Phase 2 Environmental Site Assessment, Parcel 11

Prepared for:
Hydro Aluminium Kurri Kurri Pty Ltd

On behalf of:

Prepared by:
ENVIRON Australia Pty Ltd

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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
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
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
RPD	Relative Percent Difference
UCL	Upper Confidence Limit
µg/L	Micrograms per Litre
VENM	virgin excavated natural material
-	On tables is "not calculated", "no criteria" or "not applicable"

Executive Summary

This report presents the findings of a Phase 2 Environmental Site Assessment undertaken on part of the Hydro Aluminium Kurri Kurri (Hydro) owned land known as Parcel 11. Parcel 11 is a rural property comprising approximately 150ha and is accessed from Bowditch Avenue, Kurri Kurri and located within the buffer zone and to the north east of the Hydro Aluminium Kurri Kurri Smelter. Parcel 11 predominantly comprises open farmland with scattered trees and limited infrastructure. Swamp Creek meanders through the parcel.

The objectives of the assessment were to assess the potential for contamination at Parcel 11 based on historical and current landuse and to assess the suitability of Parcel 11 for the purposes of environmental conservation (E2) and rural landscape (RU2) land use.

A Phase 1 ESA has previously been completed for the Hydro owned lands including Parcel 11 (ENVIRON (22 October 2013) Phase 1 ESA, Hydro Kurri Kurri Aluminium Smelter). The Phase 1 identified that contamination of Parcel 11 may have occurred from dust deposition due to the proximity of the Hydro smelter and illegal dumping due to the remoteness of the area.

To assess the potential for contaminants of concern on Parcel 11, a site walkover was completed and surface soil samples were collected on an approximate grid across the parcel. The site walkover identified an aluminium shed, an associated concrete water tank and a dam in the southern portion of the parcel and a bridge constructed from bake furnace refractory bricks over Swamp Creek. No potential soil contamination issues were identified associated with this infrastructure. The construction materials of the aluminium shed were inspected. The inspection did not identify any hazardous building materials.

Surface soil samples from across Parcel 11 were analysed for soluble fluoride. Fluoride results were below the preliminary screening level for residential landuse, which is considered applicable for the proposed rural landuse. No soil contamination issues were identified on Parcel 11.

Parcel 11 is suitable for the purposes of environmental conservation (E2) and rural landscape (RU2) land use.

Hydro has separately engaged a NSW EPA-accredited Site Auditor to issue a Site Audit Statement certifying that the site is suitable for the proposed use.

1 Introduction

1.1 Background

This report presents the findings of a Phase 2 Environmental Site Assessment undertaken on part of the Hydro Aluminium Kurri Kurri Pty Limited (Hydro) owned land known as Parcel 11. Parcel 11 is located off Bowditch Avenue, Loxford, New South Wales (2326). The location of Parcel 11 is shown in **Figure 1**.

The work has been performed at the request of Hydro Aluminium Kurri Kurri Pty Limited (the "Client").

Hydro is currently evaluating options for the divestment of land parcels for a range of land uses following the closure of the site in May 2014. A Rezoning Masterplan has been developed that identifies Parcel 11 to comprise land suitable for environmental conservation (E2) and rural landscape (RU2) land use.

A Phase 1 Environmental Site Assessment has previously been prepared for all Hydro owned lands and evaluated the potential for contamination. The Phase 1 identified that contamination of Parcel 11 may have occurred from dust deposition due to the proximity of the Hydro smelter, illegal dumping due to the remoteness of the area and the presence of farm buildings with the potential to comprise building materials considered hazardous, such as asbestos containing materials.

It is noted that at the time of the fieldwork, this land parcel was named Employment Land Subarea 11 and as such the soil samples reference this name. Prior to the completion of this report, a Masterplan was completed for Hydro-owned land and the use of this land parcel under the Masterplan changed from employment land to part rural land/ part conservation land. The name of the land parcel as referenced in this report subsequently changed to Parcel 11.

The location of Parcel 11 in the context of the Rezoning Masterplan is shown in **Figure 2**.

1.2 Objectives and Scope of Work

The objectives of the assessment were to assess the potential for contamination at Parcel 11 based on historical and current land use and to assess the suitability pf Parcel 11 for environmental conservation (E2) and rural landscape (RU2) land use.

The scope of work performed to meet the objectives comprised:

- a review of available information relating to land use to assess the potential for soil, groundwater or surface water contamination arising from historic and current activities;
- a review of published geological, hydrogeological and hydrological data to establish the environmental setting and sensitivity;
- field work comprising:
  - Collection of surface soil samples to provide a coarse grid assessment of the potential for dust deposition from the smelter operations;
  - A site walkover to evaluate other potential locations of buried waste or illegal dumping.

- data interpretation including comparison against relevant guidelines and a discussion of the findings in terms of human health and environment risk under the current and future land use scenarios; and
- a review of options available for remediation or management to render Parcel 11 suitable for the proposed land use.

2 Site Description

2.1 Site Location

Parcel 11 is owned by Hydro Aluminium Kurri Kurri Pty Limited and is located approximately 35km north west of the city of Newcastle and 150km north of Sydney, in the suburb of Loxford, Kurri Kurri, New South Wales, Australia. Parcel 11 is accessed from Bowditch Avenue. The location of Parcel 11 is shown in **Figure 1**.

Parcel 11 is located within the Buffer Zone of the Hydro Aluminium Kurri Kurri Smelter, to the north east of the smelter. The Buffer Zone is an area of land surrounding the smelter that provides a buffer between the smelter and surrounding communities. Parcel 11 comprises open farmland covered in grasses and other scattered small trees and shrubs. Swamp Creek meanders through the parcel. Low lying swampy land and natural ponds are present in close proximity to Swamp Creek.

Parcel 11 is located within the Cessnock Local Government Area and the majority of Parcel 11 is zoned RU2 – Rural Landscape under the Cessnock Local Environment Plan. A small area in the northern part of the site is zoned E2 – Environmental Conservation. This area represents the fringes of Wentworth Swamp which lies to the north of Parcel 11, and within Maitland Local Government Area.

Parcel 11 is approximately 150 hectares (ha) and comprises the lot numbers and deposited plans (DP) listed in **Table 1**:

Table 1: Lot and Deposited Plans for Parcel 11.

Subarea	Lot/ DP	Area (ha)	Total Area (ha)
Parcel 11	Lot 1 DP543057 Lot 3 DP233125	106.9 43.8	150.7

Land uses surrounding Parcel 11 are as follows:

- North: Wentworth Swamp and farmland;
- South: Bushland and rural residential properties;
- West: Bushland and the smelter; and
- East: A railway line then farmland and bushland. The railway line is infrequently used and transports coal.

The Smelter is located approximately 1.2km to the south west of Parcel 11.

2.2 Site Setting

2.2.1 Topography

Parcel 11 is located in a low lying swampy area of the Buffer Zone at approximately 11 mAHD. The southern portion of the parcel comprises gently rolling hills, sloping to the north towards Swamp Creek. The highest point on Parcel 11 is the eastern boundary adjacent to the railway line. The natural topography slopes towards Swamp Creek, which meanders through the parcel.

2.2.2 Regional Geology

According to the review of the regional geology described on the Sydney Basin Geological Sheet, Parcel 11 is underlain by siltstone, marl and minor sandstone from the Permian aged Rutherford Formation (Dalwood Group) in the Sydney Basin.

Undifferentiated Quaternary alluvium occurs on the surface of Parcel 11 associated with surface water bodies. Quaternary sediments which are associated with Swamp Creek (approximately 100m east of Parcel 11) and the Hunter River consist of gravel, sand, silt and clay.

2.2.3 Site Hydrology

Surface water from Parcel 11 discharges primarily via infiltration and overland flow to Swamp Creek and associated water bodies. Swamp Creek discharges into Wentworth Swamp immediately north of the parcel. Wentworth Swamp in turn discharges to the Hunter River approximately 6.5km northeast of Parcel 11 near Maitland.

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).

2.2.4 Regional 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 Parcel 11 is expected to flow towards Swamp Creek, which meanders through the parcel.

According to the NSW Office of Environment and Heritage (Natural Resource Atlas), there are 11 licensed groundwater abstractions (bores) located within 1km of Parcel 11. The majority of the groundwater bores are located within the aluminium smelter and buffer zone.

Information for 11 bores located in a 1km radius from Parcel 11 has been included in **Appendix A**. The bores are used for monitoring purposes. No further information, such as depth to water or logging information was provided.

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.nsw.gov.au/ieo/Hunter/index.htm).

2.3 Site Sensitivity

The sensitivity of Parcel 11 with respect to surface water and groundwater is considered to be moderate based on the following.

- Surface water and groundwater discharge into Swamp Creek located within Parcel 11, which discharges to the Hunter River via Wentworth Swamp within the Fishery Creek Catchment, approximately 7km northeast of Parcel 11 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 Parcel 11 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.

3 Site History

Site history investigations included in the Phase 1 ESA for the Hydro Aluminium Kurri Kurri Smelter, dated 22 October 2013 provided the following historical information about Parcel 11.

- Earliest records (aerial photograph in 1951) showed that Parcel 11 comprised cleared farmland at this time. The only major change to Parcel 11 since this time was the construction of a farm building and dam around the late 1970s.
- A small farm building was constructed on a portion of Lot 3 in DP 233125. The age of the building is unknown. Historical aerial photographs indicate the farm buildings remain at present.
- A paddock in the western portion of Parcel 11 was used for irrigation of process water from the smelter and continues to be used for this purpose.
- Parcel 11 is located approximately 1km east of the smelter boundary and may be impacted from smelter dust deposition.
- The remoteness of Parcel 11 and surrounding farmland may also give rise to illegal dumping though it is noted that the Buffer Zone area is fenced and regularly monitored by Hydro personnel.

The location of the farm building is included in **Figure 3**.

4 Previous Investigations

4.1 Soil

Soil sampling undertaken in Parcel 11 as part of the Phase 2 ESA (ENVIRON (November 2012) Phase 2 Environmental Site Assessment, Kurri Kurri Aluminium Smelter) involved the collection of nine surface soil samples to assess the potential impact of smelter dust deposition and irrigation of process water in this area. The soil samples (SB20 to SB25, SB35 to SB37) were analysed for a combination of heavy metals, total fluoride, aluminium, total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAHs). Results for heavy metals and TPH were below the selected criteria.

Surface soil sampling locations and results are included in **Appendix B**. These results are discussed further in Section 8.1.

4.2 Surface Water

4.2.1 ENVIRON

Surface water sampling was undertaken in Parcel 11 as part of additional investigations completed at an area of the smelter known as the capped waste stockpile (ENVIRON (December 2012) Environmental Site Assessment, Alcan Mound, Kurri Kurri Aluminium Smelter). Surface water samples were collected from three locations (SW4 to SW6) at Swamp Creek within Parcel 11 and analysed for pH, electrical conductivity, fluoride, free cyanide and aluminium, which are contaminants of concern associated with the capped waste stockpile.

Results for pH and electrical conductivity were consistent with a fresh water stream. Aluminium concentrations exceeded the criteria for the protection of 95% of aquatic ecosystems at the three sampling locations. Free cyanide concentrations did not exceed this criterion. Fluoride concentrations exceeded the criterion for irrigation at two of the three locations.

Surface water sampling locations and results tables are included in **Appendix B**. These results are discussed further in **Section 8.1**.

4.2.1 Hydro Routine Monitoring

Routine surface water monitoring is undertaken in Parcel 11 by Hydro on a monthly basis and for the Annual Environmental Management Review (AEMR). Surface water samples are collected from three locations from Swamp Creek in the section that traverses Parcel 11 (B, D and E). Surface water samples are routinely analysed for pH, electrical conductivity and fluoride. Biannually the samples are also analysed for free cyanide.

Results from routine monitoring between July 2013 and December 2013 were evaluated for this report. Results for pH and electrical conductivity were consistent with a fresh water stream. Fluoride concentrations generally exceeded the criterion for irrigation (1mg/L) but were below the criterion for stock watering (2mg/L).

