

NSW Trade and Investment - Crown Lands

Remediation of the Former Antimony Processing Plant- Urunga NSW

Environmental Impact Statement

November 2014

Submission of an Environmental Impact Statement (EIS)

Prepared under the *Environmental Planning and Assessment Act 1979* Section 78A(8)

EIS Prepared by

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In Respect of	GHD Pty Ltd

Development Application

Applicant Name:	NSW Trade and Investment – Crown Lands
Applicant address:	45 Wingewarra St, Dubbo, 2830
Lot No. DP No. and Address of Land to be Developed:	Lot 1 and Lot 2, DP 874874 and Lot 253, DP 46013, Hillside Drive, Urunga

Environmental Impact Statement

Section 5 of the Environmental Impact Statement (EIS) assesses the potential environmental impact of the proposed development.

Certificate

I certify that I have prepared the contents of this Statement and to the best of my knowledge:

- It has been prepared in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*
- It contains all available information that is relevant to the environmental assessment of the development to which the statement relates
- The information contained in this Statement is neither false nor misleading.

Signature: 

Name	Ben Luffman
Date:	3 November 2014

Executive summary

Introduction

This Environmental Impact Statement (EIS) has been prepared to assess the potential impacts of the proposed remediation of a former antimony processing facility located at Hillside Drive, Urunga, NSW (the Site), hereafter referred to as the 'Proposal'.

The Site was a former antimony processing plant, which operated between 1969 and 1974, and was abandoned in 1974 without clean up or remedial work. Tailings and mill waste water were discharged onto the wetland foreshore area during the plant operations. A tailings deposit approximately 1 hectare in area fans out into the adjoining wetland, and contamination from the tailings has impacted soils, sediments and surface water surrounding the tailings area. Previous investigations have identified significant contamination levels at the Site.

The Environment Protection Authority (EPA) has placed a Management Order (No. 20111405) on the Site under the provisions of the *Contaminated Land Management Act 1997*.

Recent investigations by GHD delineated the extent of contamination and were used to prepare a Remedial Action Plan (RAP) (GHD 2014). The RAP was developed to:

- Achieve compliance with the Management Order 20111405.
- Provide details necessary to remediate the contamination at the Site so that any further impact on the adjacent wetland and receiving environment is minimised, and to allow the Site to be opened to public access without unacceptable risk to human health.

This EIS presents details of the Proposal, assesses the existing natural and social environment, describes the potential impacts on the environment and presents mitigation measures to minimise and/or avoid these identified impacts.

Proposal

Various onsite and offsite options were considered. The preferred option, selected by the stakeholders including Bellingen Shire Council (BSC), Crown Lands, EPA and the Soil Conservation Service (SCS), was onsite disposal of contaminated material in a containment cell, with treatment to reduce contaminant mobility. The Proposal will generally involve:

- Vegetation clearing
- Construction of an engineered containment cell for secure long-term storage of contaminated material
- Excavation of contaminated material within the wetland, treatment to reduce contaminant mobility and placement of the treated material in the constructed containment cell
- Landform modification earthworks
- Revegetation of disturbed areas.

Statutory position

Key issues relating to the statutory position include:

- The Proposal falls under Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act), through the application of Clause 9 of State Environmental Planning Policy No 55 (Remediation of Land) and as such development consent is required.
- The Proposal is considered to be a State Significant Development under Section 78A(8A) of the EP&A Act. Accordingly NSW Catchment and Lands - Crown Lands (Crown Lands)

has been issued Director Generals Requirements (DGRs) under a State Significant Development application.

- Under Section 14 of the Contaminated Land Management Act 1997, the Environmental Protection Authority has issued a Management Order 20111405 for the remediation of the Site.
- As the Proposal includes clearing, drainage and potentially filling in a State Environmental Planning Policy (SEPP) No 14 - Coastal Wetlands listed wetland, development consent is required.
- Part of the area, requiring clearing of native vegetation, is within land zoned E2 (Environmental Conservation) and E3 (Environmental Management) where the Native Vegetation Act 2003 applies and therefore would require consent from the Minister.

Consultation

Consultation with the community has been undertaken at various phases throughout the site investigation and EIS process including multiple public meetings, media releases and direct liaison. In general, community feedback indicated there was little opposition to the Proposal as a remediation project is considered to offer significant benefits to the community through reduced potential health risks, improved environmental and ecological conditions, short term employment opportunities and restored recreational and visual amenity. Community engagement and consultation will be ongoing throughout the Proposal.

Consultation has also been undertaken with relevant government agencies to determine their requirements for any subsequent environmental impact assessment.

Soil, sediment and water

Localised, short-term impact on soils, sediment and water quality are likely, however provided stabilisation strategies are effectively implemented, medium to long-term impacts would be low. As the Proposal is a remediation project, the long term impacts on soil, sediment and water quality are positive including:

- Reduced erosion and sedimentation
- Removal of contaminated soil and sediment that have a detrimental effect on the environment
- Reduced contaminant levels in the surface water and groundwater due to the reduction/containment of the contaminant source.

The most significant, potential negative impacts relating to soil and water quality include:

- Short term erosion and sedimentation
- Mobilisation of contaminants through soil and sediment disturbance, flooding or potential failure of the containment cell
- Exposure of workers to contamination
- Acidification of surface and groundwater through the exposure of acid sulfate soils
- Groundwater infiltrating or moving through an on-site containment structure and releasing contaminated leachate.

Mitigation measures identified to minimise the above negative impacts, include but are not limited to:

- Implementing the RAP and construction of an engineered containment cell.

- Preparing and implementing a Soil and Water Management Plan in accordance with *Urban Stormwater Manual Volume 1 7 2 (Blue Book)* and IECA Guidelines.

Air

Although there is a potential impact of the Proposal on air quality, implementation of the mitigation measures, to be incorporated into a Dust Management Plan, would minimise these impacts. Monitoring would also be used to assess impacts to air quality and guide the implementation of mitigation measures. If the monitoring detects dust being transported offsite, works would cease and additional controls be implemented.

Potential impacts of the Proposal on air quality in the short term include:

- Dust generation from excavation, earthworks, construction vehicles, treatment and containment of the contaminated soil and exposed stockpiles
- Transportation and inhalation of contaminants (particularly antimony and arsenic) via dust
- Odour from the excavation of contaminated soil and sediment
- Exhaust emissions from construction machinery.

The nearest human receptors to dust and other potential air impacts would be residents on Hillside Drive and the Pacific Highway, adjacent to the Site.

The long term impact of the Proposal on air quality would be positive due to the removal of the exposed tailings deposit, remediation of exposed soil areas and revegetation. This would, in turn, reduce the potential for the mobilisation and inhalation of contaminants via dust.

Human Health Risk

Several contaminant sources have been identified at the site through past investigations including the tailings deposits, ore stockpiles, incidental contaminants, fill material, excavated sediments and exposed acid sulfate soils. Based on an assessment of the known chemicals used in the processing, the possible contaminants include arsenic, antimony, lead, copper, chromium, aluminium, mercury, cyanide, sulfur, sodium and nitrates.

Based on the identified receptors and the release, fate and transport characteristics of the contaminants, pathways through which human receptors may become exposed to contamination include inhalation, ingestion and dermal absorption of the contaminated material or affected sediments, surface water, groundwater or air.

Mitigation measures during site activities will be undertaken to eliminate (or minimise) the release mechanism, thereby cutting off transport of contamination to the potential receptors and minimising health risk.

Noise

The Proposal would result in potential noise and vibration impacts from vehicle movements during construction and machinery including excavators, trucks, compacting equipment, chain-saws, generators and hand held tools.

These noise sources would only be present during the civil works period. Upon completion, the works would not result in any additional noise or vibration sources.

A range of controls would be implemented during the civil works to minimise the noise impacts. Consultation would also occur to keep adjacent residents informed about the works.

Biodiversity

Species listed under the NSW Threatened Species Conservation Act assessed as 'likely' to occur or 'may occur' given the available and suitable habitat within the Site include:

- Three endangered or threatened ecological communities
- Two vulnerable or endangered plant species
- One endangered or vulnerable frog species
- Ten vulnerable and one endangered bird species
- Eight vulnerable mammal species
- Six migratory marine species.

Species listed under the Environmental Protection Biodiversity Conservation Act assessed as 'likely' or 'possible' to occur given the available and suitable habitat within the Site include:

- 1 endangered and 2 vulnerable plant species
- 6 migratory marine species
- 2 migratory wetland species.

The most significant potential impacts identified on ecology included:

- Clearing of terrestrial and aquatic vegetation
- Water quality impacts associated with erosion and sedimentation
- Removal of soil
- Impacts from machinery and equipment including direct mortality or injury from collision as well as the impacts of noise, exhaust fumes on air quality and the vibration created by earthmoving equipment
- Spread of weeds
- Increased edge effects on remnant adjacent vegetation.

The extent of habitat that may be removed as part of the proposed action is limited and consists primarily of highly modified and weed infested vegetation, or vegetation in poor condition due to the local site conditions, or both, thus it is not considered likely to provide core habitat for any listed threatened species. It is not considered that the extent of habitat to be removed is significant given the area of adjacent similar ecological community in better condition.

An assessment of the significance of the potential impacts identified on threatened biota was carried out via a 7-part test under Section 5A of the EP&A Act for 24 species. In conclusion, based on this assessment and given the intent of the proposed works to remediate the site, in conjunction with the implementation of an environmental management plan and revegetation during the works phase, it is considered that the proposed remediation works would be unlikely to significantly impact on threatened species, populations or ecological communities.

Aboriginal Heritage

No Aboriginal sites or places have been recorded in or near the Proposal footprint. A potential impact exists for previously unrecorded Aboriginal sites uncovered during the Proposal, especially in the locality of the current dwelling which the Coffs Harbour and District Local Aboriginal Land Council (CHLALC) identified as a potential archaeological deposit (PAD). Measures would be implemented to avoid disturbing the area of the PAD and all workers would be educated what to do if an Aboriginal item is uncovered. Based on these controls, the potential impact on potential Aboriginal sites is deemed to be minimal.

Non-Aboriginal Heritage

No recorded non-Aboriginal heritage sites were identified within 500 metres of the Site hence the potential impact on non-Aboriginal heritage is considered minimal.

Traffic

A Traffic Impact Assessment (TIA) was completed for the Proposal. Vehicles and machinery would access the Site via the Pacific Highway and Hillside Drive. The speed limit on the Pacific Highway at the intersection with Hillside Drive is 50 km/h and a speed camera is located approximately 100 metres south of the intersection. Visibility for vehicles turning from Hillside Drive onto the Pacific Highway is adequate to enable safe passage, with approximately 250 metre lines of site available in each direction.

Two access points off Hillside Drive are proposed, being approximately 40 and 200 metres east of the intersection with the Pacific Highway.

The Proposal would result in a short term increase in truck movements on the Pacific Highway and Hillside Drive. Should significant quantities of clay material be required during construction of the containment cell or backfilling the excavation, it is possible that up to 30 trucks per day may enter the Site for a period of one week on three occasions.

Impacts on the users of the Pacific Highway including public transport and pedestrians are considered to be negligible.

Despite the Proposal not being expected to cause a significant impact, the preparation and implementation of a Traffic Management Plan is recommended.

Visual amenity

Due to surrounding vegetation and the low-lying aspect of the Site, visibility of the Site is limited. Apart from the Pacific Highway and Hillside Drive adjacent to the Site, no opportunities exist to view the Site from any public vantage points such as public reserves or open space areas. The most sensitive visual receptors are the residents of 99 Pacific Highway Urunga, and the Westella Motel (107 Pacific Highway).

As the Proposal is a remediation project, most of the potential impacts on visual amenity are positive including debris (dead vegetation, metal, concrete, soil and sediment) removal and revegetation of degraded areas. A potential long term negative impact would be from the modification of the landscape through the construction of the containment cell.

Potential short-term visual impacts would result from presence of construction machinery, compounds, stockpiles, erosion and sediment control structures, discolouration (sedimentation) of the wetland, development of the access track and presence of waste and soil stockpiles.

Following the completion of construction, the Proposal is not expected to result in any significant adverse impacts to visual amenity.

Socio-economic

Most socio-economic impacts of the Proposal are positive including:

- Remediation of the Site leading to potential increased recreational amenity
- Increased visual amenity
- Decreased potential adverse health effects for receptors of contaminants (surface water and dust)
- Short term benefit of the creation of approximately ten to twenty jobs for a period of 6 months during the Proposal.

During the civil works, there would be short-term, potentially negative impacts on traffic and access, noise and vibration, visual amenity and air quality but these would be minimised through implementation of the identified mitigation measures.

Demand on Resources

The Proposal may require clay material for construction of the low permeability lining and capping in the containment cell, geomembrane, geotextile, replacement fill, topsoil, jute mesh, plants, and soil treatment chemicals. The materials would be sourced locally and imported to site. All required materials are readily available and would not adversely affect the abundance of existing energy sources or their supply.

Waste

The overall objectives of the Proposal relate to the remediation of waste generated from the past processing of antimony ore. An assessment of the potential risks (on site and off site) associated with the disturbance, transfer and disposal of the contaminated material has been undertaken and details of mitigation and management measures to minimise human health risks during the handling of the contaminated material have been outlined. The selected remediation option minimises use of municipal landfill facilities and off-site transport of waste.

The waste generated has potential to impact soil and water quality, worker safety and biodiversity, however if the wastes are managed appropriately, the risk of a significant impact as a result of waste is considered low.

Cumulative impacts

The only identified existing approved or proposed operations that may be carried out in the vicinity of the site include upgrade works on the Pacific Highway. If carried out concurrently, these works will have short term, cumulative impacts such as those relating to increased traffic, noise and demand on resources including labour, machinery and accommodation. No long term cumulative impacts are anticipated.

Environmental management

A summary of the mitigation measures is provided as a basis for a Construction Environmental Management Plan (CEMP), which would be prepared to provide an overall framework for the management of environmental impacts that could potentially arise from the Proposal.

Project justification

Alternatives were considered as part of the EIS. The reasons for justifying the final proposal are presented having regard to biophysical, economic and social considerations and the principles of ecologically sustainable development. As a remediation project, the majority of the potential impacts of the Proposal would be positive. It is not anticipated that the Proposal described in this EIS would have any significant adverse environmental impacts. The Proposal does have potential to affect the amenity of nearby residences during construction, however this would be a short-term impact and the residents would be consulted prior to and during the work.

Conclusion

To the fullest extent possible, all matters affecting or likely to affect the environment by reason of the project have been assessed under Section 111 of the EP&A Act. No significant impacts on threatened species as defined by the TSC Act were identified and therefore a Species Impact Statement is not required. The Proposal is unlikely to have a significant impact on matters of National Environmental Significance and therefore a referral under the Commonwealth EPBC Act is not required.

Abbreviations

ASS	Acid Sulfate Soil
ASSMAC	Acid Sulfate Soils Management Advisory Committee
BSC	Bellingen Shire Council
CEMP	Construction Environmental Management Plan
CLM Act	Contaminated Land Management Act
COC	Contaminant of Concern
DECCW	NSW Department of Environment, Climate Change and Water (former, now the OEH)
DLWC	Department of Land and Water Conservation
DPI	NSW Department of Primary Industries
EIL	Environmental Investigation Level
EIS	Environmental impact statement
ENM	Excavated natural material
EPA	NSW Environment Protection Authority
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW).
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPI	Environmental planning instrument
EPL	Environmental Protection Licence
FM Act	Fisheries Management Act 1994 (NSW)
GHD	GHD Pty Ltd
HIL	Health Investigation Level
HSE	Health, Safety and Environment
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area
mbgs	Metres below ground surface
MNES	Matters of National Environmental Significance.
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
OCP	Organochlorine Pesticides
OEH	Office of Environment and Heritage

PAHs	Polynuclear Aromatic hydrocarbons
PCBs	Polychlorinated Biphenyls
POEO Act	Protection of the Environment Operations Act 1997
PMF	Probable Maximum Flood
RAP	Remedial Action Plan
RMS	NSW Roads and Maritime Services
SCS	NSW Soil Conservation Service
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
TCP	Traffic Control Plan
TMP	Traffic Management Plan
TPH	Total petroleum hydrocarbons
TSC Act	Threatened Species Conservation Act 1995 (NSW)
VENM	Virgin excavated natural material
WH&S or OHS	Workplace Health and Safety

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Appendix A Management Orders

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Appendix E Remediation Action Plan

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Appendix H Ecological Assessment

Appendix I Stakeholder Consultation

Appendix J Aboriginal Heritage Information

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Appendix L Traffic Impact Assessment

1. Introduction

1.1 Overview

This Environmental Impact Statement (EIS) has been prepared to assess the potential impacts of the proposed remediation of the former antimony processing facility located at Hillside Drive, Urunga, NSW (the Site), hereafter referred to as the 'Proposal'.

The Proposal falls under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), through the application of Clause 9 of *State Environmental Planning Policy No 55 (Remediation of Land)* and therefore development consent is required. The Proposal is also considered State Significant Development under Section 89C of the EP&A Act by virtue of Clause 8 of *State Environmental Planning Policy (State and Regional Development) 2011*. Pursuant to Section 78A(8A) of EP&A Act, an EIS is required to accompany a development application to the Minister for Planning and Environment for the Proposal.

Accordingly NSW Catchment and Lands - Crown Lands (Crown Lands) has been issued Director Generals Requirements (DGRs) under State Significant Development application number SSD-5357 issued July 2012.

This EIS presents details of the Proposal, assesses the existing natural and social environment, describes the potential impacts on the environment and presents mitigation measures to minimise and/or avoid these identified impacts.

The EIS includes consideration of State and Federal factors from Clause 228 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The findings of the EIS will be considered when assessing:

- To the fullest extent possible, all matters affecting or likely to affect the environment by reason of the Proposal, under Section 111 of the EP&A Act.
- The significance of any impact on threatened species as defined by the Threatened Species Conservation Act 1995 (TSC Act), in accordance with Section 5A of the EP&A Act and therefore the requirement for a Species Impact Statement (SIS).
- Whether the Proposal is likely to have a significant impact on matters of National Environmental Significance (NES) and therefore require a referral under the Commonwealth EPBC Act.

1.2 EIS requirements

The DGRs state that '*the EIS must meet the form and content requirements of clauses 6 and 7 of Schedule 2 of the EP&A Regulation'* as well as additional requirements outlined in the DGRs. These are addressed in Sections 5.1 and 6.3.1.

1.3 Background

The Site is the former location of any antimony processing plant (Photograph 1-1) that was operated by 'Broken Hill Antimony Pty Ltd' and processed stibnite (antimony sulphide) ore mined from Wild Cattle Creek, Dorrigo from 1969 to 1974. The ore (containing impurities in the form of arsenic and mercury) was crushed and then passed through flotation cells to separate the precious metals from the rock waste. Tailings and mill waste water were discharged onto the wetland foreshore area during the plant operations. A tailings deposit approximately 1 hectare in extent fans out into the adjoining wetland. Chemicals used during the purification process

included copper sulfate, sodium cyanide, lead nitrate, dextrin, sodium ethyl xanthate and crescylic acid. Water mill water was also contaminated with dissolved antimony and arsenic salts during treatment of the crushed ore. A gravel washery was also reported to be onsite, using water from the wetland.



Photograph 1-1 Former Antimony Processing Plant, late 1970s. Source: Urunga Museum

In 1974, operations at the plant ceased due to the closure of mining production at Wild Cattle Creek. No clean-up operations or remedial work were undertaken when the site was abandoned.

In the late 1970s the property and processing plant were purchased by Mr R Tickner. In 1980, 'Australian Antimony N.L.' (owned by Mr Tickner) applied to the Bellingen Shire Council to restart operations. The application was refused.

The company excavated a series of canals to act as storage dams to supply water needed for future milling. The date of the construction of the canals has not been confirmed, although historic photos show that they were absent in 1969 but constructed prior to 1980. Whether they were constructed prior to or during the operation of the plant has not been ascertained. Since then, no further development has occurred.

In 1994 Mr Tickner approached the Bellingen Shire Council to seek Development Approval for residential use of Portions 169 and 138. The application was refused. (DLWC 1997a).

Crown Lands became aware of the contamination issues at the Site in 1995 when Mr Tickner reported the issue following the refusal of a development application. Crown Lands immediately took action to protect the public by erecting fencing and warning signs (SCS 2012).

On 2 August 2002, the Environment Protection Authority (EPA) declared the Site to be a 'Remediation Site' (Declaration No. 21020).

On 7 November 2005, 'Remediation Site' was decreased (Notice No. 22004) to remove an area of approximately 2,000 m^2 adjacent to the abandoned residences following validation sampling by Coffey (2004).

Under the provisions of the *Contaminated Land Management Act 1997* (CLM Act), Management Order (No. 20111405) applies to Lot 253, DP 46013 (NSW EPA 2011) and a declaration of a remediation site (No. 21020, Area 1089) applies to Lot 1 and Lot 2, DP 874874 and Lot 253, DP46013 (NSW EPA 2002). Copies of the Management Order and amendments are presented in Appendix A.

Approximately fifteen investigations have been carried out at the Site to assess the levels of contamination including preliminary and detailed investigations by GHD (GHD, 2012a and 2012b) which included the development of a conceptual site model. The detailed investigation assessments are included in Appendix C and Appendix D and are summarised in Section 2.2.1.

In 2011, a partial clean-up of surface debris and waste materials on the Site was carried out by Entech Industries, however no remediation or management of soil or tailings contamination has occurred.

A Remedial Action Plan (RAP) (GHD 2014) is presented in Appendix E, is summarised in Section 4 and was developed to:

- Achieve compliance with the Management Order 20111405.
- Provide details necessary to remediate the contamination at the Site so that any further impact on the adjacent wetland and receiving environment is minimised, and to allow the Site to be opened to public access without unacceptable risk to human health.

2. Site Description

2.1 Location and description

The Site is located on the southern side of Hillside Drive, adjacent to the Pacific Highway, approximately 1.5 kilometres (km) from the town centre of Urunga, on the mid-north coast of NSW, as presented in Figure 2-1. The Site comprises part of Lot 1 and Lot 2 DP 874874, part Lot 7062 DP 1108434 and part of Lot 253 DP 46013. All lots are Crown land.

Site features are presented in Figure 2-2. In general, the Site consists of:

- A disturbed area incorporating various features associated with the former antimony processing facility that is largely devoid of vegetation (Photograph 2-2 to 2-6).
- A tailings area of approximately one hectare that is devoid of vegetation, extending from the former processing area into an adjacent, State Environmental Planning Policy (SEPP) 14 wetland (no. 354) (Photograph 2-7 to 2-11).
- Visually impacted melaleuca trees in the wetland area, adjacent to the tailings deposit.
- A generally forested area adjacent to the SEPP 14 wetland in which endangered fauna species have previously been recorded.
- Surface material (within the disturbed areas) consisting of imported fill and tailings (Photograph 2-12).
- Some remaining infrastructure consisting mainly of foundations of the former processing facility and loading ramps.
- Several abandoned buildings, adjacent to Hillside Drive (Photograph 2-13).
- Several remaining stockpiles of ore, rubbish and bricks.
- An ‘L’ shaped canal that was apparently excavated from the wetland in approximately 1979, after operation of the processing facility had ceased (Photograph 2-14 and 2-15).
- A series of ‘S’ shaped canals (possibly constructed for use in tailings settling) (Photograph 2-16 and 2-17).

The Site is located between the footslope of a small ridge to the north and west, and the SEPP 14 wetland to the south and east. Flood waters are shown to periodically inundate the Site (as shown in Figure 2-2) with the Probable Maximum Flood (PMF) level inundating the tailings, former gravel processing area (within the lower part of the former processing area) and the canal systems. The PMF does not cover the full extent of the former processing area.

The wetland drains into Station Creek which is partially tidal. No tidal influence has been recorded at the Site, however tidal influences may periodically inundate portions of the tailings area during different hydrological conditions. Station Creek discharges into Urunga Lagoon which forms part of the Bellinger-Kalang estuarine system.

Neighbouring land uses consist of:

- A SEPP 14 wetland and land owned by the Coffs Harbour and District Local Aboriginal Land Council, to the south and east.
- Hillside Drive and residential land to the north.
- Residential and commercial properties to the west and the Pacific Highway beyond.

501,000 502,000 503,000

6,626,000

6,625,000

KALANG RIVER
FITZROY STREET
COOPERS LANE
ORARA STREET
BONVILLE STREET
MINERVA LANE
MORGO STREET
NEWRY STREET
CRESCENT STREET
PANORAMA PARADE
SOUTH STREET
PILOT STREET
HIGH STREET
PACIFIC HIGHWAY
HILLSIDE DRIVE
RALEIGH
KALANG RIVER
BELLINGER RIVER
MYLESTOM
BELLINGER RIVER
PACIFIC OCEAN
URUNGA
Urunga Lagoon
Wetland
Urunga Antimony Contaminated Site
NORTH COAST RAILWAY
CEMETERY ROAD
HUNGRY HEAD ROAD



1:8,000 (at A3)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- North Coast Railway Line
- Contours
- SEPP14 Wetland
- WaterFeature
- Site Boundary

CLIENTS | PEOPLE | PERFORMANCE

NSW Catchment and Lands- Crown Lands
Former Antimony Processing Plant, Urunga NSW

Job Number	22-16251
Revision	0
Date	7 Apr 2014

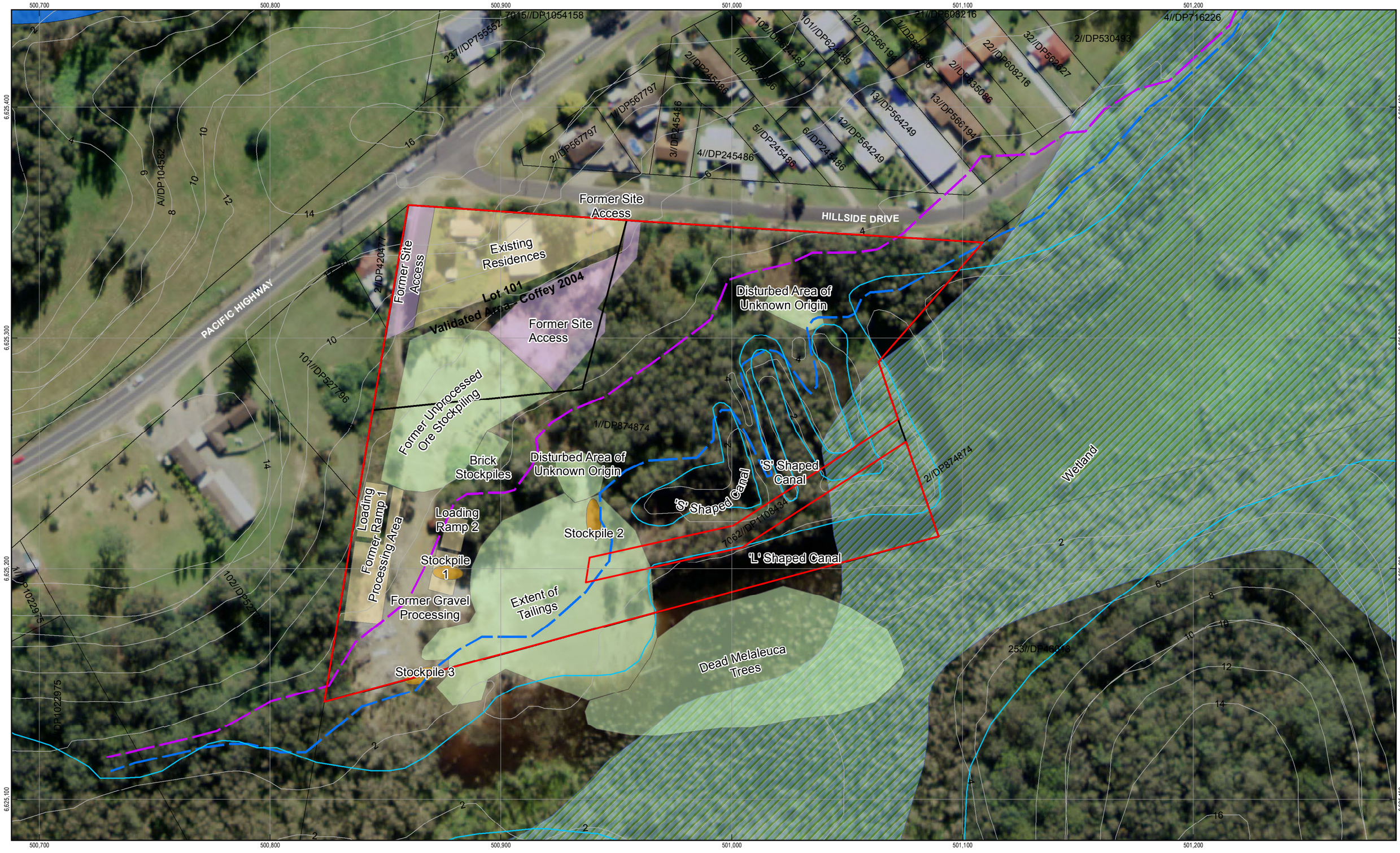
Site Location

Figure 2-1

G:\22\16251\gis\maps\working\22_16251_01_SiteLocationOverview_Rev_A.mxd

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Data source: DPI,: Aerials - 2012. Created by Sdouglas

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1:1,500 (at A3)

0 10 20 40 60 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

Flood Levels - BSC Flood Risk Maps (2008)

- 100 Year
- Probable Maximum Flood (PMF)
- Waters Edge (August 2012)
- Lidar Contours
- Lot
- SEPP14 Wetland
- Site Boundary

CLIENTS | PEOPLE | PERFORMANCE

NSW Catchment and Lands- Crown Lands
Former Antimony Processing Plant, Urunga NSW

Site Details

Job Number	22-16251
Revision	2
Date	7 Apr 2014

Figure 2-2

G:\2\16251\gis\maps\working\22_16251_01_SiteLocationDetailed.mxd

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Data source:DPI, Aerials 2012. Created by: Sdouglas

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Photograph 2-1 Former processing area, looking north. November 2012.



Photograph 2-2 Former processing area, debris, tailings and wetland, looking East. November 2012.



Photograph 2-3 Debris, stockpile and former gravel washing area, looking southeast. November 2012.



Photograph 2-4 Former unprocessed ore stockpile area and bricks to the north of the Site. November 2012.



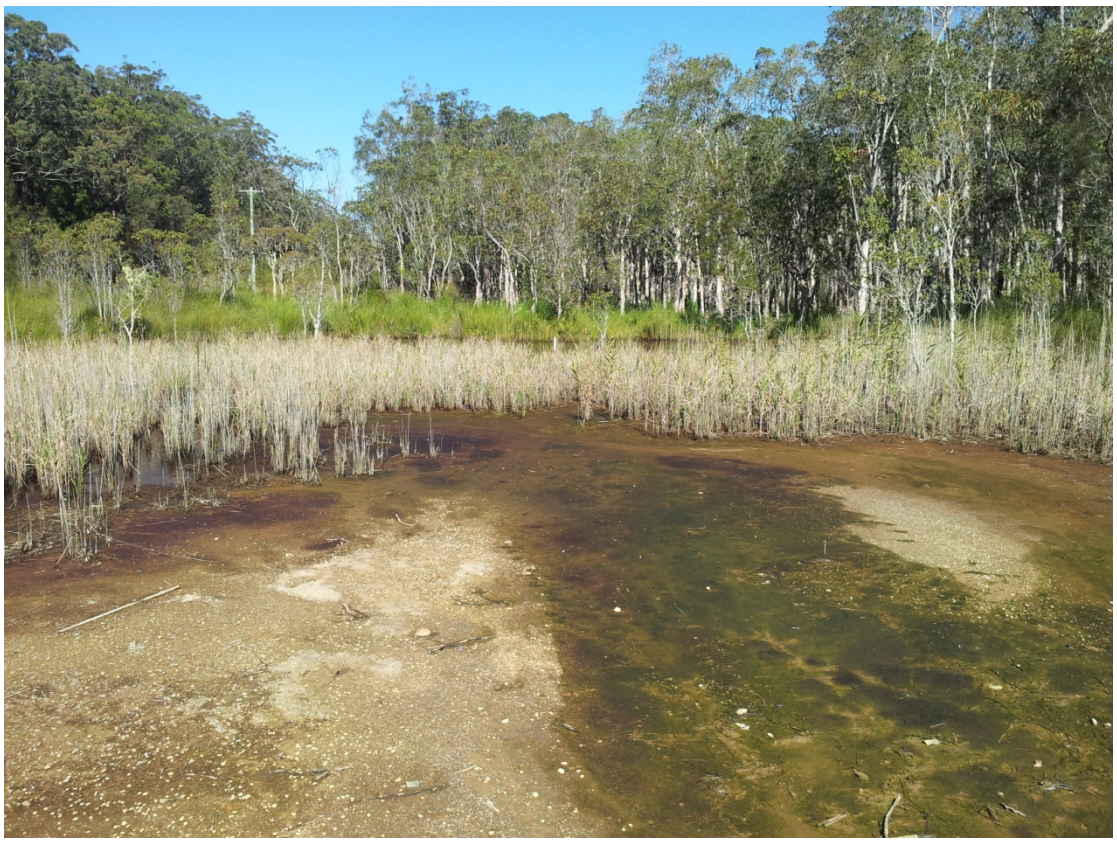
Photograph 2-5 Residual debris and stockpile. November 2012.



Photograph 2-6 Main tailings area, wetland and dead Melaleuca trees looking East. Note old fence-line buried by tailings. November 2012.



Photograph 2-7 Eastern portion of tailings deposit, looking East. November 2012.



Photograph 2-8 Tailings adjacent to wetland on southwest portion of Site, looking southwest. November 2012.



Photograph 2-9 Tailings deposit adjacent to the wetland, looking south. November 2012.



Photograph 2-10 Wetland approximately 30 metres south of the tailings deposit, looking south. November 2012.



Photograph 2-11 Area of unknown disturbance in northeast portion of Site. November 2012.



Photograph 2-12 Abandoned building at north western entrance to the site. April 2014.



Photograph 2-13 Western portion of the 'L' shaped canal, looking East. November 2012.



Photograph 2-14 Eastern portion of 'L' shaped canal and adjoining wetland, looking east. November 2012.



Photograph 2-15 Western end of the 'S' shaped canals, looking east. November 2012.



Photograph 2-16 Central portion of 'S' shaped canals, looking east. November 2012.

2.2 Previous investigations

Previous investigations undertaken at the Site include:

- DMR 1977. *Urunga Mineral Processing Plant Investigation*. Department of Mineral Resources Mines Inspection Branch
- SPCC 1984. *Water Quality in the Bellingen and Kalang Rivers*. State Pollution Control Commission, Northern Rivers Study No. 2
- Hicks 1993, *Investigation of Trace Metal Concentrations in Urunga Lagoon*. Bachelor Degree Thesis, The University of New England- Northern Rivers
- DLWC 1995. *Assessment of Contaminated Crown Land at Urunga*. Department of Land and Water Conservation
- DLWC 1997a. Part 1 Urunga Contaminated Site Background and Results. Department of Land and Water Conservation
- DLWC 1997b. *Part 2 Urunga Contaminated Site Remediation Options.* Department of Land and Water Conservation
- DLWC 2002 Wasteland to Wetland. Evaluation of Options for Remediation of the Former Antimony Processing Plant at Urunga, NSW. NSW Department of Land and Water Conservation, Resource Analysis Unit North Coast
- Repath, P and Body, M 2003. Flora and Fauna Evaluation for the Urunga Antimony Contaminated Site: An inventory assessment for an EIS
- Coffey 2004. Validation Assessment of Stripped Area
- DMR 2004, NSW. Abandoned Minesite Database. Urunga Mineral Preparation Plant. Department of Mineral Resources
- NSW EPA 2008. Former Antimony Processing Plant Soil Sampling Results. Environmental Protection Authority
- SCS 2012. Urunga Antimony Processing Plant. Contaminated Site - Project Application & Preliminary Environmental Assessment Prepared for NSW Department of Planning. Soil Conservation Service
- GHD (July, 2012a). Former Antimony Processing Plant, Urunga, NSW – Preliminary Investigation Report
- GHD (December, 2012b). Former Antimony Processing Plant, Urunga, NSW – Detailed Investigation Report
- GHD (February, 2013). Former Antimony Processing Plant, Urunga, NSW – Detailed Investigation Report Addendum One – Supplementary Sampling Results

These investigations are summarised in Section 2.2.1 and relevant data was incorporated into the detailed investigation report (GHD 2012b) as discussed in Section 2.2.2.

2.2.1 Previous Investigations

Between 1974 and 1977, some initial investigative work was undertaken by the then Department of Mineral Resources (DMR) in an attempt to determine whether or not the waste management practices adopted by Broken Hill Antimony Pty Ltd were polluting Station Creek and Urunga Lagoon. Investigations primarily comprised samples of surface water at three locations including runoff from the tailings dump, an effluent drain and the lagoon, approximately 1 km from the processing plant. Investigations found that antimony and arsenic

were the major pollutants present, contamination of the site was serious and the impact on the lagoon was of concern. No action was taken regarding these findings (DLWC 1997).

In 1984, an investigation of metal contamination at the Site was initiated by the (then) owner of the Site, Mr R. Tickner. The investigation was completed by the Soil Conservation Service (SCS) and the findings of the investigation confirmed that the tailings were contaminated with aluminium, lead, antimony and arsenic.

In 1984, the then State Pollution Control Commission (SPCC) also investigated sediment and water samples at nine sites throughout the lagoon and wetland. The main conclusions of this investigation were that contamination occurred in the immediate vicinity of the plant, metal contamination was still detectable approximately 1 km from the site, and trace metal contamination was not evident in the lagoon.

A survey of metal contaminated sediments was undertaken by Hicks (a student) in 1993 in response to the past investigations. The study focussed on the wetland as well as the Urunga Lagoon. Sediment samples were collected from nine stations and analysed for size fractions and select metals in different particle fractions. The study concluded excessive metal concentrations were present within close proximity to the antimony processing plant, especially for antimony and arsenic but concentrations were found to decrease with distance away from the plant, being detectable for approximately one km and no contamination was found in the lagoon.

In 1995, the then Department of Land and Water Conservation (DLWC) conducted a soil/sediment analysis to assess the levels and extent of metal contamination on the Crown land portion of the study area. Soil or sediment samples were taken from ten stations distributed over the Site. These investigations concluded significant metal contamination was present, as high as 850 times the selected thresholds. The volume of contaminated tailings at the Site was estimated by DLWC to be 8,500 to 9,500 m^3.

In 1997, based on previous investigations, the then Centre for Natural Resources (a department within DLWC) was commissioned by the State Lands Service (also DLWC) to undertake more comprehensive investigations and develop remediation options for the tailings area. DLWC noted that although the highest levels of metals were generally found in tailings layers, significant contamination was also detected in the underlying peat, shallow wetland sediments and in the imported fill layer. Deeper natural soil materials showed low levels or no contaminants. DLWC found that the surface waters of the wetland and creek are contaminated by heavy metals (Arsenic, Antimony, Copper, Aluminium and Iron) and to a lesser extent, cyanide (CN). High concentrations of CN found upstream of the tailings suggests that its source was not confined to the tailings. Concentrations of As and Sb were highest followed by Cu and Pb. Arsenic concentrations were highest in the area of the wetland, immediately downstream of the tailings. Although Hg was found in the soil / sediment, it was not present in detectable levels within the surface waters. DLWC stated that while metal concentrations within the groundwater were above acceptable levels for the protection of aquatic ecosystems, they were considerably less than that present within the tailings, suggesting that under the prevailing conditions the mobility of metals offsite through the groundwater system is limited. DLWC also examined a number of remediation options.

On 2 August 2002, the EPA declared the site to be a remediation site under the Contaminated Land Management Act 1997. The Site was considered to present a significant risk of harm to human health and the environment. Further details regarding the reasons for the declaration were provided in the declaration.

Coffey Geosciences Pty Ltd (Coffey) conducted an assessment of a portion of Lot 1 to validate clean up measures consisting of the stripping of surface soils. No details of the stripping were provided. The area (approximately 2000 m^2) was validated as part of a proposed development

which extended over four separate allotments including Lot 1, and consisted of mixed commercial activities and an aged care village (Coffey 2003).

As a result of the Coffey investigation and report, an area defined in the north-west part of Lot 1, DP874874 (where the existing residences are located) was removed from the Remediation Site Declaration dated 2 August 2002. The declaration remained in force for the remainder of Lot 1, all of Lot 2 and the adjoining crown land.

A flora and fauna assessment of the Site was undertaken by Redpath and Body in 2001 and reported in 2003. This is further discussed in Section 6.4

In 2008 EPA staff conducted X Ray Fluorescence (XRF) sampling of surface soils with a focus on the tailings area.

In November 2011, Entech was engaged by the EPA via Bellingen Shire Council to remove some of the surface waste from the site. The hazardous chemical waste was removed from site, transported to Chemsal's licenced hazardous waste facility and the treated waste disposed of to landfill. Some of the bulk debris was also removed.

In July 2011, the NSW Food Authority conducted soil and sediment sampling and testing for metals in fish (flathead), crabs and oysters caught in Urunga Lagoon. None of the results exceeded the Food Standards Code (FSC), however further analysis was recommended to determine inorganic arsenic levels (as the FSC is based on inorganic not total arsenic) and for lead levels in the oyster samples as greater sensitivity was needed to assess compliance with the FSC limits for lead.

A university of NSW PhD student was reported to have monitored water quality in the Urunga Lagoon below the Urunga sewerage treatment plant in the lagoon. This data was not available at the time of time of writing.

On the 16 November 2011, the EPA released Management Order 20111405 regarding the Site which is the order that led to the remediation currently being proposed. The Management Order calls for:

- The preparation of a remedial action plan;
- Implementation of the remedial action plan; and
- The carrying out of directions consistently with the EPA guidelines.

On 22 May 2012, Management Order 20111405 was amended to reflect the transfer of Lots 1 & 2, DP 874874 from Harry Ross Tickner to the State of New South Wales hence adding Lots 1 and 2 to Management Order 20111405. The Amended Management Order also excludes the north-west part of Lot 1 DP874874 located adjacent to Hillside Drive, Urunga as defined by the map included as part of Notice Number 22004. Additionally, due to the delays in the transfer of land, the deadline dates of the Management Order were also revised.

2.2.2 Recent Investigation Summaries

In 2012, the Soil Conservation Service was engaged by NSW Catchment & Lands - Crown Lands to project manage the rehabilitation of the Site. GHD was then engaged to undertake a series of investigations as summarised below. Sampling locations are presented in Figure 2-3.

Preliminary Investigation Report, July 2012

A Preliminary Investigation Report (PIR) by GHD (July 2012) found more than twenty sources of relevant data including eight previous contaminant investigations and four historic aerial photographs. An assessment of the reliability of the historic data was conducted with four sources of data deemed reliable for use in ongoing assessments. Other historic data was used

to aid in the understanding of the sources and extent of the contamination. The investigation also included:

- Interviews with former site staff.
- An assessment of the historic data that confirmed the main contaminants of concern as antimony, arsenic and mercury.
- Development of a preliminary conceptual site model (CSM) identifying contaminant sources, exposure pathways and receptors.
- Identification of data gaps.
- Development of a sampling analysis and quality plan.

Detailed Investigation Report, December 2012

A Detailed Investigation Report (DIR)(GHD, December 2012) incorporated data from the PIR and a field investigation comprising sampling and analysis of soil, sediment and water from:

- 63 soil boreholes.
- 38 sediment boreholes.
- 9 surface water locations.
- 4 groundwater monitoring wells.
- 3 stockpiles and 2 loading ramps.
- Brick stockpiles.

Findings of the investigation were used to update the CSM that was developed in the PIR (GHD 2012) and included:

- Antimony and arsenic were evident as the key contaminants of concern (COC)s.
- Other COCs included mercury, chromium, nickel, zinc, copper, lead and cyanide.
- In nearly all cases, where one of the COCs was present in significant concentrations, more significant concentrations of either antimony or arsenic were present. As a result, these analytes were deemed to be representative indicator analytes and the governing contaminants.
- Incidental contaminants may also be present on the Site including:
  - Total Petroleum Hydrocarbons
  - Polynuclear Aromatic Hydrocarbons
  - Organochlorine Pesticides
  - Polychlorinated Biphenyls
  - Asbestos.
- Surface water and sediment (and to a lesser extent, groundwater) were noted as the main media for the transportation of COCs on the Site.
- Generally, contaminants exceeding relevant assessment criteria in surface water, groundwater and sediment correlated with those that exceeded assessment criteria in the soils.
- In most cases, the leachable concentrations of COCs in the soil and sediment were significantly less than total concentrations, suggesting the physical migration of contaminated soil or sediment has been the more important contaminant migration pathway.

- Notwithstanding the above, where there were significant concentrations of antimony and arsenic in soil or sediment samples, the corresponding leachable concentrations were well above ANZECC trigger values for protection of aquatic ecosystems.
- For “soil” samples (being those taken from “dry” areas of the site, including the tailings area, during GHD’s investigations) the degree of contamination generally reduces quite quickly so that the site can be divided into significantly impacted and relatively unimpacted areas. The exceptions to this are primarily adjacent to the ‘L’ shaped canal (where contamination is either within 10 times the assessment criteria, or covered by cleaner material), the south western corner of the site, and the area of disturbance at the north east corner of the site.
- For the majority of the COCs, dissolved concentrations were similar to total concentrations in the surface and groundwater samples, indicating the measured concentrations of contaminants are mobile in the water and not just bound to suspended particles.
- Concentrations of the main COCs in the soil recorded in this investigation were within a similar order of magnitude as those recorded in the historical investigations.
- Reduced total concentrations of COCs in the surface water were noted from the 1997 round of sampling to the present. This may be due to many factors and does not necessarily indicate an overall reduction in concentrations.
- The interpreted extent of the contamination was defined, as discussed in Section 2.3.
- Estimated volumes of impacted soil and sediment were included but were updated following the supplementary investigation as discussed below.
- The soils and sediment in the vicinity of the tailing deposit were analysed and are considered to be Acid Sulfate soils. Accordingly, the CEMP is to include details regarding acid sulfate soil management in accordance with the requirements of the *Acid Sulfate Soils Management Advisory Committee (ASSMAC) guidelines* (Ahern et al. 1998).
- The groundwater table onsite ranged from approximately 0.4 to 1.4 mbgs and groundwater is interpreted to discharge into the wetland. The tailings material and underlying peat are expected to be highly permeable and hence the contaminants are likely to have high groundwater connectivity to the wetland. Characteristics of deeper groundwater or groundwater flow into the site are not known.

Supplementary Investigation Summary, February 2013

A supplementary sampling program was completed to address data gaps identified in the DIR and assist in the definition of the area requiring remediation and the development of the Remediation Action Plan.

The investigation incorporated data from the DIR and a field investigation comprising an additional ten soil and 14 sediment sample locations as well as samples from a soil stockpile and two solidified cores of waste concentrate (referred to as ‘mercury plugs’) that were identified following completion of the detailed investigation report.

Results from the supplementary sampling and analysis were used to update the Conceptual Site Model that was developed in the DIR. Changes were made regarding the horizontal extent of the impact on the soil such that it:

- Includes moderate impact downgradient of the ‘mercury plugs’.
- Includes a portion of the vegetated area between the former ore stockpile area and the tailings area.

- Does not extend beyond the boundary fence to the west of the former processing facility.
- Extends approximately 30 m west of the site boundary, south of the former processing area, but is not fully delineated in the south western portion of the site.

Changes to the CSM were made regarding the extent of the impact on the sediment such that it:

- Extends further to the south east of the tailings deposit than interpreted in the DIR.
- Shows impact in the base of the 'L' Shaped canal to be generally less than that outside of the canal.
- Is of a similar area but of a lesser magnitude in the area to the east of the 'L Shaped' canal than interpreted in the DIR.

Results from the stockpile (Stockpile 4) indicated relatively minor exceedances of the adopted health based assessment criteria for antimony and arsenic only.

Results from the two 'mercury plugs' indicated significantly elevated concentrations of antimony (up to 41,900 mg/kg), mercury (up to 5,840 mg/kg) and arsenic (up to 1,660 mg/kg).

Ongoing surface water monitoring

Ongoing surface water monitoring has been carried out on an approximately monthly basis from January 2013 until the present and data compiled by the SCS. Sampling locations include adjacent to the tailings deposit, Station Creek and the sea lido in Urunga.

A comparison of arsenic and antimony concentrations with primary contact-recreation thresholds can be summarised as:

- Exceeding the thresholds adjacent to the tailings deposit in most sampling events, with concentrations showing a degree of correlation with rainfall events
- Exceeding thresholds in Station Creek during three sampling events
- Being below thresholds a the sea lido

A comparison of arsenic and antimony concentrations with aquatic ecosystem thresholds can be summarised as:

- Exceeding the thresholds adjacent to the tailings deposit in all sampling events, with concentrations showing a degree of correlation with rainfall events
- Exceeding thresholds in Station Creek during most sampling events
- Being below thresholds a the sea lido

2.3 Adopted assessment criteria

The adopted soil assessment criteria (Table 2-1) were initially established as part of the PIR, with further review and development of antimony criteria as described in the RAP. As the proposed future use of the Site is as a reserve, the most applicable default exposure setting was considered to be 'NEHF E- Parks, Recreational, Open space' as published in DEC (2006). This exposure setting corresponds with the NEPM HIL (E) from NEPC (1999). These criteria were developed prior to the release of the *National Environment Protection (Assessment of Site Contamination) Measure* 1999 (the NEPM) as amended in May 2013 (NEPC, 2013). Assessment criteria for arsenic and antimony (being the governing contaminants) have been reviewed in the context of the amended NEPM for finalisation of the RAP, as required by EPA guidance for adoption of the amended NEPM, It is noted that the former exposure setting E is now referred to in the amended NEPM as HIL C.

No criteria are given in NEPC 2013 for antimony, therefore the following assessment criteria have been adopted for assessment of antimony concentrations:

- ANZECC/NH&MRC (1992) Environmental Investigation level - 20 mg/kg
- HIL C – 120 mg/kg, which will be considered for validation in areas where there is a particular potential for more frequent exposure by young children
- HIL for 'bushland' open space / recreational area' – 300 m/kg (site specific criterion developed in accordance with NEPC 2013 methodology, and essentially the same as the HIL of 310 mg/kg used in investigations and assessment preceding the RAP), which is considered applicable to the majority of the site.

Further information regarding the derivation of these assessment criteria is provided in the RAP (Appendix E).

Table 2-1 Adopted Soil Assessment Criteria

Analyte	Units	NEPM 1999 HIL E	NEPM 2013 EIL
Antimony(1)	mg/kg	120 – *310**	20
Arsenic	mg/kg	*200* / 300*	*20* / 40*
Cadmium	mg/kg	40	3
Chromium (III+VI)(2)	mg/kg	200	50(2)
Cyanide Total(3)	mg/kg	500	-
Copper	mg/kg	2000	100
Lead	mg/kg	600	600
Manganese	mg/kg	3000	500
Mercury	mg/kg	30	1
Nickel	mg/kg	600	60

* Criteria used in initial assessment shown in italic, subsequently updated for the RAP in accordance with the amended NEPM (NEPC 2013).

The adopted sediment assessment criteria (Table 2-2) for most analytes were derived from the ANZECC /ARMCANZ (2000) *Interim Sediment Quality Guidelines*. No criterion was available from ANZECC /ARMCANZ (2000) for cyanide. The Dutch intervention values (MHSPE 1994) for sediment of 20 mg/kg for free cyanide and 50 mg/kg for complex cyanides, have been adopted in this case.

Table 2-2 Adopted Sediment Assessment Criteria

Analyte	Units	ISQG- Low	ISQG- High
Antimony	mg/kg	2	25
Arsenic	mg/kg	20	70
Cadmium	mg/kg	1.5	10
Chromium	mg/kg	80	370
Copper	mg/kg	65	270
Cyanide	mg/kg	20	50
Lead	mg/kg	50	220
Mercury	mg/kg	0.15	1
Nickel	mg/kg	21	52
Zinc	mg/kg	200	410

The adopted water assessment criteria for water (Table 2-3) were derived from the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000) for Freshwater. As the Site is deemed to be a 'slightly to moderately disturbed system', the 95%

level of protection of species was identified as being applicable in conjunction with the 99% level for selected analytes deemed to have a bioaccumulative effect.

Table 2-3 Adopted Water Assessment Criteria

Analyte	Units	ANZECC 2000 Fresh Water Slightly-moderate disturbed system
Aluminium	mg/L	0.05
Antimony	mg/L	0.009
Arsenic	mg/L	0.013
Cadmium	mg/L	0.0002
Chromium (III)[1]	mg/L	0.00331
Chromium (VI)	mg/L	0.001
Copper	mg/L	0.0014
Cyanide Total	mg/L	0.007
Lead	mg/L	0.0034
Mercury (inorganic)[2]	mg/L	0.00006
Mercury (methyl)	Mg/L	ID2
Nickel	mg/L	0.011

2.4 Extent of soil and sediment contamination

As part of the most recent round of investigations completed by GHD, the interpreted extent of contamination was presented as areas:

- Exceeding the adopted assessment criteria.
- Exceeding ten times the adopted assessment criteria.
- Exceeding thirty times the adopted assessment criteria.

These areas are presented on Figure 2-3 to Figure 2-6. The interpreted extent of the contamination in the soil can be summarised as:

- Approximately correlating with the absence of vegetation.
- Including the tailings deposit, former processing area and portions of the former unprocessed ore stockpiling area.
- Extending into the south west corner of the site and likely across the property boundary near the wetland, however the extent of this impact has not been fully delineated.
- Extending along the embankment in the vicinity of the 'L' shaped canal, at a depth of 1 m to 1.7 m from the current ground surface (likely associated with the original soil surface prior to placement of spoil from excavation of the canal).
- Not extending into the north east portion of the site with the exception of an area of unknown disturbance, to the north of the 'L' Shaped canal.
- Not extending to the southern side of the wetland.
- Varying in depth from approximately 0.5 metres below ground surface (mbgs) in the north west portion of the impact to 2.2 mbgs near the water's edge and at some locations within the tailings deposit.

The extent of the impact in the sediment can be summarised as:

- Showing highest levels of impact adjacent to the tailings deposit, extending approximately 50 m downstream of the tailing deposit, extending across the wetland some 50 m to the south of the tailings deposit (roughly correlating with vegetation dieback), and within and adjacent to the north eastern portion of the 'L' shaped canal.
- Including the western and south eastern portions of the 'S' shaped canals.
- Ranging from depths of about 1 mbgs near the tailings to 0.1 mbgs in the southern portion of the wetland.
- Generally having greatest antimony and arsenic concentrations in the surface sediment (0-0.1 mbgs).
- Generally corresponding with the visual presence of tailings sediment (grey silt).

2.5 Volume of soil and sediment contamination

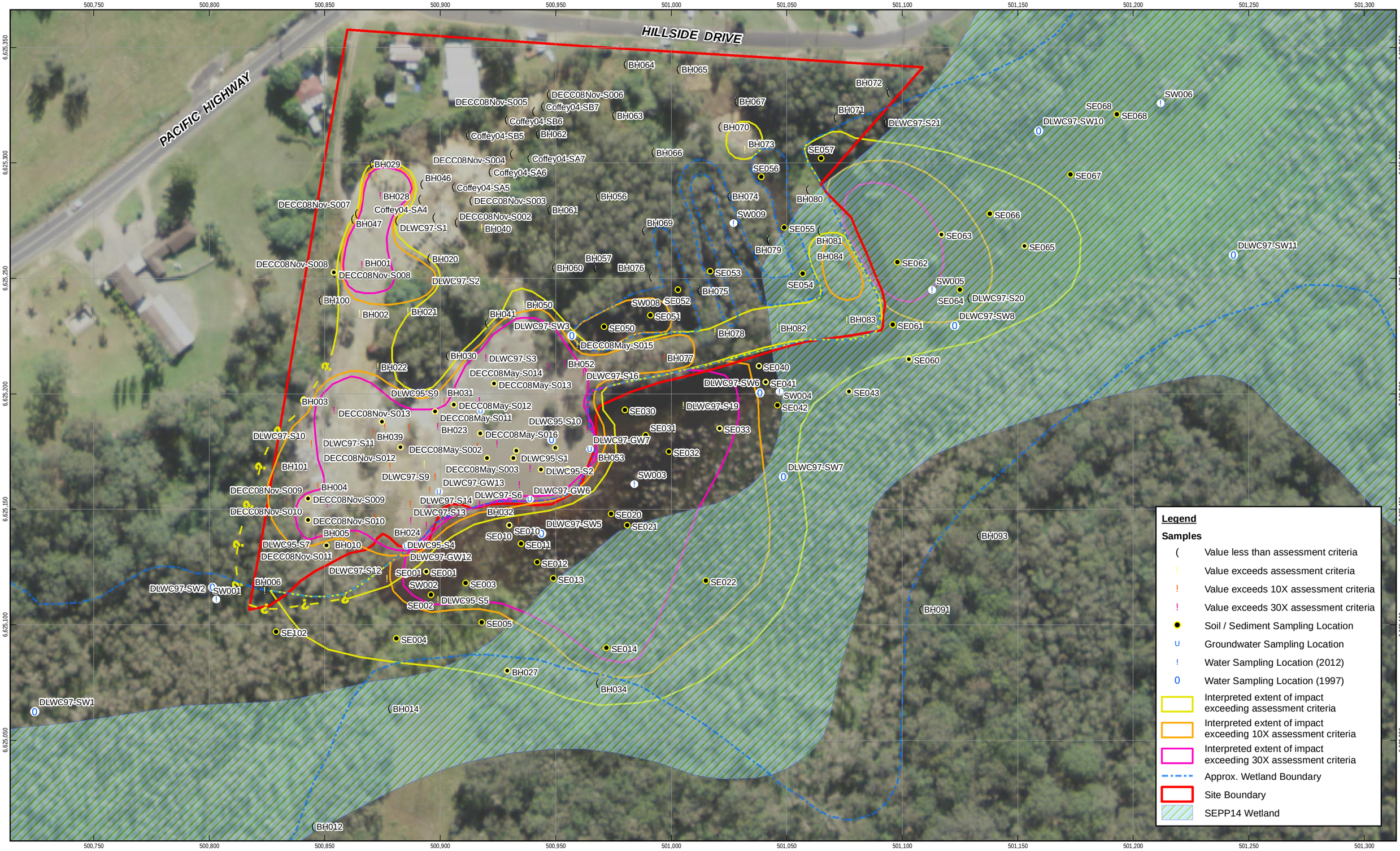
Estimates of the volumes of impacted soil and sediment are as follows:

Soil (adopted assessment criteria 310 mg/kg antimony, 200 mg/kg arsenic)

- 5,800 m^3 exceeding 30 times the adopted assessment criteria.
- 14,000 m^3 (encompassing the volumes above) exceeding 10 times the adopted assessment criteria.
- 28,300 m^3 (encompassing the volumes above) exceeding the adopted assessment criteria.

Sediment (adopted assessment criteria 25 mg/kg antimony, 70 mg/kg arsenic)

- 2,600 m^3 exceeding 30 times the adopted assessment criteria.
- 4,600 m^3 (encompassing the volumes above) exceeding 10 times the adopted assessment criteria.
- 10,200 m^3 (encompassing the volumes above) exceeding the adopted assessment criteria.



1:1,500 Paper Size A3

0 10 20 40 60 80

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

O

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga NSW
Detailed Investigation Report

Job Number	22-16251
Revision	A
Date	06 Dec 2012

All Sampling Locations (historic and current) with Interpreted Extent of Impact

Figure 2-3

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Data source: DPI, Aerials, 2012. Created by:ihamilton

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NORTH

SOUTH

Former Site Access

Former Unprocessed Ore Stockpiling Area

Former Processing Area

Tailings Deposit

BH029

BH047

BH001

BH002

BH022

DLWC97-GW4

BH031

BH053

Water Surface

Silty **GRAVEL** - brown

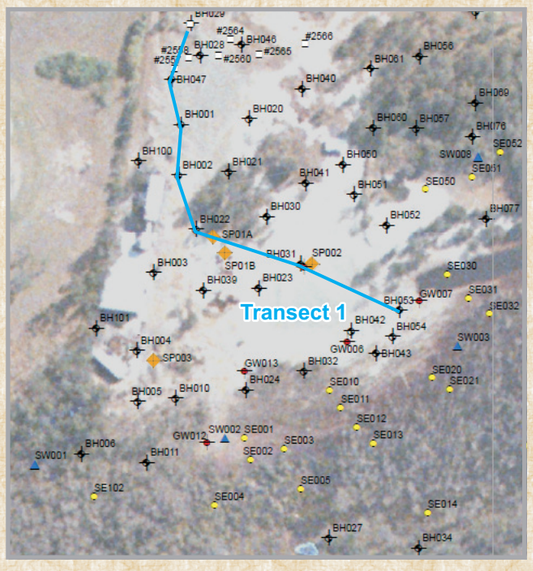
Sandy **SILT** - brown

Clayey **SILT** - dark brown

Tailings - silty **SAND** - grey

Silty **CLAY** - orange/grey

12,250 3416
3360 1520
<415
200.3
2053 264.9
1000 232.8
544
10,030 4413
9164 1386
9670 5280
1160
11,070 11,020
5320 3580
569.3 726.7
1330
825.3 568.4



LITHOLOGY

- Sand
- Silt
- Clay
- Gravel
- Interpreted Lithological Boundary

Surface elevation not to scale

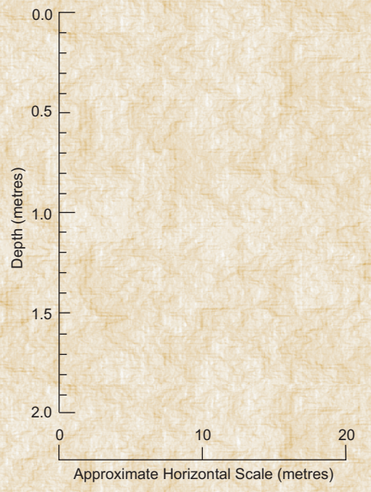
100/200 Antimony/Arsenic Concentrations (mg/kg)

388 **Sb** = Antimony Concentrations (mg/kg)

212 **As** = Arsenic Concentrations (mg/kg)

Source: Lab or XRF

- 30 times Assesment Criteria
- 10 times Assesment Criteria
- Exceeds Assesment Criteria



N

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NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga, NSW
Detailed Investigation Report

Section Transect 1

Job Number	22-16251
Revision	A
Date	5 Oct 2012

Figure 2-4

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WEST **EAST**

Former Processing Area | Tailings Deposit | Embankment adjacent to 'L' Shaped Canal

BH004 BH039 BH023 DLWC97-GW4 BH031 BH052 BH077

Sandy **SILT** - brown

Silty **CLAY** - grey

Clayey **SAND** - grey

Tailings
Silty **SAND** - grey

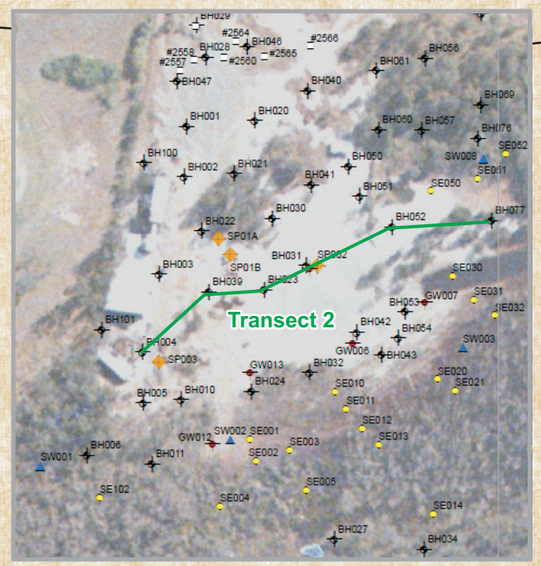
Clayey **SILT** - dark brown

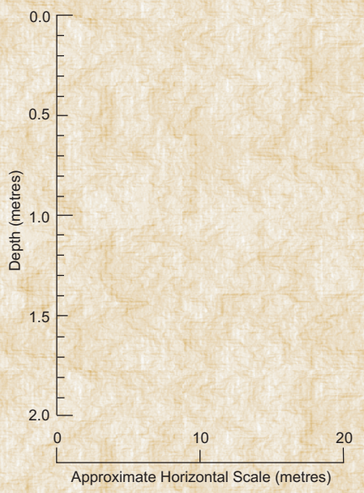
Silty/sandy **CLAY** - orange/grey

Embankment
Sandy **SILT**

SILT

	BH004	BH039	BH023	BH031	BH052	BH077
Sandy SILT - brown	4700 / 1950	2485 / 1262	12,400 / 89,000	10,830 / 4413	13,650 / 3917	388 / 432
		221.2	4260 / 1461	9164 / 1386	13,470 / 7019	212 / 477.1
Silty CLAY - grey	2050 / 1160	444.4		9670 / 5280	<681 / 1141	882 / 2130
Clayey SAND - grey		6494 / 945.2				
		2967		1180	2079 / 2211	
Silty/sandy CLAY - orange/grey					698.6 / 223.5	





LITHOLOGY
- Sand
- Silt
- Clay
- Gravel
- Interpreted Lithological Boundary

Surface elevation not to scale

100/200 Antimony/Arsenic Concentrations (mg/kg)

388 **Sb** = Antimony Concentrations (mg/kg)

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Source: Lab or XRF
- 30 times Assesment Criteria
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- Exceeds Assesment Criteria

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Former Antimony Processing Plant, Urunga, NSW
Detailed Investigation Report

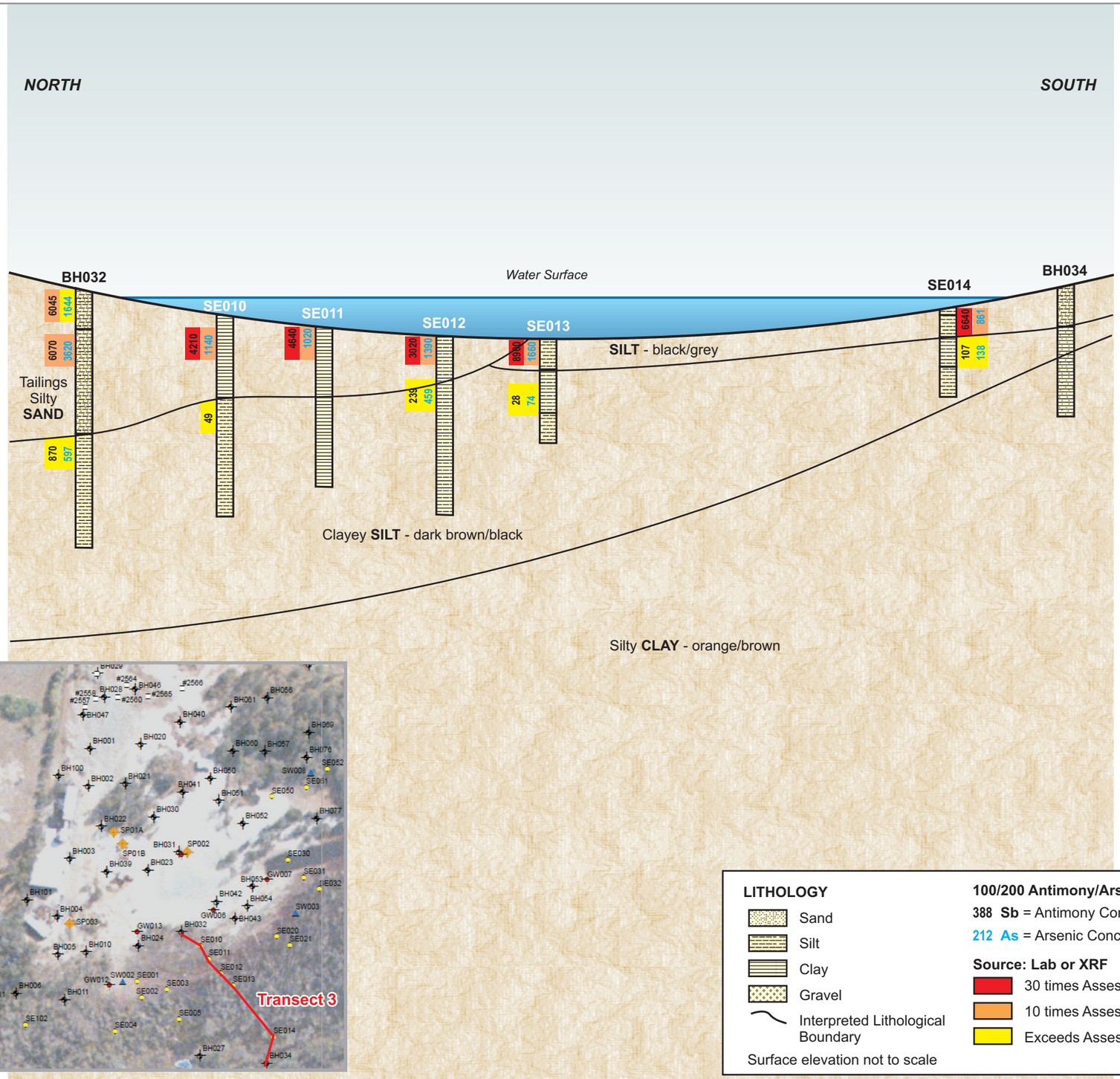
Section Transect 2

Job Number	22-16251
Revision	A
Date	5 Oct 2012

Figure 2-5

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NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga, NSW
Detailed Investigation Report

Section Transect 3

Job Number	22-16251
Revision	A
Date	5 Oct 2012

Figure 2-6

GHD\Launceston\22\2216251_LTN_04.cdr

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2.6 Surface water contamination

As well as being a primary receptor of contamination at the site, surface water is one of the main media for the transportation of COCs from the Site. In summary, contamination of surface water in the vicinity of the site can be summarised as:

- Aluminium, antimony, arsenic and copper concentrations exceeded assessment criteria through the wetland to Station Creek.
- In relation to antimony and arsenic concentrations:
  - Relatively low antimony and arsenic concentrations upstream of the Site.
  - A rapid increase in the concentrations within the proximity of the tailings.
  - Maximum concentrations within 50m downstream of the tailings.
  - A relatively linear decrease in concentrations with increasing distance, downstream of the tailings.
  - Reduced total concentrations from the 1997 round of sampling to the present. This may be due to many factors (e.g. recent rainfall events, sampling methodology) and does not necessarily indicate an overall reduction in concentrations.
- Dissolved antimony concentrations were, on average, about 75% of the total concentrations, indicating the majority of the antimony is present in soluble form.
- Dissolved arsenic concentrations were, on average, 40% of the total concentrations, indicating a greater proportion of the arsenic was bound to suspended particles.

Ongoing surface water monitoring has been carried out on an approximately monthly basis from January 2013 until the present and data compiled by the SCS. Sampling locations include adjacent to the tailings deposit, Station Creek and the sea lido in Urunga.

A comparison of arsenic and antimony concentrations with primary contact-recreation thresholds can be summarised as:

- Exceeding the thresholds adjacent to the tailings deposit in most sampling events, with concentrations showing a degree of correlation with rainfall events
- Exceeding thresholds in Station Creek during three sampling events
- Being below thresholds a the sea lido

A comparison of arsenic and antimony concentrations with aquatic ecosystem thresholds can be summarised as:

- Exceeding the thresholds adjacent to the tailings deposit in all sampling events, with concentrations showing a degree of correlation with rainfall events
- Exceeding thresholds in Station Creek during most sampling events
- Being below thresholds a the sea lido

2.7 Groundwater contamination

Seven groundwater wells are installed onsite. A summary of contamination of the groundwater includes:

- Antimony and arsenic concentrations in the vicinity of the tailings deposit exceed 30 times the assessment criteria and antimony concentrations in groundwater were approximately an order of magnitude higher than surface water concentrations. Arsenic concentrations in groundwater were approximately three orders of magnitude higher than surface water concentrations.

- Antimony and arsenic concentrations in groundwater were generally consistent throughout the tailings area.
- Assessment criteria exceedances were also noted for aluminium, chromium, copper, lead, mercury, nickel and zinc. Copper and zinc concentrations were of similar magnitude to those in surface water, with the concentrations of the other metals generally at least an order of magnitude higher than in surface water.

The potential transportation of contaminants through the migration of groundwater is supported by the elevated concentrations of COCs in the groundwater within the vicinity of the tailings deposit and the expected permeable characteristics of the tailings. Analysis in GHD's investigations was for dissolved metals, so the reported concentrations can be expected to be mobile in the groundwater.

