required to demonstrate that, following excavation of all fill materials, remaining soils are within the adopted guidelines for the site.

Validation will involve:

- Visual assessment and documentation (photograqphic) of remaining soils for absence of fill materials.

Soil sampling across the excavation is not required as there is no risk of impact to the natural soils from the stockpiled and buried material or from the soil matrix.

10.2 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 investigation. The DQO process is a systematic, seven step process that defines the criteria that the sampling should satisfy in accordance with the requirements of DEC (2006) Guidelines for the NSW Site Auditor Scheme (2nd Edition).

Step 1 – State the Problem

In its current state, the site is not considered suitable for the proposed land use due to impacts to visual amenity from stockpiled and buried fill and remediation is required. Remediation of the stockpiled and buried fill is required to remove the impacts to visual amenity. The materials that are stockpiled and buried at the site include bake furnace refractory brick, concrete and bitumen. No potential contaminants of concern were identified at concentrations above the site guidelines, including heavy metals, fluoride, PAHs or SVOCs. .

Further details of site contaminants are presented in **Section 7.**

The remediation methodology is detailed above in **Section 9.4**. The remediation process involves the removal of stockpiled and buried materials and sorting prior to temporary storage as potentially recyclable material or later inclusion in a whole-of-site strategy. The Clay Borrow Pit is to be reshaped following visual validation of the removal of materials.

Step 2 – Identify the Decisions

The validation SAQP is to ensure that all relevant contamination has been identified on the site, that all contamination identified has been adequately assessed, that remediation has been carried out successfully and that strategies are in place to ensure that the site is not re-contaminated in the future.

Sections 7 and 8 of this RAWP outline the previous investigations completed to assess potential contaminants of concern, the validity of the data, the remediation strategy proposed and the appropriateness of this remediation strategy for the impact to visual amenity.

To validate the effectiveness of the remediation strategy, visual validation of the removal of stockpiled and buried material is required. Validation sampling of soil is not required as there is no risk of impact to the natural soils from the stockpiled and buried material or from the soil matrix. The site will be considered remediated when the remediation program has been carried out successfully. Remediation is deemed to be successful when:

- All fill materials have been removed from the Clay Borrow Pit Area, sorted and appropriately relocated;
- Excavations have been reshaped to an accepted landform.

Step 3 – Identify Inputs to the Decision

For the remediation of the Clay Borrow Pit site the following input into the decision making process is required:

- A visual evaluation of the removal of all stockpiled and buried materials is required to validate the remedial works.
- Documented materials tracking that demonstrates all materials have been appropriately relocated as described in **Section 9.7**.
- Final survey that demonstrates the landform has been reshaped to achieve the objectives of the final landform as described in **Section 9.10**.

Step 4 – Definition of the Boundaries of the Investigation

The site boundaries have been outlined and defined within this RAWP and are presented in **Figure 2**. Remediation applies to fill materials both buried and above ground.

Step 5 – Development of Decision Rules

Decision rules for the validation of the remedial works are based around visual validation of the removal of stockpiled and buried materials, including refractory brick, concrete and bitumen. The decision rules are as follows:

- Can it be visually confirmed that stockpiled and buried fill materials have been removed from the Clay Borrow Pit;
- Visual validation should show that the walls and base of the excavation are within red / grey, medium to high plasticity clay.
- If visual validation cannot be confirmed, additional excavation should be completed until the excavation can be validated as being in red / grey, medium to high plasticity clay.

Step 6 – Specification of the Acceptable Limits on Decision Errors

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

- The decision to be made is that all stockpiled and buried fill material has been excavated from the Clay Borrow Pit and that the resultant excavation is within natural red / grey clay.

- Possible decision errors include deciding that all stockpiled and buried fill material has been removed when it has not or deciding that the resultant excavation is within natural red / grey clay when it is not.

- As the validation of the removal of stockpiled and buried fill material is visual, there is no acceptable limit on decision errors.

Step 7 – Optimisation of the design of the collection of data

The excavation is to be photographed on a daily basis to show the removal of stockpiled and buried fill material. The photolog shall be used to demonstrate compliance with the remedial strategy.

Justification for the validation program is presented in **Table 10.1**.

Table 10.1: Validation Sampling Program

Validation Sample Type	Sample Frequency and Justification	Analytes
Visual documentation of the removal of fill materials	Excavations are to be photographed and a photographic log maintained and included in the validation report.	N/A

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.

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 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.

10.3 Remediation Acceptance Guidelines

Remediation acceptance is a visual validation of the removal of stockpiled and buried materials, with the resultant excavation to be within red / grey, medium to high plasticity clay.

10.4 Validation Report

A Validation Report will be compiled by the environmental consultant on completion of the works. This report will contain an overview of the remediation activities conducted and document the following:

- Site description.
- Details of the fieldwork undertaken.
- Supporting factual evidence of the remediation work including photographic and field records, and materials tracking data including waste disposal dockets.
- Volumes of excavated material and location of excavations/stockpiles.
- Surveyed plan of sampling locations for each analyte.
- Visual validation of the removal of all stockpiled and buried wastes.
- Visual validation of the resultant excavation being in natural red / grey clay.
- A statement indicating the suitability of the Site for the proposed land use

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).

10.5 HOLD POINT

At the completion of remedial works the Contractor is to provide to the Principal for review and approval a validation report that demonstrates that the RAWP has been successfully implemented. The requirements of the validation report are presented in **Section 10.4**

11 Construction Environmental Management Plan

11.1 HOLD POINT

Prior to the commencement of remediation works a Construction Environmental Management Plan (CEMP) shall be developed for written approval by the Principal. The CEMP is to incorporate the following detailed management plans.

11.2 Construction Environmental Management Plan

The contractor is to prepare a CEMP consistent with the "Guideline for the Preparation of Environmental Management Plans" (NSW Department of Infrastructure, Planning and Natural Resources, 2004). The CEMP is to address the issues discussed in **Sections 11.3** to **11.14.**

11.3 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.

11.4 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.

11.5 Community Consultation

The Principal will be responsible for community liaison activities including notification and complaints handling.

11.6 Air Controls

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 should be considered:

- 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
- All vehicles to travel on designated access roads.
- Temporarily ceasing an activity that generates dust that could affect a sensitive receiver.

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 identified 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.

11.7 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 11.4**.

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.

11.8 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 Smelter 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.

11.9 Surface Water and Groundwater Control

Surface water

Previous analysis has identified that potential contaminants of concern were generally identified at concentrations below the laboratory detection limits and therefore the generation of dissolved contaminants in surface water runoff is not expected. Surface water controls are required to manage erosion and sediment control (refer to **Section 11.8**, and surface water collected within excavations.

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

- Erosion and sediment controls outlined in **Section 11.8** 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 11.8**). Where the water is required to be pumped from the excavation it is to be subjected to the sediment controls outlined in **Section 11.8** prior to discharge from the site.
- The contractor is to keep themselves informed of weather conditions and the potential for rain events and proactively manage the site.

Groundwater

Perched groundwater is expected to be encountered within the buried fill materials in the eastern portion of the Clay Borrow Pit. The Contractor is to develop a methodology for management of this water during excavation. The following control measures should be considered:

- The Western Surge Pond on the Smelter site can be utilised for the discharge of water.

– Perched groundwater being discharged to the Western Surge Pond does not require analysis for suitability as analysis completed by ENVIRON in 2012 indicates that concentrations of heavy metals, fluoride, PAHs and SVOCs are within the ranges of other waters which are managed through the Smelter stormwater management system.

The interception of this water is not considered to be an interception of groundwater under the *Water Act 1912*. This groundwater is perched or trapped sub-surface water within a former excavation.

11.10 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 11.4**).
- 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.

11.11 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.

11.12 Hazardous Materials

11.12.1 Contractor 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.

11.12.2 Waste Materials

Although no ACM (fragments of asbestos sheeting) was identified on the site it should be considered that there is a low potential for ACM to be present.

The Contractor is to develop and implement an Asbestos Removal Control Plan consistent with the Asbestos Management Protocol included in **Section 14.1**.

11.13 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.

12 Health and Safety

12.1 HOLD POINT

Prior to the commencement of any works, a project specific Health and Safety plan is to be developed for written approval by the Principal.

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;
- The presence of other site personnel, work and traffic.

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

- Hydro Aluminum'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.
- Applicable state and federal regulations, legislation and codes of practice.

13 Remediation Schedule

The final remediation schedule will be discussed with the Contractor. A proposed schedule up to the completion of a draft validation report is outlined below.

Table 13.1: Remediation Schedule

Task	Estimated Duration	Estimated Completion Date
Cessnock City Council Category 2 notification	30 days	Completed
Contractor Procurement	4 wks	Completed
Preliminaries (documentation)	3 wks	19/1/2015
Site establishment and mobilisation	1 wk	28/1/15
Site works	6 – 8 wks	1/5/15
Demobilisation	1 wk	15/5/15
Validation reporting	3 wk	30/6/15

14 Environmental Controls Contingency Plan

This section of the RAWP 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 11** are designed to be sufficiently protective under the normal range of site conditions. The contingencies presented in **Table 14.1** are to be implemented where unexpected site conditions or circumstances arise.

Table 14.1: 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.
Discovery of ACM	Stop work and implement the Asbestos Removal Control Plan. Refer to **Section 14.1.**	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

14.1 Asbestos Management Protocol

14.2 HOLD POINT

The Contractor is to submit an Asbestos Removal Control Plan in accordance with this Protocol to the Principal for written approval 10 working days prior to the commencement of the asbestos removal.

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.

14.2.1 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 10**.

14.2.2 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 (refer to **Section 14.1**).

15 Regulatory Approvals and Licensing

Table 15.1 outlines the regulatory requirements applicable at the time of preparation of the RAWP.