Surface water sampling locations and results tables are included in **Appendix B**. These results are discussed further in **Section 8.1**.

4.3 Bake Furnace Refractory Brick

Bake furnace refractory brick has been used with the Hydro buffer zone to create accessible tracks and create causeways across the creeks. Bake furnace refractory bricks are used as an insulating material to line the bake furnace for baking of anodes and are a by-product of aluminium smelting.

A chemical assessment of the bricks was undertaken in ENVIRON (2012) Application for Exemption – Refractory Brick. The chemical characterisation was undertaken on twenty composite samples and included analysis for metals, non metallic inorganics and polycyclic aromatic hydrocarbons. The average chemical concentrations have been compared against NEPM (2013) criteria in **Table 3**. None of the average concentrations exceed the NEPM (2013) criteria for residential landuse, adopted as the relevant guideline for rural land use, and on this basis bake furnace refractory brick is not considered to be of environmental concern.

Table 2: Refractory Brick Chemical Characterisation

Analyte	PQL	Average	HIL A - NEPM (2013) Criteria	Average > NEPM (2013)
Metals				
Arsenic	4	-	100	No
Beryllium	1	-	60	No
Boron	3	26	4500	No
Cadmium	0.5	0.5	20	No
Chromium	1	12	100	No
Lead	1	5	300	No

Molybdenum	1	1	-	No
Nickel	1	5	400	No
Selenium	2	-	200	No
Tin	1	1	-	No
Mercury	0.1	-	40	No
Silver	1	-	-	No
Copper	1	12	6000	No
Zinc	1	7	7400	No
Vanadium	0.5	20	-	No
Non Metallic Inorganics				
Total Fluoride	50	191	440*	No
Total Cyanide	0.5	-	-	No
Sulphur	1	1871	-	No
Total Organic Carbon	1	1910	-	No
Chloride	1	-	-	No
Electrical Conductivity	1	902	-	No
pH	1	9	-	No
Polycyclic Aromatic Hydrocarbons				
Sum of reported PAH	0.1	-	300	No

All units are mg/kg on a dry weight basis.
*Fluoride preliminary screening level for residential landuse from ENVIRON (2013)

5 Sampling and Analytical Quality Plan

5.1 Potential Areas and Contaminants of Concern

Based on Parcel 11 historical information as discussed in **Section 3**, the following areas of concern were identified:

- smelter dust deposition;
- use of the property for rural purpose;
- irrigation of stormwater from the smelter; and
- illegal dumping.

Investigation of impacts from irrigation was identified previously for a range of potential contaminants of concern and identified fluoride concentrations to be elevated above background. Other analytes were not identified, or where below site criteria and are therefore not considered to be potentially of concern.

Based on the historical site information and previous sampling, potential contaminants of concern are:

- asbestos; and
- fluoride.

5.2 Data Quality Objectives and Data Quality Indicators

Data quality objectives (DQOs) and Data Quality Indicators (DQIs) were developed by ENVIRON using the US EPA seven-step DQO process. Completing the seven-step process helps to define the purpose of the assessment and the type, quality and quantity of data needed to inform decisions relating to the assessment of site contamination.

The seven-step DQO process and DQIs are included in **Appendix G**.

5.3 Sampling Design

The sampling design has been optimised following the development of DQOs and DQIs. The sampling design is outlined below. ENVIRON notes that the historical site activities indicate potential contamination to surface soils only. Potential impacts to surface water from runoff occurring during irrigation were identified. Whilst it is noted that irrigation is minimised to not allow runoff it is recognised that this could occur under some circumstances. Routine monitoring is undertaken by Hydro as discussed previously, and this data is presented and discussed in **Section 8.1**. Surface water sampling was therefore not included in the sampling design.

5.3.1 Fluoride

To assess the potential for fluoride in soil from dust deposition from the Hydro Aluminium Kurri Kurri Smelter, surface soil samples were collected at a rate of one sample per 5ha.

The sample density is lower than that suggested in Table A of NSW EPA (1995) Contaminated Sites: Sampling Design Guidelines. The density is considered adequate for the purposes of this investigation for the following reasons:

- aerial dust deposition is likely to be relatively consistent over the surface of the parcel and therefore sampling on a low density will allow for identification of whether or not dust deposition is an issue; and

- in the event that elevated or variable fluoride concentrations are identified, additional sampling will be completed.

Samples were collected by trowel from surface soils on an approximate grid across open areas of Parcel 11. Sample locations will be logged by GPS.

Soil samples were placed into laboratory-supplied paper bags and stored in an ice-filled cooler for transportation to the laboratory. Soil samples were transported to the laboratory under chain of custody conditions. Intra-laboratory duplicate soil samples were collected at a rate of 10%.

Soil samples were analysed for soluble fluoride, as this is the portion of total fluoride that is available for uptake in receptors including biota, flora, fauna and humans. The laboratory was NATA accredited for the analysis.

5.3.2 Asbestos

To assess the potential for asbestos and other illegally dumped wastes to be present at Parcel 11, a site walkover of accessible areas was completed.

The location and type of dumped wastes were detailed on Field Information Sheets and logged by GPS. Where asbestos was confidently identified by the field personnel, no sampling was completed. If not, a sample of potential asbestos containing material (ACM) was collected for laboratory analysis. ACM fragments were collected into a zip-lock bag using dedicated disposable gloves.

ACM fragments were analysed for asbestos identification by a laboratory NATA accredited for the analysis.

6 Basis for Assessment Criteria

6.1 Soil

The criteria proposed for the assessment of soil contamination were sourced from the following references:

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

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

- HIL A - residential with garden/accessible soil (home grown produce <10% fruit and vegetable intake, (no poultry), also includes children day care centres, preschools and primary schools
- HSLs for commercial/industrial use - Health screening levels 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;
- EIL for commercial/ industrial use – ecological investigations levels applicable for assessing risk to terrestrial ecosystems. EILs depend on specific soil physicochemical properties and generally apply to the top 2 m of soil.
- ESLs for commercial/ industrial use – ecological screening levels developed for selected petroleum hydrocarbon compounds and fractions and are applicable for assessing risk to terrestrial ecosystems. These are also generally applicable to the top 2m of soil.
- 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 heavy metals and PAHs in soil are presented in **Table 3:**

Table 3: Soil Assessment Criteria (mg/kg) – Health and Ecological Investigation Levels

	HIL A	**EIL[1]**
Arsenic	100	100
Cadmium	20	-
Chromium (VI)	100	410 (Cr III, 10% Clay)
Copper	6000	110
Lead	300	1100
Nickel	400	100

Table 3: Soil Assessment Criteria (mg/kg) – Health and Ecological Investigation Levels		
	HIL A	**EIL[1]**
Zinc	7,400	230
Mercury (inorganic)	40	-
Fluoride	Ref Table 5	-
Carcinogenic PAHs (as BaP TEQ)	3	-
Total PAHs	300	-

1 EILs represent the added contaminant limit (ACL) added to the ambient background concentration (ABC) using the NEPM (2013) EIL Calculation Spreadsheet and pH and cation exchange capacity (CEC) data from the adjacent Parcel 14 (Lab Batch ES1405849, sample ID P14 TP2: 0.3-0.5).

The applicable assessment criteria for petroleum hydrocarbons in soil are presented in **Table 4** and **Table 5**:

Table 4: Soil Assessment Criteria for Vapour Intrusion - HSL A & HSL B (mg/kg) - Sand				
	0 to <1m	**1m to <2m**	**2m to <4m**	**4m+**
Toluene	160	220	310	540
Ethylbenzene	55	NL	NL	NL
Xylenes	40	60	95	170
Naphthalene	3	NL	NL	NL
Benzene	0.5	0.5	0.5	0.5
F1(4)	45	70	110	200
F2(5)	110	240	440	NL

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

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

3 To obtain F1 subtract the sum of BTEX concentrations from the C6-C10 fraction.

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

Table 5: 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)**
		Urban residential and public open space	**Residential, parkland and public open space**
F1 C6- C10	Fine	180*	800
F2 >C10-C16	Fine	120*	1000
F3 >C16-C34	Fine	1300	3500
F4 >C34-C40	Fine	5600	10000

Table 5: 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)**
		Urban residential and public open space	**Residential, parkland and public open space**
Benzene	Fine	65	-
Toluene	Fine	105	-
Ethylbenzene	Fine	125	-
Xylenes	Fine	45	-
Benzo(a)pyrene	Fine	0.7	-

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

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

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

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

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 5**. The HSLs are generic to all soil types.

Table 5. 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 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**:

Table 6: Site Specific Soil Assessment Criteria (mg/kg) for Fluoride	
Preliminary screening levels	
Land Use	**Preliminary screening level**
Residential landuse	F 440mg/kg
Recreational landuse	F 1200mg/kg
Commercial/ industrial landuse	F 17000mg/kg

Soil investigation results for the samples taken from a grid formation across Parcel 12 have been compared against the residential land use screening level. The fluoride 'residential land

use' screening level is considered to be suitably protective of both 'residential' and 'rural residential' land use because the exposure pathways (including vegetable ingestion) and behavioural assumptions (e.g. soil ingestion rate) for the child are considered to be identical under residential and rural residential land use scenarios.

There is a possibility that the rural plots may contain a low density of domestic livestock such as poultry and goats, however there is limited evidence of fluoride accumulation in milk and edible tissues of animals fed high levels of fluorides (ATSDR, 2003; NAS, 1971). Rather, fluoride accumulates primarily (up to approximately 99%) in the skeletal tissues of terrestrial animals that consume fluoride-containing foliage (WHO, 1997; ATSDR, 2003). This assumption is supported by site-specific data collected during the 29th annual cattle survey conducted in March 2012 on cattle located within the site's buffer zone, and surrounding areas (AECOM, 2013). The results of this survey concluded that cattle has had little or no exposure to excess environmental fluoride; skeletal fluoride levels decreased compared to 2011 levels, with all fluoride measurements below the toxic threshold; and all cattle examined were in good health and body condition. Consequently, the residential screening level is considered to be suitably protective of rural residential land use that may contain a low density of domestic livestock.

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

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

6.2 Surface Water

The assessment criteria proposed for the assessment of water are sourced from the following references:

- ANZECC & ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
- National Environment Protection Council (2013) National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1) (NEPM 2013).

7 Results

7.1 Site Walkover

A site walkover was completed to identify areas of environmental concern, such as illegally dumped wastes and fill at Parcel 11. The entrance to Parcel 11 is from Bowditch Avenue, which borders the southern boundary of Lot 2. There are no roadways or tracks within Lot 1 or Lot 2. On Lot 3 a track extends from the south east corner northwards past the only building developments on the parcel.

Parcel 11 comprises grazing land with stands of mature trees in the southern and north western portions of the parcel and along the banks of Swamp Creek. Swamp Creek meanders through the parcel and there are approximately six waterholes associated with Swamp Creek. A dam and a shed are located in the southern portion of the parcel. The shed is of aluminium construction, with a concrete water tank and aluminium silo adjoining. A bridge across Swamp Creek has been constructed at the northern-most area of Lot 3. The bridge is constructed from bake furnace refractory bricks source from the smelter. Parcel 11 is traversed by a 120kv power lines.

The aluminium shed, tank and silo were the subject of an Audit conducted by ENVIRON in 2014. The Audit comprised an inspection of the external building construction materials. These materials were aluminium and timber and based on the inspection it is unlikely that hazardous materials are present.

No signs of disturbed land or of land filling were observed during the walkover, except as described above for the construction of a bridge.

Photographs are included in **Appendix C**. Field Information Sheets are included in **Appendix D**.

7.2 Soil Investigations

Twenty-one surface soil samples were collected from across Parcel 11 at a rate of one sample per 7ha to assess the potential for fluoride in soil from dust deposition from the Hydro Aluminium Kurri Kurri Smelter as shown in **Figure 3**. A generalised lithology of the surface soils encountered at Parcel 11 is as follows:

- Topsoil: Silt, grey, dry, with some clay.