3. Need and options considered

3.1 Strategic need for the proposal

Under the provisions of the CLM Act, Management Order (No. 20111405) applies to Lot 253, DP 46013 (NSW EPA 2011) and a declaration of a remediation site (No. 21020, Area 1089) applies to Lot 1 and Lot 2, DP 874874 and Lot 253, DP46013 (NSW EPA 2002).

A portion of Lot 1, DP 874874 was removed from remediation area 1089 by means of a Notice to End Remediation Declaration (No. 22004) in November 2005 (NSW EPA 2005). This was reflected in a Notice to Amend Management Order (No. 20124407) issued on May 22, 2012 (NSW EPA 2012a). The dates for each milestone of the Management Order were revised in a further Notice to Amend Management Order (No. 20124422) issued on September 9, 2012 (NSW EPA 2012b). A copy of the Management Order and amendments are presented in Appendix A.

The proposed remediation is in compliance with the following requirements of the Management Order:

1) Engage a qualified, experienced and reputable remediation contractor to implement the RAP as approved in writing by the EPA.

2) Engage a qualified, experienced and reputable environmental consultant to prepare a validation report that describes the remedial works that were undertaken and makes recommendations for additional works, maintenance, monitoring and/or contingency plan implementation to ensure that the significant contamination is appropriately managed in the long term.

3) Submit the validation report to the EPA.

3.2 Proposal objectives

The objectives of the Proposal are to:

- Achieve compliance with the Management Order 20111405
- Remediate the contamination at the Site so that any further impact on the adjacent wetland and receiving environment is minimised
- Allow the Site to be opened to public access without unacceptable risk to human health

The intention of Crown Lands is to use the site as Public Open Space. Considering this proposed land use and the location of the site (adjoining a SEPP 14 wetland and upstream of Urunga Lagoon), the Proposal also aims to meet the following requirements:

- Remediation should result in final landforms that facilitate beneficial use of the site as public open space, and satisfy relevant stakeholders to the maximum practical extent.
- Remaining contamination should not present any unacceptable risks to the environment.
- Remediation works should not cause greater environmental or health impacts than would occur if the contamination is left in place.
- Concentrations of contaminants should be below appropriate health-based assessment criteria in surface soils and soils likely to be disturbed during use of the site (taking into account potential redevelopment works).
- Concentrations of contaminants exceeding ecological investigation levels must not be placed in a location or manner that could reasonably be expected to exacerbate existing risks of potential impact to ecological receptors.

- Remediation must be able to be completed within the funding available for the work.

The adopted remediation activity must also:

- Be cost effective to ensure maximum reduction in bio-available contaminants over the long term.
- Consider the latest approaches to stabilisation of the key contaminants of concern.
- Allow for the impact of periodic flooding and tidal influence at the Site.
- Favour solutions that separate contaminated material from water within the hydrological zones.
- Effectively manage acid sulfate soils (ASS).
- Be in compliance with all relevant Commonwealth, State and Local legislation.

3.3 Alternatives and options considered

3.3.1 Identified options

Four broad options for remediating the Site were identified as part of the RAP (Appendix E). These were developed from a conceptual site model which was presented in the Detailed Investigation Report (GHD 2012b). The four remediation options are summarised in the following subsections.

Option 1 – Off-site reprocessing and disposal

- Option 1 would involve the removal of source material, long haul transport (to as far as Ipswich, Queensland), off-site reprocessing and disposal at an appropriate ore processing facility or landfill (Option 1B). The processing facility considered during the assessment was Hillgrove Mine (near Armidale NSW) because it is the closest antimony processing area to the Site hence minimising transport cost. Hillgrove Mine has infrastructure to process similar minerals, although the tailings dam at the facility would likely need to be upgraded to accommodate the additional material.
- An alternative option i.e. Option 1B, is the disposal of the untreated material at an appropriately licenced landfill able to accept the untreated material. The landfills investigated were in south-east Queensland because NSW does not have landfills licenced to accept much of the untreated material.

The main tasks involved with Option 1 and 1B would include:

- Site and access establishment
- Removing existing infrastructure and rubbish
- Installing environmental management controls (eg water, soil, clearing limits)
- Excavation of material
- Haulage of material to reprocessing site or landfill
- Reprocessing or disposal at landfill
- Rehabilitation of excavation area

Option 2 - Off-site disposal

- Option 2 would involve removal of source material, treatment on-site or off-site, long haul transport, and disposal to a licensed facility (Grafton Landfill) within a containment cell or isolated (segregated) portion of the landfill.

The main tasks involved in Option 2 would include:

- Site and access establishment
- Removing existing infrastructure and rubbish
- Installing environmental management controls (eg water, soil, clearing limits)
- Excavation of material
- Treatment of material
- Possible establishment of a containment cell at the landfill
- Haulage to landfill
- Rehabilitation of excavation area

Option 3 - On-site disposal

- Option 3 would involve removal of source material, possible treatment on-site (Option 3A) or onsite containment without treatment (Option 3B), short haul transport for disposal to a containment cell on-site.

The main tasks involved in this option would include:

- Additional investigations to better define constraints/parameters for this option
- Site and access establishment
- Removing existing infrastructure and rubbish
- Installing environmental management controls (eg water, soil, clearing limits)
- Excavation of material
- Treatment of material
- Establishment of an on-site containment cell
- Placement of material in containment cell
- Rehabilitation of excavation area
- Ongoing monitoring of groundwater and surface water quality

Option 4 - In-situ containment

- Option 4 would involve leaving the source material in place, possibly with stabilisation or treatment (Option 4B), and construction of a containment system in-situ to prevent direct exposure or mobilisation and separate contaminated material from surface and ground waters.

The main tasks involved in this option would include:

- Additional investigations to better define constraints/parameters for this option
- Site and access establishment
- Removing existing infrastructure and rubbish
- Installing environmental management controls (eg water, soil, clearing limits)
- Possible treatment of material
- Establishment in-situ containment cell
- Monitoring of groundwater and surface water quality

Option 5 – Do nothing

The option of 'Do Nothing' was not assessed in detail as it was not considered appropriate due to the identified, current impact resulting in a lack of vegetation in the vicinity of the tailings deposit and potential risk associated with further, potential mobilisation of impacted soil, sediment and water. This option, however may apply to "fringe" areas of the site, where the impact of any form of remediation is deemed to outweigh any marginal benefits from completing the remediation.

3.3.2 Methodology for selection of preferred option

The preferred option was based on the following factors:

- Long term feasibility
- Technical feasibility
- Data gaps
- Cost
- Site characteristics
- Availability of appropriate disposal sites (for excavation and off-site disposal)
- Implementation timeframe
- Contractor availability
- Resource availability (e.g. backfill)
- Legislative requirements
- Ongoing monitoring requirements
- Ongoing liabilities
- Health, Safety and Environment (HSE) requirements
- Community acceptance
- Other environmental considerations

Inputs to the decision making process were obtained via:

- Previous investigation reports and site conceptual models
- Community and Government agency consultation
- Consultant advice
- Civil contractor advice and costings

3.3.3 Analysis of options

An analysis of the four options was carried out as part of the RAP (Appendix E). Essentially, all options could be designed to meet the Proposal objectives, with the main differences (apart from cost) being whether most contaminated material is removed from Site (hence liability for long-term management passes to other parties) and the degree of certainty that contamination will be securely contained on site without unacceptable adverse long term impacts.

Within the options of 'on-site containment (Option 3) and in-situ containment (Option 4), a risk assessment was also carried out as part of the RAP (Table 3-1) to assess the level of compliance with the Proposal objectives and environment and health risk.

A summary of the findings of the analysis of the options and the risk assessment is presented in the following subsections.

Option 1A – Off-site reprocessing and disposal

Off-site reprocessing was considered a desirable outcome because it would remove the contamination from the site, and would recover resources (eg. gold and antimony) from the contaminated material that could be sold to offset the costs of processing. While the concentration of valuable metals available for extraction is not sufficient to justify the cost of transport and processing, the cost of this option is reasonable compared to the other options.

However, due to the limited resource recovery potential, no processor has been found that is willing to take the material. The on-going off-site liability relating to the management of the residual contaminated material inherited by the reprocessing plant is also considered undesirable. There were also strong community concerns and public opinion against any reprocessing facilities receiving the material, arising in part from previous discharges to the environment from off-site antimony mining and processing facilities.

Option 2 - Off-site disposal

Off-site disposal provides the advantages of limiting the on-going liability and risk. It would remove the contamination from the site using an established waste management process and facilities, and thus offers a high level of reliability and is also likely to be acceptable to the community. The cost associated with this option is the most significant disadvantage, particularly if landfill levies apply (although these levies may be considered representative of the costs of cell construction and ongoing monitoring that are borne by the landfill facility). The transport and treatment of the material at a hazardous waste landfill at Ipswich, Queensland was also assessed. Again, the transport and disposal costs combined to make this option very expensive.

Depending on available funding, the cost of this option would limit the area that could be remediated.

Option 3A – On-site treatment and disposal

On-site disposal is technically similar to the off-site disposal option, however the contamination would remain on site, and there would be on-going liability and risks which may not be acceptable to the community. The site constraints and technical feasibility, especially in the long term, are also limitations associated with this option. The main advantage of this option, compared to off-site disposal, is the lower cost because it would avoid transport and disposal fees. However, the construction costs (which would be related to the degree of on-going liability and risk) as well as the on-going management and monitoring required for this option would offset some of the cost savings of the remediation works. Further understanding of site conditions (groundwater and geotechnical) would also be required for a robust design of the on-site containment cell.

Option 3B – On-site disposal without treatment

The advantages and disadvantages of this option are similar to Option 3A. It is less expensive than Option 3A but also presents more risks because the contaminants would be more mobile due to a lack of treatment.

Option 4A – In-situ containment without treatment

In-situ containment is considered to be the lowest cost and best value for money option, with the least impact during remediation and requiring the least off-site resources, but would also entail the greatest on-going liability and risk. Additional investigations (in particular groundwater and

geotechnical) would be required to determine the viability of this option and the technical details required for adequate in-situ containment. The additional investigations, combined with the greater on-going management and monitoring required for this option would offset some of the cost savings of the remediation works. This option may also be considered a medium term solution until more funding is available in the future or new technologies provide more cost effective, onsite treatment options.

Option 4B – In-situ containment with treatment

This option would be similar to Option 4A but includes treating the material which reduces contaminant mobilisation and associated risks. However, this option would be more expensive and a similar cost as Options 3A and 3B which have a similar or lower risk.

3.4 Preferred option

Option 3A was selected as the preferred option by the stakeholders including Bellingen Shire Council (BSC), Crown Lands, EPA and the Soil Conservation Service (SCS). This option would remove the material, immobilise the most leachable materials and place it in a containment cell onsite. This option was considered to be the most appropriate form of remediation when considering the above constraints, particularly in relation to:

- Cost
- Long term reliability
- Site characteristics and suitability
- Ongoing liability
- Ongoing management
- Potential environmental impact

Table 3-1 Risk assessment of onsite containment cell options

Scenario	Status Quo	In-situ containment without treatment	In-situ containment with treatment	Engineered Containment Cell with treatment	Engineered Containment Cell without treatment
Direct Exposure to Contamination					
Leachate migration direct from material, via surface water or via groundwater					
Migration of contaminated tailings / sediments through direct erosion or release					
Stabilisation is or becomes ineffective	NA				NA
Failure of leachate collection systems	NA	NA	NA		
Release of leachate through liner.	NA	NA	NA		
Failure of cap – small scale leaks	NA				
Failure of cap – large scale erosion	NA				
Unplanned disturbance to cell	NA				
Flood damage to containment	NA				
Batter instability	NA				
Mass movement – slumping	NA				
Mass movement – sliding	NA				

Scenario	Status Quo	In-situ containment without treatment	In-situ containment with treatment	Engineered Containment Cell with treatment	Engineered Containment Cell without treatment
Liquifaction (eg seismic)	NA				
Mass movement – settlement	NA				
Effects on local hydrology (flooding)	NA				

V – Very high risk, immediate action required involving emergency response.
H – High risk, immediate action required by site management.
M – Medium risk, management action required. Check frequently (eg. monthly).
L – Low risk, manage with standard operating procedure. Check periodically (eg. annually).

3.5 Extent of remediation

An additional phase of the assessment of options was to determine the most appropriate extent of the remediation. This was carried out via a qualitative assessment of the benefits of remediating additional area verses the impacts associated with that remediation, and an assessment of the volume and mass of the contamination removed with an increase in the area remediated as presented in Figure 3-2.

3.5.1 Risk assessment

It was considered that the main function of a site specific risk assessment would be to establish concentrations of the contaminants of concern (COCs) that would result in a particular level of impact/species protection at the periphery of the areas of contamination. Concentrations of COCs in the most significantly impacted areas of the Site are clearly above the relevant assessment criteria and are having an evident impact on the environment (and hence clearly require remediation or management). Even with site specific risk assessment, there would still be some uncertainty as to acceptable concentrations of COCs at the periphery of the impacted area, and other factors such as the cost and net environmental benefit of extending the area of remediation are likely to have greater influence on the decision process than a more precise understanding of the level of risk. The RAP has therefore concentrated primarily on evaluating the most appropriate remediation methodology to manage the most significant areas of impact, with decisions on the subsequent extent of remediation in peripheral areas to be made in consultation with the stakeholders.

3.5.2 Volume and mass of contamination removed

The cost of remediation and the impacts incurred during the remediation works were assessed against the impacts and risks of leaving areas of contamination in place. It was proposed that areas do not warrant remediation where the following conditions apply:

- Contamination is present at concentrations less than relevant health investigation levels (on a statistical basis for the subject area) and/or the potential for exposure is acceptably low.
- Contamination concentrations are nominally less than 10 times the ecological investigation levels, or higher exceedances are relatively isolated in extent and in an area where there would be a high risk of ecological impact by remediation activities.
- The area is physically stable and has a good cover of viable vegetation.
- Extensive disturbance of the area would be required to remove or treat the contamination.

A summary of areas potentially requiring remediation are presented Table 3-2 and Figure 3-1 along with conservative estimates of the volume of material contaminated and the mass of antimony in each area. Figure 3-2 illustrates the cumulative effect and the diminishing returns after the main areas of contamination have been remediated.

3.5.3 Outcome of assessment of extent of remediation

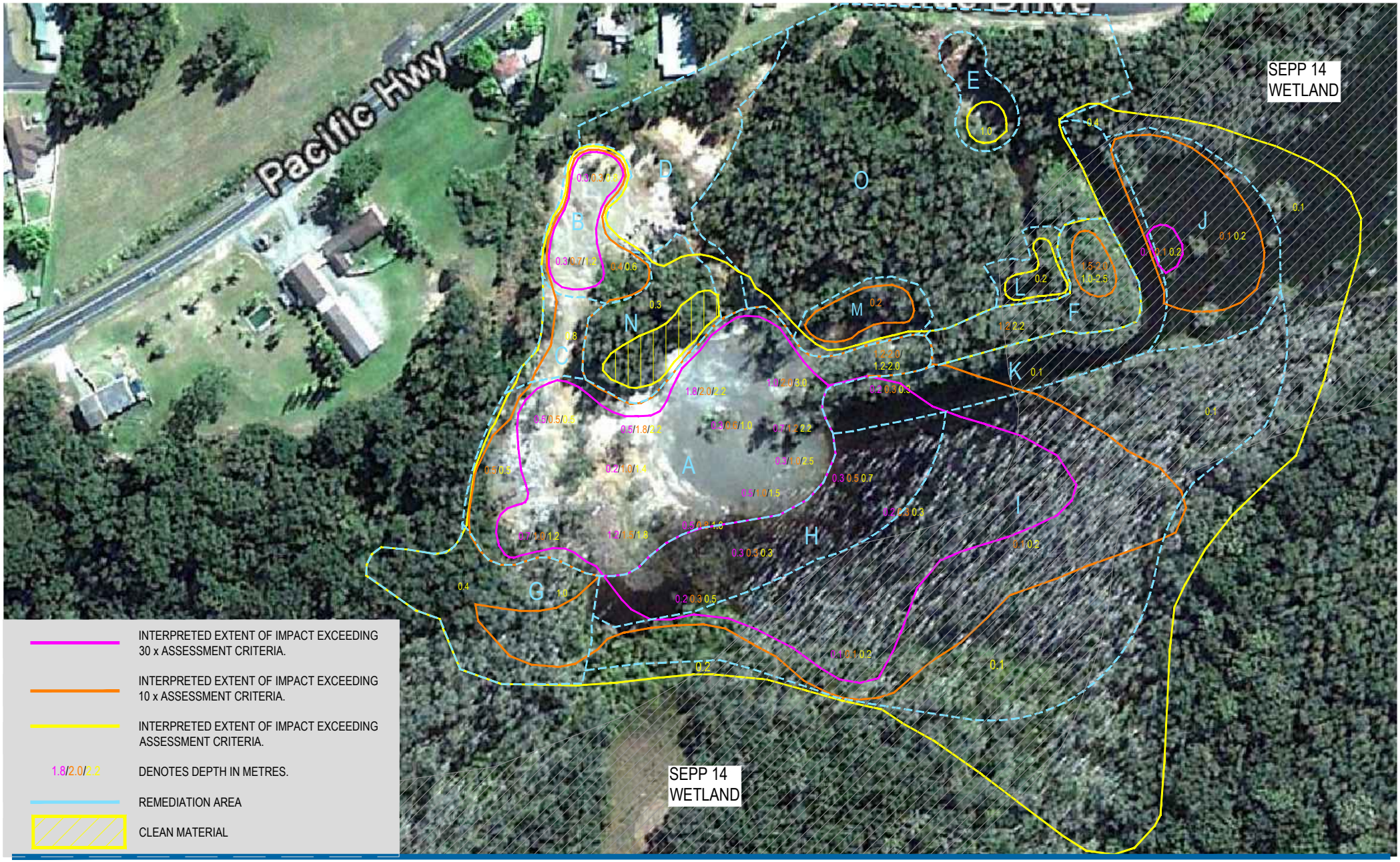
In summary:

- Area A is considered the priority for remediation due to the concentration and mass of contamination plus its proximity to the edge of the wetland. Remediating this area would remove approximately 82% of the overall amount of contamination identified onsite.
- Extending the remediation area to include Areas B, C and H would increase the overall mass of antimony removed from the site to 266 tonnes or 93% of the total amount

identified onsite. These areas could be remediated relatively easily and with minimal impact.

- Area I also has a relatively large volume and mass of contamination but access would be difficult and the impact of remediation in relation to the benefit needs to be considered.
- Contamination exists at Areas F, J, K, M and N but there is limited volume and most areas are covered in vegetation or under water. Area M could be relatively easily remediated but the cost and damage caused by remediating the other areas may be greater than the benefits.
- Area G is not as contaminated as other areas and is heavily vegetated, but may require remediation because it is offsite.
- It is also recommended that Areas D and E be rehabilitated during the remediation because access is readily available and it would improve the aesthetics of the site.
- No remediation is considered necessary at Areas L and O.

The recommendations listed above would result in removal of approximately 97% of the contamination identified onsite. Removal of contamination from the remaining areas is not deemed beneficial as the potential negative environmental impacts on those areas is deemed to exceed the potential positive environmental impacts from contaminant removal.



N

0 20 40 60m

SCALE 1:2000 AT ORIGINAL SIZE

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NSW Catchment & Lands - Crown Lands
Former Antimony Processing Plant - Urunga
Detailed Investigation Report

REMEDIATION AREAS

Job Number 22-16251
Revision A
Date Oct 2012

Figure 3-1

230 Harbour Drive Coffs Harbour NSW 2450 Australia T 61 2 6650 5600 F 61 2 6650 5601 E cfsmail@ghd.com W www.ghd.com

Plot Date: 3 April 2014 - 12:40 PM Plotted by: Ian Gould Cad File No: G:\22\16251\CADD\Drawings\22-16251-FIG 1 & 2.dwg

Table 3-2 Remediation areas

Area	Description	Characteristics	Area (m^2)	Estimated Contaminated Volume (m^3)	Estimated Mass of Antimony (tonnes)	Comment
A*	Main tailings and former processing area	Significant contamination, exceeding 30 x HIL E in most of area. Contains tailings, remnant stockpiles and miscellaneous contamination / waste materials. Little or no vegetation. Groundwater exceeds ANZECC criteria by more than 30 times.	10,300	19,000	240	Requires remediation. Extent is relatively insensitive to selected clean-up levels, as there is a relatively quick cut-off to lower levels at boundaries of area.
B*	Former ore stockpile area	Significant contamination, exceeding 30 x HIL E. Level area with little or no vegetation.	1,730	1,170	13	Requires remediation. Extent may vary somewhat, but not expected to have significant effect on overall volumes or remediation strategy.
C*	Between ore stockpile and process area	Level area with little or no vegetation.	700	580	2	Requires remediation. The extent is relatively shallow and may vary laterally, but not expected to have significant effect on overall volumes or remediation strategy.
D*	Former site access area	Relatively well characterised, no significant contamination. Little vegetation, likely because area has been excavated to bedrock.	3,430	<1	<1	Will require rehabilitation for aesthetic reasons.
E*	North eastern disturbed area	Some contamination less than 10 x HIL E, XRF data indicates significant lead and zinc contamination. No vegetation. Drainage pathway. Likely source of impact to north end of S shaped canals and north end of L shaped canal (elevated zinc).	900	200	<1	Likely to require remediation subject to further characterisation. Will require rehabilitation for aesthetic reasons.
F	Panhandle adjoining L shaped canal	Contamination exceeds 10 x HIL E at some locations, at former ground level generally beneath at least 0.5 m 'clean' soil. Vegetation is healthy. Boundary between Area A and Area F to be determined.	1,950	970	5	Low risk to health or environment due to relatively limited extent (likely previously impacted natural soils) and lack of exposure to contamination. Could be managed by installing a boardwalk through this area, also making use of the physical characteristics for beneficial future use of the site.
G*	South west of processing plant	Contamination exceeds criteria and extends into adjacent property. Extend of contamination extends to	3,400	280	<1	Remediation likely to be required, subject to further delineation to define

Area	Description	Characteristics	Area (m^2)	Estimated Contaminated Volume (m^3)	Estimated Mass of Antimony (tonnes)	Comment
	and tailings area.	at least 0.5 mbgs and additional work required to delineate horizontal extent. Area is extensively vegetated.				extent and degree of contamination, including on adjacent property. Extent of remediation will need to be determined.
H*	Wetland adjoining south of tailings area.	Significant impact exceeding 30 x HIL E and 30 x sediment criteria. Surface water exceeds ANZECC criteria by more than 10 times. Significant impact to vegetation apparent. Boundary between Area H and Area I to be determined. Further delineation of extent and degree and ecology / ecotoxicology studies (eg. field survey) recommended to aid decisions on extent of remediation.	4,000	1,930	11	Remediation considered being required, extent will require consideration of cost, impacts during remediation vs risks associated with leaving contamination in place. Boundary between Area H and Area I to be determined.
I*	Southern side of wetland.	Significant impact exceeding 30 x sediment criteria, but vegetation does not show as significant impact as Area H.	18,800	2,280	10	May not warrant remediation due to considerations of cost and impacts during remediation vs risks associated with leaving contamination in place.
J	Wetland east of L shaped canal.	Significant impact exceeding 30 x sediment criteria. Vegetation does not show significant impact. Further delineation of extent and degree and ecology / ecotoxicology studies recommended to aid decisions on extent of remediation.	3,800	350	1	May not warrant remediation due to considerations of cost and impacts during remediation vs risks associated with leaving contamination in place.
K	L shaped canal	Areas of contamination adjacent to tailings but less than adjacent wetland sediments. Significant depth likely to limit potential exposure.	3,300	520	2	Likely no remediation, subject to further sampling and possibly ecotox survey.
L	SE corner of S shaped canal	Elevated As, Sb and Zn with respect to sediment criteria and EILs, but not significantly above HIL E. No apparent impact, well vegetated, low potential for migration offsite.	660	60	<1	No remediation proposed.
M*	Western end of S shaped canals.	Adjoins tailings area, apparent impact from migration of sediments from tailings area. Sb and As greater than 10 times HIL E and sediment criteria, little vegetation, potential for exposure.	1,125	120	<1	Remediate in conjunction with Area A.
N	Vegetated area between ore stockpile area and tailings area.	The extent of impact was noted to extend into the north western portion of the vegetated area. Contamination extended to approximately 0.2 mbgs.	2,140	635	1	Remediate the northern western portion in conjunction with Area B and C.

Area	Description	Characteristics	Area (m^2)	Estimated Contaminated Volume (m^3)	Estimated Mass of Antimony (tonnes)	Comment
O	North eastern portion of site.	Mainly densely vegetated, no significant signs of impact, relatively well characterised, contaminant concentrations less than 10 x HIL E and in most cases less than EILs.	15,550	0	0	No remediation proposed.

*Indicates areas to be remediated

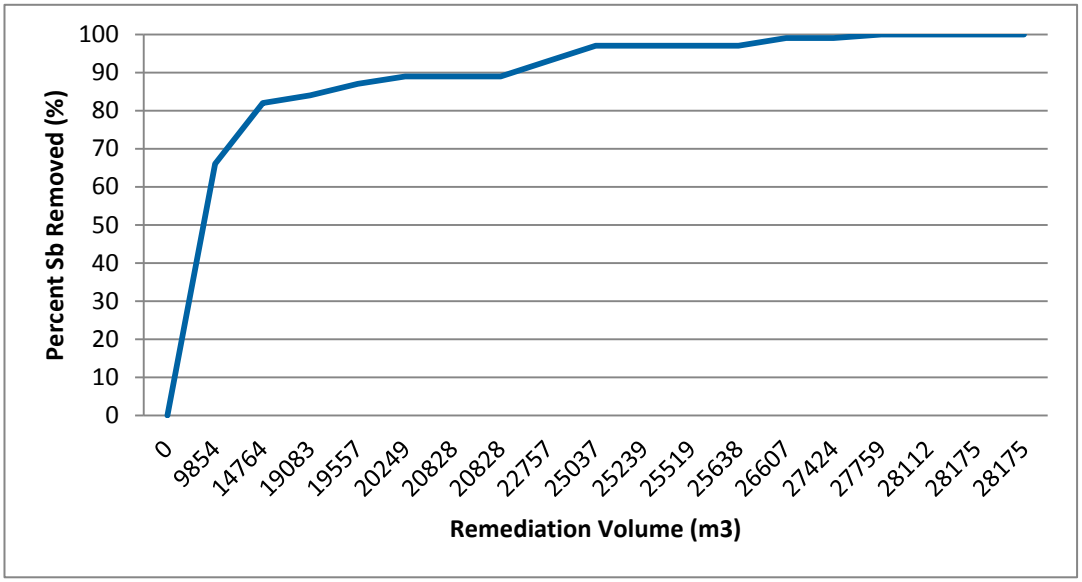


Figure 3-2 Proportion of antimony removed compared to the volume of material removed

4. Proposal description

4.1 Proposal overview

As discussed in Section 3.4, remediation option 3A – Onsite Disposal with Treatment was selected as the option that best met the remediation objectives. A detailed methodology for the Proposal is presented in the RAP (Appendix E). Treatment requirements would vary depending on the degree of contamination, leachability and physical characteristics (eg. soil type) of the excavated material. As discussed in Section 3.5, the proposed extent of remediation would involve excavation of areas A, B, C, D, E, G (part), H, I (part) and M, as shown on Figure 4-1. The extent of excavation within Areas I and G would be limited to where healthy vegetation commences. An overview of remediation methodology is summarised in the following subsections.

The Proposal will generally involve:

- Removal of old processing facility remnants and surface debris
- Removing power poles
- Clearing of vegetation for the purpose of extracting underlying contaminated material
- Landform earthworks to divert uncontaminated clean water away from the site and control the flow of surface water across the contaminated site
- Construction of the containment cell
- Importing clean material for engineering purposes including construction of containment cell, surface capping, void filling, land reshaping or habitat purposes
- Excavating contaminated material within the wetland for the purpose of bulk removal
- Stabilisation / treatment of excavated contaminated materials
- Placement of the contaminated material into the containment cell
- Dewatering of surface or groundwater which enters the excavation works
- Capping and completion of the containment cell
- Revegetation

In addition to the proposal, and under a separate Early Works Package, the site will be prepared as much as practical ahead of the remediation works. This includes:

- Removal of existing dwelling & office
- Clearing of garden plants
- Remove and reuse brick stockpile
- Remove electricity power lines/conductors
- Importing clean material for future use in the remediation

These works are the subject of a development application (2014/DA-00115) recently approved by Bellingen Shire Council and affect the uncontaminated parcel of land only.

4.2 Site Establishment

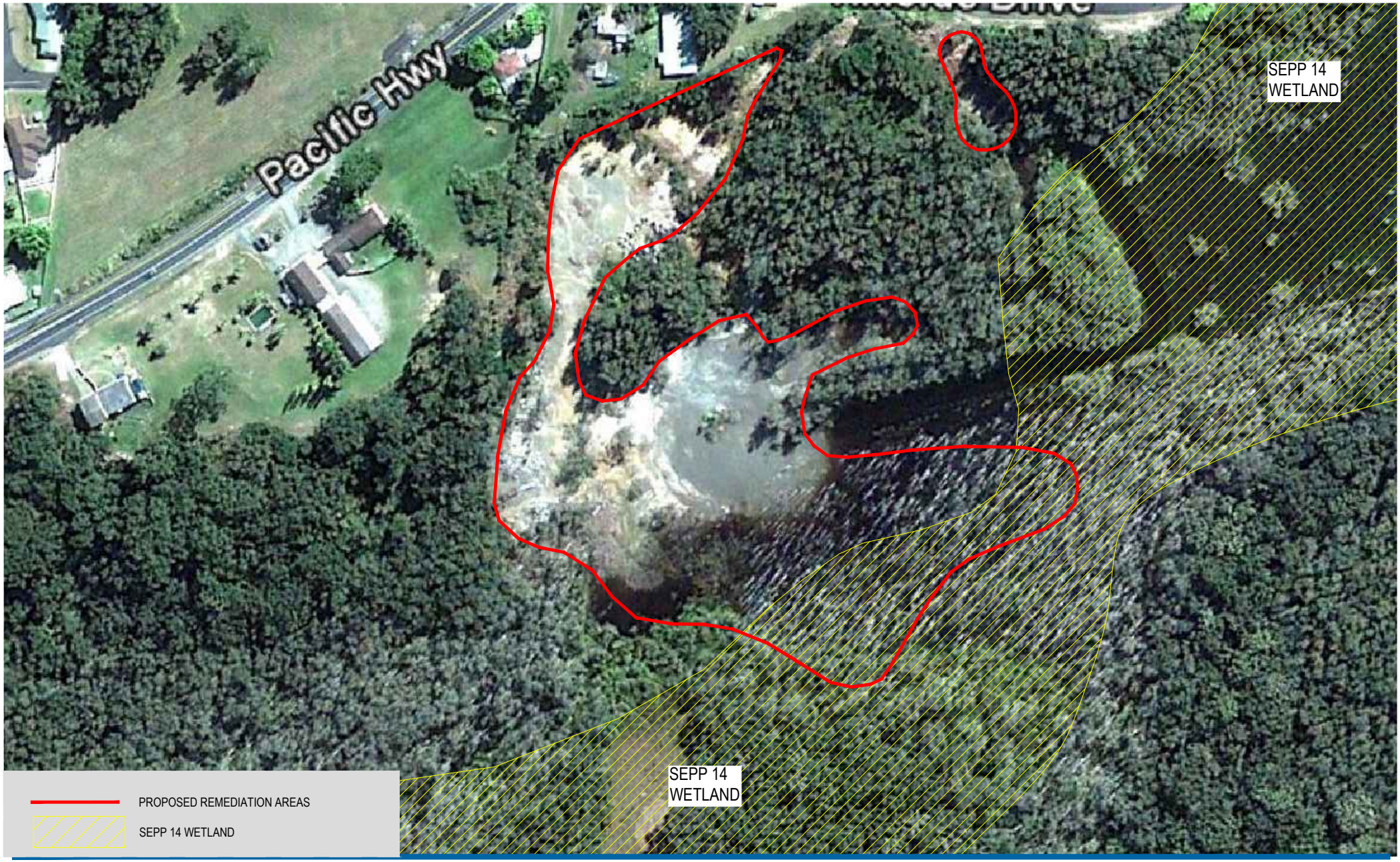
The remediation works would be subject to key management plans including:

- Workplace Health & Safety (WHS) Management Plan
- Quality Management Plan

- Construction Environmental Management Plan (CEMP) which incorporates details regarding:
  - Soil and water management
  - Acid sulfate management
  - Waste management
  - Noise management
  - Air quality management
  - Flora and fauna management, including a Vegetation Management Plan
  - Traffic Management Plan

Site establishment would also require:

- Establishing access to, from and within the site
- Setup of a site compound
- Full perimeter of security fencing (to water's edge)
- Appropriate warning signs related to construction and hazardous waste
- Disposal of residual building waste including old processing mill structures and stockpiles
- Clearing of vegetation



N

0 20 40 60m

SCALE 1:2000 AT ORIGINAL SIZE

NSW Catchment & Lands - Crown Lands
Former Antimony Processing Plant - Urunga
Detailed Investigation Report

PROPOSED REMEDIATION AREAS

Job Number 22-16251
Revision A
Date Apr 2014

Figure 4-1

230 Harbour Drive Coffs Harbour NSW 2450 Australia **T** 61 2 6650 5600 **F** 61 2 6650 5601 **E** cfsmail@ghd.com **W** www.ghd.com

Plot Date: 9 April 2014 - 3:37 PM Plotted by: Ian Gould Cad File No: G:\22\16251\CADD\Drawings\22-16251-FIG 1 & 2.dwg



DENOTES ROADS

1 IN 100 YEAR FLOOD

PMF (PROBABLE MAXIMUM FLOOD)

N

0 20 40 60m

SCALE 1:2000 AT ORIGINAL SIZE

GHD

NSW Catchment & Lands - Crown Lands
Former Antimony Processing Plant - Urunga
Detailed Investigation Report

Proposed Treatment and Containment Cell Location

Job Number 22-16251
Revision A
Date MAR 2014

Figure 4-2

230 Harbour Drive Coffs Harbour NSW 2450 Australia **T** 61 2 6650 5600 **F** 61 2 6650 5601 **E** cfsmail@ghd.com **W** www.ghd.com

Plot Date: 8 July 2014 - 2:42 PM Plotted by: Ian Gould Cad File No: G:\22\16251\CADD\Drawings\22-16251-FIG 1 & 2.dwg

4.3 Water management

Stormwater and groundwater management will be required including:

- Implement erosion and sediment controls in accordance with *Urban Stormwater Manual Volume 1 and 2 (Blue Book)* and IECA Guidelines.
- Install perimeter controls of contaminated area in the wetland.
- Separation and diversion of uncontaminated stormwater away or through the site.
- Management of stormwater and dewatering from the remediation areas which will include a sediment basin to allow treatment before discharge (if required).
- Setup washdown bay that drains to sediment basin.
- Remediation design to allow for flooding and expected climate change water level increases.
- Minimising inflow groundwater into sections of excavations, using temporary barriers, if required.
- Locating any on-site containment areas away from groundwater influences.

4.4 Vegetation clearing

Approximately 2.9 hectares of vegetation will be cleared but over half is regrowth and dominated by weeds. The vegetation clearing is to allow for the creation of work areas and containment cell. Retained, fallen timber and the weed-seed-free vegetation waste will be used on-site for habitat or mulched for revegetation and landscaping work.

4.5 Excavation

The excavation works will include the following steps:

- Marking of identified areas of contamination to be excavated and review of excavation procedures by the contractor and supervisor, including required management measures to protect health and safety and the environment.
- Supervision by appropriately qualified personnel to guide excavations on the basis of visual observations, previous analytical results and field results.
- Excavation and construction of the containment cell.
- Excavation of the contaminated soil.
- Addition and mixing of lime or other treatment additives, as required.
- Transportation of material to the containment cell.
- Verification that the extent of remediation is consistent with the remediation objectives.
- Backfilling and compaction with validated fill (where required).
- Re-contouring of the backfilled excavation to be consistent with the required landform.
- Cleaning and decontaminated of plant and equipment.

Based on the known hydrogeological characteristics of the site it is expected that groundwater seepage will be encountered for all works in the wetland foreshores (including the main tailings dump), and localised dewatering may be required.

4.6 Excavation validation

As outlined in Section 7 of the RAP (Appendix E), the proponent will submit a validation report to the EPA following the remediation works to quantify any residual contamination (if any) remaining. “Validation” of the remediation works will be based more on verification that the extent of remediation is consistent with the principles for nominating the remediation areas, rather than a traditional process of sampling and analysis to verify compliance with the adopted assessment criteria.

4.7 Soil treatment

Hazmat Services Pty Ltd (Hazmat) and Bairad (Prescience) Pty Ltd have completed treatment trials on nine samples from different areas of the Site to determine the most effective methods of contaminant immobilisation.

Composite samples were tested using single extraction and multi-extraction leaching procedures and compared to the requirements of the NSW EPA Waste Guidelines. The treatment trials indicated that the material could be immobilised and achieve pH stabilisation appropriate for long term landfill disposal. A Specific Immobilisation Approval was sought and provided by NSW EPA based on the following treatment regime:

a. For higher contaminant level spoil and dredgings (0.5% – 1.5+% As+ Sb total):

4% MgO + 4% MgCO3 + 2% FeSO4.7H2O

b. For lower contaminant level spoil and dredgings (0.05% – 0.5+% As+ Sb total):

2% MgO + 2% MgCO3 + 1% FeSO4.7H2O

c. Unprocessed natural rock and screenings >50mm will require no treatment for landfill disposal unless pH adjustment is required. Adjustment of pH would require use of Calcium carbonate alone.

Treatment will require temporary stockpiling of the excavated material in the treatment area to allow for dewatering and separation into one of the three categories above. The drained stockpiled material will then be fed into a mixing plant for mixing of the contaminated material with the treatment chemicals at the required dose. Material will be tested in accordance with the Quality Assurance & Control (QA/QC) and material passing will be placed in the containment cell. Material rejected will be returned to the treatment process for restabilisation.

4.8 Containment cell construction

The design intent of the proposed cell is to provide secure long-term containment of contaminated material, reducing the environmental impact to an acceptable level whilst minimising ongoing management requirements by the land holder (eg. avoid long-term leachate management requirements).

The containment cell will be constructed on site in the location shown in Appendix F. The configuration of the containment cell would be confirmed during detailed design but it is expected to consist of:

- Excavation and installation of surface water diversion drains.
- Construction of a low permeability base and side slope layer, inclusive of leachate conveyance and collection.
- Filling with treated contaminated material.
- Construction of a low permeability cap, possibly including a synthetic liner.

- Reshaping and revegetating the surface to be consistent with the surrounding area.

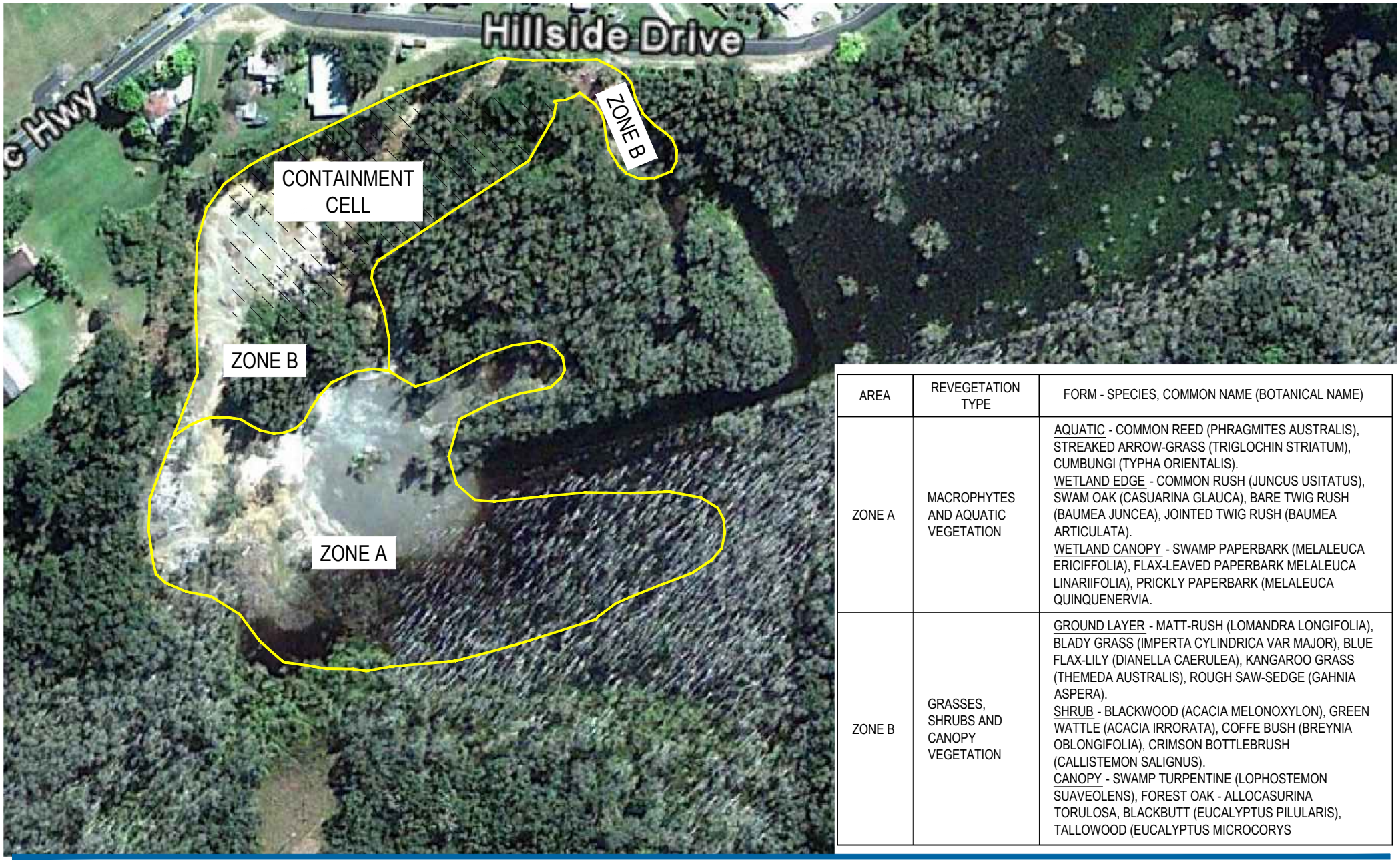
4.9 Backfill and land forming

On completion of the excavation and subsequent verification, the excavation will be backfilled (where required) with validated material. The wetland will be retained in a shape that reflects the original ground surface, prior to the placement of the tailings. Excavated areas outside of the wetland will be land formed to reflect the original land surface. The containment cell will be shaped to blend into the surrounding landforms.

Where fill materials are to be imported, they will be tested to verify classification as Virgin Excavated Natural Material (VENM) or Excavated Natural Material (ENM). Earth materials will require placement in accordance with engineering specifications, landscaping plans and erosion and sediment control.

4.10 Revegetation

Following land forming, all disturbed areas apart from the access road and a cleared buffer adjacent to Hillside drive will be revegetated with native species that are consistent with the adjacent vegetation communities. A concept vegetation management plan is shown in Figure 4-3, with the intended result illustrated in Figure 4-4. The containment cell is to be designed to be able to support the growth of trees. This is achieved without compromising the containment cell through the use of a root barrier. The density and numbers of trees will be selected to reflect the surrounding, undisturbed landscape.



AREA	REVEGETATION TYPE	FORM - SPECIES, COMMON NAME (BOTANICAL NAME)
ZONE A	MACROPHYTES AND AQUATIC VEGETATION	AQUATIC - COMMON REED (PHRAGMITES AUSTRALIS), STREAKED ARROW-GRASS (TRIGLOCHIN STRIATUM), CUMBUNGI (TYPHA ORIENTALIS). WETLAND EDGE - COMMON RUSH (JUNCUS USITATUS), SWAM OAK (CASUARINA GLAUCA), BARE TWIG RUSH (BAUMEA JUNCEA), JOINTED TWIG RUSH (BAUMEA ARTICULATA). WETLAND CANOPY - SWAMP PAPERBARK (MELALEUCA ERICIFFOLIA), FLAX-LEAVED PAPERBARK MELALEUCA LINARIIFOLIA), PRICKLY PAPERBARK (MELALEUCA QUINQUENERVIA.
ZONE B	GRASSES, SHRUBS AND CANOPY VEGETATION	GROUND LAYER - MATT-RUSH (LOMANDRA LONGIFOLIA), BLADY GRASS (IMPERTA CYLINDRICA VAR MAJOR), BLUE FLAX-LILY (DIANELLA CAERULEA), KANGAROO GRASS (THEMEDA AUSTRALIS), ROUGH SAW-SEDGE (GAHNIA ASPERA). SHRUB - BLACKWOOD (ACACIA MELONOXYLON), GREEN WATTLE (ACACIA IRRORATA), COFFE BUSH (BREYNIA OBLONGIFOLIA), CRIMSON BOTTLEBRUSH (CALLISTEMON SALIGNUS). CANOPY - SWAMP TURPENTINE (LOPHOSTEMON SUAVEOLENS), FOREST OAK - ALLOCASURINA TORULOSA, BLACKBUTT (EUCALYPTUS PILULARIS), TALLOWOOD (EUCALYPTUS MICROCORYS

N

0 20 40 60m

SCALE 1:2000 AT ORIGINAL SIZE

NSW Catchment & Lands - Crown Lands
Former Antimony Processing Plant - Urunga
Environmental Impact Statement

Concept Vegetation Plan

Job Number 22-16251
Revision A
Date JUNE 2014

Figure 4-3

230 Harbour Drive Coffs Harbour NSW 2450 Australia **T** 61 2 6650 5600 **F** 61 2 6650 5601 **E** cfsmail@ghd.com **W** www.ghd.com

Plot Date: 25 June 2014 - 8:21 AM Plotted by: Ian Gould Cad File No: G:\22\16251\CADD\Drawings\22-16251-FIGURE 01.dwg



SOURCE: SOIL CONSERVATION SERVICE

N

NSW Catchment & Lands - Crown Lands
Former Antimony Processing Plant - Urunga
Environmental Impact Statement

Aerial View of Final Site Condition

Job Number 22-16251
Revision A
Date JUNE 2014

Figure 4-4

230 Harbour Drive Coffs Harbour NSW 2450 Australia **T** 61 2 6650 5600 **F** 61 2 6650 5601 **E** cfsmail@ghd.com **W** www.ghd.com

Plot Date: 30 June 2014 - 4:44 PM Plotted by: Ian Gould Cad File No: G:\22\16251\CADD\Drawings\22-16251-FIGURE 4-4.dwg

4.13 Disposal of soils and refuse

Where soil and refuse wastes are to be removed from site, they will be classified for waste disposal purposes, and disposed in accordance with the requirements of *the Protection of the Environment Operations Amendment (Scheduled Activities and Waste) Regulation 2008* made under the *Protection of the Environment Operations Act 1997* (POEO Act) and the waste classification guidelines (NSW DECCW 2009).

An experienced environmental professional will be engaged to oversee the classification of the waste and the Project Manager shall ensure its transport and disposal at an appropriately licensed landfill.

Building and demolition waste generated from the project (e.g. bricks, concrete, metal, and timber) is expected to be classified as General Solid Waste (non-putrescible). These materials will be recycled or re-used where possible. This waste will be stockpiled separately from other waste and further advice sought prior to off-site disposal to landfill if required.

4.14 Environmental monitoring and ongoing management

The preferred option will result in contaminated material remaining onsite in the containment cell, as well as some lower levels of contamination remaining in situ. This will present some environmental risks that will need to be assessed, monitored and managed. The requirements of the ongoing monitoring and management of the site will be documented in a Long Term Management Plan. The Long Term Management Plan will include:

- Site Description
- Site History
- Description of Remediation and Containment
- Risk Assessment
- Management including:
  - Leachate management
  - Erosion control
  - Revegetation
- Monitoring including:
  - Groundwater
  - Surface Water
  - Vegetation and Habitat Surveys
- Contingency Plan

4.15 Construction hours and duration

The remediation is anticipated to take approximately 4-6 months to complete. As discussed in Section 7, the ideal time to commence the civil works is in the spring and early summer due to low water levels in the wetland and reduced chance of flooding. The works may commence in 2014 or 2015.

Hours of construction are proposed as:

- Monday to Friday: 7 am to 6 pm
- Saturday: 8 am to 1 pm

No work is proposed on Sundays or public holidays.

4.16 Workforce

It is estimated that the workforce may be in the range of 10 to 20 people at any one time.

4.17 Plant and equipment

The following plant and equipment may be used but is not limited to:

- Trucks (up to 30 per day)
- 2 x light vehicles for use on-site
- 10 x light vehicles for staff transportation to site
- 3 x excavators
- 1 x bulldozer
- 1 x drott
- 3 x dump trucks
- 1 x skid steer loader
- 1 x compactor
- 1 x watercart
- 1 x concrete crusher
- 1 x front end loader
- multiple pumps
- 1 x fixed diesel generator
- 1 x mobile diesel generator
- 1 x diesel refuelling station
- 1 x crib shed
- 1 x amenity shed
- 1 x shipping container (storage)

4.18 Materials required for construction

The final design of the containment cell is yet to be confirmed however the following information is available regarding an estimate of quantities required for the construction:

- Clean material excavated during the construction of the containment cell will be reused onsite as backfill, construction of the containment cell or landscaping.
- Clay material will be required for construction of the low permeability base and cap of the containment cell. Based on the concept design it is estimated that up to 12,000 m^3 may be required. This material will be sourced from onsite or an approved, offsite source of ENM or VENM.
- Depending on how much material is required and how much can be sourced from onsite, up to 5,000 m^3 of material may be required to backfill the excavation. This material will be sourced from onsite or an approved, offsite source of ENM or VENM.
- Quantities of other materials required include geotextiles, rock, jute mesh and plants. These will be sourced from local suppliers.

- Petrol, diesel and lubricating oils in quantities required for the operation of machinery would be sourced from local suppliers.

4.19 Stockpile areas

Stockpiling will be prioritised in areas away from drainage lines, existing vegetation and outside the remediation footprint. , as shown in Figure 4-2.

4.20 Traffic management and access

Machinery would access the Site via the Pacific Highway and Hillside Drive. Two access roads would be constructed/re-instated as part of the Proposal. These access locations have previously been used for Site access but will require development in terms of vegetation clearing, widening and stabilisation of the surface in order to support the proposed machinery. The proposed locations are provided on Figure 4-2.

The Proposal would result in an increase in truck movements on the Pacific Highway and Hillside Drive. An average of ten vehicles per day and maximum of twenty vehicles per day would access the Site for the majority of the project. The maximum rate of offsite trucks accessing the Site would be thrity per day during three material import periods which include:

- Construction of containment cell base
- Construction of containment cell cap
- Backfilling of the excavation

A Traffic Management Plan would be developed as appendices to the Construction Environment Management Plan. The Traffic Management Plan is to detail traffic management and access safeguard measures to ensure safe passage of motorists.

Further details relating to traffic and access are included in Section 7.13.

4.21 Ancillary facilities

Site facilities will be provided in accordance with the requirements of '*Amenities for Construction Work Code of Practice 1997- WorkCover NSW'*. The proposed compound area has not yet been finalised however it is anticipated that it will be located adjacent to the buildings between the Site and Hillside Drive. The compound may include a portable toilet, secure and bunded storage areas for site materials including fuel and chemicals, and possibly a lunch room and office for on-site personnel.

If significant infrastructure is stored onsite, the areas may be securely fenced with temporary fencing. Signage would be erected advising the general public of access restrictions. The ancillary facilities would be kept onsite from approximately one week before the mobilisation of machinery until the completion of civil works. Upon completion of the Proposal, the temporary site compound, work area and stockpiles would be removed, the site cleared of all rubbish and materials and rehabilitated.

4.22 Public utility adjustment

Prior to the commencement of the works, the contractor shall confirm on site, the location and dimensions of all existing service structures. The contractor shall protect service authority assets in accordance with the authority's requirements. Should relocation of services be required, the contractor shall determine a recommended option for relocation in consultation with the authority concerned.

4.23 Property acquisition

Cadastral boundaries and landowners are shown in Figure 2-2. The land is currently owned by the Crown. No property acquisition is proposed.

5. Statutory planning

5.1 Environmental Planning and Assessment Act

The provisions of the EP&A Act govern development within the State of NSW. The approval pathway for assessment and determination of development is dependent on which part of the Act applies.

The Proposal falls under Part 4 of the EP&A Act, through the application of Clause 9 of *State Environmental Planning Policy No 55 (Remediation of Land)* and therefore development consent is required. The development is also considered State Significant Development according to Clause 8 of *State Environmental Planning Policy (State and Regional Development).* Accordingly, the Minister is the consent authority.

This EIS has been prepared to provide the Minister and other determining authorities with information on matters affecting or likely to affect the environment and to comply with the requirements of the EP&A Act. Appendix G of this EIS considers the factors listed under Clause 228 of the EP&A Regulation.

The DGRs state that '*the EIS must meet the form and content requirements of clauses 6 and 7 of Schedule 2 of the EP&A Regulation 2000'* as well as additional requirements outlined in the DGRs.

The EP&A Act is supplemented by a number of environmental planning instruments (EPIs), namely State Environmental Planning Policies (SEPPs) and Local Environmental Plans (LEPs). The EPIs relevant to the Proposal are discussed below.

5.2 State Environmental Planning Policies (SEPP)

5.2.1 State Environmental Planning Policy No 14—Coastal Wetlands

The aim of SEPP 14 is to ensure that the coastal wetlands are preserved and protected in the environmental and economic interests of the State.

Clause 7(1) requires consent for the following activities on land mapped as SEPP 14:

a) Clearing

b) constructing a levee

c) draining

d) filling

Comment: The Proposal is located adjacent to, and would include some works within a SEPP 14 wetland (no. 354), as shown in Figure 2-2. The SEPP 14 wetland boundary shown is approximate only and does not represent the true boundary. As the Proposal includes clearing, drainage, excavation and potentially filling within the SEPP 14 wetland, consent is required from the consent authority. As the proposal is considered State significant development the Minister would be the consent authority. This EIS provides all necessary information in order for the Minister to approve the Proposal.

5.2.2 State Environmental Planning Policy (State and Regional Development) 2011

The aims of this Policy are as follows:

(a) to identify development that is State significant development,

(b) to identify development that is State significant infrastructure and critical State significant infrastructure, and

(c) to confer functions on joint regional planning panels to determine development applications.

Schedule 1 (Clause 24) of the Policy describes the types of remediation that are considered state significant.

Clause 24 'Remediation of contaminated land' states:

(1) Development for the purpose of remediation of land that is category 1 remediation work on significantly contaminated land if the work is required to be carried out under the Contaminated Land Management Act 1997 by a management order that requires:

(a) the taking of action of the kind referred to in section 16 (d) or (g) of that Act, or

(b) the preparation of a plan of management that provides for the taking of any such action.

Comment: The proposed remediation is subject to this Policy by virtue of Management Order 20111405, which requires the remediation of the site. The Minister is, therefore, the determining authority.

5.2.3 State Environmental Planning Policy No 55 – Remediation of Land

The aims and objectives of *State Environmental Planning Policy No. 55 – Remediation of Land* (SEPP 55) are to provide a state-wide planning approach to potentially contaminated land. It also promotes the remediation of contaminated land to reduce the risk of harm.

SEPP 55 aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment.

Clause 8 of SEPP 55 outlines the types of remediation that requires consent and those that do not. Category 1 remediation works require consent. Pursuant to Clause 9, a category 1 remediation work is a remediation work (not being a work to which clause 14 (b) applies) that is:

(a) designated development, or

(b) carried out or to be carried out on land declared to be a critical habitat, or

(c) likely to have a significant effect on a critical habitat or a threatened species, population or ecological community, or

(d) development for which another State environmental planning policy or a regional environmental plan requires development consent, or

(e) carried out or to be carried out in an area or zone to which any classifications to the following effect apply under an environmental planning instrument:

(i) coastal protection,

(ii) conservation or heritage conservation,

(iii) habitat area, habitat protection area, habitat or wildlife corridor,

(iv) environment protection,

(v) escarpment, escarpment protection or escarpment preservation,

(vi) floodway,

(vii) littoral rainforest,

(viii) nature reserve,

(ix) scenic area or scenic protection,

(x) wetland, or

(f) carried out or to be carried out on any land in a manner that does not comply with a policy made under the contaminated land planning guidelines by the council for any local government area in which the land is situated (or if the land is within the unincorporated area, the Western Lands Commissioner).

Comment: According to Clause 9 of the SEPP, the proposed remediation is considered Category 1 remediation works as it will be undertaken within an environmental protection zone pursuant to Bellingen LEP 2010 (as discussed in Section 5.3), hence consent is required.

5.2.4 State Environmental Planning Policy No 71 – Coastal Protection

Pursuant to Clause 7 of SEPP 71, the matters for consideration set out in clause 8 are to be taken into account by a consent authority when it determines a development application to carry out development on land to which this Policy applies.

Clause 8 'Matters for consideration' are as follows:

(a) the aims of this Policy set out in clause 2,

(b) existing public access to and along the coastal foreshore for pedestrians or persons with a disability should be retained and, where possible, public access to and along the coastal foreshore for pedestrians or persons with a disability should be improved,

(c) opportunities to provide new public access to and along the coastal foreshore for pedestrians or persons with a disability,

(d) the suitability of development given its type, location and design and its relationship with the surrounding area,

(e) any detrimental impact that development may have on the amenity of the coastal foreshore, including any significant overshadowing of the coastal foreshore and any significant loss of views from a public place to the coastal foreshore,

(f) the scenic qualities of the New South Wales coast, and means to protect and improve these qualities,

(g) measures to conserve animals (within the meaning of the Threatened Species Conservation Act 1995) and plants (within the meaning of that Act), and their habitats,

(h) measures to conserve fish (within the meaning of Part 7A of the Fisheries Management Act 1994) and marine vegetation (within the meaning of that Part), and their habitats

(i) existing wildlife corridors and the impact of development on these corridors,

(j) the likely impact of coastal processes and coastal hazards on development and any likely impacts of development on coastal processes and coastal hazards,

(k) measures to reduce the potential for conflict between land-based and water-based coastal activities,

(l) measures to protect the cultural places, values, customs, beliefs and traditional knowledge of Aboriginals,

(m) likely impacts of development on the water quality of coastal waterbodies,

(n) the conservation and preservation of items of heritage, archaeological or historic significance,

(o) only in cases in which a council prepares a draft local environmental plan that applies to land to which this Policy applies, the means to encourage compact towns and cities,

(p) only in cases in which a development application in relation to proposed development is determined:

- *(i) the cumulative impacts of the proposed development on the environment, and*
- *(ii) measures to ensure that water and energy usage by the proposed development is efficient.*

Comment: Consideration has been given to each of the above matters in developing the RAP and in considering environmental impacts and developing mitigation measures in this EIS.

5.2.5 North Coast Regional Environmental Plan 1988

From 1 July 2009 regional environmental plans are now deemed State environmental planning policies. The North Coast Regional Environmental Plan 1988 applies to the Site. Relevant clauses are addressed below.

Clause 15 Development control—wetlands or fishery habitats

The council shall not consent to an application to carry out development for any purpose within, adjoining or upstream of a river or stream, coastal or inland wetland or fishery habitat area or within the drainage catchment of a river or stream, coastal or inland wetland or fishery habitat area unless it has considered the following matters:

(a) the need to maintain or improve the quality or quantity of flows of water to the wetland or habitat,

(b) the need to conserve the existing amateur and commercial fisheries,

(c) any loss of habitat which will or is likely to be caused by the carrying out of the development,

(d) whether an adequate public foreshore reserve is available and whether there is adequate public access to that reserve,

(e) whether the development would result in pollution of the wetland or estuary and any measures to eliminate pollution,

(f) the proximity of aquatic reserves dedicated under the Fisheries Management Act 1994 and the effect the development will have on these reserves,

(g) whether the watercourse is an area of protected land as defined in section 21AB of the Soil Conservation Act 1938 and any measures to prevent soil erosion, and

(h) the need to ensure that native vegetation surrounding the wetland or fishery habitat area is conserved, and

(i) the recommendations of any environmental audit or water quality study prepared by the Department of Water Resources or the Environment Protection Authority and relating to the river, stream, wetland, area or catchment.

Comment: Consideration has been given to the provisions of Clause 15 in Sections 5.1 and 5.2 of this EIS.

Clause 29A Development control—natural areas and water catchment

(1) The council must not grant consent for the clearing of natural vegetation in environmental protection, scenic protection or escarpment preservation zones unless it is satisfied that:

(a) the wildlife habitat will not be significantly disturbed by the proposed development, and

(b) the scenery will not be adversely affected by the proposed development, and

(c) an erosion and sediment control plan will be implemented which will successfully contain on the site any erosion or sediment caused by the proposed development.

(2) In this clause, clearing of natural vegetation means:

(a) the removal of the majority of the vegetation, ground cover, topsoil or flora (other than noxious weeds, or trees which are dead, dangerous, exotic or propagated for horticultural purposes) within an area in excess of 1 hectare, or

(b) the reduction of the canopy or the population of any one tree species in excess of 20 per cent within an area in excess of 1 hectare,

but does not include such removal or reduction:

(c) within 3 metres of the boundary of land in different ownership or occupation for constructing or maintaining a fence, or

(d) within 0.5 metre of the common boundary of land in different ownership or occupation to allow a registered surveyor to survey the boundary.

Comment: Consideration has been given to the provisions of Clause 29A in Section 5.4 of this EIS.

5.3 Local Environmental Plans (LEPs)

The Proposal is located within the Bellingen Shire and the provisions of *Bellingen Local Environment Plan 2010* apply to the Site. The zones that apply to the Site include.

- Zone R1 General Residential
- Zone E2 Environmental Conservation
- Zone E3 Environmental Management

Under Zone R1 General Residential, the proposed remediation would be permissible with development consent. The works would be exempt under the Zones E2 – Environmental Conservation and Zone E3 – Environmental Management because they would be considered 'environmental protection works'.

Other relevant clauses of the LEP to the proposal include:

Clause 5.5 - Development within the coastal zone

Clause 5.9 - Preservation of trees or vegetation

Clause 7.1 – Acid sulfate soils

Clause 7.2 – Earthworks

Clause 7.3 – Flood planning

Clause 7.4 – Water

Clause 7.5 – Biodiversity

Comment: Consideration has been given to each of the above clauses in developing the RAP and in developing mitigation measures in this EIS.

5.4 Relevant NSW Legislation

5.4.1 Contaminated Land Management (CLM) Act 1997

The CLM Act 1997 is administered by the EPA and local Councils. It provides a regime for investigation and, where appropriate remediation of land affected by contamination that poses a significant risk of harm to human health or the environment. The CLM Act specifies responsibilities for managing contaminated land and the role of the EPA in the assessment of contamination and the supervision of the investigation, remediation and management of contaminated sites. NSW has a comprehensive suite of guidelines relating to assessment and management of contamination, administered under the CLM Act *1997* and the *Protection of the Environment Operations* (POEO) Act 1997.

Comment: Under Section 14 of the CLM Act, the EPA has issued a Management Order 20111405 for the remediation of the site. A copy of the Management Order is provided in Appendix A.

5.4.2 Protection of the Environment Operations (POEO) Act 1997

The requirements of the POEO Act 1997, and associated schedules and regulations, are relevant to the remedial phase of the project. The objectives of the Act include to protect, restore and enhance the quality of the environment in NSW, having regard to the need to maintain ecologically sustainable development (ESD).

The POEO Act includes requirements not to pollute waters, to prevent or minimise air pollution, to maintain and operate plant in a proper and efficient condition/manner and to deal with materials in a proper and efficient manner to minimise noise impacts, and to minimise and manage wastes. The Act also requires notification to the EPA when a pollution incident occurs that causes or threatens material harm to the environment.

The provisions of the POEO Act relating to the pollution of waters and waste disposal are particularly relevant to the proposal and would need to be considered during the remediation work.

Environmental Protection Licences are issued under the POEO Act. Under Schedule 43 'Types of licences' of the POEO Act:

'Environment protection licences may be issued for the following purposes:

(a) to authorise the carrying out of scheduled development work at any premises, as required under section 47,

(b) to authorise the carrying out of scheduled activities at any premises, as required under section 48,

(c) to authorise the carrying out of scheduled activities not related to premises, as required under section 49,

(d) to control the carrying out of non-scheduled activities for the purpose of regulating water pollution resulting from any such activity, as referred to in section 122.'

Schedule 1 'Scheduled Activities', Clause 15 'Contaminated soil treatment' of the POEO Act states:

(1) This clause applies to contaminated soil treatment, meaning the on site or off site treatment of contaminated soil (including, in either case, incineration or storage of contaminated soil but excluding excavation for treatment at another site).

(2) The activity to which this clause applies is declared to be a scheduled activity if:

(a) in any case, it has the capacity to treat more than 1,000 cubic metres per year of contaminated soil received from off site, or

(b) where it treats contaminated soil originating exclusively on site, it has a capacity:

–(i) to incinerate more than 1,000 cubic metres per year of contaminated soil, or

–(ii) to treat (otherwise than by incineration) and store more than 30,000 cubic metres of contaminated soil, or

–(iii) to disturb more than an aggregate area of 3 hectares of contaminated soil.

Comment: As the site will not be receiving or treating any soil from 'off site' Section 15(2)(a) is not applicable. With regard to Section 15(2)(b); contaminated soil originating exclusively from 'on site sources' are proposed to be treated however the treatment will not involve:

- Incineration (i)
- Treatment or storage of over 30,000 m^3 of contaminated soil (ii)
- Disturbing more than an aggregate area of 3 hectares of contaminated soil (iii).

Accordingly, an EPL is not required.

5.4.3 Protection of the Environment (Waste) Regulations 2005

The POEO (Waste) Regulation governs disposal of waste including waste classification and tracking requirements for materials requiring off-site disposal and discharges to the environment.

In the dictionary of the POEO Act, waste includes:

'(a) any substance (whether solid, liquid or gaseous) that is discharged, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration in the environment, or

(b) any discarded, rejected, unwanted, surplus or abandoned substance, or

(c) any otherwise discarded, rejected, unwanted, surplus or abandoned substance intended for sale or for recycling, processing, recovery or purification by a separate operation from that which produced the substance, or

(d) any processed, recycled, re-used or recovered substance produced wholly or partly from waste that is applied to land, or used as fuel, but only in the circumstances prescribed by the regulations, or

(e) any substance prescribed by the regulations to be waste.

A substance is not precluded from being waste for the purposes of this Act merely because it is or may be processed, recycled, re-used or recovered'.

Comment: The contaminated soil is classified as 'waste', under the definition above. However, as it is not being taken off site, it does not require classification or tracking. Also most of the regulatory aspects apply to "waste received from off-site" (with the notable exception of contaminated soil treatment works as discussed above), and hence do not apply for these onsite works. Any other material proposed to be removed from site (e.g. debris) is to be classified and tracked in accordance with the POEO (Waste) Regulation.

5.4.4 Water Act

The *Water Act 1912* (Water Act) governs access, trading and allocation of licences associated with both surface and underground water sources, where a Water Sharing Plan (WSP) has not been put in place. The elements to which the Water Act applies include extraction of water from

a river, extraction of water from underground sources, aquifer interference and capture of surface runoff in dams.

Comment: The Proposal is likely to intercept the aquifer when excavating the contaminated material and during the installation of groundwater monitoring wells. According to Clause 112(1)(b) of the Water Act, the Crown does not require a licence.

5.4.5 Water Management (WM) Act 2000

The *WM Act 2000* aims to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations.

The WM Act also provides for the preparation of water management plans, which contain much of the detail necessary for the operation of the Act. Water Management Plans address matters such as water sharing, water use, drainage and floodplain management and water source protection. The Site is located within the *Water Sharing Plan for the Bellinger River Area Unregulated and Alluvial Water Sources 2008*.

Comment: A Controlled Activity Approval (CAA) under the WM Act is required for certain types of developments and activities that are carried out in or near a river, lake or estuary. In accordance with clause 39A of the *Water Management Regulations 2004*, Public authorities and local councils are exempt from a CAA, pursuant to Section 344 (1) (a) of the WM Act in relation to all controlled activities that they carry out in, on or under waterfront land. Accordingly, a CAA would not be required for the Project.

5.4.6 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) is administered by the Department of Primary Industries and its objectives are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations.

Pursuant to Section 199 of the FM Act, '*a public authority (other than a local government authority) must, before it carries out or authorises the carrying out of dredging or reclamation work:*

(a) give the Minister written notice of the proposed work, and

(b) consider any matters concerning the proposed work that are raised by the Minister within 28 days after the giving of the notice (or such other period as is agreed between the Minister and the public authority).'

Comment: Written notice of the proposed remediation would needs to be given to the Minister because the Proposal involves excavating material from 'water land' (as defined in the FM Act).

Part 7A of the FM Act provides for threatened species conservation including measures to:

- Conserve biological diversity of fish and marine vegetation
- Prevent the extinction and promote the recovery of threatened species
- Provide for the listing of threatened species for the purposes of this Part

Comment: Threatened species, populations are listed in Schedules 4, 4a and 5 of the FM Act. The potential impacts of the Proposal on threatened species and communities are discussed in Section 7.10.3 and Appendix H.

5.4.7 Native Vegetation Act 2003

In 2005, the NSW Government introduced laws to end broad scale land clearing across the state. The Office of Environment and Heritage (OEH) is the government agency charged with ensuring native vegetation is protected for future generations. The *Native Vegetation Act 2003*

applies to the clearing of native vegetation outside certain specified areas, and requires development consent from the Minister for Planning and Infrastructure.

Section 12 of the *Native Vegetation Act 2003* states that native vegetation must not be cleared except in accordance with a development consent granted in accordance with the Act.

Comment: The majority of the remediation area, where clearing of native vegetation is required, is zoned R1 – General Residential which is excluded from the NV Act. However, part of the area, requiring clearing of native vegetation, is within land zoned E2 (Environmental Conservation) and E3 (Environmental Management) where the NV Act applies and therefore would require consent from the Minister.

5.4.8 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* is administered by OEH. Section 5A of the EP&A Act lists a number of factors to be taken into account in deciding whether there is likely to be a significant impact on threatened species, populations or ecological communities or their habitats.

Should a threatened species or community be impacted, a test of significance must be completed to determine the significance of the impact. A Species Impact Statement (SIS) is required if there is likely to be a significant impact on a threatened species, population or ecological community or its habitat.

Comment: The potential impact of the Proposal on threatened species and communities has been discussed in Sections 7.10.3 and Appendix H. In conclusion, based on the assessment, the overview 7-part test and given the intent of the proposed works to remediate the site, in conjunction with the implementation of an environmental management plan during the works phase, it is considered that the proposed remediation works would be unlikely to significantly impact on threatened species, populations or ecological communities. An SIS is not considered necessary.

5.5 Commonwealth Legislation

5.5.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999) establishes a requirement for Commonwealth environmental assessment and approval for actions that are likely to have a significant impact on matters of national environmental significance, the environment on Commonwealth land, or actions taken on Commonwealth land. Matters of national significance include:

- World heritage properties
- National heritage places
- Wetlands of international importance
- Listed threatened species and ecological communities
- Listed migratory species
- Commonwealth marine areas
- Nuclear actions

Comment: An assessment of potential impacts on biodiversity is provided in Section 7.10.3 and Appendix H.

Species listed under the EPBC Act assessed as 'likely' to occur or 'may occur' given the available and suitable habitat within the site included:

- Four vulnerable and two endangered plants
- One vulnerable frog species
- One endangered and two vulnerable bird species
- One endangered and listed marine bird species
- Five listed migratory/marine bird species with Bonn, CAMBA, JAMBA and ROKAMBA status
- One vulnerable and one endangered mammal species
- Two listed marine bird species
- Three listed migratory marine bird species and four listed marine/migratory wetland bird species
- One migratory wetland bird species

The EPBC Act assessment of significance determined that no significant impacts are considered likely on the threatened species or migratory birds listed under the EPBC Act and therefore no referral to the Commonwealth Minister in relation to the EPBC Act is necessary.

One threatened EEC, *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast*, was recorded within the study area. An assessment of significance was undertaken for this EEC, which determined that no significant impacts are likely.