Table 15.1: Key Relevant Legislation and Regulations

Legislation or Regulation	Relevance
State Environmental Planning Policy 55 – Remediation of Land (SEPP 55)	Under SEPP 55 remediation work are permissible in any zone, regardless of any provision in another environmental planning instrument (such as a local environmental plan). SEPP 55 also establishes: Category 1 remediation works: remediation that required development consent. This includes remediation that is: designated development; likely to have a significant impact on ecological values; deemed as requiring development consent by another SEPP; within a sensitive land zone under a local environmental plan; or not consistent with a contaminated land planning guideline made by the relevant council. Category 2 remediation works: remediation which does not require development consent. This is any remediation that is not deemed category 1 remediation works. The Clay Borrow Pit remediation works are considered to fall under Category 2 and Hydro will notify Cessnock City Council 30 days prior to commencement of remediation works.
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. The Clay Borrow Pit and the Smelter site storage area are regulated under Environment Protection Licence (EPL) 1548. Activities proposed for the remediation works are consistent with the scheduled activities permitted by the EPL.
Cessnock Local Environmental Plan 2011 (Cessnock LEP)	The Cessnock LEP is the key local land use planning document for the Cessnock local government area. Category 2 remediation works are permissible without consent however SEPP55 requires notification to Council, as outlined above.
Protection of the Environment Operations (Waste) Regulation 2005	The regulations make requirements relating to non-licensed waste activities and waste transporting. Section 42 of the Regulation stipulates special transportation, re-use or recycling requirements relating to asbestos waste and must be complied with regardless whether the activity is licensed. The requirements for the transportation of asbestos waste include: • bonded asbestos material must be securely packaged at all times, • friable asbestos material must be kept in a sealed container, • asbestos-contaminated soils must be wetted down,

Table 15.1: Key Relevant Legislation and Regulations	
Legislation or Regulation	**Relevance**
	• all asbestos waste must be transported in a covered, leak-proof vehicle. The requirements relating to the off site disposal of asbestos waste are as follows: • asbestos waste in any form must be disposed of only at a waste facility that may lawfully receive the waste, • when asbestos waste is delivered to a waste facility site, the occupier of the waste facility site must be informed by the person delivering the waste that the waste contains asbestos, • when unloading and disposing of asbestos waste at a waste facility site, the waste must be unloaded and disposed of in such a manner as to prevent the generation of dust or the stirring up of dust, • asbestos waste disposed of at a waste facility site must be covered with virgin excavated natural material or other material as approved in the facility's environment protection licence. • Section 48 of the Regulation requires that wastes are stored in an environmentally safe manner. It also stipulates that vehicles used to transport waste must be covered when loaded. The Regulation exempts certain waste streams from the full waste tracking and record keeping requirements. Waste tracking is required only for hazardous wastes. However these are not anticipated to be present on the site.
Native Vegetation Act 1993 (NV Act)	The NV Act controls the clearance of native vegetation in NSW, including identifying clearance activities requiring development consent and where exclusions from the need for consent apply. Section 22 of the act states that clearing for the purpose of "routine agriculture management activities" does not require development consent. The definition of "routine agriculture management activities" includes "any activity reasonably considered necessary to remove or reduce an imminent risk of serious personal injury or damage to property." The purpose of the works is to remediate the area suitable for its existing use, currently rural land as part of the smelter buffer zone. In the event that the contractor determines that a tree poses a risk of injury or property damage, this section applies and development consent is not required.
National Parks and Wildlife Act 1974 (NPW Act)	Under the NOW Act it is an offence to harm protected fauna. Protected fauna are native fauna species. In the event that a tree is required to be removed the contractor is to avoid harm to native fauna.
Threatened Species Conservation Act 1995 (TSC Act)	The TSC Act lists threatened flora and fauna specispecieds and endangered ecological communities. In the event that a tree is required to be removed the

Table 15.1: Key Relevant Legislation and Regulations	
Legislation or Regulation	**Relevance**
	contractor is to avoid harm to native fauna. The contractor should also avoid any further clearance of native vegetation in the event that it is an endangered ecological community.
Water Management Act 2000	A controlled activity approval is required for works in or within 40 metres of a natural watercourse. Works in the Clay Borrow Pit itself are located in excess of 40m from Black Waterholes Creek. However, transport to the Smelter stockpile area requires traversing this creek on an existing roadway. If upgrades to the roadway are required to complete the works, then a controlled activity approval under the Water Management Act 2000 may be required. The Contractor will be responsible for advising the Principal if an upgrade is required and is to seek the neccessary approvals. Evidence of the approvals is to be provided to Hydro prior to commencing any works.
Water Act 1912	A groundwater interception licence is required for works that intercept groundwater. However minor temporary dewatering activities that is estimated to be less than three megalitres per year (including both construction dewatering and subsequent managed inflows) will generally not require a licence or approval from the Office of Water. Groundwater is not expected to be intercepted during the works. In the unlikely event it is intercepted, it is likely to require dewatering of less than three megalitres per year.

16 Project Quality Management Plan

16.1 HOLD POINT

The Contractor will prepare a Project Quality Management Plan that will outline the quality management measures to be implemented for all relevant elements of the Project including Inspection and Test Plans that will be applied to demonstrate that the requirements of the RAWP have been implemented.

17 Long Term Management

The RAWP has been designed to remove any requirement for long term site management from the Clay Borrow Pit in relation to contamination. Once remediation is complete and the site has been validated as suitable for the proposed industrial/commercial use, no further remediation management is proposed. Reshaping of the landform and interim soil and erosion management of the site prior to redevelopment will be undertaken in accordance with the site CEMP.

Management of stockpiled materials at the Smelter site stockpile area is required until such time the disposal method is determined and available. For this period the stockpile management will be in accordance with the site wide Hydro stormwater management procedures and would be implemented by the Principal.

18 Roles and Responsibilities

Table 18.1 summarises the expected roles and responsibilities of all stakeholders in the remediation works:

Table 18.1: Roles and Responsibilities

Stakeholder	Name and Contact Details	Role/Responsibility
Principal	Hydro Aluminium Kurri Kurri Pty Ltd	Owner of the ClAy Borrow Pit and ultimately responsible for all works on the site. Will engage/contract all other parties.
Principal's Environmental Representative	ENVIRON Australia Pty Ltd	Person employed by or sub-contracted to Hydro to oversee/provide technical advice on remediation works
Remediation Contractor	Enviropacific Services Pty Ltd	Company contracted to undertake remediation works. Will supply all plant and personnel to conduct works as outlined in this RAWP and as required under local, state and federal legislation
Remediation Supervisor or Project Manager	Enviropacific Services Pty Ltd	Responsible Person appointed by Contractor to supervise/coordinate all aspects of remedial works on behalf of the Contractor. Is the primary point of contact for the project.
Contractor's Environmental Consultant	DLA Environmetal	Appropriately qualified environmental consulting company/person appointed to validate the implementation of the RAWP. 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 RAWP for submission and review by the Principal
Contaminated Land Auditor	Ross McFarland, AECOM	Hydro has engaged a Contaminated Land Auditor to prepare a Contaminated Land Audit for the site in accordance with the Contaminated Land Management Act 1997. The Contaminated Land Auditor will be appointed by Hydro.

19 Conclusions and Recommendations

Environmental site assessment has confirmed that site remediation is required to address the impact to visual amenity present in a filled area located at the Clay Borrow Pit as a result of historical smelter management activities.

The evaluation of suitable remedial options identified the preferred option to comprise excavation and coarse sorting of all fill materials and transportation to an interim storage area identified on the Smelter plant site. The majority of materials are expected to be suitable for beneficial reuse following evaluation in accordance with the NSW EPA resource recovery general and specific exemptions. Other materials that are not suitable for reuse will be temporarily stockpiled for incorporation in a whole-of-site remediation strategy.

This RAWP outlines the remediation methodology to be followed and the validation required to demonstrate that the remediation has been successfully implemented.

Following remediation and successful validation the site will be suitable for the proposed commercial/industrial land use.

20 References

ANZECC & NHMRC (ANZECC 1992) Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites;

ENVIRON Australia Pty Ltd (ENVIRON 2012) Phase 2 ESA, Kurri Kurri Aluminium Smelter, Norsk Hydro ASA, 1 November 2012;

ENVIRON Australia Pty Ltd (ENVIRON 2012a) Application for Exemption – Refractory Brick, Hydro Aluminium Pty Ltd, August 2012.

ENVIRON Australia Pty Ltd (ENVIRON 2012a) Sampling, Analysis and Quality Plan, Refractory Brick Characterisation, December 2012.

ENVIRON Australia Pty Ltd (ENVIRON 2013) Tier 2 Ecological Risk Assessment, Kurri Kurri Aluminium Smelter, Part of the Kurri Kurri Aluminium Smelter, Hart Road, Loxford, 20 March 2013;

ENVIRON Australia Pty Ltd (ENVIRON 2013a) Preliminary Screening Level, Health Risk Assessment for Fluoride and Aluminium, Part of the Kurri Kurri Aluminium Smelter, Hart Road, Loxford, 2 April 2013;

ENVIRON Australia Pty Ltd (ENVIRON 2013b) Phase 1 ESA, Hydro Kurri Kurri Aluminium Smelter, 22 October 2013;

Hunter Catchment Management Trust (HCTM 2000) Wallis and Fishery Creeks Total Catchment Management Strategy;

NEPC (1999) National Environmental Protection (Assessment of Site Contamination) Amendment Measure (NEPM) 2013;

New South Wales Department of Environment and Conservation (NSW DEC 2006) Guidelines for the NSW Site Auditor Scheme (Second Edition);

New South Wales Department of Environment and Conservation (NSW DEC 2007) Guidelines for the Assessment and Management of Groundwater Contamination;

NSW DECC (2008) Waste Classification Guidelines.

21 Limitations

ENVIRON Australia prepared this report in accordance with the scope of work as outlined in our proposal to Hydro Aluminium Kurri Kurri Pty Ltd dated 5th June 2014 and in accordance with our understanding and interpretation of current regulatory standards.

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

The conclusions presented in this report represent 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.