7.3 Soil Results

Soil results from the current and previous investigations have been compared against the NEPM (2013) guidelines. ENVIRON notes that these guidelines superseded the NEPM (2006) guidelines used to assess previous investigation results.

A summary of the soil results is presented in **Table 7**. Laboratory tables are included in **Appendix E** and laboratory reports are included in **Appendix F**.

Table 7: Summary of Soil Results

Analyte	No. of Samples	Maximum Concentration (mg/kg)	No. exceeding Site Criteria	Criteria Exceeded (mg/kg)
Fluoride	30	510	2	440
Arsenic	9	6.2	0	-
Cadmium	9	0.3	0	-
Chromium	9	22.5	0	-
Copper	9	17.6	0	-
Nickel	9	30.9	0	-
Lead	9	23.3	0	-
Zinc	9	267	1	230 (EIL)
Mercury	9	<0.1	0	-
BaP TEQ	9	2.3	0	-
Total PAHs	9	11.5	0	-
TRH C6-C10	9	<10	0	-
TRH >C10-C16	9	<50	0	-
TRH >C16-C34	9	<100	0	-
TRH >C34-C40	9	<100	0	-

The results of the surface soil sampling for fluoride demonstrate that surface soils at Parcel 11 have not been impacted by stack particulate fallout from the Hydro Aluminium Smelter.

7.4 Quality Assurance/ Quality Control

A quality assurance assessment for this report is presented in **Appendix G**. An assessment was made of data completeness, comparability, representativeness, precision and accuracy based on field and laboratory considerations, as outlined in NSW DEC (2006) and NSW EPA (2007) guidelines. Overall it is considered that the completed investigation works and the data are of suitable quality to meet the project objectives.

8 Discussion

8.1 Conceptual Site Model

Parcel 11 consists of cleared land for cattle grazing and comprises stands of mature trees, Swamp Creek and associated waterholes. Parcel 11 is bounded by a dedicated coal railway line to the east and bush and/or farm land to the north, east, south and west and is located in the eastern portion of the Buffer Zone of the Hydro Aluminium Kurri Kurri Smelter.

Infrastructure on the site comprises an aluminium shed, silo, concrete water tank and farm dam in the southern portion and a bridge constructed from bake furnace refractory bricks over Swamp Creek in the central portion of the parcel. No areas of fill or hummocky ground and no illegally dumped wastes were identified during the site walkover.

The aluminium shed was the subject of a Hazardous Materials Audit completed by ENVIRON in 2014. The audit did not identify any hazardous building materials.

Parcel 11 has not been affected by dust deposition of fluoride from the Hydro Aluminium Kurri Kurri Smelter, with soluble fluoride concentrations in surface soils below the preliminary screening criteria for residential landuse. It is noted that total fluoride concentrations in two samples collected from the irrigation paddock as part of the 2012 Phase 2 ESA (2012a) exceed the preliminary screening criteria for residential landuse of 440mg/kg. This is not considered to be an issue, as the 95% Upper Confidence Limit (UCL) for this data set was 385mg/kg, below the preliminary screening criteria for residential landuse. In addition, as total fluoride was analysed and soluble fluoride concentrations from this investigation are considerably lower, total fluoride concentrations are not considered representative of the available fluoride in soils at Parcel 11. In addition, there is currently no source of aerial fluoride emissions as the smelter has now ceased production.

The irrigation area has not been impacted by fluoride, heavy metals, TPH or PAHs. The zinc exceedence is marginally over the EIL and does not warrant further investigation.

Surface water sampling results from additional investigations at the capped waste stockpile (2012b) and from routine monitoring conducted by Hydro indicated that Swamp Creek has marginally elevated concentrations of fluoride in the southern portion of Parcel 11, which decrease by half at down gradient sampling locations. The sampling location in the southern portion of Parcel 11 is located adjacent to a dam that is located down gradient of leachate impacted groundwater associated with the capped waste stockpile. The impacted groundwater exfiltrates to surface at several topographically low areas between the capped waste stockpile and the dam, and the dam is considered to collect surface water runoff at times of high flow (i.e. during high rainfall events). The close proximity of the dam to Swamp Creek indicates that the dam provides an discharge point to Swamp Creek. ENVIRON completed an ecological risk assessment (ENVIRON (March 2013) Tier 2 Ecological Risk Assessment, Kurri Kurri Smelter), which provided a comparison of surface water quality upstream and downstream of this inflow point and concluded that there was no significant change in risk from fluoride concentrations in Swamp Creek as a result of surface water inflow from impacted groundwater associated with the capped waste stockpile.

Aluminium concentrations at the three sampling location at Swamp Creek exceeded the criterion for the protection of 95% of aquatic ecosystems. The ecological risk assessment

(ENVIRON 2013a) concluded that there were no apparent risks from aluminium concentrations within surface water in Swamp Creek.

9 Conclusions

This report presents the findings of a Phase 2 Environmental Site Assessment undertaken on part of the Hydro Aluminium Kurri Kurri (Hydro) owned land known as Parcel 11. Parcel 11 is a rural property comprising approximately 150ha and is accessed from Bowditch Avenue, Kurri Kurri and located within the buffer zone and to the north east of the Hydro Aluminium Kurri Kurri Smelter. Parcel 11 predominantly comprises open farmland with scattered trees and limited infrastructure. Swamp Creek meanders through the parcel.

The objectives of the assessment were to assess the potential for contamination at Parcel 11 based on historical and current landuse and to assess the suitability of Parcel 11 for the purposes of environmental conservation (E2) and rural landscape (RU2) land use.

A Phase 1 ESA has previously been completed for the Hydro owned lands including Parcel 11 (ENVIRON (22 October 2013) Phase 1 ESA, Hydro Kurri Kurri Aluminium Smelter). The Phase 1 identified that contamination of Parcel 11 may have occurred from dust deposition due to the proximity of the Hydro smelter and illegal dumping due to the remoteness of the area.

To assess the potential for contaminants of concern on Parcel 11, a site walkover was completed and surface soil samples were collected on an approximate grid across the parcel. The site walkover identified an aluminium shed, an associated concrete water tank and a dam in the southern portion of the parcel and a bridge constructed from bake furnace refractory bricks over Swamp Creek. No potential soil contamination issues were identified associated with this infrastructure. The construction materials of the aluminium shed were inspected. The inspection did not identify any hazardous building materials.

Surface soil samples from across Parcel 11 were analysed for soluble fluoride. Fluoride results were below the preliminary screening level for residential landuse, which is considered applicable for the proposed rural landuse. No soil contamination issues were identified on Parcel 11.

Parcel 11 is suitable for the purposes of environmental conservation (E2) and rural landscape (RU2) land use.

Hydro has separately engaged a NSW EPA-accredited Site Auditor to issue a Site Audit Statement certifying that the site is suitable for the proposed use.

10 References

AECOM. 2013. Hydro Aluminum – 2012 Annual Environmental Management Review. 2 June 2013;

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

ENVIRON (November 2012) Phase 2 Environmental Site Assessment, Kurri Kurri Aluminium Smelter (2012a);

ENVIRON (December 2012) Environmental Site Assessment, Alcan Mound, Kurri Kurri Aluminium Smelter (2012b);

ENVIRON (March 2013) Tier 2 Ecological Risk Assessment, Kurri Kurri Aluminium Smelter (2013a);

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

ENVIRON (October 2013) Phase 1 ESA, Hydro Kurri Kurri Aluminium Smelter (2013c);

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

National Academy of Sciences. 1971a. Biologic effects of atmospheric pollutants: Fluorides. Washington, DC: National Academy of Sciences, National Research Council, Committee on Biologic Effects of Atmospheric Pollutants, 239.

National Environment Protection Council (2013) National Environmental Protection (Assessment of Site Contamination) Amendment Measure (NEPM);

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

World Health Organisation (1997) Environmental Health Criteria for Fluorides and Fluorosis. 2nd ed. Internal Technical Report, International Program on Safety, WHO, Geneva.

11 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 25 June 2012 and in accordance with our understanding and interpretation of current regulatory standards.

A representative program of sampling and laboratory analyses was undertaken as part of this investigation, based on past and present known uses of Parcel 11. While every care has been taken, concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. We cannot therefore preclude the presence of materials that may be hazardous.

Site conditions may change over time. This report is based on conditions encountered at Parcel 11 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.

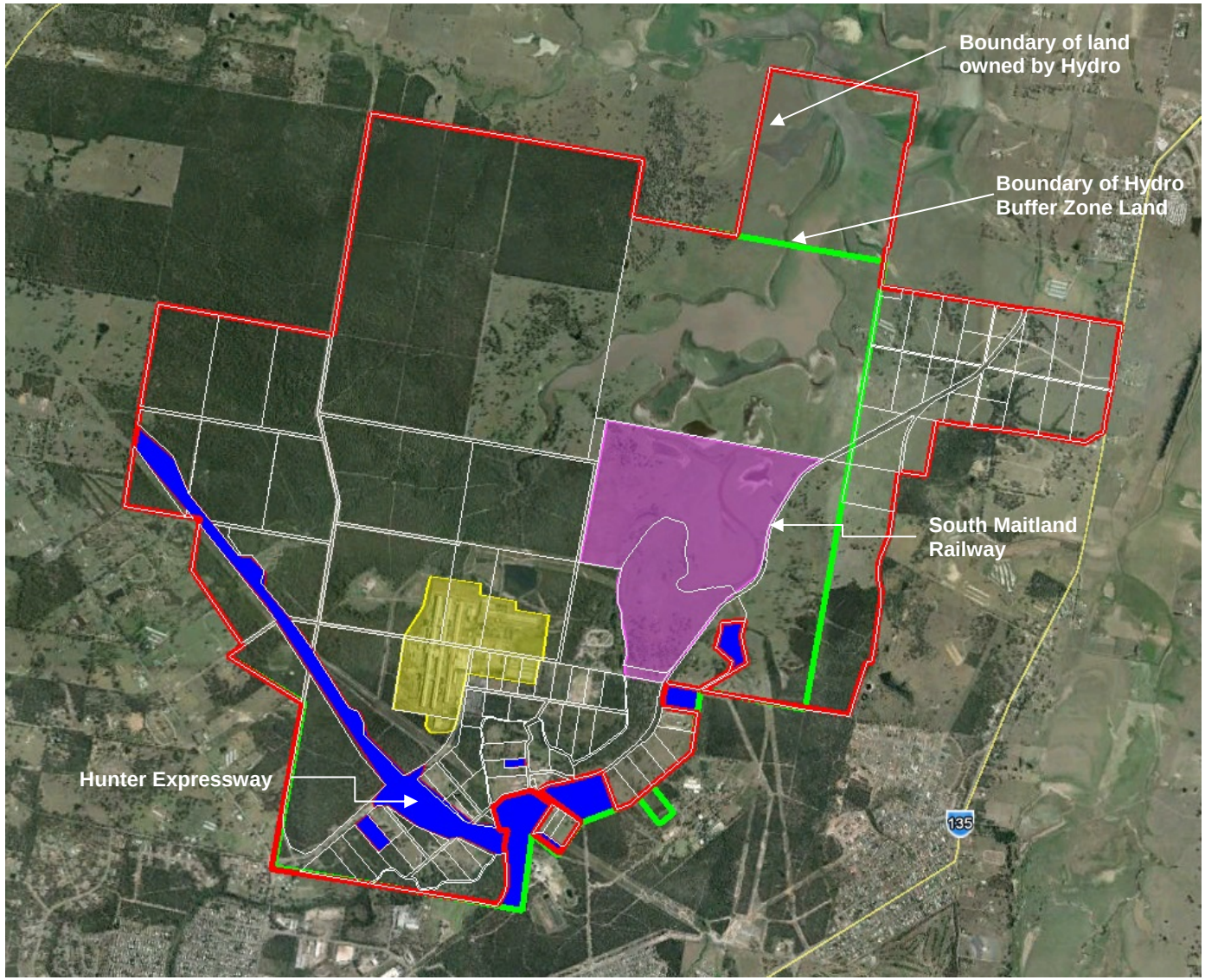
ENVIRON did not independently verify all of the written or oral information provided to ENVIRON during the course of this investigation. While ENVIRON has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided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

11.1 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



Google Earth Pro: Licence valid till 5/2/15.