The key impacts associated with the Proposal include habitat loss and weed invasion. In order to minimise these key impacts it is proposed that an Environmental Management Plan for the Proposal be prepared.

5.6 Statutory Position

Following examination of all relevant statutory planning instruments, it is concluded that under the EP&A Act, the Proposal is subject to assessment under Part 4 of the EP&A Act and several other forms of legislation. In addition to the need for consent from the Minister, the following approvals or licenses would be required:

Table 5-1 Agency Approvals

Agency	Approval
Minister of Planning and Infrastructure	Approval under the *Environmental Planning and Assessment Act 1979*, *Native Vegetation Act 2003 and SEPP 14*
NSW Environment Protection Authority	Approval of the EPA as required by the Management Order 20111405.
Department of Trade and Investment, Regional Infrastructure and Services	Notification under Section 199 of the *Fisheries Management Act 1994* for dredging.

6. Consultation

6.1 Community consultation

Consultation with the community has been undertaken at various phases throughout the site investigation and EIS process. Details are provided in Appendix I. Consultation activities have included:

- Development of a Communication Plan
- Two public meetings held at the Urunga Golf Club
- A mailout and letter drop to nearby residents
- Use of a community feedback forms (provided to residents and at meetings)
- Meetings with interested community groups (e.g. Urunga Chamber of Commerce, Community Groups, Bellingen Environment Centre, Bellingen Shire Council)
- Media releases which were then converted to newspaper articles
- TV News and radio articles
- Direct liaison (meetings and written correspondence) with relevant stakeholders

Details of the community consultation completed are summarised in Table 6-1. In general, community feedback indicated there was very little opposition to the Proposal as a remediation project is considered to offer significant benefits to the community through reduced potential health risks, improved environmental conditions, short term employment opportunities and restored recreational and visual amenity.

Community engagement activities for the next stages of the process and the exhibition period of the EIS would include the following:

- Consultation with residents along Hillside Drive including Stepping Stones Pre School and Child Care in regard to potential noise, traffic and dust impacts.
- Public exhibition of the EIS to allow interested parties to formally comment on the Proposal.

Table 6-1 Details of community consultation

Date	Stakeholders	Forum	Notes
19 June 2012	BSC Shire Community	Newspaper	Article in paper informing community that investigations are commencing
31 Oct 2012	Urunga Chamber of Commerce	Private Presentation	SCS presented to the Chamber with a view of getting preferred option from Chamber Chamber responded by email stating preferred option is option 2
15 Nov 2012	Community Groups	Private Letter	Inviting community groups to attend Investigation results meeting
19 Nov 2012	Local Community	Media release	Discussing project and inviting community to meeting
27 Nov 2012	Local Community Fisheries EPA NSW Health Office of Water Derelict Mines	Public Meeting	See minutes in Appendix I
27 Nov 2012	Meeting Attendees	Feedback Form	Provided forms for community feedback- nil received. No submissions detailing preferred option. However, extensive email feedback all regarding protest to using Hillgrove mine for disposal (approx 50 emails) Extensive media coverage against the use of Hillgrove in Jan 2013
5 March 2014	Bronwyn Shipp (Westrella Motel Owner)	Email & Phone Correspondence	SCS requested permission to enter property for further investigations Requesting investigation results from her land. Supplementary report provided No discussion on preferred option as yet
26 Feb 2014	Bellingen Shire Council Senior Staff & Councillors	Private Meeting	SCS & Crown Lands & EPA presented option selection presentation. Some councillors expressed concern that the waste would be kept on-site No motions were passed (not determining authority) to accept the option but generally it was accepted

Date	Stakeholders	Forum	Notes
26 Feb 2014	Terry Wall Coffs Harbour Land Council	Private Meeting	SCS & Crown Lands & EPA presented option selection presentation. SCS provided follow-up email summarising the option for CHALC formal review. SCS explained that CHALC have two options for land title transfer in regards to contamination: Excise the SEPP 14 wetland boundary in contamination zone plus 20m buffer from title Retain SEPP 14 wetland boundary in contamination zone but accept receiving contaminated sediments. CHALC had no issue with a containment cell at Hillside Drive
6 Mar 2014	Chris Phillips (neighbour)	Private Meeting	No problem with a containment cell downslope of the current security fence Requested a grassed finish to containment cell to match existing Enjoys the vegetated outlook and will be disappointed if cleared. SCS confirmed it will be cleared. Insisted on a landscape plan to revegetate for the purposed of screening the site
6 Mar 2014	Urunga Chamber of Commerce	Private Presentation	SCS gave option presentation. Chamber recommended notifying residents along Hillside Drive ahead of public meeting Recommended to focus on detail of preferred option rather than other redundant options Need to cover issues regarding environmental impacts
26 Mar 2014	Bellingen Environment Centre	Members AGM Meeting	SCS asked to update the group on the project SCS presented the options report presentation Concern raised over design life of containment cell Concern raised over earthquake robustness of containment cell Concern raised on whether it will be safe for children to swim in the Lagoon afterwards

Date	Stakeholders	Forum	Notes
21 May 2014	Hillside Drive Residents & Neighbours (Stepping Stones to Highway)	Mail Drop & Face to Face Discussion	Only half residents home so leaflet left in letterbox SCS explained the project and potential impacts No. 12 - Stepping Stones was unaware of the site when the business commenced in 2005. • Concerned about truck movements in front of the long day care centre • Concerned about dust generation, with many kids having asthma • SCS informed Stepping Stones that mitigation measures will be implemented to address such concerns. No. 10 – expressed concern over losing fence. SCS explained that discussions on fence retention can be decided during project. No. 97 Pac Hwy asked if the contaminated site could be responsible for developing heart conditions.SCS stated that the contaminants are known to affect soft tissues but it is impossible for SCS to know if that would cause disease in any one individual. Westella Motel – no comment. No. 131 Pac Hwy do not consider themselves affected by the site.
20 May 2014		Media Release	Media release discussing RAP and public meeting - “Plan to fix poisoned land”
20 May 2014	Mid North Coast Community	Radio coverage	News article based on Media Release
27 May 2014	Community Groups	Email Mail Out	Invited community groups in Bellingen Shire to attend proposed 29th May 2014 meeting
29 May 2014	Local Community EPA NSW Health	Public Meeting	Presentation of recommended option to approximately 20 community members and representatives of environmental groups. Provided question & answer time Provided forms for submitting a written response if preferred. Concern over effect of sea level rise on containment cell Concern over durability & design life of containment cell Show of hands demonstrated most attendees are satisfied that on-site option the best way forward
30 May 2014	Mid North Coast Com munity	Radio Interview	Summary of presentation in news grab for radio.

6.2 Aboriginal community involvement

A search of the Aboriginal Heritage Information Management System (AHIMS) database (Appendix J) found that no Aboriginal sites or places have been recorded in or near the Proposal footprint. An area to the south of the wetland (outside of the Proposal) was subject to a successful Aboriginal land claim in 1985, by the Coffs Harbour and District Local Aboriginal Land Council (CHDLALC). Due to the emerging contamination issue, a portion of the claim adjacent to the wetland was removed in 1997. This area removed from the claim was increased in 2002 to provide a larger buffer between the claim area and the contaminated wetland. The plan showing these notional boundaries is provided in Appendix J.

The CHDLALC was also consulted as part of the EIS process. This included a site inspection by two CHDLALC cultural heritage officers. A consultation letter regarding the outcomes of the inspection is provided in Appendix J and details provided in Section 7.11.

6.3 Government agency consultation

In preparing this EIS consultation has been undertaken with relevant government agencies to determine their requirements for the EIS. This consultation involved written and phone correspondence and face to face meetings. A summary of the comments formally received is presented in Table 6-2. Full responses are contained in Appendix B.

Table 6-2 Government Authority Submissions

Requirements	Where addressed in EIS
NSW Department of Planning and Infrastructure (DoPI) Comments were provided in the form of DGRs on July 16 2012. A summary of the DGRs is provided in Table 6-3. Comments were also provided on a preliminary draft EIS on 12 May 2014. These comments are provided in Appendix I.	Table 6-3
NSW Environment Protection Authority (EPA) The EPA has been involved in the management of the Site since 2002 (and likely earlier) through the declaration of the site to be a 'remediation site' and the issuing of management orders. The EPA also reviewed and approved the various stages of investigations carried out by the Soil Conservation Service and GHD from 2011 to present. A formal response was also provided to DoPI in regard to the DGRs and is provided in Appendix B. The key issues to be addressed in the EIS were: • Contaminated sites assessment and remediation • Air quality (dust management) • Noise impacts • Waste (including soil treatment and immobilisation of contaminants in waste) • Soil and sediment (including the assessment and management of acid sulfate soil) • Water quality (groundwater and surface water) • Threatened species (flora and fauna including the SEPP 14 wetland) • Cultural heritage (Aboriginal and non-Aboriginal) • Occupational health and safety (including traffic management). The EPA recommended that a CEMP be provided to address the key environmental issues. The plan must provide mitigation and management options describing measures to prevent, control, abate or minimise the identified environmental impacts of the project and to reduce and/or manage the risks to the environment and health. Further feedback was provided in June 2014 indicating that: • A qualitative approach to the assessment of likely impacts on air quality and noise is appropriate, however a quantitative approach for monitoring of dust is required.	Section 7 Section 8

Requirements	Where addressed in EIS
• The noise assessment should be done in accordance with the Interim Construction Noise Guidelines, and adopt the 'Qualitative Assessment Method'. The CEMP should then detail a response plan to excessive noise levels and/or noise complaints. • An appropriate plan for dust monitoring including conservative criteria for dust levels based on the contaminants of concern is provided.	
Roads and Maritime Services (RMS) RMS provided feedback to DoPI on July 10 2012. Their key concern relates to the safety and efficiency of the state classified road network, in particular Hillside Drive and the Pacific Highway. The RMS requested that the EIS include a detailed traffic study that takes into account: • An assessment of traffic impacts on the capacity, efficiency and safety of road users • The number and type of vehicle trips to be generated by the Proposal • Existing and proposed access conditions • Intersection sight distances • Road improvements • Proposed haulage routes • Servicing and parking arrangements • Connectivity to existing developments • Impact on transport (public and school bus routes) • Provisions for pedestrians and alternative modes of transport • Traffic noise. Requirements were outlined, should construction activities on any roads be required. A Road Safety Audit undertaken by a suitably qualified person is required to ensure haulage routes do not adversely impact on the safety of the road network. RMS were also contacted by GHD on 2 June 2014 to have the opportunity to update the information they provided in 2012. The correspondence was regarded to be still current. No update is required.	Section 4.20 Section 7.13
Bellingen Shire Council (BSC) BSC provided feedback to DoPI on July 3 2012. They requested the following be addressed in the EIS: • Traffic impacts • Potential conflicts with downstream users of the watercourse during the remediation phase (i.e. fishing and other recreational activities) • Management of public perception and community expectations during the remediation phase and post remediation • Aboriginal heritage impacts • Contemporary legislative provisions. BSC were also contacted in June 2014 for further input. No additional information provided in relation to requirements for the EIS.	Section 5 Section 6.4 Section 7.11 Section 7.13 Section 7.15
NSW Ministry of Health The Ministry of Health provided feedback to DoPI on July 5 2012. They requested the following be addressed in the EIS: • A comprehensive communication and community consultation strategy including the nearby child care centre, concerned citizens and the Coffs Harbour and District Local Aboriginal Land Council • An assessment of public health risk including dust emissions and public access. A draft of the human health risk assessment was sent to the NSW Ministry of Health in June 2014 for review and the assessment was updated based on the comments received.	Section 6 Section 7.3 Section 7.4 Appendix I

Requirements	Where addressed in EIS
NSW Department of Primary Industries (DPI) including the **NSW Office of Water** (NoW) DPI provided feedback to DoPI on July 16 2012. DPI requested that the EIS address: • Adequate water supply for the Proposal • Water licencing requirements • Proposed groundwater works including monitoring bores, extraction, dewatering, testing and monitoring • Requirements to intercept groundwater and predicted dewatering volumes, water quality and disposal/retention methods of contaminated water • Impacts of the Proposal on adjacent, licenced water users, basic landholder rights or groundwater dependent ecosystems • Associated impacts on the local and regional groundwater system due to the proposed remediation works • Potential impacts on groundwater and surface water due to the potential onsite disposal/containment of contaminated material • A detailed monitoring program and mitigation plan to address surface and groundwater impacts on and offsite impacts on watercourses and drainage lines onsite and adjacent to the site and future management of these areas including the SEPP 14 wetland, Station Creek and Urunga Lagoon • Acid sulfate soils, including and acid sulfate management plan. A referral was made to DPI Fisheries, however no separate response was made at that time. DPI Fisheries was also contacted in June 2014 and they indicated they would like to be involved in the final landform design, revegetation and creation of fish habitat. DPI also requested provisions are provided to control erosion and sediment and site water and water quality monitoring is undertaken. NoW was contacted by telephone on 23 June 2014. The main concern was that surface water and groundwater quality was monitored.	Section 4 Section 5.4.5 Section 7.2

6.3.1 Director General's requirements

The DGRs for the preparation of this EIS were provided by the Department of Planning and Infrastructure (DP&I) based on the information provided by Crown Lands. The DGRs were prepared in consultation with the relevant government agencies and BSC.

A summary of key issues raised in the DGRs and the section of the EIS where they are addressed is provided in Table 6-3. An unabridged copy of the DGRs and associated agency submissions are provided in Appendix B.

Table 6-3 Director General's requirements

Issue category	Requirement	Section addressed in EIS
General requirements	A comprehensive, detailed and genuine community consultation and engagement. This process must ensure that the community is both informed of the proposal and is actively engaged in issues of concern to them. Sufficient information must be provided to the community so that it has a good understanding of what is being proposed and of the potential impacts.	Section 6 Appendix I
	A detailed description of the development, including: • need for the proposed development • justification for the proposed development • likely staging of the development • likely interactions between the development and existing, approved and proposed operations in the vicinity of the site • plans of all proposed building works.	Section 3 Section 4 Section 9
	Consideration of all relevant environmental planning instruments, including identification and justification of any inconsistencies with these instruments.	Section 5
	Risk assessment of the potential environmental impacts of the development, identifying the key issues for further assessment.	Section 7
	Detailed assessment of the key issues specified below, and any other significant issues identified in this risk assessment, which includes: • a description of the existing environment, using sufficient baseline data • an assessment of the potential impacts of all stages of the development, including any cumulative impacts, taking into consideration relevant guidelines, policies, plans and statutes • a description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the development, including proposals for adaptive management and/or contingency plans to manage any significant risks to the environment.	Section 7
	Consolidated summary of all the proposed environmental management and monitoring measures, highlighting commitments included in the EIS.	Section 8
Key issues	**Contamination** - including: • a contaminated land assessment carried out in accordance with the requirements of Management Order (20111405)for the site • a Remedial Action Plan approved by the EPA detailing the works to remediate the site, which includes: – characterisation of the nature and extent of contaminated material and any contaminated groundwater plumes – details of the proposed remediation process, including treatment methodologies and processes – justification for the proposed treatment and remediation criteria	Section 3.2 Section 4.14 Section 5.4.1 Section 7.2 Section 4

Issue category	Requirement	Section addressed in EIS
	– details of proposed remediation management measures including the management of excavated material, stockpiles and wastewater – a site validation plan – details of compliance with the Contaminated Land Management Act 1997. • details of the final landform following remediation and the suitability of any fill material • on-going management of the site following remediation works • details of the final use of the site.	Section 5.4.1 Section 4 Long term site management plan (pending)
	Human Health and Risk - including: • an assessment of the potential risks (on site and off site) associated with the disturbance, transfer and disposal of contaminated material • details of mitigation and management measures to minimise human health risks and ensure the safety of workers during the development.	Section 7.4
	Soil and Water - including: • an assessment of the potential soil, groundwater and surface water impacts of the development, including a detailed description of surface and groundwater conditions pre and post remediation works • consideration of sea level rise and how this would be managed • identification of potential impacts on the SEPP 14 wetlands, Station Creek and Urunga Lagoon • details of water supply, licensing requirements, groundwater works • dewatering and management of contaminated water • an assessment of the potential to impact on acid sulfate soils • identification of potential conflicts with other water users, including other licensed users, recreational users and groundwater dependent ecosystems • a detailed description of the mitigation and management controls that would be put in place to manage erosion and sediment, stormwater, groundwater and acid sulphate soils (if present) during and after remediation works.	Section 7.2 Section 5.4 CEMP (pending)
	Transport and Access - including: • a description of site accesses, haulage routes, internal roads and parking required as a result of the development • predictions of the traffic generated by the development including number and type of vehicle trips • an assessment of the potential impacts on the capacity, efficiency and safety of the road network, including an analysis of intersection sight distances • details of any upgrades to road infrastructure that would be required.	Section 4.20 Section 7.13

Issue category	Requirement	Section addressed in EIS
	Waste - including: • accurate estimates of the quantity and classification of the potential liquid and non-liquid waste streams of the development • a description of storage, treatment (including immobilisation of contaminants), disposal and re-use for all waste generated by the development • a description of the measures that would be implemented to ensure that any waste produced is appropriately handled, processed and disposed of.	Section 4 Section 7.17
	Biodiversity - including: • assessment of the impact on threatened species, populations and ecological communities, including the SEPP 14 coastal wetland • a description of the measures that would be implemented to minimise and/or offset identified impacts.	Section 7.10 Appendix H
	Noise and Vibration - including: • an assessment of all noise impacts on surrounding residential receivers, including road transportation noise • any vibration impacts • details of the proposed noise and vibration management and monitoring measures.	Section 7.9
	Air Quality and Odour - including: • a quantitative assessment of the air quality and odour impacts of the development on surrounding receivers, including impacts from road transportation (Note. A qualitative approach was subsequently approved by the EPA). • details of the proposed management and monitoring measures.	Section 7.3
	Heritage - including: • an Aboriginal cultural heritage assessment including effective consultation with relevant Aboriginal community groups • a non-Aboriginal cultural heritage assessment, including a statement of heritage impact for any State significant or locally significant historic heritage items • details of proposed management and monitoring measures.	Section 7.11 Section 7.12 Appendix J Appendix K
	Visual- including: • impacts on surrounding receivers and from public areas • an assessment of the visual impacts and landscaping that would be implemented following the remediation works.	Section 7.14
	Social- including: • a comprehensive community consultation strategy to be implemented during and after remediation works • an assessment of public health risks.	Section 7.15 Section 7.4
Plans and Documents	The EIS must include all relevant plans, architectural drawings, diagrams and relevant documentation required under Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*. These documents should be included as part of the EIS rather than as separate documents.	Appendix F

Issue category	Requirement	Section addressed in EIS
Consultation	During the preparation of the EIS, you must consult with the relevant local, State or Commonwealth Government authorities, service providers, community groups and affected landowners. In particular, you must consult with the: • Environment Protection Authority • Office of Environment and Heritage • Bellingen Shire Council • Department of Primary industries, including the NSW Office of Water and NSW Fisheries • NSW Transport (Roads and Maritime Services) • NSW Health • WorkCover NSW • the local community and stakeholders. The EIS must describe the consultation process and the issues raised, and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided.	Section 6

6.4 Ongoing or future consultation

Crown Lands is committed to ongoing stakeholder consultation. This will occur through the continuation of regular updates to stakeholders and additional progress and planning meetings as required.

7. Environmental impact assessment

This section of the EIS provides an assessment of the environmental risks associated with the Proposal and a detailed description of those medium and high risk environmental impacts associated with the construction and lifetime of the Proposal. The factors specified in clause 228(2) of the *Environmental Planning and Assessment Regulation 2000* are also considered in Appendix G. Site-specific safeguards are provided to ameliorate the identified, potential impacts.

7.1 Environmental Aspects, Impacts and Risks

Table 7-1 has been used to compile Table 7-2 Environmental Risk Rating for the activities relevant to this project.

All activities during the different stages of the Proposal have been examined to determine their potential impacts on the environment without mitigation measures. The risk rating is determined by considering the likelihood and consequence of an activity impacting upon an aspect of the environment. The risk ratings are determined by considering the potential managed impact of approved activities as identified in this EIS.

This highlights the significant risks that require controls to be implemented to reduce the risk to an acceptable level. Appropriate control measures to mitigate or minimise the risks are identified in Section 7.2 to Section 7.18.

Table 7-1 Significance rating matrix

Likelihood	Consequence		
	Low	Medium	High
Will occur	M	H	VH
Would not be surprised if it occurred	L	M	H
Not likely to occur	VL	L	M

POTENTIAL FOR ENVIRONMENTAL HARM

VH = *Serious environmental harm* - Causes actual or potential harm to the environment which is widespread, or of a high impact or is irreversible.

H = High environmental harm – Causes actual or potential harm to the environment which is significant but reversible

M = *Moderate environmental harm* - Causes actual or potential harm to the environment which is manageable or reversible.

L/M = *Unreasonable environmental harm* - Likely interference with an environmental value, (eg noise, dust) such that environmental nuisance may be caused.

L =. Minor environmental harm

VL = *No environmental harm* - Does not cause actual environmental harm or damage to the environment

Table 7-2 Environmental Risk Rating

Activity	Potential Impact on environment											
	Contamination	Health	Soil	Water	Traffic	Waste	Ecology	Noise	Air	Heritage	Visual	Social
Construction	H	H	M	H	M	M	M	M	H	M	M	M
Operation	L	L	L	L	VL	VL	VL	VL	VL	VL	VL	VL

As shown by Table 7-2 all aspects have the potential to cause a high to medium environmental harm during the remediation works. Following remediation the environmental risk is reduced to low or very low.

7.2 Soil, sediment and water

A detailed assessment of soil and water quality including a conceptual site model was completed by GHD in 2012 as part of a detailed site investigation.

7.2.1 Existing environment

Topography

The Site is located between the footslope of a small ridge to the north and west and the SEPP 14 wetland to the south and east. Elevation of the Site ranges from approximately two to fourteen metres Australian Height Datum. A description of Site features is presented in Section 1.3.

Geology and soils

The Site is underlain by Carboniferous and Permian aged Dunny Creek Conglomerate, comprising slate, phyllite, schistose sandstone and schistose conglomerate. These rocks are part of the Nambucca Slate Belt within the Nambucca Block.

The lower southern portion of the Site is underlain by undifferentiated Holocene aged sediments set down in a freshwater swamp environment, comprising organic mud, peat, clay, silt and marine sand associated with the low lying waterway.

The bedrock slopes above the mill at the site are in the Pine Creek (pn) erosional soil landscape comprising gravelly red soils which can be strongly to very strongly acidic, high aluminium toxicity, high topsoil organic matter, low shallow subsoil wet bearing strength and low permeability. Limitations include high erosion hazard, high run-on and steep slopes.

The low foot slopes above the tailings area are mottled grey red clays of the Bowra Creek (ba) soil landscape.

The wetland area below the tailings is predominantly permeable acid peats and impermeable grey humic clays of the Charlmont (ch) swamp soil landscape group, comprising deep, poorly drained structured plastic clays on slopes less than 2% with elevations of less than 10 m AHD. These soils are strongly to extremely acid, sodic, saline soils with high aluminium toxicity potential, high organic matter, low to very low wet bearing strength and low subsoil permeability. Additional limitations include flood hazard, waterlogging, and permanently high watertable, high to severe foundation hazard and high to severe acid sulfate soil hazard.

Soils were also assessed as part of the *Detailed Investigation Report* (GHD 2012b) and a *Factual Geotechnical Investigation Report* (GHD 2014). In general terms, subsurface conditions encountered comprised:

- Thin topsoil overlying residual soil and extremely weathered (soil strength) phyllite bedrock on the upper slopes.

- General and tailings fill overlying estuarine silt and peat over alluvial soils at the toe of the slope.

Inter-fingering of the alluvium occurred on the lower slopes, encountered stratigraphically between the topsoil and residual soil. Minor areas of fill were noted on the mid slopes associated with the former unprocessed ore stockpile.

The extent of soil contamination is detailed in Section 2.4.

The acid sulfate soils (ASS) risk map indicate that the soils on the Site are classified as 'disturbed terrain' hence no likelihood of ASS is provided. The wetland area downstream of the Site is classified as having "a high probability within 1 m of the ground surface" with soils being deposited in an estuarine swamp environment with surface elevations between 0 and 1 m AHD. Due to this, the Site could be assumed to display similar characteristics. The classification indicates that there is a 'severe environmental risk if ASS are disturbed by activities such as shallow drainage, excavation or clearing'. ASS generate acid where pyritic material is exposed to oxygen. Increased acidity may, in turn, exacerbate the mobilisation of metal contaminants (GHD 2012b).

During the detailed investigation, 18 samples from 11 locations (in the tailings (including the underlying soils at a depth of 2.0 mbgs), the sediment adjacent to the tailings and the vicinity of the canals) were analysed for field analysis of potential acid sulfate soils (PASS) with all samples indicating a high likelihood of acid sulphate generation potential for all these materials.

Based on the field analysis, nine samples from five locations (in the tailings and in the sediment adjacent to the tailings) were analysed for Suspension Peroxide Oxidation Combined Acidity and Sulfur (SPOCAS) analysis. Based on the percentage of oxidisable sulfur (net acidity-sulphur) and a comparison with the Action Criteria in the *Acid Sulfate Soils Management Advisory Committee (ASSMAC) guidelines* (Ahern et al. 1998), the preparation of a detailed management plan and development consent will be required for works that disturb the soil.

Surface water

Rainfall for the Site averages approximately 1700 mm per annum with March receiving the highest falls (average of 234 mm) and September receiving the least (average of 60 mm) (BOM 2014).

Several small drainage lines meander through the site from the small catchment. Flood waters are shown to periodically inundate the Site with the Probable Maximum Flood (PMF) level inundating the tailings, former gravel processing area and the canal systems. The PMF level does not cover the full extent of the former processing area. No tidal influence was noted during previous investigations however tidal influences may periodically inundate portions of the tailings during different hydrological conditions. Aerial photographs and anecdotal evidence from different times of the year indicate a significant seasonal fluctuation in the water level in the wetland.

The wetland drains into Station Creek (which is partially tidal) before discharging into Urunga Lagoon, which forms part of the Bellinger-Kalang estuarine system.

The wetland environment sees limited use by recreational users due to limited access.

The extent of surface water contamination is detailed in Section 2.6.

Groundwater

Five groundwater monitoring wells were installed onsite by DLWC in 1997 and two additional wells were installed by GHD in 2014. A review of the NSW NR Atlas (2014) indicates there are no licenced bores within 1 km of the site. The nearest are about 1 km west of the Site on a slightly higher elevation and with a reported SWL of 19.5 m. These are used for domestic and

stock purposes. Five licenced bores are located in Urunga at the bowling club, caravan park and golf club. These have a SWL of approximately 2.5m and are reported to be used for commercial irrigation and groundwater dewatering.

A summary of groundwater characteristics noted during GHD investigations include:

- Groundwater onsite ranged from approximately 0.4 to 6.49 mbgs
- Groundwater is interpreted to discharge into the wetland.
- Soil permeability was tested in two monitoring wells upgradient of the proposed containment cell. Permeability rates were variable and found to be in the order of 0.004 to 0.03 m/day
- pH values in the order of 4.4-6.6 indicated a slightly acidic environment
- Electrical Conductivity levels indicate the groundwater is relatively fresh
- The two monitoring wells up and down gradient of the proposed containment cell do not show any impacts from COCs
- Antimony and arsenic concentrations for all monitoring wells in the vicinity of the tailings deposit exceed 30 times the assessment criteria
- Antimony concentrations in groundwater were approximately an order of magnitude higher than surface water concentrations and arsenic concentrations in groundwater were approximately three orders of magnitude higher than surface water concentrations
- Assessment criteria exceedances were also noted for the monitoring wells in the vicinity of the tailings deposit for aluminium, chromium, copper, lead, mercury, nickel and zinc. Copper and zinc concentrations were of similar magnitude to those in surface water, with the concentrations of the other metals generally at least an order of magnitude higher than in surface water.

Receptors to contaminants in soil, groundwater and surface water

There are a number of potential human and environmental receptors of the contamination, provided an exposure pathway is present. The receptors may include human health and environmental receptors including:

- On site personnel that are involved in site works including remediation
- Residents/workers on adjacent properties
- Future recreational users of the Site, depending on the future land use
- Recreational users of the lower portions of the wetland, Station Creek or Urunga Lagoon
- The SEPP 14 Wetland adjacent to the Site
- Terrestrial flora and fauna that inhabit or visit the site
- Terrestrial flora and fauna on adjacent land
- Aquatic and benthic flora and fauna inhabiting the wetland and canals
- Aquatic and benthic flora and fauna inhabiting the lower portions of the wetland, Station Creek and Urunga Lagoon

7.2.2 Potential impacts

Assessments of the potential impacts on human health from exposure to the COCs are discussed in Section 7.4.

As the Proposal is a remediation project, most of the potential impacts on soil and water quality are positive including:

- Reduced erosion and sedimentation
- Removal of contaminated soil and sediment that have a detrimental effect on the environment
- Reduced contaminant levels in the surface water and groundwater due to the reduction/containment of the contaminant source

Potential negative impacts relating to soil and water quality include:

- Short term erosion and sedimentation resulting from exposed soils relating to vehicle movements, stockpiled materials, vegetation removal
- Sedimentation resulting from offsite vehicle movements including machinery and support vehicles driving off road and transporting dirt and mud onto nearby sealed roads
- Mobilisation of COCs through soil and sediment disturbance
- Mobilisation of COCs through leachate generated from disturbance activities
- Mobilisation of COCs through exposure of groundwater during excavation
- Mobilisation of COCs through the failure of the containment cell
- Exposure of workers to COCs during the Proposal
- Erosion, sedimentation, mobilisation of COCs and damage to machinery should the site flood during works
- Mobilisation of contaminants through the handling of other contaminant sources identified onsite (e.g. waste stockpiles)
- Dust generation from excavation works and vehicle movement over exposed soils
- Compaction of soil from the movement of large machinery
- Contamination of soil, surface water or groundwater from oil or chemical spills, especially where machinery is working in the water
- Acidification of surface water and groundwater and mobilisation of COCs through the exposure of acid sulfate soils
- Changes to water quality resulting from modified flows in the watercourse
- Releasing contaminated groundwater into adjacent surface waters
- Mixing of contaminated surface waters with uncontaminated or lesser contaminated groundwater
- Groundwater inundating open excavations and earthen remediation structures
- Discharge of contaminated groundwater into the wetland
- Groundwater infiltrating or moving through an on-site containment structure and releasing contaminated leachate

The containment cell has been designed to provide secure long-term containment of contaminated material without unacceptable environmental impact or health risk and minimise ongoing management requirements by the land holder (eg. avoid long-term leachate management requirements). The reagent quantities have been optimised to the lowest amounts for practical treatment. There is no indication these low aggresivity reagents will cause landfill

environmental problems, and all reagents are expected to precipitate as “insoluble” mineral species.

The containment cell has been designed to be above the PMF level and groundwater and surface water monitoring is to be implemented as part of the RAP. Should significant concentrations of contaminants become mobile through a major flood event during construction or failure of the containment cell, impacts to receptors in the wetland and Urunga lagoon may result (including ecological and human health).

It is likely that the groundwater will be intercepted during excavation of the contaminated material, hence dewatering may be required. This water is to be reused onsite or discharged following treatment for suspended solids and pH. As the groundwater at the Site is interpreted to discharge into the wetland, any potential impacts on other users of the groundwater and the regional groundwater system are deemed to be negligible.

The RAP provides a summary of dewatering procedures and mitigation measures aimed to minimise the potential for contaminants to mobilise into the wetland during excavation. Further details will be provided in the CEMP. Previous investigations have also found the contaminants dissolved concentrations to be much lower than total concentrations, indicating that dispersal of the majority of contaminants can be contained via limiting the movement of sediment. Where contaminants do become mobile and are released into the wetland environment, the impact would be similar (but shorter term) to those experienced since the deposition of the contaminants in the 1970s. Investigations of contaminant levels in the surface water show a rapid decrease in contaminant concentrations with distance from the Site.

Potential impacts on the water level in the wetland from sea level rise are uncertain however the effects would be minimised by the constriction and elevation drop in Station Creek. Regardless, the toe of the containment cell is to have armouring to minimise failure of the cell in the case that the PMF is exceeded.

Localised, short-term impact on soils and water quality are likely, however provided stabilisation and containment strategies are effectively implemented, medium to long-term impacts would be low. As the Proposal is a remediation project, the long term impacts on soil and water quality are positive.

7.2.3 Mitigation measures

The following measures are recommended to minimise potential impacts of the Proposal on soil, sediment and water:

Impact	Environmental safeguards	Responsibility	Timing
Soil and water quality	All site work is to be undertaken in accordance with the RAP.	Contractor	Pre and during construction
	The site is to have security fence installed to prevent unauthorised public access including warning signs.	Crown Lands	Pre-construction
	Soil and water management will be documented in the CEMP including details of erosion and sediment control. Stormwater and groundwater management details are to include: • Implement erosion and sediment controls in accordance with *Urban Stormwater Manual Volume 1 7 2 (Blue Book)* and IECA Guidelines. • Install perimeter controls of contaminated area in the wetland. • Separation and diversion of uncontaminated	Contractor	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	stormwater away or through the site. • Management of stormwater and dewatering from the remediation areas which will include a sediment basin to allow treatment before discharge (if required). Discharge of water from the remediation or treatment areas will be avoided if possible, with water to be managed within the remediation areas by return to excavations where dewatering is no longer required, or used for dust suppression / moisture control of stockpiles and material to be placed in the containment cell. • Setup washdown bay that drains to sediment basin. • Remediation design to allow for flooding and expected climate change water level increases. • Considering impermeable barriers around groundwater inflow sections of excavations • Minimising inflow groundwater into sections of excavations, using temporary barriers (eg. sheet piling), if required. • Groundwater assessment and treatment details (prior to discharge into the environment). The CEMP is also to outline a procedure for the containment and management of sediment laden site water, dewatering and regular inspection, maintenance and cleaning of erosion and sediment controls.		
	Floating, hydrocarbon booms with barrier silt curtains are to be placed in the wetland, encompassing all areas of excavation or potential run-off from the Proposal.	Contractor	Pre and during construction
	Acid sulfate management is to be addressed as part of the CEMP, in accordance with the ASSMAC Guidelines (Ahern, C.R., Stone, Y. and Blunden, B. 1998). The ASSMAC should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.	Contractor	Pre-construction
	Spill Management Procedures (SMP) for spills of fuels, oils or chemicals would be developed for inclusion in the CEMP. The SMP would include procedures for the capture and removal of spills, the location and maintenance of emergency spill equipment on site (e.g. spill kits), and 24 hour contact numbers for key agencies required in the case of an emergency response. All staff are to be made aware of the location of the spill kit and trained in its use.	Contractor	Pre-Construction
	A detailed WHS Management Plan is to be developed that outlines methods for minimising exposure of workers to COCs.	Contractor	Pre-Construction
	Work areas are to be divided into two zones with dynamic boundaries as work progresses being defined as 'Contaminated' and 'Uncontaminated' and having strict protocols within and between these zones to minimise cross contamination	Contractor	Construction
	Where possible, excavation of material within the PMF level is to be conducted outside of the historic flood times (i.e. conduct works between June and January).	Contractor	Construction
	Stockpiled material would be located and stored away from drainage lines and clean water diversion drains would be installed to protect stockpiles from flowing waters.	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	Stockpiles are to be managed in accordance with *Urban Stormwater Manual Volume 1 7 2 (Blue Book)* and IECA Guidelines.		
	Machinery used to operate within the water in the wetland is to be thoroughly cleaned prior to entry onto the site and visibly inspected for leaks prior to entry into the water. Oil or grease present on machinery that has potential to enter the waterway is to be cleaned off using an absorbent cloth prior to entry into the water.	Contractor	Construction
	Visual monitoring of water quality in the wetland (i.e. hydrocarbon spills/slicks) is to be undertaken to identify any potential spills. This is to be conducted on a daily basis and on an hourly basis when machinery is working within 10 metres of the water surface.	Contractor	Construction
	Work would be suspended in periods of heavy rain and machinery would be removed from the flood zone during flood events.	Contractor	Construction
	Disturbance to soil and vegetation outside of the work area is to be minimised. Where the work area is not obvious (eg tailings area, stockpile areas and access roads), the work area is to be delineated with a visual indicator (e.g. tape).	Contractor	Construction
	Vehicle and equipment movement would be confined to established designated work areas, roads, access tracks and compound site/ temporary materials stockpile area.	Contractor	Construction
	A vehicle washdown bay would be provided for plant and equipment leaving the contaminated zone. This shall comprise of a hardstand area for pressure cleaning plant and equipment before leaving site. Wastewater from the washdown bay is to be directed to a controlled area.	Contractor	Construction
	A shaker grid will be provided for plant and equipment leaving the uncontaminated zone to remove soil d from vehicle tyres. Where material is inadvertently transported onto pavement surfaces (e.g. Hillside Drive, via truck tires) is to be assessed and removed as required. Material spilled from trucks onto any roads is to be removed immediately.	Contractor	Construction
	Erosion and sediment control devices would be maintained and monitored daily during construction and left in situ until the site has been stabilised.	Contractor	Construction
	Disturbed areas are to be stabilised progressively, where practicable, during the works.	Contractor	Construction
	Where previously unidentified contaminants (e.g. asbestos, drums containing chemicals, staining) are identified during works by observation of any unusual physical/sensory characteristics, work is to cease, the area isolated and appropriate advice sought from the Project Manager/Superintendent.	Contractor	Construction
	The refuelling of plant and maintenance of machinery would be undertaken in an impervious, bunded area, above the probable maximum flood level. Drip trays are also to be used when refuelling.	Contractor	Construction
	All fuels, chemicals, and liquids would be managed as to prevent potential impact on the surface and groundwater. Machinery fuel and soil treatment reagents are to be stored in an impervious, bunded area (with 110 per cent capacity of the largest container) within the compound site, when not	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	being used.		
	Plant and equipment would be inspected regularly to ensure there are no leakages of fuel, oil and hydraulic fluid.	Contractor	Construction
	Vehicle wash downs are not to occur onsite, apart from the removal of contaminants prior to machinery leaving site. Wash downs are to take place in a designated area with appropriate controls to prevent hydrocarbon contamination.	Contractor	Construction
	All erosion and sediment control structures are to be removed once the site has been stabilised.	Contractor	Post-construction
	Ongoing monitoring of the containment cell including groundwater and surface water is to be carried out, as required by the EPA and other relevant regulatory authorities.	Crown Lands	Post-construction
	The containment cell is to be managed in accordance with the RAP and any additional requirements identified through ongoing monitoring.	Crown Lands	Post-construction

7.3 Air quality

The proposal has the potential to impact the local air quality in the short term, especially via generation of dust. Due to the nature of the proposal, the EPA has recommended a qualitative approach to air quality assessment and a quantitative approach to dust monitoring, as documented in Appendix I.

This approach involved:

- A desktop review of site plans, aerial photographs, and topographic maps to gain an understanding of the existing environment in terms of local terrain, existing/proposed operations and sensitive receptors surrounding the site.
- A review of available ambient air quality data and meteorological data to gain an understanding of existing air quality in the vicinity of the site.
- Determining applicable dust criteria with consideration to the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DEC, 2005).
- Establishing mitigation and management measures to reduce dust impacts from the site
- Establishing dust monitoring programmes.

7.3.1 Existing environment

Sensitive receivers identified in the vicinity of the site are detailed in Table 7-3.

Figure 7-1 shows a site aerial image and the location of identified sensitive human receivers. These receivers have been identified to represent those with the greatest potential for adverse dust impact. The wetland and surrounding ecosystem comprise the nearest ecological receptors.

Table 7-3 Identified sensitive receivers

Receiver	Receiver type	Nearest quarry activity	Approximate distance to nearest activity (m)/direction
R1	Residential	Excavation/Treatment area	150 m west
R2	Residential/ Commercial- Westella Motel	Access Road	60 m west
R3	Residential	Access Road	10 m west
R4	Residential	Access Road	60 m north
R5	Residential/ Commercial- Urunga Smash Repairs	Access Road	40 m north
R6	Residential	Access Road	50 m north
R7	Residential	Access Road	30 m north
R8	Residential	Access Road	30 m north
R9	Residential	Access Road	30 m north
R10	Residential	Access Road	40 m north east
R11	Residential	Access Road	50 m north east
R12	Residential/ Commercial- Stepping Stones Child Care Centre	Access Road	70 m north east



Figure 7-1 Site location and identified sensitive receivers (source: Google)

Ambient air quality

The NSW OEH operates ambient air quality monitoring stations in selected areas around NSW, however the closest air quality data to the Urunga region is in Tamworth or the Lower Hunter regions. These sites are subjected to additional industrial and urban sources compared to a rural location. In view of this, an ambient level of PM_{10} of 15 $\mu g/m^3$ has been assumed for rural coastal NSW areas away from the drier inland, industrial sources and urbanised environments.

Previous investigations of the soil (through boreholes, testpitting etc.) did not report any significant odours although sediment removed from the wetland was reported to contain an 'organic' (decomposing material) odour, similar to most wetland environments.

Local meteorology

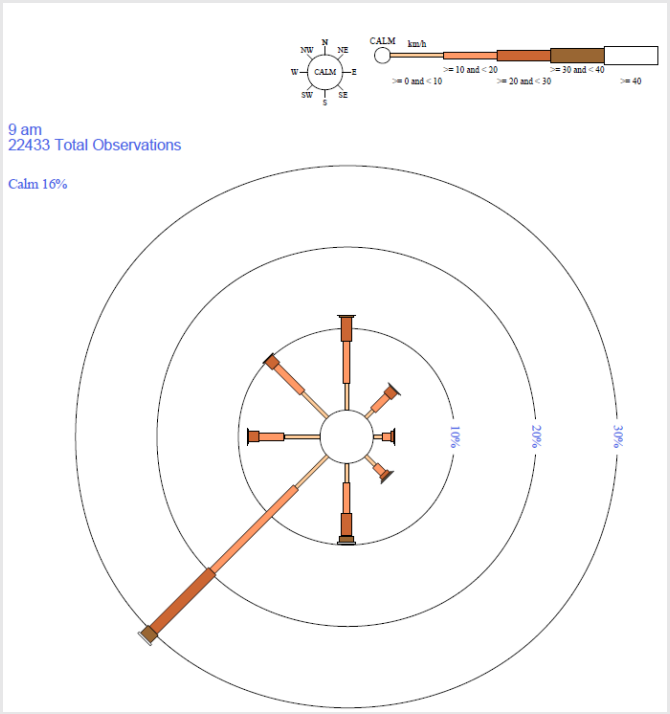
The transport and dispersion of the air emissions from the quarry would be influenced by prevailing synoptic flows and vertical temperature profiles that would alter both diurnally and with wind direction.

Meteorology data was obtained from the Bureau of Meteorology's Coffs Harbour automatic weather station (AWS) for this assessment, which is the nearest AWS, situated approximately 25 km north of the site. Weather data collected at this location is considered to be site-representative of weather conditions at the subject site for the purposes of this assessment.

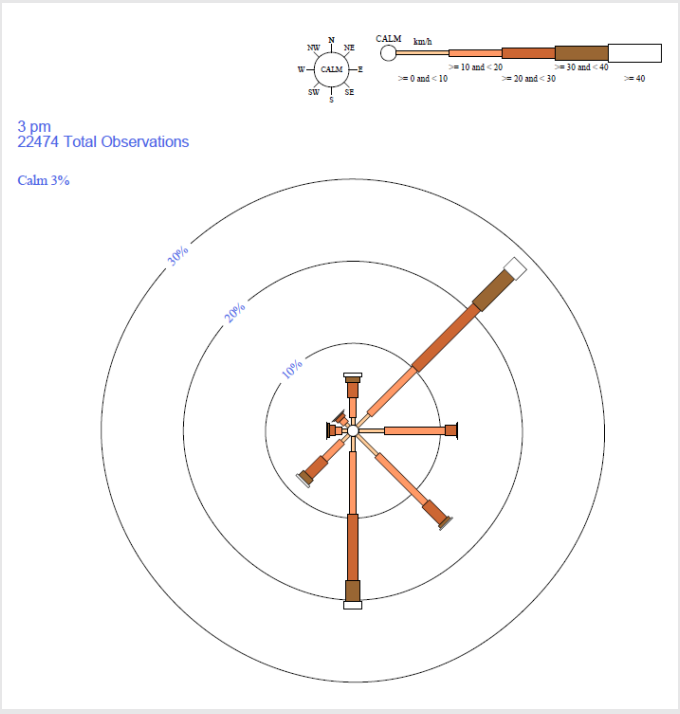
The climate of the Urunga area can be broadly defined as warm temperate. The maximum mean daily temperature is 27˚C in January and the mean minimum temperature is 7.6˚C in July (BOM 2014). The annual maximum mean temperature is 23.3˚C and the annual minimum mean temperature is 14.0˚C (BOM 2014).

Annual Wind data is presented in Figure 7-2. Wind data was also assessed for spring and early summer as this is the most likely time of year for the civil works (due to low water levels and less rain). Annual data for this time period is presented in Figure 7-3 and Figure 7-4. In summary, morning wind is predominantly from the southwest and afternoon wind is predominantly from the north east. The afternoon wind rose shows that approximately 20% of the winds are from the south, blowing towards nearby residents, however only 10% of these winds are above 18 km/hr when dust lift-off can become significant.

Due to the lack of nearby air pollution sources, prevalence of coastal breezes and surrounding wetland environment, the existing air quality in the vicinity of the Site is considered high. Localised dust impact is potentially present during dry, high wind periods in the vicinity of the tailings deposit and exposed soil in the former stockpile and processing areas. Vehicles travelling on the Pacific Highway would also be a source of particulate emissions.

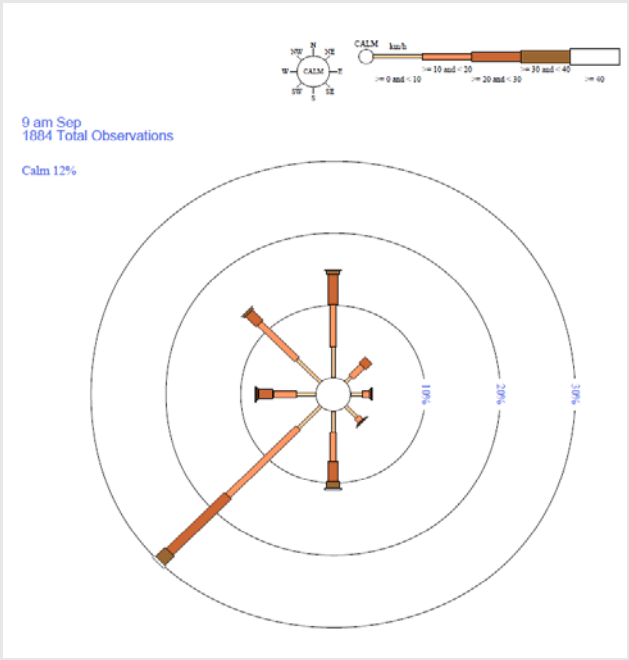


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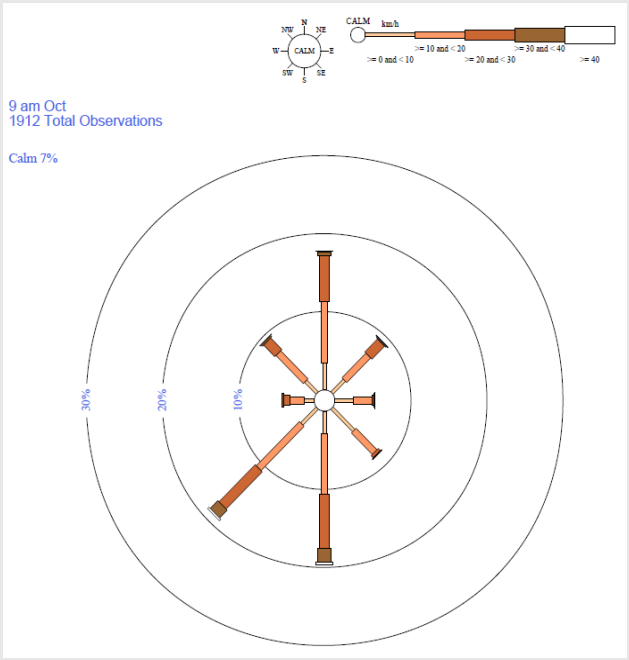


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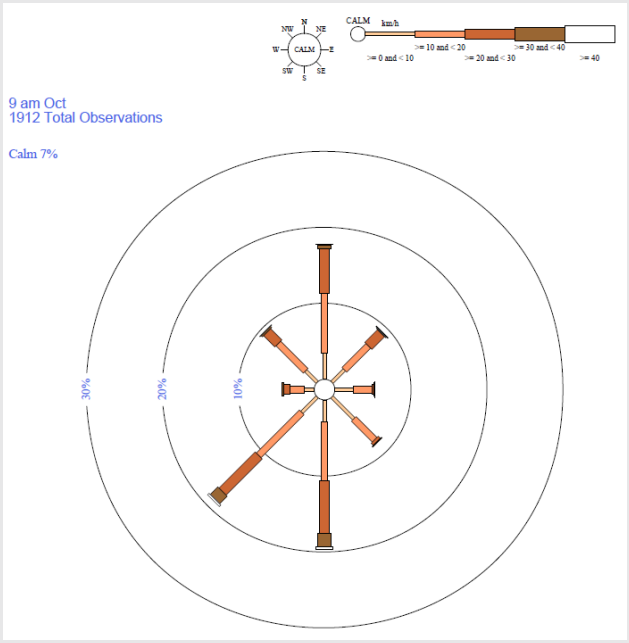
Figure 7-2 Average annual wind direction and speed for Coffs Harbour (BOM 2012)



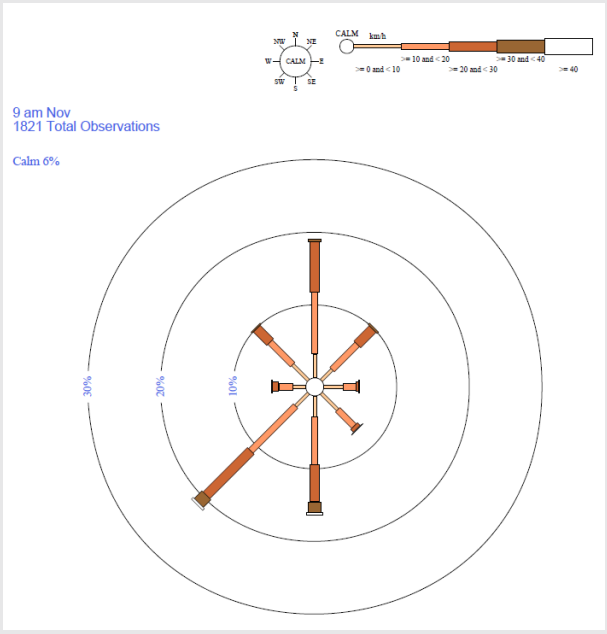
September



November

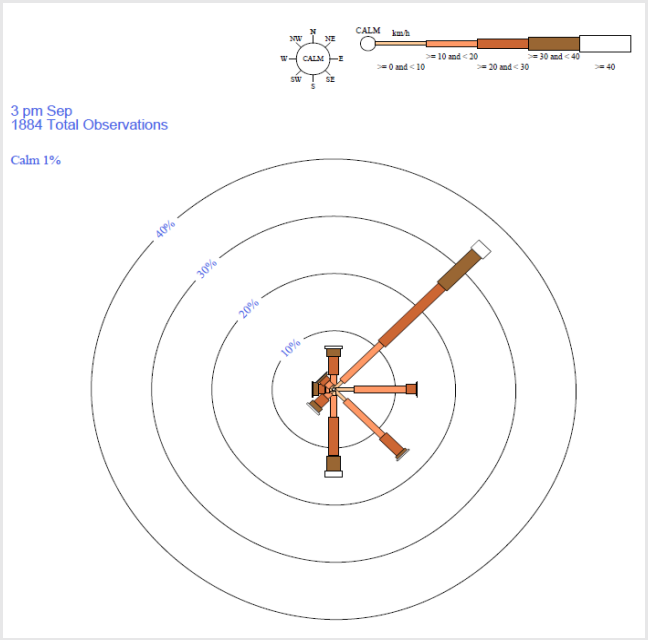


October

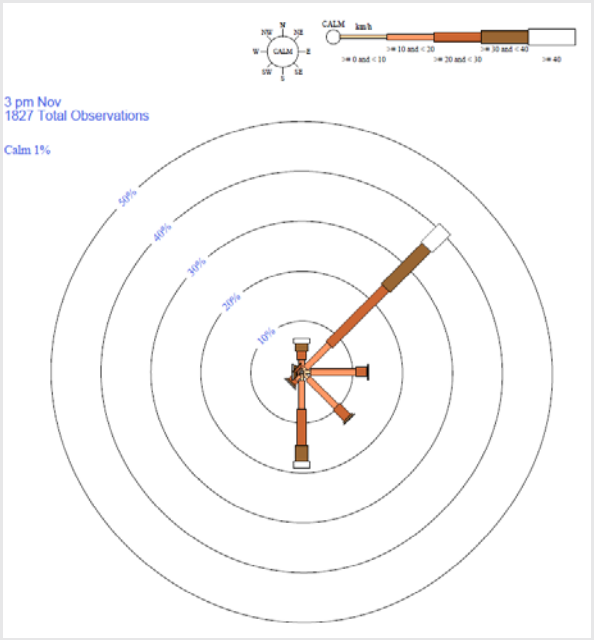


December

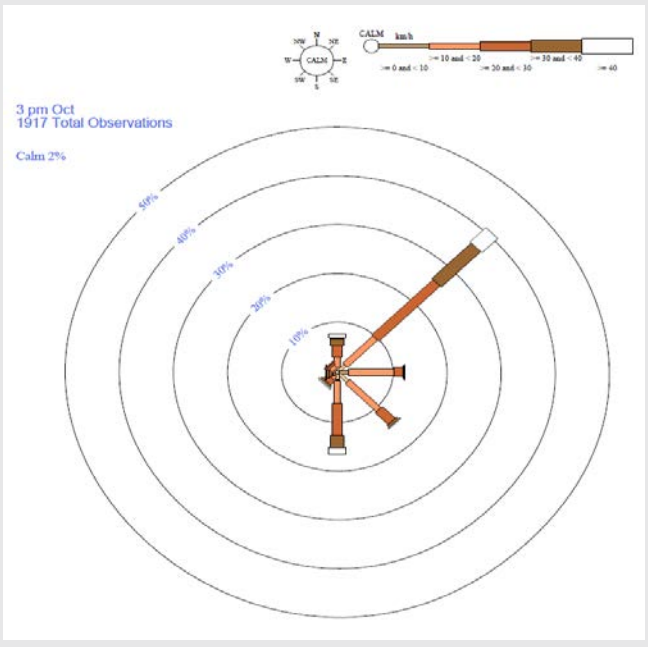
Figure 7-3 Average annual wind direction and speed for Coffs Harbour – 9am for September to December (BOM 2012)



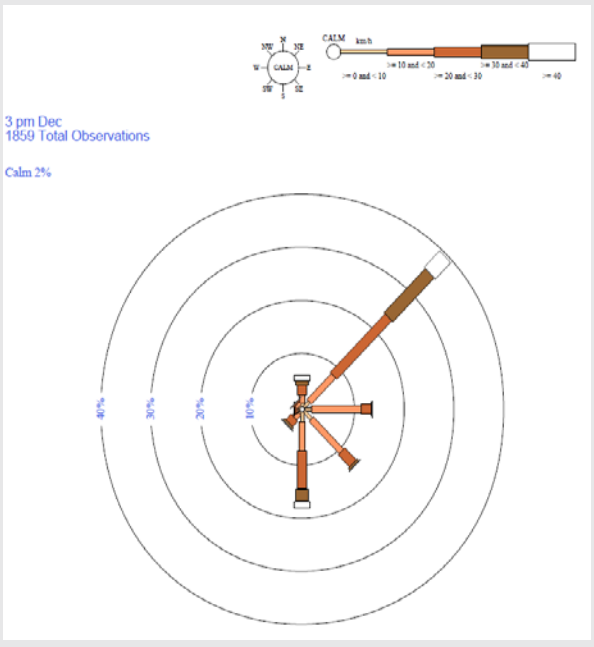
September



November



October



December

Figure 7-4 Average annual wind direction and speed for Coffs Harbour – 3 pm for September to December (BOM 2012)

7.3.2 Potential impacts

Potential impacts of the Proposal on air quality in the short term include:

- Dust generation from excavation, earthworks and construction vehicles driving over exposed soils
- Dust generated during the treatment and containment of the contaminated soil
- Dust generated from wind erosion of exposed stockpiles and soils
- Transportation and inhalation of contaminants (particularly antimony and arsenic) via dust
- Odour from the excavation of contaminated soil and sediment
- Exhaust emissions from construction machinery

Vehicle exhaust emissions during the Proposal also have the potential to impact on air quality, however the impact is likely to be negligible given the relatively short construction timeframe, isolated location and limited number of estimated vehicle movements.

The long term impact of the Proposal on air quality would be positive due to the removal of the exposed tailings deposit, remediation of exposed soil areas and revegetation. This would, in turn, reduce the potential for the mobilisation and inhalation of contaminants via dust. Impacts on air quality via vehicle movements onsite during the ongoing monitoring and maintenance of the Site would be negligible.

Due to the variability of wind conditions at the Site, scheduling works around wind direction is not deemed feasible. Accordingly, implementation of monitoring and mitigation measures is required to minimise the potential impacts from dust.

Potential impacts on workers through the inhalation of dust would be managed via the contractor, in accordance with relevant HSE regulations and procedures.

A human health assessment of potential effects of inhalation of dust and in particular, dust contaminated with antimony and arsenic is addressed in Section 7.4.

Dust impact assessment criteria

Air quality impact assessment criteria are prescribed within the NSW OEH *Approved Methods* (OEH 2005). The assessment criteria are presented in Table 7-4. As outlined in Section 7.3.3, real-time dust monitoring will be required during civil works to assess compliance with this criteria. If the dust monitors are placed onsite at least one month prior to commencement of civil works a true background deposition rate can be applied instead of the assumed background concentration of 15 $\mu g/m^3$.

Although inhalation of COCs bound to the dust potentially pose an additional negative impact on human health (as discussed in Section 7.4), no specific figures are available for antimony, arsenic or mercury. Accordingly, the criteria presented in Table 7-4 are deemed to apply.

Table 7-4 Dust assessment criteria

Pollutant	Averaging period	Criterion
PM_{10}	24 hours	50 $\mu g/m^3$
	Annual	30 $\mu g/m^3$
TSP	Annual	90 $\mu g/m^3$
Dust deposition (insoluble fraction)	Annual	4 g/m^2/month*

** Maximum allowable cumulative impact of 4 g/m^2/month. Maximum increase is 2 g/m^2/month*

PM10: the fraction of suspended Particulate Matter with an aerodynamic diameter less than 10μm

TSP: total suspended particulate matter less than 50 microns (μm) in aerodynamic diameter.

7.3.3 Mitigation Measures

The following measures are recommended to minimise potential impacts of the Proposal on air quality.

Impact	Environmental safeguards	Responsibility	Timing
Air Quality	Provide the community with a well-publicised contact point to report any dust concerns to both the contractor and landowner.	Crown Lands	Pre-Construction
	A detailed dust monitoring plan will be developed as part of the Site CEMP.	Crown Lands	Pre-Construction
	Site workers are to wear appropriate personal protective equipment to satisfy WorkCover requirements and minimise exposure to dust and associated contaminants.	Contractor	Construction
	Dust monitoring is to be carried out at three locations (in total including the • Westella Motel • Stepping Stones Pre School • Residence at the intersection of the Pacific Highway and Hillside Drive, adjacent to the site. Monitoring will be undertaken using real-time dust monitors in accordance with DEC's "*Approved Method for the Sampling and Analysis of Air Pollutants in NSW*" guidelines. Real-time dust monitoring results are to be displayed and trigger values set to alarm the contractor when the following criteria is met: 24-hour average PM_{10}=50 $\mu g/m^3$ Works are to cease immediately if dust plumes from site activities are visible at nearby sensitive receptors. Dust mitigation measures are to be revised if the incremental dust deposition levels exceed the relevant dust criteria. If mitigation measures cannot achieve the relevant criteria, all dust-creating work must cease until conditions improve to a point that the criteria can be met.	Contractor	Construction
	During strong southerly or south-easterly winds, dust generating activities will cease or employ high level management (eg. continual spraying, or full enclosure). Where possible, high dust risk activities will be scheduled during low wind or northerly directional wind.	Contractor	Construction
	Stockpiles or areas that may generate dust are to be managed to suppress dust emissions (i.e. through application of water sprays or covering/re-vegetating).	Contractor	Construction
	Specific routes for haulage and access would be designated and vehicle speeds would be limited to 15 km/hr.	Contractor	Construction
	All trucks carrying soil to or from the site are to be covered. Haulage within the site will be managed via either a retractable cover, dust control spray or allowing a reasonable space between the top of the load and top of the trailer.	Contractor	Construction
	If significant dust generation is observed from a particular activity, water carts would be used to suppress dust.	Contractor	Construction
	Construction areas and stockpiles would be pre-watered before they are disturbed and watering would continue during any activities where fugitive dust may be produced.	Contractor	Construction
	Existing vegetation would be retained where possible and cleared areas and stockpiles would be revegetated	Contractor	Construction and Post-

Impact	Environmental safeguards	Responsibility	Timing
	as soon as practicable with fast growing species for rapid coverage to temporarily or permanently stabilise soil.		construction
	Water sprays are to be used where soil is mixed/sifted as part of the treatment process.	Contractor	Construction
	Works are not to be carried out during strong winds or in weather conditions where high levels of dust or air borne particulates are likely (dry, windy).	Contractor	Construction
	Vehicles transporting waste or other materials offsite that may produce odours or dust are to be covered during transportation.	Contractor	Construction
	All construction plant, equipment, vehicles and machinery would be maintained in accordance with manufacturer's specifications in order to meet the requirements of the Protection of the Environment Operations Act, 1997 and associated regulations.	Contractor	Construction
	Vehicles and operating equipment used on site are to be switched off when not operating in order to minimise exhaust emissions from vehicles and other equipment operating.	Contractor	Construction
	Vegetation or other materials are not to be burnt on site.	Contractor	Construction
	All air quality complaints must be addressed within 24 hours.	Contractor	Construction

7.4 Human health

A human environmental health risk assessment is a process to estimate the nature and probability of adverse health effects in humans who may be exposed to chemicals or other harmful substances in the environment. The guideline for environmental health risk assessment in Australia is the *Environmental Health Risk Assessment Guidelines for assessing human health risks from environmental hazards* (Enhealth 2002).

The ultimate aim of a risk assessment is to provide the best possible scientific, social and practical information about the risks, so that these can be discussed more broadly and the best decisions made as to what to do about them.

A human health risk assessment (as described in Enhealth 2002) is generally based on four stages, namely:

- Issue identification
- Hazard identification and dose-response assessment
- Exposure assessment
- Risk characterisation

7.5 Issue identification

Issue identification is a process to identify issues for which risk assessment is useful and establishes a context for the risk assessment.

The issue is potential exposure of human receptors to the contaminants during the Proposal. Several contaminant sources have been identified at the site through past investigations including the tailings deposits, ore stockpiles, incidental contaminants, fill material, excavated sediments and exposed, acid sulfate soils. Details of the degree of contamination are provided in Sections 2.2 to 2.7.

Human health risks associated with exposure to noise and increased traffic are outside of the scope of this risk assessment and are discussed in Sections 7.9 and 7.13, respectively.

7.6 Hazard identification and dose-response assessment

Hazard identification is the process of determining what adverse effects are likely to occur from an exposure to a chemical or other substance and whether any adverse health effects are likely to occur in humans.

Chemicals used during the former ore purification process pose the hazard to human health and include copper sulfate, sodium cyanide, lead nitrate, dextrin, sodium ethyl xanthate and crescylic acid. Mill water was also contaminated with dissolved antimony and arsenic salts during treatment of the crushed ore. Based on an assessment of the known chemicals used in the processing, the possible contaminants include arsenic, antimony, lead, copper, chromium, aluminium, mercury, cyanide, sulfur, sodium and nitrates.

As discussed in Section 2.3, human health exposure criteria for these analytes have been developed by the Department of Environment and Conservation (2006) and updated in the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (the NEPM) (NEPC, 1999), as amended in May 2013 (NEPC 2013). Exposure to concentrations exceeding these criteria may result in adverse health effects on humans.

During the Detailed Investigation Report (GHD 2012b) a comparison of the analyte concentrations with the adopted assessment criteria was carried out: As the proposed, future use of the Site is as a reserve, the most applicable exposure setting was considered to be '*NEHF E- Parks, Recreational, Open space'* as published in DEC (2006) (now designated HIL C in the amended NEPM). The findings of the assessment were:

- The major soil and sediment COCs include antimony, arsenic and mercury. Less significant COCs in terms of risk include zinc, copper, lead, cyanide
- The major surface and groundwater COCs include antimony, arsenic and mercury. Less significant COCs in terms of risk include chromium and nickel, zinc, cyanide
- Incidental contaminants may also be present on the Site, (especially in the residual stockpiles) including:
  - Total Petroleum Hydrocarbons
  - Polynuclear, Aromatic Hydrocarbons
  - Organochlorine Pesticides
  - Polychlorinated Biphenyls
  - Asbestos

Adopted threshold criteria and rationale for COCs are presented in Section 2.3. Key COC properties relating to human health impact are as follows:

- **Antimony** is a non-essential element in humans, animals and plants and antimony compounds show toxic properties similar to those of arsenic including:
  - Adverse health impacts, if inhaled or ingested may include eye and lung irritation and heart and lung problems, stomach pain, diarrhea, vomiting, and stomach ulcers (SEWPaC 2012).
  - Little information is available on the transformations and transport of antimony in various environmental media (e.g. air, water, soil) and the mobility of antimony in soils is not clearly understood. Some studies indicate that antimony is highly mobile, while others conclude that it strongly adsorbs to soil. In water, it usually adheres to sediments.
- **Arsenic** has a high acute (short-term) toxicity to humans, aquatic life, birds and land animals. Organic arsenic compounds are very persistent in the environment and are

expected to bioaccumulate in fish and shellfish (SEWPaC 2012). Other properties are summarized as follows:

  - The immediate symptoms of acute arsenic poisoning include vomiting, abdominal pain and diarrhoea. These are followed by numbness and tingling of the extremities, muscle cramping and death, in extreme cases. The first symptoms of long-term exposure to high levels of inorganic arsenic (e.g. through drinking-water and food) are usually observed in the skin, and include pigmentation changes, skin lesions and hard patches on the palms and soles of the feet (hyperkeratosis). These occur after a minimum exposure of approximately five years and may be a precursor to skin cancer.
  - In addition to skin cancer, long-term exposure to arsenic may also cause cancers of the bladder and lungs. The International Agency for Research on Cancer (IARC) has classified arsenic and arsenic compounds as carcinogenic to humans, and has also stated that arsenic in drinking-water is carcinogenic to humans.
  - Other adverse health effects that may be associated with long-term ingestion of inorganic arsenic include developmental effects, neurotoxicity, diabetes and cardiovascular disease.

- **Mercury** and its compounds have high acute (short-term) and high chronic (long-term) toxicity on aquatic life. Ingestion of fish contaminated with mercury has potential to cause poisoning in humans, birds and land animals exposed in the same manner. Mercury and its compounds are highly persistent in water and the environment and will have the potential to bioaccumulate or concentrate in the tissues of fish. These concentrations will be considerably higher than the water from which the fish is taken (SEWPaC 2012).
  - Elemental and methylmercury are toxic to the central and peripheral nervous systems. The inhalation of mercury vapor can produce harmful effects on the nervous, digestive and immune systems, lungs and kidneys, and may be fatal. The inorganic salts of mercury are corrosive to the skin, eyes and gastrointestinal tract, and may induce kidney toxicity if ingested.
  - Neurological and behavioral disorders may be observed after inhalation, ingestion or dermal exposure of different mercury compounds. Symptoms include tremors, insomnia, memory loss, neuromuscular effects, headaches and cognitive and motor dysfunction. Mild, subclinical signs of central nervous system toxicity can be seen in workers exposed to an elemental mercury level in the air for several years. Kidney effects have been reported, ranging from increased protein in the urine to kidney failure.

7.7 Exposure assessment

Exposure assessment is the process of measuring or estimating the magnitude, frequency, and duration of exposure to a chemical or other substance in the environment, or estimating future exposures for a chemical that has not yet been released.

There are a number of potential human receptors of the contamination, provided an exposure pathway is present. During the recent investigations completed by GHD (2012 to 2014) the receptors have been classified as being present in the ‘Source Zone’, the ‘Impact Zone’, and the ‘Receptor Zone’.

Human health receptors identified in the Source Zone and Impact Zone include on site personnel that are involved in site works included in the Proposal, and users of surrounding land

Human health receptors identified in the Receptor Zone include recreational users of the lower portions of the wetland, Station Creek or Urunga Lagoon. The number of receptors using the

wetland and upper reaches of Station Creek are likely to be relatively small and restricted to people in kayaks/canoe. At Urunga Lagoon the number of receptors would be greater and their exposure increased through swimming. Residents/workers on adjacent properties are located along Hillside Drive and the Pacific Highway. Figure 2-2 shows the location of the residents to the site and include residential properties, Westella Motel and Stepping Stones Child Care.

Based on the identified receptors and the release, fate and transport characteristics of the contaminants, pathways through which human receptors may become exposed to contamination include inhalation, ingestion and dermal absorption of the contaminated material or affected sediments, surface water, groundwater or air. A summary of the potential contamination risks and risk to human receptors are presented in Table 7-5. These are discussed briefly below in the context of the site setting:

- There are 12 nearby properties to the site, consisting of:
  - Two residential properties and a motel to the west
  - Five residential properties and a motor vehicle repair shop to the north
- Two residential properties and a child care facility to the north east.
- Local meteorology indicates morning wind is predominantly from the southwest and afternoon wind is predominantly from the north east (refer to Section 6.3, air quality), therefore morning winds will likely be the time of greatest risk to occupants of surrounding properties, particularly the child care facility.
- Inhalation Exposure Pathway: There is the potential for a range of contaminants (especially antimony and arsenic) at the site's surface to be mobilised by wind and to be inhaled by human receptors in the form of dust. This pathway is considered to be significant.
- Secondary direct contact occurs where contaminated dust deposits in the surface soil and accumulates such that the concentrations in the ground reach levels that could be a risk through oral ingestion of soil, dermal contact through skin, uptake through home-grown produce and ingested, or deposited onto rooftops, contaminating drinking water supply. While these are generally considered to be significant pathways, the duration of the remediation project is expected to be less than 6 months, and therefore is highly unlikely that build-up of contaminated soils could occur in this timeframe to such an extent that these exposure routes become significant.
- There is no indication in the site history or previous investigations that volatile contaminants are likely to be present on the site. Although both cyanide and mercury can occur in vapour form, both have relatively low vapour pressures and no enclosed spaces are present or proposed at the site where vapours are likely to accumulate.

Table 7-5 Potential human contamination risks

Source	Identified Contaminant of Concern	Significant Pathway(s)	Potential Receptors of Concern			
			Source Zone and Impact Zone	Receptor Zone		
			Health	Health		
			Site workers/ visitors	Recreational users of adjacent land, waterways and lagoon	Residential users of adjacent land to the west of the Site	Northerly Residents and Stepping Stones Child Care
Tailings Deposits, former processing area and former unprocessed ore stockpile area	Heavy Metals (As, Sb, Pb, Cu, Hg), Cn	Migration via surface water				
		Leaching of contaminants to groundwater				
		Direct dermal contact				
		Dispersion of contaminants in dust and inhalation				
		Dispersion of contaminants in dust and deposition, followed by direct contact (ingestion, dermal, plant uptake, tank water)				
		Discharge of contaminated groundwater to surface water				
Fill Material	Heavy Metals (As, Sb, Pb, Cu, Al, Hg), Cn	Migration via surface water				
		Leaching of contaminants to groundwater				
		Direct dermal contact				
		Dispersion of contaminants in dust and inhalation				
		Dispersion of contaminants in dust and deposition, followed by direct contact (ingestion, dermal, plant uptake, tank water)				
		Discharge of contaminated groundwater to surface water				

Incidental Contamination (not assessed in this investigation)	Asbestos, TPH, PAH, OCPs and PCBs	Migration via surface water				
		Leaching of contaminants to groundwater				
		Direct dermal contact				
		Dispersion of contaminants in dust and inhalation				
		Dispersion of contaminants in dust and deposition, followed by direct contact (ingestion, dermal, plant uptake, tank water)				
		Discharge of contaminated groundwater to surface water				
Residual Contamination not Remediated	Heavy Metals (As, Sb, Pb, Cu, Hg), Cn	Migration via surface water				
		Leaching of contaminants to groundwater				
		Direct dermal contact				
		Dispersion of contaminants in dust and inhalation				
		Dispersion of contaminants in dust and deposition, followed by direct contact (ingestion, dermal, plant uptake, tank water)				
		Discharge of contaminated groundwater to surface water				

Estimated sensitivity to impact from potential contamination source

- NA or minimal potential for impact to receptor
- Potential for Impact to receptor
- High potential for impact to receptor

7.8 Risk characterisation

A risk characterisation conveys the risk assessor's judgment as to the nature and presence or absence of risks, along with information about how the risks were assessed, where assumptions and uncertainties still exist, and where policy choices will need to be made.