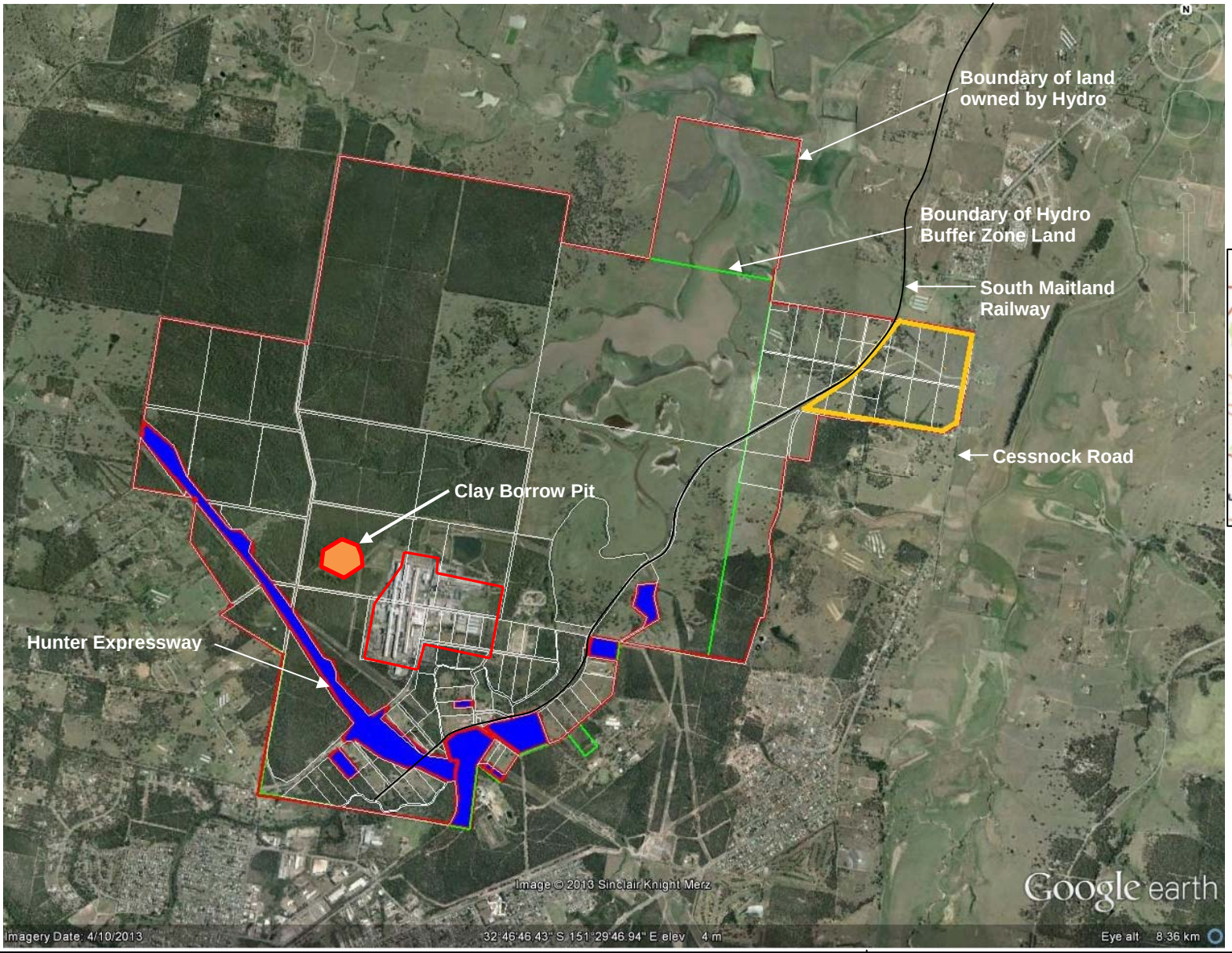
ENVIRON did not independently verify all of the written or oral information provided to ENVIRON during the course of this investigation. While ENVIRON has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided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