Approximate Location of Smelter

Approximate Location of Buffer Zone

Land not owned by Hydro

Parcel 11

N

Hydro Aluminium Kurri Kurri – Phase 2 Environmental Site Assessment

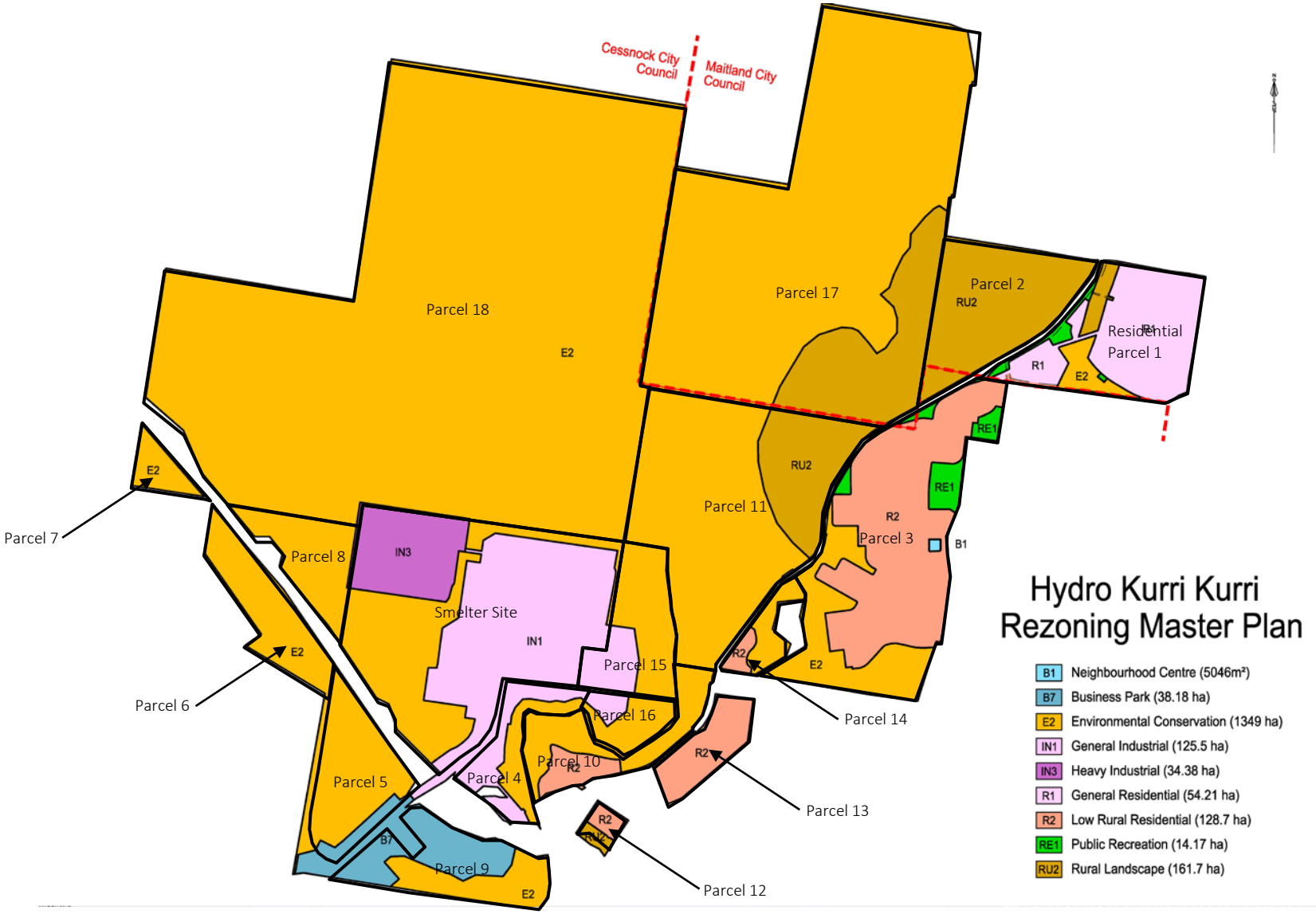
Parcel 11 - Site Location

ENVIRON

JOB NO: AS130348

DATE: Septembet 2014

FIGURE 1



Proposed Land Zonings taken from
Hydro Kurri Kurri Preliminary Masterplan dated 26/3/15

Hydro Aluminium Kurri Kurri – Phase 2 Buffer Zone investigations

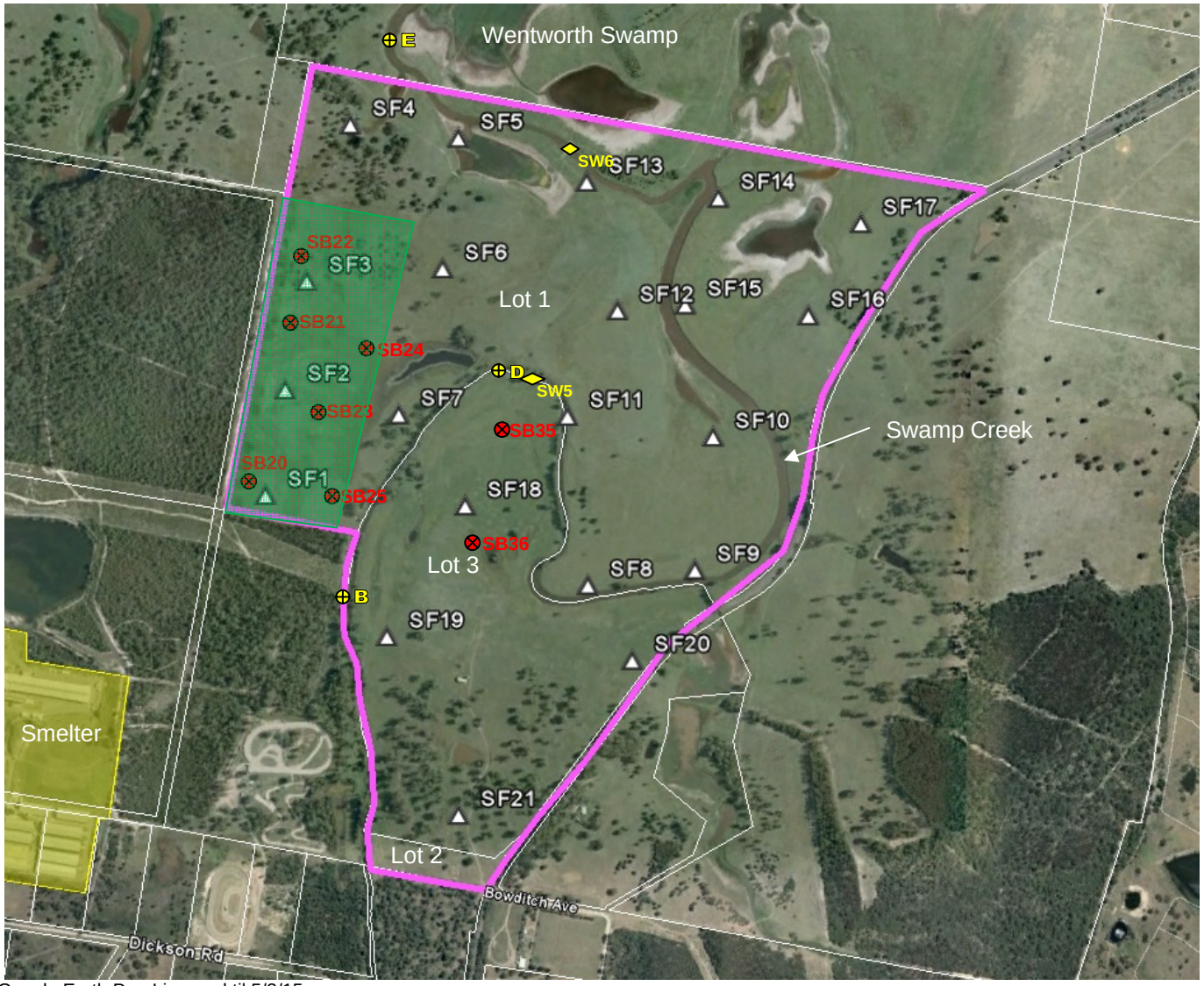
Land Parcels and Proposed Land Zoning

ENVIRON

JOB NO: AS 130348

DATE: March 2015

FIGURE 2



KEY:

- Site Boundary
- SF — Soil Sample for Fluoride Analysis (Nov2013)
- SB22 — Soil sample (Apr2012)
- SW7 — Surface Water Sample (Apr2012)
- E — Surface water sample monthly monitoring

N

Google Earth Pro: Licenced til 5/2/15

Hydro Aluminium Kurri Kurri – Phase 2 Environmental Site Assessment

Parcel 11 – Soil Sampling Locations

ENVIRON

JOB NO: AS130348

DATE: September 2014

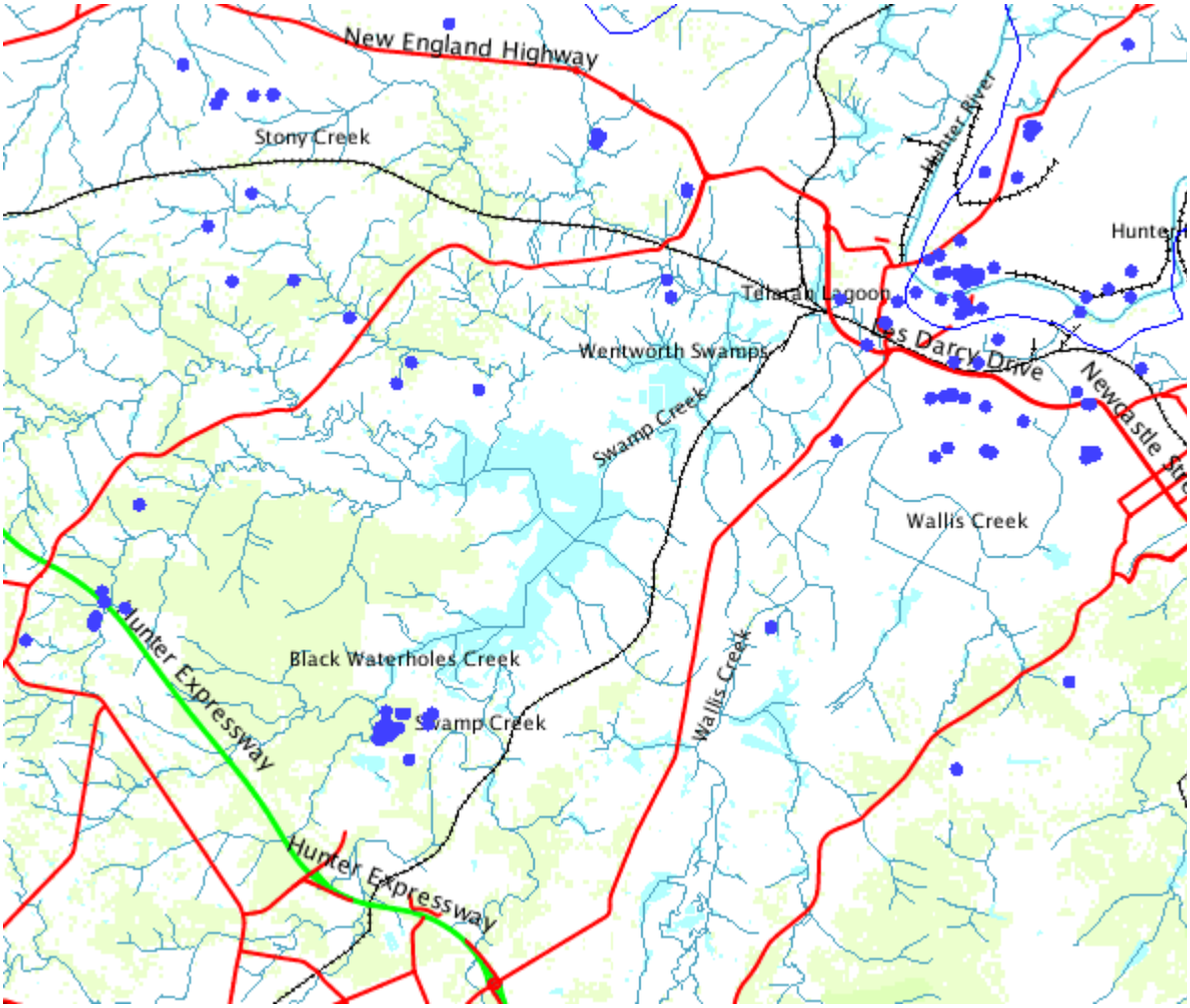
FIGURE 3

Appendix A

Surrounding Groundwater Bores

Groundwater Wells near Employment Land Subarea 11

Map created with NSW Natural Resource Atlas - http://www.nratlas.nsw.gov.au
Wednesday, January 08, 2014