The main risks to human health from the Proposal are:

- Exposure to COC for site workers via inhalation of dust, and incidental oral exposure and dermal absorption of the contaminated material including affected soil, sediments, surface water, groundwater.
- Exposure to COC for nearby human receptors (including residents, children in Stepping Stones child care centre, commercial properties) via inhalation of dust, direct contact (oral and dermal) from accumulating dust deposition in surface soils, and ingestion via contamination of drinking water supply in water tanks on residential properties.
- Exposure to COC for the public via dermal contact of affected soil, sediments, surface water, groundwater, should they gain unauthorised access to site.
- Exposure to COC for recreational users of Station Creek via dermal absorption of surface water.

Health risk is a combination of exposure and toxicology. A high level of risk combined with high levels of toxicity is considered to be a high risk exposure situation. To reduce the risks to low, exposure levels must be reduced.

For an exposure to occur, a complete pathway must exist between the source of contamination and the receptor. Where the exposure pathway is incomplete, there is no exposure, and hence no risk.

An exposure pathway consists of the following elements:

- Source.
- Release mechanism (e.g. leaching, dust emission).
- Transport media (e.g. soil, groundwater, sediment, surface water, air).
- Exposure point, where the receptor comes in contact with the contamination.
- Exposure route (e.g. inhalation, ingestion, dermal contact).

Where the pathway for a chemical from the source to the receptor is incomplete, there is no incremental risk due to the presence of contamination.

Mitigation measures during site activities will be undertaken to eliminate (or minimise) the release mechanism, thereby cutting off transport of contamination to the potential receptors and minimising health risk. Mitigation measures are discussed in detail in Sections 7.2 (soils, sediment and water management), 7.3 (air quality and dust management) and 7.17 (Waste Management). The residual risk to human health, following implementation of mitigation measures is deemed to be low.

A summary of the mitigation measures for each receptor is presented in the following table.

Table 7-2 Summary of mitigation measures to manage health risk.

Source type	Transport mechanism	Receptors of concern	Mitigation measures
Impacted soil, sediment and water	Direct contact (oral, dermal) and dust inhalation	Onsite workers visitors to site during works Public gaining unauthorised access	Soils, sediments and water management (Section 7.2). Waste Management (Section 7.17) Health and Safety documentation for site works.
Impacted soil and sediment	Dust emission and deposition in surrounding properties, resulting in dust inhalation, direct contact (oral and dermal) with cumulating dust in surface soil, contamination of tank water collected off residential roof tops.	Surrounding residents Children in Stepping Stone child care centre Surrounding commercial properties.	Air quality and dust management (Section 7.3)
Impacted soil and sediments	Runoff overland flow, leaching to groundwater and discharge into surface water bodies.	recreational users of Station Creek via dermal absorption of surface water	Soils, sediments and water management (Section 7.2). Waste Management (Section 7.17)

7.9 Noise and vibration

The proposal has the potential to generate noise in the short term. Due to the nature of the proposal, the EPA has recommended a qualitative assessment noise assessment in accordance with the *Interim Construction Noise Guidelines* (DECC, 2009) (ICNG) as documented in Appendix I. The EPA also require that the CEMP detail a response plan to excessive noise levels and/or noise complaints.

The ICNG was developed to focus on applying a range of work practices most suited to minimise construction noise impacts, rather than focusing only on achieving numeric noise levels. While some noise from construction sites is inevitable, the aim of the ICNG is to protect the majority of residences and other sensitive land uses from noise pollution most of the time.

A qualitative assessment under the ICNG involves

- Identification of noise sources
- Identification of noise receivers
- Assessing the level of noise from the sources
- Implementing feasible and reasonable work practices to minimise or avoid noise.

7.9.1 Noise receivers

Sensitive, human noise receivers are similar to those identified as sensitive air quality receivers and are detailed in Table 7-3 and Figure 7-1. The nearest receivers to noise and vibration generated from the Proposal are private residences adjacent to Hillside Drive and the Pacific Highway including Stepping Stones Pre School and Child Care located at 12 Hillside Drive, to

the north east of the Site. The wetland and surrounding ecosystem comprise the nearest ecological receivers.

The Site is located adjacent to a residential area and the Pacific Highway where ambient noise levels are dominated by traffic using the Pacific Highway. In lieu of baseline noise monitoring data, a daytime background noise level at residential receivers has conservatively been assumed to be 35 dB(A) L_{90}. Due to the proximity of the Pacific Highway, it is likely daytime background noise levels would be higher.

7.9.2 Noise and Vibration Sources

Construction noise

The Proposal would result in the following potential noise and vibration sources:

- Vehicle movements during construction
- Machinery use including excavators, trucks, compaction equipment, chain-saws, generators and hand held tools.

These noise sources would be present during the civil works period. Upon completion, the works would not result in any additional noise or vibration sources. An assessment of noise impacts following the civil works period is not considered necessary.

Typical noise levels produced by the types of construction plants anticipated to be used were sourced from Australian standard AS 2436: 1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites* and from GHD's internal database. These represent the loudest construction noise sources expected to be found on site and are summarised in .

Table 7-6 Estimated Plant Item Noise Levels, dB(A)

Plant	Estimated sound power dB(A)	Estimated SPL dB(A) at Distance (m)						
		50	100	200	500	700	1000	1200
Dozer	105	63	57	51	43	40	37	35
Excavator	100	58	52	46	38	35	32	30
Back Hoe	97	55	49	43	35	32	29	27
Compactor	108	66	60	54	46	43	40	38
Loader	104	62	56	50	42	39	36	34
Roller	102	60	54	48	40	37	34	32
Dump Truck	102	60	54	48	40	37	34	32
Heavy Vehicle	103	61	55	49	41	38	35	33
Compressor	86	44	38	32	24	21	18	16

The magnitude of off-site noise impact associated with construction would be dependent upon a number of factors:

- The intensity of construction activities
- The location of construction activities
- The type of equipment used
- Intervening terrain
- The prevailing weather conditions.

During any given period, the machinery items to be used on-site would operate at maximum sound power levels for only brief stages. At other times, the machinery may produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all construction equipment would be operating at their maximum sound power levels at any one time.

Construction vibration

Energy from construction equipment is transmitted into the ground and transformed into vibrations, which attenuates with distance. The magnitude and attenuation of ground vibration is dependent on the following:

- The efficiency of the energy transfer mechanism of the equipment (i.e. impulsive, reciprocating, rolling or rotating equipment)
- The frequency content
- The impact medium stiffness
- The type of wave (surface or body)
- The ground type and topography

Due to the above factors, there is inherent variability in ground vibration predictions without site-specific measurement data. The NSW RTA *Environmental Noise Management Manual* provide typical construction equipment ground vibration levels at a distance of 10 metres from the source. The rate of vibration attenuation can be calculated from the following regression analysis formula:

$$V = kD^{-n}$$

where,

V = PPV

D = Distance

n = attenuation exponent. The value of n generally lies between 0.8 and 1.6 with a relatively common value of 1.5[1] .

The predicted ground vibrations at various distances are shown in Table 7-7 for typical construction equipment.

Table 7-7 Predicted Construction Equipment Vibration Levels (mm/s PPV)

Plant Item[2]	Human Perception Preferred Criteria *(Maximum Criteria)*		Predicted Ground Vibration				
	Day	Night	10 m	30 m	50 m	100 m	300 m
15t Roller	0.28 *(0.56)*	0.2 *(0.4)*	7.5	1.4	0.7	0.2	<0.1
Dozer	0.28 *(0.56)*	0.2 *(0.4)*	3.3	0.6	0.3	0.1	<0.1
7t compactor	0.28 *(0.56)*	0.2 *(0.4)*	6.0	1.2	0.5	0.2	<0.1
Backhoe	0.28 *(0.56)*	0.2 *(0.4)*	1	0.2	0.1	<0.1	<0.1

Table 7-7 indicates that vibration levels range from 1 mm/s to 7.5 mm/s at a distance of approximately 10 metres. Vibration levels are shown to drop below the human comfort criterion at a distance of approximately 100 metres.

[1] Construction Vibrations: State of the Art, John Wiss, 1981

[2] NSW RTA Environment noise management manual

7.9.3 Construction noise criteria

The ICNG provides guidance for assessment of construction noise. The guideline recommends standard hours for construction activities as:

- Monday to Friday: 7 am to 6 pm
- Saturday: 8 am to 1 pm
- No work on Sundays or Public Holidays

If the construction activities are proposed to be undertaken outside of the recommended standard hours, the ICNG acknowledges that the following activities may have justification for this on the basis of:

- The delivery of oversized plant or structure
- Emergency work
- Works for which it can be demonstrated that there is a need to operate outside the recommended standard hours

Table 7-8 details construction noise goals at the potentially impacted sensitive receivers.

Table 7-8 Construction Noise Goals, dB(A)

Receiver Type	Noise Management Level LAeq(15min)	
	Recommended Standard Hours	Outside Recommended Standard Hours
Residential Receivers	Noise affected level: 45 dB(A) Highly noise affected level: 75 dB(A)	Noise affected level: 40 dB(A)
Classrooms at school and other educational institutions	Internal noise level: 45 dB(A)	

The *noise affected level* represents the point above which there may be some community reaction to noise. Where the *noise affected level* is exceeded, all feasible and reasonable work practices to minimise noise should be applied and all potentially impacted residences should be informed of the nature of the works, expected noise levels, duration of works and a method of contact. The *noise affected level* is the background noise level plus 10 dB(A) during recommended standard hours and the background noise level plus 5 dB(A) outside of recommended standard hours.

The *highly noise affected level* represents the point above which there may be strong community reaction to noise. Where noise is above this level, any feasible and reasonable ways to reduce noise below this level should be carefully considered. If no quieter work method is feasible and reasonable, the impacted residence should be clearly explained the duration and noise levels of the works and any respite periods that would be provided. The ICNG sets the *highly noise affected level* during standard hours (e.g. day period) at 75 dB(A).

7.9.4 Vibration criteria

Human comfort criteria

Vibration criteria have been set with consideration to the DECCW "*Assessing Vibration: A technical Guideline, 2006*". BS 6472 – 1992, "*Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)*" is recognised in the guideline as the preferred standard for assessing the "human comfort criteria" for residential building types. The standard defines vibration limits in terms of Peak Particle Velocity (PPV) (mm/s). The BS 6472 human comfort peak vibration limits are shown in Table 7-9 for the frequency range of 8 Hz to 80 Hz which is applicable to construction works. These values are limits that may cause loss of amenity to the

occupant. BS 6472 also recognises that higher vibration levels are tolerable for short term construction projects as undue restriction on vibration levels can significantly prolong construction works and result in greater annoyance.

Table 7-9 Human Comfort Vibration Limits from 8 Hz to 80 Hz

Receiver Type	Period[3]	Continuous Vibration (mm/s PPV[4])		Intermittent and Impulsive Vibration (mm/s PPV[5])		Intermittent vibration dose value (VDV) ($m/s^{1.75}$)
		Preferred	Maximum	Preferred	Maximum	
Residential	Day	0.28	0.56	8.6	17	0.2
	Night	0.2	0.4	2.8	5.6	0.13

Structural Damage to Buildings

Currently, there is no Australian Standard that sets the criteria for the assessment of building damage caused by vibration. Guidance of limiting vibration values is attained from reference to German Standard *DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structures.*

Short-term vibration guideline values are presented in Table 7-10.

Table 7-10 Guideline Values for Short Term Vibration on Structures (DIN 4150-3)

Line	Type of structure	Guideline values for velocity, vi(t)[1] [mm/s]		
		1 Hz to 10 Hz	10 Hz to 50 Hz	50Hz to 100Hz[2]
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy.	5	5 to 15	15 to 20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order).	3	3 to 8	8 to 10

[1] The term v_i refers to vibration levels in any of the x, y or z axes.
[2] At frequencies above 100Hz the values given in this column may be used as minimum values.

7.9.5 Potential impacts

Based on a comparison of the potential noise and vibration levels (Section 7.9.2) with the noise and vibration criteria (Section 7.9.3 and 7.9.4), it is likely that the criteria will be exceeded at several receivers.

Accordingly, feasible and reasonable mitigation measures are presented in Section 7.9.6 to assist in minimising construction noise impacts, in accordance with the ICNG.

[3] Day is between 7 am and 10 pm and night is between 10 pm and 7 am.

[4] Based on sinusoidal vibration sources

[5] Based on sinusoidal vibration sources

Some activities such as excavation, rolling and compacting may produce levels of vibration that are perceptible and potentially intrusive when construction activities are located within 50 m of a residence.

Vibration levels are, however expected to be well below the most stringent structural damage criteria of 3 mm/s at receivers located at distances greater than 30 m. Where vibrations are perceptible and intrusive, however residents may have the perception that structural damage is being caused.

Vibration mitigation measures detailed in 7.9.6 should be considered if construction works are within 30 m of residents.

The construction works will be transient in nature, which is likely to significantly mitigate the reaction to construction noise and vibration.

Potential impacts of noise and vibration on ecology are addressed in Section 7.10.

7.9.6 Mitigation measures

The following measures are recommended to minimise potential noise and vibration impacts of the Proposal.

Impact	Environmental safeguards	Responsibility	Timing
Noise and Vibration	A noise monitoring plan would be developed as part of the CEMP.	Contractor	Pre-Construction
	Community consultation is to be carried out including: • Informing potentially noise affected neighbours about the nature of the construction stages and the duration of noisier activities. • Keeping potentially noise affected neighbours up to date on progress. • Providing contact details on a site board at the front of the site, and maintaining a complaints register. • Asking about any concerns that potentially noise affected neighbours may have and discuss possible solutions. • Providing a copy of the CEMP including noise management details, if requested.	Crown Lands	Pre-Construction
	Construction activities would be scheduled during the recommended construction hours (i.e. 7am to 6pm Monday to Friday. 8am to 1pm Saturdays).	Contractor	Construction
	All site workers would be informed during the site induction and regular toolbox about the potential for noise impacts on local residents and encouraged to take all practical and reasonable measures to minimise noise during the course of their activities.	Contractor	Construction
	All equipment would be inspected during routine plant checks to ensure they are in good working order. Machines found to produce excessive noise compared to normal industry expectations would be removed from the site or stood down until repairs or modifications can be made.	Contractor	Construction
	Use alternatives to ‘beeper’ style movement alarms on the	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	equipment most commonly used onsite (e.g. broadband style 'quacker' alarms). Arrange the work site to minimise the use of movement alarms on vehicles and mobile plant.		
	Use radio communication as opposed to 'horn beep' communication between machinery where practicable.	Contractor	Construction
	Locate noisy plant away from potentially noise affected neighbours or behind barriers, such as sheds.	Contractor	Construction
	As far as possible noise mitigation measures will be applied such as minimising materials dropping heights into or out of trucks, locating noise sources so as to avoid direct line of sight with noise receivers and facing ventilation or exhaust openings away from noise receivers.	Contractor	Construction
	The idling of machinery and equipment when not in use for prolonged periods of time is to be minimised.	Contractor	Construction
	Time awareness for vibration intensive activities should be implemented through scheduling these activities during the least sensitive time periods and sequencing operations so that vibration intensive activities do not occur simultaneously.	Contractor	Construction

7.10 Biodiversity

An ecological assessment was completed by GHD, is presented in Appendix H and is summarised in the following subsections.

7.10.1 Methodology

The key tasks in the ecological assessment included:

- A desktop review of available reports (including a previous investigation for the Site: Redpath, P. and Body, M., 2003), data and maps. Database searches for threatened biota, including TSC Act and FM Act species and matters of national environmental significance (MNES under the EPBC Act).
- A site inspection for flora and fauna and noting the general nature and condition of the habitats present and their relevance to potential threatened biota, including an assessment of habitats for threatened species, populations and ecological communities (as listed under the TSC Act) and the wetland adjoining the SEPP 14 listed wetland.
- Preparation of a preliminary vegetation map of the site, using available data (e.g. aerial imagery, vegetation data and contours).
- An overview assessment of the significance of potential impacts on threatened biota (as listed under the TSC Act and FM Act), according to the 7-part test under Section 5A of the EP&A Act.
- Identification of suitable measures to mitigate and/or offset potential impacts.

7.10.2 Existing environment

Desktop investigation

The Redpath and Body (2003) assessment identified:

- 21 vulnerable fauna species, three endangered fauna species, one threatened species, and four vegetation communities with no threatened flora species, from a records and database searches.
- 73 fauna species recorded on site, including one endangered species and six vulnerable species including:
  - Black-necked Stork (*Ephippiorhynchus asiaticus*) – endangered
  - Australasian Bittern (*Botaurus poiciloptilus*) – vulnerable
  - Glossy-black Cockatoo (*Calyptorhynchus lathami*) – vulnerable
  - Grey Crowned Babbler (*Pomatostomus temporalis*) – vulnerable
  - Mangrove Honeyeater (*Lichenosstomus fasciogularis*) – vulnerable
  - Northern Long-eared Bat (*Nyctophilus bifax*) – vulnerable
  - Little Bent-wing Bat (*Miniopterus australis*) – vulnerable
- Four vegetation communities:
  - Swamp sclerophyll forest
  - Wet sclerophyll forest
  - Dry sclerophyll forest
  - Weed dominated vegetation

The BioNet Search returned a total of 6,147 records of 956 species from which GHD generated a likelihood of occurrence table for threatened species, populations and ecological communities under the TSC Act that are likely to occur within the study area or that may occur because there is habitat present within the study area.

Species listed under the NSW TSC Act assessed as ‘likely’ to occur or ‘may occur’ given the available and suitable habitat within the site included:

- Three endangered or threatened ecological communities
- Two vulnerable or endangered plant species
- One endangered or vulnerable frog species
- Ten vulnerable and one endangered bird species
- Eight vulnerable mammal species
- Six migratory marine species

A search of the DPI (Fishing and Aquaculture) Threatened and protected species – records viewer returned no species for the Site.

Species listed under the EPBC Act assessed as ‘likely’ to occur or ‘may occur’ given the available and suitable habitat within the site included:

- 1 endangered and 2 vulnerable plant species
- 6 migratory marine species
- 2 migratory wetland species

Flora

Key observations of flora from the site investigation conducted on May 14 2013 included:

- The site was not in use at the time of the survey. The site has historically been substantially cleared and contained disused rusting equipment and infrastructure.
- The wetland contained vegetated areas, and areas where vegetation had died but remained standing.
- A dilapidated artificial drainage system located within the cleared section still served to direct stormwater across the site and into the adjacent wetland.
- The wetland was located in the south east of the site, and its extent and depth is likely to vary according to seasonal conditions and rainfall.
- Native vegetation has been removed from much of the site as a result of historical clearing. There was some indication that regeneration of native vegetation has occurred in some parts of the site.
- Three vegetation communities (as shown in Figure 7-5) were present on site including:
  - *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions* – An endangered ecological community immediately adjacent to the wetland to the west and east.
  - *Dry Grassy Blackbutt-Tallowwood Open Forest of the central parts of the North Coast of NSW* comprising the remainder of the site that is not in the low lying areas. It is dominated by *Eucalyptus pilularis* (Blackbutt) or *E. microcorys* (Tallowwood).
  - *Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* – An endangered ecological community dominated by sedges approximately one metre tall such as *Baumea articulata, Eleocharis equisetina* and *Lepironia articulata* as well as floating species in more open water spaces such as *Ludwigia peploides* subsp *montevidensis.*
- Areas of high weed density were observed within the study area. Species observed are listed in Table 7-11 including their NSW Department of Primary Industries (Agriculture) Noxious Weed Listing under the Noxious Weeds Act 1993, and inclusion on the list of Weeds of National Significance (WONS).

Table 7-11 Weed species observed within the site

Botanical name	Common name	Declaration status*
Ageratina adenophora	Crofton Weed	Class 4
Ageratum houstonianum	Blue Billy Goat Weed	
Andropogon virginicus	Whisky Grass	
Asparagus sp.	Asparagus Fern	
Chrysanthemoides monilifera	Boneseed	Class 4
Bidens pilosa	Farmers' Friends	
Colocasia esculenta	Elephants Ear (Taro)	
Cortaderia sp.	Pampas Grass	Class 4
Cotoneaster glaucophyllus	Cotoneaster	
Desmodium uncinatum	Silver-leaved Desmodium	

Botanical name	Common name	Declaration status*
Erythrina crista-galli	Coral Tree	
Gymnocoronis spilanthoides	Senegal Tea (unconfirmed)	Class 1
Ipomoea cairica	Morning Glory Vine	
Lantana camara	Lantana	Class 4 & WONS
Monstera deliciosa	Fruit Salad Plant	
Musa sp.	Banana Palms	
Paspalum dilatatum	Paspalum	
Rubus fruticosus sp.	Blackberry	Class 4
Schefflera actinophylla	Umbrella Tree	
Senna pendula var. glabrata	Easter Cassia	
Solanum mauritianum	Wild Tobacco Plant	

*NSW *Noxious Weeds Act 1993* declaration status includes:

Class 1 The plant must be eradicated from the land and the land must be kept free of the plant

Class 2 The plant must be eradicated from the land and the land must be kept free of the plant

Class 3 The plant must be fully and continuously suppressed and destroyed

Class 4 The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction and the plant must not be sold propagated or knowingly distributed



1:1,500 (at A3)

0 10 20 40 60 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Lot
- Contour
- SEPP14
- Approx. Extent of Clearing
- Dry Grassy Blackbutt - Tallowwood (GBT)
- Sedgeland / Rushland - Freshwater Wetland (FW)
- Paperbark - Swamp Sclerophyll Forest (SSF)
- Paperbark - Swamp Sclerophyll Forest (SSF) (dead)
- Cleared / exotic
- Regrowth

GHD

CLIENTS | PEOPLE | PERFORMANCE

NSW Catchment and Lands- Crown Lands
Former Antimony Processing Plant, Urunga NSW

Job Number 22-16251
Revision A
Date 25 Jun 2014

Vegetation Communities on Site

Figure 7-5

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© 2012. Whilst every care has been taken to prepare this map. GHD, LPI, DoPI and OEH make no representations or warranties about its accuracy, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred as a result of the product being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: LPI, Aerials 2012, DTDB, 2012; OEH, vegetation mapping, 2014; DoPI, SEPP14, 2013. Created by: gmcdiarmid, fmackay, tmorton

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Fauna

Key observations of fauna from the site investigation conducted on 14 May 2013 included:

- Observations or evidence of fauna on site including bandicoots, wallabies, frogs (Eastern Sedge Frog, *Litoria fallax*), woodland birds and snakes.
- Fauna habitat as described in Table 7-12.
- It is likely that bat, microbat and flying fox activity would be prevalent in association with the wetland because of the likelihood of flying insects as a food source and in association with the surrounding vegetation where flowering plants provide food for nectivorous species. No grey-headed flying fox camp site was observed.
- Given the proximity to the coast, to the estuary, to other wetlands and to dense vegetation, there are extensive and diverse habitat types present within and immediately adjacent to the Site. Many species of wetland birds, including listed migratory species would be likely occur at least on an occasional basis at the site.

Table 7-12 Habitat types observed on site

Habitat types	Description and potential fauna type present
Closed forest	Forest with a canopy and dense shrub layer with some emergent trees, reduced light availability, higher humidity than more open areas providing habitat especially for birds, arboreal and ground-dwelling mammals, reptiles, invertebrates
Paperbark forest	Inundated, partially inundated or periodically inundated, providing habitat for semi-aquatic species or those dependent on aquatic species as a food source such as invertebrates, frogs, reptiles, bats, microbats
Open forest edges / clearings	Forest edges and cleared areas provide thoroughfares for many species, partially forest habitat and adjacent open spaces providing an increased diversity in available habitat types allowing larger mammals access, and flight paths for many birds and bats
Casuarina forest	May be dense or sparse and provides particular habitat for black cockatoos of many species
Mudflats	Provides forage habitat for many waterbirds, marine and aquatic at this location
Sedgelands	Provide aquatic habitat with emergent vegetation particularly beneficial to breeding aquatic species such as dragonflies
Aquatic	Providing habitat for fish and other aquatic species requiring permanent or semi-permanent fresh to slightly brackish water. Provides forage for bats and microbats above the water's surface

7.10.3 Potential impacts

Potential negative impacts on flora and fauna through exposure to contaminants are discussed in the Detailed Investigation Report (GHD 2012b). Environmental receptors to the contamination include:

- The SEPP 14 Wetland adjacent to the Site.

- Terrestrial flora and fauna that inhabit or visit the site.
- Aquatic and benthic flora and fauna inhabiting the wetland and canals.
- Aquatic and benthic flora and fauna inhabiting the lower portions of the wetland, Station Creek and Urunga Lagoon.

Based on the identified receptors and the release, fate and transport characteristics of the contaminants, pathways through which receptors may become exposed to contamination include inhalation, ingestion and dermal absorption of the contaminated material or affected sediments, surface water, groundwater or air. These are discussed briefly below in the context of the site setting:

- Ingestion Exposure Pathway: Ingestion of COCs by benthic and aquatic fauna. Many COCs also have the potential to bioaccumulate.
- Dermal Exposure Pathway: The contaminants may enter via sorption through biological membranes such as skin or gills. Exposure to the contaminants in the soil via this pathway could be of concern to ecological health in the vicinity of the Site. However, dermal exposure could also be a major concern where contaminated sediments, groundwater or surface water come into direct contact with benthic and aquatic flora and fauna, adding to the bioaccumulation occurring through ingestion.
- Inhalation Exposure Pathway: There is the potential for a range of contaminants (especially antimony and arsenic) at the site's surface to be mobilised by wind and to be inhaled by receptors in the form of dust.

There is no indication in the site history or previous investigations that volatile contaminants are likely to be present on the site. Although both cyanide and mercury can occur in vapour form, both have relatively low vapour pressures and no enclosed spaces are present or proposed at the site where vapours are likely to accumulate. Based on this, vapour phase contamination is not considered a significant exposure pathway.

As a remediation project, the long term impacts on the environment are likely to be positive, including a reduction in contaminant concentrations in the soil, sediment, surface water and groundwater. This would, in turn lead to the positive long term impacts of re-established vegetation on areas that have been devoid of vegetation for approximately fifty years, providing potential fauna habitat and increased ecological amenity.

Potential, short term negative impacts on ecology from the Proposal may include:

- Clearing of low grade, terrestrial vegetation which is likely to include the native vegetation that has re-established since operations ceased, as well as some native vegetation along the boundaries of the disturbed area.
- Clearing of aquatic vegetation including the dead trees in the wetland. This will result in short term removal of habitat and short term potentially negative impacts on water quality associated with erosion, sedimentation and increased contaminant concentrations prior to the positive, long term impacts of reduced contamination and increased ecological amenity.

- Disturbance of soil leading to potential for runoff, sedimentation and changes in water quality in the adjacent wetland.
- Impacts from machinery and equipment on local fauna from construction machinery (direct mortality or injury from collision), as well as the impacts of noise, exhaust fumes on air quality and the vibration created by earthmoving equipment.
- Spread of weeds.
- Increased edge effects on remnant adjacent vegetation. The current edges of the site are well vegetated and form an informal barrier to weed incursions further into the adjacent vegetation communities. Disturbance to this 'barrier' vegetation is likely to result in the re-establishment of a new 'edge' which may result in a reduction in the condition of the adjacent vegetation patch and a greater weed incursion.

The SEPP 14 wetland boundary as presented in the figures in this EIS is approximate only and does not represent the true boundary, however it is likely that some work will be carried out in approximately 2,500 m^2 of the SEPP 14 wetland. Work will include clearing of impacted (low health) vegetation and excavation of sediment. As discussed above, although the work may result in the short term removal of habitat and short term potentially negative impacts on water quality associated with erosion, sedimentation and increased contaminant concentrations, these impacts will be offset by positive long term impacts on the wetland through a reduction in contaminant concentrations in the sediment and surface water. This will in turn lead to increased vegetation health and ecological amenity.

7.10.4 Assessment of significance of the potential impacts

An assessment of the significance of the potential impacts identified on threatened biota was carried out via a 7-part test under Section 5A of the EP&A Act. The test was carried out for the following species, based upon their likelihood of occurrence:

- Leafless Tongue-orchid (*Cryptostylis hunteriana*)
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South Easter Corner Bioregions
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions
- Swamp Sclerophyll Forest on Coast Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions
- Wallum Froglet (*Crinia tinnula*) - vulnerable
- Australasian Bittern (*Botaurus poiciloptilus*) - vulnerable
- Black Bittern (*Ixobrychus flavicollis*) - vulnerable
- Black-necked Stork (*Ephippiorhynchus asiaticus*) – endangered
- Brolga (*Grus rubicunda*) – vulnerable

- Comb-crested Jacana (*Irediparra gallinacea*) – vulnerable
- Eastern Grass Owl (*Tyto longimembris*) – vulnerable
- Eastern Osprey (*Pandion cristatus*) - vulnerable
- Glossy-black Cockatoo (*Calyptorhynchus lathami*) - vulnerable
- Little Eagle (*Hieraaetus morphnoides*) - vulnerable
- Mangrove Honeyeater (*Lichenostomus fasciogularis*) – vulnerable
- Rose-crowned Fruit-dove (*Ptilinopus regina*) – vulnerable
- Square-tailed Kite (*Lophoictinia isura*) – vulnerable
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) – vulnerable
- Eastern Freetail-bat (*Mormopterus norfolkensis*) – vulnerable
- Eastern Long-eared Bat (*Nyctophilus bifax*) – vulnerable
- Greater Broad-nosed Bat (*Scoteanax rueppellii*) – vulnerable
- Grey-headed Flying-fox (*Pteropus poliocephalus*) - vulnerable
- Little Bent-wing Bat (*Miniopterus australis*) – vulnerable
- Southern Myotis (*Myotis macropus*) - vulnerable

Key points from the assessment concluded:

- Due to the degraded nature of the habitats present in the site, it is unlikely that these species would be solely dependent on the Site for their lifecycle.
- Given the availability of adjacent and nearby habitats, it is not considered likely that the proposed action would have an adverse effect on the life cycle of any of the species considered likely to occur or that may occur on the Site.
- It is not considered likely that the Proposal will adversely affect the extent of the EEC such that the local occurrence is likely to be placed at risk of extinction as the site and the proposed disturbance footprint represent a small portion of the adjoining Swamp Sclerophyll Forest.
- The vegetation within or in close proximity to the site has been impacted by the antimony processing plant in the past and impacts are continuing to spread from the Site. The proposed remediation is expected to halt the spread of these impacts and to reinstate, as far as practicable, the site to its pre-disturbed condition.
- Given the degraded and weed infested nature of the Site, it is not considered likely that the proposed action will modify the composition of the ecological community such that its local occurrence would be placed at risk of extinction. At the completion of remediation works, it is expected that there will be an overall improvement in the conditions of the site.
- The extent of habitat that may be removed as part of the proposed action is limited and consists primarily of highly modified and weed infested vegetation, or vegetation in poor condition due to the local site conditions, or both, thus it is not

considered likely to provide core habitat for any listed threatened species. It is not considered that the extent of habitat to be removed is significant given the area of adjacent similar ecological community in better condition.

- Habitats on site have predominantly been historically cleared, and it is not considered likely that the Proposal will significantly further fragment or isolate habitats.
- It is not considered that the habitat that will be removed for the remediation works is of importance to threatened species, as it is not likely to be core habitat for listed threatened species, while the wetland has previously been degraded. Similar ecological communities are present in the region and will persist to support threatened species if they occur.
- The action of remediation is considered to be generally supportive of recovery and abatement of threat for the Site and its associated flora and fauna.
- Whilst vegetation clearing constitutes a key threatening process, the aim of the remediation works is to remove a threat and reduce the level of ongoing impact resulting from past land use practices. Vegetation clearing is necessary to complete the remediation works. It will only result in a short term impact, with longer term improvement in the Site and local/regional ecological conditions expected.

In conclusion, based on the results of the ecological assessment and the 7-part test in conjunction with the implementation of an environmental management plan during the works phase, it is considered that the proposed remediation works would be unlikely to significantly impact threatened species, populations or ecological communities.

A species impact statement is therefore not considered necessary under the *Threatened Species Conservation Act 1995 or* Commonwealth *Environment Protection and Biodiversity Conservation Act 2000*.

7.10.5 Mitigation measures

The following mitigation measures are recommended to minimise the potential impacts identified in relation to flora and fauna.

Impact	Environmental safeguards	Responsibility	Timing
Biodiversity	As part of job-site induction prior to arrival on-site, awareness of ecology related issues would be provided for relevant staff.	Contractor	Pre-construction
	The Vegetation Management Plan is to include details of weed management to prevent the spread of introduced species and declared noxious plants recorded within the study area.	Contractor	Pre-construction
	The extent of clearing is to be clearly marked prior to clearing works commencing.	Contractor	Pre-construction
	Where possible, time the remediation works during the dry season and to avoid the common fauna breeding season (e.g. Black-necked Stork in Spring)		

Impact	Environmental safeguards	Responsibility	Timing
	in order to reduce the impact on local fauna		
	An inspection of the works area for fauna is to be completed immediately prior to commencement of the proposed works (each day), by a site staff member. Should injured fauna be found on the site, local wildlife care groups and/or veterinarians are to be contacted immediately.	Contractor	Construction
	Establish sediment barriers to avoid contamination flowing into the downstream wetland areas, monitor and maintain	Contractor	Construction
	Conduct an inspection of any hollow bearing trees before or immediately after falling. Should injured fauna be found, local wildlife care groups and/or veterinarians are to be contacted immediately	Contractor	Construction
	Remove only the wetland vegetation (dead and alive) that is necessary to achieve the remediation outcomes agreed	Contractor	Construction
	Retain fallen timber and the weed-seed-free vegetation waste on-site for habitat or mulched for revegetation and landscaping work	Contractor	Construction
	Provide a fertile topsoil surface at the completion of the remediation works by importing certified clean and appropriate soils.	Contractor	Construction
	Revegetate to reduce the amount of exposed/bare ground in order to restore similar-to-local conditions	Contractor	Construction
	Implement a water quality monitoring program prior to the commencement of remediation works (parameters will be determined following initial water quality data collection and analysis). Undertake water quality testing weekly during remediation, and monthly for two years after completion (or as directed by the approval authority). Include water monitoring at two other downstream locations, including the estuary and the downstream wetland	Contractor	Construction
	Complete weed hygiene procedures prior to plant and machinery entering the site to reduce the risk of new weed species being introduced.	Contractor	Construction

7.11 Aboriginal heritage

7.11.1 Existing environment

A search of the Aboriginal Heritage Information Management System (AHIMS) database found that no Aboriginal sites or places have been recorded in or near the Proposal footprint. The results of the search are contained Appendix J. An area to the south of the wetland (outside of the Proposal) was subject to a successful Aboriginal land claim in 1985, by the CHDLALC. Due to the emerging contamination issue, a portion of the claim adjacent to the wetland was removed in 1997. This area removed from the claim was

increased in 2002 to provide a larger buffer between the claim area and the contaminated wetland. The plan showing these notional boundaries is provided in Appendix J.

The CHDLALC was also consulted as part of the EIS process. This included a site inspection by two CHDLALC cultural heritage officers. The letter from CHDLALC is included in Appendix J and findings included:

- No objects of Aboriginal origin were located or identified.
- The property's northern boundary (where the current dwelling and entry points to the property are located) holds strong potential to contain potential archaeological deposits (PAD) and this area should be void of any earth disturbance activities. Should earth disturbance activities be required in this area further consultation with CHDLALC should be sought prior to the activities.
- All other areas of the property are deemed to be culturally sterile due to the previous land use activities, however an unexpected find procedure should be developed to give directions to staff should any unexpected find occur.
- Should any objects be suspected to be of Aboriginal origin be uncovered during the works all works must cease immediately in the vicinity of the find and CHDLALC notified immediately to allow inspection of objects and clearance granted for works to recommence in that area.

7.11.2 Potential impacts

A potential impact exists for previously unrecorded Aboriginal sites uncovered during the Proposal however, given the historical high levels of disturbance from previous Site operations, the potential impact on potential Aboriginal sites is deemed to be minimal.

In the location of the potential PAD, identified by the CHDLALC, there is a higher potential for Aboriginal sites to be uncovered. As the PAD area will only be used for access and stockpiling, no excavation would occur within the PAD. In consultation with CHDLALC and OEH, it is proposed to lay geofabric on the surface and construct a workable platform to avoid disturbing the existing ground surface. All material would be removed at the completion of the remediation. It is therefore considered unlikely that any potential Aboriginal items would be damaged.

7.11.3 Mitigation measures

The following measures are recommended to minimise potential impacts of the Proposal on Aboriginal Heritage.

Impact	Environmental safeguards	Responsibility	Timing
Aboriginal heritage	The Coffs Harbour and District Local Aboriginal Land Council (CHDLALC) is to be consulted prior to earth disturbance activities adjacent to the property's northern boundary (where the current dwelling and entry points to the property are located) as the LALC believe the area holds strong potential to contain potential archaeological deposits (PAD).	Crown Lands	Pre-Construction
	The area of the PAD would be covered in geofabric and sub base (or similar material) to avoid disturbing the ground surface of the area.	Contractor	Construction
	If Aboriginal heritage items are uncovered during the works, all works in the vicinity of the find must cease and the Project Manager contacted immediately. The Coffs Harbour and District Local Aboriginal Land Council (CHDLALC), as the local authority for cultural heritage in this area, is then to be contacted. Works in the vicinity of the find must not recommence until clearance has been received from CHDLALC, the Cultural Heritage Division of OEH and the Project Manager.	Contractor	Construction
	Should human remains be found all works in the vicinity of the find must cease and NSW Police contacted. Works in the vicinity of the find must not recommence until clearance from the Police and OEH.	Contractor	Construction

7.12 Non-Aboriginal heritage

7.12.1 Existing environment

Reviews of relevant heritage databases were conducted including:

- Commonwealth Heritage Register
- Australian Heritage Database
- NSW Heritage Register
- World Heritage List
- Bellingen LEP 2010

Results of the database searches are presented in Appendix K.

Twenty nine items listed by local government and state agencies were listed in the vicinity of Urunga however none were within 500 metres of the Site.

7.12.2 Potential impacts

As no recorded non-Aboriginal heritage sites were identified within 500 metres of the Site, the potential impact on non-Aboriginal heritage is minimal.

7.12.3 Mitigation measures

The following measures are recommended to minimise potential impacts of the Proposal on non-Aboriginal Heritage.

Impact	Environmental safeguards	Responsibility	Timing
Non-Aboriginal heritage	If any items defined as relics under the NSW Heritage Act 1977 are uncovered during the works, all works must cease in the vicinity of the find and the Project Manager contacted immediately.	Contractor	Construction

7.13 Traffic

A Traffic Impact Assessment (TIA) was completed for the Proposal. The TIA is contained in Appendix L and a summary is provided below.

7.13.1 Existing environment

Key roads in the surrounding area are the Pacific Highway and Hillside Drive.

Pacific Highway

The Pacific Highway is a national road transport route along Australia's east coast. In Urunga, the Pacific Highway is the primary road route from Nambucca Heads through Urunga to Coffs Harbour. Construction is currently underway of an upgrade of the Pacific Highway. The Nambucca to Urunga section is scheduled for completion in 2016.

In the township of Urunga, the Pacific Highway has a sign posted speed limit of 50km/hr. A fixed speed camera is located on the road 100 metres south-west of the intersection of Pacific Highway and Hillside Drive.

There is one lane in each direction with lanes line-marked 3.5 metres wide with sealed shoulders varying from 0.5 to 1.0 metres wide. .

In 2007, approximately 10,550 vehicles per day used the Pacific Highway at this location

Hillside Drive

The intersection of Pacific Highway and Hillside Drive is a rural basic left turn in the minor road (BAL). There is no pavement widening allowing traffic to pass around right tuning vehicles on the Pacific Highway and there are no auxiliary lanes provided for accelerating or decelerating vehicles.

Hillside Drive is approximately 7 metres wide with no line marking. The road provides direct access for residential properties, generally located on the northern side of Hillside

Drive. SO-type kerb is located in front of properties. There is no formal drainage on the southern side of Hillside Drive.

The Average Daily Traffic on Hillside Drive was 401 in 1995.

Crash history

Crash history on the roads in close proximity of the study area was provided by Roads and Maritime Services (RMS) for the period between January 2009 and December 2013.

During the 5 year reporting period, there were 26 crashes recorded, one crash causing fatalities, 10 injury crashes and 15 non-casualty crashes. 22 of these crashes occurred on the Pacific Highway. On the Pacific Highway, 8 crashes were attributed to rear-end type.

There was one crash on The Pacific Highway reported at the intersection of Hillside Drive, a rear-end type crash. There were no crashes reported on Hillside Drive.

There were two crashes recorded on High Street, both off bend into object type. There were also two crashes reported on Pilot Street, both off road into object types.

Sight distance

The recommended safe intersection sight distance is 97 metres and a minimum gap sight distance of 69 metres for a 50 km/hr speed zone. Site measurements indicated that visibility for vehicles turning from Hillside Drive onto the Pacific Highway have approximately 250 metres line of sight available in each direction. The sight distance at Hillside Drive is also within the recommendations of Austroads.

7.13.2 Potential impacts

At its peak, the site would be expected to generate 60 truck movements and 20 staff movements per day. The likely traffic volumes at the Hillside Drive intersection were be estimated, and compared with design warrants in the Austroads Guide to Road Design Part 4A. Based on this warrant, and the relatively low volume of traffic that would be turning into and out of Hillside Drive, no intersection upgrade is considered necessary. Further, the increase in traffic activity will be for a relatively short period of time, and the available sight distance in all directions is very good.

Haulage route

Haulage of materials would primarily be between the site and the Pacific Highway via Hillside Drive, for distribution onto the wider network. Routes will depend on the source and destination of materials.

Impact on vulnerable road users

There are no dedicated facilities for pedestrians or cyclists on Hillside Drive. Given the relatively low traffic volumes on the road and the scale of traffic increase expected, there is not expected to be any deterioration in safety for pedestrians or cyclists. Similarly, there will be no direct impact on any existing bus stops, or bus services.

There are no school zones with the study area. As such, there will be no impact to the safety of school zones.

On-site traffic management

The site will be accessed via Hillside Drive. A site office and amenities block will be located within the site. At this location, there is expected to be sufficient space for the manoeuvring and parking of staff vehicles, and other site vehicles as required.

Traffic movement within the site will depend on the task being undertaken at the time. Vehicle access paths will be established to suit the specific activities being undertaken.

Details of the long term use of the Site have not yet been finalised however a passive public space/recreational use is likely. This may result in a minor increase in vehicles parking along Hillside Drive and increased on-site pedestrian access. This development would be subject to a separate application.

7.13.3 Mitigation measures

The following measures are recommended to minimise potential impacts of the Proposal on traffic.

Impact	Environmental safeguards	Responsibility	Timing
Traffic and access	A detailed Traffic Management Plan would be prepared and appended to the CEMP, which would include such measures to provide safe access points to work areas from the adjacent road network, temporary speed restrictions when necessary, adequate sight distances and prominent warning signage.	Contractor	Pre-construction
	Residents in the vicinity of the access tracks must be consulted in regard to access issues.	Crown Lands	Pre-construction
	No machinery or vehicles are to park along Hillside Drive overnight.	Contractor	Construction
	Vehicle access is to be maintained to all driveways along Hillside Drive.	Contractor	Construction
	Access tracks are to be stabilised or rehabilitated following completion of the works.	Contractor	Construction

7.14 Visual amenity

7.14.1 Existing environment

As shown in the photographs presented in Section 1.3, the Site consists of

- A disturbed area incorporating the various features associated with the former antimony processing facility, that is largely devoid of vegetation
- A tailings area of approximately one hectare that is devoid of vegetation, extending from the former processing area into an adjacent wetland
- A generally forested area adjacent (south of) the wetland

- Surface material (within the disturbed areas) consisting of imported fill and tailings
- Some remaining infrastructure consisting mainly of foundations of the former processing facility and loading ramps
- Several remaining stockpiles of ore, rubbish and bricks
- Visually impacted (dead) *melaleuca* trees in the wetland area, adjacent to the tailings deposit

The site is visible from the Pacific Highway (Photographs 6-1 to 6-5) and Hillside Drive (Photographs 6-5 to 6-7), however the view is partially obscured by the surrounding vegetation and the low-lying aspect of the Site.

The most sensitive visual receptors are the residents of 99 Pacific Highway Urunga, and the Westella Motel (107 Pacific Highway). Their views of the site are currently, partially obscured by vegetation along the northern and western boundaries. Where practicable, this vegetation will remain, however some will be removed as part of the works and will give a clear line of sight into the project.

Other residents along Hillside Drive have views of the access points to the site but limited views of the proposed containment cell area.



Photograph 7-1 View of site from Pacific Highway, adjacent to Westella Motel



Photograph 7-2 View of site from Pacific Highway



Photograph 7-3 View of site from Pacific Highway



Photograph 7-4 View of site from Pacific Highway and Hillside Drive



Photograph 7-5 View of site from Hillside Drive



Photograph 7-6 View of site from Hillside Drive

7.14.2 Potential impacts

The Proposal will be visible by:

- Users of the Pacific Highway and Hillside Drive
- Residents of 99 Pacific Highway Urunga
- Residents and patrons of the Westella Motel (107 Pacific Highway)
- Residents along Hillside Drive, who will have views of the access point roads but limited views of the proposed containment cell area.

Potential short-term negative visual impacts would result from:

- Vegetation removal
- Development of the access road
- Presence of construction machinery, compounds, stockpiles, erosion and sediment control structures
- Discolouration (sedimentation) of the wetland
- Presence of waste and soil stockpiles

Potential long term visual impacts would result from:

- Changes to topography from earthworks and construction of the containment cell
- Removal of the tailings deposit
- Removal of waste and derelict infrastructure
- Removal of the fence and warning signs
- Increased extent of the wetland
- Removal of the impacted melaleuca trees

- Presence of vegetation following revegetation
- Presence of recreational users of the site

As the Proposal is a remediation project, most of the long term, potential impacts on visual amenity are considered to be positive.

7.14.3 Mitigation measures

The following measures are recommended to minimise potential impacts associated with visual amenity by the Proposal.

Impact	Environmental safeguards	Responsibility	Timing
Visual Amenity	Prior to the commencement of Proposal, nearby affected visual receptors (residents) would be notified and informed of the range of activities to be conducted and likely visual impacts.	Crown Lands	Pre-Construction
	The Vegetation Management Plan (as an appendices to the CEMP) is to be developed that will document the proposed landscaping of the remediated site (with consideration of visual screening for neighbours, vegetation species selection, a five year maintenance program and weed control).	Contractor	Pre-Construction
	Disturbance to soil and vegetation outside of the work area is to be minimised.	Contractor	Construction
	Vehicle and equipment movement would be confined to established designated roads, access tracks and compound site/ temporary materials stockpile area.	Contractor	Construction
	Work areas are to be stabilised progressively during the works.	Contractor	Construction
	The finished levels of the containment cell and excavation are would be as consistent as possible with the surrounding landscape	Contractor	Construction
	Rehabilitation and seeding works are undertaken as soon as possible following completion of the proposed works. The rehabilitation is to be consistent with the surrounding vegetation communities.	Contractor	Post-construction
	All erosion and sediment control structures, compounds, stockpiles and the perimeter fence are to be removed once the site has been rehabilitated.	Contractor	Post-construction
	Working areas are to be maintained, kept free of rubbish and cleaned up at the end of each working day.	Contractor	Demolition

7.15 Socio-economic

7.15.1 Existing environment

The Proposal is located within the Bellingen Shire. The Shire has a population of approximately 14,000 people and Urunga has a population of approximately 2,000 people. The main economic drivers in the area are tourism, fisheries and agriculture.

The Site is located to the south of a residential area. The Stepping Stones Pre School and Child Care is located at 12 Hillside Drive, to the north east of the Site.

The Site is currently fenced and locked with signs warning of the contaminated nature of the Site. As mentioned previously, the Site drains to Urunga Lagoon and then the Bellinger River which are both popular recreational locations for fishing, boating, swimming, etc.

As discussed in Section 6.1, consultation with the community has been undertaken at various phases throughout the site investigation and EIS process.

7.15.2 Potential Impacts

In general, community feedback indicated there was very little opposition to the Proposal as a remediation project is considered to offer significant benefits to the community.

Most socio-economic impacts of the Proposal were positive including:

- Increased recreational amenity of the site and surrounds
- Decreased potential risk to human health, as discussed in Section 7.4 including decreased potential for contaminants to be accumulated in fish downstream of the site
- Increased visual amenity, as discussed in Section 7.14
- Short term benefit of the creation of approximately ten to twenty jobs for a period of 6 months during the Proposal

With tourism being one of the main industries in the area, housing for employees during Site works would be adequate.

During the civil works, there would be short-term, potentially negative impacts on amenity and access which have been assessed in the following sections of the EIS:

- Traffic and access (Section 7.13)
- Noise and vibration (Section 7.4)
- Visual amenity (Section 7.14)
- Air quality (Section 7.3)
- Water quality (Section 7.2)

Overall, the socio-economic impacts of the Proposal are considered to be positive.

7.15.3 Mitigation measures

The following measures are recommended to minimise potential impacts on the community.

Impact	Environmental safeguards	Responsibility	Timing
Socio-economic	Where possible, construction workers would be sourced locally to minimise the number of workers needing to relocate to the area.	Contractor	Construction
	Where possible, construction materials would be sourced from local industries and manufacturers.	Contractor	Construction
	In the extreme event where contaminated material spills from the site containment structures, the following will be undertaken: • notification to EPA of environmental spill • notification to Bellingen Shire Council who have authority to preclude access to waterways • installation of temporary signage (pre-printed) to preclude access to selected parts of Urunga Lagoon and Station Creek • monitoring of water quality at Urunga Lagoon • reopening access once test results show water quality is safe for recreational use under the appropriate guidelines	Crown Lands	Pre and during Construction

7.16 Demand on resources

7.16.1 Existing environment

The local area has access to a range of resources. There is a constant demand on these resources from existing development and current construction projects. The most significant current demand on local resources is from the Pacific Highway Upgrade works.

7.16.2 Potential impacts

The Proposal would require the following resources:

- Clay material will be required for construction of the low permeability barriers in the containment cell. Quantities have not been calculated however it is estimated that up to 12,000 m^3 may be required. This material will be sourced from an approved, offsite source.
- Depending on how much material is required and how much can be sourced from onsite, up to 5000 m^3 of topsoil may be required to provide a growing medium for vegetation.
- Unconfirmed quantities of other materials will be required including geotextile, jute mesh and plants. These will be sourced from local suppliers.

- Petrol, diesel and lubricating oils in quantities required for the operation of machinery would be sourced from local suppliers.
- Soil treatment chemicals (including lime).
- Plants for revegetation, sourced from local nurseries.
- Labour, machinery and equipment from local contractors.
- Water as required for dust suppression.

The materials would be sourced locally and imported to site. All required materials are readily available and would not adversely affect the abundance of existing energy sources or their supply.

7.16.3 Mitigation Measures

The following measures are recommended to minimise potential impacts of the Proposal on resource availability.

Impact	Environmental safeguards	Responsibility	Timing
Demand on resources	Procurement must endeavour to use materials and products with a recycled content where that material or product is cost and performance effective.	Contractor	Construction
	Excavated material must be reused on-site for fill wherever feasible.	Contractor	Construction

7.17 Waste management

7.17.1 Existing environment

The overall objectives of the Proposal is to remove waste from the receiving environment. and the selected remediation option minimises use of municipal landfill facilities and off-site transport of waste.

The Proposal is anticipated to result in the following waste:

- 28,000 m^3 of waste soil for containment
- Waste water resulting from dewatering
- Debris and materials from existing stockpiles (including metal and potential asbestos containing material)
- Bricks stockpiled in the northern portion of the Site
- Two ‘mercury plugs’ located immediately west of the processing area
- Cleared weeds
- Construction waste - excess material generated during construction (eg concrete, geotextile etc)

- Human waste collected in the portable toilets
- General waste generated by construction employees, such as food wrappings, drink bottles and damaged safety equipment e.g. gloves

Details relating to the disposal of the waste material are outlined in the RAP (Appendix E) including (as per the DGRs):

- The assessment, handling, treatment and transportation of the contaminated soil and sediment
- Stockpiling of wastes or recovered materials and procedures to prevent cross contamination at the site
- Waste processing related to the project, including reuse, recycling, reprocessing or treatment (including immobilisation) both on and off site
- Methods for disposing of all wastes or recovered materials generated by the Proposal
- Dewatering
- The proposed controls for managing the environmental impacts of these activities

All waste disposal, re-use and recycling options were investigated as part of the RAP as discussed in Section 3.3. An assessment of the potential risks (on site and off site) associated with the disturbance, transfer and disposal of the contaminated material details of mitigation and management measures to minimise human health risks during the handling of the contaminated material are also outlined in the RAP and Section 7.2.

Any material generated during the Proposal that is proposed to leave site will require appropriate licences and approvals, (treatment if required), transport and disposal of the material in accordance with statutory requirements.

Details of waste management are to be included in the CEMP that details arrangements for management, transport and/or disposal of any waste generated would need to be included in the Contractor's EMP. If required, a Waste Management Register would be kept detailing the types and amounts of waste collected, when, by whom, and to where it was transported and disposed.

One of the main legislative instruments for the management of waste in NSW is the *Waste Avoidance and Resource Recovery Act 2001* which aims to achieve a reduction in waste generation and turning waste into a recoverable resource. Resource and waste management is prioritised according the principles of the resource management hierarchy as defined in the Act. The POEO (Waste) Regulation 2005 regulates the management and disposal of waste. Any contaminated soil leaving Site would need to be tracked during transportation and would need to be removed by an appropriately licensed waste transporter to an appropriately licensed waste facility. Section 143 of the POEO Act provides that it is an offence to transport waste to a place that cannot be used as a waste facility for that waste.

The waste hierarchy consists of the following:

- Avoidance of unnecessary resource consumption

- Resource recovery (including reuse, reprocessing, recycling and energy recovery)
- Disposal

As discussed in Section 3.5, approximately 3% of the waste (contaminated soil and sediment) identified onsite would remain as it is not deemed beneficial to remove that material. The potential negative impacts on those areas that would occur from remediation are deemed to exceed the potential positive impacts from contaminant removal.

7.17.2 Potential impacts

- The waste generated has the potential to impact soil and water quality, worker safety, visual amenity and biodiversity.

Potential negative impacts relating to management of waste soil and water include:

- Mobilisation of COCs through dust, stormwater or leachate generated from exposed soils or failure of the containment cell
- Exposure of workers to COCs during the Proposal
- Contamination of soil, surface water or groundwater from oil or chemical spills, especially where machinery is working in the water
- Acidification of surface water and groundwater and mobilisation of COCs through the exposure of acid sulfate soils
- Releasing contaminated groundwater into adjacent surface waters
- Mixing of contaminated surface waters with uncontaminated or lesser contaminated groundwater
- Groundwater infiltrating or moving through an on-site containment structure and releasing contaminated leachate

The containment cell has been designed to provide secure long-term containment of contaminated material without unacceptable environmental impact or health risk and minimise ongoing management requirements by the land holder (eg. avoid long-term leachate management requirements).

If the wastes are managed according to Section 7.17.3, the risk of a significant impact as a result of waste is considered low.

The long term operation of the Proposal (containment management) is unlikely to produce significant waste emissions.

7.17.3 Mitigation measures

Mitigation measures to minimise the impact of waste on human receptors and the environment are provided in:

- Soil, sediment and water (Section 7.2)
- Human health (Section 7.4)

- Air quality (Section 7.3)

The following measures are recommended to minimise potential impacts of the Proposal via generation of waste.

Impact	Environmental safeguards	Responsibility	Timing
Waste management	Resource management hierarchy principles are to be followed including: • Avoid unnecessary resource consumption as a priority. • Resource recovery (including reuse of materials, reprocessing, recycling and energy recovery). • Disposal.	Contractor	Planning phase
	The PM shall ensure that waste arising from the works is removed and disposed of in accordance with the requirements of the NSW EPA and WorkCover Authority, together with the relevant legislative requirements, namely: • Work Health and Safety Act, 2011 and Regulations, 2011. • Contaminated Land Management Act, 1997 and Regulations, 2008. • Protection of the Environment Operations Act, 1997 and Regulations, 2008. • EPA's Waste Classification Guidelines 2008.	Contractor	Planning phase
	Excess materials must be disposed of according to the following (in order): • Reuse onsite. • Removal by a contractor for reuse or sale (where approved). • Disposal at an approved materials recycling or waste disposal facility. • As otherwise provided for by the relevant waste legislation.	Contractor	Planning phase and Construction
	Site inductions must include appropriate waste management actions.	Contractor	Pre-construction
	Disposal of materials would not be permitted on any land on or around the site, except at approved locations.	Contractor	Construction
	Working areas are to be maintained, kept free of rubbish and cleaned up at the end of each working day.	Contractor	Construction
	The site is to have security fence installed to prevent unauthorised public access including warning signs.	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	Waste material is not to be left on site once the works have been completed, apart from the residual contaminated soil and water outside of the remediation area.	Contractor	Construction
	Garbage receptacles must be provided and recycling of materials encouraged. Rubbish would be transported to an appropriate waste disposal facility.	Contractor	Construction
	Toilet facilities must be provided for workers.	Contractor	Construction
	Waste is not to be burnt on site.	Contractor	Construction

7.18 Cumulative impacts

Cumulative impacts can result from a combination of impacts from the Proposal and other, unrelated projects being carried out in a similar geographic area.

The only identified existing, approved or proposed operations that may be carried out in the vicinity of the site include upgrade works on the Pacific Highway. If carried out concurrently, these works will have short term, cumulative impacts such as those relating to increased traffic, noise and demand on resources including labour, machinery and accommodation. No long term cumulative impacts are anticipated.

8. Environmental management

8.1 Implementation process

The safeguards and mitigation measures to protect the environment during the construction and operation of the Proposal are identified in Sections 7.2 to 7.18 of this EIS and summarised below in Section 8.2.

These are to be further developed in the CEMP that forms part of the construction documentation. The CEMP would include the allocation of responsibilities for implementing the environmental management safeguards and mitigating measures, and would be prepared by the construction contractor (yet to be determined in a separate process), and approved by Crown Lands prior to construction commencement.

An Environmental Officer (EO) is to be nominated by the construction contractor to assume day to day operational responsibility for ensuring that the protection and mitigation measures contained within the CEMP are implemented, for monitoring the effectiveness of these measures, for investigating possible improvements to these measures and for preparing and supplying the supplementary plans that are to accompany the CEMP.

In summary, it is the responsibility of all to ensure that environmental protection measures are implemented and that the environment is protected to the highest standard during construction and operation of the Proposal. On-going monitoring and improvement, if practicable, of the safeguard and mitigation measures would ensure the impacts on the environment are minimised throughout the life of the Proposal.

8.2 Summary of proposed safeguards

Table 8-1 provides a summary of all the recommended mitigation measures and safeguards discussed in this EIS for inclusion in the CEMP.

Table 8-1 Summary of mitigation measures

No.	Impact	Environmental safeguards	Responsibility	Timing
1	Soil and water quality	All site work is to be undertaken in accordance with the RAP.	Contractor	Pre and during construction
2	Soil and water quality	The site is to have security fence installed to prevent unauthorised public access including warning signs.	Crown Lands	Pre-construction
3	Soil and water quality	Soil and water management will be documented in the CEMP including details of erosion and sediment control. Stormwater and groundwater management details are to include: • Implement erosion and sediment controls in accordance with *Urban Stormwater Manual Volume 1 7 2* (Blue Book) and IECA Guidelines. • Install perimeter controls of contaminated area in the wetland. • Separation and diversion of uncontaminated stormwater away or through the site. • Management of stormwater and dewatering from the remediation areas which will include a sediment basin to allow treatment before discharge (if required). Discharge of water from the remediation or treatment areas will be avoided if possible, with water to be managed within the remediation areas by return to excavations where dewatering is no longer required, or used for dust suppression / moisture control of stockpiles and material to be placed in the containment cell. • Setup washdown bay that drains to sediment basin. • Remediation design to allow for flooding and expected climate change	Contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		water level increases. • Considering impermeable barriers around groundwater inflow sections of excavations • Minimising inflow groundwater into sections of excavations, using temporary barriers (eg. sheet piling), if required. • Groundwater assessment and treatment details (prior to discharge into the environment). The CEMP is also to outline a procedure for the containment and management of sediment laden site water, dewatering and regular inspection, maintenance and cleaning of erosion and sediment controls.		
4	Soil and water quality	Floating, hydrocarbon booms with barrier silt curtains are to be placed in the wetland, encompassing all areas of excavation or potential run-off from the Proposal.	Contractor	Pre and during construction
5	Soil and water quality	Acid sulfate management is to be addressed as part of the CEMP, in accordance with the ASSMAC Guidelines (Ahern, C.R., Stone, Y. and Blunden, B. 1998). The ASSMAC should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.	Contractor	Pre-construction
6	Soil and water quality	Spill Management Procedures (SMP) for spills of fuels, oils or chemicals would be developed for inclusion in the CEMP. The SMP would include procedures for the capture and removal of spills, the location and maintenance of emergency spill equipment on site (e.g. spill kits), and 24 hour contact numbers for key agencies required in the case of an emergency response. All staff are to be made aware of the location of the spill kit and trained in its use.	Contractor	Pre-Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
7	Soil and water quality	A detailed WHS Management Plan is to be developed that outlines methods for minimising exposure of workers to COCs.	Contractor	Pre-Construction
8	Soil and water quality	Work areas are to be divided into two zones with dynamic boundaries as work progresses being defined as 'Contaminated' and 'Uncontaminated' and having strict protocols within and between these zones to minimise cross contamination	Contractor	Construction
9	Soil and water quality	Where possible, excavation of material within the PMF level is to be conducted outside of the historic flood times (i.e. conduct works between June and January).	Contractor	Construction
10	Soil and water quality	Stockpiled material would be located and stored away from drainage lines and clean water diversion drains would be installed to protect stockpiles from flowing waters. Stockpiles are to be managed in accordance with *Urban Stormwater Manual Volume 1 7 2 (Blue Book)* and IECA Guidelines.	Contractor	Construction
11	Soil and water quality	Machinery used to operate within the water in the wetland is to be thoroughly cleaned prior to entry onto the site and visibly inspected for leaks prior to entry into the water. Oil or grease present on machinery that has potential to enter the waterway is to be cleaned off using an absorbent cloth prior to entry into the water.	Contractor	Construction
12	Soil and water quality	Visual monitoring of water quality in the wetland (i.e. hydrocarbon spills/slicks) is to be undertaken to identify any potential spills. This is to be conducted on a daily basis and on an hourly basis when machinery is working within 10 metres of the water surface.	Contractor	Construction
13	Soil and water quality	Work would be suspended in periods of heavy rain and machinery would be removed from the flood zone during flood events.	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
14	Soil and water quality	Disturbance to soil and vegetation outside of the work area is to be minimised. Where the work area is not obvious (eg tailings area, stockpile areas and access roads), the work area is to be delineated with a visual indicator (e.g. tape).	Contractor	Construction
15	Soil and water quality	Vehicle and equipment movement would be confined to established designated work areas, roads, access tracks and compound site/ temporary materials stockpile area.	Contractor	Construction
16	Soil and water quality	A vehicle washdown bay would be provided for plant and equipment leaving the contaminated zone. This shall comprise of a hardstand area for pressure cleaning plant and equipment before leaving site. Wastewater from the washdown bay is to be directed to a controlled area.		
17	Soil and water quality	A shaker grid will be provided for plant and equipment leaving the uncontaminated zone to remove soil d from vehicle tyres. Where material is inadvertently transported onto pavement surfaces (e.g. Hillside Drive, via truck tires) is to be assessed and removed as required. Material spilled from trucks onto any roads is to be removed immediately.	Contractor	Construction
18	Soil and water quality	Erosion and sediment control devices would be maintained and monitored daily during construction and left in situ until the site has been stabilised.	Contractor	Construction
19	Soil and water quality	Disturbed areas are to be stabilised progressively, where practicable, during the works.	Contractor	Construction
20	Soil and water quality	Where previously unidentified contaminants (e.g. asbestos, drums containing chemicals, staining) are identified during works by observation of any unusual physical/sensory characteristics, work is to cease, the area isolated and	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		appropriate advice sought from the Project Manager/Superintendent.		
21	Soil and water quality	The refuelling of plant and maintenance of machinery would be undertaken in an impervious, bunded area, above the probable maximum flood level. Drip trays are also to be used when refuelling.	Contractor	Construction
22	Soil and water quality	All fuels, chemicals, and liquids would be managed as to prevent potential impact on the surface and groundwater. Machinery fuel and soil treatment reagents are to be stored in an impervious, bunded area (with 110 per cent capacity of the largest container) within the compound site, when not being used.	Contractor	Construction
23	Soil and water quality	Plant and equipment would be inspected regularly to ensure there are no leakages of fuel, oil and hydraulic fluid.	Contractor	Construction
24	Soil and water quality	Vehicle wash downs are not to occur onsite, apart from the removal of contaminants prior to machinery leaving site. Wash downs are to take place in a designated area with appropriate controls to prevent hydrocarbon contamination.	Contractor	Construction
25	Soil and water quality	All erosion and sediment control structures are to be removed once the site has been stabilised.	Contractor	Post-construction
26	Soil and water quality	Ongoing monitoring of the containment cell including groundwater and surface water is to be carried out, as required by the EPA and other relevant regulatory authorities.	Crown Lands	Post-construction
27	Soil and water quality	The containment cell is to be managed in accordance with the RAP and any additional requirements identified through ongoing monitoring.	Crown Lands	Post-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
28	Air Quality	Provide the community with a well-publicised contact point to report any dust concerns to both the contractor and landowner.	Crown Lands	Pre- Construction
29	Air Quality	A detailed dust monitoring plan will be developed as part of the Site CEMP.	Crown Lands	Pre- Construction
30	Air Quality	Site workers are to wear appropriate personal protective equipment to satisfy WorkCover requirements and minimise exposure to dust and associated contaminants.	Contractor	Construction
31	Air Quality	Dust monitoring is to be carried out at three locations in total, including the: • Westella Motel • Stepping Stones Pre School • Residence at the intersection of the Pacific Highway and Hillside Drive, adjacent to the site. Monitoring will be undertaken using real-time dust monitors in accordance with DEC's "Approved Method for the Sampling and Analysis of Air Pollutants in NSW" guidelines. Real-time dust monitoring results are to be displayed and trigger values set to alarm the contractor when the following criteria is met: 24-hour average PM10=50 µg/m3 Works are to cease immediately if dust plumes from site activities are visible at nearby sensitive receptors. Dust mitigation measures are to be revised if the incremental dust deposition levels exceed the relevant dust criteria. If mitigation measures cannot achieve the relevant criteria, all dust-creating work must cease until conditions improve to a	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		point that the criteria can be met.		
32	Air Quality	During strong southerly or south-easterly winds, dust generating activities will cease or employ high level management (eg. continual spraying, or full enclosure). Where possible, high dust risk activities will be scheduled during low wind or northerly directional wind.	Contractor	Construction
33	Air Quality	Stockpiles or areas that may generate dust are to be managed to suppress dust emissions (i.e. through application of water sprays or covering/re-vegetating).	Contractor	Construction
34	Air Quality	Specific routes for haulage and access would be designated and vehicle speeds would be limited to 15 km/hr.	Contractor	Construction
35	Air Quality	All trucks carrying soil to or from the site are to be covered. Haulage within the site will be managed via either a retractable cover, dust control spray or allowing a reasonable space between the top of the load and top of the trailer.	Contractor	Construction
36	Air Quality	If significant dust generation is observed from a particular activity, water carts would be used to suppress dust.	Contractor	Construction
37	Air Quality	Construction areas and stockpiles would be pre-watered before they are disturbed and watering would continue during any activities where fugitive dust may be produced.	Contractor	Construction
38	Air Quality	Existing vegetation would be retained where possible and cleared areas and stockpiles would be revegetated as soon as practicable with fast growing species for rapid coverage to temporarily or permanently stabilise soil.	Contractor	Construction and Post-construction
39	Air Quality	Water sprays are to be used where soil is mixed/sifted as part of the treatment process.	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
40	Air Quality	Works are not to be carried out during strong winds or in weather conditions where high levels of dust or air borne particulates are likely (dry, windy).	Contractor	Construction
41	Air Quality	Vehicles transporting waste or other materials offsite that may produce odours or dust are to be covered during transportation.	Contractor	Construction
42	Air Quality	All construction plant, equipment, vehicles and machinery would be maintained in accordance with manufacturer's specifications in order to meet the requirements of the Protection of the Environment Operations Act, 1997 and associated regulations.	Contractor	Construction
43	Air Quality	Vehicles and operating equipment used on site are to be switched off when not operating in order to minimise exhaust emissions from vehicles and other equipment operating.	Contractor	Construction
44	Air Quality	Vegetation or other materials are not to be burnt on site.	Contractor	Construction
45	Air Quality	All air quality complaints must be addressed within 24 hours.	Contractor	Construction
46	Noise and Vibration	A noise monitoring plan would be developed as part of the CEMP.	Contractor	Pre- Construction
47	Noise and Vibration	Community consultation is to be carried out including: ◗ Informing potentially noise affected neighbours about the nature of the construction stages and the duration of noisier activities. ◗ Keeping potentially noise affected neighbours up to date on progress. ◗ Providing contact details on a site board at the front of the site, and maintaining a complaints register. ◗ Asking about any concerns that potentially noise affected neighbours may have	Crown Lands	Pre-Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		and discuss possible solutions. Providing a copy of the CEMP including noise management details, if requested.		
48	Noise and Vibration	Construction activities would be scheduled during the recommended construction hours (i.e. 7am to 6pm Monday to Friday. 8am to 1pm Saturdays).	Contractor	Construction
49	Noise and Vibration	All site workers would be informed during the site induction and regular toolbox about the potential for noise impacts on local residents and encouraged to take all practical and reasonable measures to minimise noise during the course of their activities.	Contractor	Construction
50	Noise and Vibration	All equipment would be inspected during routine plant checks to ensure they are in good working order. Machines found to produce excessive noise compared to normal industry expectations would be removed from the site or stood down until repairs or modifications can be made.	Contractor	Construction
51	Noise and Vibration	Use alternatives to 'beeper' style movement alarms on the equipment most commonly used onsite (e.g. broadband style 'quacker' alarms). Arrange the work site to minimise the use of movement alarms on vehicles and mobile plant.	Contractor	Construction
52	Noise and Vibration	Use radio communication as opposed to 'horn beep' communication between machinery where practicable.	Contractor	Construction
53	Noise and Vibration	Locate noisy plant away from potentially noise affected neighbours or behind barriers, such as sheds.	Contractor	Construction
54	Noise and Vibration	As far as possible noise mitigation measures will be applied such as minimising materials dropping heights into or out of trucks, locating noise sources so as to avoid direct line of sight with noise receivers and facing ventilation or exhaust	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		openings away from noise receivers.		
55	Noise and Vibration	The idling of machinery and equipment when not in use for prolonged periods of time is to be minimised.	Contractor	Construction
56	Noise and Vibration	Time awareness for vibration intensive activities should be implemented through scheduling these activities during the least sensitive time periods and sequencing operations so that vibration intensive activities do not occur simultaneously.	Contractor	Construction
57	Biodiversity	As part of job-site induction prior to arrival on-site, awareness of ecology related issues would be provided for relevant staff.	Contractor	Pre-construction
58	Biodiversity	The Vegetation Management Plan is to include details of weed management to prevent the spread of introduced species and declared noxious plants recorded within the study area.	Contractor	Pre-construction
59	Biodiversity	The extent of clearing is to be clearly marked prior to clearing works commencing.	Contractor	Pre-construction
60	Biodiversity	Where possible, time the remediation works during the dry season and to avoid the common fauna breeding season (e.g. Black-necked Stork in Spring) in order to reduce the impact on local fauna		
61	Biodiversity	An inspection of the works area for fauna is to be completed immediately prior to commencement of the proposed works (each day), by a site staff member. Should injured fauna be found on the site, local wildlife care groups and/or veterinarians are to be contacted immediately.	Contractor	Construction
62	Biodiversity	Establish sediment barriers to avoid contamination flowing into the downstream wetland areas, monitor and maintain	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
63	Biodiversity	Conduct an inspection of any hollow bearing trees before or immediately after falling. Should injured fauna be found, local wildlife care groups and/or veterinarians are to be contacted immediately	Contractor	Construction
64	Biodiversity	Remove only the wetland vegetation (dead and alive) that is necessary to achieve the remediation outcomes agreed	Contractor	Construction
65	Biodiversity	Retain fallen timber and the weed-seed-free vegetation waste on-site for habitat or mulched for revegetation and landscaping work	Contractor	Construction
66	Biodiversity	Provide a fertile topsoil surface at the completion of the remediation works by importing certified clean and appropriate soils.	Contractor	Construction
67	Biodiversity	Revegetate to reduce the amount of exposed/bare ground in order to restore similar-to-local conditions	Contractor	Construction
68	Biodiversity	Implement a water quality monitoring program prior to the commencement of remediation works (parameters will be determined following initial water quality data collection and analysis). Undertake water quality testing weekly during remediation, and monthly for two years after completion (or as directed by the approval authority). Include water monitoring at two other downstream locations, including the estuary and the downstream wetland	Contractor	Construction
69	Biodiversity	Complete weed hygiene procedures prior to plant and machinery entering the site to reduce the risk of new weed species being introduced.	Contractor	Construction
70	Aboriginal heritage	The Coffs Harbour and District Local Aboriginal Land Council (CHDLALC) is to be consulted prior to earth disturbance activities adjacent to the property's northern boundary (where the current dwelling and entry points to the property are located) as the LALC believe the area holds strong potential to contain potential	Crown Lands	Pre-Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		archaeological deposits (PAD.		
71	Aboriginal heritage	The area of the PAD would be covered in geofabric and sub base (or similar material) to avoid disturbing the ground surface of the area.	Contractor	Construction
72	Aboriginal heritage	If Aboriginal heritage items are uncovered during the works, all works in the vicinity of the find must cease and the Project Manager contacted immediately. The Coffs Harbour and District Local Aboriginal Land Council (CHDLALC), as the local authority for cultural heritage in this area, is then to be contacted. Works in the vicinity of the find must not recommence until clearance has been received from CHDLALC, the Cultural Heritage Division of OEH and the Project Manager.	Contractor	Construction
73	Aboriginal heritage	Should human remains be found all works in the vicinity of the find must cease and NSW Police contacted. Works in the vicinity of the find must not recommence until clearance from the Police and OEH.	Contractor	Construction
74	Non-Aboriginal heritage	If any items defined as relics under the NSW Heritage Act 1977 are uncovered during the works, all works must cease in the vicinity of the find and the Project Manager contacted immediately.	Contractor	Construction
75	Traffic and access	A detailed Traffic Management Plan would be prepared and appended to the CEMP, which would include such measures to provide safe access points to work areas from the adjacent road network, temporary speed restrictions when necessary, adequate sight distances and prominent warning signage.	Contractor	Pre-construction
76	Traffic and access	Residents in the vicinity of the access tracks must be consulted in regard to access issues.	Crown Lands	Pre-construction
77	Traffic and access	No machinery or vehicles are to park along Hillside Drive overnight.	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
78	Traffic and access	Vehicle access is to be maintained to all driveways along Hillside Drive.	Contractor	Construction
79	Traffic and access	Access tracks are to be stabilised or rehabilitated following completion of the works.	Contractor	Construction
80	Visual Amenity	Prior to the commencement of Proposal, nearby affected visual receptors (residents) would be notified and informed of the range of activities to be conducted and likely visual impacts.	Crown Lands	Pre-Construction
81	Visual Amenity	The Vegetation Management Plan (as an appendices to the CEMP) is to be developed that will document the proposed landscaping of the remediated site (with consideration of visual screening for neighbours, vegetation species selection, a five year maintenance program and weed control).	Contractor	Pre- Construction
82	Visual Amenity	Disturbance to soil and vegetation outside of the work area is to be minimised.	Contractor	Construction
83	Visual Amenity	Vehicle and equipment movement would be confined to established designated roads, access tracks and compound site/ temporary materials stockpile area.	Contractor	Construction
84	Visual Amenity	Work areas are to be stabilised progressively during the works.	Contractor	Construction
85	Visual Amenity	The finished levels of the containment cell and excavation are would be as consistent as possible with the surrounding landscape	Contractor	Construction
86	Visual Amenity	Rehabilitation and seeding works are undertaken as soon as possible following completion of the proposed works. The rehabilitation is to be consistent with the surrounding vegetation communities.	Contractor	Post- construction

No.	Impact	Environmental safeguards	Responsibility	Timing
87	Visual Amenity	All erosion and sediment control structures, compounds, stockpiles and the perimeter fence are to be removed once the site has been rehabilitated.	Contractor	Post-construction
88	Visual Amenity	Working areas are to be maintained, kept free of rubbish and cleaned up at the end of each working day.	Contractor	Demolition
89	Socio-economic	Where possible, construction workers would be sourced locally to minimise the number of workers needing to relocate to the area.	Contractor	Construction
90	Socio-economic	Where possible, construction materials would be sourced from local industries and manufacturers.	Contractor	Construction
91	Socio-economic	In the extreme event where contaminated material spills from the site containment structures, the following will be undertaken: • notification to EPA of environmental spill, • notification to Bellingen Shire Council who have authority to preclude access to waterways • installation of temporary signage (pre-printed) to preclude access to selected parts of Urunga Lagoon and Station Creek • monitoring of water quality at Urunga Lagoon • reopening access once test results show water quality is safe for recreational use under the appropriate guidelines	Crown Lands	Pre and during Construction
92	Demand on resources	Procurement must endeavour to use materials and products with a recycled content where that material or product is cost and performance effective.	Contractor	Construction
93	Demand on	Excavated material must be reused on-site for fill wherever feasible.	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
	resources			
94	Waste management	Resource management hierarchy principles are to be followed including: • Avoid unnecessary resource consumption as a priority. • Resource recovery (including reuse of materials, reprocessing, recycling and energy recovery). • Disposal.	Contractor	Planning phase
95	Waste management	The PM shall ensure that waste arising from the works is removed and disposed of in accordance with the requirements of the NSW EPA and WorkCover Authority, together with the relevant legislative requirements, namely: • Work Health and Safety Act, 2011 and Regulations, 2011. • Contaminated Land Management Act, 1997 and Regulations, 2008. • Protection of the Environment Operations Act, 1997 and Regulations, 2008. • EPA's Waste Classification Guidelines 2008.	Contractor	Planning phase
96	Waste management	Excess materials must be disposed of according to the following (in order): • Reuse onsite. • Removal by a contractor for reuse or sale (where approved). • Disposal at an approved materials recycling or waste disposal facility. As otherwise provided for by the relevant waste legislation.	Contractor	Planning phase and Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
97	Waste management	Site inductions must include appropriate waste management actions.	Contractor	Pre- construction
98	Waste management	Disposal of materials would not be permitted on any land on or around the site, except at approved locations.	Contractor	Construction
99	Waste management	Working areas are to be maintained, kept free of rubbish and cleaned up at the end of each working day.	Contractor	Construction
100	Waste management	The site is to have security fence installed to prevent unauthorised public access including warning signs.	Contractor	Construction
101	Waste management	Waste material is not to be left on site once the works have been completed, apart from the residual contaminated soil and water outside of the remediation area..	Contractor	Construction
102	Waste management	Garbage receptacles must be provided and recycling of materials encouraged. Rubbish would be transported to an appropriate waste disposal facility.	Contractor	Construction
103	Waste management	Toilet facilities must be provided for workers.	Contractor	Construction
104	Waste management	Waste is not to be burnt on site.	Contractor	Construction
105	Hazards and risks	Store dangerous goods in an appropriately bunded area	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
106	Hazards and risks	Keep and maintain spill control kits at appropriate locations and ensure all staff are trained in their use	Contractor	Construction
107	Hazards and risks	Use a specific refuelling vehicle equipped with an approved fuel dispenser, for refuelling	Contractor	Construction
108	Hazards and risks	Maintain a register of dangerous goods on site	Contractor	Construction
109	Hazards and risks	If available, use a safe alternative to the dangerous good	Contractor	Construction
110	Hazards and risks	Ensure that bushfire management procedures are addressed in the CEMP	Contractor	Construction
111	Hazards and risks	Prepare and implement a WHS Plan	Contractor	Construction

8.3 Monitoring requirements

Short term surface water, groundwater, erosion and sediment control, air quality, fauna, noise generation, plant and equipment, fuel leak and waste generation monitoring requirements are outlined in Section 7.