21.1 User Reliance

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

Figures



Approximate Location of Smelter

Approximate Location of Buffer

Land not owned by Hydro

Clay Borrow Pit Area

N

Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit

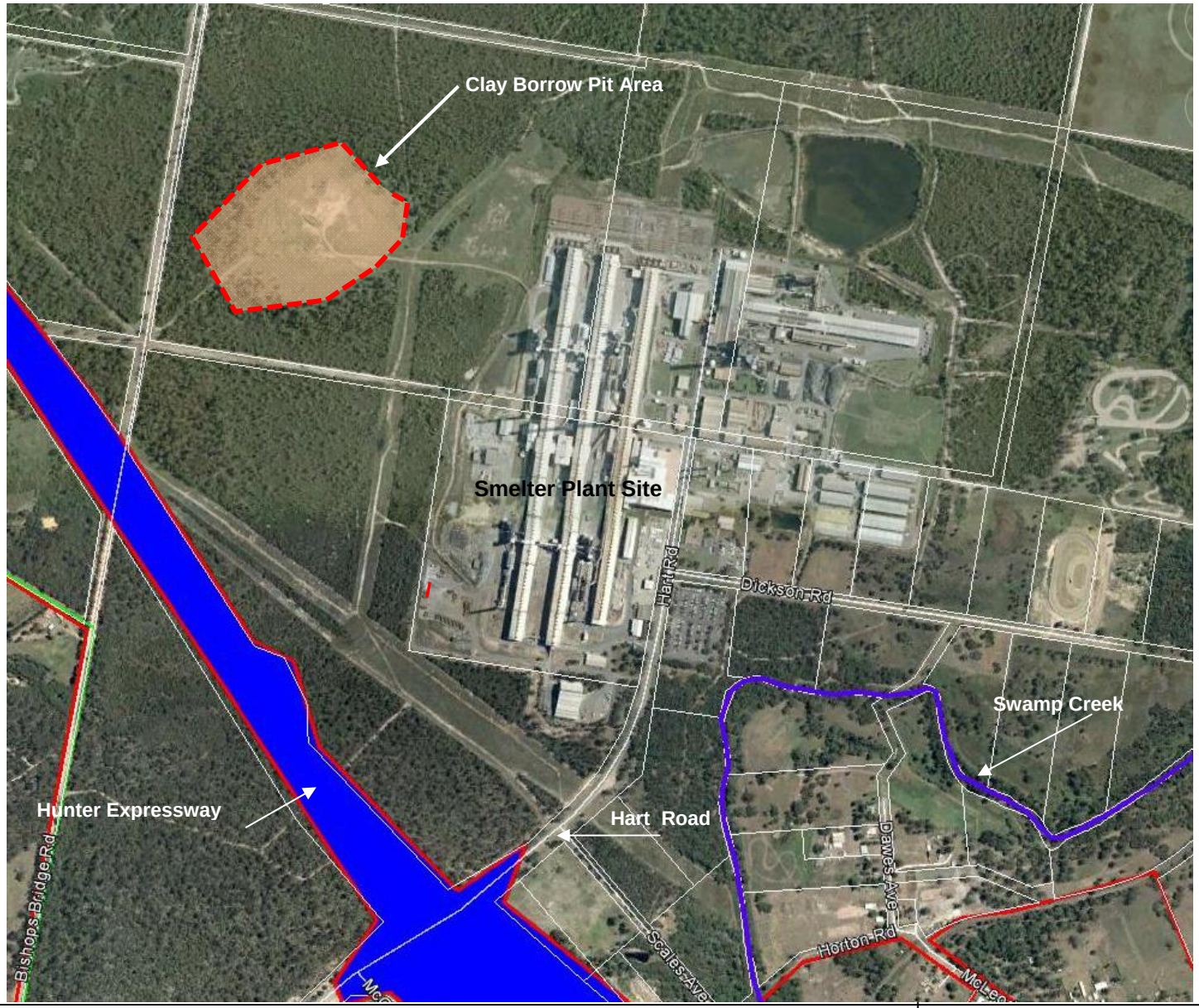
Site Location

ENVIRON

JOB NO: AS130386

DATE: June 2014

FIGURE 1



Hunter Expressway Alignment

Clay Borrow Pit Area

N

Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit

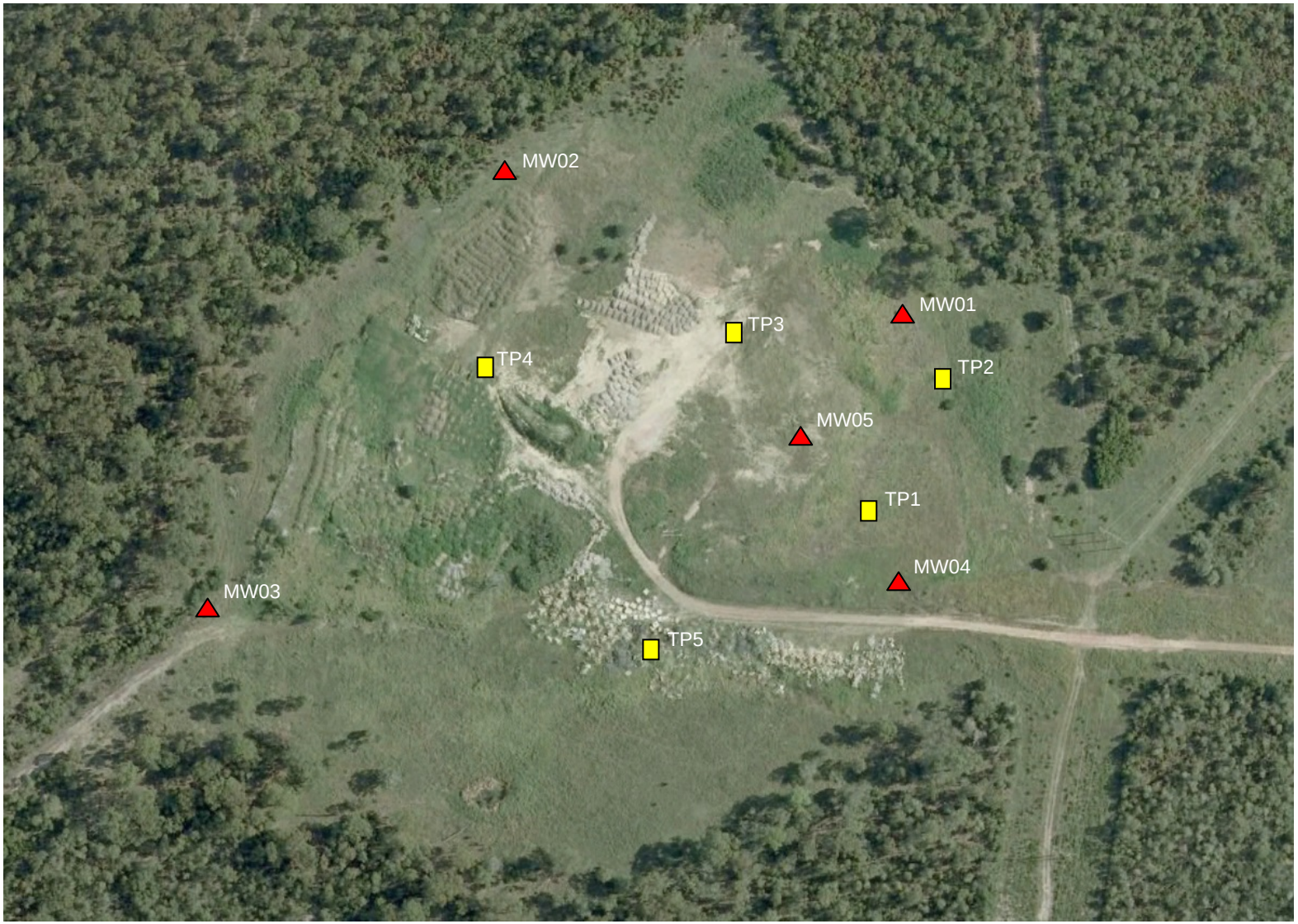
Site Layout

ENVIRON

JOB NO: AS130386

DATE: June 2014

FIGURE 2



Test Pit Locations

Borehole Locations

Approximate Scale1cm: 28m

N

Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit

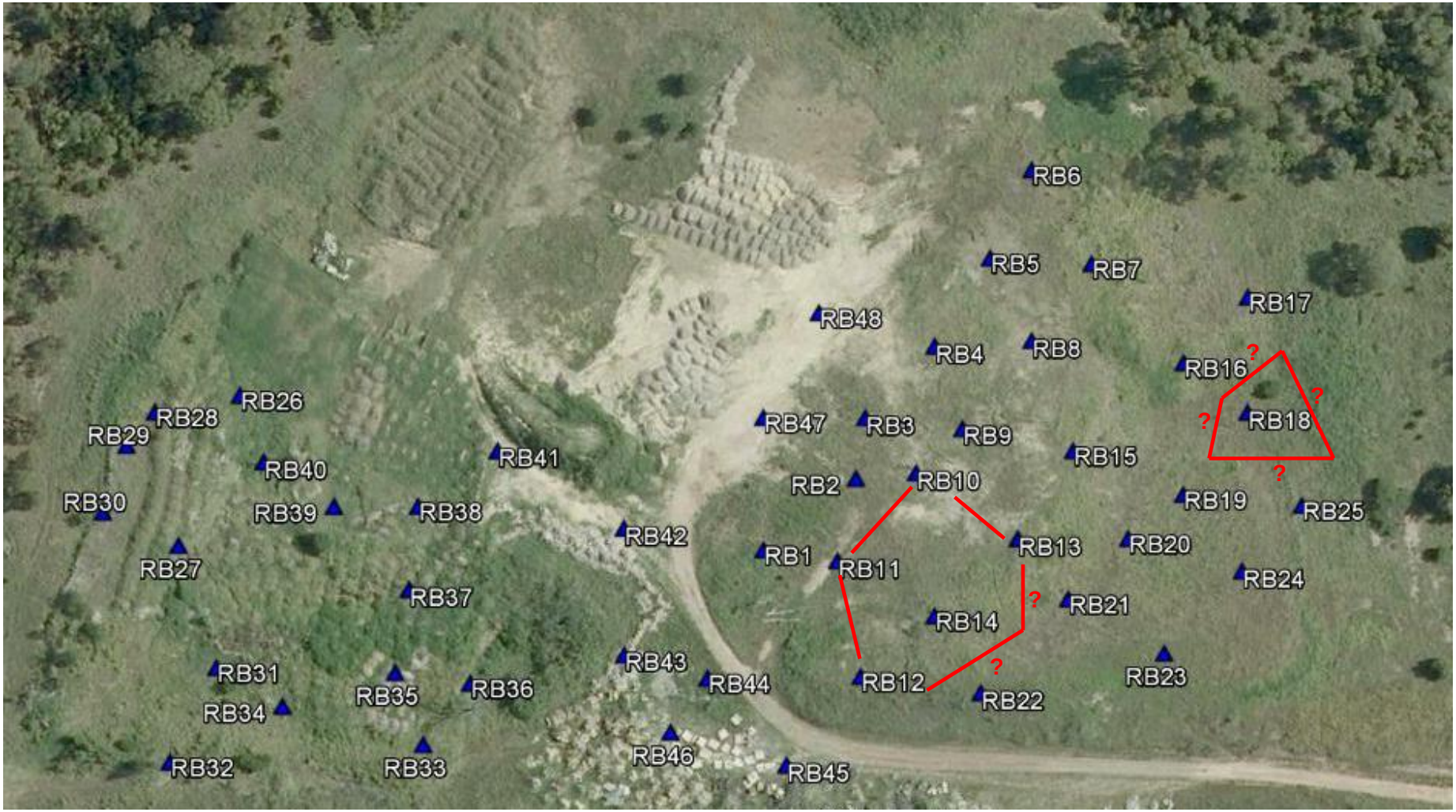
Sampling Locations, 2012 Phase 2 ESA

ENVIRON

JOB NO: AS130386

DATE: December 2014

FIGURE 3

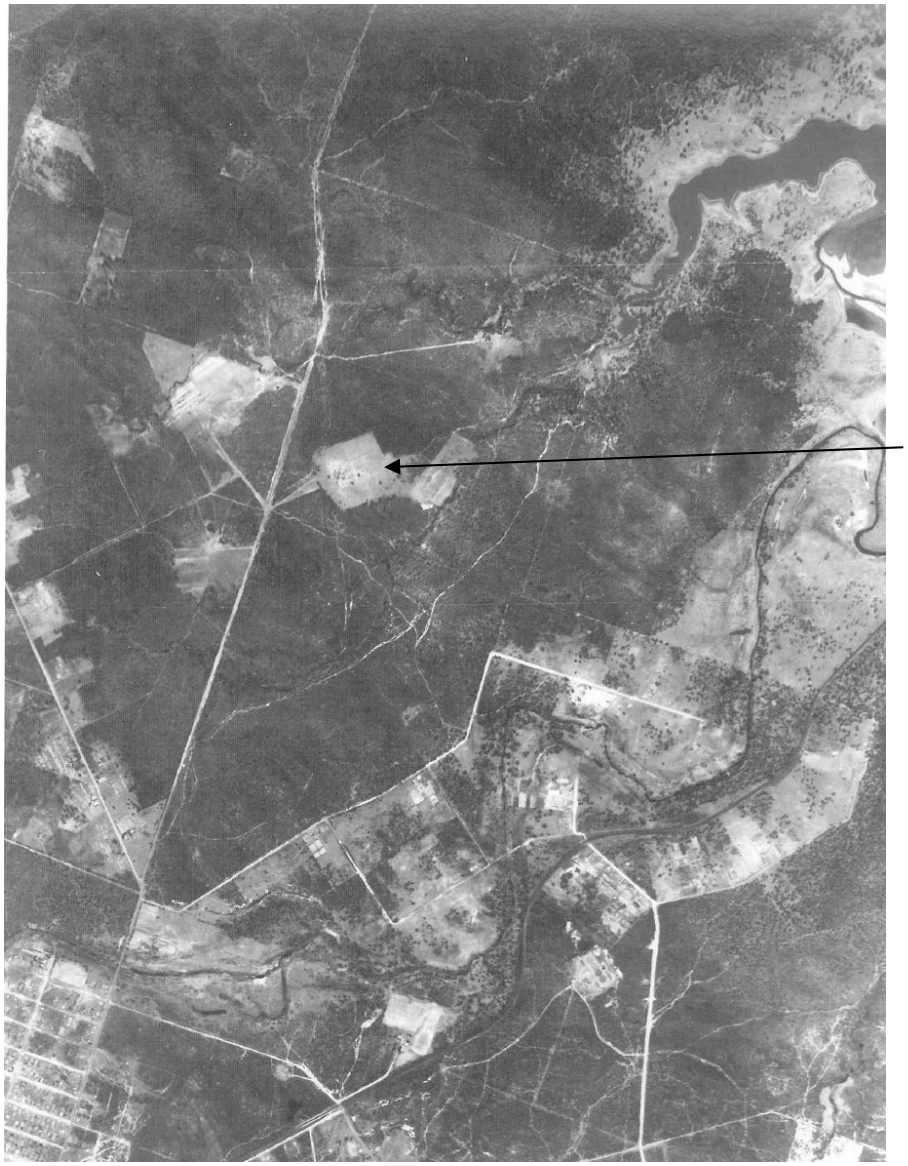


NB Aerial image is dated 2009 and may not reflect actual current (August 2014) stockpile locations

Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit	Brick Sampling Locations – August 2014
ENVIRON JOB NO:AS130386 DATE: December 2014	FIGURE 4