0 15 Km

Legend

Symbol	Layer	Custodian
	Cities and large towns renderImage: Cannot build image from features	
Cowra	Populated places renderImage: Cannot build image from features	
	Towns	
	Groundwater Bores	
	Catchment Management Authority boundaries	
	Major rivers	

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079088

Works Details (top)

GROUNDWATER NUMBER	GW079088
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371306.00
EASTING	358054.00
LATITUDE	32 47' 13"
LONGITUDE	151 29' 3"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079090

Works Details (top)

GROUNDWATER NUMBER	GW079090
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371368.00
EASTING	358105.00
LATITUDE	32 47' 11"
LONGITUDE	151 29' 5"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079092

Works Details (top)

GROUNDWATER NUMBER	GW079092
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371429.00
EASTING	358078.00
LATITUDE	32 47' 9"
LONGITUDE	151 29' 4"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079093

Works Details (top)

GROUNDWATER NUMBER	GW079093
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371460.00
EASTING	358078.00
LATITUDE	32 47' 8"
LONGITUDE	151 29' 4"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079094

Works Details (top)

GROUNDWATER NUMBER	GW079094
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371462.00
EASTING	358234.00
LATITUDE	32 47' 8"
LONGITUDE	151 29' 10"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

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Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079096

Works Details (top)

GROUNDWATER NUMBER	GW079096
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371707.00
EASTING	358152.00
LATITUDE	32 47' 0"
LONGITUDE	151 29' 7"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079097

Works Details (top)

GROUNDWATER NUMBER	GW079097
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371679.00
EASTING	358335.00
LATITUDE	32 47' 1"
LONGITUDE	151 29' 14"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079099

Works Details (top)

GROUNDWATER NUMBER	GW079099
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371003.00
EASTING	358448.00
LATITUDE	32 47' 23"
LONGITUDE	151 29' 18"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079101

Works Details (top)

GROUNDWATER NUMBER	GW079101
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371680.00
EASTING	358387.00
LATITUDE	32 47' 1"
LONGITUDE	151 29' 16"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079102

Works Details (top)

GROUNDWATER NUMBER	GW079102
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371685.00
EASTING	358725.00
LATITUDE	32 47' 1"
LONGITUDE	151 29' 29"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, January 6, 2014

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW079103

Works Details (top)

GROUNDWATER NUMBER	GW079103
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	20 - HUNTER
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6371530.00
EASTING	358675.00
LATITUDE	32 47' 6"
LONGITUDE	151 29' 27"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

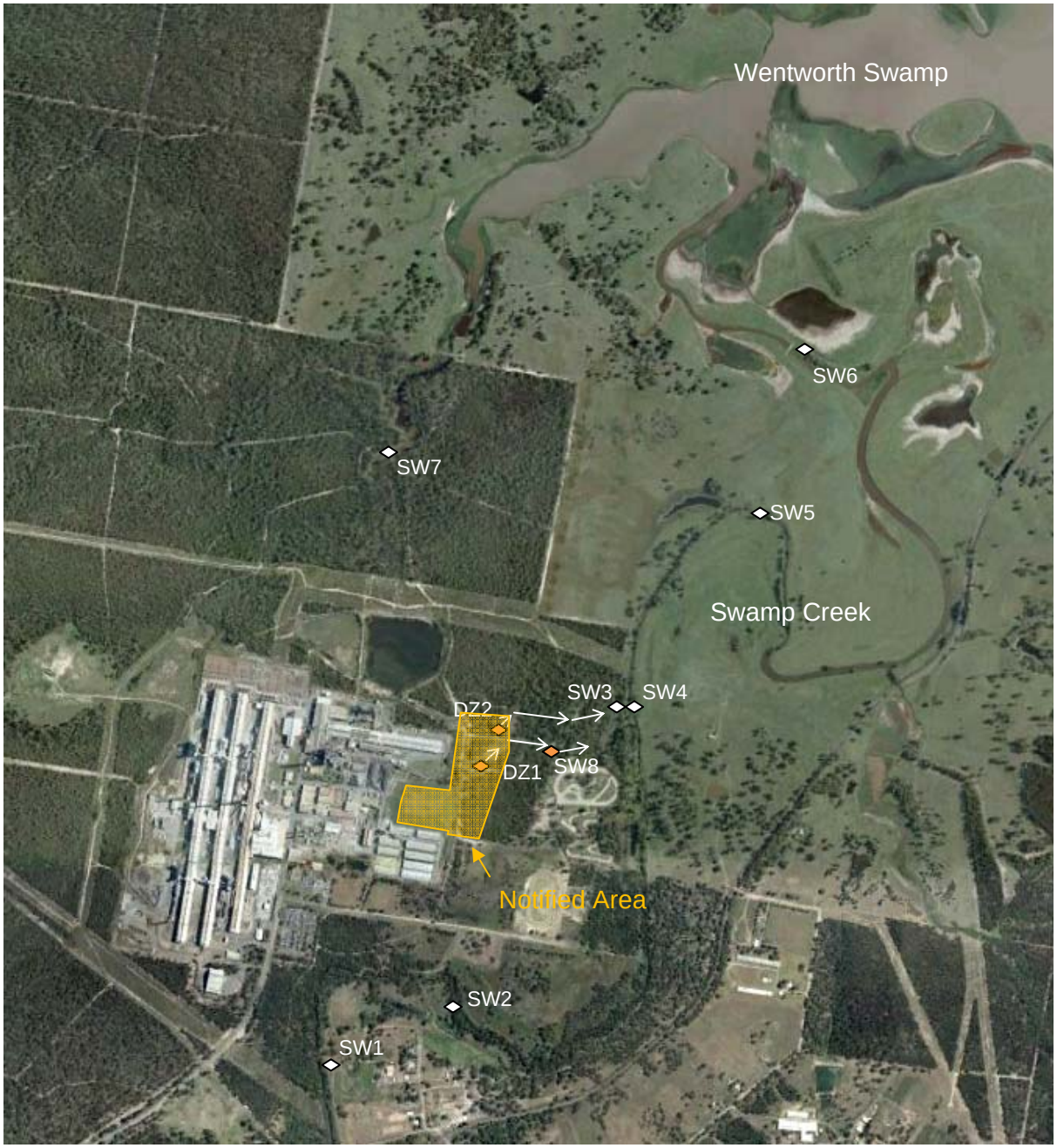
Drillers Log (top)

no details

Topographic base map

Appendix B

Data From Previous Investigations



HYDRO AUSTRALIA

SUPPLEMENTARY ESA, ALCAN MOUND

Surface Water Sampling Locations

TABLE LR3 Surface Water Analytical Results

Sample Identification	PQL	Guideline			SW4	SW4	SW5	SW5	SW6	SW6
Date		95% Fresh [A]	Irrigation	Stock	9/8/12	28/9/12	9/8/12	28/9/12	9/8/12	28/9/12
Depth to Water (mAHD)					Surface	Surface	Surface	Surface	Surface	Surface
Sample Appearance					Clear	Clear	Clear	Clear	Clear	Clear
Sample collected by					KJG	SC	KJG	SC	KJG	SC
Analytes										
pH		6.5-8			8.1	7.2	8	7.3	8	7.2
Electrical Conductivity			4500-7700		1100	1300	1200	1400	1300	1200
Soluble Fluoride	0.1	5	1	2	1.5	1.6	0.89	0.68	1.2	0.59
Total Cyanide	0.004				<0.004	0.23	<0.004	210	<0.004	0.16
Free Cyanide	0.004		0.007		<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Total Aluminium pH>6.5	0.01	0.055	5	5	0.27	0.37	0.24	0.2	0.59	1.7
Calcium	0.5				24	30	23	32	27	28
Potassium	0.5				12	13	11	13	9.2	9.6
Sodium	0.5				200	240	190	260	200	210
Magnesium	0.5				19	23	18	27	23	26
Hydroxide Alkalinity	5				<5	<5	<5	<5	<5	<5
Bicarbonate Alkalinity	5				130	120	110	120	120	99
Cabonate Alkalinity	5				<5	<5	<5	<5	<5	<5
Total Alkalinity	5				130	120	110	120	120	99
Sulphate	1				84	110	90	120	100	110
Chloride	1				210	270	230	310	230	250
Ionic Balance	%				7	6.7	4.4	6	5.4	7

All results in mg/L

PQL = Practical Quantitation Limit.

[A] ANZECC 2000 95% Protection Level for Receiving Water Type

Guidelines in *italics* are low level reliability guidelines

* 5mg/L for Fluoride is based on the value used by another Aluminium Smelter

NHMRC guidelines for total cyanide are based on cyanogen chloride (as cyanide).

Results shaded grey are in excess of the primary acceptance criteria: ANZECC 95%, NHMRC

Table 8.1: Surface Water Quality around the Hydro Aluminium Kurri Kurri Smelter for 2013

MONTH		A	14	B	D	E	31	1	2	44	3	9	62
January	pH	7.4	7.4	7.3	7.3	7.8	dry	6.8	5.1	dry	dry	dry	7.7
	Conductivity (uS/cm)	780	1000	900	910	1000	dry	3800	5200	dry	dry	dry	970
	Fluoride (mg/L)	0.8	30.0	0.8	0.9	1.2	dry	5.8	5.1	dry	dry	dry	1.2
February	pH	7.0		6.8	6.8	6.7						5.8	5.9
	Conductivity (uS/cm)	700		720	740	620						970	1100
	Fluoride (mg/L)	0.3		0.5	0.5	0.5						3.5	0.5
March	pH	6.7		6.7	6.7	6.5						6.7	6.5
	Conductivity (uS/cm)	570		410	270	260						230	250
	Fluoride (mg/L)	0.2		0.6	0.4	0.4						0.6	0.4
	Free Cyanide (mg/L)					<0.002							<0.002
April	pH	7.5		7.2	7.2	8.2	6.9	6.7	6.9	6.9	6.2	6.8	7.6
	Conductivity (uS/cm)	970		1100	1100	1200	750	1000	1100	550	340	740	660
	Fluoride (mg/L)	0.6		0.6	0.6	0.7	0.4	2.7	2.8	0.6	0.5	2.0	0.9
May	pH	7.5		7.2	7.1	7.2						6.2	7.1
	Conductivity (uS/cm)	880		1000	1000	1000						930	130
	Fluoride (mg/L)	0.5		0.5	1.0	0.7						2.7	0.2
June	pH	7.7		7.4	7.3	7.2						4.6	5.4
	Conductivity (uS/cm)	880		880	970	970						1200	1700
	Fluoride (mg/L)	0.5		0.5	1.0	0.8						2.9	0.9
	Free Cyanide (mg/L)					<0.002							<0.002

Table 8.1 (cont): Surface Water Quality around the Hydro Aluminium Kurri Kurri Smelter for 2013