The site will also require long-term monitoring to assess potential long term impacts of contaminated material remaining onsite in the containment cell and residual contaminated material outside of the remediation area. A Long Term Management and Monitoring Plan will be developed in accordance with the requirements of the EPA. The Long Term Management Plan will include:

- Background information
- A description of remediation and containment
- A risk assessment
- Monitoring and management procedures for:
  - Leachate management
  - Erosion control
  - Revegetation
  - Groundwater
  - Surface Water
  - Vegetation and Habitat Surveys
- A Contingency Plan

8.4 Contingency plans

The presence of previously unidentified types of contaminants may be identified during works by observation of any unusual physical/sensory characteristics of the impacted soil or groundwater.

An example of unexpected situations that may arise include:

- Unexpected discovery of hazardous building materials such as asbestos containing materials
- Contaminants in addition to the type already identified on-site may be encountered (e.g. drums and material with visual or olfactory evidence of contamination)
- Contaminated material in addition to the type already identified on-site may fail the NSW EPA Waste Classification Guidelines, and not be acceptable for disposal
- Side effects of site works such as unacceptable levels of odour, noise, dust, and surface runoff may be generated

The Project Manager/Superintendent should be notified if such impacts are noted and the following procedures followed:

- Stop work and make the area secure
- Follow the procedures listed in the RAP (Appendix E)

9. Project justification

9.1 Strategic need and justification

The Proposal is needed to:

- Achieve compliance with Management Order 20111405
- Remediate the contamination at the Site so that any further impact on the adjacent wetland and receiving environment is minimised
- Allow the Site to be opened to public access without unacceptable risk to human health.

9.2 Project alternatives and preferred option

Project alternatives and the selection process for the preferred option are presented in Section 3.3. Onsite disposal with treatment was selected as the preferred option.

9.3 Principles of ecologically sustainable development

The Proposal's consistency or otherwise with the objects of the EP&A Act is summarised in Table 9-1.

Table 9-1 Compliance with the EP&A Act

Object	Comment
5(a)(i) To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment.	The Proposal would promote the conservation of a natural area via the remediation of an impacted area including a SEPP 14 wetland. Social and economic development of the area would be promoted creating employment opportunities during construction, and restoring the recreational value of the area and by encouraging visitors to the area in the long term.
5(a)(ii) To encourage the promotion and co-ordination of the orderly economic use and development of land.	The Proposal would promote the orderly economic use and development of land by restoring the recreational value of the land.
5(a)(iii) To encourage the protection, provision and co-ordination of communication and utility services.	The contractor will be responsible for conducting an assessment of communication and utility services in the area prior to commencement of works.
5(a)(iv) To encourage the provision of land for public purposes.	Public use of land would be promoted through restoring the recreational value of the site including the wetland.
5(a)(v) To encourage the provision and co-	The Proposal would restore the recreational

Object	Comment
ordination of community services and facilities.	value of the site.
5(a)(vi) To encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.	An ecological assessment is provided in Appendix H. The Proposal will encourage the protection of the environment, including the protection and conservation of native animals and plants through removal of a contaminant source and the restoration of potential fauna habitat. A CEMP would be prepared and implemented to manage potential short-term environmental impacts during civil works.
5(a)(vii) To encourage ecologically sustainable development.	Ecologically sustainable development is considered in Sections 9.3.1 to 9.3.4. The development is considered to be ecologically sustainable.
5(a)(viii) To encourage the provision and maintenance of affordable housing.	Not relevant to the Proposal.
5(b) To promote the sharing of the responsibility for environmental planning between different levels of government in the State.	Not relevant to the Proposal.
5(c) To provide increased opportunity for public involvement and participation in environmental planning and assessment.	The public have been involved in the environmental planning and assessment through consultation, as outlined in Section 6.

9.3.1 The precautionary principle

The Precautionary Principle states that "*if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation*".

Threats of serious or irreversible damage to the environment could result from not conducting any remediation activities, or from dispersal of contaminants during the Proposal or failure of the containment cell.

The detailed assessment of potential environmental impacts in the preparation of the design has sought to minimise impacts on the natural amenity of the study area while maintaining engineering feasibility and safety. Scientifically sound data used in the evaluation was obtained from more than ten previous site investigations including a detailed site assessment completed by GHD in 2013. Stakeholder and community consultation was also carried out.

A number of safeguards have been proposed to minimise potential impacts. These safeguards would be implemented during construction and operation of the Proposal. No safeguards have been postponed as a result of lack of scientific certainty.

9.3.2 Intergenerational equity

The Intergenerational Equity principle states, "*the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations".*

The health, diversity and productivity of the environment would be enhanced for the benefit of future generations by the Proposal via remediation of a contaminated area and restoring the recreational and ecological value of the Site.

Should the Proposal not proceed, the principle of intergenerational equity may be compromised as future generations would inherit a contaminated site which is subject to reduced ecological, visual amenity and socio-economic values.

9.3.3 Conservation of biological diversity and ecological integrity

This principle states that the "*diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival*".

A thorough assessment of the existing local environment has been undertaken in order to identify and manage any potential impacts of the Proposal on local biodiversity. Specific design efforts have been taken to minimise impacts upon the local biodiversity.

The Proposal is considered to have a net positive impact on biological diversity and ecological integrity through the remediation of impacted habitat. An ecological assessment and appropriate site-specific safeguards are provided in 7.10 and Appendix H of this EIS. Site-specific safeguards include consideration of design impacts upon biodiversity, vegetation management and weed management.

9.3.4 Improved valuation, pricing and incentive mechanisms

This principle requires that "*costs to the environment should be factored into the economic costs of a project*".

This EIS has examined the environmental consequences of the Proposal and identified safeguard measures for areas which have the potential to experience adverse impacts. This indicates that the remediation design presented in the RAP has been developed with an environmental objective in mind. Implementation of these safeguard measures would result in an economic cost to Crown Lands. This signifies that environmental resources have been given appropriate valuation.

9.4 Summary of beneficial effects

The Proposal would have a net beneficial impact as it would:

- Restore ecological, recreational, visual and social amenity
- Reduce erosion and sedimentation
- Remove contaminated soil and sediment that have a detrimental effect on the environment

- Reduced contaminant levels in the surface water and groundwater due to the reduction/containment of the contaminant source
- Create employment during construction.

9.5 Summary of adverse effects

- The Proposal has potential to have a short term impact on several factors, the most significant of which include:
- Erosion and sedimentation resulting from exposed soils relating to vehicle movements, stockpiled materials and vegetation removal
- Mobilisation of COCs into surface water and groundwater through soil and sediment disturbance or failure of the containment cell
- Exposure of workers to COCs during the Proposal
- Dust generated from excavation works
- Traffic impacts through vehicle movements during construction
- Noise generated from machinery use
- Visual impact of machinery and infrastructure during construction
- Habitat loss through clearing of aquatic vegetation including the dead trees in the wetland.

Safeguards and management measures as discussed in this EIS would manage and minimise the severity and duration of these impacts. There are not expected to be any significant long-term negative impacts as a result of the Proposal.

9.6 Conclusions

As a remediation project, the majority of the potential impacts of the Proposal would be positive. It is not anticipated that the Proposal described in this EIS would have any significant adverse environmental impacts. The Proposal does have potential to affect the amenity of nearby residences in the short term however residents would be informed and consulted prior to the work commencing. The Proposal would result in some minor short-term adverse impacts which would be managed through the adoption of appropriate and targeted environmental mitigation measures identified in this EIS and summarised in Table 8-1.

The Proposal and associated environmental impacts have been assessed in accordance with Clause 228 of the Environmental Planning and Assessment Regulation 2000, Section 111 of the *Environmental Planning and Assessment Act 1979*, the *Threatened Species Conservation Act 1995*, the *Fisheries Management Act 1994*, and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

There would be no significant impact on threatened species, as listed under the *Threatened Species Conservation Act 1995* and/or *Fisheries Management Act 1994*, and therefore no requirement for a Species Impact Statement in accordance with Section 5A of the *Environmental Planning and Assessment Act 1979*.

The proposal would not significantly impact on a matter of national environmental significance or Commonwealth land and therefore referral to the Commonwealth Department of Environment is not required under the *Environment Protection and Biodiversity Conservation Act 1999*.

10. Limitations

This EIS for the Former Antimony Processing Plant - Urunga NSW (the "Report"):

- has been prepared by GHD Pty Ltd ("GHD") for NSW Trade and Investment - Crown Lands
- may be used and relied on by NSW Trade and Investment - Crown Lands
- may be used by and provided to the NSW EPA and the relevant planning authority for the purpose of meeting statutory obligations in accordance with the relevant sections of the CLM Act 1997 or the Environment Planning and Assessment (EP&A) Act 1979
- may only be used for the purpose as stated in Section 1.1 of the Report (and must not be used for any other purpose)

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described throughout this report, GHD disclaims liability arising from any of the assumptions being incorrect.

Additional disclaimer to be used if GHD relies on information provided by client and/or others

If GHD has relied on information provided by the client and/or others when preparing the document containing the following should be added to the generic disclaimer detailed above:

GHD has prepared this report on the basis of information provided by NSW Trade and Investment - Crown Lands and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including

s and omissions in the report which were caused by errors or omissions in that information.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

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Appendices

Appendix A Management Orders

Note 1: On 22 May 2012, the EPA granted an amendment to the milestone dates set out in the Management Order. Other than the amendments set out in Notice 20124407, the remaining terms of the Management Order remain in force.

Note 2: On 26 September 2012, the EPA granted an amendment to the milestone dates set out in the Management Order. Other than the amendments set out in Notice 20124422, the remaining terms of the Management Order remain in force.

Environment Protection Authority

Management order

(Section 14 of the Contaminated Land Management Act 1997)

Order Number 20111405; Declaration Number 21020; Area Number 1089

Service: By registered mail

The Proper Officer
State of New South Wales (Department of Trade and Investment, Regional Infrastructure and Services)
GPO Box 5477
SYDNEY NSW 2001

Background

1. On 2 August 2002 the Environment Protection Authority ("EPA") declared Lots 1 and 2 in DP 874874 at Hillside Drive Urunga, and Lot 253 in DP 46013 at Urunga to be a remediation site (Declaration No. 21020).
2. On 7 November 2005 the EPA issued Notice No. 22004 to amend the area of the declared remediation site so that it comprised Lot 253 in DP 46013, Lot 2 in DP 874874 and only part of Lot 1 in DP 874874.
3. As a result of the commencement of Schedule 1 [61] to the *Contaminated Land Management Amendment Act 2008* on 1 July 2009, all references in Declaration No. 21020 and Notice No. 22004 to a "remediation site" are taken to be references to "significantly contaminated land".
4. The land became significantly contaminated from activities carried out on the land by Broken Hill Antimony Pty Ltd, including antimony ore crushing and processing. The EPA considers Broken Hill Antimony Pty Ltd to be a person who is responsible for significant contamination of the land, however the company was deregistered in 1992 and no longer exists.
5. Under the *Contaminated Land Management Act 1997* ("the Act"), a management order may be issued to "an appropriate person" within the meaning of the Act. It is not practicable to specify the person who is responsible for significant contamination of the land to which this order applies as an appropriate person because the entity no longer exists. An owner of the land to which a management order applies is an appropriate person within the meaning of the Act. The State of New South Wales (Department of Trade and Investment, Regional Infrastructure and Services) is the owner of the land to which this order applies and I determine that it is an appropriate person to be the subject of this order.
6. The EPA has sought voluntary proposals from interested parties since 2002 and despite collaboration and cooperation from time to time, no credible remediation proposals have been submitted.
7. Prior to the making of this order the EPA considered all submissions it has received as to whether an order should be made.

Land to which this order applies

This order applies to that part of the significantly contaminated land in Declaration No. 21020, as amended by Notice No. 22004, that is listed in the following table ("the land"):

Description	Address
Lot 253 in DP 46013	Hillside Drive Urunga

Nature of significant contamination and nature of harm affecting the land

1. The substances causing the contamination (the "significant contaminants") are:

   Arsenic, antimony and mercury.

2. The EPA believes that the land is contaminated and that the contamination is significant enough to warrant regulation, for the following reasons:

   i) Harm has occurred as indicated by dying Melaleuca trees on the periphery of the land;

   ii) Concentrations of the significant contaminants on and around the land exceed the relevant human health guidelines;

   iii) Concentrations of the significant contaminants on and around the land exceed the relevant ecological guidelines;

   iv) Concentrations of the significant contaminants in surface water and groundwater on and around the land exceed the ANZECC water quality criteria for the protection of aquatic ecosystems;

   v) The significant contaminants have migrated off the land through surface erosion and been deposited as sediments in Station Creek;

   vi) Harm may be caused to the biota that is in contact with the significant contaminants on the land, and in the water and sediments around the land;

   vii) The disturbance of the acid sulphate soils on and around the land may cause further mobilisation of the significant contaminants and hence increase the risk of further harm being caused;

   viii) There may be human and ecological exposure pathways to the significant contaminants in the soils, groundwater, sediments and waters on and around the land.

Actions required by this order

I, Niall Johnston, direct the State of New South Wales (Department of Trade and Investment, Regional Infrastructure and Services) as an appropriate person to do each of the following in relation to the land:

A. Prepare a remedial action plan

1) Engage a qualified, experienced and reputable environmental consultant to undertake investigation works and prepare a remedial action plan (RAP) in accordance with Directions 3 to 5 below.

2) Notify the EPA of the consultant that has been engaged.

3) Prepare the following preliminary documentation:

   i) Undertake a review of all available contamination data relating to the land;

   ii) Identify data gaps with respect to the nature of the contamination, the lateral and vertical extent of the contamination, and the aspects of the environment at the land;

   iii) Prepare a conceptual site model (CSM);

   iv) Prepare a sampling, analysis and quality plan (SAQP) to fill the data gaps and enable refinement of the CSM so that appropriate remediation can be planned;

   v) Submit a report containing the CSM and SAQP to the EPA for review and approval.

4) Implement the SAQP as approved in writing by the EPA, including taking the following action:

   i) Carry out necessary field work;

ii) Update the CSM;

iii) Prepare an investigation report that includes a brief outline of at least two different options for remediation;

iv) Submit the investigation report to the EPA for review and approval.

5) Prepare a RAP to remediate the harm caused and being caused by the significant contamination of the land. The RAP must:

i) Provide a detailed consideration of the remedial options nominated by the EPA from those outlined in the investigation report plus any other options put forward in writing by the EPA;

ii) Nominate the preferred remedial option and provide reasoning;

iii) Provide sufficient detail in the RAP to enable it to be implemented by a remediation contractor. This should include but not be limited to:
(a) An estimation of the volume of material requiring remediation;
(b) Detailed characterisation of the nature of the material requiring remediation;
(c) Figures, maps and/or plans showing with precision the location of the material requiring remediation, and the methods and design of any remedial system;
(d) Detailed descriptions of any remedial technologies to be utilised;
(e) A contingency plan should the nominated remedial method fail.

iv) Submit the RAP to the EPA for review and approval.

B. Implement the remedial action plan

1) Engage a qualified, experienced and reputable remediation contractor to implement the RAP as approved in writing by the EPA.

2) Engage a qualified, experienced and reputable environmental consultant to prepare a validation report that describes the remedial works that were undertaken and makes recommendations for additional works, maintenance, monitoring and/or contingency plan implementation to ensure that the significant contamination is appropriately managed in the long term.

3) Submit the validation report to the EPA.

C. Carry out directions consistently with guidelines

1) Carry out the directions in this order consistently with any relevant guidelines made or approved by the EPA under section 105 of the Act.

Timing of the actions required by this order

The actions required by this order must be completed in accordance with the following table as may be varied from time to time by the EPA in writing.

Action	**Reference**	**Date**
Notify EPA of consultant	A. (2)	19 December 2011
Submit CSM and SAQP	A. (3) (v)	20 February 2011
Submit investigation report	A. (4) (iv)	14 May 2012
Submit RAP	A. (5) (iv)	10 December 2012
Commence implementation of the RAP	B. (1)	

		21 January 2013
Submit validation report	B. (3)	10 June 2013

[Signed 16 November 2011]

NIALL JOHNSTON
Manager Contaminated Sites

(by delegation)

Date: **16 November 2011**

NOTE:

Cost Recovery

Section 34 of the Act allows the EPA to recover its costs in connection with the issue of, monitoring actions under and seeking compliance with, a management order.

Information recorded by the EPA

Section 58 of the Act requires the EPA to maintain a public record. A copy of this management order will be included in the public record on the Department of Environment, Climate Change and Water's public website and at the principal office of the EPA and such other places as the EPA thinks fit.

Information recorded by councils

Section 59 of the Act requires the EPA to give a copy of this order to the relevant local council. The council is then required to note on its planning certificate issued pursuant to s 149(2) of the *Environmental Planning and Assessment Act 1979* that the land is currently subject to a management order. The EPA is required to notify council as soon as practicable when the order is no longer in force and the notation on the s 149(2) certificate can be removed.

Relationship to other regulatory instrument

This order does not affect the provisions of any relevant environmental planning instruments which may control the land on which the land is located or provisions of any other environmental protection legislation administered by the EPA.

Guidelines made or approved under s 105 of the Act

All the directions must be carried out consistently with all relevant guidelines made or approved under s 105 of the Act. See http://www.environment.nsw.gov.au/clm/guidelines.htm.

Appeals against this decision

You can appeal to the Land and Environment Court against this order. The deadline for lodging the appeal is 21 days after you were given notice of this order.

Guidelines made or approved by the EPA under section 105 of the Contaminated Land Management Act 1997

July 2009

Guidelines made by the EPA

- *Contaminated Sites: Guidelines for Assessing Service Station Sites*, December 1994.
- *Contaminated Sites: Guidelines for the Vertical Mixing of Soil on Former Broad-Acre Agricultural Land*, January 1995.
- *Contaminated Sites: Sampling Design Guidelines*, September 1995.

- *Contaminated Sites: Guidelines for Assessing Banana Plantation Sites*, October 1997.
- *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*, November 1997.
- *Contaminated Sites: Guidelines for Assessing Former Orchards and Market Gardens*, June 2005.
- *Contaminated Sites: Guidelines for the NSW Site Auditor Scheme (2nd edition),* April 2006.
- *Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination*, March 2007.
- *Contaminated Sites: Guidelines on the Duty to Report under the Contaminated Land Management Act 1997*, June 2009.

Note: All references in the EPA's contaminated sites guidelines to the *Australian Water Quality Guidelines for Fresh and Marine Waters* (ANZECC, November 1992) are replaced as of 6 September 2001 by references to the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ, October 2000), subject to the same terms.

Guidelines approved by the EPA

- *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites,* published by Australian and New Zealand Environment and Conservation Council and the National Health and Medical Research Council (NHMRC), January 1992.
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Paper No 4, October 2000.

EnHealth (formerly National Environmental Health Forum monographs)

- *Composite Sampling*, by Lock, W. H., National Environmental Health Forum Monographs, Soil Series No.3, 1996, SA Health Commission, Adelaide.
- *Environmental Health Risk Assessment: Guidelines for assessing human health risks from environmental hazards*, Department of Health and Ageing and EnHealth Council, Commonwealth of Australia, June 2002.

National Environment Protection Council publications

National Environment Protection (Assessment of Site Contamination) Measure 1999

- The Measure includes a policy framework for the assessment of site contamination, Schedule A and Schedule B.

(I) Schedule A

- *Recommended General Process for the Assessment of Site Contamination*.

(II) Schedule B -Guidelines

(1) *Guideline on Investigation Levels for Soil and Groundwater*

(2) *Guideline on Data Collection, Sample Design and Reporting*

(3) *Guideline on Laboratory Analysis of Potentially Contaminated Soils*

(4) *Guideline on Health Risk Assessment Methodology*

(5) *Guideline on Ecological Risk Assessment*

(6) *Guideline on Risk Based Assessment of Groundwater Contamination*

(7a) *Guideline on Health-Based Investigation Levels*

(7b) *Guideline on Exposure Scenarios and Exposure Settings*

(8) *Guideline on Community Consultation and Risk Communication*

(9) *Guideline on Protection of Health and the Environment During the Assessment of Site Contamination*

(10) *Guideline on Competencies & Acceptance of Environmental Auditors and Related Professionals*

Other documents

- *Guidelines for the Assessment and Clean Up of Cattle Tick Dip Sites for Residential Purposes*, NSW Agriculture and CMPS&F Environmental, February 1996.
- *Australian Drinking Water Guidelines*, NHMRC & National Resource Management Ministerial Council, 2004.

Note: On 22 May 2012, Management Order (No. 20111405) was amended to include new Lot / DP information and updated milestone dates. Other than these amendments the remaining terms of the Management Order remain in force.

Environment Protection Authority

Notice to amend Management Order

(Section 44 of the Contaminated Land Management Act 1997)

Notice Number 20124407; Area Number 1089

Background

The land to which this notice applies, together with other lands, was declared as "significantly contaminated land" (declaration no.21020) and is the subject of a management order (order no. 20111405) issued by the Environment Protection Authority ("the EPA"). The management order directed the recipient of the order to carry out contamination management. This notice must be read in conjunction with the original management order (order no. 20111405).

Amendment

The amendment of the order is necessary due to the transfer of the neighbouring land (Lots 1 & 2 in DP 874874) from Harry Ross Tickner (Tickner) to the State of New South Wales (Department of Trade and Investment, Regional Infrastructure and Services). As the Tickner land is Declared (Declaration number 21020) the Management Order is to be amended to also include management of the contamination on the Tickner site by Department of Trade and Investment, Regional Infrastructure and Services. The management order excludes the north-west part of Lot 1 of DP874874 located adjacent to Hillside Drive, Urunga as defined by the map included as part of Notice Number 22004. This part of land has been removed from the declaration by the EPA on 7th November 2005.

Additionally, due to the delays in the transfer of land the dates of the Management Order (Part C) have been revised as per the table below.

Action	Reference	Date (Original)	Date (Amended)
Notify EPA of consultant	A. (2)	19 December 2011	Completed 8 March 2012
Submit Conceptual Site Model (CSM) and Sampling Analysis and Quality Plan (SAQP)	A. (3) (v)	20 February 2011 (sic)	*24 May 2012*
Submit investigation report	A. (4) (iv)	14 May 2012	*14 August 2012*
Submit Remedial Action Plan (RAP)	A. (5) (iv)	10 December 2012	*10 December 2012*
Commence implementation of the RAP	B. (1)	21 January 2013	*21 April 2013*
Submit validation report	B. (3)	10 June 2013	*10 September 2013*

Land to which this notice applies

Description	Address
Part of Lot 1 in DP874874,	Hillside Drive, Urunga NSW

Lot 2 in DP874874 and Lot 253 in DP46013	

[Signed]

JOHN COFFEY
Acting Manager Contaminated Sites
Environment Protection Authority

Date: 22 May 2012

NOTE:

Information recorded by the EPA

Section 58 of the Contaminated Land Management Act 1997 requires the EPA to maintain a public record. A copy of this notice will be included in the public record.

Information recorded by councils

Section 59 of the Act requires the EPA to give a copy of this notice to the relevant local council. The council may then make appropriate consequential modifications to the planning certificate issued in relation to the land to which this notice applies pursuant to s.149 of the *Environmental Planning and Assessment Act 1979*.

Relationship to other regulatory instrument

This repeal notice does not affect the provisions of any relevant environmental planning instruments which apply to the land or provisions of any other environmental protection legislation administered by the EPA.

Previous regulatory instrument

As of 1 July 2009, all current declarations for investigation area or declarations for remediation sites are taken to be declarations for significantly contaminated land, all current orders for investigation area and orders for remediation site are taken to be management orders and all current voluntary investigation and remediation agreements are taken to be voluntary management proposals.

Environment Protection Authority

Notice to amend Management Order

(Section 44 of the Contaminated Land Management Act 1997)

Notice Number 20124422; Area Number 1089

Background

The land to which this notice applies, together with other lands, was declared as "significantly contaminated land" (declaration no.21020) and is the subject of a management order (order no. 20111405) issued by the Environment Protection Authority ("the EPA"). The management order directed the recipient of the order to carry out contamination management. This notice must be read in conjunction with the original management order (order no. 20111405).

Amendment

The amendment of the order is necessary due to further delays in the transfer of land and an increased sampling size compared with the original proposal. The dates of the Management Order (Part C) have been revised as per the table below.

Action	**Reference**	**Date (Amended 22/05/2012)**	**Date (Amendment September 2012)**
Notify EPA of consultant	A. (2)	Completed 8 March 2012	
Submit Conceptual Site Model (CSM) and Sampling Analysis and Quality Plan (SAQP)	A. (3) (v)	24 May 2012	Completed 25 May 2012
Submit investigation report	A. (4) (iv)	14 August 2012	*30 November 2012*
Submit Remedial Action Plan (RAP)	A. (5) (iv)	10 December 2012	*15 February 2013*
Commence implementation of the RAP	B. (1)	21 April 2013	*21 June 2013*
Submit validation report	B. (3)	10 September 2013	*15 November 2013*

Land to which this notice applies

Description	Address
Part of Lot 1 in DP874874, Lot 2 in DP874874 and Lot 253 in DP46013	Hillside Drive, Urunga NSW

NIALL JOHNSTON
Manager Contaminated Sites
Environment Protection Authority

Date: 26/9/2012

NOTE:

Information recorded by the EPA

Section 58 of the Contaminated Land Management Act 1997 requires the EPA to maintain a public record. A copy of this notice will be included in the public record.

Information recorded by councils

Section 59 of the Act requires the EPA to give a copy of this notice to the relevant local council. The council may then make appropriate consequential modifications to the planning certificate issued in relation to the land to which this notice applies pursuant to s.149 of the *Environmental Planning and Assessment Act 1979.*

Relationship to other regulatory instrument

This repeal notice does not affect the provisions of any relevant environmental planning instruments which apply to the land or provisions of any other environmental protection legislation administered by the EPA.

Previous regulatory instrument

As of 1 July 2009, all current declarations for investigation area or declarations for remediation sites are taken to be declarations for significantly contaminated land, all current orders for investigation area and orders for remediation site are taken to be management orders and all current voluntary investigation and remediation agreements are taken to be voluntary management proposals.

NSW EPA

Our reference: DOC13/2681
Contact: Matthew James 9995 5707

Mr Richard Chewings
Manager Natural Resource Services, Catchments and Lands
Department of Primary Industries
PO Box 865
DUBBO NSW 2830

CONTAMINATION OF CROWN LAND AT URUNGA
APPROVAL OF DETAILED INVESTIGATION REPORT

Dear Mr Chewings,

Thank you for providing the following two reports to the NSW Environment Protection Authority (EPA) as required by the Management Order 20111405 under the *Contaminated Land Management Act (CLM Act) 1997.*

- Detailed Investigation Report, Former Antimony Processing Plant – Urunga, submitted by GHD, dated 10 December 2012 (Final)
- Detailed Investigation Report Addendum One – Supplementary Sampling Results, Former Antimony Processing Plant – Urunga, submitted by GHD, dated 11 February 2013 (Final)

The EPA Contaminated Sites Regulatory Unit has reviewed the reports and is satisfied that the obligations of the Management Order have been met and subsequently approves the Reports.

A Remediation Action Plan (RAP) should now be prepared and submitted to the EPA for review and approval as per the Management Order 20111405.

Should you have any questions regarding this matter please contact Matthew James on (02) 9995 5707 or John Coffey on 02 9995 5621.

Yours sincerely

28/2/2013

NIALL JOHNSTON
Manager Contaminated Sites
Environment Protection Authority (EPA)

cc. Bellingen Shire Council

PO Box A290 Sydney South NSW 1232
59-61 Goulburn St Sydney NSW 2000
Tel: (02) 9995 5000 Fax: (02) 9995 5999
TTY (02) 9211 4723
ABN 30 841 387 271
www.environment.nsw.gov.au

Appendix B Director Generals Requirements

NSW GOVERNMENT | Planning & Infrastructure

Contact: Deana Burn
Phone: 02 9228 6569
Fax: 02 9228 6466
Email: deana.burn@planning.nsw.gov.au

Mr Richard Chewings
Department of Primary Industries – Crown Lands Division
PO Box 865
DUBBO NSW 2830

Our Ref: SSD - 5357

Dear Mr Chewings

State Significant Development – Director-General's Requirements
Urunga Antimony Plant Remediation Project (SSD-5357)

I have attached a copy of the Director General's environmental assessment requirements (DGRs) for the preparation of an Environmental Impact Statement for the Urunga Antimony Plant Remediation Project.

These requirements are based on the information you have provided to date and have been prepared in consultation with the relevant government agencies and Bellingen Shire Council. Their comments, which you should address appropriately when preparing the EIS, are also attached (see Attachment 2). Please note that the Department may alter these requirements at any time, and that you must consult further with the Department if you do not lodge a development application and EIS for the development within two years of the date of issue of these DGRs. The Department will review the EIS for the development carefully before putting it on public exhibition, and will require you to submit an amended EIS if it does not adequately address the DGRs.

I wish to emphasise the importance of effective and genuine community consultation and the need for proposals to proactively respond to the community's concerns. Accordingly a comprehensive, detailed and genuine community consultation and engagement process must be undertaken during preparation of the EIS. This process must ensure that the community is both informed of the proposal and is actively engaged in issues of concern to them. Sufficient information must be provided to the community so that it has a good understanding of what is being proposed and of the potential impacts.

Your proposal may require a separate approval under Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). If an EPBC Act approval is required, I would appreciate it if you would advise the Department accordingly, as the Commonwealth approval process may be integrated into the NSW approval process, and supplementary DGR's may need to be issued.

I would appreciate it if you would contact the Department at least two weeks before you propose to submit the development application and EIS for your development. This will enable the Department to:

- confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*); and
- determine the number of copies (hard-copy and CD-ROM) of the EIS required for review.

If you have any enquiries about these requirements, please contact Deana Burn on the above details.

Yours sincerely

16.7.12

Chris Wilson
Executive Director
Major Projects Assessment
As delegate for the Director-General

Director General's Environmental Assessment Requirements

Section 78A(8A) of the *Environmental Planning and Assessment Act*

State Significant Development

Application Number	SSD-5357
Development	Remediation of contaminated land at the derelict antimony processing site in Urunga
Location	Hillside Drive, Urunga
Applicant	Department of Primary Industries – Crown Lands Division
Date of Issue	July 2012
General Requirements	The Environmental Impact Statement (EIS) must meet the form and content requirements in clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In addition, the EIS must include a: • detailed description of the development, including: – need for the proposed development; – justification for the proposed development; – likely staging of the development; – likely interactions between the development and existing, approved and proposed operations in the vicinity of the site; – plans of all proposed building works. • consideration of all relevant environmental planning instruments, including identification and justification of any inconsistencies with these instruments. • risk assessment of the potential environmental impacts of the development, identifying the key issues for further assessment. • detailed assessment of the key issues specified below, and any other significant issues identified in this risk assessment, which includes: – a description of the existing environment, using sufficient baseline data; – an assessment of the potential impacts of all stages of the development, including any cumulative impacts, taking into consideration relevant guidelines, policies, plans and statutes; and – a description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the development, including proposals for adaptive management and/or contingency plans to manage any significant risks to the environment. • consolidated summary of all the proposed environmental management and monitoring measures, highlighting commitments included in the EIS.
Key issues	The EIS must address the following specific matters: • **Contamination** – including: – a contaminated land assessment carried out in accordance with the requirements of Management Order (20111405) for the site; – a Remedial Action Plan approved by the EPA detailing the works to remediate the site, which includes: o characterisation of the nature and extent of contaminated material and any contaminated groundwater plumes; o details of the proposed remediation process, including treatment methodologies and processes; o justification for the proposed treatment and remediation criteria; o details of proposed remediation management measures including the management of excavated material, stockpiles and

wastewater;
    - a site validation plan; and
    - details of compliance with the *Contaminated Land Management Act 1997*.
  - details of the final landform following remediation and the suitability of any fill material;
  - on-going management of the site following remediation works; and
  - details of the final use of the site.
- **Human Health and Risk** – including:
  - an assessment of the potential risks (on site and off site) associated with the disturbance, transfer and disposal of contaminated material; and
  - details of mitigation and management measures to minimise human health risks and ensure the safety of workers during the development.
- **Soil and Water – including:**
  - an assessment of the potential soil, groundwater and surface water impacts of the development, including a detailed description of surface and groundwater conditions pre and post remediation works;
  - consideration of sea level rise and this would be managed;
  - identification of potential impacts on the SEPP 14 wetlands, Station Creek and Urunga Lagoon;
  - details of water supply, licensing requirements, groundwater works, dewatering and management of contaminated water;
  - an assessment of the potential to impact on acid sulfate soils;
  - identification of potential conflicts with other water users, including other licensed users, recreational users and groundwater dependent ecosystems; and
  - a detailed description of the mitigation and management controls that would be put in place to manage erosion and sediment, stormwater, groundwater and acid sulphate soils (if present) during and after remediation works.
- **Transport and Access** – including:
  - a description of site accesses, haulage routes, internal roads and parking required as a result of the development;
  - predictions of the traffic generated by the development including number and type of vehicle trips;
  - an assessment of the potential impacts on the capacity, efficiency and safety of the road network, including an analysis of intersection sight distances; and
  - details of any upgrades to road infrastructure that would be required.
- **Waste** – including:
  - accurate estimates of the quantity and classification of the potential liquid and non-liquid waste streams of the development;
  - a description of storage, treatment (including immobilisation of contaminants), disposal and re-use for all waste generated by the development; and
  - a description of the measures that would be implemented to ensure that any waste produced is appropriately handled, processed and disposed of.
- **Biodiversity** – including:
  - assessment of the impact on threatened species, populations and ecological communities, including the SEPP 14 coastal wetland; and
  - a description of the measures that would be implemented to minimise and/or offset identified impacts.
- **Noise and Vibration –** including:
  - an assessment of all noise impacts on surrounding residential receivers, including road transportation noise;
  - any vibration impacts; and
  - details of the proposed noise and vibration management and monitoring measures.

	• **Air Quality and Odour** – including: – a quantitative assessment of the air quality and odour impacts of the development on surrounding receivers, including impacts from road transportation; and – details of the proposed management and monitoring measures. • **Heritage** – including: – an Aboriginal cultural heritage assessment including effective consultation with relevant Aboriginal community groups; – a non-Aboriginal cultural heritage assessment, including a statement of heritage impact for any State significant or locally significant historic heritage items; and – details of proposed management and monitoring measures. • **Visual** – including: – impacts on surrounding receivers and from public areas; and – an assessment of the visual impacts and landscaping that would be implemented following the remediation works. • **Social** – including: – a comprehensive community consultation strategy to be implemented during and after remediation works; and – an assessment of public health risks.
Plans and Documents	The EIS must include all relevant plans, architectural drawings, diagrams and relevant documentation required under Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*. These documents should be included as part of the EIS rather than as separate documents.
Consultation	During the preparation of the EIS, you must consult with the relevant local, State or Commonwealth Government authorities, service providers, community groups and affected landowners. In particular, you must consult with the: • Environment Protection Authority; • Office of Environment and Heritage; • Bellingen Shire Council; • Department of Primary Industries, including the NSW Office of Water and NSW Fisheries; • NSW Transport (Roads and Maritime Services); • NSW Health; • WorkCover NSW; and • the local community and stakeholders. The EIS must describe the consultation process and the issues raised, and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided.
Further consultation after 2 years	If you do not lodge an EIS for the development within 2 years of the issue date of these DGRs, you must consult with the Director General in relation to the requirements for lodgement.
References	The assessment of the key issues listed above must take into account relevant guidelines, policies, and plans as identified. While not exhaustive, Attachment 1 contains a list of some of the guidelines, policies, and plans that may be relevant to the environmental assessment of this development.

ATTACHMENT 1
Technical and Policy Guidelines

The following guidelines may assist in the preparation of the Environmental Impact Statement. This list is not exhaustive and not all of these guidelines may be relevant to your proposal.

Many of these documents can be found on the following websites:
http://www.planning.nsw.gov.au
http://www.bookshop.nsw.gov.au
http://www.publications.gov.au

Aspect	Policy /Methodology
Risk Assessment	
	AS/NZS 4360:2004 Risk Management (Standards Australia)
	HB 203:2006 Environmental Risk Management – Principles & Process (Standards Australia)
Contamination	
	State Environmental Planning Policy No 55 - Remediation of Land
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC & NHMRC)
	National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC)
	Managing Land Contamination - Planning Guidelines SEPP 55 – Remediation of Land (DUAP and EPA)
	Contaminated Sites: Sampling Design Guidelines (NSW EPA)
	Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites (NSW EPA)
	Guidelines for the Assessment and Management of Groundwater Contamination (DECC)
Soil and Water	
Coastal	NSW Coastal Policy (NSW Government 1997)
	State Environmental Planning Policy No 71 - Coastal Protection
	NSW Coastal Planning Guideline – Adapting to Sea Level Rise (NSW Govt. 2010)
	Floodplain Risk Management Guideline - Practical Consideration of Climate Change (DECC)
Surface Water	National Water Quality Management Strategy: Water quality management - an outline of the policies (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Policies and principles - a reference document (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Implementation guidelines (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	Bunding and Spill Management (EPA)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DEC, 2004)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (DEC)
	The NSW State Rivers and Estuaries Policy (NSW Water Resources Council)
Groundwater	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	NSW State Groundwater Policy Framework Document (DLWC)

	NSW State Groundwater Quality Protection Policy (DLWC)
	NSW State Groundwater Dependent Ecosystem Policy (DLWC)
	NSW Wetlands Policy
Acid Sulfate Soils	Acid Sulfate Soil Manual (ASSMAC 1998)
	Acid Sulfate Soil Planning Maps
	Acid Sulfate Soils Laboratory Methods Guidelines (2004)
Erosion and Sediment	Managing Urban Stormwater: Soils & Construction (Landcom)
	Design Manual for Soil Conservation Works - Technical Handbook No. 5 (Soil Conservation Service of NSW)
	Soil and Landscape Issues in Environmental Impact Assessment (DLWC)
	Wind Erosion – 2nd Edition
Stormwater	Managing Urban Stormwater: Strategic Framework. Draft (EPA)
	Managing Urban Stormwater: Council Handbook. Draft (EPA)
	Managing Urban Stormwater: Treatment Techniques (EPA)
	Managing Urban Stormwater: Source Control. Draft (EPA)
	Managing Urban Stormwater: Harvesting and Reuse (DEC)
Wastewater	National Water Quality Management Strategy: Guidelines for Sewerage Systems - Effluent Management (ARMCANZ/ANZECC)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems - Use of Reclaimed Water (ARMCANZ/ANZECC)
	National Water Quality Management Strategy - Guidelines For Water Recycling: Managing Health And Environmental Risks (Phase1) (EPHC, NRMMC & AHMC)
	National Water Quality Management Strategy - Guidelines For Water Recycling: Managing Health And Environmental Risks (Phase1) (EPHC, NRMMC & AHMC)
Transport and Access	
	State Environmental Planning Policy (Infrastructure)
	Guide to Traffic Generating Developments (RTA)
	Road Design Guide (RTA)
Waste	
	Waste Classification Guidelines (EPA 2008)
	Waste Avoidance and Resource Recovery Strategy 2007 - Overview (DECC)
	Waste Avoidance and Resource Recovery Performance Report 2006 (DECC)
	Resource Recovery Exemptions (DECC)
Biodiversity	
	Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians (DECCW 2009)
	Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DECC 2004)
	Threatened Species Assessment Guidelines: the Assessment of Significance (DECC 2007)
	Guidelines for Threatened Species Assessment (DoP 2005)
	NSW State Groundwater Dependent Ecosystem Policy (DLWC)
	State Environmental Planning Policy (Coastal Wetlands)
	Policy & Guidelines - Aquatic Habitat Management and Fish Conservation (NSW Fisheries)
Noise	
	NSW Industrial Noise Policy (EPA, 2000)
	NSW Road Noise Policy (OEH, 2011)
	Interim Construction Noise Guideline (DECC, 2009)
Vibration	
	Environmental Noise Management – Assessing Vibration: a technical guide (DEC)
	DIN 4150 Part 3 – Structural Vibration: effects of vibration on structures (ISO, 1999)
	Assessing Vibration – A Technical Guide 2006 (DEC)

Air Quality	
	Protection of the Environment Operations (Clean Air) Regulation 2002
	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DEC)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC)
Odour	
	Technical Framework: Assessment and Management of Odour from Stationary Sources in NSW (DEC)
	Technical Notes: Assessment and Management of Odour from Stationary Sources in NSW (DEC)
Heritage	
Aboriginal	Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DEC 2005)
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
Non-Aboriginal	NSW Heritage Manual (NSW Heritage Office & DUAP)
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
Social and Economic	
	Draft Economic Evaluation in Environmental Impact Assessment (DOP)

Appendix C Detailed Investigation Report



NSW Catchment and Lands- Crown Lands

Former Antimony Processing Plant- Urunga NSW

Detailed Investigation Report

December 2012

Executive summary

A Detailed Investigation of a former antimony processing facility located at Hillside Drive, Urunga, NSW was completed to provide a key input to achieve compliance with the Management Order 20111405. The investigation incorporated data from the Preliminary Investigation Report (GHD 2012) and a field investigation comprising sampling and analysis of soil, sediment and water from:

- 63 soil boreholes.
- 38 sediment boreholes.
- 9 surface water locations.
- 4 groundwater monitoring wells.
- 3 stockpiles and 2 loading ramps.
- Brick stockpiles.

The investigation was carried out in accordance with a Sampling Quality and Analysis Plan that was incorporated into the Preliminary Investigation Report (GHD 2012) and was reviewed and approved by the Environmental Protection Authority. Results were compared to adopted assessment criteria to provide:

- A comparison with historic concentrations and impact extent.
- Data to assess horizontal and vertical delineation.
- Data necessary for a remediation options assessment.
- An assessment of surface water and groundwater quality.
- Baseline data for assessing any future impact from site activities or remediation.

Findings of the investigation were used to update the Conceptual Site Model that was developed in the Preliminary Investigation Report (GHD 2012) and included:

- Antimony and arsenic were evident as the key contaminants of concern (COC)s.
- Other COCs included mercury, chromium, nickel, zinc, copper, lead and cyanide.
- In nearly all cases, where one of the COCs was present in significant concentrations, more significant concentrations of either antimony or arsenic were present. As a result, these analytes were deemed to be representative indicator analytes and the governing contaminants.
- Incidental contaminants may also be present on the Site including:
  - Total Petroleum Hydrocarbons;
  - Polynuclear Aromatic Hydrocarbons;
  - Organochlorine Pesticides;
  - Polychlorinated Biphenyls; and
  - Asbestos.
- Surface water and sediment (and to a lesser extent, groundwater) were noted as the main media for the transportation of COCs on the Site.

- Generally, contaminants exceeding relevant assessment criteria in surface water, groundwater and sediment correlated with those that exceeded assessment criteria in the soils.
- In most cases, the leachable concentrations of COCs in the soil and sediment were significantly less than total concentrations, suggesting the physical migration of contaminated soil or sediment has been the more important contaminant migration pathway.
- Notwithstanding the above, where there were significant concentrations of antimony and arsenic in soil or sediment samples, the corresponding leachable concentrations were well above ANZECC trigger values for protection of aquatic ecosystems.
- For “soil” samples (being those take from “dry” areas of the site, including the tailings area, during GHD’s investigations) the degree of contamination generally reduces quite quickly so that the site can be divided into significantly impacted and relatively unimpacted areas. The exceptions to this are primarily adjacent to the ‘L’ shaped canal (where contamination is either within 10 times the assessment criteria, or covered by cleaner material), the south western corner of the site (which has insufficient sampling to define), and the area of disturbance at the north east corner of the site.
- For the majority of the COCs, dissolved concentrations were similar to total concentrations in the surface and groundwater samples, indicating the measured concentrations of contaminants are mobile in the water and not just bound to suspended particles.
- Concentrations of the main COCs in the soil recorded in this investigation were within a similar order of magnitude as those recorded in the historical investigations.
- Reduced total concentrations of COCs in the surface water were noted from the 1997 round of sampling to the present. This may be due to many factors and does not necessarily indicate an overall reduction in concentrations.
- The interpreted extent of the contamination in the soil can be summarised as:
  - Roughly correlating with the absence of vegetation.
  - Including the tailings deposit, former processing area and portions of the former unprocessed ore stockpiling area.
  - Extending into the south west corner of the site and likely across the property boundary near the wetland, however the extent of this impact has not been fully delineated.
  - Extending along the embankment in the vicinity of the ‘L’ shaped canal, at a depth of 1 m to 1.7m from the current ground surface (likely associated with the original soil surface prior to placement of spoil from excavation of the canal).
  - Not extending into the north east portion of the site with the exception of an area of unknown disturbance, to the north of the ‘L’ Shaped canal.
  - Not extending to the southern side of the wetland.
  - Varying in depth from approximately 0.5 metres below ground surface (mbgs) in the north west portion of the impact to 2.2 mbgs near the water’s edge and at some locations within the tailings deposit.
- The extent of the impact in the sediment can be summarised as:
  - Showing highest levels of impact adjacent to the tailings deposit, extending approximately 50 m downstream of the tailing deposit, extending across the wetland

some 50 m to the south of the tailings deposit (roughly correlating with vegetation dieback), and within and adjacent to the north eastern portion of the 'L' shaped canal.
  - Including the western and south eastern portions of the 'S' shaped canals.
  - Ranging from depths of about 1 mbgs near the tailings to 0.1 mbgs in the southern portion of the wetland.
  - Generally having greatest antimony and arsenic concentrations in the surface sediment (0-0.1 mbgs).
  - Generally corresponding with the visual presence of tailings sediment (grey silt).
- Estimated volumes of impacted soil and sediment were:
  - 8,700 m^3 of soil and 2,500 m^3 of sediment exceeding 30 times the adopted assessment criteria.
  - 11,300 m^3 of soil and 3,600 m^3 of sediment (encompassing the volumes above) exceeding 10 times the adopted assessment criteria.
  - 26,500 m^3 of soil and 6,700 m^3 of sediment (encompassing the volumes above) exceeding the adopted assessment criteria.
- The soils and sediment in the vicinity of the tailing deposit analysed and are considered to be Acid Sulfate soils. The preparation of a detailed Acid Sulfate Soils Management Plan (ASSMP) will be required for works that disturb the soil in that area.
- The groundwater table onsite ranged from approximately 0.4 to 1.4 mbgs and groundwater is interpreted to discharge into the wetland. The tailings material and underlying peat are expected to be highly permeable and hence the contaminants are likely to have high groundwater connectivity to the wetland. Characteristics of deeper groundwater or groundwater flow into the site are not known.

This Executive Summary presents a brief summary of the information described in this report, and should be read in the context of the more detailed information presented in the body of this report, the scope of work and the limitations discussed in Section 9.

Abbreviations

ASSMAC	Acid Sulfate Soils Management Advisory Committee
As	Arsenic
CLM Act	Contaminated Land Management Act
CN	Cyanide
CSM	Conceptual Site Model
COC	Contaminant of Concern
Cr	Chromium
Cu	Copper
DECCW	NSW Department of Environment, Climate Change and Water (former, now the OEH)
DLWC	Department of Land and Water Conservation
DO	Dissolved Oxygen
DQO	Data Quality Objectives
EC	Electrical Conductivity
EIL	Environmental Investigation Level
EPA	NSW Environment Protection Authority
EQL	Estimated Quantitation Limit
GPS	Global Positioning System
Hg	Mercury
HIL	Health Investigation Level
ISQG	Interim Sediment Quality Guideline
LIDAR	Light Detection and Ranging
m	Metres
mbgs	Metres below ground surface
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Litre (generally equivalent to parts per million)
mTOC	Metres below Top of Casing
µg/L	Micrograms per Litre (generally equivalent to parts per billion)
NATA	National Association of Testing Authorities
NEPM	National Environmental Protection Measure
NSW	New South Wales

OCP	Organochlorine Pesticides
OEH	Office of Environment and Heritage
OH&S or OHS	Occupational Health and Safety
PAHs	Polynuclear Aromatic hydrocarbons
PASS	Potential Acid Sulfate Soil
Pb	Lead
PBIL	Phytotoxicity Based Investigation Levels
PCBs	Polychlorinated Biphenyls
PMF	Probable Maximum Flood
PQL	Practical Quantitation Limit
PSA	Particle Size Analysis
Redox	Oxidation-reduction potential
RPD	Relative Percent Difference
SOP	Standard Operating Procedure
SPOCAS	Suspension Peroxide Oxidation Combined Acidity and Sulfur
QA	Quality Assurance
QC	Quality Control
RAP	Remediation Action Plan
Sb	Antimony
SCS	Soil Conservation Service
SWL	Standing Water Level
SEPP	State Environmental Planning Policy
SWMS	Safe Work Method Statement
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total petroleum hydrocarbons
UCL	Upper Confidence Limit
USCS	Unified Soil Classification System
WA	Weak Acid
XRF	X-Ray Fluorescence

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1. Introduction

The Soil Conservation Service (SCS) has been engaged by NSW Catchment & Lands - Crown Lands (Crown Lands) to project manage the rehabilitation of a former antimony processing facility located at Hillside Drive, Urunga, NSW (the Site). GHD has been engaged to undertake a series of tasks relating to that project including

- A Preliminary Investigation Report, which has previously been completed[1].
- This Detailed Investigation Report.
- A Remediation Action Plan which will be based on the findings of this report.

1.1 Background

The Site is located at Urunga, NSW, to the south east of the Pacific Highway and adjoining a SEPP 14 wetland as illustrated in Figure 1 and Figure 2. The proposed investigation area comprises part of Lot 1 and Lot 2 DP 874874 and Lot 253 DP 46013. Part of Lot 1 and Lot 2 was transferred to the Crown in 2012.

The site was a former antimony processing plant, which operated between 1969 and 1974, and was abandoned in 1974 without clean up or remedial work. Tailings and mill waste water were discharged onto the foreshore area during the plant operations. A tailings deposit approximately 1 ha in extent fans out into the adjoining wetland. The tailings and adjoining environment are contaminated by a range of heavy metals, particularly by arsenic, antimony and mercury. A belt of dead *Melaleuca* trees characterises the periphery of the tailings deposit. The tailings area is devoid of vegetation, and is periodically inundated by high tides and/or surface runoff.

A partial clean-up of surface debris and waste materials on the former antimony processing site has been carried out by Entech Industries (Entech), however no remediation or management of soil or tailings contamination has occurred.

A series of canals lies to the east of the tailings area, separating the contaminated area to some degree from the adjacent wetland and Station Creek, which runs through the wetland, discharging into Urunga Lagoon further to the east.

Under the provisions of the Contaminated Land Management Act 1997 (CLM Act), a Management Order (No. 20111405) applies to Lot 253, DP 46013 (Crown Land) (NSW EPA 2011). Following the land transfer from Tickner to Crown Lands (Notice to Amend Management Order 20124407) the Management Order also applies to Lot 1 and Lot 2, DP 874874. A portion of Lot 1, DP 874874 was removed from remediation area 1089 by means of a Notice to End Remediation Declaration (No. 22004) in November 2005 (NSW EPA 2005). This was reflected in a Notice to Amend Management Order (No. 20124407) issued on May 22, 2012 (NSW EPA 2012a). The dates for each milestone of the Management Order were revised in a further

[1] GHD 2012. Former Antimony Processing Plant- Urunga, NSW. Preliminary Investigation Report. Prepared for NSW Catchment and Lands- Crown Lands, July 2012.

Notice to Amend Management Order (No. 20124422) issued on September 9, 2012 (NSW EPA 2012b).

1.2 Objectives

The objectives of the overall remediation program are to:

- Achieve compliance with the Management Order 20111405 and Notices to Amend Management Order 20124407 and 20124422.
- Remediate the contamination at the Site so that any further impact on the adjacent wetland and receiving environment is minimised, and to allow the Site to be opened to public access without unacceptable risk to human health.

The specific objectives of the Detailed Investigation Report are to:

- Confirm, by field investigations, whether the present extent and degree of contamination is consistent with that indicated by previous studies.
- Provide more accurate delineation of the degree versus vertical and horizontal extent of contamination.
- Refine the Conceptual Site Model (CSM) developed in the Preliminary Investigation Report.
- Provide a more detailed assessment of potential acid sulfate soil impacts that may be associated with various remediation options.
- Liaise closely with the SCS and the Environmental Protection Authority (EPA) in determining the extent of required investigations, selecting the most appropriate remediation options for detailed review, and agreeing on the preferred remediation strategy for subsequent documentation in the Remedial Action Plan (RAP).
- Provide a Detailed Investigation Report to the EPA for review and approval.

This report will provide the foundation for the development the RAP.

1.3 Scope

The scope of the Detailed Assessment was set out in the Preliminary Investigation Report, which was reviewed and approved by the EPA and was to:

- Conduct field investigations to provide data to delineate the extent and degree of contamination.
- Assess the data in relation to previous studies.
- Develop an updated CSM.
- Present remediation options to form the basis for the RAP.

2. Location and Description

The Site is located on the southern side of Hillside Drive, adjacent to the Pacific Highway, approximately 1.5km from the town centre of Urunga, on the mid-north coast of NSW, as presented in Figure 1. Historic investigations have shown contamination to be located across several land parcels including:

- Lot 1 DP 874874.
- Lot 2 DP 874874.
- Lot 253 DP 46013.

Site features are presented in Figure 2. Photographs of the Site are presented in Appendix B. In general, the Site consists of:

- A disturbed area incorporating the various features associated with the former antimony processing facility, that is largely devoid of vegetation.
- A tailings area of approximately one hectare that is devoid of vegetation, extending from the former processing area into an adjacent, State Environmental Planning Policy (SEPP) 14 wetland (no. 354).
- A generally forested area adjacent to the SEPP 14 wetland in which 21 vulnerable and 3 endangered fauna species have previously been recorded (Redpath 2003).
- Surface material (within the disturbed areas) consisting of imported fill and tailings.
- Some remaining infrastructure consisting mainly of foundations of the former processing facility and loading ramps.
- Several remaining stockpiles of ore, rubbish and bricks.
- An 'L' shaped canal that has apparently been excavated from the wetland.
- A series of 'S' shaped canals (possibly constructed for use in tailings settling).
- Visually impacted *melaleuca* trees in the wetland area, adjacent to the tailings deposit.

Based on aerial photographs received from SCS following completion of the Preliminary Investigations (see Appendix D), the L shaped canal and S shaped canals were constructed about 1979, after operation of the processing facility had ceased (see Section 3.1.1).

The Site is located between the footslope of a small ridge to the north and west and the SEPP 14 wetland to the south and east. Several small drainage lines meander through the Site from the small catchment. Flood waters (data provided by BSC 2008) are shown to periodically inundate the Site (Figure 2) with the Probable Maximum Flood (PMF) level inundating the tailings, former gravel processing area (within the lower part of the former processing area) and the canal systems. The PMF does not cover the full extent of the former processing area.

The wetland drains into Station Creek which is partially tidal. No tidal influence was noted at the Site during the field investigation program; however tidal influences may periodically inundate portions of the tailings during different hydrological conditions. Station Creek discharges into Urunga Lagoon which forms part of the Bellinger-Kalang estuarine system.

The groundwater table onsite is approximately 1 metre below the ground surface (mbgs) and groundwater is interpreted to discharge into the wetland. Groundwater has only been investigated within the tailings area using existing shallow drive-point wells. Characteristics of deeper groundwater or groundwater flow into the site are not known.

Neighbouring land uses consist of:

- A SEPP 14 wetland and land owned by the Coffs Harbour and District Local Aboriginal Land Council, to the south and east.
- Hillside Drive and residential land to the north.
- Residential and commercial properties to the west followed by the Pacific Highway.

3. Preliminary Investigation

A summary of the Preliminary Investigation is outlined in the following subsections.

3.1 Desktop Review and Site Visit

3.1.1 Ore Processing and Site Development

The antimony processing plant was operated by 'Broken Hill Antimony Pty Ltd' and processed stibnite (antimony sulphide) ore mined from Wild Cattle Creek, Dorrigo from 1969 to 1974. The ore (containing impurities in the form of arsenic and mercury) was crushed and then passed through flotation cells to separate the precious metals from the rock waste. Reject material was dumped as tailings on the foreshore of the adjacent wetland. Chemicals used during the purification process included copper sulfate, sodium cyanide, lead nitrate, dextrin, sodium ethyl xanthate and crescylic acid. Water mill water was also contaminated with dissolved antimony and arsenic salts during treatment of the crushed ore. A gravel washery was also reported to be onsite, using water from the wetland.

In 1974, operations at the plant ceased due to the closure of mining production at Wild Cattle Creek. No clean-up operations or remedial work were undertaken when the site was abandoned.

In the late 1970s the property and processing plant were purchased by Mr R Tickner. In 1980, 'Australian Antimony N.L.' (owned by Mr Tickner) applied to the Bellingen Shire Council to restart operations. The application was refused.

A series of canals were constructed between 1979 and 1980. Since then, no further development has occurred.

In 1994 Mr Tickner approached the Bellingen Shire Council to seek Development Approval for residential use of Portions 169 and 138. Approval was not given (DLWC 1997a).

Crown Lands became aware of the contamination issues at the Site in 1995 when Mr Tickner reported the issue following the refusal of a development application. Crown Lands immediately took action to protect the public by erecting fencing and warning signs (SCS 2012).

3.1.2 Previous Investigations

More than twenty sources of relevant data including eight previous contaminant investigations were identified. An assessment of the reliability of the historic data was conducted with four sources of data deemed reliable for use in ongoing assessments. Those included data supplied from:

- The Department of Land and Water Conservation (DLWC) 1995.
- DLWC 1997.

- Coffey 2004.
- NSW Department of Environment Climate Change and Water (DECCW) 2008.

Historic photographs obtained from Urunga Museum and historical aerial photos were also reviewed to provide data used to provide and increased understanding of the Site.

Data gaps were also identified from an assessment of the data from previous investigations. These gaps provided the foundation for the Sampling Analysis and Quality Plan (SAQP) presented in the Preliminary Investigation Report (GHD 2012).

3.1.3 Site Visit and Interviews with Former Staff

A Site visit and inception meeting was held on May 9, 2012. It was attended by representatives from:

- GHD.
- EPA.
- Bellingen Shire Council.
- Crown Lands.
- SCS.

Interviews with former site staff were also conducted on May 17, 2012 that aided in the understanding of the sources of the contaminants.

Observations from the Site visit and information obtained from the interviews were used to aid in the development of the Preliminary Conceptual Site Model (CSM) and provide data for the development of SAQP.

3.1.4 Additional Data

Following the submission of the Preliminary Investigation Report, additional aerial photographs were obtained. A summary of findings from these photographs included:

- 1967: No activities or structures are evident on the site except for a small building (likely a house) in the north west corner.
- 1973: The area of the unprocessed ore stockpiling (as shown on Figure 2) is devoid of vegetation and the extent of the tailings deposit is limited to the immediate vicinity of the former processing area.
- 1979 (very poor resolution): The canals appear to be absent and the extent of the tailings deposit has increased to a similar extent to that noted in the current investigation. Disturbed areas extend across the northern portion of the site.
- 1980: The canals are evident and disturbance is apparent over much of the site. Other observations are provided in the Preliminary Investigation Report.
- 2009: Site features reflect those noted during the current investigation. A significant increase in water level between 1991 and 2009 were noted.

3.2 Preliminary Conceptual Site Model

The information obtained from the desktop review and Site visit was used to develop a Preliminary CSM identifying potential contaminant source areas, receptors and exposure pathways.

The CSM divided the area into Source, Impact and Receptor Zone, illustrated on Figure 15 and defined as follows:

- Source Zone, included the tailings deposits, ore stockpiles, former stockpiling area, former processing areas, incidental contaminants and fill material. The source zone potentially extends over the western boundary in the southern portion of the site. The Source Zone covers an area of approximately 16,000 m^2.
- Impact Zone, defined as the areas that are potentially directly impacted (secondary impact) by the contaminants, excluding the Source Zone. This area includes the eastern portion of the Site, the wetland immediately adjacent to the tailings, the 'L' shaped canal and the 'S' shaped canals. The Impact Zone covers an area of approximately 50,000 m^2.
- Receptor Zone, defined as the areas that may be indirectly affected by the contaminants. The area includes sensitive biota in the receiving wetland area including upstream and downstream aquatic fauna and peripheral vegetation. It also includes Lot 101, which has been validated in part by Coffey 2004 and is considered unlikely to have been significantly impacted by contamination from the Site. The Receptor Zone may also include the residential properties adjoining the Site to the west.

Information from the Preliminary CSM has been incorporated into the Updated CSM presented in Section 6.

3.3 Sampling Analysis and Quality Plan

A SAQP was developed entailing:

- 70 soil sampling locations.
- 30 sediment sampling locations.
- 9 surface water sampling locations.
- 5 groundwater sampling locations.

The SAQP also outlined:

- Data Quality Objectives (DQOs).
- An outline of proposed sampling methodology.
- An analytical schedule.
- Identified contaminant assessment criteria.

The DQOs identified in the SAQP in the Preliminary Investigation Report (GHD 2012) were based those defined in the NSW DEC *Guidelines for the NSW Site Auditor Scheme*

(2nd edition, 2006). The DQO process was applied to the investigation program, as described below, to ensure that data collection activities were appropriate and achieve the project objectives. The DQO process involves the following steps:

- **Step 1**: Stating the problem.
- **Step 2**: Identifying the decision.
- **Step 3:** Identifying inputs to the decision.
- **Step 4:** Defining the study boundaries.
- **Step 5:** Developing a decision rule.
- **Step 6:** Specifying limits on decision errors.
- **Step 7:** Optimising the design for obtaining data.

An assessment as to compliance with the steps is outlined in Section 5.7.

4. Detailed Investigation Methodology

The detailed investigation methodology was based on the SAQP outlined in the Preliminary Investigation Report, which was reviewed and approved by the EPA. A summary of the rationale and details of the sampling are provided in the following subsections.

4.1 Sampling Locations

4.1.1 Soil and Sediment

Sixty three soil and 38 sediment boreholes were advanced to enable an assessment of soil and sediment lithology and physical and chemical parameters. Sampling locations were based on those provided in the SAQP with modifications applied where required due to site features or as data became available from the field analysis. Locations were selected to provide adequate data to delineate the impacted areas and provide a sampling density suitable for calculating impacted soil and sediment volume data required for the RAP. Soil sampling locations are presented in Figure 3.

The sampling densities before and after the current investigation are presented in Table 1.

Table 1Soil and Sediment Sampling Density

Zone	Approximate Area of Zone (m2)	Number of reliable, historic soil and sediment sampling locations	Approximate Historic soil and sediment sampling density	Number of additional soil and sediment sampling locations provided in this assessment	Resulting Sampling Density
Source Zone	16,000	41	1: 400 m^2	32	1:220 m^2
Impact Zone	50,000	14	1:3,600 m^2	59	1:700 m^2
Receptor Zone	>120,000*	14	1:8,500 m^2	12	1:4,500 m^2

***** The area of the receptor zone is difficult to define but was considered to encompass the area outlined in figure 5 and the wetland downstream to the railway for the purpose of this estimate.

The proposed sampling density was primarily based on a judgemental sampling plan, which is outlined in Section 2.3.1 of the 'NSW EPA Sampling Design Guidelines (1995)'. Given the known use and historical review undertaken for the site, the sampling program was designed to target and characterise the identified areas of impact, as well as to assess the distribution of contamination across the adjacent Impact Zone. The depth of the sampling locations at each area of the Site was based on the subsurface ground conditions encountered in that area. The final depths of the boreholes were determined during field works and when the depth of the target subsurface materials was achieved.