Appendix A

Historical Photographs



Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit

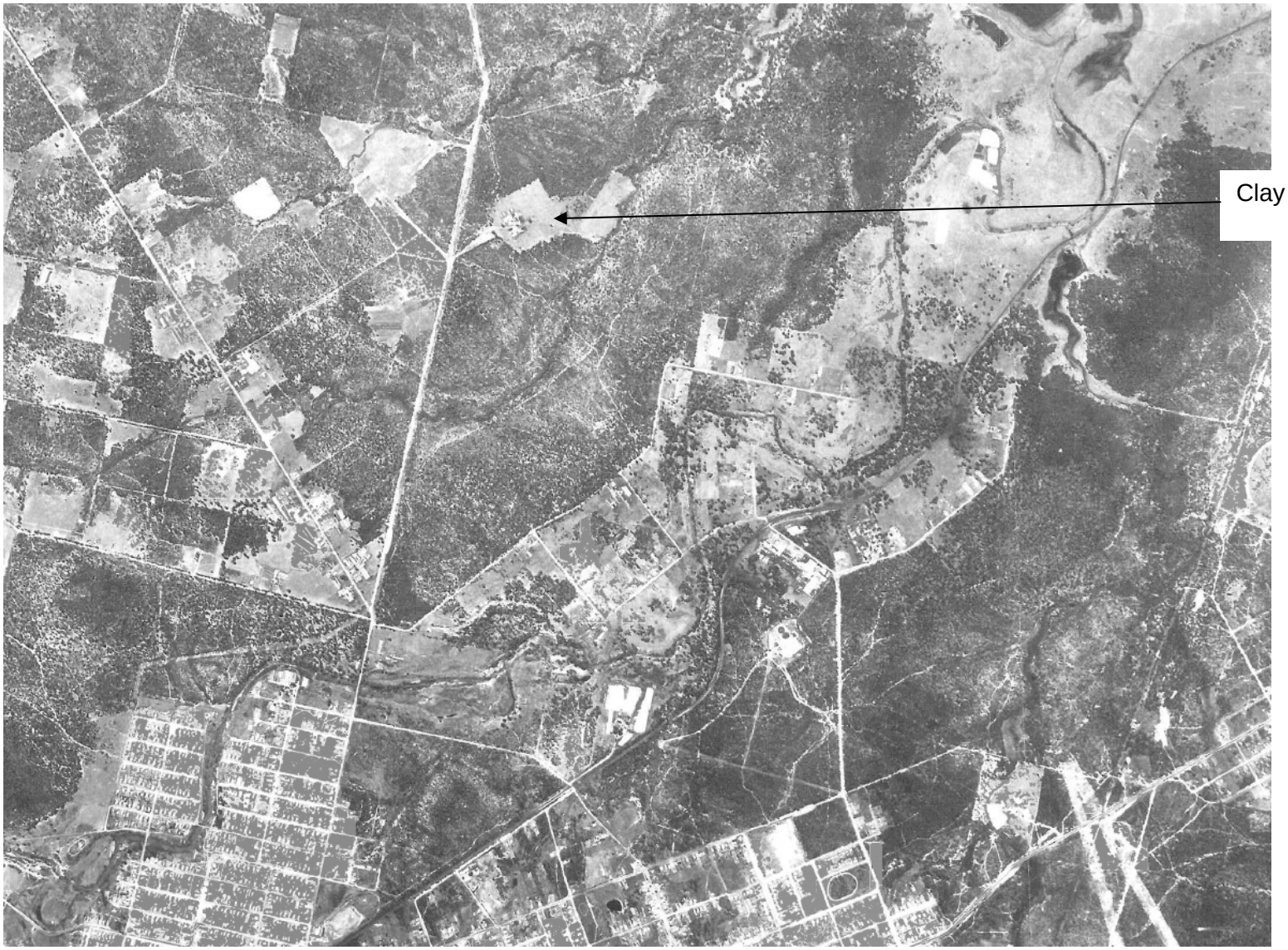
Historical Aerial Photo - 1951

ENVIRON

JOB NO:AS130386

DATE: December 2014

APPENDIX A



Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit

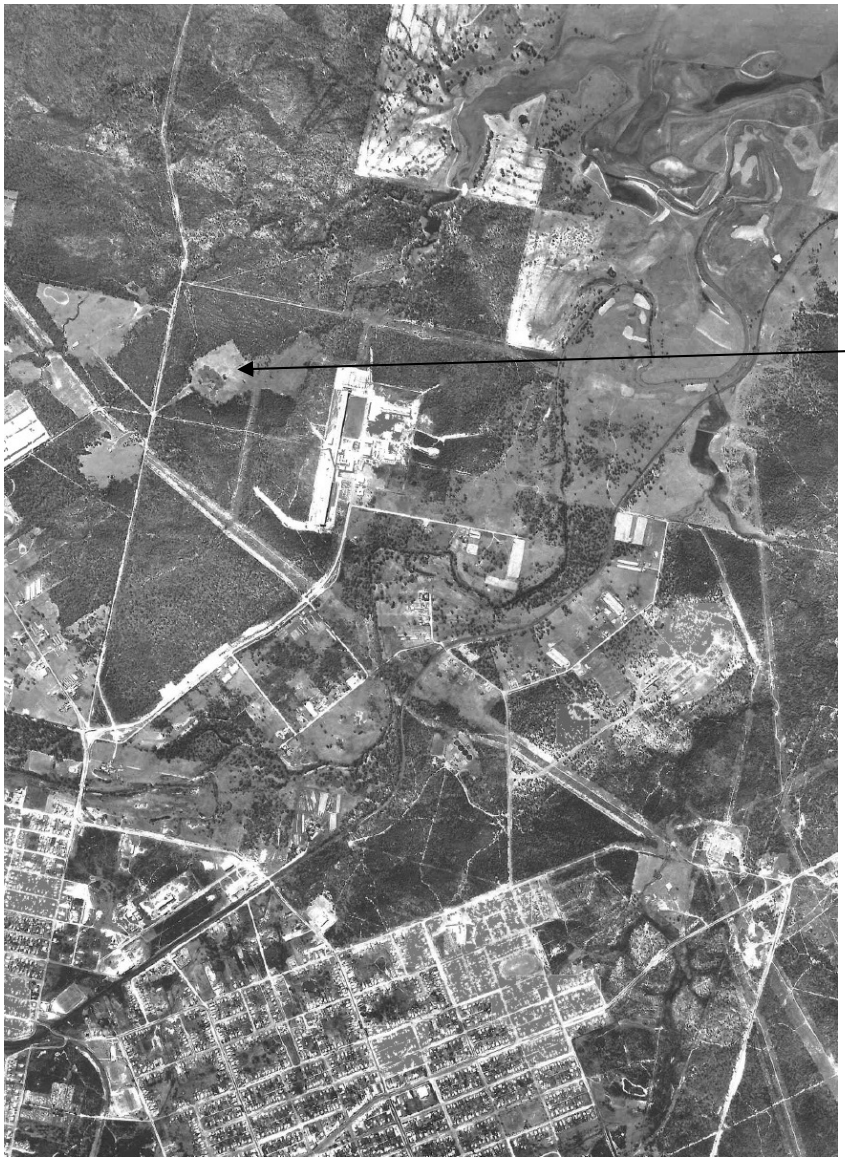
Historical Aerial Photo - 1961

ENVIRON

JOB NO:AS130386

DATE: December 2014

APPENDIX A



Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit

Historical Aerial Photo - 1975

ENVIRON

JOB NO:AS130386

DATE: December 2014

APPENDIX A

Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit

Historical Aerial Photo - 1987

ENVIRON

JOB NO:AS130386

DATE: December 2014

APPENDIX A

Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit

Historical Aerial Photo - 1994

ENVIRON

JOB NO:AS130386

DATE: December 2014

APPENDIX A

N

Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit

Historical Aerial Photo – Removal of clay around 1994

ENVIRON

JOB NO:AS130386

DATE: December 2014

APPENDIX A

Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit

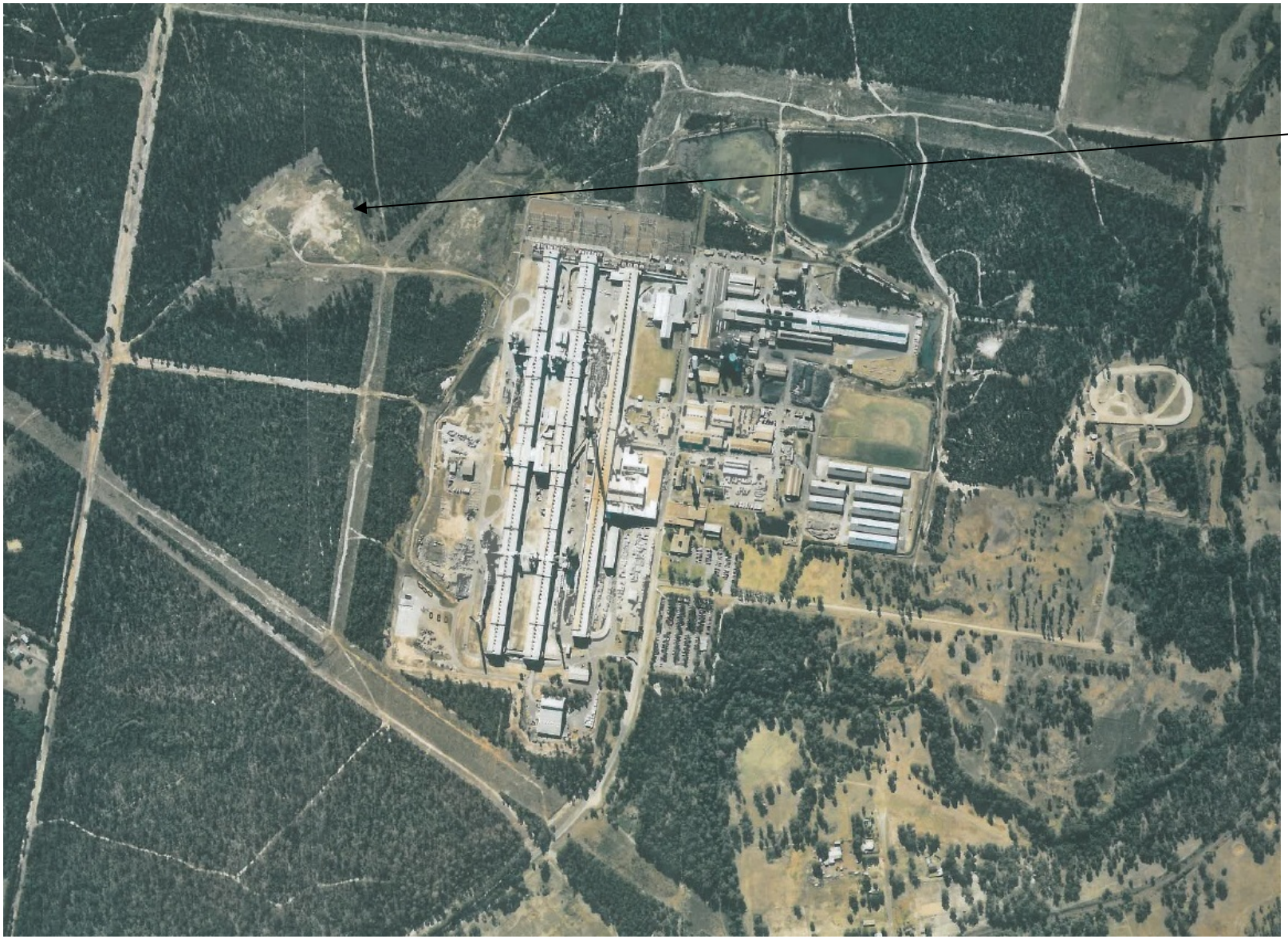
Historical Aerial Photo - 2001

ENVIRON

JOB NO:AS130386

DATE: December 2014

APPENDIX A



Hydro Aluminium Kurri Kurri – Remedial Action Works Plan, Clay Borrow Pit

Historical Aerial Photo - 2006

ENVIRON

JOB NO:AS130386

DATE: December 2014

APPENDIX A

Appendix B

EIL Site-Specific Calculations

Inputs
Select contaminant from list below
Cr_III
Below needed to calculate fresh and aged ACLs
Enter % clay (values from 0 to 100%)
1
Below needed to calculate fresh and aged ABCs
Measured background concentration (mg/kg). Leave blank if no measured value
or for fresh ABCs only
Enter iron content (aqua regia method) (values from 0 to 50%) to obtain estimate of background
7
or for aged ABCs only
Enter State (or closest State)
NSW
Enter traffic volume (high or low)
low

Outputs		
Land use	Cr III soil-specific EILs (mg contaminant/kg dry soil)	
	Fresh	Aged
National parks and areas of high conservation value	100	70
Urban residential and open public spaces	150	190
Commercial and industrial	200	320

Inputs
Select contaminant from list below
Cu
Below needed to calculate fresh and aged ACLs
Enter cation exchange capacity (silver thiourea method) (values from 0 to 100 cmolc/kg dwt)
11
Enter soil pH (calcium chloride method) (values from 1 to 14)
6
Enter organic carbon content (%OC) (values from 0 to 50%)
1
Below needed to calculate fresh and aged ABCs
Measured background concentration (mg/kg). Leave blank if no measured value
or for fresh ABCs only
Enter iron content (aqua regia method) (values from 0 to 50%) to obtain estimate of background
7
or for aged ABCs only
Enter State (or closest State)
NSW
Enter traffic volume (high or low)
low

Outputs		
Land use	Cu soil-specific EILs (mg contaminant/kg dry soil)	
	Fresh	Aged
National parks and areas of high conservation value	70	80
Urban residential and open public spaces	120	210
Commercial and industrial	170	300

Inputs
Select contaminant from list below
Ni
Below needed to calculate fresh and aged ACLs
Enter cation exchange capacity (silver thiourea method) (values from 0 to 100 cmolc/kg dwt)
11
Below needed to calculate fresh and aged ABCs
Measured background concentration (mg/kg). Leave blank if no measured value
or for fresh ABCs only
Enter iron content (aqua regia method) (values from 0 to 50%) to obtain estimate of background
7
or for aged ABCs only
Enter State (or closest State)
NSW
Enter traffic volume (high or low)
low

Outputs		
Land use	Ni soil-specific EILs (mg contaminant/kg dry soil)	
	Fresh	Aged
National parks and areas of high conservation value	35	35
Urban residential and open public spaces	80	180
Commercial and industrial	140	310

Inputs
Select contaminant from list below
Zn
Below needed to calculate fresh and aged ACLs
Enter cation exchange capacity (silver thiourea method) (values from 0 to 100 cmolc/kg dwt)
11
Enter soil pH (calcium chloride method) (values from 1 to 14)
6
Below needed to calculate fresh and aged ABCs
Measured background concentration (mg/kg). Leave blank if no measured value
or for fresh ABCs only
Enter iron content (aqua regia method) (values from 0 to 50%) to obtain estimate of background
7
or for aged ABCs only
Enter State (or closest State)
NSW
Enter traffic volume (high or low)
low