MONTH		A	14	B	D	E	31	1	2	44	3	9	62
July	pH	7.4		7.2	7.2	7.1	6.1	6.5	6.6	6.4	6.2	5.3	4.4
	Conductivity (uS/cm)	1300		1100	1200	1200	1100	980	1000	1700	110	1300	1000
	Fluoride (mg/L)	0.3		1.2	0.5	0.9	0.2	1.9	2.6	0.3	0.3	5.3	4.4
August	pH	7.4		7.4	7.3	7.3						4.5	6.5
	Conductivity (uS/cm)	1100		1100	1100	1300						1400	1400
	Fluoride (mg/L)	0.5		0.6	1.3	0.7						2.5	0.9
September	pH	6.8		6.8	6.8	6.8						4.0	6.5
	Conductivity (uS/cm)	930		990	980	1100						1700	1200
	Fluoride (mg/L)	0.6		1.2	1.6	0.9						2.0	1.1
	Free Cyanide (mg/L)					<0.002							<0.002
October	pH	7.2	7.2	7.1	7.2	7.3		7.0	6.6	6.5		3.8	6.8
	Conductivity (uS/cm)	940	510	930	1000	1100		2600	2800	1800		2300	1600
	Fluoride (mg/L)	0.6	18.0	1.7	1.7	1.4		3.6	3.2	0.5		2.8	1.7
November	pH												
	Conductivity (uS/cm)												
	Fluoride (mg/L)												
December	pH												
	Conductivity (uS/cm)												
	Fluoride (mg/L)												
	Free Cyanide (mg/L)					<0.002							<0.002

ANZECC Water Quality Criteria:	pH	Fluoride (mg/L)	Free Cyanide (mg/L)
Irrigation	4.5 - 9.0	1.0	-
Livestock	-	2.0	-
Aquatic Ecosystems	6.5 - 9.0	-	0.0052

ENVIRON

NORSK HYDRO ASA | JOB NO: DE11HDR043 | DATE: MAY 2012 | FIGURE 7: Buffer Zone and Irrigation Area Sampling Locations

TABLE LR3 Soil Analytical Results for the Buffer Zone

Sample Identification	PQL	Guideline			SB20	SB21	SB22	SB23	SB24	SB25	SB35	SB36	SB37
Sample Depth (m)		HIL 'A' [A]	HSL A & B [B]	EILs [C]	0-0.05	0-0.05	0-0.05	0-0.05	0-0.05	0-0.05	0-0.05	0-0.05	0-0.05
Date					11/04/2012	11/04/2012	11/04/2012	11/04/2012	11/04/2012	13/04/2012	3/05/2012	3/05/2012	3/05/2012
Sample Profile					TOPSOIL	TOPSOIL	TOPSOIL	TOPSOIL	TOPSOIL	TOPSOIL	TOPSOIL	TOPSOIL	TOPSOIL
PAEC Sampled					Irrigation	Irrigation	Irrigation	Irrigation	Irrigation	Irrigation	General	General	General
Sample collected by					FR	FR	FR	FR	FR	FR	KJG	KJG	KJG
Metals													
Aluminium	50	-	--	--	8520	11600	2210	8140	14800	10200	1810	1790	9040
Arsenic	1	100	--	100^	5	4	0.6	2.5	6.2	5.1	<5	<5	<5
Cadmium	0.1	20	--	--	0.5	0.3	0.1	0.2	0.2	0.4	<1	<1	<1
Chromium	1	100	--	410^	11.1	17.4	3.6	11.8	22.5	14.6	3	3	16
Copper	2	6000	--	110^	4.3	4.2	1.1	3.9	5.9	17.6	<5	<5	18
Nickel	1	400	--	35^	18.6	10.4	2.5	7.8	13.2	30.9	6	<5	18
Lead	2	300	--	1100^	13.1	15.2	6.2	13.3	22.2	23.3	<2	2	24
Zinc	5	7400	--	310^	132	63.9	19.7	42.9	38.5	267	8	10	54
Mercury	0.05	40	--	--	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoride	40	440	--	--	330	510	200	400	320	450	80	60	240
Total Petroleum Hydrocarbons (TPH)													
TPH C6-C9 (comparing against F1 and includes BTEX)	10	--	40	--	<10	<10	<10	<10	<10	<10			
TPH C10-C14 (comparing against F2 and includes naphathlene)	50	--		--	<50	<50	<50	<50	<50	<50			
TPH C15-C28	100	--		--	140	150	<100	140	280	160			
TPH C29-C36	100	--		--	<100	<100	<100	<100	130	<100			
TPH C10-C36	--	--	230	--	140	150	<50	140	410	160			
Polycyclic Aromatic Hydrocarbons (PAH)													
Naphthalene	0.5	--	--	--						<0.5			
Acenaphthylene	0.5	--	--	--						<0.5			
Acenaphthene	0.5	--	--	--						<0.5			
Fluorene	0.5	--	--	--						<0.5			
Phenanthrene	0.5	--	--	--						<0.5			
Anthracene	0.5	--	--	--						<0.5			
Fluoranthene	0.5	--	--	--						0.9			
Pyrene	0.5	--	--	--						0.9			
Benz(a)anthracene	0.5	--	--	--						1			
Chrysene	0.5	--	--	--						1.5			
Benzo(b)&(k)fluoranthene	1	--	--	--						3.3			
Benzo(k)fluoranthene	0.5	--	--	--						0.8			
Benzo(a) pyrene	0.5	3	--	--						1.2			
Indeno(1,2,3-c,d)pyrene	0.5	--	--	--						0.8			
Dibenz(a,h)anthracene	0.5	--	--	--						<0.5			
Benzo(g,h,i)perylene	0.5	--	--	--						1.1			
Sum of reported PAH	--	300	--	--						11.5			

All results are in units of mg/kg.

Blank Cell indicates testing was not completed

PQL = Practical Quantitation Limit.

[A] NEPC NEPM Schedule B(1) 2013. Table 1A(1) HIL 'A' (Low Density Residential)

[B] NEPC NEPM Schedule B(1) 2013. Table 1(A)3 HSL A& HSL B for Silt 0m to <1m

[C] NEPC NEPM Schedule B (1) 2013. Table IB, EILs applicable for urban residential/open space

Guidelines reported for Chromium are for Chromium VI

Results shown in shading are in excess of the primary acceptance criteria: HIL "A" or the Service Station Guidelines

^ Based on aged contamination, pH 7 soils, conservative CEC of 5cmolc/kg dwt,1% organic carbon content and 10% clay content

Appendix C

Site Photographs

Photo 1: Photograph showing the grassed farmland on Lot 1, facing north east.

Photo 2: General view of farmland on Lot 1, facing north.

Title:	Phase 2 ESA	Approved: KG	Project-Nr.: AS130348	Date: 24/1/2014
Site:	Parcel 11			
Client:	Hydro Aluminium Kurri Kurri		ENVIRON	

Photo 3: Photograph of the bridge over Swamp Creek on Lot 3, facing south.

Photo 4: Close-up of the bridge, showing its construction from refractory brick.

Photo 5: Photograph showing the aluminium shed on Lot 3, facing north. Note the high voltage power lines in the background.

Photo 6: Photograph of the concrete water tank adjacent to the shed.

Appendix D

Field Investigation Sheets

Site Walkover Checklist

Project No.:	AS130368	**Date and Time:**	4 Nov 13
Land Parcel:	EMP11	**Weather:**	Fine, mild.
Lot and DP:	Lot 1	**Environ Personnel:**	SC

Site Description	
Topography	Flat to gently rolling towards water courses.
Surface Geology	Alluvials.
Fill evident?	no
Hummocky ground?	no
Structures on site?	no
Location of structures	–
Building materials used in structures	–
Asbestos debris on site?	–
Location of asbestos debris?	–
Volume of asbestos debris?	–

Coordinates of Interest

Point of Interest	Easting	Northing

Description of Photographs Taken

88 - 90 From SW cnr pan N-E.
90 - 95. ~~N~~ mid S (SF11) area pan S-W-N.
96 - 101 From NE cnr (SF17) Pan N-W-S.

Miscellaneous Observations

Large open paddocks, gently rolling with Swamp ck in South and curving around across northern boundary.

Site Walkover Checklist

Project No.:	AS130348	**Date and Time:**	5 Nov 13
Land Parcel:	EMP 11	**Weather:**	Overcast, cool, light showers.
Lot and DP:	Lot 2 (Part).	**Environ Personnel:**	SC

Site Description

Topography	Slopes E → W towards Swamp Ck.
Surface Geology	Alluvials.
Fill evident?	No
Hummocky ground?	No
Structures on site?	Ausgrid Poles on E. end.
Location of structures	
Building materials used in structures	–
Asbestos debris on site?	–
Location of asbestos debris?	–
Volume of asbestos debris?	–

GPS Locations of Interest

Point of Interest	Easting	Northing
117 – 118 – At east end looking west.		

Description of Photographs Taken

Miscellaneous Field Comments

Site Walkover Checklist

Project No.:	AS130348	**Date and Time:**	5 Nov '13
Land Parcel:	EMP11	**Weather:**	O'cast, cool
Lot and DP:	Lot 3	**Environ Personnel:**	SC

Site Description

Topography	
Surface Geology	
Fill evident?	
Hummocky ground?	
Structures on site?	Shed in central area - about same loc^{n} as original house?
Location of structures	
Building materials used in structures	Iron./Aluminium./concrete water tank/Aluminium SILO.
Asbestos debris on site?	
Location of asbestos debris?	
Volume of asbestos debris?	

GPS Locations of Interest

Point of Interest	Easting	Northing
north ford (swamp Ck).	151.49486	32.78150.
Q1 - 10x10 asb. w/over - No ACM.	151.49378.	32.78224

Description of Photographs Taken

102 - 105	From N. end Pan W-S-E.
106 - 107	Ford across Swamp Ck in north - refractory brick constr.
108 - 112	From E. cnr (SF20) Pan S-EN.
113 - 116	Aluminium shed in central area.

Miscellaneous Field Comments

Large paddocks, central structure, rolling/flat,
bounded on W, N, NE, by Swamp Ck.
" " E by railway.
" " S " Lot 2?

ENVIRON

PROJECT SAMPLE REGISTER

Project No	AS1303248	Project Name	HYDRO BUFFER ZONE	Date commenced	4/11/13.
Location	EMP 11	Refer to Daily log for weather details		Date completed	

#	Sample Name	Sampled by	Easting	Northing	Depth	Description (soil type, moisture, colour, foreign content, signs of contamination) or 'refer to log'	Quality Assurance	Comments (eg lab analyse)
1	EMP11-SF1	SC	151.48922	32.78363	S	SILT; g.my. dry under grass	—	Lot 1
2	"	SF2	151.48967	32.7816	S	" " " " "	—	
3	"	SF3	151.49015	32.77957	S	" " " " "	QA1	
4	"	SF4	151.49113	32.77660		Grey SILT; dry / under grass/ trees	—	
5	"	SF5	151.49356	32.77684	S	Brown organic SILT, sl moist. adjacent to pond.	—	
6	"	SF6	151.49321	32.77933	S	Grey SILT; dry, under thick grass cover	—	
7	"	SF7	151.49222	32.78210	S	Grey SILT " " "	—	
8	"	SF8	151.49649	32.78534	S	" "	—	
9	"	SF9	151.49891	32.78505	S	" "	—	
10	"	SF10	151.49932	32.78252	S	" "		

Signed _____ Date _____

#	Sample Name	Sampled by	Easting	Northing	Depth	Description (soil type, moisture, colour, foreign content, signs of contamination) or 'refer to log'	Quality Assurance	Comments (eg lab analyse)
EMP11	SF11	SC	151.49663	32.78213	S	SILT; brown, dry, under thick grass	—	Lot 1
"	SF12		151.49716	32.78012		" " "	—	
"	SF13		151.49646	32.77767		Clayey SILT; brown, dry.	—	
"	SF14		151.49944	32.77798		SILT; grey. grey	—	
"	SF15		151.49869	32.78001		Silty CLAY; brown, dry.	—	
"	SF16		151.50167	32.78022		SILT; grey, dry. under grass	QA2	
"	SF17		151.50266	32.77846		" " " " "	—	
"	SF18		151.49372	32.78383		SILT; grey & dry.	—	Lot 3
"	SF19		151.49196	32.78631		" " "	—	
"	SF20		151.49769	32.78676		" " "	—	
"	SF21		151.49358	32.78968		SAND " fine, dry"	—	

Signed_____

Date _____

QUALITY CONTROL SAMPLING REGISTER

Project No AS130348	**Project Name**
Location EMP11	Refer to Daily log for weather details

Refer to sample register for sample description details

Sample Type	Duplicate	Duplicate pair (primary sample number)	Analysis required	Duplicate collected by
Duplicates	EMP11-QA1	EMP11-SF3		SC
	" QA2	EMP11-SF16		SC.