The rationale for the soil and sediment sampling locations is summarised below.

Source Zone

Historic results indicated that the Source Zone will likely require remediation or management. As substantial data was already available for this zone, sampling locations were limited to:

- Confirm historic concentrations and impact extent.
- Provide a correlation between field XRAY Fluorescence (XRF) and laboratory data.
- Fill data gaps in terms of horizontal and vertical delineation.
- Provide data necessary for a remediation options assessment (e.g. particle size, acid sulfate soil).

Impact Zone

The rationale for the sampling locations in the Impact Zone was to:

- Provide a correlation between field XRF and laboratory data.
- Fill data gaps in terms of horizontal and vertical delineation.
- Provide data necessary for a remediation options assessment (e.g. particle size, acid sulfate soil).

Soil sampling in the Impact Zone generally targeted:

- The vicinity of the ‘S’ and ‘L’ shaped canals.
- Potentially impacted areas to the northwest and northeast of the ‘L’ shaped canal.
- The vegetated areas in the northern portion of the Site (where the previous access was noted).
- Other areas surrounding the Source Zone.

Sediment sampling in the Impact Zone targeted the benthic layer of the wetland to the south of the tailings area and in or adjacent to the ‘L shaped’ and ‘S’ shaped canals. Sampling was undertaken at transects across these areas to assess the distribution of contamination at increasing distance from the source area and to guide decisions regarding the extent of the area requiring management or remediation.

Receptor Zone

Soil sampling in the Receptor Zone was conducted on the southern bank of the wetland.

Sediment sampling in the Receptor Zone was undertaken in areas to the south of the wetland and east of the ‘L’ shaped canal to assess contaminant concentrations beyond the Impact Zone. Sampling was conducted as part of the transects across these areas, to assess the distribution of contamination at increasing distance from the Impact Zone.

4.1.2 Bricks

Twenty five samples from 23 bricks, including at least one brick of each style or model were selected for XRF screening. Based on the XRF results, two samples were submitted

to the laboratory for crushing and analysis to verify the XRF results. The sampling was to assess the waste classification of the bricks to direct disposal options.

4.1.3 Stockpiles and Loading Ramps

Twenty two samples from three stockpiles and two loading ramps were selected for XRF screening. The results were used to assess the levels of impact within the stockpiles and govern the remediation options.

4.1.4 Surface Water

Nine surface water samples were collected during the program as shown in Figure 3. Sample locations were selected to:

- Provide an assessment of surface water quality from upstream to downstream of the Site.
- Provide a comparison with historic (DLWC 1997) data.
- Provide baseline data for assessing any future impact from site activities or remediation.

Surface water was sampled from the wetland and the 'S' shaped canals within the Impact Zone, in the wetland to the south and west of the tailings deposit and in the wetland to the east of the 'L' shaped canal within the Receptor Zone.

4.1.5 Groundwater

Five groundwater monitoring wells were installed by DLWC in 1997. Four of these wells were located and sampled as part of GHD's investigations, to assess groundwater quality. The purpose of the monitoring was to:

- Assess current groundwater quality.
- Provide a comparison with historic (DLWC 1997) data.
- Provide baseline data for assessing any future impact from site activities or remediation.

4.2 Sampling Methodology

4.2.1 Health Safety and Environment

All site investigations and visits were conducted in accordance with a site specific Safe Work Method Statement (SWMS) prepared by GHD that complied with relevant Occupational Health and Safety (OH&S) regulation and acts. The SWMS comprised a project outline, a summary of relevant Site activities and specific job-related tasks, a hazard register that identified all foreseeable hazards, a risk ranking system for the management of identified hazards, procedures for monitoring and/or implementing mitigating measures to manage all project based risks. This SWMS also included using appropriate Personal Protective Equipment, minimising contact with materials and cleaning down of equipment before leaving Site. A site specific OHS&E plan was prepared, incorporating these safety provisions and environmental management

measures required to minimise the potential impact from GHD's sampling activities on the environment and surrounding community.

All staff involved in the investigations were briefed on OHS&E requirements as well as other job specific information, such as site plans, sampling methodology, GHD proposal details, copies of relevant standard operating procedures etc.

All of GHD's field staff who operated the XRF units had completed a Radiation Safety and Operator Training course and were trained to use portable and hand-held Niton XRF units. In addition to this field staff were licensed for the use of ionising radiation apparatus and/or radioactive substances in accordance with s.6(45) Radiation Control Act 1990 (a NSW Radiation Control Act licence) with the NSW Office of Environment and Heritage (OEH).

4.2.2 Underground Service Location

Underground utilities and infrastructure were located using the 'dial before you dig' search facility and the services of a professional cable locating company (Cable and Pipe Locations Pty Ltd). Two 11kV cables were noted on the ground on the tailings area that were collapsed overhead lines. Essential Energy confirmed that the lines had been de-energised. A buried utility of unknown origin (but assumed to be an abandoned part of the former processing facility) was located to the east of the former processing building.

4.2.3 Location Data

Each site investigation location was located (easting, northings) using a hand held (Trimble) Global Positioning System (GPS), providing sub-metre horizontal accuracy. Elevation data sourced from Light Detection and Ranging (LIDAR) was used to establish a reference surface, and surface elevations to an order of magnitude suitable for the purposes of this investigation. Depths below ground surface were measured by tape measure during sampling.

Due to the limited results obtained from the groundwater wells (Section 5.4) no survey of the groundwater wells was conducted.

4.2.4 Field Documentation

Field Logbook and Sample Documentation

Written logs were maintained for all field activities. These logs covered general field observations and an account of daily works and events including:

- Works completed including start and end time.
- Weather conditions.
- Field observations.
- Results of field testing.
- Instrument calibration results.

- Sample details (e.g. time and date, sample, identification number and location, procedures used in sample collection, instrument readings, conditions surrounding the sampling location, observable characteristics).
- Decontamination procedures and health and safety monitoring.
- A register of all samples.

A copy of the field logbooks, sample registers and log sheets have been retained in the GHD job file in hard and electronic format.

Field Photography

Digital, colour photographs were taken of most sampling points, and surrounding areas, including photographs of sample cores from boreholes with any relevant site features.

Sample Labels

Samples were labelled with adhesive labels using indelible ink. The following information was included on the sample labels:

- Job number.
- Sample identification number.
- Date (and time, for water samples) of sampling.

The sample identification was also written with indelible ink on the cap of the sample bottle in case the sample label is lost or destroyed.

Each sample was assigned an individual sample identification number with the following format:

- The Sampling Code:
  - BH = Soil borehole
  - SE = Sediment
  - SW = Surface water
  - GW = Groundwater
- A unique identifier (e.g. 001-999).
- The sampling depth or interval at which the sample was taken below the surface to the nearest 0.1 m (in the case of soil or sediment).

Quality control sample labelling systems were used as follows:

- Field duplicate samples: BHDUP001, SEDUP002 etc.
- Inter laboratory duplicate sample: BHLABDUP001, SELABDUP002 etc.
- Trip blanks: TB001, TB002, etc.
- Rinsate blanks: RB001, RB002, etc.

Chain of Custody Forms

Chain of custody procedures were used to track samples and included:

- Site identification.
- Name of the sampler.
- Sample numbers.
- Nature of the sample.
- Collection date.
- Signature of sampler or field manager.
- Departure time from site.
- Dispatch courier(s).

Copies of the Chain of custody forms are provided in Appendix F.

4.3 Sampling and Field Analysis Procedures

All fieldwork was undertaken in general accordance with GHD's Standard Field Operating Procedures (SOP) including the following:

- New, disposable nitrile gloves were used for the collection of each sample.
- Samples were placed in laboratory-supplied bottles appropriate for the analysis required.
- Samples were stored in a dedicated container for transport to the project analytical laboratory with chain of custody documentation. Where required for appropriate preservation of samples prior to laboratory analysis, ice was used.
- All sampling equipment was thoroughly decontaminated (in accordance with written procedures) to mitigate cross contamination occurring between sampling locations. Sampling equipment was washed with Decon 90 and then rinsed in tap water and then deionised water prior to and after the collection of each individual sample.
- Quality Assurance/ Quality Control (QA/QC) sampling as outlined in Section 4.6.

4.3.1 Soil

Drilling

The majority of the soil boreholes were advanced using a hand auger. Boreholes offering too much resistance for hand augering were advanced with a Dingo fitted with an auger or a combination of the Dingo and hand auger.

Sampling was conducted as follows:

- Boreholes were advanced to the proposed investigation depth.
- Depending on the soil lithology encountered within the borehole, soil sampling was carried out at approximate depths of: surface to 0.1 mbgs, 0.2 to 0.3 mbgs, 0.5 mbgs, 1.0 mbgs and 0.5 metres thereafter within the soil profile until the desired depth was attained. Samples were collected from each discrete strata unit, without sampling across strata.

- Undertaking in-field XRF analysis for key metal contaminants including primarily Antimony (Sb) and Arsenic (As) and secondarily Copper (Cu) and Lead (Pb).

Soils were logged according to the Unified Soil Classification System (USCS), making observations of evidence of contamination (staining or odours), as appropriate.

Borehole logs were prepared for each soil borehole location showing geology, field screening, groundwater strikes, sampling depths and final depth. Borelogs are presented in Appendix E.

Upon completion of drilling, the boreholes were backfilled with soil cuttings, generally replaced in the same depth order as excavated. Care was taken to avoid backfilling uncontaminated portions of the borehole with any cuttings that were potentially contaminated.

XRF Procedures

XRF procedures were implemented to develop a relationship between the XRF and laboratory results. This allowed for the ability to rapidly delineate the presence and extent of contamination on site during the investigation such that the sampling regime could be altered without waiting for laboratory results.

The applicability of this technique was previously indicated by work conducted by the EPA in 2008.

A NITON XL3t XRF unit was used in accordance with procedures outlined in Appendix H of the Preliminary Investigation Report and generally involved:

- Setting the XRF for target analytes, appropriate excitation sources and parameters based on data quality objectives (DQOs).
- Calibration of the XRF using supplied blanks, verification samples and background samples.
- Preparation of the soil for sampling (ensuring the soil was not covered in standing water, did not contain any large, non-representative debris, could be contacted directly by the XRF, was covered with thin plastic (cling wrap) and contained a smooth, flat surface).
- Sample analysis. XRF measurement time for each sample was generally 30 seconds.
- Precision measurement checks.
- Submission of at least 5% of samples to a laboratory for confirmatory analysis.

4.3.2 Sediment

Sediment samples were collected using a specifically designed, sediment sampling, push tube device which was operated from a canoe or by foot (using waders). Sample cores were divided according to observable characteristics with depth, to allow separate analysis and assessment of shallower and deeper sediments and any underlying residual soils (if present). XRF analysis was not used on sediment samples due to limitations relating to XRF analysis of saturated samples.

4.3.3 Surface Water

Surface water was collected directly into laboratory-supplied bottles, from a canoe or by foot (using waders). Surface water field measurements including pH, electrical conductivity (EC), oxidation-reduction potential (redox), dissolved oxygen (DO) and temperature were recorded at each surface water sampling location. Water quality meters were calibrated at the beginning of each sampling round and periodically throughout the day.

Both unfiltered/ unpreserved and filtered/ preserved samples of surface water were collected, to allow comparison of total and dissolved metal concentrations. Samples for dissolved metals analysis were field-filtered using 0.45 µm membrane filters to remove colloidal matter before being transferred to sample containers of appropriate composition that were pre-treated in a manner appropriate for the laboratory analysis.

4.3.4 Ground Water

Following an assessment of their physical state, monitoring wells installed by DLWC (1997) were sampled as follows:

- The standing water level, at each monitoring well, was gauged using an electronic interface probe.
- Each well was redeveloped by bailer on August 17, 2012 to remove accumulated sediment. Development using a bailer allowed for a greater surging action and potentially a greater removal of sediment.
- Sampling was conducted on August 22, 2012, using a low flow pump in order to generate less disturbance of sediments that may remain present in the wells.
- The equipment requiring decontamination was cleaned using an appropriate detergent and rinsed with deionised water after each use.
- Field parameters, including pH, EC, redox, DO and temperature were measured during purging, along with observations of the presence of a sheen or odours.
- When field parameters reached equilibrium (i.e. consecutive measurements were within 10% of each other), groundwater samples were collected directly from the dedicated tubing attached to the sampling pump. Water samples were immediately placed into laboratory prepared bottles suitable for the required analyses.
- Where required for laboratory analysis, water samples were filtered in the field using 0.45 µm membrane filters to remove colloidal matter before being transferred to sample containers of appropriate composition that were pre-treated in a manner appropriate for the laboratory analysis.

4.3.5 Stockpiles and Loading Ramps

Three stockpiles and two loading ramps were analysed using XRF field analysis. Samples were taken from depths of approximately 0.1 to 0.2 m below the stockpile surface.

4.3.6 Bricks

Twenty three bricks were field screened with the XRF by taking a reading directly onto the surface of the bricks. Two samples were submitted to the laboratory for crushing and analysis to verify the XRF results.

4.4 Analytical Schedule

Based on the SAQP presented in the Preliminary Investigation report (GHD 2012) and data obtained from XRF analysis, an analytical schedule was implemented as outlined in Table 2. The implemented SAQP varied from the SAQP presented in the Preliminary Investigation report where field data provided evidence of contaminant extent that varied from that presented in the preliminary CSM. Laboratory analysis focused on the key parameters of concern, and parameters related to the mobility and toxicity of the contaminants.

Table 2 Completed Sampling and Analytical Quality Plan

Zone	Comments	Number of Sampling Locations	Laboratory Analysis																							
			Soil / Sediment																Surface Water and Ground Water							
			Aluminium	Arsenic	Antimony	Iron	Mercury	Metals suite (x8) [1]	Cyanide	pH	TCLP for metals	Weak acid digest for metals	Moisture	TOC	Cation Exchange Capacity	Particle size / clay content	Acid Sulphate screening (pH_f and pH_{fox})	SPOCAS	Aluminium [2]	Antimony [2]	Metals suite (x8) [1,2]	Cyanide	Iron	Major Cations and Anions	TDS	TSS
Source Zone	**Soil**	32 locations, 120 samples	11	21	21	6	18	15	8	8	13	-	21	4	4	4	9	6								
	Bricks	25 x brick samples	-	2	2	-	2	2	-	-	-	-	-	-	-	-	-	-								
	Groundwater	4 monitoring wells																	4	4	4	3	4	3	3	3
Impact Zone	**Soil**	27 locations, 66 samples	7	18	18	3	18	8	14	14	9	-	18	4	4	-	-	-								
	Sediment	32 locations, 79 samples	18	46	46	5	48	46	34	34	8	20	49	10	10	8	4	3								
	Surface water	7 locations																	8	8	8	8	8	8	8	8
Receptor Zone	**Soil**	6 locations, 17 samples	2	3	3	1	3	2	2	2	3	-	3	1	1	1	-									
	Sediment	6 locations, 12 samples	1	4	4	1	5	4	3	3	2	3	6	-	-	2	1	-								
	Surface water	2 locations																	10	10	10	10	10	10	10	10
TOTAL Primary Samples			39	94	94	16	94	77	61	61	35	23	97	19	19	15	14	9	22	22	22	21	22	21	21	21

[1] 8 Metals = As, Cd, Cu, Cr, Ni, Pb, Zn, Hg

[2] Metals in surface water = dissolved plus total

4.5 Assessment Criteria

Following additional data obtained during the detailed investigation (as outlined in Sections 5 and 6), updated assessment criteria are listed below.

4.5.1 Relevant Guidelines

The framework for contamination assessment is based on guidelines "made or approved", by the NSW EPA under Section 105 of the *Contaminated Land Management Act, 1997*. These guidelines include, but are not limited to the following:

- NSW OEH, Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites, 2011.
- DECC, Contaminated Sites: Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997, June 2009.
- DEC, Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination, 2007.
- DEC, Contaminated Sites: Guidelines for NSW Site Auditor Scheme. 2006.
- ANZECC, National Water Quality Management Strategy, Paper No. 4, Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), 2000.
- NEPC, National Environment Protection (Assessment of Site Contamination) Measure (NEPM), 1999.
- NSW EPA, Contaminated Sites: Sampling Design Guidelines, 1995.
- ANZECC/NHMRC, Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites, 1992.
- ANZECC /ARMCANZ Interim Sediment Quality Guidelines (ISQG), 2000.

Additional regulatory guidelines used for classification of waste material for off-site disposal (including the bricks) include:

- DECCW 2009, Waste Classification Guidelines, December 2009.

Where relevant criteria were not contained in the above guidelines, reference was made to other guideline documents, including the following:

- MHSPE 1994, Environmental Quality Objectives in the Netherlands.
- USEPA 2004 Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual.

The assessment criteria against which the project analytical data has been compared are outlined in the following subsections.

4.5.2 Soil Assessment Criteria

The adopted soil assessment criteria are presented in Table 3. The rationale for the assessment criteria is provided in the Preliminary Investigation report and summarised as follows.

Health Based Criteria

Health-based soil Investigation Levels (HILs) are provided for a range of different exposure settings, which are based on the nature of the use(s) for which the site is currently used and/or it's approved use(s). As the future use of the Site is likely to be as a reserve, the most applicable exposure setting is considered to be **NEHF E- Parks, Recreational, Open space** as published in DEC (2006). This criterion corresponds with NEPM HIL (E) from NEPC (1999) and is herein referred to as HIL (E).

Ecological Investigation Levels

Interim Ecological Investigation Levels (EILs) are presented in NEPC (1999) for urban areas and are based on considerations of phytotoxicity, ANZECC B levels and soil survey data. Assessment criteria for regional areas are 'to be developed by jurisdictions as required' (NEPC 1999). The EILs have been included as assessment criteria for evaluation of potential phytotoxic impacts, however discussions of analyte concentrations in section 5 are in relation to HIL E criteria.

DEC 2006 includes Provisional Phytotoxicity Based Investigation Levels (PBILs) which relate to the potential uptake of contaminants that may result in adverse, phytotoxic impacts on sensitive plant species. These are generally equivalent to the NEPC (1999) EILs. DEC 2006 notes, however that the PBILs have significant limitations because phytotoxicity depends on soil and species parameters in ways that are not fully understood. They are intended for use as a screening guide only and may be assumed to apply to sandy loam soils, or soils of a similar texture, for pH 6-8.

Antimony

No criteria are given in NEPC 1999 for antimony. As outlined in the Preliminary Investigation Report, the following assessment criteria have been provided for an assessment of antimony concentrations:

- ANZECC/NH&MRC (1992) Environmental Investigation level - 20 mg/kg. and
- USEPA (2004) Residential - 310 mg/kg.

Acid Sulfate soils

Potential acid sulfate soils were assessed by criterion outlined in:

- *Acid Sulfate Soils Assessment* (ASSMAC) Guidelines (Ahern et al. 1998). and
- Queensland Acid Sulfate Soil Technical Manual- Soil Management Guidelines (Dear et al. 2002).

Table 3 Adopted Soil Assessment Criteria

Analyte	Units	NEPM 1999 HIL E	NEPM 1999 EIL
Antimony(1)	mg/kg	310	20
Arsenic	mg/kg	200	20
Cadmium	mg/kg	40	3
Chromium (III+VI)(2)	mg/kg	200	50(2)
Cyanide Total(3)	mg/kg	500	-
Copper	mg/kg	2000	100
Lead	mg/kg	600	600
Manganese	mg/kg	3000	500
Mercury	mg/kg	30	1
Nickel	mg/kg	600	60

(1) Criteria for antimony will be 20 mg/kg (ANZECC/NH&MRC 1992) and 310 mg/kg (USEPA Res (2004)).
(2) Chromium analysed as Total Chromium. Health-based Criteria for Cr (VI) used as a conservative screening measure, although Chromium is considered unlikely to be present in hexavalent form. ANZECC/NHMRC (1992) Environmental Investigation Threshold (EIT) adopted for total chromium, as Chromium is considered unlikely to be present in hexavalent form.
(3) HIL for free cyanide used as a conservative measure.

4.5.3 Sediment Assessment Criteria

The adopted sediment assessment criteria for selected analytes are presented in Table 4. As outlined in the Preliminary Investigation Report, the assessment criteria for most analytes were from the ANZECC /ARMCANZ (2000) Interim Sediment Quality Guidelines (ISQG).

No criterion was available from ANZECC /ARMCANZ (2000) for cyanide. The Dutch intervention values (MHSPE 1994) for sediment of 20 mg/kg for free cyanide and 50 mg/kg for complex cyanides, have been adopted in this case.

The influence of site-specific conditions on contaminant bioavailability and toxicity to benthic invertebrates is a key consideration in the environmental risk assessment process. This is particularly relevant for contaminants with complex speciation chemistries such as arsenic (Irving et al 2008). However, Irving et al (2008) found sublethal toxicities of both arsenite (As(III)) and arsenate (As(V)) to be similar and not significantly affected by changes in DO.

In the consideration of guideline values for metals, total metals concentrations are used, however, acid-soluble metals, are more representative of a bioavailable fraction and it is envisaged that ultimately trigger value compliance will be based on this measurement (ANZECC 2000). Accordingly total concentrations were used for initial screening but where available, weak acid extractable concentrations were considered to be more appropriate in the assessment of risk.

Table 4 Adopted Sediment Assessment Criteria

Analyte	Units	ISQG- Low	ISQG- High
Antimony	mg/kg	2	25
Arsenic	mg/kg	20	70
Cadmium	mg/kg	1.5	10
Chromium	mg/kg	80	370
Copper	mg/kg	65	270
Cyanide	mg/kg	20	50
Lead	mg/kg	50	220
Mercury	mg/kg	0.15	1
Nickel	mg/kg	21	52
Zinc	mg/kg	200	410

4.5.4 Water Assessment Criteria

The adopted water assessment criteria for selected analytes are presented in Table 5. The rationale for the assessment criteria is provided in the Preliminary Investigation report.

For the purpose of this assessment, surface and groundwater quality will be compared to the assessment criteria outlined in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000). Electrical conductivity (EC) levels measured in the surface water by DLWC (1997) and during this investigation had a maximum value of 380 uS/cm. Although limited, the data indicates the receiving environment contains freshwater (brackish water is considered to have an EC of 800-1600 uS/cm (Environment Australia, 2002)), hence the guidelines for Freshwater were applied.

As the Site is deemed to be a 'slightly to moderately disturbed system', the 95% level of protection of species has been identified as being applicable in conjunction with the 99% level for selected analytes deemed to have a bioaccumulative effect.

Table 5 Adopted Water Assessment Criteria

Analyte	Units	ANZECC 2000 Fresh Water Slightly-moderate disturbed system
Aluminium	mg/L	0.05
Antimony	mg/L	0.009
Arsenic	mg/L	0.013
Cadmium	mg/L	0.0002
Chromium (III)[1]	mg/L	0.00331
Chromium (VI)	mg/L	0.001
Copper	mg/L	0.0014
Cyanide Total	mg/L	0.007
Lead	mg/L	0.0034
Mercury (inorganic)[2]	mg/L	0.00006
Mercury (methyl)	Mg/L	ID2
Nickel	mg/L	0.011

[1] A moderate reliability trigger value for chromium (III) of 3.3 µg/L for freshwater was derived, using the statistical distribution method with 95% protection and an ACR of 77.6.
[2] There were Insufficient Data (ID) to derive trigger values for methyl mercury. The 99% protection levels for organic mercury are recommended for slightly-moderately disturbed systems as a precaution for bioaccumulation.

4.5.5 Exceedance Comparison Criteria

As presented in most of the data tables in Appendix C, a comparison of the magnitude of concentrations exceeding the assessment criteria has been facilitated with the following additional criteria:

- Ten times the assessment criteria.
- Thirty times the assessment criteria.

4.6 Quality Assurance/ Quality Control (QA/QC)

4.6.1 Field Programme QA/QC

All fieldwork was conducted in general accordance with GHD's SOP, which aim at collecting environmental samples using uniform and systematic methods, as required by GHD's QA system. Key requirements of these procedures were as follows:

- Appropriately trained and experienced staff conducting and documenting site activities using photographs and notes on standard field forms such as daily site records and sampling logs.
- Decontamination procedures including the use of new disposable gloves for the collection of each sample, decontamination of sampling equipment between each sampling location (using DECON 90) and the use of dedicated sampling containers provided by the laboratory.
- Logging procedures using a recognised system.

- Ensuring all field-monitoring equipment was appropriately calibrated.
- Using documentation and Chain of Custody procedures as outlined in the SAQP.
- Collection of duplicate and triplicate samples for QA/QC purposes as outlined in the SAQP which included 5% split duplicates and 5% blind replicate samples on the basis of sections 4.7 and 4.8 of the NEPM (1999) Schedule B(3) of the NEPM and the ANZECC / ARMCANZ 2000 *Australian Guidelines for Water Quality Monitoring and Reporting*.
- Collection of one rinsate blank per day.

QA/QC precision was assessed following assessment criteria outlined in the SAQP. Precision measures the reproducibility of measurements under a given set of conditions. The precision of the data is assessed by calculating the Relative Percent Difference (RPD) between duplicate sample pairs.

$$RPD(\%) = \frac{|C_o - C_d|}{C_o + C_d} \times 100$$

Where Co = Analyte concentration of the original sample

Cd = Analyte concentration of the duplicate sample

GHD generally adopts a nominal acceptance criterion of ± 30% RPD for field duplicates and splits for inorganics and a nominal acceptance criterion of ± 50% RPD for field duplicates and splits for organics. It is noted that this will not always be achieved, particularly in heterogeneous soil or fill materials, or at low analyte concentrations.

4.6.2 Laboratory Programme QA/QC

All analyses were carried out by ALS Laboratory (who are National Association of Testing Authorities (NATA) accredited), using analytical methodology consistent with the requirements of relevant guidelines. Where practical, analytical methodologies were selected to provide a Practical Quantitation Limit (PQL) low enough for comparison with the adopted assessment criteria.

The laboratories used their internal procedures and NATA accredited methods in accordance with their quality assurance system. Laboratory quality control procedures included:

- **Laboratory duplicate samples:** Duplicate sub samples were collected by the laboratory from one sample submitted for analytical testing at an overall rate of approximately 36%. A laboratory duplicate provides data on the analytical precision and reproducibility of the test result. Ideally laboratory duplicate samples should return RPDs within the NEPM acceptance criteria of ±30%.
- **Spiked Samples:** An authentic field sample was spiked by adding an aliquot of known concentration of the target analyte(s) prior to sample extraction and analysis. A spike documents the effect of the sample matrix on the extraction and analytical techniques. Spiked samples were analysed at a rate of approximately 9%.

- **Certified Reference Standards:** A reference standard of known (certified) concentration was analysed along with a batch of samples. The Certified Reference Standard (CRS) or Laboratory Control Spike (LCS) provides an indication of the analytical accuracy and the precision of the test method and is used for inorganic analyses. LCS were analysed at a rate of approximately 12%.
- **Surrogate Standard/Spikes:** Are organic compounds which are similar to the analyte of interest in terms of chemical composition, extractability, and chromatographic conditions (retention time), but which are not normally found in environmental samples. These surrogate compounds are spiked into blanks, standards and samples submitted for organic analyses by gas-chromatographic techniques prior to sample extraction. Surrogate Standard/Spikes provide a means of checking that no gross errors have occurred during any stage of the test method leading to significant analyte loss. Although dependent on the type of analyte tested, concentrations of analytes and sample matrix should normally fall within the range of 70-130%.
- **Laboratory Blanks:** Are organic or aqueous solutions that are as free as possible of analytes of interest to which reagents are added, in the same volume, as used in the preparation and subsequent analysis of the samples. The reagent blank is carried through the complete sample preparation procedure and contains the same reagent concentrations in the final solution as in the sample solution used for analysis. The reagent blank is used to correct for possible contamination resulting from the preparation or processing of the sample. Laboratory blanks were analysed at a rate of approximately 12%. Laboratory blanks should return analyte concentrations as 'not detected'.

The individual testing laboratories conducted an assessment of the laboratory QC program internally, as discussed in Section 5.7.

5. Detailed Investigation Results

5.1 Soil

5.1.1 Lithology

Soil borehole logs are presented in Appendix E. Selected cross sections of the Site including lithological data are presented in Figures 4 to 6. A summary of soil lithology noted across the site is presented in Table 6.

In general, the lithology in the vicinity of the tailings consists of silty sand to approximately 1.5 m overlaying approximately 1 m of clayey silt (described by DLWC 1997 as peat), and then silty clay at depths greater than approximately 2.5 m.

Table 6Soil Lithology Summary

Area	Boreholes (BH#)	Zone	Lithology Summary	Approximate depth to groundwater
Tailings deposit	23,24,30,31,32,41, 42,43,50,51,52,53, 54	Source	0-1.5 m silty SAND, grey, moist 1.5-2.5 m clayey SILT, brown, wet 2.5->4.0 m silty CLAY, grey/orange, moist	0.3-0.8 m
Former Unprocessed Ore Stockpiling	1,20,21,28,29,40, 46,47	Source	0-0.3 m silty GRAVEL, brown, dry 0.3-0.7 m sandy SILT, brown, moist 0.7->1.5 m silty CLAY, orange, moist	>1.5 m
Former Processing Area	2,3,4,5,6,10,11,22, 39,100,101	Source	0-0.8 m sandy SILT, brown, dry 0.8-1.5 m clayey SILT, dark brown, moist 1.5->2.2 silty CLAY, orange/grey, wet	1.2 m
NE portion of Site	56,57,61,61,62,63, 64,65,66,67,68,70, 71,72,73	Impact	0-0.5 m sandy SILT, brown, moist 0.5->1.2 m silty CLAY	>1.2 m
Vicinity of 'L' and 'S' Shaped Canals	69,74,75,76,77,78, 79,80,81,82,83,84	Impact	0-1.0 m sandy SILT, brown, moist 1.0->1.7 m silty CLAY, orange/grey, moist/wet	1.5 m
South of Wetland	12,14,27,34,91,93	Receptor	0-0.3 m sandy SILT, brown, moist 0.3->1.0 m silty CLAY, orange/grey, moist	0.8 m

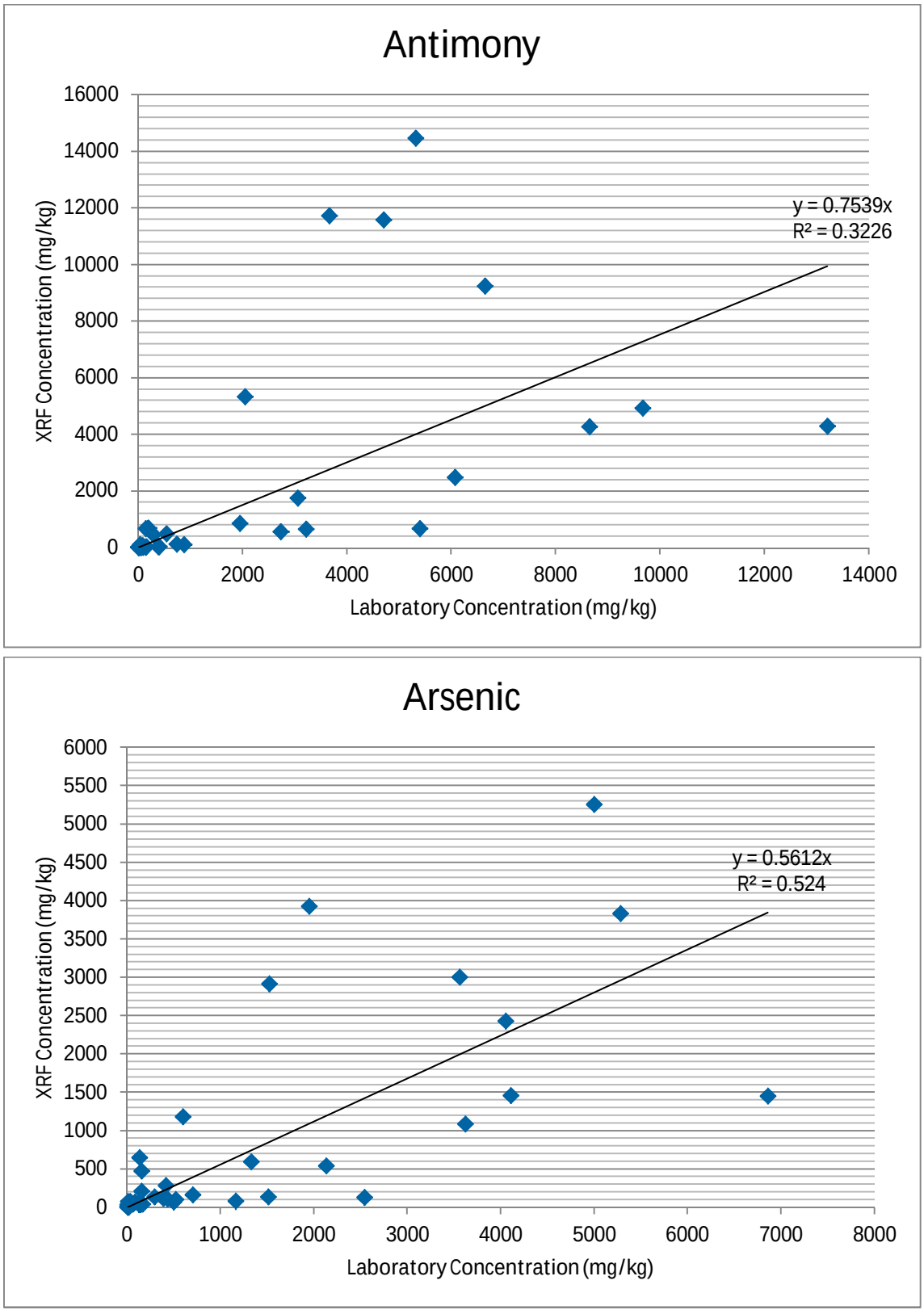
5.1.2 Field Analysis

As discussed in Section 4.3.1, an XRF unit was used for field analysis of metal concentrations in soil. Results are presented in Table C1, Appendix C. A comparison of XRF data with chemical data is presented in Table 3, Appendix C and graphically in Graph 1.

In summary, a comparison of XRF data with chemical data includes:

- RPDs were generally within 150%.
- The XRF results were, on average 75% of the laboratory concentrations for antimony and 56% of the laboratory concentrations for arsenic.
- Non-detects and low values were generally reported consistently by both the laboratory and XRF.
- Inaccuracies increased when high antimony and arsenic concentrations were encountered.
- Possible rationale for the differences include:
  - A high degree of variability in the concentrations of analytes within a given sample as indicated by relatively high RPDs found in field and interlaboratory duplicate samples (as shown in Section 5.7).
  - The non-homogenous nature of the soil.
  - Differences in the sample portion analysed. The depth of x-ray penetration is less than approximately 0.17mm.
  - Moisture content of a sample, when in excess of 20% can have a negative impact on sample precision. The cause of the error is that the XRF gives wet weight results whereas the laboratory gives dry weight results. These are not directly comparable as the dry weight results will return higher concentrations of contaminants present (as supported by this data). XRF analysis is considered less reliable if soils are identified to have a likely moisture content close to saturation.

In general, the XRF results did not correlate well with the laboratory results, however the XRF data is deemed accurate enough to give an indication of the presence/absence of the target analyte and is generally accurate enough to indicate analyte concentrations within the orders of magnitude required to classify the concentrations within the parameters used in this investigation (being exceeding assessment criteria, exceeding 10 times the assessment criteria and exceeding 30 times the assessment criteria).



Graph 1 XRF/ Chemical Data Comparison Graphs

5.1.3 Chemical Analysis

Chemical analysis results for historic and current samples are presented in Table C1, Appendix C. Soil antimony and arsenic concentrations are also presented in Figures 7 to 9. (Table C1 and Figures 7 to 9 also show XRF data). Discussions regarding comparison of analyte concentrations with 'assessment criteria' refer to HIL E criteria, as outlined in section 4.5.

A summary of soil analyte concentrations is presented in Table 7. Note that this table is based solely on laboratory analytical data, due to relatively poor correlation with XRF data. The summarised laboratory results are considered to provide a representative indication of the degree of contamination at the site, while the more extensive XRF data has been used primarily to provide further detail on the extent of contamination.

The interpreted impact extent is presented in Figures 1, 7 ,8 and 9 and estimated volumes of impacted soil are presented in Figure 10a.

In summary, results show that:

- The data was deemed adequate for the development of a CSM sufficient for the purposes of planning remediation.
- Assessment criteria exceedances were noted for antimony, arsenic, chromium, cobalt, copper, lead, mercury and cyanide. This is consistent with the COCs noted in historic investigations.
- Antimony and arsenic concentrations exceeded the assessment criteria most frequently and by the largest percentage (up to 40 times the criteria).
- Concentrations of the main COC recorded in this investigation were within a similar order of magnitude (given differences in sampling and analysis methods) as those recorded in the historical investigations. This implies concentrations have remained relatively constant over the 1995 to 2012 sampling period, and current methodology is comparable with that used in the previous investigations. (Although as indicated in Table 7, historic concentrations of some parameters such as chromium and copper were significantly higher in historic results, possibly due to different laboratory methodology at the time).
- Observations regarding the horizontal impact include:
  - The extent of significant arsenic and antimony contamination roughly follows the extent of areas without vegetation as shown in figures 7 to 9 and verified during the field investigation.
  - The impact in the south west corner of the site, near the wetland has not been delineated due to site access constraints. Delineation would entail further sampling in the neighbouring property.
  - Soil on the southern side of the wetland was free of contaminants.
  - Soil in the north east portion of the site is relatively free of contaminants with the exception of an area of unknown disturbance, to the north west of the 'L' Shaped canal. This area showed elevated antimony, arsenic and lead concentrations to a depth of approximately 1 mbgs (sample location BH073).

Elevated concentrations were also noted for mercury, zinc and copper. Zinc exceeds the EIL but not the HIL, however the concentration at this location is ten times greater than any other result, except for a location in the south west corner of the site (DLWC95-S3), sampled during the DLWC (1995) investigation.

– The soil within the embankment immediately to the north of the 'L' shaped canal showed elevated antimony and arsenic concentrations mainly from between 1 mbgs to 1.7 mbgs (current ground surface). No major change in lithology was noted at that depth, however the depths roughly correlate with the presence of groundwater. It is possible that impacted sediment and soil was excavated from the location of the 'L' shaped canal during canal and embankment construction. Relatively clean soil from deeper within the profile beneath the 'L' shaped canal would then have been placed over the impacted/ excavated sediment. Alternatively, the contaminated interval may represent the original soil surface impacted by contaminant migration from the antimony processing area prior to the canal and embankment construction (historic aerial photographs indicate the original alignment of a drainage course through the site was approximately in this area).

- Adequate data has been presented to enable vertical delineation of the contaminants in the tailings. Approximate depths of impact are shown in Figure 10a. Depths exceeding the adopted assessment criteria varied from approximately 0.5 mbgs in the north west portion of the impact to approximately 2.2 mbgs near the water's edge and some locations within the tailings deposit.
- For "soil" samples (being those take from "dry" areas of the site, including the tailings area, during GHD's investigations) the degree of contamination generally reduces quite quickly so that the site can be divided into significantly impacted and relatively unimpacted areas. The exceptions to this are primarily adjacent to the 'L' shaped canal (where contamination is either within 10 times the assessment criteria, or covered by cleaner material), the south western corner of the site (which has insufficient sampling to define), and the area of disturbance at the north east corner of the site.
- Contaminant concentrations in the relatively unimpacted areas are generally less than EILs as well as less than HIL E.
- In most cases, the leachable concentrations of COCs in the soil and sediment were significantly less than total concentrations, suggesting the physical migration of contaminated soil or sediment has been the more important contaminant migration pathway.
- Notwithstanding the above, where there were significant concentrations of antimony and arsenic in soil or sediment samples, the corresponding leachable concentrations were well above ANZECC trigger values for protection of aquatic ecosystems. This is discussed further in section 5.3.

Table 7 Laboratory Analysed Soil Chemistry Summary

Potential Contaminant/ indicator	Source Zone (mg/kg)				Impact Zone (mg/kg)				Receptor Zone (mg/kg)				Comment
	Current (Max)	Current (Min)	Historic (Max)	Historic (Min)	Current (Max)	Current (Min)	Historic (Max)	Historic (Min)	Current (Max)	Current (Min)	Historic (Max)	Historic (Min)	
Al	17,300	410	-	-	16,100	5,440	-	-	13,100	4,660	-	-	Limited data. Elevated throughout site. No assessment criteria used. Likely to be commensurate with natural soil concentrations.
Sb	13,200	<5	17,160	<1	3,220	<5	2,010	360	7	<5	39	3	COC. Assessment criteria = 310 mg/kg.
Leachable Sb (mg/L)	10.5	<0.1	-	-	10.6	<0.1	-	-	-	-	-	-	Surface water assessment criteria = 0.27 mg/L.
As	6,900	<5	9,820	<0.5	2,130	<5	309	197	16	5	84	12	COC. Assessment criteria = 200 mg/kg.
Leachable As (mg/L)	16.2	<0.1	-	-	1.1	<0.1	-	-	-	-	-	-	Surface water assessment criteria = 0.0045 mg/L.
Cd	11	<1	25.5	<0.5	3	<1	1.6	<0.5	<1	<1	0	<0.5	All laboratory results below assessment criteria of 40 mg/kg.
Cr	34	3	1,540	1.4	20	4	363	10	15	5	16	7	All current laboratory results below assessment criteria of 200 mg/kg.
Cu	724	<5	3,448	2.4	120	<5	2,716	33	12	<5	76	7.2	All current laboratory results below assessment criteria of 2000 mg/kg.
Fe	27,400	11,000	-	-	8,020	2,720	-	-	25,400	25,400	-	-	Limited data. Elevated throughout site. No assessment criteria used. Likely to be commensurate with natural soil concentrations.

Potential Contaminant/ indicator	Source Zone (mg/kg)				Impact Zone (mg/kg)				Receptor Zone (mg/kg)				Comment
	Current (Max)	Current (Min)	Historic (Max)	Historic (Min)	Current (Max)	Current (Min)	Historic (Max)	Historic (Min)	Current (Max)	Current (Min)	Historic (Max)	Historic (Min)	
Pb	996	6	3,550	5	518	8	500	33	12	8	98	6.9	All current laboratory results below assessment criteria of 600 mg/kg except 1 sample (BH032_0.3-0.5)
Hg	343	<0.1	81	<0.05	57.8	<0.1	7.9	7.9	0.1	<0.1	0.33	<0.05	Assessment criteria = 30 mg/kg. Potential COC.
Ni	9	<2	2	<1	18	<2	-	-	5	<2	-	-	All laboratory results below assessment criteria of 600 mg/kg.
Zn	695	<5	7,477	2	305	8	294	24	8	<5	128	17	All levels below assessment criteria of 14,000 mg/kg.
CN	39	<1	18	<0.1	83	<1	0.6	0.6	3	2	0.1	<0.1	All levels significantly below assessment criteria of 1,000 mg/kg.
TOC	9.46	0.2	34	0.1	17.6	0.3	4.2	4.2	2.88	2.88	31	3.6	Highly variable TOC. Similar range to historic results.
pH (units)	7.5	3	6.7	2.9	5.6	3.2	5.8	5.8	5.1	4.7	6.9	4.8	Generally acidic

Notes: Table 7 does not include XRF results. Refer to Table C1 for all results, including XRF and laboratory analysed results.
Units in mg/kg unless otherwise noted.

5.1.4 Physical Analysis

Results for soil and sediment physical characteristics are presented in Table C4, Appendix C. A summary of results includes:

- Sixteen (5 soil and 11 sediment) samples were analysed for particle size analysis (PSA).
- Lithology noted on the borehole logs closely matched the laboratory results for soil, with the classification matching in three cases and having the same key constituent for the remaining two.
- Sediment logging was generally less accurate due to the difficulties associated with the field classification of saturated sediments. In summary:
    - Laboratory results matched the field classification in two cases.
    - Laboratory results had the same key constituents as the field classification in five cases.
    - Laboratory results poorly matched field classification in four cases. This was generally in cases where a laboratory result of silty CLAY was field classified as SILT.
- The data indicates that the soil logging used by GHD is within a sufficient degree of accuracy for assessing remediation options. Sediment analysis should generally be considered to have higher clay content than the lithology presented in the borehole logs for this investigation.

5.1.5 Acid Sulfate Soil

Results for soil and sediment acid sulfate potential are presented in Table C5 Appendix C. A summary of results includes:

- Eighteen samples from 11 locations (in the tailings (including the underlying soils at a depth of 2.0 mbgs), the sediment adjacent to the tailings and the vicinity of the canals) were analysed for field analysis of potential acid sulfate soils (PASS) with all samples indicating a high likelihood of acid sulphate generation potential for all these materials.
- Based on the field analysis, nine samples from five locations (in the tailings and in the sediment adjacent to the tailings) were analysed for Suspension Peroxide Oxidation Combined Acidity and Sulfur (SPOCAS) analysis.
- Based on the percentage of oxidisable sulfur (net acidity-sulphur) and a comparison with the Action Criteria in Table 4.4 of the Acid Sulfate Soils Management Advisory Committee (ASSMAC) guidelines (Ahern et al. 1998), the preparation of a detailed management plan and development consent will be required for works that disturb the soil.
- Surface soils in the vicinity of the tailings deposit were noted to have lower pH and net acidity. This is interpreted to be a result of the soil in that area having been

exposed to oxygen and hence having already completed an acid generating reaction.

- Net acidity generally increased with depth to the maximum depth analysed (1.8-2.0m).

5.2 Sediment

5.2.1 Lithology

Sediment borehole logs are presented in Appendix E. A cross section of the wetland area including sediment lithological data is presented in Figure 6. A summary of sediment lithology noted across the site is presented in Table 8.

Table 8 Sediment Lithology Summary

Area	Boreholes (SE#)	Zone	Lithology Summary
Adjacent and West of Tailings	1,2,3,4,5,6,10,11, 12,13,14,20,21,22, 102	Impact	0-0.3 m clayey SILT, dark brown 0.3->1.1 m silty CLAY, grey
Within 'S' Shaped Canals	50,51,52,53,54,56	Impact	0->0.6 m silty CLAY, grey
Adjacent to 'L' Shaped Canal	30,31,32,33,40,41, 42,43,55,57,60,61, 62	Impact	0->0.7 silty CLAY, dark brown/grey
East of 'L Shaped Canal	63,64,65,66,67,68	Receptor	0-0.2 m SILT, organic matter, black 0.2-0.3 m sandy CLAY, dark grey 0.3->0.6 m SILT, organic matter, black

5.2.2 Field Observations

A summary of the environment from which the sediment was sampled is as follows:

- Upstream (west) of tailings deposit: Swampland consisting of reeds, grass, *melaleuca* trees and ferns (as shown in Photo 16, Appendix B). Vegetation showed little physical evidence of impact.
- Vicinity of tailings deposit: An area of dead *melaleuca* trees which was relatively devoid of other vegetation (as shown in Photos 14 and 15, Appendix B). Impact from former site activities was highly evident.

- Adjacent to and east of the 'L' shaped canal: Lilies, reeds and *melaleuca* trees (as shown in Photos 11 and 12, Appendix B) showing little physical evidence of impact.
- Neither discernible flow nor tidal influence was noted during the investigation.
- The water level was noted to be significantly lower by SCS staff in late October 2012. This was following a relatively low rainfall period.
- An old fenceline in the tailings area is buried in sediment, with only approximately 0.3 m of each post exposed, indicating the water level and sediment have risen since the installation of the fence (although water levels may be seasonally variable, as noted above).

5.2.3 Chemical Analysis

Chemical analysis for sediment samples are presented in Table C2, Appendix C. Antimony and arsenic concentrations with interpreted impact extent are presented in Figures 11 and 12. Estimated volumes of impacted sediment are presented in 10b. A summary of sediment analyte concentrations is presented in Table 9.

Discussions regarding comparison of analyte concentrations with 'assessment criteria' refer to the ANZECC /ARMCANZ (2000) Interim Sediment Quality Guidelines as outlined in Section 4.5.3.

In summary, results show that:

- The data was deemed adequate for the development of a CSM sufficient for the purposes of planning remediation.
- As outlined in section 4.5.3, a comparison with weak acid extractable metal concentrations with the assessment criteria was deemed more applicable than total concentrations in assessing the bioavailability of the analytes.
- The weak acid extractable antimony, arsenic, copper, lead and zinc concentrations exceeded the relevant assessment criteria most frequently. A comparison of total with weak acid extractable concentrations for antimony and arsenic are presented in Graph 2. For a conservative approach, it is noted with some confidence that the weak acid extractable concentrations are unlikely to exceed 40% and 25% of the total metal concentrations for antimony and arsenic respectively.
- Although total concentrations of antimony, arsenic, copper, lead, mercury (and to a lesser extent, zinc and chromium) were either elevated or noted to exceed the assessment criteria at most locations, the weak acid extractable concentrations indicate lower bioavailability of those analytes. Applying the comparative ratios of 40% and 25% for antimony and arsenic, respectively to the total metals concentrations results in approximately 20% of the samples analysed reduced to a lower assessment category (being exceeding, exceeding 10 times or exceeding 30 times the assessment criteria).
- In most cases, the leachable concentrations of COCs in the sediment were significantly less than total concentrations, suggesting the physical migration of

contaminated sediment has been the more important contaminant migration pathway.

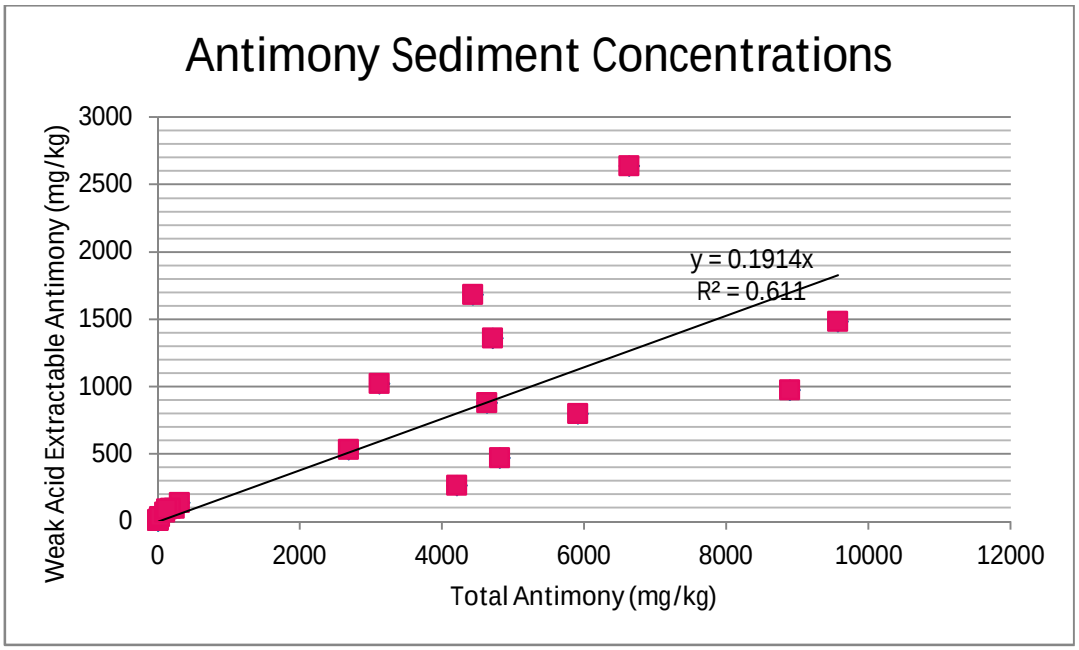
- Notwithstanding the above, where there were significant concentrations of antimony and arsenic in sediment samples, the corresponding leachable concentrations were well above ANZECC trigger values for protection of aquatic ecosystems. This is discussed further in section 5.3.
- Regarding the horizontal extent of the impacted sediment:
  - The interpreted impact extent of antimony and arsenic were similar. The antimony concentrations were generally higher than arsenic in comparison with their respective adopted assessment criteria.
  - Showing highest levels of impact adjacent to the tailings deposit, extending approximately 50 m downstream of the tailing deposit, extending across the wetland some 50 m to the south of the tailings deposit (roughly correlating with vegetation dieback), and within and adjacent to the north eastern portion of the 'L' shaped canal.
  - The impacted sediments adjacent to the eastern portion of the 'L' shaped canal may be as a result of deposition in an 'eddy' that would be present during high flow events. The other possible source of this impact would be from discharge from the north eastern end of the 'S' shaped canals; however relatively low concentrations of COC in sediment samples from the 'S' shaped canals indicate this is the less likely source.
  - The western portion of the 'S' shaped canals was impacted at concentrations exceeding 30 times the adopted assessment criteria. Topography in that area and proximity to the tailings area indicates the likelihood for surface run-off from the tailings deposit to directly enter the western-most portion of the 'S' Shaped canals. Limited connectivity was noted from this portion of the canal to the eastern (remaining) portion of the 'S' shaped canal system. This was supported by the lack of significant impact from COCs in the eastern area.
  - The south eastern portion of the 'S' Shaped canal (Sample SE054) was impacted. This may be associated with potential impact relating to placement of spoil from excavation of the canal.
  - Insufficient data was available to delineate the full extent of sediment impact to the south east of the site, adjacent to the southern shore of the wetland. Similarly, sediment data to the north east of the 'L' shaped canal is limited. The importance of these data gaps will depend on decisions regarding the extent of remediation across the wetland areas.
- Regarding the vertical extent of the impacted sediment:
  - Depths of impact ranges from about 0.5 mbgs near the tailings to 0.1 mbgs in the southern portion of the wetland.
  - The greatest concentrations were generally noted in the surface sediment (0-0.1 m).
  - In several cases (where organic matter was noted to overlay the sediment), the highest concentrations were noted in the second lithological layer (eg 0.2-0.4m).

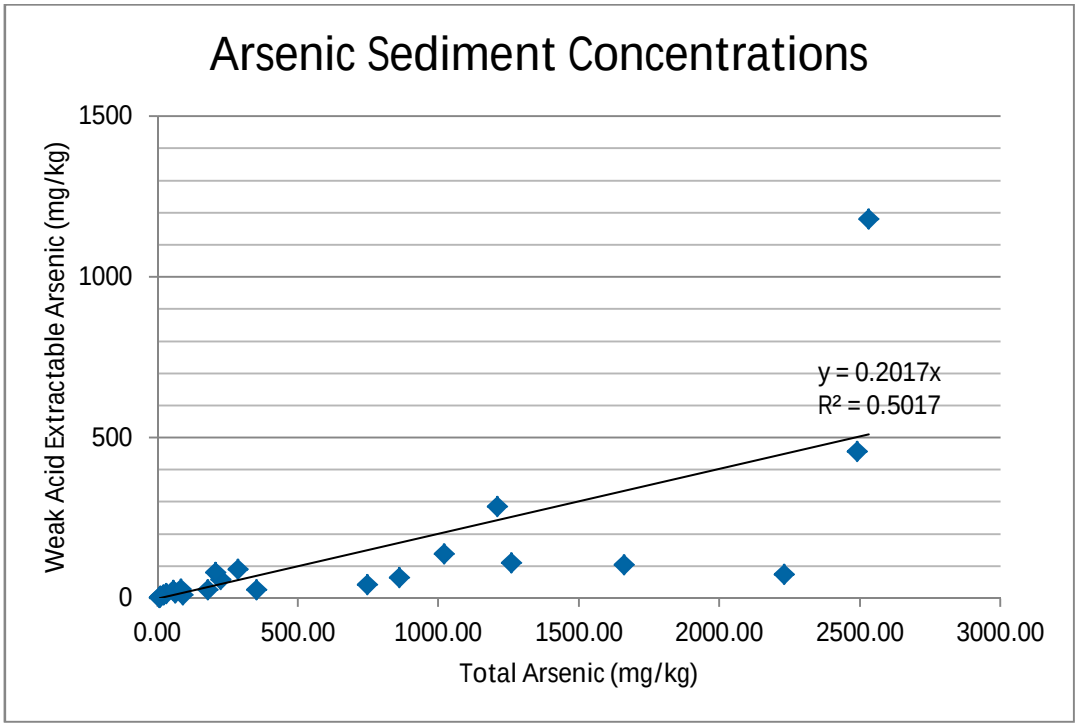
Table 9 Sediment Chemistry Summary

Potential Contaminant	Impact Zone (mg/kg)		Receptor Zone (mg/kg)		Comment
	Max	Min	Max	Min	
Al	18,400	990	7,700	7,700	No defined assessment criteria. Likely to be commensurate with natural soil concentrations.
Sb- Total	11,900	<5	242	130	COC- Elevated levels, likely at least 2.5 times higher than the more applicable weak acid (W.A.) extractable concentrations.
Sb- W.A. Extractable	2,640	2.9	96	90.9	COC- reduced from total levels but significantly exceeding assessment criteria of 25 mg/kg in vicinity of tailing deposit.
Sb- Leachable (mg/L)	8.8	<0.1	1.1	0.6	COC- Limited data. Surface water assessment criteria = 0.27 mg/L.
As- Total	5,410	6	286	22	COC- Elevated levels, likely at least 4 times higher than the more applicable W.A. extractable concentrations..
As- W. A. Extractable	1,180	2.3	91.4	11.7	COC- Significantly reduced from total levels but still significantly exceeding assessment criteria of 70 mg/kg in vicinity of tailing deposit.
As- Leachable (mg/L)	3.8	<0.1	0.3	0.1	COC- Limited data. Surface water assessment criteria = 0.0045 mg/L.
Cd	8	<1	4	<1	All values less than assessment criteria of 10 mg/kg.
Cr	1,450	3	15	10	All values except 1 (SE002_0.0-0.1) less than assessment criteria of 370 mg/kg.
Cu	1,900	6	310	73	Approx. half samples exceed assessment criteria of 270 mg/kg, W.A. extractable values reduced but some still exceed assessment criteria. Limited data on leachable concentrations.
Fe	11,600	2,870	6,610	6,610	No defined assessment criteria. Likely to be commensurate with natural soil concentrations.
Pb	3,280	<5	54	21	Possible COC- Elevated levels exceed assessment criteria of 220 mg/kg, W.A. extractable values reduced but some still exceed assessment criteria. Limited data on leachable concentrations.
Hg	151	<0.1	0.9	0.1	COC- Elevated levels exceed assessment criteria of 1 mg/kg. Leachable concentrations below LOR of 0.001 mg/L (surface water assessment criteria 0.00006 mg/L) except for SE032 (0.0082 mg/L).

Potential Contaminant	Impact Zone (mg/kg)		Receptor Zone (mg/kg)		Comment
	Max	Min	Max	Min	
Ni	26	<2	10	6	All values less than assessment criteria of 52 mg/kg.
Zn	2,150	<5	1,130	74	Possible COC- Elevated levels exceed assessment criteria of 410 mg/kg, W.A. extractable values not significantly reduced. Leachable levels range from 0.9 to 9.1 mg/L. Surface water assessment criteria 0.008 mg/L.
CN	235	<2	4	<1	Possible COC- 5 samples exceed assessment criteria of 50 mg/kg.

Notes: Table 9 does not include XRF results (only limited XRF data for sediment, and not considered reliable due to high moisture content). Refer to Table C1 for all results, including XRF and laboratory analysed results.
Units in mg/kg unless otherwise noted.





Graph 2 Comparison of Total Versus Weak Acid Extractable Concentrations in Sediment.

5.2.4 Physical Analysis

Results for soil and sediment physical analysis are discussed in section 5.1.4.

5.2.5 Acid Sulfate Soil

Results for soil and sediment acid sulfate testing are discussed in section 5.1.5.

5.3 Surface Water

5.3.1 Field Observations

A summary of the environment from which the surface water was sampled is as follows:

- Upstream (west) of tailings deposit: Swampland consisting of reeds, grass, *melaleuca* trees and ferns. Vegetation showed little physical evidence of impact.
- Vicinity of tailings deposit: An area of dead *melaleuca* trees which is relatively devoid of other vegetation (as shown in Photos 14 and 15, Appendix B). Impact from former site activities was highly evident.
- Adjacent to and east of the 'L' shaped canal: Lilies, reeds and *melaleuca* trees (as shown in Photos 11 and 12, Appendix B) showing little physical evidence of impact.
- Neither discernible flow nor tidal influence was noted during the investigation.
- The water level was noted to be significantly lower by SCS staff in late October 2012. This was following a relatively low rainfall period.

5.3.2 Field Analysis

Field analytical results are presented in Table C6, Appendix C.

pH values were between 4.9 and 6.9 which indicates a slightly acidic environment. Values were consistent with DLWC 1997 data and not considered acidic enough to assist in the large scale mobilisation of heavy metals. The pH values may indicate limited impact from potential oxidisation of acid sulfate soils.

EC levels measured in the surface water by DLWC (1997) and during this investigation had a maximum value of 320 µS/cm. Although limited, the data indicates the wetland contains freshwater. Brackish water is considered to have an EC of 800-1600 µS/cm (Environment Australia, 2002).

DO values were relatively low and may be attributable to the relatively stagnant nature of the water within the wetland.

5.3.3 Chemical Analysis

Chemical analysis for historic and current surface water samples are presented in Table C6, Appendix C. Aluminium, antimony, arsenic, copper, lead and zinc concentrations are also presented in Figure 13.

A summary of current surface water analyte concentrations is presented in Table 10. A graphical representation of antimony and arsenic results is presented in Graph 3.

Discussions regarding comparison of analyte concentrations with 'assessment criteria' refer to the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000) for freshwater in a 'slightly to moderately disturbed system', as outlined in Section 4.5.4.

In summary, results show that:

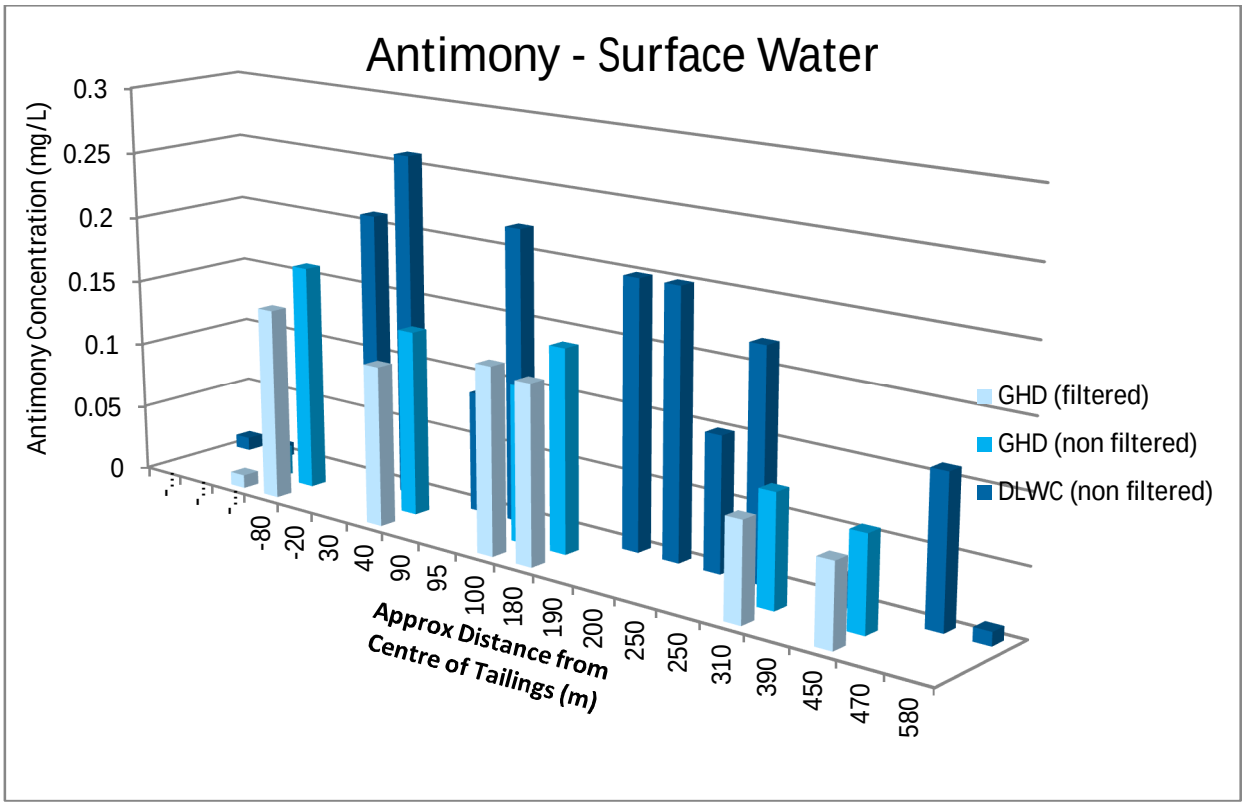
- The data was deemed adequate for the development of a CSM sufficient for the purposes of planning remediation.
- Aluminium, antimony, arsenic and copper concentrations for most samples exceeded the assessment criteria.
- Cadmium and zinc concentrations were elevated in several samples, but except as follows were within an order of magnitude of the assessment criteria. Zinc concentrations from two locations (SW008 and SW009) in the 'S' Shaped canal were particularly elevated (up to 30 times the assessment criteria).
- Total lead concentrations exceeded the assessment criteria in most cases, however no dissolved concentrations exceeded the criteria.
- During the current investigation, the elevated aluminium concentrations were reasonably consistent at all sites, with the greatest concentration recorded upstream of the tailings area. Aluminium concentrations were not elevated in the soils. This suggests that these concentrations are representative of natural levels.
- Copper concentrations were significantly lower than those measured in previous investigations, and were within an order of magnitude of the assessment criteria.
- In relation to antimony and arsenic concentrations, Graph 3 shows:
  - Relatively low antimony and arsenic concentrations upstream of the Site.
  - A rapid increase in the concentrations within the proximity of the tailings.
  - Maximum concentrations within 50m downstream of the tailings.
  - A relatively linear decrease in concentrations with increasing distance, downstream of the tailings.
  - Reduced total concentrations from the 1997 round of sampling to the present. This may be due to many factors (e.g. recent rainfall events, sampling methodology) and does not necessarily indicate an overall reduction in concentrations.
- Dissolved antimony concentrations were, on average, about 75% of the total concentrations, indicating the majority of the antimony is present in soluble form.
- Dissolved arsenic concentrations were, on average, 40% of the total concentrations, indicating a greater proportion of the arsenic was bound to suspended particles.
- DLWC results showed cyanide exceedances. GHD found all cyanide concentrations to be below the Estimated Quantitation Limit (EQL) and the assessment criteria.

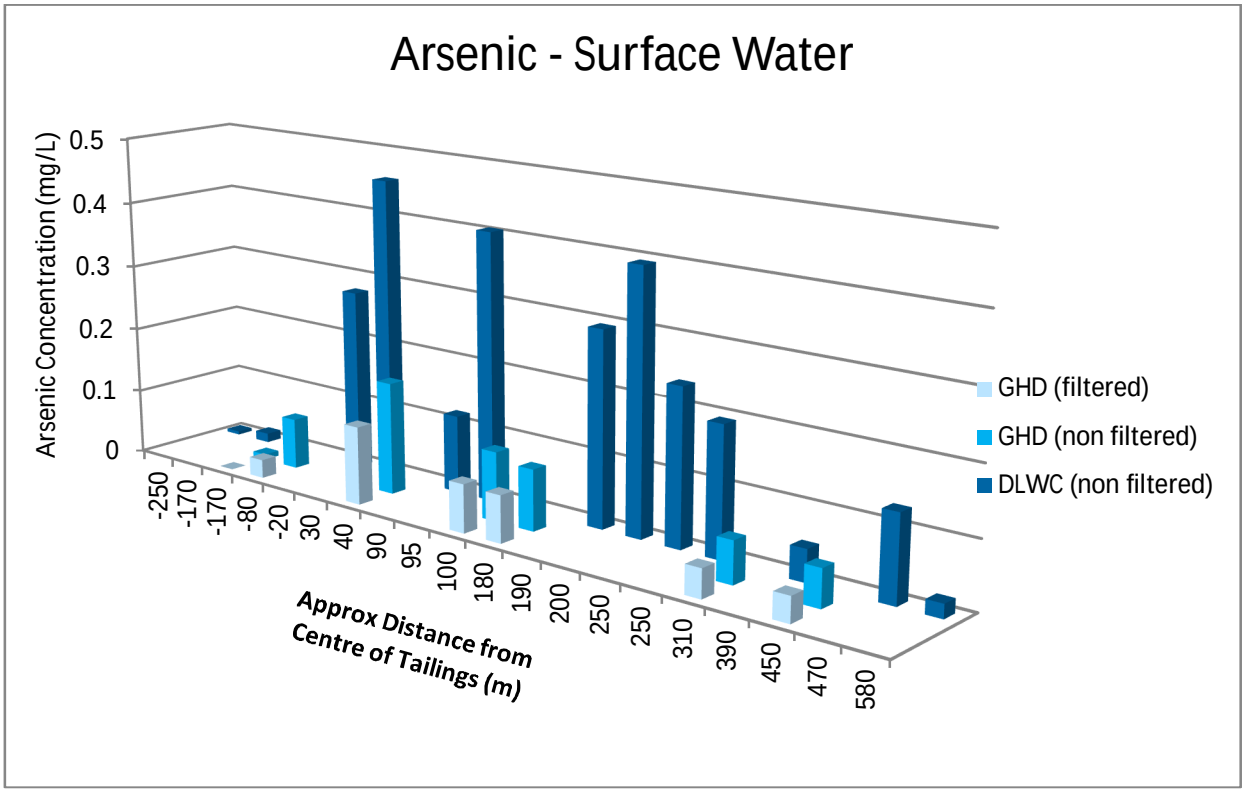
Table 10 Surface Water Chemistry Summary

Potential Contaminant	Impact Zone (mg/L)		Receptor Zone (mg/L)		Comment
	Max	Min	Max	Min	
Total Al	0.25	0.05	0.36	0.24	Most results exceed assessment criteria of 0.055 mg/L. Upstream sample highest concentration. Historic data relatively consistent with current.
Dissolved Al	0.21	0.03	0.018	0.09	Most exceed assessment criteria of 0.055 mg/L. Dissolved levels 0-25% less than total values.
Total Sb	0.244	0.018	0.083	0.022	COC- All results exceed assessment criteria of 0.009 mg/L. Most exceed 10 x assessment criteria. Relatively minor reduction from historic results noted.
Dissolved Sb	0.155	0.012	0.073	0.01	COC- All exceed assessment criteria of 0.009. Dissolved levels 0-25% less than total values.
Total As	0.171	0.016	0.063	0.008	COC- All results but 1 exceed assessment criteria of 0.013 mg/L. Significant reduction from historic results noted.
Dissolved As	0.118	0.002	0.043	<0.001	COC- Most exceed assessment criteria of 0.013 mg/L. Dissolved levels approx. 30% less than total values.
Total Cd	0.0006	<0.0001	<0.0001	<0.0001	All values except 1 (SW09 in 'S' shaped canal) less than assessment criteria of 0.0002 mg/L.
Dissolved Cd	0.0005	<0.0001	<0.0001	<0.0001	All values except 1 less than assessment criteria of 0.0002 mg/L. Consistent with total Cd values.
Total Cr	0.001	<0.001	0.001	<0.001	All values less than assessment criteria of 0.001 mg/L.
Dissolved Cr	<0.001	<0.001	<0.001	<0.001	All values less than assessment criteria of 0.001 mg/L.
Total Cu	0.017	0.007	0.021	0.013	Possible COC- All values except 1 (SW01 upstream sample) exceed assessment criteria of 0.0014 mg/L, but by less than ten times. Significant reduction from historic results noted.
Dissolved Cu	0.012	0.008	0.01	0.001	All values except 1 greater than assessment criteria of 0.0014 mg/L. Dissolved levels 0-25% less than total values.