Outputs		
Land use	Zn soil-specific EILs (mg contaminant/kg dry soil)	
	Fresh	Aged
National parks and areas of high conservation value	75	170
Urban residential and open public spaces	190	480
Commercial and industrial	280	700

Appendix C

Borehole and Test Pit Logs from Phase 2 Assessment Report

BOREHOLE NUMBER MW01

ENVIRON

CLIENT Norsk Hydro ASA | PROJECT NAME Phase 2 ESA

PROJECT NUMBER DE11HDR043 | PROJECT LOCATION Kurri Kurri

DATE STARTED 11/4/12 | COMPLETED 11/4/12 | R.L. SURFACE | DATUM

DRILLING CONTRACTOR Terratest | SLOPE 90° | BEARING ---

EQUIPMENT | HOLE LOCATION Clay Borrow Pit

HOLE SIZE | LOGGED BY KJG | CHECKED BY

NOTES

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
Pushtube							Fill Sandy Gravelly Clay: brown, med plasticity, angularcoarse gravel, clay, red with some gravel, wet.	0.3-0.4m PID 0 ppm	FILL
							Clay: black, high plasticity, moist.		ESTUARINE SEDIMENTS
				2			Clay: grey, high plasticity, some sand, moist	1.4-1.5m (DUP1) PID 0 ppm	
							Silty Clay: yellow, some sand, dry		RESIDUAL CLAY/EW SANDSTONE
				4			Clay: grey, high plasticity, some sand, moist.		
ADT	12/4/12						EW Sandstone/Residual Sandy Clay: brown-yellow, low plasticity, fine grained sand slightly moist.		
				6					
				8			grading to clay: brown, high plasticity, moist, moist to wet at 9m		
				10			EW Sandstone		EW SANDSTONE
				12			Borehole MW01 terminated at 11.5m		

BOREHOLE / TEST PIT KURRI KURRI.GPJ GINT STD AUSTRALIA.GDT 18/5/12

BOREHOLE NUMBER MW02

ENVIRON

CLIENT Norsk Hydro ASA | PROJECT NAME Phase 2 ESA

PROJECT NUMBER DE11HDR043 | PROJECT LOCATION Kurri Kurri

DATE STARTED 11/4/12 | COMPLETED 12/4/12 | R.L. SURFACE | DATUM

DRILLING CONTRACTOR Terratest | SLOPE 90° | BEARING ---

EQUIPMENT | HOLE LOCATION Clay Borrow Pit

HOLE SIZE | LOGGED BY KJG | CHECKED BY

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
Pushtube	None Encountered		0			Topsoil with some fill	0-0.05m (PID 0 ppm)	FILL
						Clay: grey, high plasticity, moist.	0.5-0.6m (PID 0 ppm)	RESIDUAL CLAY
			2			interbedded red/grey clay		
						Clay: grey, high plasticity, moist.		
ADT						Sandy Clay: red, low plasticity, dry.		
			4					
			6			grading to grey clay		
						EW Siltstone, grey, dry		EW SILTSTONE
			8					
			10					
			12					
			14					
			16			Borehole MW02 terminated at 16m		
			18					

BOREHOLE NUMBER MW03a

ENVIRON

CLIENT Norsk Hydro ASA | PROJECT NAME Phase 2 ESA

PROJECT NUMBER DE11HDR043 | PROJECT LOCATION Kurri Kurri

DATE STARTED 12/4/12 | COMPLETED 12/4/12 | R.L. SURFACE | DATUM

DRILLING CONTRACTOR Terratest | SLOPE 90° | BEARING ---

EQUIPMENT | HOLE LOCATION Clay Borrow Pit

HOLE SIZE | LOGGED BY KJG | CHECKED BY

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
ADT	None Encountered		0.0			Fill: Sandy Clay: brown		FILL
			0.5			Fill: Gravelly Sandy Clay: some white-orange gravel (bricks?), brick fragment at 1m.	0.4-0.5 (DUP2) (PID 0 ppm)	
			1.0			Topsoil: Sand, black with some angular gravel.	1.2-1.3m (PID 0 ppm)	RESIDUAL CLAY
						Clay: dark grey, high plasticity with some gravel		
			1.5			Clay: brown/grey, high plasticity, moist.		
			2.0					
			2.5					
			3.0			Borehole MW03a terminated **at 3m**		
			3.5					
			4.0					
			4.5					
			5.0					

BOREHOLE / TEST PIT KURRI KURRI.GPJ GINT STD AUSTRALIA.GDT 18/5/12

BOREHOLE NUMBER MW03b

ENVIRON

CLIENT Norsk Hydro ASA | PROJECT NAME Phase 2 ESA

PROJECT NUMBER DE11HDR043 | PROJECT LOCATION Kurri Kurri

DATE STARTED 12/4/12 | COMPLETED 12/4/12 | R.L. SURFACE | DATUM

DRILLING CONTRACTOR Terratest | SLOPE 90° | BEARING ---

EQUIPMENT | HOLE LOCATION Clay Borrow Pit

HOLE SIZE | LOGGED BY KJG | CHECKED BY

NOTES

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
ADT	▼			0			Topsoil: Gravelly Clay: brown, low plasticity	0-0.1m (PID 0 ppm)	TOPSOIL
							Clay: grey-brown, high plasticity, moist.		RESIDUAL CLAY
				2					
				4			Clay: grey, medium plasticity		
				6			Clay: red, medium plasticity, moist		
							Clay: brown, medium plasticity, moist		
				8			Clay: grey.		
							Clay: brown.		
							Clay: khaki, high plasticity, with some gravel. wet.		
				10			EW Siltstone as Clay: dark grey, medium plasticity, dry.		EW SILTSTONE
				12			Borehole MW03b terminated at 11.5m		

BOREHOLE NUMBER MW04

ENVIRON

CLIENT Norsk Hydro ASA
PROJECT NAME Phase 2 ESA
PROJECT NUMBER DE11HDR043
PROJECT LOCATION Kurri Kurri

DATE STARTED 12/4/12 COMPLETED 12/4/12 R.L. SURFACE ___ DATUM ___
DRILLING CONTRACTOR Terratest SLOPE 90° BEARING ---
EQUIPMENT ___ HOLE LOCATION Clay Borrow Pit Entrance
HOLE SIZE ___ LOGGED BY KJG CHECKED BY ___
NOTES ___

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
ADT	▼			0			Silty Clay: black, high plasticity, moist.	0-0.1m (PID 0 ppm)	ESTUARINE SEDIMENTS
							Clay: red, low plasticity, dry.		RESIDUAL CLAY
				2					
				4					
				6			Clay: grey, low plasticity, dry.		
				8					
							EW Siltstone, grey fine grained.		EW SILTSTONE
				10					
				12			Borehole MW04 terminated at 11.5m		

BOREHOLE / TEST PIT KURRI KURRI.GPJ GINT STD AUSTRALIA.GDT 18/5/12

BOREHOLE NUMBER MW05

ENVIRON

CLIENT Norsk Hydro ASA **PROJECT NAME** Phase 2 ESA

PROJECT NUMBER DE11HDR043 **PROJECT LOCATION** Kurri Kurri

DATE STARTED 12/4/12 **COMPLETED** 12/4/12 **R.L. SURFACE** _____ **DATUM** _____

DRILLING CONTRACTOR Terratest **SLOPE** 90° **BEARING** ---

EQUIPMENT _____ **HOLE LOCATION** Clay Borrow Pit in old dam fill

HOLE SIZE _____ **LOGGED BY** KJG **CHECKED BY** _____

NOTES _____

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
ADT	▼			0			Fill: Clayey Silt: medium plasticity with some gravel.		FILL
							Fill: Clay: red-grey, high plasticity.		
							Fill: Gravelly Sandy Clay: low plasticity, with some brick (red).	0.6-0.8m (PID 0 ppm)	
				1			Fill: Gravelly Clay: brown, coarse grained, angular gravel (brick).		
				2			Fill: Gravelly Clay: brown, low plasticity with some brick.	1.8-2.0m (DUP3,3A), (PID 0 ppm)	
				3			Fill: Gravelly Sand: khaki, coarse grained, wet..		
				4			Fill: Gravel: khaki, fine grained, wet.		
Pushtube							Clay: grey/red, high plasticity, moist.		RESIDUAL CLAY
				5					
				6			Borehole MW05 terminated at 6m		
				7					
				8					
				9					
				10					

BOREHOLE / TEST PIT KURRI KURRI.GPJ GINT STD AUSTRALIA.GDT 18/5/12

TEST PIT NUMBER TP1

ENVIRON

CLIENT Norsk Hydro ASA | PROJECT NAME Phase 2 ESA

PROJECT NUMBER DE11HDR043 | PROJECT LOCATION Kurri Kurri

DATE STARTED 12/4/12 | COMPLETED 12/4/12 | R.L. SURFACE | DATUM

EXCAVATION CONTRACTOR | SLOPE --- | BEARING ---

EQUIPMENT Excavator 20T | TEST PIT LOCATION Clay Borrow Pit

TEST PIT SIZE | LOGGED BY FR | CHECKED BY SC

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
E			0.5			FILL, silty SAND/sandy SILT, minor clay content, brown, moist		FILL
			1.0			FILL, sandy CLAY, brown, moist, bricks, concrete, timber, concrete to 0.2m in size. Hole unstable at 1.6m due to water ingress.		
	▼		1.5					
			2.0			Test Pit terminated at 1.8m (approx.) Borehole TP1 terminated at 1.8m		
			2.5					
			3.0					

BOREHOLE / TEST PIT KURRI KURRI.GPJ GINT STD AUSTRALIA.GDT 18/5/12

TEST PIT NUMBER TP2

ENVIRON

CLIENT Norsk Hydro ASA **PROJECT NAME** Phase 2 ESA

PROJECT NUMBER DE11HDR043 **PROJECT LOCATION** Kurri Kurri

DATE STARTED 12/4/12 **COMPLETED** 12/4/12 **R.L. SURFACE** _____ **DATUM** _____

EXCAVATION CONTRACTOR _____ **SLOPE** --- **BEARING** ---

EQUIPMENT Excavator 20T **TEST PIT LOCATION** Clay Borrow Pit

TEST PIT SIZE _____ **LOGGED BY** FR **CHECKED BY** SC

NOTES _____

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
E	▼		0.5 1.0			FILL, silty SAND, includes broken concrete slabs up to ~0.8m, bricks, metal bar, brown, red to yellow, slightly moist. Water ingress, hole unstable.		FILL
			1.5 2.0 2.5 3.0			Test Pit terminated at 1.2m Borehole TP2 terminated at 1.2m		