Signed_____

Date _____

Appendix E

Results Tables

TABLE A: Soil Analytical Results - Grid Sampling

Sample Depth: 0.0m - 0.01m

Sampling Date: 4/11/13

Laboratory PQL: 5 mg/kg

Site Specific HIL - Fluoride: 440mg/kg

Sample Identification	Soluble Fluoride mg/kg (1:5 soil:water)
EMP11-SF1	63
EMP11-SF2	60
EMP11-SF3	49
EMP11-SF4	3
EMP11-SF5	3
EMP11-SF6	3
EMP11-SF7	5
EMP11-SF8	2
EMP11-SF9	2
EMP11-SF10	2
EMP11-SF11	2
EMP11-SF12	3
EMP11-SF13	2
EMP11-SF14	2
EMP11-SF15	2
EMP11-SF16	3
EMP11-SF17	3
EMP11-SF18	3
EMP11-SF19	4
EMP11-SF20	4
EMP11-SF21	2

TABLE B: Soil Quality Assurance/ Quality Control Results

Sample Identification	EMP11-SF3	EMP11-QA1	RPD %	EMP11-SF16	EMP11-QA2	RPD %
Sample Depth (m)	0-0.01			0-0.01		
Duplicate Type	Intralaboratory			Intralaboratory		
Sample Profile	TOPSOIL			TOPSOIL		
Sample collected by	SC			SC		
Non Metallic Inorganics						
Fluoride	49	48	2	3	3	0

Note all units in mg/kg

BOLD identifies where RPD results

intralaboratory	interlaboratory	
>50	>60	where both sample results exceed ten x PQL
>75	>85	where both sample results are within 5 to 10 x PQL
>100	>100	where both sample results are within 2 to 5 x PQL
AD>2.5 * PQL		where one or both sample results are <2 x PQL

BOLD identified where blanks >0

Where results are within two of the above ranges the most conservative criteria have been used to assess duplicate performance

Appendix F

Laboratory Reports

1/2

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0690 E: adelaide@alsglobal.com
☐BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
☐GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com
☐MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
☐MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
☐MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
☐NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com
☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
☐TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
☐WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: Environ Australia	**TURNAROUND REQUIREMENTS :** (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☐ Standard TAT (List due date):	**FOR LABORATORY USE ONLY (Circle)**
OFFICE: 19B, 50 Glebe Road, The Junction, NSW 2291		☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact? Yes No N/A
PROJECT: Hydro Buffer Zone **PROJECT NO.:**	**ALS QUOTE NO.:**	**COC SEQUENCE NUMBER (Circle)**	Free Ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER: AS130348 **PURCHASE ORDER NO.:**	**COUNTRY OF ORIGIN:**	COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Steve Cadman **CONTACT PH:** 4962 5444		OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER: Steve Cadman **SAMPLER MOBILE:** 0423 583 538	**RELINQUISHED BY:**	**RECEIVED BY:**	**RELINQUISHED BY:** **RECEIVED BY:**
COC Emailed to ALS? (YES / NO) **EDD FORMAT (or default):**	DATE/TIME: 8/11/13	DATE/TIME: 8/11/13 1120	DATE/TIME: 8/11/13 1700 DATE/TIME: 8/11/13 1700
Email Reports to (will default to PM if no other addresses are listed): scadman@environcorp.com			
Email Invoice to (will default to PM if no other addresses are listed): scadman@environcorp.com			

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	Soluble Fluoride								Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	EMP11-SF1	4/11/2013	S	Pulp Bag	1	✓								
2	EMP11-SF2	4/11/2013	S	Pulp Bag	1	✓								
3	EMP11-SF3	4/11/2013	S	Pulp Bag	1	✓								
4	EMP11-SF4	4/11/2013	S	Pulp Bag	1	✓								
5	EMP11-SF5	4/11/2013	S	Pulp Bag	1	✓								
6	EMP11-SF6	4/11/2013	S	Pulp Bag	1	✓								
7	EMP11-SF7	4/11/2013	S	Pulp Bag	1	✓								
8	EMP11-SF8	4/11/2013	S	Pulp Bag	1	✓								
9	EMP11-SF9	4/11/2013	S	Pulp Bag	1	✓								
10	EMP11-SF10	4/11/2013	S	Pulp Bag	1	✓								
11	EMP11-SF11	4/11/2013	S	Pulp Bag	1	✓								
12	EMP11-SF12	5/11/2013	S	Pulp Bag	1	✓								
				TOTAL	12									

Environmental Division
Sydney
Work Order
ES1324140

Telephone : +61-2-8784 8555

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

CERTIFICATE OF ANALYSIS

Work Order	: **ES1324140**	Page	: 1 of 7
Client	: **ENVIRON AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR STEVE CADMAN	Contact	: Client Services
Address	: PO BOX 560 NORTH SYDNEY NSW, AUSTRALIA 2060	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scadman@environcorp.com	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 99548114	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: HYDRO BUFFER ZONE	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 08-NOV-2013
Sampler	: ----	Issue Date	: 15-NOV-2013
Site	: ----		
		No. of samples received	: 23
Quote number	: SY/285/10	No. of samples analysed	: 23

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ashesh Patel	Inorganic Chemist	Sydney Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	EMP11-SF1	EMP11-SF2	EMP11-SF3	EMP11-SF4	EMP11-SF5
			Client sampling date / time	04-NOV-2013 15:00	04-NOV-2013 15:00	04-NOV-2013 15:00	04-NOV-2013 15:00	04-NOV-2013 15:00
Compound	CAS Number	LOR	Unit	ES1324140-001	ES1324140-002	ES1324140-003	ES1324140-004	ES1324140-005
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**7.9**	**7.9**	**9.1**	**7.2**	**32.1**
EK040: Fluoride								
Fluoride	16984-48-8	1	mg/kg	**63**	**60**	**49**	**3**	**3**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	EMP11-SF6	EMP11-SF7	EMP11-SF8	EMP11-SF9	EMP11-SF10
			Client sampling date / time	04-NOV-2013 15:00	04-NOV-2013 15:00	04-NOV-2013 15:00	04-NOV-2013 15:00	04-NOV-2013 15:00
Compound	CAS Number	LOR	Unit	ES1324140-006	ES1324140-007	ES1324140-008	ES1324140-009	ES1324140-010
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	5.9	12.0	16.7	12.7	29.5
EK040: Fluoride								
Fluoride	16984-48-8	1	mg/kg	3	5	2	2	2

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	EMP11-SF11	EMP11-SF12	EMP11-SF13	EMP11-SF14	EMP11-SF15
			Client sampling date / time	04-NOV-2013 15:00	05-NOV-2013 15:00	05-NOV-2013 15:00	05-NOV-2013 15:00	05-NOV-2013 15:00
Compound	CAS Number	LOR	Unit	ES1324140-011	ES1324140-012	ES1324140-013	ES1324140-014	ES1324140-015
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	11.0	15.6	15.2	9.1	18.1
EK040: Fluoride								
Fluoride	16984-48-8	1	mg/kg	2	3	2	2	2

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	EMP11-SF16	EMP11-SF17	EMP11-SF18	EMP11-SF19	EMP11-SF20
			Client sampling date / time	05-NOV-2013 15:00	05-NOV-2013 15:00	05-NOV-2013 15:00	05-NOV-2013 15:00	05-NOV-2013 15:00
Compound	CAS Number	LOR	Unit	ES1324140-016	ES1324140-017	ES1324140-018	ES1324140-019	ES1324140-020
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	9.1	10.5	19.2	8.9	6.8
EK040: Fluoride								
Fluoride	16984-48-8	1	mg/kg	3	3	3	4	4

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	EMP11-SF21	EMP11-QA1	EMP11-QA2	----	----
			Client sampling date / time	05-NOV-2013 15:00	05-NOV-2013 15:00	05-NOV-2013 15:00	----	----
Compound	CAS Number	LOR	Unit	ES1324140-021	ES1324140-022	ES1324140-023	----	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**3.7**	**13.3**	**8.5**	----	----
EK040: Fluoride								
Fluoride	16984-48-8	1	mg/kg	**2**	**48**	**3**	----	----

QUALITY CONTROL REPORT

Work Order	: **ES1324140**	Page	: 1 of 4
Client	: **ENVIRON AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR STEVE CADMAN	Contact	: Client Services
Address	: PO BOX 560 NORTH SYDNEY NSW, AUSTRALIA 2060	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scadman@environcorp.com	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 99548114	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: HYDRO BUFFER ZONE	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 08-NOV-2013
Sampler	: ----	Issue Date	: 15-NOV-2013
Order number	: ----		
		No. of samples received	: 23
Quote number	: SY/285/10	No. of samples analysed	: 23

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out ir compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ashesh Patel	Inorganic Chemist	Sydney Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA055: Moisture Content (QC Lot: 3154223)									
ES1324139-002	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	17.0	16.8	1.1	0% - 50%
ES1324140-011	EMP11-SF11	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	11.0	11.0	0.0	0% - 50%
EA055: Moisture Content (QC Lot: 3154224)									
ES1324140-020	EMP11-SF20	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	6.8	6.7	0.0	No Limit
ES1324220-011	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	4.6	4.9	5.8	No Limit
EK040S: Fluoride Soluble (QC Lot: 3154258)									
ES1324139-001	Anonymous	EK040S: Fluoride	16984-48-8	1	mg/kg	4	3	38.7	No Limit
ES1324140-008	EMP11-SF8	EK040S: Fluoride	16984-48-8	1	mg/kg	2	2	0.0	No Limit
EK040S: Fluoride Soluble (QC Lot: 3154259)									
ES1324140-019	EMP11-SF19	EK040S: Fluoride	16984-48-8	1	mg/kg	4	8	59.4	No Limit
ES1324308-005	Anonymous	EK040S: Fluoride	16984-48-8	1	mg/kg	1	1	0.0	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EK040S: Fluoride Soluble (QCLot: 3154258)								
EK040S: Fluoride	16984-48-8	1.0	mg/kg	<1	25.0 mg/kg	79.4	69	117
EK040S: Fluoride Soluble (QCLot: 3154259)								
EK040S: Fluoride	16984-48-8	1.0	mg/kg	<1	25.0 mg/kg	79.8	69	117

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK040S: Fluoride Soluble (QCLot: 3154258)							
ES1324139-001	Anonymous	EK040S: Fluoride	16984-48-8	25.0 mg/kg	91.0	70	130
EK040S: Fluoride Soluble (QCLot: 3154259)							
ES1324140-019	EMP11-SF19	EK040S: Fluoride	16984-48-8	25.0 mg/kg	86.4	70	130

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report						
				Spike	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	MSD	Low	High	Value	Control Limit
EK040S: Fluoride Soluble (QCLot: 3154258)										
ES1324139-001	Anonymous	EK040S: Fluoride	16984-48-8	25.0 mg/kg	91.0	----	70	130	----	----
EK040S: Fluoride Soluble (QCLot: 3154259)										
ES1324140-019	EMP11-SF19	EK040S: Fluoride	16984-48-8	25.0 mg/kg	86.4	----	70	130	----	----