Potential Contaminant	Impact Zone (mg/L)		Receptor Zone (mg/L)		Comment
	Max	Min	Max	Min	
Total Fe	2.94	0.54	5.38	1.74	No assessment criteria identified. Results slightly reduced from historic data.
Dissolved Fe	1.21	0.13	1.05	0.54	No assessment criteria identified.
Total Pb	0.005	<0.001	0.006	0.001	Exceeded assessment criteria of 0.0034 mg/L at approximately half of the locations. Consistent with historic data.
Dissolved Pb	0.003	<0.001	0.003	<0.001	Less than assessment criteria of 0.0034 mg/L at all locations.
Total Hg	-	-	<0.001	<0.001	<EQL (0.0001 mg/L) in all cases. EQL>assessment criteria of 0.00006 mg/L.
Dissolved Hg	<0.0001	<0.0001	-	-	<EQL in all cases. EQL>assessment criteria of 0.00006 mg/L.
Total Ni	0.003	<0.001	<0.001	<0.001	All values less than assessment criteria of 0.011 mg/L.
Dissolved Ni	0.003	<0.001	<0.001	<0.001	All values less than assessment criteria of 0.011 mg/L. Consistent with total values.
Total Zn	0.848	0.016	0.048	0.016	All values except exceeded assessment criteria of 0.008 mg/L.
Dissolved Zn	0.82	0.018	0.047	0.018	All values except exceeded assessment criteria of 0.008 mg/L. Consistent with total values.
CN	<0.004	<0.004	0.044	<0.005	All current values less than assessment criteria of 0.007 mg/L. Significant reduction from historic data.
TDS	194	104	129	105	Indicates freshwater, tolerable to most environmental receptors. Limited potential transportation of contaminants.
TSS	15	<5	43	8	Low turbidity. Limited potential transportation of contaminants via suspended particles.

Notes: Table 10 only includes current analytical results. See Table C6 for historic results.
Units in mg/L unless otherwise noted.





Graph 3 Surface Water Chemistry Graphs

5.4 Groundwater

5.4.1 Field Observations

Five groundwater monitoring wells were installed by DLWC in 1997. Four of these wells were located and sampled to assess groundwater quality. Monitoring well DLW97-GW13 (in the tailings area) could not be located.

In general, the water was slightly turbid with a brown tinge. Recharge rates were very slow indicating a possible blockage of the screen of the wells as soil lithology surrounding the monitoring wells would indicate high permeability rates.

Standing groundwater levels (SWL) measured from top of casing (TOC) are presented in Table 11. Due to limited data, groundwater contours were not calculated, however groundwater was interpreted to discharge into the wetland. Although the data from the wells cannot be considered to be reliable, a comparison with the DLWC 1997 data indicates a similar standing water level.

Table 11 Standing Groundwater Levels

Monitoring Well	SWL (mTOC) - 2012	TOC elevation (arbitrary, from DLWC 1997) (m)	SWL (m above arbitrary datum)- 2012	SWL (m above arbitrary datum)- DWLC 1997
GW004	1.445	99.63	98.185	Dry
GW006	0.425	98.78	98.355	98.02
GW007	0.585	98.74	98.155	97.77
GW012	0.585 (very slow recharge rate)	98.65	98.065	97.96

5.4.2 Field Analysis

Field analytical results are presented in Table C7, Appendix C.

pH values in the order of 4.4-6.6 indicated a slightly acidic environment. Values were relatively consistent with DLWC 1997 data and similar to the pH of surface water in the adjacent wetland.

EC levels were slightly more elevated than in the surface water with a maximum value of 1144 µS/cm and an average value of 768 µS/cm. Although limited, the data indicates the groundwater is relatively fresh.

5.4.3 Chemical Analysis

Chemical analysis for historic and current groundwater samples are presented in Table C7, Appendix C. Select metal concentrations are also presented in Figure 14.

A summary of current groundwater analyte concentrations is presented in Table 12. A graphical representation of antimony and arsenic results is presented in Graph 4.

Discussions regarding comparison of analyte concentrations with 'assessment criteria' refer to the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000) for freshwater in a 'slightly to moderately disturbed system', as outlined in Section 4.5.4.

In summary:

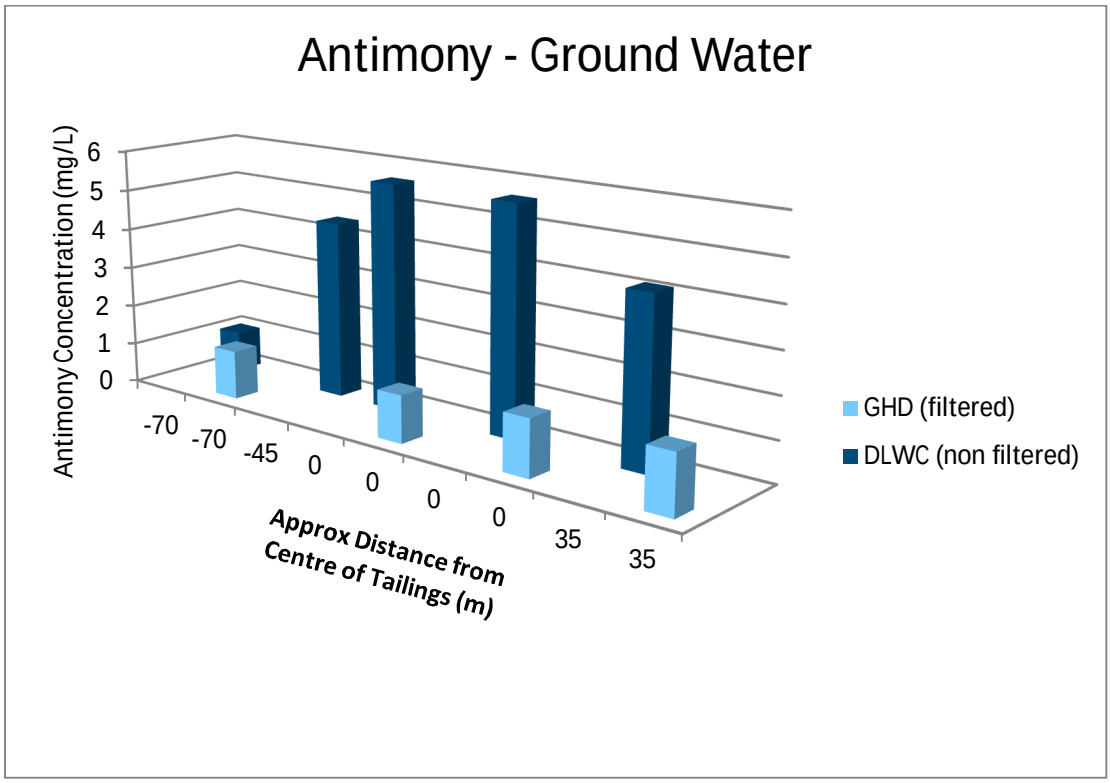
- The amount and quality of the data was deemed inadequate for the development of a detailed CSM. Depending on the requirements of the RAP, further investigations of groundwater may be required.
- Due to low monitoring well recharge rates, insufficient sample volumes were available for analysis of both total and dissolved metal concentrations. Only dissolved concentrations were analysed in these investigations.
- Insufficient data was available to compare current with historic data due to a difference in the analysis completed (i.e. no total concentrations analysed).
- Antimony and arsenic concentrations for all samples exceed 30 times the assessment criteria. Antimony concentrations in groundwater were approximately an order of magnitude higher than surface water concentrations. Arsenic concentrations in groundwater were approximately three orders of magnitude higher than surface water concentrations.
- Antimony and arsenic concentrations in groundwater were generally consistent across the Site.
- Assessment criteria exceedances were also noted for aluminium, chromium, copper, lead, mercury, nickel and zinc. Copper and zinc concentrations were of similar magnitude to those in surface water, with the concentrations of the other metals generally at least an order of magnitude higher than in surface water.

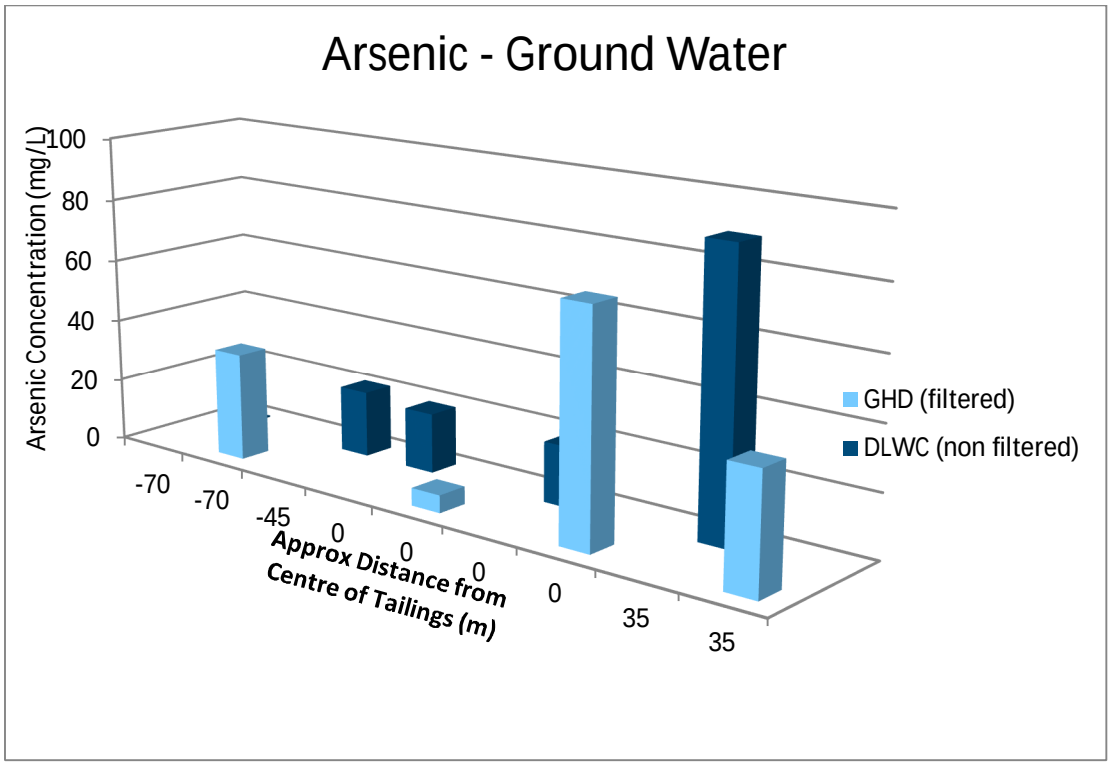
Further groundwater investigations may be required to gain greater certainty regarding the shallow aquifer and obtain data regarding groundwater at greater depths. This would enable an analysis of the flow characteristics, conductivity and migration pathways, particularly if contamination is to be left onsite or contained in-situ.

Table 12 Ground Water Chemistry Summary

Potential Contaminant	Source Zone (mg/L)		Comment
	Max	Min	
Dissolved Al	2.19	0.05	All locations except GW12 exceed assessment criteria of 0.055 mg/L. Generally an order of magnitude higher than surface water concentrations.
Dissolved Sb	1.45	1.17	All locations exceed 30 x assessment criteria of 0.009 mg/L.
Dissolved As	72.6	5.56	All locations exceed 30 x assessment criteria of 0.013 mg/L.
Dissolved Cd	0.0001	<0.0001	All values less than assessment criteria of 0.0002 mg/L.
Dissolved Cr	0.132	0.006	All locations except GW07 exceed 10 x assessment criteria of 0.001 mg/L. GW07 exceeds assessment criteria.
Dissolved Cu	0.027	0.001	All locations exceed assessment criteria of 0.0014 mg/L. One location (GW004) exceeds 10 x assessment criteria.
Dissolved Fe	90.5	9.05	No identified assessment criteria. Concentrations approximately two orders of magnitude higher than surface water concentrations.
Dissolved Pb	0.125	0.002	All locations except GW12 exceed assessment criteria of 0.0034 mg/L.
Dissolved Hg	0.0026	<0.0001	All locations exceed assessment criteria of 0.00006 mg/L.
Dissolved Ni	4.07	0.013	All locations exceed assessment criteria of 0.011 mg/L.
Dissolved Zn	0.208	0.051	All locations exceed assessment criteria of 0.008 mg/L.
CN	0.597	<0.004	Exceeded assessment criteria of 0.007 mg/L at GW06 and GW07. GW06 has a higher concentration than historic data.
TDS	970	412	Indicates freshwater, comparable to receiving surface water environment.
TSS	1,190	356	Low turbidity. Indicates sampling methodology has not resulted in significant entrainment of suspected solids.

Notes: Only includes current analytical results. See Table C7 for historic results.
Units in mg/L unless otherwise noted.





Graph 4 Groundwater Chemistry Graphs

5.5 Stockpiles

Three stockpiles and two abandoned loading ramps were analysed for metals concentrations using XRF analysis only.

5.5.1 Field Observations

The stockpiles consisted mainly of ore material and soil with some debris including metal and possible asbestos containing material. Photographs of the stockpiles are shown as Photos 3 and 4, Appendix B.

5.5.2 Field Analysis

Results of the XRF analysis are presented in Table C1, Appendix C. In summary:

- Antimony and arsenic concentrations within the stockpiles and the small loading ramp were of a similar magnitude to that of the tailings deposit (exceeding 10 x the assessment criteria, with many samples exceeding 30 x the assessment criteria).
- The antimony and arsenic concentrations in stockpiles 1 and 3 were higher than those in stockpile 2.
- The large loading ramp (only one sample taken) did not appear to be contaminated.

5.6 Bricks

Twenty three bricks including at least one of each type were analysed for metal concentrations using XRF analysis. Additionally, two of the bricks were submitted for laboratory analysis. Analysis was to assess whether the bricks had been manufactured from impacted soil material and to provide a waste classification for disposal.

5.6.1 Field Observations

The bricks appeared structurally sound and showed no signs of impact from site activities.

5.6.2 Field and Chemical Analysis

Field and chemical analysis is presented in Table C8, Appendix C. Results indicate:

- The bricks do not contain metal concentrations beyond background levels, and do not appear to have been manufactured from site materials.
- Exceedances of the General Solid Waste assessment criteria were noted for chromium and mercury, however in most cases the EQL of the XRF exceed the assessment criteria and hence does not necessarily indicate an exceedance.
- One laboratory concentration of mercury (6 mg/kg) exceeded the General Solid Waste (non leachable) assessment criteria of 4 mg/kg. The leachable mercury concentration could be analysed for further comparison with the General Solid Waste TCLP criteria, however given the bricks do not appear to have been

manufactured from site materials, they should be able to be pre-classified as General Solid Waste.

- All analyte concentrations were less than the Restricted Waste assessment criteria.

5.7 Data Quality Analysis

5.7.1 Field QA/QC Programme

All fieldwork was conducted in general accordance with standard FOP including decontamination procedures, sample identification procedures, information requirements for soil bore logs, chain of custody information, sample duplicate frequency and field equipment calibration requirements.

Two soil trip blanks were analysed for antimony and arsenic. Results are summarised in Table C9, Appendix C. Both had results less than the EQL.

Rinsate samples were collected for soil sampling equipment on each of the five days of sampling and analysed for antimony and arsenic. Results are summarised in Table C9, Appendix C. Results showed concentrations ranging from 0.01 to 1.64 mg/L for antimony and from 0.004 to 3.59 mg/L for arsenic. This shows minor levels of cross contamination between samples that are deemed insignificant given the assessment criteria concentrations of 310 and 200 mg/kg respectively.

Rinsate samples were not taken for surface water or groundwater due to a lack of significant potential for cross contamination.

One soil sampling location (BH023) was incorrectly labelled in the field (as BH034). This was noted in the field notes but the data is presented as BH034 in the laboratory results.

5.7.2 Precision

Results for RPDs between duplicate samples are presented in Table C9, Appendix C.

RPDs for approximately half of the field and interlab duplicate soil samples were greater than 50% indicating a high degree of variability in concentrations of all analytes present. This is likely due to the non-homogenous nature of the soil, especially in the tailings deposit.

Given the non-homogenous nature of the soil; however, the duplicate data indicates that the field QA/QC is of an acceptable quality for the assessment of the soil in relation to impacts from the historic site activities and the development of remediation options.

5.7.3 Accuracy

The NATA certified laboratory QA/QC sheets, as presented in Appendix F, refer to a QC program comprising the analysis of spikes, method blanks, surrogates, holding times and duplicate samples.

Non QA/QC compliances noted in the laboratory reports includes:

- Holding time exceedances for all soil samples for cyanide and pH. The impacts of these exceedances are not deemed to have a significant impact on the data due to consistency with historic data.
- Holding time exceedances for 24 soil samples for mercury (second round of analysis). Similarly, the impacts of these exceedances are not deemed to have a significant impact on the data.
- Regarding duplicates, method Blanks, laboratory control samples and matrix spikes:
  - For all matrices, no method blank value outliers occurred.
  - For all matrices, no duplicate outliers occurred.
  - For all matrices, no laboratory control outliers occurred.
  - For all matrices, no matrix spike outliers occurred.
- For all regular sample matrices, no surrogate recovery outliers occurred.
- No quality control sample frequency outliers existed.

Based on a review of the laboratory QA / QC data, it is considered that the analytical results are reasonably representative of analyte concentrations at the time of the investigation.

Compliance with the seven DQO steps as outlined in the SAQP are outlined as follows:

Step 1: Stating the Problem

The 'problem' as it stands is consistent with that outlined in the SAQP in that the Site has been significantly impacted by previous use as an antimony processing plant. The Site also contains a significant SEPP 14 wetland which has been affected by contamination from the processing plant.

Contamination has been identified as having adverse impacts on the Site's suitability for various uses and environmental receptors, as described in the CSM in Section 6.

A management order has been placed on the site requiring preparation and implementation of a RAP to address the contamination.

Step 2: Identifying the Decisions

Sufficient data was required to allow development and implementation of a RAP to address the identified contamination impacts from past Site uses that have resulted in unacceptable risks to human health or the environment. The specific study questions have been addressed in the following sections:

- What is the extent of the contamination and has it changed from the previous investigations? Sections 5 and 6.
- To what point in the "Impact Zone" should remediation extend? Section 7.
- How significant is the migration of contamination in groundwater? Sections 5.4 and 6.

- What is the significance and risk of ecological effects beyond the immediate area of source contamination? Section 6.
- Is there sufficient data to assess remediation options? Sections 5, 6 and 7.
- If the immediate source area is adequately contained / managed / remediated, will ecological impacts in the surrounding area recover in a reasonable time frame? This is a factor to be considered in the selection of remediation options and extent of remediation undertaken (Section 7). Further studies may be required.

Step 3: Identifying Inputs to the Decision

The Detailed Investigation sampling program was designed to provide sufficient information to allow a sound scientific and statistical evaluation of the questions set out in Step 2. This was achieved by:

- Collection of soil, sediment, surface and groundwater samples to provide sound site coverage and statistically valid data sets upon which to base subsequent decisions. This included limited sampling in areas of previous testing to verify previous results, with more extensive sampling to address data gaps identified in the Preliminary Investigation Report. At this stage, comprehensive hydrogeological characterisation of the site was not undertaken. Areas of likely "incidental contamination" were noted for remediation or management requirements, but assessment focused on contamination associated with the former antimony processing plant.
- Comparing the analytical data to applicable guidelines to evaluate the potential for contamination to adversely impact upon human health and / or environmental receptors. A site-specific risk assessment has not been completed.
- Qualitative evaluation of Step 5 was undertaken by means of the comparison above, and considered further in evaluation of the identified remediation options outlined in section 7.

The significance of assessment criteria exceedances in terms of 'risk' that the measured concentrations may present to human health or the environment have been assessed in Section 6. The client may determine what level of risk it is prepared to accept and what degree of management of that risk is possible and acceptable. These decisions will be discussed with the relevant stakeholders and taken into account in evaluation of remediation or management options.

Step 4: Defining the Study Boundaries

With respect to physical boundaries, the lateral boundaries of the investigation areas were defined as follows:

- The northern property boundary adjoining Hillside Drive, excluding the subdivided portion of Lot 1.
- The western property boundary.
- The southern edge of the wetland.
- The wetland immediately east of the eastern edge of the 'L' shaped canal.

The vertical soil boundary was the underlying natural clay soils or identified maximum depth of contaminant impact.

Step 5: Developing a Decision Rule

In order to decide whether the data obtained was sufficiently precise, accurate, reliable and reproducible for the Site at the time of the investigation, field and laboratory QA/QC procedures were utilised throughout the sampling programmes and all sampling work was carried out in accordance with GHD's Standard Field Operating Procedures, which are based on relevant guidelines and current industry practices. QA/QC results were compared to nominal acceptance limits and are discussed in Section 5.7.

Project analytical data has been compared to EPA approved guidelines. The nominated assessment criteria are presented in Section 4.5. On the basis of this comparison, a decision has been made as to whether or not the contamination poses a potential risk (environmental or health based), warranting further assessment.

Step 6: Specifying Limits on Decision Errors

With regard to the Detailed Site Investigation, two primary decision error-types had potential to occur due to uncertainties or limitations in the project data set:

- A sample/area may be deemed to pass the nominated assessment criteria, when in fact it does not. This may occur if contamination is 'missed' due to limitations in the sampling plan, or if the project analytical data set is unreliable.
- A sample/area may be deemed to fail the nominated assessment criteria, when in fact it does not. This may occur if the project analytical data set is unreliable, due to inappropriate sampling, sample handling, or analytical procedures.

To minimise the potential for decision errors, data quality indicators (DQIs) were established, for completeness, comparability, representativeness, precision and accuracy.

The SAQP outlined DQIs for sampling techniques and laboratory analysis of collected samples identifying the acceptable level of error for this investigation. The DQOs were assessed by reference to data quality indicators as follows:

- **Data Representativeness** - expresses the degree with which sample data accurately and precisely represents a characteristic of a population or an environmental condition. Representativeness has been achieved by collecting samples in an appropriate pattern across the site, and by using an adequate number of sample locations to characterise the site. Consistent and repeatable sampling techniques and methods were utilised throughout the sampling.
- **Completeness** - defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal was set at there being sufficient valid data generated during the study.
- **Comparability** - is a qualitative parameter expressing the confidence with which one data set can be compared with another. This was achieved through maintaining a level of consistency in techniques used to collect samples and

ensuring analysing laboratories use consistent analysis techniques and reporting methods. Comparability had particular relevance when using XRF as a field screening tool. Details regarding XRF comparability are provided in Section 5.1.2.

- **Precision** - measures the reproducibility of measurements under a given set of conditions. Precision of the data is assessed in Section 5.7.2.
- **Accuracy** - measures the bias in a measurement system. Accuracy can be undermined by such factors as field contamination of samples, poor preservation of samples, poor sample preparation techniques and poor selection of analytical techniques by the analysing laboratory. Accuracy was assessed by reference to the analytical results of laboratory control samples, laboratory spikes, laboratory blanks and analyses against reference standards. Compliance with the "acceptance limits" on laboratory control samples were assessed in Section 5.7.3.
- Accuracy of the field works was assessed by examining the level of contamination detected in field and equipment blanks as also outlined in Section 5.7.3.

Step 7: Optimise the Design for Obtaining Data

The investigations were undertaken in accordance with the SAQP (incorporated as part of the Preliminary Investigation Report) which was reviewed and approved by the EPA, giving consideration to the DQOs and to the financial and time constraints of the project. Works was completed in accordance with NSW OEH guidelines and accepted industry standards.

6. Updated Conceptual Site Model

The following Updated CSM has been developed, based on information obtained from the Preliminary CSM and data obtained from the results presented in Section 5.

6.1 Site Description

6.1.1 General

Site features are presented in Figure 1 and Figure 2. In general, the Site consists of:

- A disturbed area incorporating the various features associated with the former antimony processing facility that is largely devoid of vegetation.
- A tailings area of approximately one hectare that is devoid of vegetation, extending from the former processing area into an adjacent, State Environmental Planning Policy (SEPP) 14 wetland (no. 354).
- A generally forested area adjacent to the SEPP 14 wetland in which 21 vulnerable and 3 endangered fauna species have previously been recorded (Redpath 2003).
- Surface material (within the disturbed areas) consisting of imported fill and tailings.
- Some remaining infrastructure consisting mainly of foundations of the former processing facility and loading ramps.
- Several remaining stockpiles of ore, rubbish and bricks.
- An 'L' shaped canal that has apparently been excavated from the wetland.
- A series of 'S' shaped canals (possibly constructed for use in tailings settling).
- Visually impacted *melaleuca* trees in the wetland area, adjacent to the tailings deposit.

Based on aerial photographs received from SCS following completion of the Preliminary Investigations (see Appendix D), the L shaped canal and S shaped canals were constructed about 1979, after operation of the processing facility had ceased (see Section 3.1.1).

The Site is located between the footslope of a small ridge to the north and west and the SEPP 14 wetland to the south and east. Several small drainage lines meander through the Site from the small catchment. Flood waters (data provided by BSC 2008) are shown to periodically inundate the Site (Figure 2) with the Probable Maximum Flood (PMF) level inundating the tailings, former gravel processing area (within the lower part of the former processing area) and the canal systems. The PMF does not cover the full extent of the former processing area.

The wetland drains into Station Creek which is partially tidal. No tidal influence was noted at the Site during the field investigation program; however tidal influences may periodically inundate portions of the tailings during different hydrological conditions.

Station Creek discharges into Urunga Lagoon which forms part of the Bellinger-Kalang estuarine system.

The groundwater table onsite is approximately 1 metre below the ground surface (mbgs) and groundwater is interpreted to discharge into the wetland. Groundwater has only been investigated within the tailings area using existing shallow drive-point wells. Characteristics of deeper groundwater or groundwater flow into the site are not known.

Neighbouring land uses consist of:

- A SEPP 14 wetland and land owned by the Coffs Harbour and District Local Aboriginal Land Council, to the south and east.
- Hillside Drive and residential land to the north.
- Residential and commercial properties to the west followed by the Pacific Highway.

6.1.2 Soils

Reference to the Macksville Nambucca 1:100,000 Soil Landscape Map indicates the bedrock slopes above the mill at the site are in the Pine Creek (pn) landscape being gravelly red kurosols. The low footslopes above the tailings area are mottled grey red clays of the Bowra Creek (ba) soil landscape. The wetland area below the tailings is predominantly permeable acid peats and impermeable grey humic clays of the Charlmont (ch) soil landscape group (typically wetlands). This soil type contains high sulphide content presumably in both organic and inorganic forms (SCS 2012).

As outlined in Section 5.1.5 the soils in the vicinity of the tailing deposit are considered to be Acid Sulfate soils. The preparation of a detailed Acid Sulfate Soil Management Plan (ASSMP) will be required for works that disturb the soil in that area. This is to be provided as part of the RAP. Acid sulfate soils generate acid where pyritic material is exposed to oxygen. Increased acidity may, in turn exacerbate the mobilisation of metal contaminates.

In general, the lithology in the vicinity of the tailings consists of silty Sand to approximately 1.5 mbgs overlaying approximately 1 m of clayey Silt (described by DLWC as peat) and then silty Clay from approximately 2.5 mbgs.

6.1.3 Hydrology

The Site sits between the footslope of a small ridge to the north and west and the SEPP 14 wetland to the south and east. Several small drainage lines meander through the site from the small catchment. Flood waters (BSC 2008) are shown to periodically inundate the Site (Figure 2) with the PMF level inundating the tailings, former gravel processing area and the canal systems. The PMF level does not cover the full extent of the former processing area. The wetland drains into Station Creek which is partially tidal. No tidal influence was noted during the field investigation program; however tidal influences may periodically inundates portions of the tailings during different hydrological conditions. Aerial photographs and anecdotal evidence from different times of the year indicate a significant fluctuation in the water level in the wetland, with the wetland in the vicinity of the tailings deposit apparently being dry at some times. Station Creek discharges into Urunga Lagoon which forms part of the Bellinger-Kalang estuarine system.

6.1.4 Hydrogeology

The groundwater table onsite ranged from approximately 0.4 to 1.4 mbgs and is interpreted to discharge into the wetland. The standing water level was noted to be relatively consistent between the 1997 and 2012 sampling events. Groundwater has only been investigated within the tailings area. Recharge rates within the monitoring wells were very slow indicating a possible blockage of the screen of the wells as soil lithology surrounding the monitoring wells would indicate high permeability rates. Characteristics of deeper groundwater or groundwater flow into the site are not known.

6.2 Source, Impact and Receptor Zones

For the purposes of the CSM, the Site has been divided into the following zones, as presented in Figure 15:

- Source Zone, including the tailings deposits, ore stockpiles, former stockpiling area, former processing areas, incidental contaminants and fill material. The Source Zone covers an area of approximately 16,000 m^2. It is anticipated that remediation will be required across most, if not all of the Source Zone.
- Impact Zone, defined as the areas that are potentially, directly impacted (secondary impact) by the contaminants, excluding the Source Zone. This area includes the eastern portion of the Site, the wetland immediately adjacent to the tailings, the potentially impacted areas to the northwest and northeast of the 'L' shaped canal and the benthic layer within the 'S' shaped canals. The Impact Zone covers an area of approximately 50,000 m^2. GHD's investigations indicate that some areas of the impact zone have not been significantly impacted by contamination and are unlikely to require remediation, whereas other areas have been more significantly impacted, but remediation may be difficult due to accessibility or potential impacts from the remediation works. This is discussed further in Section 7.
- Receptor Zone, defined as the area that is considered unlikely to have been significantly impacted by contamination from the Site but may be indirectly affected by the contaminants. The area includes sensitive biota in the receiving wetland area including upstream and downstream aquatic fauna and peripheral vegetation to the south of the wetland and east of the 'L' shaped canal beyond the Impact Zone. It also includes Lot 101, which has been validated in part by Coffey 2004 and may also include the residential properties adjoining the Site to the west. It is not anticipated that any remediation will be required in the receptor zone.

6.3 Contaminant Characterisation

6.3.1 Contaminants of Concern (COC)

Several potential contaminant sources have been identified at the site including the tailings deposits, ore stockpiles, incidental contaminants, fill material, excavated sediments (from the creation of the canals) and any exposed, acid sulfate soils.

Chemicals used during the purification process included copper sulfate, sodium cyanide, lead nitrate, dextrin, sodium ethyl xanthate and crescylic acid. Mill water was also contaminated with dissolved antimony and arsenic salts during treatment of the crushed ore (DLWC 1997). All steps within the flotation method used to concentrate the stibnite were performed at an alkaline pH (up to 11.5). To obtain this pH, large amounts of caustic soda (sodium hydroxide) and soda ash (sodium carbonate) were used (DLWC 1997).

Based on an assessment of the known chemicals used in the processing, the possible contaminants would include As, Sb, Pb, Cu, Cr, Al, Hg, CN, S, Na and nitrates. Sodium hydroxide and sodium carbonate are expected to have ameliorating effects on preventing acidity of the tailings, and are not considered to be potential contaminants.

Based on a comparison of the historic results (in the Preliminary Investigation Report) and current analyte concentrations with the adopted assessment criteria:

- Antimony and arsenic were evident as the key COCs.
- In nearly all cases, where one of the other possible COCs was present in significant concentrations, more significant concentrations of either antimony or arsenic were present. As a result, these analytes (antimony and arsenic) were deemed to be representative indicator analytes and the governing contaminants.
- Aluminum and iron concentrations throughout the site appeared similar to background samples, and are considered likely to be commensurate with concentrations in uncontaminated media. These analytes are not considered COCs in this investigation.
- Chromium and nickel concentrations in the groundwater exceeded the adopted assessment criteria at most groundwater sampling locations. However chromium and nickel concentrations in the soil, sediment and surface water were generally less than the relevant assessment criteria and are not deemed to be COCs in this investigation.
- Zinc concentrations were significantly less than the adopted health-based assessment criteria in soil and sediment and generally less than the EILs for soil, but exceeded sediment criteria at some locations (primarily in the eastern portion of the site) which may indicate a different source of contamination. Zinc exceeded the assessment criteria for most of the groundwater and surface water sampling locations, but for the aforementioned reasons are not considered a COC associated with the antimony tailings, and are unlikely to govern remediation.
- Copper and lead concentrations were noted to exceed the adopted assessment criteria in the sediment, surface water and groundwater. Concentrations of copper and lead in a limited number of soil samples also exceeded the relevant HIL assessment criteria, but except in rare cases, always in association with higher levels of arsenic or antimony contamination. Copper and lead are deemed to be COCs in this investigation but are deemed unlikely to govern remediation.
- Mercury concentrations exceeding the assessment criteria were noted in all media (except surface water, where the LOR was higher than the criterion) and were noted to generally correlate with antimony and arsenic concentrations. Mercury is

considered to be a COC in this investigation but is unlikely to govern remediation (apart from one location (SE032) where mercury only was analysed).

- Cyanide was noted to be relatively low in soil, slightly elevated in some sediments but recent surface water results were all below surface water assessment criteria. Most groundwater samples exceeded the relevant assessment criteria. Cyanide is hence considered a minor COC in this investigation but is deemed unlikely to govern remediation.
- Incidental contaminants may also be present on the Site, (especially in the residual stockpiles) including:
  - Total Petroleum Hydrocarbons (TPH);
  - Polynuclear, Aromatic Hydrocarbons (PAH);
  - Organochlorine Pesticides (OCP);
  - Polychlorinated Biphenyls (PCB); and
  - Asbestos.

6.3.2 Key Contaminant Properties

Antimony

Antimony is a non-essential element in humans, animals and plants and antimony compounds show toxic properties similar to those of arsenic. Adverse health impacts, if inhaled or ingested may include eye and lung irritation and heart and lung problems, stomach pain, diarrhea, vomiting, and stomach ulcers (SEWPaC 2012).

Little information is available on the transformations and transport of antimony in various environmental media (e.g. air, water, soil) and the mobility of antimony in soils is not clearly understood. Some studies indicate that antimony is highly mobile, while others conclude that it strongly adsorbs to soil. In water, it usually adheres to sediments.

ANZECC (2000) reports that two forms of antimony are found in natural water: antimony (III) occurs under moderately oxidising conditions, whereas antimony (V) predominates in highly oxidising environments. Most of the toxicological studies have been completed on antimony (III). ANZECC (2000) states that bioconcentration factors of 40 for freshwater fish and 16,000 for freshwater invertebrates have been reported. Freshwater algae are the most sensitive of the organisms tested with a concentration of 760 µg/L resulting in a 50% decrease in growth over a 96 hour exposure. This is in contrast to freshwater fish which showed 50% mortalities at concentrations of 9,000 to 12,000 µg/L and daphnia showing immobilisation at 12,100 to 423,450 µg/L (ANZECC 2000).

This assessment was supported by an investigation on the Macleay River where Ashley et al (2007) demonstrated that antimony and, to a lesser extent arsenic, are bioavailable, with uptake into common riparian vegetation and aquatic alga species, especially in reducing, organic-rich conditions in backswamps and oxidising acidic conditions.

In contrast, SEWPaC (2012), reports that most antimony compounds show little or no tendency to accumulate in aquatic life

Antimony is more soluble at neutral pH than at low pH (University of Otago 2012).

Arsenic

Arsenic has a high acute (short-term) toxicity to aquatic life, birds and land animals. Where soil arsenic content is high, plant growth may be reduced. Arsenic has a high chronic (long-term) toxicity to aquatic life, and moderate chronic toxicity to birds and land animals. Organic arsenic compounds are very persistent in the environment and are expected to bioaccumulate in fish and shellfish (SEWPaC 2012).

Several forms of arsenic occur in natural waters, depending upon the redox potential and pH, the two most common being arsenic (III) and arsenic (V). Both arsenic (III) and arsenic (V) form stable bonds with carbon, resulting in numerous organo-arsenic compounds, some of which are very toxic (e.g. methylarsine) (NSW EPA 2000).

In their study on the Macleay River, Ashley et al (2007) demonstrated that arsenic is bioavailable, with uptake into common riparian vegetation and aquatic alga species, especially in reducing, organic-rich conditions in backswamps and oxidising acidic conditions.

Arsenic is also more soluble at neutral pH than at low pH (University of Otago 2012).

Mercury

Both mercury and its compounds have high acute (short-term) and high chronic (long-term) toxicity on aquatic life. Ingestion of fish contaminated with mercury has potential to cause poisoning in humans, birds and land animals exposed in the same manner. Mercury and its compounds are highly persistent in water and the environment and will have the potential to bioaccumulate or concentrate in the tissues of fish. These concentrations will be considerably higher than the water from which the fish is taken (SEWPaC 2012).

Of particular concern to the aquatic environment is the fact that inorganic forms of mercury (of relatively low toxicity and availability to bioconcentrate) may be converted by bacteria in-situ into organomercury complexes (particularly methylmercury), which are more toxic and tend to bioaccumulate (ANZECC 2000).

There are insufficient data to derive a trigger value for methyl mercury for either fresh or marine water (ANZECC 2000). Methyl mercury analysis was hence not completed as part of this assessment due to the limited additional value that this data would provide to the development of the RAP.

6.3.3 Contaminant Media and Fate

Based on the CSM, the main pathways for transport of contaminants identified in the soil/tailings (the Source Zone) would be through surface water runoff, groundwater discharge or mobilisation of sediments. Airborne dust would also be a migration pathway for transport of contaminants from exposed areas of the site.

COC distribution

Generally, contaminants exceeding relevant assessment criteria in surface water, groundwater and sediment were the same as those that exceeded assessment criteria for soils (including tailings and remaining ore stockpiles).

In nearly all cases, where one of the COCs was present in significant concentrations, more significant concentrations of either antimony or arsenic were present. As a result, these analytes were deemed to be representative indicator analytes and the governing contaminants.

Soil

Soils in the source zone (including tailings and remaining ore stockpiles) represent the main mass of contaminants on the site, with concentrations of arsenic and antimony in most samples exceeding the soil assessment criteria by several orders of magnitude. In most cases, the leachable concentrations of COCs were significantly less than total concentrations indicating that although total concentrations often exceed the adopted soil assessment criteria by several orders of magnitude, the percentage of COCs available for transportation into the groundwater or surface water is significantly reduced. Notwithstanding this, where there were significant concentrations of antimony and arsenic in soil or sediment samples, the corresponding leachable concentrations were well above ANZECC trigger values for protection of aquatic ecosystems and hence migration through surface water and groundwater is considered to be a significant pathway.

Sediment

Data from GHD's investigations indicate concentrations of the main COCs in sediment are generally 60 to 80% of those found in the soil.

The transportation of contaminants through the mobilisation of sediment from the source area (which may include historic discharges from the operation of the antimony processing facility, as well as contaminant transport subsequent to its closure) is supported by contaminant distribution in the sediment with the most elevated concentrations noted adjacent to the tailings deposit, extending approximately 50 m south and east of the tailing deposit and adjacent to the north eastern portion of the 'L' shaped canal. This is interpreted to reflect the distribution of sediment that would be expected from flood events transporting sediment downstream. The impacted sediments to the north east of the 'L' shaped canal may be as a result of deposition in an 'eddy' that would be present during high flow events. The other possible source of this impact would be from discharge from the north eastern end of the 'S' shaped canals; however relatively low concentrations of COC in sediment samples from the 'S' shaped canals indicate this is the less likely source.

Elevated concentrations of COCs were also noted to correspond with the visual presence of tailings sediment (grey silt) and were generally confined to the surface layer of sediment.

A comparison with weak acid extractable metal concentrations with the assessment criteria was deemed more applicable than total concentrations in assessing the bioavailability of the analytes. It is noted that the weak acid extractable concentrations are unlikely to exceed 40% and 25% of the total metal concentrations for antimony and arsenic respectively. Applying the these ratios results in approximately 20% of the samples analysed reduced to a lower assessment category (being exceeding, exceeding 10 times or exceeding 30 times the assessment criteria).

Limited data regarding the leachable concentrations of COCs in the sediment indicated that leachable concentrations were significantly less than total concentrations. This suggests the physical migration of contaminated sediment has been the more important contaminant migration pathway.

A study of antimony and arsenic concentrations in the Macleay River Valley (Ashley et al 2007) indicates that antimony and arsenic are absorbed by riparian vegetation and aquatic algae growing in impacted sediment, that antimony uptake is greater than that of arsenic and that there are large variations in the relative uptakes between species.

Surface Water

As well as being a primary receptor of contamination at the site, surface water is one of the main media for the transportation of COCs from the Site. This is evident by the contaminant distribution in the surface water including:

- Relatively low COC concentrations upstream of the Site.
- A rapid increase in the concentrations within the proximity of the tailings.
- Maximum concentrations approximately 50m downstream of the tailings.
- A relatively linear decrease in concentrations with increasing distance downstream of the tailings.

Dissolved COC concentrations were generally 45-75% of the total COC concentrations in surface water indicating that the majority of the COCs are present in a dissolved form and not just bound to suspended particles. This relates both to the bioavailability and mobility of the contaminants in surface water.

Under oxidising, near-neutral pH conditions, antimony and arsenic have significant solubilities, with stream waters passing through contaminated sediments continuing to leach metalloids and allowing bio-availability (Ashley et al 2007). Reducing organic conditions and oxidising acid sulfate soil conditions in backswamp regions can also contribute to mobility and bio-availability (Ashley et al 2007).

Groundwater

Concentrations of arsenic in groundwater were in some cases an order of magnitude higher than leachable concentrations of arsenic in soils, and generally concentrations of antimony in groundwater were similar to leachable concentrations of antimony in soils. Concentrations of antimony and arsenic in groundwater were generally one to three orders of magnitude higher than their respective concentrations in surface water.

The potential transportation of contaminants through the migration of groundwater is supported by the elevated concentrations of COCs in the groundwater within the vicinity of the tailings deposit and the expected permeable characteristics of the tailings. Analysis in GHD's investigations was for dissolved metals, so the reported concentrations can be expected to be mobile in the groundwater.

Groundwater investigations have not been sufficient to assess the significance of this migration pathway. Any remediation options that do not involve removal of the

contaminant source would need to further investigate groundwater characteristics (including flow).

6.3.4 Contaminant Delineation

Horizontal Extent

The interpreted extent of the contamination in the soil and sediment is presented in Figures 3, 7, 8, 9, 10a and 10b. The extent of impact in the surface water and groundwater are presented in Figures 13 and 14, respectively. The data indicates considerable impact in the tailings, sediments and groundwater (given limited data), and a lesser extent of impact on the surface water quality, further decreasing with distance from the site.

Observations regarding the horizontal impact in the soil include:

- Roughly following the extent of areas without vegetation.
- The impact in the south west corner of the site, near the wetland has not been delineated due to site access constraints. Delineation would entail further sampling in the neighbouring property.
- Soil on the southern side of the wetland was free of contaminants.
- Soil in the north east portion of the site is relatively free of contaminants with the exception of an area of unknown disturbance, to the north west of the 'L' Shaped canal.
- The soil within the embankment immediately to the north of the 'L' shaped canal showed elevated antimony and arsenic concentrations mainly from between 1 mbgs to 1.7 mbgs (current ground surface). It is possible that impacted sediment and soil was excavated from the location of the 'L' shaped canal during canal and embankment construction. Alternatively, the contaminated interval may represent the original soil surface impacted by contaminant migration from the antimony processing area prior to the canal and embankment construction (historic aerial photographs indicate the original alignment of a drainage course through the site was approximately in this area).

Observations regarding the horizontal extent of the impacted sediment include:

- The interpreted impact extent of antimony and arsenic were similar. The antimony concentrations were generally higher than arsenic in comparison with their respective adopted assessment criteria.
- Showing highest levels of impact adjacent to the tailings deposit, extending approximately 50 m downstream of the tailing deposit, extending across the wetland some 50 m to the south of the tailings deposit (roughly correlating with vegetation dieback), and within and adjacent to the north eastern portion of the 'L' shaped canal.
- The impacted sediments adjacent to the eastern portion of the 'L' shaped canal may be as a result of deposition in an 'eddy' that would be present during high flow events. The other possible source of this impact would be from discharge from the

north eastern end of the 'S' shaped canals; however relatively low concentrations of COC in sediment samples from the 'S' shaped canals indicate this is the less likely source.

- The western portion of the 'S' shaped canals was impacted at concentrations exceeding 30 times the adopted assessment criteria. Topography in that area and proximity to the tailings area indicates the likelihood for surface run-off from the tailings deposit to directly enter the western-most portion of the 'S' Shaped canals. Limited connectivity was noted from this portion of the canal to the eastern (remaining) portion of the 'S' shaped canal system. This was supported by the lack of significant impact from COCs in the eastern area.
- The south eastern portion of the 'S' Shaped canal was impacted. This may be associated with potential impact relating to placement of spoil from excavation of the canal.
- Insufficient data was available to delineate the full extent of sediment impact to the south east of the site, adjacent to the southern shore of the wetland. Similarly, sediment data to the north east of the 'L' shaped canal is limited. The importance of these data gaps will depend on decisions regarding the extent of remediation across the wetland areas.

Vertical Extent

The interpreted, vertical extent of the impact in the soil is presented in Figures 10a and 10b. Depths vary from approximately 0.5m in the north west portion of the impact to 2.2 m near the water's edge and at some locations within the tailings deposit.

Impacts in the sediment ranged in depth from about 1m near the tailings to 0.1m on the south of the wetland. The greatest antimony and arsenic concentrations were generally noted in the surface sediment (0-0.1 m).

6.3.5 Estimated Volume of Impacted Soil and Sediment

Estimated volumes of impacted soil and sediment are shown in Figures 10a and 10b. The rationale for the estimated horizontal extent is outlined in Sections 5.1.3 and 5.2.3 and as follows. The interpreted vertical extent of the impacted soil was based on the interpolated concentrations of antimony and arsenic noted during the investigation as well as an assessment of the lithology in each borehole. The vertical extent of the impact was based on limited data (being samples that were advanced to a depth where no impact was identified) hence a high degree of interpretation was required.

Volumes were conservatively based on an assumption that contaminant impacts at the perimeter of an impacted area were at the same depth of impact noted at locations within and adjacent to that perimeter, rather than tapering up to the surface from those locations.

6.3.6 Contaminant Concentration/Time Relationship

Concentrations of COCs in the soil recorded in this investigation were within a similar order of magnitude (given differences in sampling and analysis methods) as those

recorded in the historical investigations. This implies concentrations have remained relatively constant over time.

Reduced total concentrations of COCs in the surface water were noted from the 1997 round of sampling to the present. This may be due to many factors (e.g. recent rainfall events, sampling methodology) and does not necessarily indicate an overall reduction in concentrations. Further rounds of sampling and analysis would be required to assess changes to COC concentrations over time.

Data from sediment and groundwater was insufficient for historic comparisons due to lack of historic data and/or differences in sampling methodology.

6.4 Contaminant Receptors

There are a number of potential human and environmental receptors of the contamination, provided an exposure pathway is present. The receptors have been classified as being present in the 'Source Zone', the 'Impact Zone', and the 'Receptor Zone' as outlined in the following subsections.

6.4.1 Source Zone and Impact Zone

Human health and environmental receptors identified in the Source Zone and Impact Zone include:

- On site personnel that are involved in site works including remediation.
- Future recreational users, depending on the future land use.
- The SEPP 14 Wetland adjacent to the Site.
- Terrestrial flora and fauna that inhabit or visit the site.
- Aquatic and benthic flora and fauna inhabiting the wetland and canals.

6.4.2 Receptor Zone

Receptors identified in the Receptor Zone include:

- Recreational users of the lower portions of the wetland, Station Creek or Urunga Lagoon.
- Residents/workers on adjacent properties.
- Terrestrial flora and fauna on adjacent land.
- Aquatic and benthic flora and fauna inhabiting the lower portions of the wetland, Station Creek and Urunga Lagoon.

The exposure pathways by which these receptors may be impacted by potential contamination are discussed below.

6.5 Exposure Pathways

Based on the identified receptors and the release, fate and transport characteristics of the contaminants, pathways through which receptors may become exposed to contamination

include inhalation, ingestion and dermal absorption of the contaminated material or affected sediments, surface water, groundwater or air. A summary of the potential contamination risks and risk to receptors are presented in Table 13. These are discussed briefly below in the context of the site setting:

- Ingestion Exposure Pathway: Ingestion of COCs by site occupants may occur through day-to-day activities and contact with contaminated soil. This pathway is important as COCs in sediments, groundwater (as pore water close to discharge interfaces) or surface water are ingested by benthic and aquatic fauna and many COCs have the potential to bioaccumulate. Recreational users of surface water also are at risk of ingesting contaminated water or eating aquatic organisms (yabbies, prawns or fish) caught by recreational fishermen. This pathway is also of concern to terrestrial fauna and birds where the contaminated water is used for drinking and aquatic organisms are a food source.
- Dermal Exposure Pathway: The contaminants may enter via sorption through biological membranes such as skin or gills. Exposure to the contaminants in the soil via this pathway could be of concern to human and ecological health in the vicinity of the Site. However, dermal exposure could also be a major concern where contaminated sediments, groundwater or surface water come into direct contact with benthic and aquatic flora and fauna, adding to the bioaccumulation occurring through ingestion. Recreational users of surface water are also at risk of dermal exposure to COCs.
- Inhalation Exposure Pathway: There is the potential for a range of contaminants (especially antimony and arsenic) at the site's surface to be mobilised by wind and to be inhaled by receptors in the form of dust, however, the amount of exposure is dependent on particle size.
- There is no indication in the site history or previous investigations that volatile contaminants are likely to be present on the site. Although both cyanide and mercury can occur in vapour form, both have relatively low vapour pressures and no enclosed spaces are present or proposed at the site where vapours are likely to accumulate. Based on this, vapour phase contamination is not considered a significant exposure pathway.

6.6 Other Site Features

6.6.1 Stockpiles

The stockpiles consisted mainly of ore material and soil with some debris including metal and possible asbestos containing material. The metal concentrations and COCs in the stockpiles were similar to those found in the tailings deposit. The potential asbestos containing material may present a significant health risk to sensitive receptors, especially if disturbed.

6.6.2 Bricks

Anecdotal evidence suggests the bricks contained onsite were manufactured off-site and are unlikely to be impacted by site activities (GHD 2012). One laboratory concentration of mercury (6 mg/kg) exceeded the General Solid Waste (non leachable) assessment criteria of 4 mg/kg. The leachable mercury concentration could be analysed for further comparison with the General Solid Waste TCLP criteria, however given the bricks do not appear to have been manufactured from site materials, they should be able to be pre-classified as General Solid Waste.

6.7 Further Investigation Requirements

The quantity and quality of data obtained from the current and historic investigations is deemed adequate for the formulation of this CSM and for a preliminary assessment of remediation options. Depending on the selected remediation option and the extent of remediation proposed, further investigations may be required including the following:

- Aquatic ecotoxicology assessment to better assess the impacts of contaminated sediments and the implications of leaving some or all of these materials in situ.
- Infill sampling to better delineate the extent and degree of sediment impacts, particularly in the wetland to the south east of the tailings area, and to the south and east of the 'L' shaped canal.
- Sampling on adjacent properties to the west of the southern portion of the former processing area to delineate the extent of off-site impact in this direction.
- More detailed investigations of groundwater, to assess groundwater flow characteristics and on-going migration pathways, particularly if contamination is to be left or contained in-situ.
- Geotechnical properties of the site and tailings if on-site containment is proposed.
- Treatment trials to assess effectiveness of treatment to reduce the mobility of contaminants in the tailings and contaminated soils and sediments.
- Ecological study of the wetland areas proposed for remediation, to assess the impacts of remediation and assist in design of rehabilitation requirements.

6.8 CSM Summary

A summary of the potential contamination risk and risk to receptors are depicted in Figures 16 and 17 and Table 13.

Table 13: Conceptual Site Contamination Model

Source	Identified Contaminant of Concern	Contaminant Release Mechanism(s)		Potential for Contamination	Significant Pathway(s)						Potential Receptors of Concern										
											Source Zone and Impact Zone					Receptor Zone				
											Health	Ecological				Health		Ecological		
		Primary	Secondary		Surface Water (SW)	Sediment (SED)	Groundwater (GW)	Direct Contact (D)	Aeolian (A)- Dust	Vapour (V)	Site visitors/ Recreational users	SEPP 14 Wetland	'L' Shaped Canal	Terrestrial Flora and Fauna	Aquatic/Benthic Flora and Fauna	Recreational users of adjacent land, waterways and lagoon	Residential users of adjacent land to the west of the Site	Off-site SEPP 14 Wetland	Terrestrial flora and fauna on adjacent land to the west of the Site	Aquatic / Benthic flora and fauna inhabiting off-site waterways and lagoon
Tailings Deposits, former processing area and former unprocessed ore stockpile area	Heavy Metals (As, Sb, Pb, Cu, Hg), Cn	Migration of contaminants as sediment and dissolved / suspended in surface water via overland flow; leaching of contaminants to groundwater. Dermal contact, ingestion and inhalation (dust during dry conditions) of contaminants.	Discharge of contaminated groundwater to surface water. Leaching of contaminants and direct contact with contaminants in sediments that have migrated from source area.	High	✔	✔	✔	✔	✔		D, A	SW, SED, GW, D	SW, SED, GW, D	D, SW, GW	SW, GW, D	SW	D, A	SW, SED, GW, D	D, A	SW, SED
Stockpiles	Heavy Metals (As, Sb, Pb, Cu, Cr, Al, Hg), CN	Migration of contaminants as sediment and dissolved / suspended in surface water via overland flow; leaching of contaminants to groundwater. Dermal contact, ingestion and inhalation (dust during dry conditions) of contaminants.	Discharge of contaminated groundwater to surface water. Leaching of contaminants and direct contact with contaminants in sediments that have migrated from source area.	High	✔	✔	✔	✔	✔		D, A	SW, SED, GW, D	SW, SED, GW, D	D, SW, GW	SW, GW	SW	A	SW, SED, GW, D	A	SW, SED
Incidental Contamination (not assessed in this investigation)	Asbestos, TPH, PAH, OCPs and PCBs	Migration of contaminants as dissolved / suspended in surface water via overland flow; leaching of contaminants to groundwater. Dermal contact, ingestion and inhalation (dust during dry conditions) of contaminants.	Discharge of surface water runoff and groundwater to environmental receptors.	Medium	✔		✔	✔	✔		D, A	SW, GW	SW, GW	D, SW, GW	SW, GW	SW	A	SW, GW	A	SW
Fill Material	Heavy Metals (As, Sb, Pb, Cu, Al, Hg), Cn	Migration of contaminants as dissolved / suspended in surface water via overland flow; leaching of contaminants to groundwater. Dermal contact, ingestion and inhalation (dust during dry conditions) of contaminants.	Discharge of surface water runoff and groundwater to environmental receptors.	Low	✔		✔	✔	✔		D, A	SW, GW	SW, GW	D, SW, GW	SW, GW	SW	A	SW, GW	A	SW
Embankement adjacent to 'L' shaped canal. Possibly excavated sediments from the canals	Heavy Metals (As, Sb, Pb, Cu, Hg), Cn	Migration of contaminants as sediment.	Discharge of contaminated groundwater to surface water.	Low		✔	✔					SED, GW	SED, GW		SED, GW, D					
Area of unknown disturbance to NE of 'L' shaped canal	Heavy Metals (As, Sb, Pb, Cu, Hg, Zn)	Migration of contaminants as sediment and dissolved / suspended in surface water via overland flow; leaching of contaminants to groundwater. Dermal contact, ingestion and inhalation (dust during dry conditions) of contaminants.	Discharge of contaminated groundwater to surface water. Leaching of contaminants and direct contact with contaminants in sediments that have migrated from source area.	Medium	✔	✔	✔	✔	✔		D, A	SW, SED, GW, D	SW, SED, GW, D	D, SW, GW	SW, GW, D	SW	D, A	SW, SED, GW, D	D, A	SW, SED
Acid Sulphate Soils	Sulphuric acid and resulting, mobilised metals	Excavation and exposure leading to generation of acids and greater mobility of heavy metal contaminants.	Migration of contaminants to surface water via overland flow and leaching of contaminants to groundwater and potential discharge to surface water	Medium	✔		✔				D	SW, GW	SW, GW	D, SW, GW	SW, GW	SW		SW, GW		SW

Estimated sensitivity to impact from potential contamination source

- NA or minimal potential for impact to receptor
- Potential for Impact to receptor
- High potential for impact to receptor

7. Remediation Considerations

7.1 Remediation Requirements

It is evident from previous investigations and the additional data obtained by GHD that significant contaminant impact is present in soils (including tailings and waste stockpiles) on the site, sediment in adjoining areas, groundwater on the site and surface water on and adjoining the site. Section 6 summarises the pathways and impacts relevant to the identified contamination. In addition to the evident impacts and risks to human health and the environment, there is a regulatory requirement to address contamination on the site, by way of the Management Orders discussed in Section 1.1. The questions remaining to be resolved are the extent and means of remediation or management that will be applied.

Remediation requirements and options have been discussed previously in:

- DLWC 1997.
- A Site visit and inception meeting that was held on May 9, 2012 and attended by representatives from:
  - GHD.
  - NSW Environmental Protection Authority (EPA).
  - Bellingen Shire Council.
  - Crown Lands. and
  - Soil Conservation Service.
- Urunga Antimony Processing Plant Contaminated Site - Project Application & Preliminary Environmental Assessment (SCS 2012)

7.2 Remediation Objectives

The intention of Crown Lands is to use the site as Public Open Space. Considering this proposed land use and the location of the site (adjoining a SEPP 14 wetland and upstream of Urunga Lagoon), the following remediation objectives should be met:

- Remediation should enable the site to be safely opened to public access, without unacceptable risk to health from contamination.
- Remediation should result in final landforms that facilitate beneficial use of the site as public open space, and satisfy relevant stakeholders to the maximum practical extent.
- Remaining contamination should not present any unacceptable risks to the environment.
- Remediation works should not cause greater environmental or health impacts than would occur if the contamination is left in place.
- Concentrations of contaminants should be below appropriate health-based assessment criteria in surface soils and soils likely to be disturbed during use of the site (taking into account potential regrading of the site during redevelopment works).
- Concentrations of contaminants exceeding ecological investigation levels must not be placed in a location or manner that could reasonably be expected to exacerbate existing risks of potential impact to ecological receptors.
- Remediation must be able to be completed within the funding available for the work.
- Remediation must meet the requirements of EPA Management Order.

The adopted remediation activity must also:

- Be cost effective to ensure maximum reduction in bio-available contaminants over the long term.
- Consider the latest approaches to stabilisation of the key contaminants of concern.
- Allow for the impact of periodic flooding and tidal influence at the site.
- Favour solutions that separate contaminated material from water within the hydrological zones.
- Consider the management of acid sulfate soils (ASS).
- Be in compliance with all relevant Commonwealth, State and Local legislation.

The decision process governing remediation should also consider the final land form and land use. For instance, management measures or institutional controls may be an effective means of controlling risks in some areas, if these are compatible with long-term beneficial use of the area. These considerations are likely to be specific to each particular area of the site. GHD considers that effective planning and a clear vision of the final land form and use will result in the most cost effective remediation as well as the best outcome for rehabilitation of the site. The involvement of key stakeholders at the remediation planning stage will be essential to this outcome.

7.3 Identified Remediation Options

Four broad options for remediating the site have currently been identified. These are briefly outlined as follows:

- Off-site Reprocessing: Removal of source material, long haul transport, and off-site reprocessing at an appropriate ore processing facility.
- Off-site Disposal: Removal of source material, possible treatment on-site or off-site, long haul transport, and disposal to a licensed facility with possible containment cell.
- On-site Disposal: Removal of source material, possible treatment on-site, short haul transport for disposal to a possible containment cell on-site.
- In-situ Containment: Leave source material in place, possible stabilisation or treatment, and construct containment system in-situ to prevent direct exposure or mobilisation and separate contaminated material from surface and ground waters.

While a single remediation strategy may be selected for the overall works, it is likely that a combination of strategies may be applicable to some areas of the site (i.e. outside the main remediation area), particularly in areas where a management rather than intrusive remediation approach is considered to be more appropriate (following the considerations described elsewhere in this report).

The option of 'Do Nothing' was not considered appropriate due to the identified, current impact resulting in a lack of vegetation in the vicinity of the tailings deposit and potential risk associated with further, potential mobilisation of impacted soil, sediment and water. However, this may apply to "fringe" areas of the site, as noted above.

7.4 Remediation Action Plan

Evaluation, selection and implementation of the preferred remediation option will require the development of a RAP which would be prepared in accordance with the OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites*. The RAP will:

- Provide a detailed consideration of the remedial options nominated by the EPA from those outlined in the Investigation Report or other options put forward in writing by the EPA.
- Outline requirements for the protection of the Environment and Community.
- Nominate the preferred remedial option and provide reasoning.
- Provide sufficient detail in the RAP to enable it to be implemented by a remediation contractor. This will include, but not be limited to:
  - Assessment / Remediation Criteria and Clean up Goals.
  - Detailed characterisation of the nature of the material requiring remediation.
  - Figures, maps and/or plans showing with precision the location of the material requiring remediation.
  - The methods and design of the preferred remedial system.
  - Descriptions of any remedial technologies to be utilised.
  - Basis of validation of the remediation works.
  - Quality Assurance/Quality Control Plan.
  - Outline of Health and Safety requirements.
- Provide a contingency plan, should the nominated remedial method fail.

The RAP will require sufficient detail to enable the preferred method to be costed and implemented by a remediation contractor, but will not include detailed methodology for implementation. This will enable the remediation contractor the flexibility to propose their preferred methodology.

The RAP will be provided to SCS for submission to the EPA for review and approval.

8. Conclusion

A Detailed Investigation of a former antimony processing facility located at Hillside Drive, Urunga, NSW was completed to provide a key input to achieve compliance with the Management Order 20111405. The investigation incorporated data from the Preliminary Investigation Report (GHD 2012) and a field investigation comprising sampling and analysis of soil, sediment and water from:

- 63 soil boreholes.
- 38 sediment boreholes.
- 9 surface water locations.
- 4 groundwater monitoring wells.
- 3 stockpiles and 2 loading ramps.
- Brick stockpiles.

The investigation was carried out in accordance with a Sampling Quality and Analysis Plan that was incorporated into the Preliminary Investigation Report (GHD 2012) and was reviewed and approved by the Environmental Protection Authority. Results were compared to adopted assessment criteria to provide:

- A comparison with historic concentrations and impact extent.
- Data to assess horizontal and vertical delineation.
- Data necessary for a remediation options assessment.
- An assessment of surface water and groundwater quality.
- Baseline data for assessing any future impact from site activities or remediation.

Findings of the investigation were used to update the Conceptual Site Model that was developed in the Preliminary Investigation Report (GHD 2012) and included:

- Antimony and arsenic were evident as the key COCs.
- Other COCs included mercury, chromium, nickel, zinc, copper, lead and cyanide.
- In nearly all cases, where one of the COCs was present in significant concentrations, more significant concentrations of either antimony or arsenic were present. As a result, these analytes were deemed to be representative indicator analytes and the governing contaminants.
- Incidental contaminants may also be present on the Site including:
  - Total Petroleum Hydrocarbons;
  - Polynuclear Aromatic Hydrocarbons;
  - Organochlorine Pesticides;
  - Polychlorinated Biphenyls; and
  - Asbestos.
- Surface water and sediment (and to a lesser extent, groundwater) were noted as the main media for the transportation of COCs on the Site.
- Generally, contaminants exceeding relevant assessment criteria in surface water, groundwater and sediment correlated with those that exceeded assessment criteria in the soils.

- In most cases, the leachable concentrations of COCs in the soil and sediment were significantly less than total concentrations, suggesting the physical migration of contaminated soil or sediment has been the more important contaminant migration pathway.
- Notwithstanding the above, where there were significant concentrations of antimony and arsenic in soil or sediment samples, the corresponding leachable concentrations were well above ANZECC trigger values for protection of aquatic ecosystems.
- For “soil” samples (being those take from “dry” areas of the site, including the tailings area, during GHD’s investigations) the degree of contamination generally reduces quite quickly so that the site can be divided into significantly impacted and relatively unimpacted areas. The exceptions to this are primarily adjacent to the ‘L’ shaped canal (where contamination is either within 10 times the assessment criteria, or covered by cleaner material), the south western corner of the site (which has insufficient sampling to define), and the area of disturbance at the north east corner of the site.
- For the majority of the COCs, dissolved concentrations were similar to total concentrations in the surface and groundwater samples, indicating the measured concentrations of contaminants are mobile in the water and not just bound to suspended particles.
- Concentrations of the main COCs in the soil recorded in this investigation were within a similar order of magnitude as those recorded in the historical investigations.
- Reduced total concentrations of COCs in the surface water were noted from the 1997 round of sampling to the present. This may be due to many factors and does not necessarily indicate an overall reduction in concentrations.
- The interpreted extent of the contamination in the soil can be summarised as:
  - Roughly correlating with the absence of vegetation.
  - Including the tailings deposit, former processing area and portions of the former unprocessed ore stockpiling area.
  - Extending into the south west corner of the site and likely across the property boundary near the wetland, however the extent of this impact has not been fully delineated.
  - Extending along the embankment in the vicinity of the ‘L’ shaped canal, at a depth of 1 m to 1.7m from the current ground surface (likely associated with the original soil surface prior to placement of spoil from excavation of the canal).
  - Not extending into the north east portion of the site with the exception of an area of unknown disturbance, to the north of the ‘L’ Shaped canal.
  - Not extending to the southern side of the wetland.
  - Varying in depth from approximately 0.5 metres below ground surface (mbgs) in the north west portion of the impact to 2.2 mbgs near the water’s edge and at some locations within the tailings deposit.
- The extent of the impact in the sediment can be summarised as:
  - Showing highest levels of impact adjacent to the tailings deposit, extending approximately 50 m downstream of the tailing deposit, extending across the wetland some 50 m to the south of the tailings deposit (roughly correlating with vegetation dieback), and within and adjacent to the north eastern portion of the ‘L’ shaped canal.
  - Including the western and south eastern portions of the ‘S’ shaped canals.

  - Ranging from depths of about 0.5 mbgs near the tailings to 0.1 mbgs in the southern portion of the wetland.
  - Generally having greatest antimony and arsenic concentrations in the surface sediment (0-0.1 mbgs).
  - Generally corresponding with the visual presence of tailings sediment (grey silt).
- Estimated volumes of impacted soil and sediment were:
  - 8,700 m^3 of soil and 2,500 m^3 of sediment exceeding 30 times the adopted assessment criteria.
  - 11,300 m^3 of soil and 3,600 m^3 of sediment (encompassing the volumes above) exceeding 10 times the adopted assessment criteria.
  - 26,500 m^3 of soil and 6,700 m^3 of sediment (encompassing the volumes above) exceeding the adopted assessment criteria.
- The soils and sediment in the vicinity of the tailing deposit analysed and are considered to be Acid Sulfate soils. The preparation of a detailed Acid Sulfate Soils Management Plan (ASSMP) will be required for works that disturb the soil in that area.
- The groundwater table onsite ranged from approximately 0.4 to 1.4 mbgs and groundwater is interpreted to discharge into the wetland. The tailings material and underlying peat are expected to be highly permeable and hence the contaminants are likely to have high groundwater connectivity to the wetland. Characteristics of deeper groundwater or groundwater flow into the site are not known.

9. Limitations

This report: has been prepared by GHD for NSW Catchment and Lands- Crown Lands and may only be used and relied on by NSW Catchment and Lands- Crown Lands for the purpose agreed between GHD and the NSW Catchment and Lands- Crown Lands as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than NSW Catchment and Lands- Crown Lands arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by various third parties. GHD has not independently verified or checked beyond the agreed scope of work and does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

This Report should be read in full and no excerpts are taken to be representative of the findings of this Report.