BOREHOLE / TEST PIT KURRI KURRI.GPJ GINT STD AUSTRALIA.GDT 18/5/12

TEST PIT NUMBER TP3

ENVIRON

CLIENT Norsk Hydro ASA
PROJECT NAME Phase 2 ESA
PROJECT NUMBER DE11HDR043
PROJECT LOCATION Kurri Kurri

DATE STARTED 12/4/12 COMPLETED 12/4/12
R.L. SURFACE
DATUM
EXCAVATION CONTRACTOR
SLOPE ---
BEARING ---
EQUIPMENT Excavator 20T
TEST PIT LOCATION Clay Borrow Pit
TEST PIT SIZE
LOGGED BY FR
CHECKED BY SC
NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
E			0.5			FILL, silty clayey SAND, oranga/yellow, minor rubble content.		FILL
			1.0					
			1.5					
	▼					Testpit unstable at water ingress		
			2.0			Terminated at approx. 2.0m Borehole TP3 terminated at 2m		
			2.5					
			3.0					

BOREHOLE / TEST PIT KURRI KURRI.GPJ GINT STD AUSTRALIA.GDT 18/5/12

TEST PIT NUMBER TP4

ENVIRON

CLIENT Norsk Hydro ASA | PROJECT NAME Phase 2 ESA

PROJECT NUMBER DE11HDR043 | PROJECT LOCATION Kurri Kurri

DATE STARTED 12/4/12 | COMPLETED 12/4/12 | R.L. SURFACE | DATUM

EXCAVATION CONTRACTOR | SLOPE --- | BEARING ---

EQUIPMENT Excavator 20T | TEST PIT LOCATION Clay Borrow Pit

TEST PIT SIZE | LOGGED BY FR | CHECKED BY SC

NOTES Stockpiled concrete, refractory brick, bitumen around location

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
E	None encountered		0.5			FILL, sandy CLAY, some gravel cobbles including natural rock and slag		FILL
						silty SAND; relict topsoil		TOPSOIL
			1.0			sandy CLAY, moist, stiff, orange, mottled grey, EW SANDSTONE/RESIDUAL		EW SANDSTONE
			1.5					
			2.0			Test Pit terminated at 1.6m Borehole TP4 terminated at 1.6m		
			2.5					
			3.0					

BOREHOLE / TEST PIT KURRI KURRI.GPJ GINT STD AUSTRALIA.GDT 18/5/12

TEST PIT NUMBER TP5

ENVIRON

CLIENT Norsk Hydro ASA
PROJECT NAME Phase 2 ESA
PROJECT NUMBER DE11HDR043
PROJECT LOCATION Kurri Kurri

DATE STARTED 12/4/12 COMPLETED 12/4/12
R.L. SURFACE
DATUM
EXCAVATION CONTRACTOR
SLOPE ---
BEARING ---
EQUIPMENT Excavator 20T
TEST PIT LOCATION Clay Borrow Pit
TEST PIT SIZE
LOGGED BY FR
CHECKED BY SC
NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
E	None encountered		0.5			silty SAND; topsoil, black, slightly moist		TOPSOIL
			1.0			sandy CLAY; stiff, slightly moist, mottled orange/brown/yellow, EW SANDSTONE/RESIDUAL		EW SANDSTONE
			1.5			Test pit terminated at 1.1m Borehole TP5 terminated at 1.1m		
			2.0					
			2.5					
			3.0					

BOREHOLE / TEST PIT KURRI KURRI.GPJ GINT STD AUSTRALIA.GDT 18/5/12

Appendix D

Summary of Results from Phase 2 Assessment Report

TABLE LR1 Soil Analytical Results for the Clay Borrow Pit

Sample Identification	PQL	Guideline					MW01	MW02	MW03A	MW05
Sample Depth (m)		HIL D[A]	HSL D[B]	EIL C/I[C]	Management Limits[D]	ESL C/I[E]	0.3-0.4	0-0.05	0.4-0.5	1.8-2.0
Date							11/04/2012	11/04/2012	12/04/2012	12/04/2012
Sample Profile							FILL	FILL	FILL	FILL
PAEC Sampled							CBP	CBP	CBP	CBP
Sample collected by							KJG	KJG	KJG	KJG
Metals										
Aluminium	50	NL*	-	-	-	-	10400	14400	17600	9510
Arsenic	1	3000	-	160	-	-	4.9	7.9	4.1	4.9
Cadmium	0.1	900	-	-	-	-	<0.1	<0.1	1	0.1
Chromium (VI)	1	3600	-	320 (Cr III)	-	-	14.6	22.4	27.9	16.3
Copper	2	240,000	-	300	-	-	7.9	1.8	12.4	11.1
Nickel	1	6000	-	310	-	-	13.3	4.9	35.4	15.8
Lead	2	1500	-	1800	-	-	8.4	11.1	26.2	15
Zinc	5	400,000	-	700	-	-	31.6	15.4	75.5	76.7
Mercury (inorganic)	0.05	730	-	-	-	-	<0.1	<0.1	<0.1	<0.1
Fluoride	40	17000*	-	-	-	-	310	190	2120	1030
Non Metallic Inorganics										
Total Cyanide	1	1500	-	-	-	-				
Polycyclic Aromatic Hydrocarbons (PAH)										
Naphthalene	0.5	-	-	370	-	-	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5
Acenaphthene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5
Fluorene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5
Phenanthrene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5
Anthracene	0.5	-	-	-	-	-	<0.5	<0.5	0.8	<0.5
Fluoranthene	0.5	-	-	-	-	-	<0.5	<0.5	0.7	<0.5
Pyrene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	0.5	-	-	-	-	-	<0.5	<0.5	0.9	0.6
Chrysene	0.5	-	-	-	-	-	<0.5	<0.5	2.2	1.4
Benzo(b)&(k)fluoranthene	1	-	-	-	-	-	1	<1	3	3
Benzo(k)fluoranthene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5
Benzo(a) pyrene	0.5	-	-	1.4	-	-	0.7	<0.5	1.2	1
Indeno(1,2,3-c,d)pyrene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5
Dibenz(a,h)anthracene	0.5	-	-	-	-	-	<0.5	<0.5	0.5	<0.5
Benzo(g,h,i)perylene	0.5	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ		40	-	-	-	-	<0.5	<0.5	1.52	1.34
Sum of reported PAH	--	4000	-	-	-	-	0.5	<0.5	0.7	<0.5
Total Petroleum Hydrocarbons (TPH)										
TPH C6-C9	10	-	260	-	800	-				
TPH C10-C14	50	-	NL	-	1000	170				
TPH C15-C28	100	-	-	-	5000	1700				
TPH C29-C36	100	-	-	-	10,000	3300				
TPH C10-C36	--	-	-	-	-	-				
Polychlorinated Biphenyls										
Total PCBs	1	-	-	-	-	-				
Semi Volatile Organic Compounds										
Total PAHs	1	4000	-	-	-	-	<LOR	<LOR	<LOR	<LOR
Total Phenols	1	240,000	-	-	-	-	<LOR	<LOR	<LOR	<LOR
Phthalate Esters	5	-	-	-	-	-	<LOR	<LOR	<LOR	<LOR
Nitrosamines	1	-	-	-	-	-	<LOR	<LOR	<LOR	<LOR
Nitroaromatics and Ketones	1	-	-	-	-	-	<LOR	<LOR	<LOR	<LOR
Haloethers	0.5	-	-	-	-	-	<LOR	<LOR	<LOR	<LOR
Chlorinated Hydrocarbons	1	-	-	-	-	-	<LOR	<LOR	<LOR	<LOR
Anilines and Benzidines	1	-	-	-	-	-	<LOR	<LOR	<LOR	<LOR
Organochlorine Pesticides	1	-	-	-	-	-	<LOR	<LOR	<LOR	<LOR
Organophosphorus Pesticides	0.5	-	-	-	-	-	<LOR	<LOR	<LOR	<LOR
Miscellaneous Compounds	0.5	-	-	-	-	-	<LOR	<LOR	<LOR	<LOR
Volatile Organic Compounds										
Monocyclic Aromatic Hydrocarbons	5	-	-	-	-	-				
Oxygenated Compounds	0.5	-	-	-	-	-				
Sulfonated Compounds	1	-	-	-	-	-				
Fumigants	0.5	-	-	-	-	-				
Halogenated Aliphatic Compounds	5	-	-	-	-	-				
Halogenated Aromatic Compounds	0.5	-	-	-	-	-				
Trihalomethanes	0.5	-	-	-	-	-				

All results are in units of mg/kg.

Blank Cell indicates testing was not completed

PQL = Practical Quantitation Limit.

[A] NEPM (2013) Health Investigation Level 'D' (Industrial/ Commercial)

[B] NEPM (2013) Soil Health Screening Level for Vapour Intrusion 'D' Commercial/ Industrial

[C] NEPM (2013) Ecological Investigation Levels for Commercial/ Industrial

[D] NEPM (2013) Management Limits for TPH Fractions F1 to F4 in soil - note that the F1 to F4 fractions are different to the fractions reported here

[E] NEPM (2013) Ecological Screening Level for Commercial/ Industrial

* Fluoride (soluble) and aluminium Preliminary Screening Criteria from ENVIRON (2013) 'Preliminary Screening Level Health Risk Assessment for Fluoride and Aluminium'

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 Groundwater Analytical Results