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1324140**	Page	: 1 of 5
Client	: ENVIRON AUSTRALIA PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR STEVE CADMAN	Contact	: Client Services
Address	: PO BOX 560 NORTH SYDNEY NSW, AUSTRALIA 2060	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: scadman@environcorp.com	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 99548114	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: HYDRO BUFFER ZONE	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 08-NOV-2013
Sampler	: ----	Issue Date	: 15-NOV-2013
Order number	: ----		
		No. of samples received	: 23
Quote number	: SY/285/10	No. of samples analysed	: 23

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with recommended holding times (USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content							
Snap Lock Bag (EA055-103)							
EMP11-SF1, EMP11-SF2, EMP11-SF3, EMP11-SF4, EMP11-SF5, EMP11-SF6, EMP11-SF7, EMP11-SF8, EMP11-SF9, EMP11-SF10, EMP11-SF11	**04-NOV-2013**	**----**	----	----	**12-NOV-2013**	18-NOV-2013	✓
Snap Lock Bag (EA055-103)							
EMP11-SF12, EMP11-SF13, EMP11-SF14, EMP11-SF15, EMP11-SF16, EMP11-SF17, EMP11-SF18, EMP11-SF19, EMP11-SF20, EMP11-SF21, EMP11-QA1, EMP11-QA2	**05-NOV-2013**	**----**	----	----	**12-NOV-2013**	19-NOV-2013	✓
EK040: Fluoride							
Snap Lock Bag (EK040S)							
EMP11-SF1, EMP11-SF2, EMP11-SF3, EMP11-SF4, EMP11-SF5, EMP11-SF6, EMP11-SF7, EMP11-SF8, EMP11-SF9, EMP11-SF10, EMP11-SF11	**04-NOV-2013**	**12-NOV-2013**	11-NOV-2013	×	**14-NOV-2013**	10-DEC-2013	✓
Snap Lock Bag (EK040S)							
EMP11-SF12, EMP11-SF13, EMP11-SF14, EMP11-SF15, EMP11-SF16, EMP11-SF17, EMP11-SF18, EMP11-SF19, EMP11-SF20, EMP11-SF21, EMP11-QA1, EMP11-QA2	**05-NOV-2013**	**12-NOV-2013**	12-NOV-2013	✓	**14-NOV-2013**	10-DEC-2013	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Fluoride - Soluble	EK040S	4	37	**10.8**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Moisture Content	EA055-103	4	40	**10.0**	**10.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Fluoride - Soluble	EK040S	2	37	**5.4**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Fluoride - Soluble	EK040S	2	37	**5.4**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Fluoride - Soluble	EK040S	2	37	**5.4**	**5.0**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Moisture Content	EA055-103	SOIL	A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Fluoride - Soluble	EK040S	SOIL	APHA 21st ed., 4500 F--C Soluble Fluoride is determined after a 1:5 soil/water extract using an ion selective electrode.

Preparation Methods	Method	Matrix	Method Descriptions
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of distilled water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW 846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**
- **For all matrices, no Matrix Spike outliers occur.**

Regular Sample Surrogates

- **For all regular sample matrices, no surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

Matrix: **SOIL**

Method	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EK040: Fluoride						
Snap Lock Bag						
EMP11-SF1, EMP11-SF2, EMP11-SF3, EMP11-SF4, EMP11-SF5, EMP11-SF6, EMP11-SF7, EMP11-SF8, EMP11-SF9, EMP11-SF10, EMP11-SF11	12-NOV-2013	11-NOV-2013	**1**	----	----	----

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**

Appendix G

QA/QC Assessment

APPENDIX F

DATA QUALITY OBJECTIVES

To ensure that reliable data of adequate type was collected and assessed for the investigation, the seven-step Data Quality Objective (DQO) approach, endorsed in the NSW DEC (2006) Guidelines for the NSW Site Auditor Scheme 2nd Edition, will be adopted. The DQOs set quality assurance and quality control parameters for the field and laboratory programs to ensure data of appropriate reliability will be used to assess the environmental conditions at Parcel 11.

ENVIRON has developed DQOs in accordance with the seven-step process, which is presented below.

Step 1 – State the Problem

Based on the information available from the Phase 1 ESA, uses of Parcel 11 appear to be limited to farmland. This use of Parcel 11 requires confirmation via a site walkover and judgemental sampling. In addition, the potential for fluoride in surface soils from dust deposition from the Hydro smelter requires assessment.

Step 2 – Identification of the Goals (Decisions) of the Study

The following decisions are to be made from this study:

- Are the current and former uses of Parcel 11 consistent with site observations?
- Has Parcel 11 been impacted by fluoride from dust deposition from the Hydro smelter?
- Has Parcel 11 been impacted by other contaminants from historical site use?
- Is Parcel 11 suitable for environmental conservation and rural landscape landuse?

Step 3 – Identify Information Inputs to the Decision or Goal of the Study

The inputs required to make the above decisions as listed below:

- A site walkover, including collection of field notes and photographs;
- Results of surface soil samples collected for fluoride analysis;
- Results of other soil samples from fill/ hummocky ground collected for suitable analysis during the site walkover;
- Proposed land use;
- Appropriate NSW contamination guidelines.

Step 4 – Define the Study Boundaries

Spatial boundaries - the study boundaries have been defined as the spatial boundary of Parcel 11, as shown on Figure 1.

Vertical boundaries – as areas of concern at Parcel 11 are restricted to surface soils, the vertical boundary of the study is the top 200mm unless subsurface contamination issues are identified during the site walkover.

Temporal boundaries – the temporal boundary is limited to the data collected during the investigation works.

Constraints within the study boundaries – This investigation does not require investigation of subsurface soils or groundwater unless impacts to subsurface soils or groundwater are considered likely to have occurred from the historical site activities.

Step 5 – Develop a Decision Rule

The decision rules for this investigation are as follows:

- If it is determined that the data generated through this investigation is reliable for use in producing a site conceptual model and assessing the suitability of Parcel 11 for environmental conservation and rural landscape landuse, then an assessment of the suitability of Parcel 11 for environmental conservation and rural landscape landuse will be made;

- If it is determined that the data generated through this investigation is not suitable, comprehensive or reliable for use in producing a site conceptual model, then further investigations may be recommended prior to the development of a site conceptual model and assessment of the suitability of Parcel 11 for environmental conservation and rural landscape landuse.

Step 6 – Specify Performance or Acceptance Criteria that the Data need to Achieve

Acceptable limits on decision errors have been developed based on the Data Quality Indicators (DQIs) of precision, accuracy, representativeness, comparability and completeness. The DQIs for this investigation are outlined below.

The potential for significant decision errors were minimized by:

- Completion of a QA/QC assessment of the investigation data to assess if the data satisfies the DQIs;

- Assessment of whether appropriate sampling and analytical densities were completed for the purpose of the investigation; and

- Ensuring that the criteria set for the investigation were appropriate for the proposed use of Parcel 11.

Minimization of the potential for significant decision errors limits the potential that a conclusive statement may be incorrect.

Step 7 – Optimisation of the Design of Collection of Data

The collection of data was optimized by the completion of a Phase 1 ESA, data gap review and development of a sampling design, which is included in Section 5.3. Attainment of the DQOs has been assessed by reference to the DQIs, presented below.

DATA QUALITY INDICATORS

The project Data Quality Indicators (DQIs) have been established to set acceptance limits on field and laboratory data collected as part of this investigation. Field and laboratory procedures acceptance limits are set at different levels for different projects and by different laboratories. Non-compliances with acceptance limits are to be documented and discussed in the report. The DQIs are presented in Table A.

Table A: Data Quality Indicators

DQI	Field	Laboratory	Acceptability Limits
Completeness	All critical locations sampled, including targeted sampling of areas of environmental concern identified during the site walkover. Fluoride soil sampling completed on a reduced density to identify if fluoride in surface soils is an issue. All samples collected Experienced sampler Documentation correct	All critical samples analysed and all analytes analysed according to Standard Operating Procedures (SOPs) Appropriate Practical Quantitation Limits (PQLs) Sample documentation complete Sample holding times complied with	As per NEPM (2013)
Comparability	Experienced sampler In the event of multiple sampling events: Same types of samples collected Same sampling methodologies used Climatic conditions	Same analytical methods used Same PQLs Same units Same primary and secondary laboratories	As per NEPM (2013)
Representativeness	Appropriate media sampled Relevant media sampled	All samples analysed according to SOPs	
Precision	Collection of duplicate samples Sampling methodologies appropriate and complied with	Analysis of: Blind duplicate samples at rate of 1 in 10 samples Split duplicate samples at rate of 1 in 20 samples Laboratory duplicate samples	 RPD of 30 to 50% RPD of 30 to 50% RPD of 30 to 50%

Accuracy	Sampling methodologies appropriate and complied with.	Analysis of: Method blanks Matrix spikes Surrogate spikes Laboratory control samples Reagent blanks Reference material	 Non-detect 70 to 130% 70-130% 70 to 130%

QUALITY ASSURANCE AND QUALITY CONTROL

A quality assurance assessment for this report is presented in Table A and B below. An assessment was made of data completeness, comparability, representativeness, precision and accuracy based on field and laboratory considerations, as outlined in NSW DEC (2006) and NSW EPA (2007) guidelines.

Table A: QA/QC – Sampling and Analysis Methodology Assessment

Sampling Methodology	ENVIRON Assessment
Sampling Pattern and Locations	Surface soil sampling was undertaken on a grid pattern across Parcel 11 to assess the impact of particulate fallout from Hydro Aluminium Smelter.
Sampling Density	Twenty-one soil samples were collected from a grid across the entire site which is approximately 150 ha. The purpose of the sampling was to assess for impacts from smelter particulate fallout and therefore is considered suitable in density and spatial layout.
Sample depths	Surface soil samples were collected from a grid across Parcel 11 from the soil surface.
Sample Collection Method	Surface soil samples across Parcel 11 were collected directly from the ground surface using using dedicated disposable gloves and a hand trowel. The hand trowel was brushed clean prior to sample collection. Soil samples were collected into laboratory supplied, acid rinsed glass jars.
Decontamination Procedures	Surface soil samples across Parcel 11 were collected directly from the ground surface using using dedicated disposable gloves and a hand trowel. The hand trowel was generally used to loosen the soil prior to sample collection and was brushed clean.
Sample handling and containers	All soil samples were placed into laboratory-supplied, acid-rinsed glass jars. Soil samples were placed on ice following collection and during transportation to the laboratory.
Chain of Custody	Samples were transported to the laboratory under chain of custody conditions. The chain of custody forms were signed by the laboratory on receipt of the samples.
Detailed description of field screening protocols	Field screening for volatiles was not completed during soil sampling as volatile contaminants were not the main chemical of concern.

Table A: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling Methodology	**ENVIRON Assessment**
Calibration of field equipment	No equipment requiring calibration was used.
Sampling Logs	Field Information Sheets are included in Appendix B.

Table B: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	**ENVIRON Comments**
Field quality control samples	Intra-laboratory duplicate soil samples were analysed at a ratio of 1:10 for fluoride analysed for the grid samples across the entire site. No rinsate blank samples were collected.
Field quality control results	Intra-laboratory duplicate results are presented in Table B. There were no RPD exceedences for the intra-laboratory duplicates collected for this assessment.
NATA registered laboratory and NATA endorsed methods	ALS was the primary laboratory. ALS laboratory certificates are NATA stamped and both labs are accredited for the analyses performed for this assessment.
Analytical methods	A summary of analytical methods were included in the laboratory test certificates.
Holding times	Review of the COCs and laboratory certificates indicate that holding times were met.
Practical Quantitation Limits (PQLs)	PQLs for all soil were below Parcel 11 assessment criteria.
Laboratory quality control samples	Laboratory quality control samples including duplicates, laboratory control samples, matrix spikes, surrogate spikes and blanks were undertaken by the laboratories at appropriate frequencies.
Laboratory quality control results	All results for laboratory soil duplicates, laboratory control samples, matrix spikes and surrogates were acceptable and no detections were made in blank samples.

Overall it is considered that the completed investigation works and the data obtained adequately complied with the requirements of NSW DEC (2006) and NSW EPA (2007) guidelines and that the data is of suitable quality to meet the project objectives.