Sample Identification	PQL	Guideline			MW01	MW01	MW03	MW03	MW04	MW04	MW05	MW05
Date		95% Fresh [A]	Irrigation	Stock	2/5/12	24/7/12	2/5/12	24/7/12	2/5/12	24/7/12	2/5/12	24/7/12
PAEC Sampled					CBP	CBP	CBP	CBP	CBP	CBP	CBP	CBP
Sample Appearance					Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Sample collected by					KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG
Metals												
Aluminium pH>6.5	10	55	5000	5000	20		590		2530		30	
Arsenic	1	24	100	500	<10	<1	<10	3	<10	<1	2	2
Cadmium	0.1	2*	10	10	<1	1.1	<1	2	3.1	2.7	0.1	0.2
Chromium	1	1	100	1000	<10	<1	<10	4	<10	<1	<1	<1
Copper	1	126*	200	1000	<10	5	<10	3	<10	4	3	3
Nickel	1	99*	200	1000	<10	58	488	420	938	600	15	15
Lead	1	91.8*	2000	100	<10	<1	<10	3	<10	<1	1	<1
Zinc	5	720*	2000	20,000	<50	64	847	1100	1840	1000	30	9
Mercury	0.1	0.6	2	2	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05
Fluoride	100		1000	2000	1200		2500		5500		15000	
Non Metallic Inorganics												
Free Cyanide	4	7										
Total Cyanide	4	NA										
Total Petroleum Hydrocarbons (TPH)												
TPH C6-C9	20											
TPH C10-C14	50											
TPH C15-C28	10											
TPH C29-C36	50											
TPH C6-C36		7	LOR	LOR								
Polycyclic Aromatic Hydrocarbons (PAH)												
3-Methylcholanthrene	0.1											
2-Methylnaphthalene	0.1											
7.12-Dimethylbenz(a)anthracene	0.1											
Acenaphthene	0.1											
Acenaphthylene	0.1											
Anthracene	0.1	*0.4*										
Benz(a)anthracene	0.1											
Benzo(a)pyrene	0.05	0.2										
Benzo(b)fluoranthene	0.1											
Benzo(e)pyrene	0.1											
Benzo(g.h.i)perylene	0.1											
Benzo(k)fluoranthene	0.1											
Chrysene	0.1											
Coronene	0.1											
Dibenz(a.h)anthracene	0.1											
Fluoranthene	0.1	1.4										
Fluorene	0.1											
Indeno(1.2.3.cd)pyrene	0.1											
N-2-Fluorenyl Acetamide	0.1											
Naphthalene	0.1	16										
Perylene	0.1											
Phenanthrene	0.1	2										
Pyrene	0.1											
Semivolatile Organic Compounds (SVOCs)												
Organochlorine Pesticides (OCP)												
alpha-BHC	2				<2		<2		<2		<2	
HCB	2				<2		<2		<2		<2	
delta-BHC	2				<2		<2		<2		<2	
Heptachlor	2	0.09			<2		<2		<2		<2	
Aldrin	2	*0.001*			<2		<2		<2		<2	
Heptachlor epoxide	2				<2		<2		<2		<2	
Chlordane	2	0.08			<2		<2		<2		<2	
Endosulfan	2	0.2			<2		<2		<2		<2	
Dieldrin	2	*0.01*			<2		<2		<2		<2	
DDE	2	*0.03*			<2		<2		<2		<2	
Endrin	2	0.02			<2		<2		<2		<2	
DDD	2				<2		<2		<2		<2	
Endrin aldehyde	2				<2		<2		<2		<2	
Endosulfan sulfate	2				<2		<2		<2		<2	
DDT	4	0.01			<4		<4		<4		<4	

TABLE LR2 Groundwater Analytical Results

Sample Identification	PQL	Guideline			MW01	MW01	MW03	MW03	MW04	MW04	MW05	MW05
Date		95% Fresh [A]	Irrigation	Stock	2/5/12	24/7/12	2/5/12	24/7/12	2/5/12	24/7/12	2/5/12	24/7/12
PAEC Sampled					CBP	CBP	CBP	CBP	CBP	CBP	CBP	CBP
Sample Appearance					Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Sample collected by					KJG	KJG	KJG	KJG	KJG	KJG	KJG	KJG
Organophosphorous Pesticides (OPP)												
Dichlorvos	2				<2		<2		<2		<2	
Dimethoate	2	0.15			<2		<2		<2		<2	
Diazinon	2	0.01			<2		<2		<2		<2	
Chlorpyrifos-methyl	2				<2		<2		<2		<2	
Malathion	2	0.05			<2		<2		<2		<2	
Fenthion	2	0.2			<2		<2		<2		<2	
Chlorpyrifos	2				<2		<2		<2		<2	
Bromophos-ethyl	2				<2		<2		<2		<2	
Chlorfenvinphos	2				<2		<2		<2		<2	
Prothiofos	2				<2		<2		<2		<2	
Ethion	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	
Phthalate Esthers												
Dimethylphthalate	2	3700			<2		<2		<2		<2	
Diethylephthalate	2	1000			<2		<2		<2		<2	
Nitrosamines												
Total Nitrosamines	2				<2		<2		<2		<2	
Nitroaromatics and Ketones												
Total Nitroaromatics and Ketones	2				<2		<2		<2		<2	
Haloethers												
Total Haloethers	2				<2		<2		<2		<2	
Chlorinated Hydrocarbons												
Total Chlorinated Hydrocarbons	2				<2		<2		<2		<2	
Anilines and Benzidines												
Total Anilines and Benzidines	2				<2		<2		<2		<2	
Miscellaneous Compounds												
Total Misscellaneous Compounds	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

* Hardness Modified Trigger Values for Cd. Cu, Ni, Pb, Zn

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

Appendix E

Summary of Results from 2014 Refractory Brick Testing

TABLE 1 Refractory Brick Wastes - Batch Testing Results

Sample Identification				Summary statistics*				Exemption Criteria**		RB2	RB3	RB4	RB9	RB10	RB11	RB12	RB13	RB14	RB15	RB17	RB18	RB24	RB26	RB27	RB28	RB29	RB30	RB31	RB32	RB33	RB34	RB35	RB35
	Units	Test method	PQL	min	Average	Max	Stdev	Maximum Average Concentration	Absolute Maximum Concentration																									
Moisture Content		Inorg-008		0.1	2.8	8.8	2.14	-	-	1.3	2.7	4.4	3.3	3.1	1.2	2.6	4.1	3.1	5.1	4.7	8.8	6.8	2.5	3.1	2.3	5.3	2.5	4.5	3.9	2.1	3.5	3.1	
Metals																																	
Arsenic	mg/kg dry weight	Metals-020 ICP-AES	4	2.0	2.0	2.0	0.00	15	30	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Cadmium	mg/kg dry weight	Metals-020 ICP-AES	1	0.2	0.2	**2.0**	0.27	0.5	1	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	**2**	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg dry weight	Metals-020 ICP-AES	3	0.5	2.7	20.0	4.59	40	80	2	13	<1	2	1	<1	<1	1	16	3	7	6	1	20	<1	3	<1	6	1	<1	<1	<1	2	2
Copper	mg/kg dry weight	Metals-020 ICP-AES	0.5	0.5	2.1	9.0	2.20	40	80	<1	8	1	<1	2	<1	1	<1	4	3	5	9	3	4	<1	3	3	3	3	1	<1	1	4	3
Nickel	mg/kg dry weight	Metals-020 ICP-AES	1	0.5	2.0	8.0	1.55	25	50	<1	6	2	<1	3	1	2	1	3	8	3	3	3	3	2	3	4	2	1	2	<1	2	3	3
Lead	mg/kg dry weight	Metals-020 ICP-AES	1	0.5	1.1	10.0	1.50	50	100	<1	<1	<1	<1	<1	<1	1	<1	1	2	<1	10	2	<1	<1	<1	<1	1	2	<1	<1	<1	<1	<1
Zinc	mg/kg dry weight	Metals-020 ICP-AES	1	0.5	2.0	25.0	3.95	150	300	<1	2	1	<1	2	3	3	2	4	25	1	10	3	1	<1	1	<1	1	2	1	<1	<1	2	1
Mercury		Metals-020 ICP-AES	1	0.05	0.05	0.05	0.00	0.5	1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Non Metallic Inorganics																																	
Total Fluoride	mg/kg dry weight	NEPM-404	50	25.0	86.8	**730.0**	158.91	300	600	59	170	25	25	25	25	25	25	**730**	25	25	470	500	25	210	25	25	25	25	25	25	25	25
Total Cyanide	mg/kg dry weight	Inorg-013	0.5	0.0	0.0	0.0	0.00	-	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Polycyclic Aromatic Hydrocarbons (PAH)																																	
Benzo(a)pyrene	mg/kg dry weight	Org-012	0.05	0.0	0.0	0.4	0.06	-	1	NA	0.39	NA	NA	<0.05	NA	NA	<0.05	NA	NA	NA	NA	NA	NA	<0.05	NA	NA	<0.05	NA	NA	NA	NA	NA	NA
Sum of reported PAH	mg/kg dry weight	Org-012	--	0.8	1.1	3.5	0.91	-	40	NA	4	NA	NA	ND	NA	NA	ND	NA	NA	NA	NA	NA	NA	ND	NA	NA	ND	NA	NA	NA	NA	NA	NA

NA not analysed

PQL = Practical Quantitation Limit.

*Statistics set non-detect results at 0.5 PQL concentration

** from Draft Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption 2012 (Table 2)

Results shown in bold/shading are in excess of the Exemption limits (Table 2)

chromium is total chromium

TABLE 1 Refractory Brick Wastes - Batch Testing Results

Sample Identification			PQL	Summary statistics*				Exemption Criteria**		RB36	RB37	RB38	RB39	RB40	RB41	RB42	RB43	RB44	RB45	RB46	RB47	RB48
	Units	Test method		min	Average	Max	Stdev	Maximum Average Concentration	Absolute Maximum Concentration													
Moisture Content		Inorg-008		0.1	2.8	8.8	2.14	-	-	4	3.4	3.9	4.5	3.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Metals																						
Arsenic	mg/kg dry weight	Metals-020 ICP-AES	4	2.0	2.0	2.0	0.00	15	30	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Cadmium	mg/kg dry weight	Metals-020 ICP-AES	1	0.2	0.2	**2.0**	0.27	0.5	1	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg dry weight	Metals-020 ICP-AES	3	0.5	2.7	20.0	4.59	40	80	<1	<1	<1	14	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	mg/kg dry weight	Metals-020 ICP-AES	0.5	0.5	2.1	9.0	2.20	40	80	<1	<1	<1	8	<1	<1	<1	<1	2	<1	1	4	<1
Nickel	mg/kg dry weight	Metals-020 ICP-AES	1	0.5	2.0	8.0	1.55	25	50	1	2	<1	2	<1	<1	<1	<1	2	<1	2	<1	<1
Lead	mg/kg dry weight	Metals-020 ICP-AES	1	0.5	1.1	10.0	1.50	50	100	2	<1	<1	<1	<1	<1	2	1	<1	1	1	1	2
Zinc	mg/kg dry weight	Metals-020 ICP-AES	1	0.5	2.0	25.0	3.95	150	300	<1	<1	<1	2	<1	<1	1	<1	<1	<1	<1	<1	<1
Mercury		Metals-020 ICP-AES	1	0.05	0.05	0.05	0.00	0.5	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
Non Metallic Inorganics																						
Total Fluoride	mg/kg dry weight	NEPM-404	50	25.0	86.8	**730.0**	158.91	300	600	25	25	200	25	25	25	25	25	25	25	25	25	25
Total Cyanide	mg/kg dry weight	Inorg-013	0.5	0.0	0.0	0.0	0.00	-	1	<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
Polycyclic Aromatic Hydrocarbons (PAH)																						
Benzo(a)pyrene	mg/kg dry weight	Org-012	0.05	0.0	0.0	0.4	0.06	-	1	NA	<0.05	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.05	NA
Sum of reported PAH	mg/kg dry weight	Org-012	--	0.8	1.1	3.5	0.91	-	40	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA

NA not analysed

PQL = Practical Quantitation Limit.

*Statistics set non-detect results at 0.5 PQL concentration

** from Draft Hydro Aluminium Kurri Kurri Bake Ovens Refractory Brick Exemption 2012 (Table 2)

Results shown in bold/shading are in excess of the Exemption limits (Table 2)

chromium is total chromium