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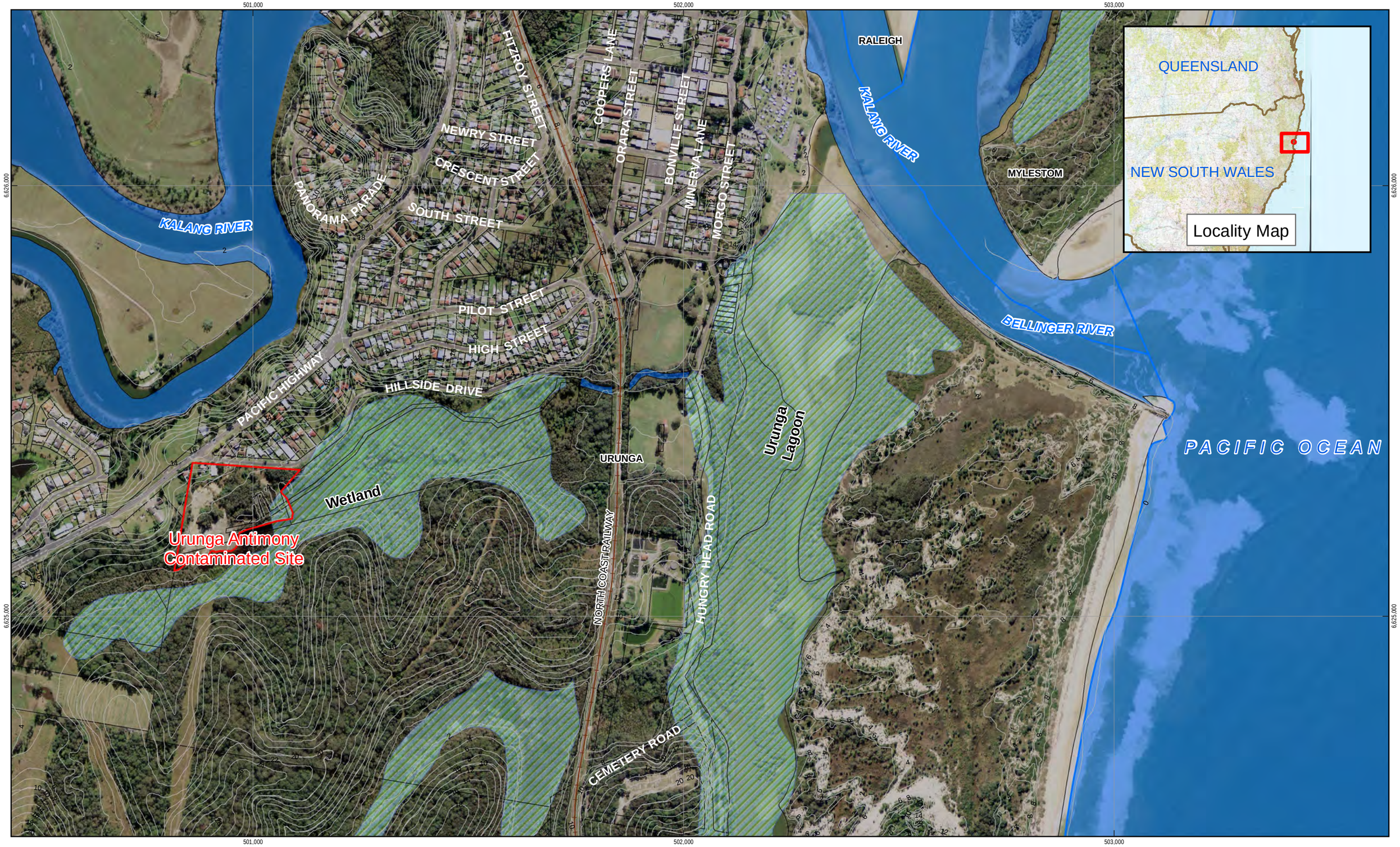
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Appendices

Appendix A - Figures



1:8,000 (at A3)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

- North Coast Railway Line
- Contours
- SEPP14 Wetland
- WaterFeature
- Urunga Antimony Contaminated Site

NSW Catchment and Lands- Crown Lands
Former Antimony Processing Plant, Urunga NSW

Job Number	22-16251
Revision	A
Date	08 Nov 2012

Site Location Features - Overview

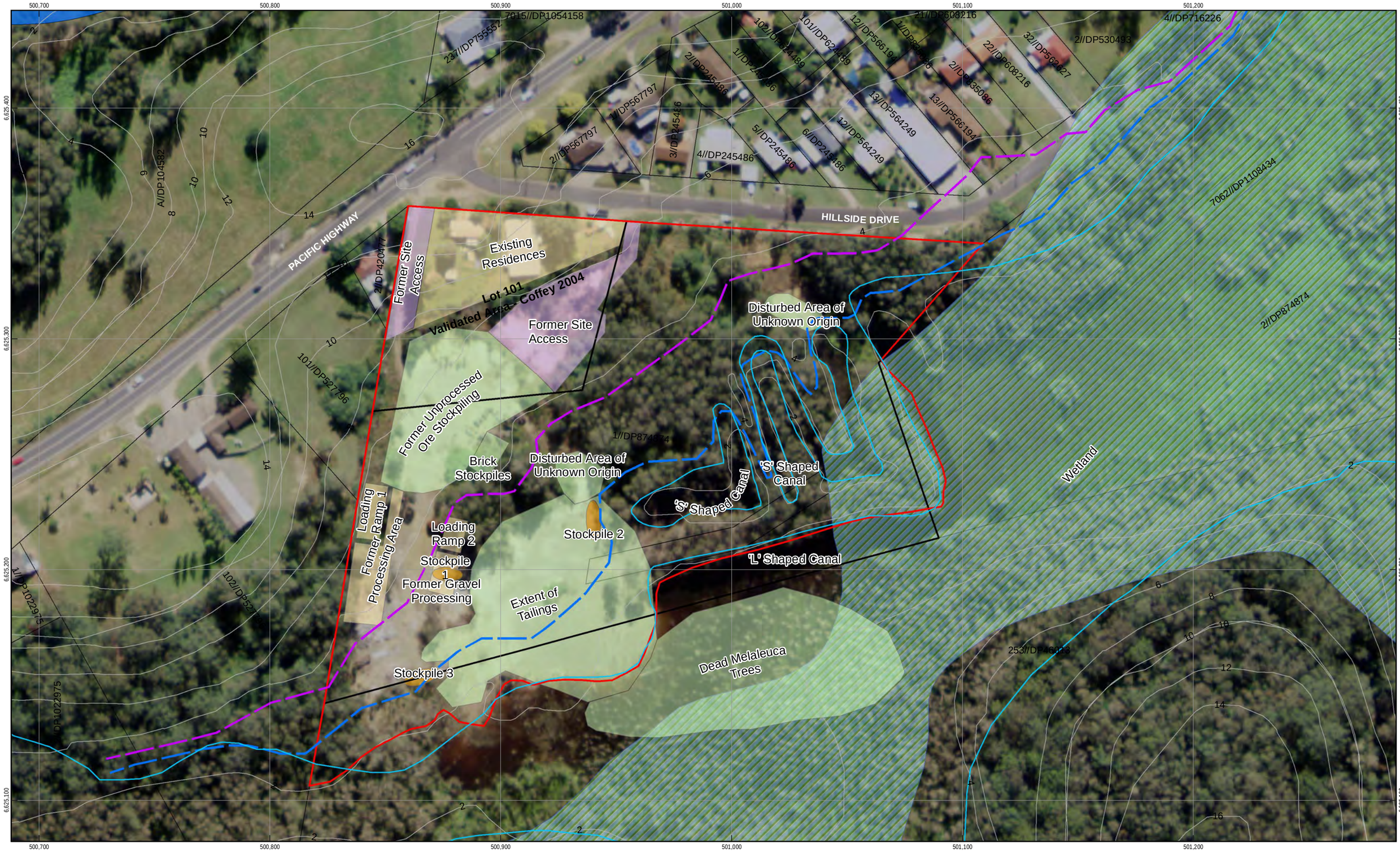
Figure 1

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Data source: DPI,: Aerials - 2012. Created by Sdouglas

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1:1,500 (at A3)

0 10 20 40 60 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

Flood Levels - BSC Flood Risk Maps (2008)

- 100 Year
- Probable Maximum Flood (PMF)
- Waters Edge (August 2012)
- Lidar Contours
- Lot
- SEPP14 Wetland
- Urunga Antimony Contaminated Site

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NSW Catchment and Lands- Crown Lands
Former Antimony Processing Plant, Urunga NSW

Site Location
Features - Detailed

Job Number	22-16251
Revision	A
Date	08 Nov 2012

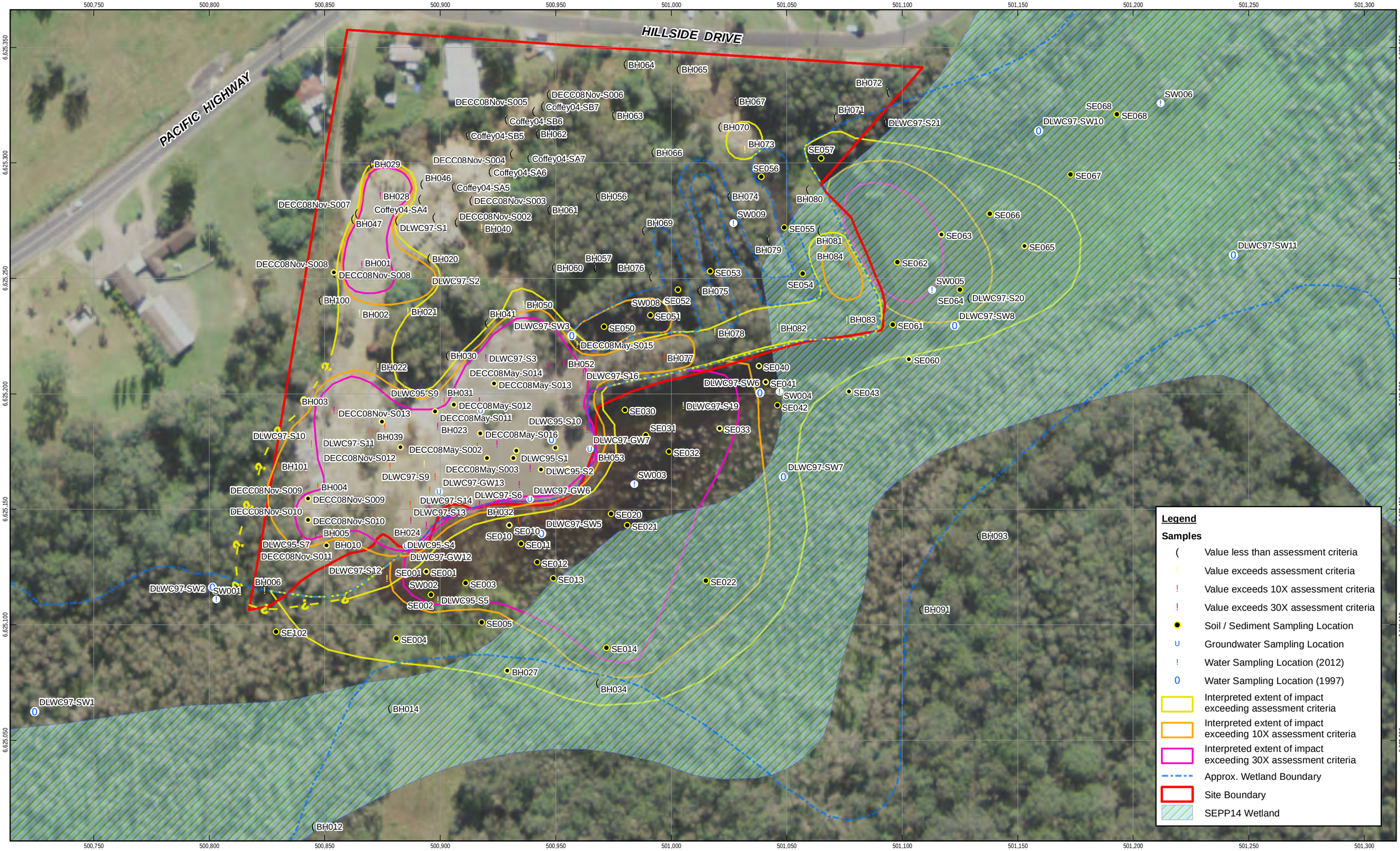
Figure 2

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1:1,500 Paper Size A3

0 10 20 40 60 80

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

O

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga NSW
Detailed Investigation Report

Job Number	22-16251
Revision	A
Date	06 Dec 2012

All Sampling Locations (historic and current) with Interpreted Extent of Impact

Figure 3

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NORTH **SOUTH**

Former Site Access

Former Unprocessed Ore Stockpiling Area

Former Processing Area

Tailings Deposit

BH029 BH047 BH001 BH002 BH022 DLWC97-GW4 BH031 BH053

Water Surface

Silty **GRAVEL** - brown

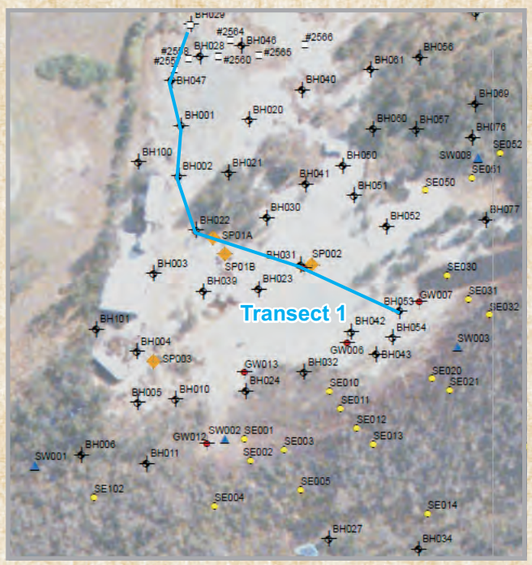
Sandy **SILT** - brown

Clayey **SILT** - dark brown

Tailings - silty **SAND** - grey

Silty **CLAY** - orange/grey

12,250 3416 3360 1520 <415 200.3 2053 264.9 1000 232.8 544 10,030 4413 9164 1386 9670 5280 1180 11,070 11,030 5320 3560 569.3 726.7 1330 825.3 568.4



LITHOLOGY

- Sand
- Silt
- Clay
- Gravel
- Interpreted Lithological Boundary

Surface elevation not to scale

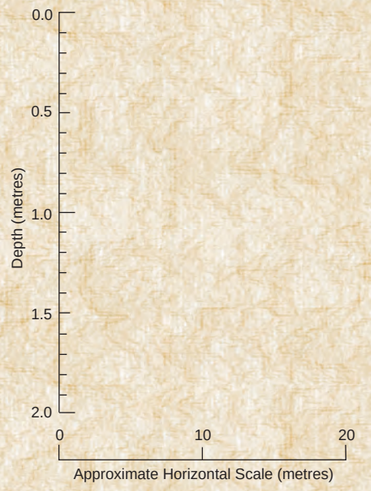
100/200 Antimony/Arsenic Concentrations (mg/kg)

388 **Sb** = Antimony Concentrations (mg/kg)

212 **As** = Arsenic Concentrations (mg/kg)

Source: Lab or XRF

- 30 times Assesment Criteria
- 10 times Assesment Criteria
- Exceeds Assesment Criteria



N

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NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga, NSW
Detailed Investigation Report

Geological Cross Section Transect 1

Job Number	22-16251
Revision	A
Date	5 Oct 2012

Figure 4

GHD\Launceston\22\2216251_LTN_02.cdr

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WEST **EAST**

Former Processing Area | Tailings Deposit | Embankment adjacent to 'L' Shaped Canal

BH004 **BH039** **BH023** **DLWC97-GW4** **BH031** **BH052** **BH077**

Sandy **SILT** - brown

Silty **CLAY** - grey

Clayey **SAND** - grey

Tailings
Silty **SAND** - grey

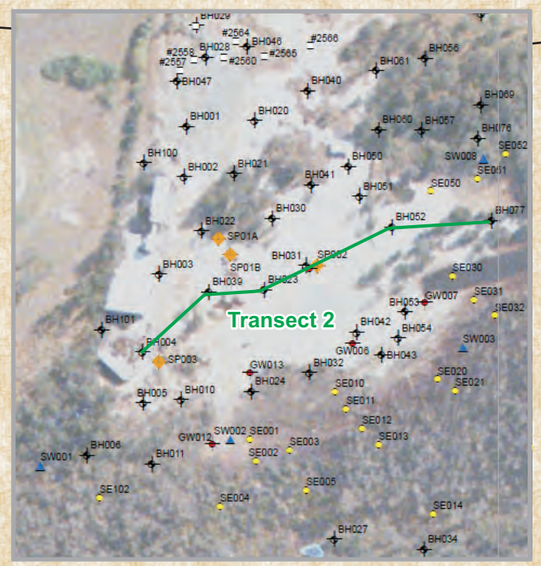
Clayey **SILT** - dark brown

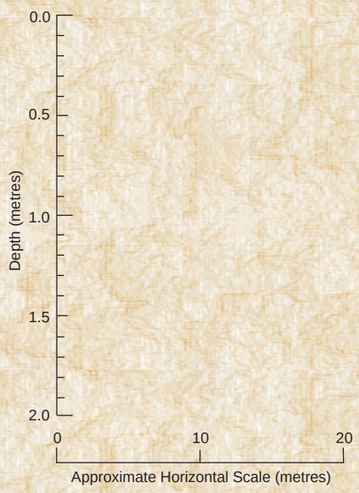
Silty/sandy **CLAY** - orange/grey

Embankment
Sandy **SILT**

SILT

	BH004	BH039	BH023	BH031	BH052	BH077
Sandy SILT - brown	4700 / 1950	2485 / 1262	12,400 / 69,000	10,830 / 4413	13,650 / 3917	388 / 432
		221.2	4260 / 1461	9164 / 1386	13,470 / 7019	212 / 477.1
Silty CLAY - grey	2050 / 1160	444.4		9670 / 5280	<681 / 1141	882 / 2130
Clayey SAND - grey		6494 / 945.2				
		2967		1180	2079 / 2211	
Silty/sandy CLAY - orange/grey					698.6	
					223.5	





LITHOLOGY

- Sand
- Silt
- Clay
- Gravel
- Interpreted Lithological Boundary

Surface elevation not to scale

100/200 Antimony/Arsenic Concentrations (mg/kg)

388 **Sb** = Antimony Concentrations (mg/kg)

212 **As** = Arsenic Concentrations (mg/kg)

Source: Lab or XRF

- 30 times Assesment Criteria
- 10 times Assesment Criteria
- Exceeds Assesment Criteria

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga, NSW
Detailed Investigation Report

Geological Cross Section Transect 2

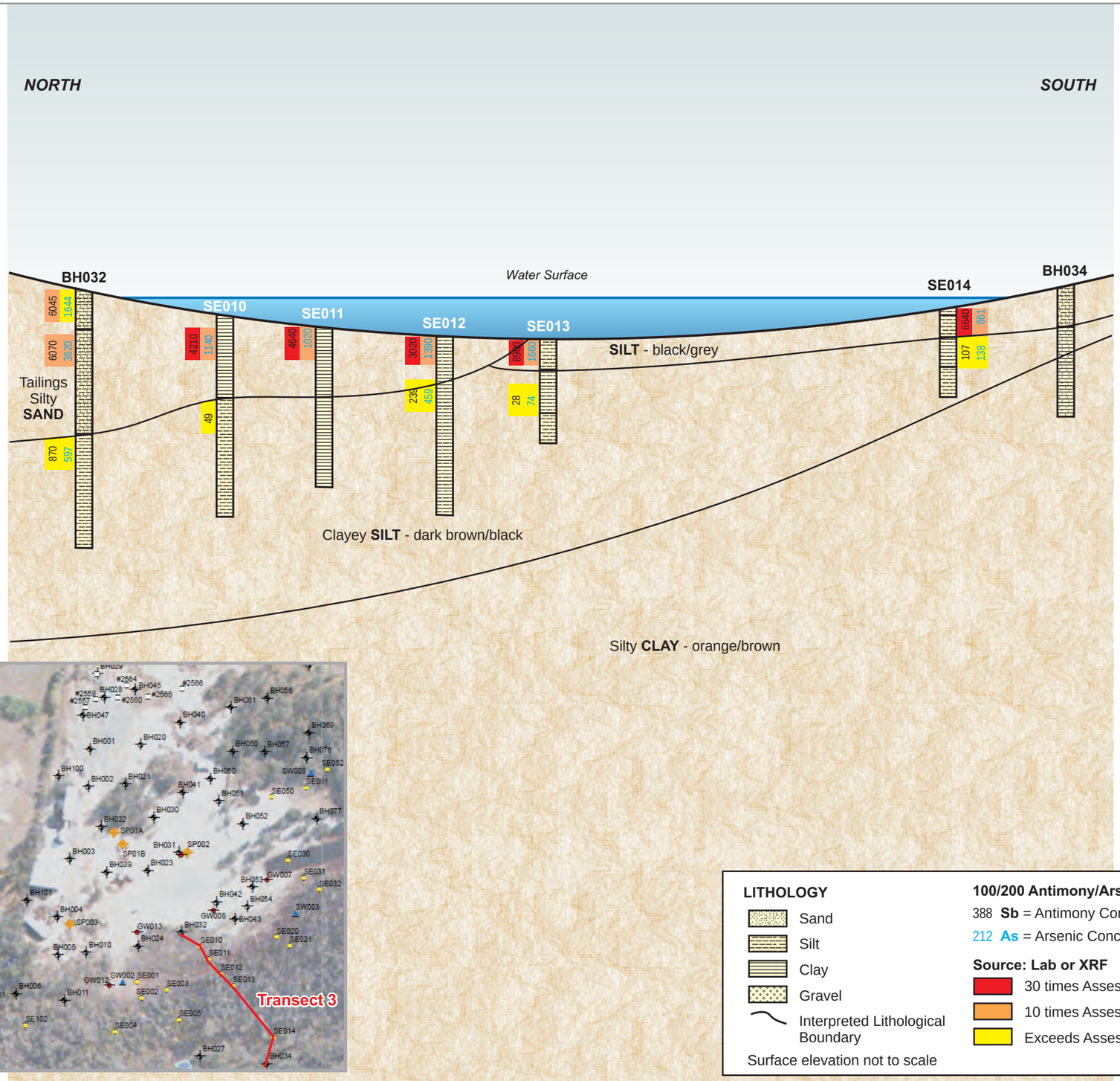
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Figure 5

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Geological Cross Section Transect 3

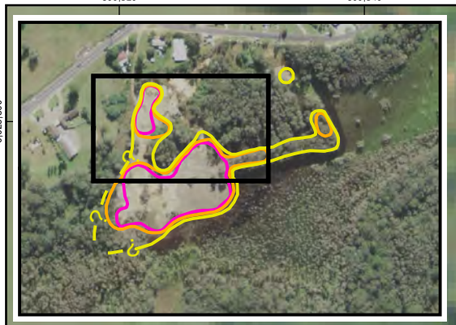
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Figure 6

GHD\Launceston\22\2216251_LTN_04.cdr

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Legend

Samples

- (Value less than assessment criteria
- ! Value exceeds assessment criteria
- ! Value exceeds 10X assessment criteria
- ! Value exceeds 30X assessment criteria
- Interpreted extent of impact exceeding assessment criteria
- Interpreted extent of impact exceeding 10X assessment criteria
- Interpreted extent of impact exceeding 30X assessment criteria
- Approx. Wetland Boundary

BH028		Sb	As
0-0.2	L	12,600	**5000**
0.3-0.5	L	978	**599**
0.8-1	X	-	13.67

BH001		Sb	As
0-0.2	X	12,250	**3416**
0.3-0.5	L	3660	**1520**
0.7-0.9	X	<415	**26.86**
1-1.2	X	239.4	**200.3**

BH002		Sb	As
0-0.2	X	2053	**264.9**
0.5-0.7	L	<5	<5
1-1.2	X	20.62	14.48

BH022		Sb	As
0-0.2	X	1000	**232.8**
0.5-0.7	L	544	**132**

BH003		Sb	As
0-0.2	X	9378	**1152**
0.5-0.7	X	<16.78	8.01
1-1.2	X	<15.62	<3.5

BH040		Sb	As
0-0.2	X	350.8	**140.9**
0.3-0.5	X	<16.23	4.51

DLWC97-S2		Sb	As
0.15-0.25	L	3410	**478**

BH021		Sb	As
0-0.2	X	2842	**790.7**

BH050		Sb	As
0-0.2	X	1173	**165.3**
0.5-0.7	X	<21.25	<5.18
1-1.2	X	<16.04	**42.35**

BH052		Sb	As
0-0.2	X	13,650	**3917**
0.5-0.7	X	13,470	**7019**
1-1.2	X	<681	**1141**
1.8-2	X	2079	**2211**
2.3-2.5	X	258.2	**698.6**
2.8-3	X	65.03	**223.5**

DECC08May-S015		Sb	As
0-0.01	X	1388	**291**

BH077		Sb	As
0-0.2	L	388	**432**
0.3-0.5	L	93	**157**
1-1.2	L	36	**156**
1.5-1.7	L	882	**2130**
2-2.2	L	144	**165**

DLWC97-S3		Sb	As
0.2-0.3	L	6150	**6250**
0.8-0.9	L	6550	**3610**
1.9-2	L	2	6.6

BH031		Sb	As
0-0.2	X	10,830	**4413**
0.5-0.7	X	9164	**1386**
1-1.2	L	9670	**5280**
1.8-2	X	125.2	**1180**

DECC08May-S014		Sb	As
0-0.01	X	19,100	**7170**

DLWC97-S16		Sb	As
0.16-0.26	L	32	**1870**
0.55-0.65	L	110	**233**
0.75-0.85	L	12,400	**9820**

DECC08May-S012		Sb	As
0-0.01	X	12,160	**6226**

DECC08May-S013		Sb	As
0-0.01	X	21,850	**10,260**

DLWC95-S9		Sb	As
0-0.1	L	7843	**5041**

DLWC97-S4		Sb	As
0.28-0.38	L	6780	**5950**
1-1.1	L	9020	**6970**
1.2-1.3	L	3110	**1980**

DECC08May-S011		Sb	As
0-0.01	X	12,450	**9193**

DLWC97-S19		Sb	As
0-0.1	L	360	**309**

BH066, Coffey04-SA7, DECC08Nov-S004, BH029, Coffey04-SA6, BH046, Coffey04-SA5, BH056, Coffey04-SA4, DECC08Nov-S003, BH061, DECC08Nov-S007, BH047, DLWC97-S1, DECC08Nov-S001, DECC08Nov-S002, BH069, BH020, BH060, BH057, DECC08Nov-S008, BH076, BH100, BH041, BH030

500,820 500,840 500,860 500,880 500,900 500,920 500,940 500,960 500,980 501,000

6,625,300 6,625,280 6,625,260 6,625,240 6,625,220 6,625,200

1:500 Paper Size A3

0 2.5 5 10 15 20

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

O

Sample Ident. — BH028 | Sb | As | — Antimony conc. (mg/kg)
0-0.2 | L | 12,600 | 5000 — Arsenic conc. (mg/kg)
0.3-0.5 | L | 978 | 599
0.8-1 | X | - | 13.67
Sample depth — Data source X=XRF L=Laboratory

- Value less than assessment criteria
- Value exceeds assessment criteria
- Value exceeds 10X assessment criteria
- Value exceeds 30X assessment criteria

GHD

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga NSW
Detailed Investigation Report

Job Number 22-16251
Revision A
Date 06 Dec 2012

Soil Sampling Locations with Antimony and Arsenic Concentrations (NW Portion)

Figure 7

C:\Projects\22\16251\GIS\Maps\Deliverables\22_16251_10_SoilNWportion_revA.mxd

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Data source: DPI, Aerials, 2012. DWLC, Bores/1995,1997. Coffey, Bores/2004. DECC, Bores/2008. GHD,Bores,Wetland Boundary,(Digitized)/2012. Created by:ihamilton

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BH003		Sb	As
0-0.2	X	9378	1152
0.5-0.7	X	<16.78	8.01
1-1.2	X	<15.62	<3.5

DLWC95-S9		Sb	As
0-0.1	L	7843	5041

DECC08May-S011		Sb	As
0-0.01	X	12,450	9193

DECC08May-S010		Sb	As
0-0.01	X	9245	4191

DECC08Nov-S013		Sb	As
0-0.01	X	340,800	39,410

DLWC97-S11		Sb	As
0.2-0.3	L	4660	1850
1-1.1	L	566	47
1.4-1.5	L	2480	1160

DLWC97-S10		Sb	As
0.4-0.5	L	58	36
1-1.1	L	1370	236
1.5-1.6	L	3280	77

BH039		Sb	As
0-0.2	X	2485	1262
0.5-0.7	X	20.32	221.2
1-1.2	X	444.4	155
1.5-1.7	X	6494	945.2
2-2.2	X	2967	103.8
2.2-2.4	X	<14.18	53.55

BH101		Sb	As
0-0.2	L	5400	2540
0.5-0.7	X	71.23	34
1-1.2	X	56.77	13.56

DLWC97-S9		Sb	As
0.2-0.3	L	7360	1510
1.15-1.25	L	32	12

DECC08May-S001		Sb	As
0-0.01	X	6813	1866

BH004		Sb	As
0-0.2	L	4700	1950
0.5-0.7	X	<17.01	<3.8
1-1.2	L	2050	1160
1.5-1.7	X	218.6	76.3
2-2.2	X	56.49	43.78

DLWC97-S13		Sb	As
0.2-0.3	L	4760	2410
0.7-0.8	L	56	26

DECC08Nov-S009		Sb	As
0-0.01	X	17,960	3381

DLWC95-S3		Sb	As
1.1-1.2	L	69	37
0.2-0.3	L	2745	1194
0.65-0.75	L	7647	306
0.8-0.85	L	549	332

DLWC95-S6		Sb	As
0-0.1	L	6569	2869
0.15-0.2	L	3137	738
0.4-0.5	L	17,160	1229

DLWC95-S7		Sb	As
0-0.1	L	549	184
0.2-0.3	L	169	82
0.6-0.7	L	11,180	266
0.7-0.8	L	6275	504

DECC08May-S009		Sb	As
0-0.01	X	20,720	3005

DECC08Nov-S010		Sb	As
0-0.01	X	15,970	4878

BH005		Sb	As
0-0.2	X	<19.47	19.09
0.3-0.5	X	3312	372.6
1-1.2	X	4206	278.9
1.5-1.8	X	1197	367.6
2-2.2	X	99.63	149.6

BH010		Sb	As
0-0.2	X	509.1	191.6
0.3-0.5	X	4479	83.45
1-1.2	X	<16.01	3.82
1.5-1.8	X	<15.5	6.05

DECC08May-S011		Sb	As
0-0.01	X	922	87

DLWC95-S4		Sb	As
0-0.1	L	11,670	2910
0.4-0.48	L	1863	655
0.8-0.9	L	9118	1557

DLWC97-S12		Sb	As
0.1-0.2	L	475	36
0.7-0.8	L	2830	60

BH006		Sb	As
0-0.3	L	1950	702

DLWC95-S5		Sb	As
0-0.1	L	2010	197

BH031		Sb	As
0-0.2	X	10,830	4413
0.5-0.7	X	9164	1386
1-1.2	L	9670	5280
1.8-2	X	125.2	1180

DECC08May-S013		Sb	As
0-0.01	X	21,850	10,260

DLWC97-S4		Sb	As
0.28-0.38	L	6780	5950
1-1.1	L	9020	6970
1.2-1.3	L	3110	1980

DECC08May-S012		Sb	As
0-0.01	X	12,160	6226

BH023		Sb	As
0-0.1	L	12,400	6900
0-0.2	X	4277	1453
0.5-0.7	L	8650	4110

DECC08May-S016		Sb	As
0-0.01	X	11,990	3368

DLWC97-S5		Sb	As
0.07-0.17	L	4980	8740
0.5-0.6	L	5170	3340
1-1.1	L	5920	2130

DLWC95-S8		Sb	As
0.3-0.36	L	7157	4262
0.7-0.8	L	1029	279

DLWC95-S1		Sb	As
0-0.1	L	9020	2671
0.4-0.5	L	7059	3596
0.6-0.7	L	9020	4897

DECC08Nov-S012		Sb	As
0-0.01	X	20,250	3097

DLWC97-S8		Sb	As
0.05-0.15	L	2340	1550
1.5-1.6	L	32	25

DECC08May-S004		Sb	As
0-0.01	X	24,200	7536

DECC08May-S003		Sb	As
0-0.01	X	26,000	5980

DECC08May-S002		Sb	As
0-0.01	X	12,680	4557

DLWC97-S17		Sb	As
0-0.1	L	7990	5080

DECC08May-S005		Sb	As
0-0.01	X	26,490	5914

DECC08May-S006		Sb	As
0-0.01	X	46,330	14,030

DLWC97-S14		Sb	As
0.1-0.2	L	3640	929

DECC08May-S007		Sb	As
0-0.01	X	12,590	4126

BH054		Sb	As
0-0.2	X	11,960	1019
0.3-0.5	X	13,710	2085
1-1.2	X	484.5	483.6
1.5-1.7	X	<12.9	86.59

DECC08May-S008		Sb	As
0-0.01	X	12,800	2935

DLWC95-S2		Sb	As
0-0.1	L	7843	3527
0.2-0.3	L	5784	3048
0.4-0.5	L	10,490	3022
0.5-0.55	L	48	45
0.8-1	L	15	485

BH032		Sb	As
0-0.2	X	6405	1644
0.3-0.5	L	6070	3620
1-1.2	X	870	597
1.5-1.8	X	<11.72	67.38

DLWC97-S18		Sb	As
0-0.1	L	4260	3430

BH043		Sb	As
0-0.2	X	9818	4841
0.3-0.5	X	10,090	2938
1-1.2	X	311.2	528.3
1.5-1.7	X	353.6	576

BH042		Sb	As
0-0.2	X	16,490	4982
0.3-0.5	X	4213	1337
1-1.2	X	131.9	770.8
1.5-1.7	X	<11.3	16.15

DLWC97-S6		Sb	As
0.24-0.34	L	3330	3120
0.55-0.65	L	4020	1590
0.9-1	L	960	629

BH024		Sb	As
0-0.2	X	10,150	2397
0.3-0.5	L	6640	4050
1-1.2	L	192	130
1.5-1.8	X	<11.67	277.3
2-2.2	L	31	33

DLWC97-S7		Sb	As
0.27-0.37	L	2560	3000
1-1.1	L	943	891

BH053		Sb	As
0-0.2	X	11,070	11,930
0.3-0.5	L	5320	3560
1-1.2	X	569.3	726.7
1.5-1.7	L	150	1330
2-2.2	X	825.3	568.4
3.2-3.5	L	23	80

DLWC95-S10		Sb	As
0-0.1	L	10,590	7582
0.2-0.3	L	5882	6352
0.7-0.8	L	1186	3648



Legend

Samples

- (Value less than assessment criteria
- ! Value exceeds assessment criteria
- ! Value exceeds 10X assessment criteria
- ! Value exceeds 30X assessment criteria

Interpreted extent of impact exceeding assessment criteria

Interpreted extent of impact exceeding 10X assessment criteria

Interpreted extent of impact exceeding 30X assessment criteria

Approx. Wetland Boundary

1:500 Paper Size A3

0 2.5 5 10 15 20

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

O

Sample Ident. — BH028 | Sb | As | Antimony conc. (mg/kg)

BH028		Sb	As
0-0.2	L	12,600	5000
0.3-0.5	L	978	599
0.8-1	X	-	13.67

Arsenic conc. (mg/kg)

Sample depth

Data source X=XRF L=Laboratory

Value less than assessment criteria
Value exceeds assessment criteria
Value exceeds 10X assessment criteria
Value exceeds 30X assessment criteria

GHD

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga NSW
Detailed Investigation Report

Job Number 22-16251
Revision A
Date 06 Dec 2012

Soil Sampling Locations with Antimony and Arsenic Concentrations (SE Portion)

Figure 8

C:\Projects\22\16251\GIS\Maps\Deliverables\22_16251_11_SoilSWportion_revA.mxd

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1:500 Paper Size A3

0 2.5 5 10 15 20

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Sample Ident. — BH028 Sb As — Antimony conc. (mg/kg) — Arsenic conc. (mg/kg)

		Sb	As
0-0.2	L	12,600	5000
0.3-0.5	L	978	599
0.8-1	X	-	13.67

Sample depth — Data source X=XRF L=Laboratory

Value less than assessment criteria
Value exceeds assessment criteria
Value exceeds 10X assessment criteria
Value exceeds 30X assessment criteria

GHD

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga NSW
Detailed Investigation Report

Job Number	22-16251
Revision	A
Date	08 Nov 2012

Soil Sampling Locations with Antimony and Arsenic Concentrations (Eastern Portion)

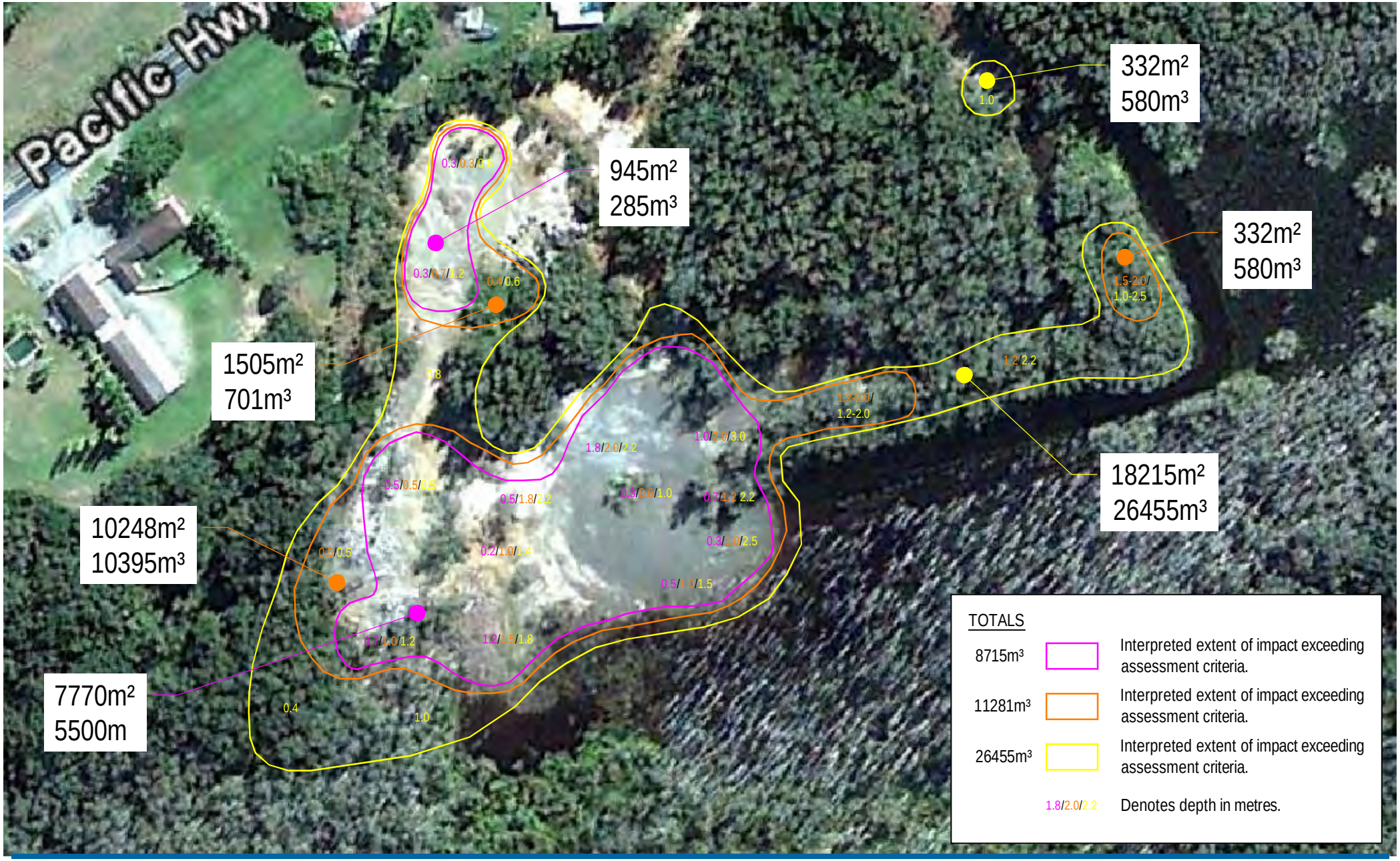
Figure 9

C:\Projects\22\16251\GIS\Maps\Deliverables\22_16251_12_SoilEstportion_revA.mxd

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N

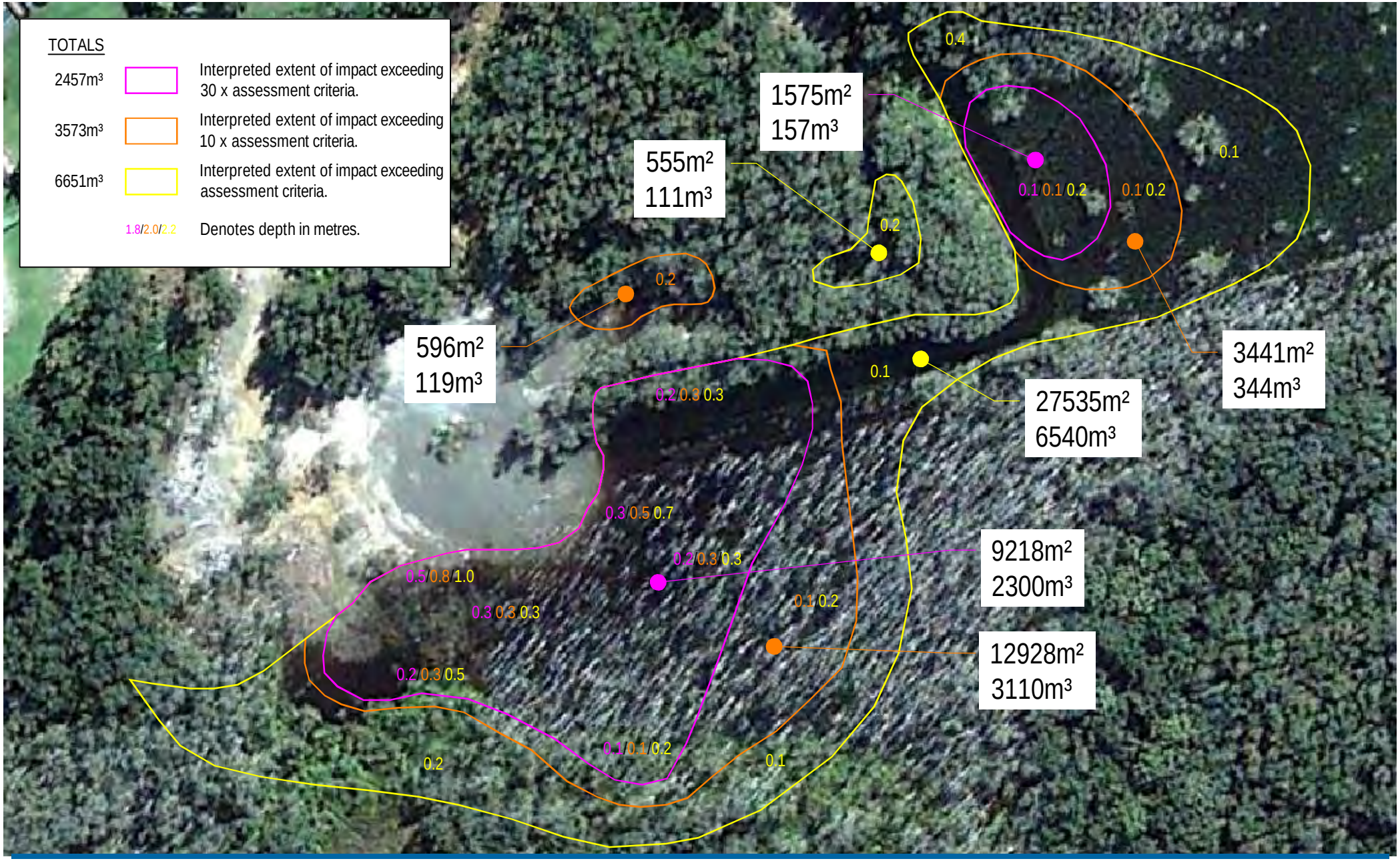
NSW Catchment & Lands - Crown Lands
Former Antimony Processing Plant - Urunga
Detailed Investigation Report
Estimated Area & Volume of Impacted Soil

Job Number 22-16251
Revision A
Date Oct 2012

Figure (10a)

230 Harbour Drive Coffs Harbour NSW 2450 Australia T 61 2 6650 5600 F 61 2 6650 5601 E cfsmail@ghd.com W www.ghd.com

Plot Date: 7 November 2012 - 1:33 PM Plotted by: Ian Gould Cad File No: G:\22\16251\CADD\Drawings\22-16251-FIG 1 & 2.dwg



N

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NSW Catchment & Lands - Crown Lands
Former Antimony Processing Plant - Urunga
Detailed Investigation Report
Estimated Area & Volume of Impacted Sediment

Job Number 22-16251
Revision A
Date Oct 2012

Figure (10b)

230 Harbour Drive Coffs Harbour NSW 2450 Australia T 61 2 6650 5600 F 61 2 6650 5601 E cfsmail@ghd.com W www.ghd.com

Plot Date: 8 November 2012 - 2:27 PM Plotted by: Ian Gould
Cad File No: G:\22\16251\CADD\Drawings\22-16251-FIG 1 & 2.dwg

500,850 500,900 500,950 501,000 501,050 501,100 501,150 501,200 501,250

6,625,300 6,625,250 6,625,200 6,625,150 6,625,100

SE068 SE057 SE056 SE067 SE066 SE055 SE062 SE053 SE054 SE064 SE052 SE051 SE050 SE061 SE040 SE041 SE043 SE042 SE030 SE031 SE032 SE020 SE021 SE010 SE011 SE012 SE013 SE001 SE003 SE002 SE022 SE005 SE102 SE004 SE014

Legend

- Leachable Antimony - Value less than assessment criteria
- Extractable Antimony - Value less than assessment criteria
- Extractable Antimony - Value exceeds assessment criteria
- Extractable Antimony - Value exceeds 10X assessment criteria
- Extractable Antimony - Value e xceeds 30X assessment criteria
- Total Antimony - Value less than assessment criteria
- Total Antimony - Value exceeds assessment criteria
- Total Antimony - Value exceeds 10X assessment criteria
- Total Antimony - Value exceeds 30X assessment criteria
- Interpreted extent of sediment exceeding assessment criteria
- Interpreted extent of sediment exceeding 10X assessment criteria
- Interpreted extent of sediment exceeding 30X assessment criteria
- Approx. Wetland Boundary

1:1,150 Paper Size A3

0 5 10 20 30 40 50

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

O

NOTE:
Concentrations shown for the shallowest sample only (generally 0.0m to 0.1m)

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga NSW
Detailed Investigation Report

Job Number	22-16251
Revision	A
Date	06 Dec 2012

Sediment Antimony Concentrations

Figure 11

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500,800 500,850 500,900 500,950 501,000 501,050 501,100 501,150 501,200 501,250

6,625,300 6,625,250 6,625,200 6,625,150 6,625,100

SE068 SE057 SE056 SE067 SE066 SE055 SE062 SE053 SE054 SE064 SE052 SE051 SE050 SE061 SE040 SE041 SE043 SE042 SE030 SE031 SE032 SE020 SE021 SE010 SE011 SE012 SE001 SE003 SE013 SE022 SE002 SE005 SE102 SE004 SE014



Legend

- Leachable Arsenic - Value less than assessment criteria
- Extractable Arsenic - Value less than assessment criteria
- Extractable Arsenic - Value exceeds assessment criteria
- Extractable Arsenic - Value exceeds 10X assessment criteria
- Extractable Arsenic - Value exceeds 30X assessment criteria
- Extractable Arsenic - Value less than assessment criteria
- Extractable Arsenic - Value exceeds assessment criteria
- Extractable Arsenic - Value exceeds 10X assessment criteria
- Extractable Arsenic - Value exceeds 30X assessment criteria
- Interpreted extent of sediment exceeding 10X assessment criteria
- Interpreted extent of sediment exceeding assessment criteria
- Approx. Wetland Boundary

1:1,183 Paper Size A3

0 5 10 20 30 40 50

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

O

NOTE:
Concentrations shown for the shallowest sample only (generally 0.0m to 0.1m)

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga NSW
Detailed Investigation Report

Job Number	22-16251
Revision	A
Date	06 Dec 2012

Sediment Arsenic Concentrations

Figure 12

C:\Projects\22\16251\GIS\Maps\Deliverables\22_16251_14_SedimentArsenic_revA.mxd

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500,800 501,000 501,200 501,400 501,600 501,800 502,000

6,625,600 6,625,400 6,625,200 6,625,000

Kalang River

PACIFIC HIGHWAY

HILLSIDE DRIVE

DLWC97 -SW18	Al	Sb	As	Cu	Pb	Zn
	<0.05	<0.01	0.031	<0.005	<0.01	-

DLWC97 -SW15	Al	Sb	As	Cu	Pb	Zn
	<0.05	<0.01	0.021	0.008	<0.01	-

DLWC97 -SW17	Al	Sb	As	Cu	Pb	Zn
	<0.05	<0.01	0.037	0.005	<0.01	-

DLWC97 -SW14	Al	Sb	As	Cu	Pb	Zn
	0.11	0.02	0.048	0.009	<0.01	-

DLWC97 -SW10	Al	Sb	As	Cu	Pb	Zn
	0.22	0.1	0.236	0.055	0.009	-

SW007	Al	Sb	As	Cu	Pb	Zn
	0.2	0.07	0.056	0.012	0.004	0.041

DLWC97 -SW16	Al	Sb	As	Cu	Pb	Zn
	0.09	<0.01	0.053	<0.005	<0.01	-

DLWC97 -SW9	Al	Sb	As	Cu	Pb	Zn
	0.25	0.2	0.394	0.142	0.009	-

SW005	Al	Sb	As	Cu	Pb	Zn
	0.22	0.151	0.092	0.014	0.004	0.032

DLWC97 -SW13	Al	Sb	As	Cu	Pb	Zn
	0.16	0.03	0.058	0.005	<0.01	-

DLWC97 -SW12	Al	Sb	As	Cu	Pb	Zn
	0.14	0.11	0.128	0.008	<0.01	-

SW009	Al	Sb	As	Cu	Pb	Zn
	0.05	0.018	0.016	0.016	<0.001	0.848

SW006	Al	Sb	As	Cu	Pb	Zn
	0.24	0.083	0.063	0.013	0.006	0.048

SW008	Al	Sb	As	Cu	Pb	Zn
	0.09	0.244	0.069	0.007	0.002	0.114

DLWC97 -SW3	Al	Sb	As	Cu	Pb	Zn
	0.16	0.15	0.705	0.029	<0.01	-

DLWC97 -SW11	Al	Sb	As	Cu	Pb	Zn
	0.21	0.17	0.194	0.014	<0.01	-

DLWC97 -SW8	Al	Sb	As	Cu	Pb	Zn
	0.24	0.2	0.294	0.122	0.008	-

DLWC97 -SW4	Al	Sb	As	Cu	Pb	Zn
	0.25	0.26	0.456	0.08	0.006	-

SW004	Al	Sb	As	Cu	Pb	Zn
	0.22	0.116	0.104	0.013	0.005	0.03

DLWC97 -SW5	Al	Sb	As	Cu	Pb	Zn
	0.25	0.21	0.276	0.055	<0.01	-

DLWC97 -SW6	Al	Sb	As	Cu	Pb	Zn
	0.26	0.22	0.405	0.101	0.007	-

DLWC97 -SW7	Al	Sb	As	Cu	Pb	Zn
	0.19	0.09	0.117	0.009	<0.01	-

SW003	Al	Sb	As	Cu	Pb	Zn
	0.25	0.139	0.171	0.017	0.005	0.026

SW002	Al	Sb	As	Cu	Pb	Zn
	0.19	0.171	0.077	0.011	0.002	0.016

DLWC97 -SW2	Al	Sb	As	Cu	Pb	Zn
	0.85	<0.01	0.014	<0.005	<0.01	-

SW001	Al	Sb	As	Cu	Pb	Zn
	0.36	0.022	0.008	0.021	0.001	0.016

DLWC97 -SW1	Al	Sb	As	Cu	Pb	Zn
	0.38	<0.01	0.005	<0.005	<0.01	-

- Value less than ANZECC 2000 FW Slightly - moderate disturbed system criteria
- Value exceeds ANZECC 2000 FW Slightly - moderate disturbed system criteria
- Value exceeds 10X ANZECC 2000 FW Slightly - moderate disturbed system criteria
- Value exceeds 30X ANZECC 2000 FW Slightly - moderate disturbed system criteria

1:3,500 Paper Size A3

0 25 50 100 150 200

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Legend

- ! Water Sampling Location (2012)
- 0 Water Sampling Location (1997)
- Approx. Wetland Boundary
- 0.25 Total metal concentration (mg/L)

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga NSW
Detailed Investigation Report

Job Number	22-16251
Revision	A
Date	06 Dec 2012

Surface Water Sampling Locations

Figure 13

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Data source: DPI, Aerials, 2012. Created by:ihamilton

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DLWC97-GW4	Al	Sb	As	Cu	Pb	Ni	Hg	Zn
1997- Total	9.7	5.6	19	0.17	3	-	0.046	-
2012- Filtered	1.15	1.17	5.56	0.027	0.017	4.07	<0.0001	0.208

DLWC97-GW7	Al	Sb	As	Cu	Pb	Ni	Hg	Zn
1997- Total	6.5	4.1	89	0.184	1.6	-	0.048	-
2012- Filtered	0.67	1.45	37	0.006	0.02	0.013	0.0005	0.051

DLWC97-GW13	Al	Sb	As	Cu	Pb	Ni	Hg	Zn
1997- Total	3.2	4.4	21	0.465	0.573	-	0.019	-

DLWC97-GW6	Al	Sb	As	Cu	Pb	Ni	Hg	Zn
1997- Total	9.7	5.6	19	0.17	3	-	0.046	-
2012- Filtered	2.19	1.39	72.6	0.011	0.125	0.013	0.0026	0.063

DLWC97-GW12	Al	Sb	As	Cu	Pb	Ni	Hg	Zn
1997- Total	3.2	1	0.423	1.3	0.245	-	<0.001	-
2012- Filtered	0.05	1.21	34.5	0.01	0.002	0.022	0.0002	0.074

Value less than ANZECC 2000 FW Slightly - moderate disturbed system criteria
Value exceeds ANZECC 2000 FW Slightly - moderate disturbed system criteria
Value exceeds 10X ANZECC 2000 FW Slightly - moderate disturbed system criteria
Value exceeds 30X ANZECC 2000 FW Slightly - moderate disturbed system criteria

1:500 Paper Size A3

0 2.5 5 10 15 20 25

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Legend

U Groundwater Sampling Location

Approx. Wetland Boundary

3.2 Metal concentration (mg/L)

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga NSW
Detailed Investigation Report

Job Number	22-16251
Revision	A
Date	06 Dec 2012

Groundwater Sampling Locations

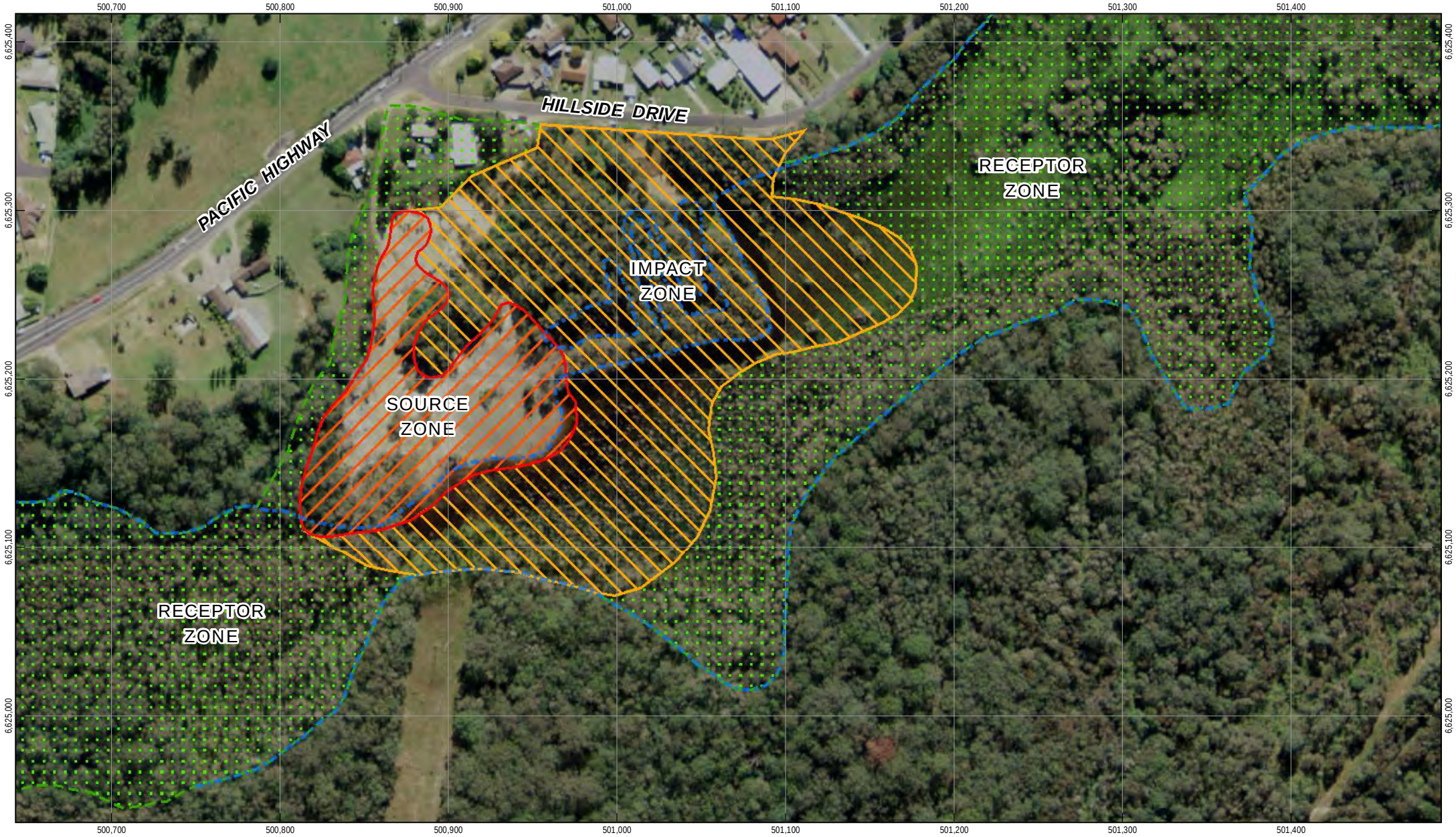
Figure 14

C:\Projects\22\16251\GIS\Maps\Deliverables\22_16251_15_Groundwater_Rev_A.mxd

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Data source: DPI, Aerials, 2012. Created by:ihamilton

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1:3,000 Paper Size A4

0 15 30 60 90 120

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Legend

- Source Zone
- Impact Zone
- Receptor Zone
- Approx. Wetland Boundary

NSW Catchment and Lands- Crown Lands
Former Antimony Processing Plant, Urunga NSW
Detailed Investigation Report

Job Number	22-16251
Revision	A
Date	08 Nov 2012

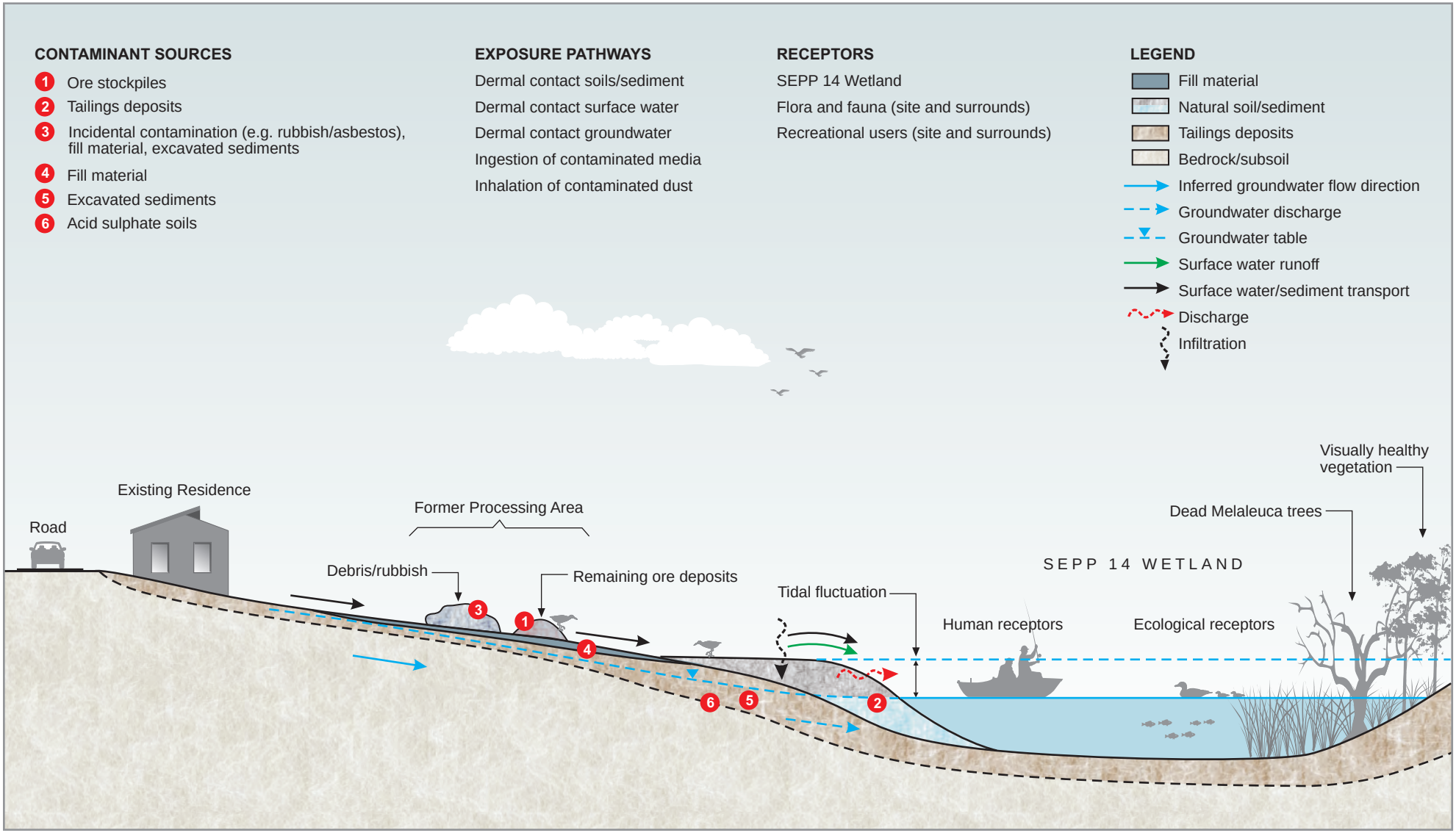
CSM - Source, Impact and Receptor Zones Figure 15

C:\Projects\22\16251\GIS\Maps\Deliverables\22_16251_08_SiteZonesOverview_revA.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

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Data source: DPI: Aerials - 2012. Created by Sdouglas, jvc



NOT TO SCALE

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Detailed Investigation Report

Conceptual Site Model

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Revision	A
Date	5 Oct 2012

Figure 16

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500,800 500,900 501,000 501,100 501,200 501,300

6,625,400 6,625,300 6,625,200 6,625,100

PACIFIC HIGHWAY

HILLSIDE DRIVE

Existing Residences

Former Site Access

Lot 101
Validated Area - Coffey 2004

Former Site Access

Former Site Access

Former Unprocessed Ore Stockpiling

Brick Stockpiles

Disturbed Area of Unknown Origin

Disturbed Area of Unknown Origin

Loading Ramp 1

Former Processing Area

Loading Ramp 2

Stockpile 1

Former Gravel Processing

Stockpile 2

Extent of Tailings

Stockpile 3

'S' Shaped Canal

'S' Shaped Canal

'L' Shaped Canal

Wetland

Dead Melaleuca Trees

Flows to Station Creek and Urunga Lagoon

1:1,500 (at A3)

0 10 20 40 60 80

Metres
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

Flood Levels - BSC Flood Risk Maps (2008)

- 100 Year
- Probable Maximum Flood (PMF)

Groundwater Flow

- Surface Water Run Off
- Sediment Transport
- Inferred Groundwater Flow

- Waters Edge (August 2012)
- Urunga Antimony Contaminated Site

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NSW Catchment and Lands- Crown Lands
Former Antimony Processing Plant, Urunga NSW

Job Number	22-16251
Revision	A
Date	08 Nov 2012

Site Location Conceptual Site Model

Figure 17

G:\2\16251\gis\maps\working\22_16251_01_ConceptualSiteModel_Rev_2.mxd

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Data source:DPI, Aerials 2012. Created by: Sdouglas

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Appendix B - Site Photographs



Photo 1: Former unprocessed ore stockpile area and bricks.



Photo 2: Former processing area, looking N.



Photo 3: Debris, stockpile and former gravel washing area, looking SE.



Photo 4: Residual debris and stockpile.



Photo 5: Debris, tailings and wetland, looking E.

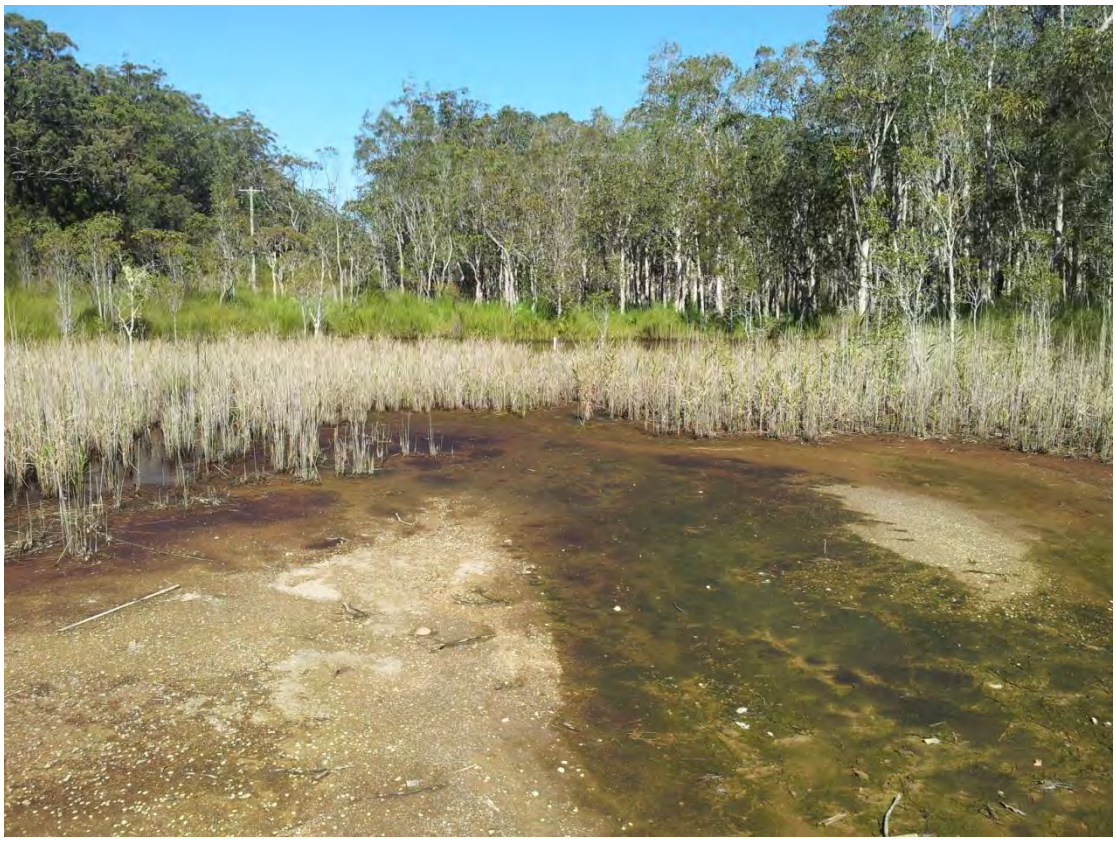


Photo 6: Tailings adjacent to wetland on SW portion of Site, looking SW (borehole location BH024). Monitoring well GW012 is visible in the background.



Photo 7: Tailings, wetland and dead Melaleuca trees looking E. Note old fence-line buried by tailings.



Photo 8: Eastern portion of tailings deposit, looking E.



Photo 9: Western end of the 'S' shaped canals.



Photo 10: Central portion of 'S' shaped canals.



Photo 11: Western portion of the 'L' shaped canal, looking E.



Photo 12: Western portion of 'L' shaped canal and adjoining wetland, looking E.



Photo 13: Area of unknown disturbance in NE portion of Site (sampling location BH073).



Photo 14: Sediment sampling equipment. Canoe is at approximate location of BH043, looking S.



Photo 15: Sediment sampling location SE012.



Photo 16: Sediment sampling methodology (location SE014).



Photo 17: Typical sediment lithology (SE041).



Photo 18: Dingo with auger used for soil sampling in areas of higher compaction.

Appendix C - Tables

Table C1: Soil Chemistry

| | | | | | Unassigned | | Inorganics | | | | | | | | | | | | Metals | | | | | | | | | | | |

| | | | Unassigned | | Inorganics | | | | | | | | | | | Metals | | | | | | | | | | |

	Unassigned		Inorganics												Metals																													
	CEC	Sulphuric Acid	Cyanide Total	Electrical conductivity *(lab)	Exchangeable Calcium	Exchangeable Magnesium	Exchangeable Potassium	Exchangeable Sodium	Moisture	pH (Lab)	Redox	Sulphur as S	TOC	Aluminium	Leachable Aluminium	Antimony	Leachable Antimony	Arsenic	Leachable Arsenic	Cadmium	Leachable Cadmium	Chromium (III+VI)	Leachable Chromium (III+VI)	Cobalt	Copper	Leachable Copper	Iron	Lead	Leachable Lead	Manganese	Mercury	Leachable Mercury	Nickel	Leachable Nickel	Selenium	Silver	Vanadium	Zinc	Leachable Zinc
	meq/100g	mg/kg	mg/kg	uS/cm	meq/100g	meq/100g	meq/100g	meq/100g	%	pH_Units	mV	mg/kg	mg/kg	mg/kg	mg/L	mg/kg	mg/L	mg/kg	mg/L	mg/kg	mg/L	mg/kg	mg/L	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/L	mg/kg	mg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/L
EQL	0.1	0.001	0.1	1000	0.1	0.1	0.1	0.1	0.5	0.1	1	0.005	0.02	1	0.1	1	0.1	0.5	0.1	0.1	0.05	0.3	0.1	0.5	0.5	0.1	50	0.5	0.1	0.5	0.05	0.001	0.5	0.1	0.5	1	2	0.5	0.1
NEPM 1999 EIL												**600**						**20**		**3**		**50**			**100**			**600**		**500**	**1**		**60**					**50**	**200**	
USEPA RES																310																								
NEPM 1999 HIL E			1000															200		40		200		200	2000			600		3000	30		600					14000		
10 times HIL E/ USEPA RES																3100		2000		400		2000		2000	20,000			6000		30,000	300		6000							
30 times HIL E/ USEPA RES																9300		6000		1200		6000		6000	60,000			18,000		90,000	900		18,000							

Field_ID	LocCode	Sample Depth	Sample Date	Source																																								
BH022_0.5-0.7	BH022	0.5-0.7	16/08/2012	Lab	-	-	-	-	-	-	-	-	18.4	-	-	-	-	5240	-	544	-	**132**	-	<1	-	9	-	-	29	-	24,600	23	-	-	-	-	<2	-	-	-	-	13	-
BH022_0.5-0.7	BH022	0.5-0.7	16/08/2012	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.2	-	1.7	-	0.2	-	<0.05	-	<0.1	-	-	<0.1	-	-	<0.1	-	-	<0.001	-	<0.1	-	-	-	-	0.7
BH022_0.5-0.7	BH022	0.5-0.7	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	489.7	-	**71.58**	-	**<14.08**	-	**<106.8**	-	-	**140.3**	-	-	<5.48	-	-	<31.71	-	-	-	-	28	-
BH023_0.0-0.1	BH023	0-0.1	15/08/2012	Lab	0.9	-	16	-	0.2	0.5	<0.1	0.1	16.6	3	-	-	2.03	410	-	12,400	-	**6,900**	-	<1	-	3	-	-	8	-	-	138	-	-	**68.6**	-	<2	-	-	-	-	10	-
BH023_0.0-0.1	BH023	0-0.1	15/08/2012	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	10.5	-	6.4	-	<0.05	-	<0.1	-	-	<0.1	-	-	<0.1	-	-	0.0026	-	<0.1	-	-	-	-	0.1
BH023_0.0-0.2	BH023	0-0.2	13/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4277	-	**1453**	-	**<15.44**	-	<22.85	-	-	<17.18	-	-	35.57	-	-	**28.26**	-	<38.88	-	-	-	-	<10.02	-
BH023_0.0-0.2	BH023	0-0.2	13/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4277	-	**1453**	-	**<15.44**	-	<22.85	-	-	<17.18	-	-	35.57	-	-	**28.26**	-	<38.88	-	-	-	-	<10.02	-
BH023_0.5-0.7	BH023	0.5-0.7	13/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4260	-	**1461**	-	**<15.48**	-	**<121.2**	-	-	<17.71	-	-	38.38	-	-	**22.23**	-	<37.35	-	-	-	-	9.74	-
BH23_0.0-0.2	BH023	0-0.2	3/08/2012	Lab	-	-	-	-	-	-	-	-	16.5	-	-	-	-	-	-	13,200	-	**6860**	-	-	-	-	-	-	-	-	-	-	-	-	**146**	-	-	-	-	-	-	-
BH23_0.5-0.7	BH023	0.5-0.7	3/08/2012	Lab	-	-	-	-	-	-	-	-	18.4	-	-	-	-	-	-	8650	-	**4110**	-	-	-	-	-	-	-	-	-	-	-	-	**42.8**	-	-	-	-	-	-	-
BH024_0.0-0.2	BH024	0-0.2	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10,150	-	**2397**	-	**<21.53**	-	**<140.2**	-	-	**140.5**	-	-	310.6	-	-	**30.52**	-	<48.88	-	-	50.98	-	-
BH024_0.3-0.5	BH024	0.3-0.5	14/08/2012	Lab	-	-	32	-	-	-	-	-	34.2	4	-	-	-	-	-	6640	-	**4050**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH024_0.3-0.5	BH024	0.3-0.5	14/08/2012	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6	-	0.8	-	1.4	-	<0.05	-	<0.1	-	0.2	-	-	<0.1	-	-	<0.001	-	<0.1	-	-	-	-	0.2
BH024_0.3-0.5	BH024	0.3-0.5	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9228	-	**2431**	-	**<19.08**	-	**<128.2**	-	-	**531.6**	-	-	**656.7**	-	-	**42.34**	-	<45.27	-	-	96.67	-	-
BH024_1.0-1.2	BH024	1-1.2	14/08/2012	Lab	-	-	3	-	-	-	-	-	41	6.1	-	-	-	-	-	192	-	**130**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH024_1.0-1.2	BH024	1-1.2	14/08/2012	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.8	-	2.2	-	1.3	-	<0.05	-	<0.1	-	-	<0.1	-	-	<0.1	-	-	<0.001	-	<0.1	-	-	-	-	5.2
BH024_1.0-1.2	BH024	1-1.2	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	677.5	-	**652.5**	-	**<13.95**	-	**<102.8**	-	-	**2318**	-	-	184.9	-	-	**14.61**	-	<31.07	-	-	-	-	35.7	-
BH024_1.5-1.8	BH024	1.5-1.8	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<11.67	-	**277.3**	-	**<10.3**	-	**<68.63**	-	-	<10.16	-	-	<3.45	-	-	**<3.45**	-	<21.28	-	-	-	-	**211.3**	-
BH024_2.0-2.2	BH024	2-2.2	14/08/2012	Lab	-	-	1	-	-	-	-	-	35.3	6.1	-	-	-	-	-	31	-	**33**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH024_2.0-2.2	BH024	2-2.2	14/08/2012	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.1	-	0.4	-	<0.1	-	<0.05	-	<0.1	-	-	<0.1	-	-	<0.1	-	-	<0.001	-	<0.1	-	-	-	-	5.7
BH024_2.0-2.2	BH024	2-2.2	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<15.95	-	**78.47**	-	**<13.55**	-	**<102.8**	-	-	96.38	-	-	11.15	-	-	**<5.03**	-	<31.61	-	-	30.73	-	-
BH028_0.0-0.2	BH028	0-0.2	16/08/2012	Lab	-	-	-	-	-	-	-	-	5.2	-	-	-	-	1150	-	12,600	-	**5000**	-	<1	-	3	-	-	23	-	11,000	11	-	-	-	-	<2	-	-	27	-	-
BH028_0.0-0.2	BH028	0-0.2	16/08/2012	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6	-	4.2	-	1.6	-	<0.05	-	<0.1	-	-	<0.1	-	-	<0.1	-	-	<0.001	-	<0.1	-	-	-	-	0.1
BH028_0.0-0.2	BH028	0-0.2	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**5259**	-	-	-	<24.81	-	-	55.67	-	-	25.02	-	-	**44.15**	-	**209**	-	-	51.08	-	-
BH028_0.3-0.5	BH028	0.3-0.5	16/08/2012	Lab	-	-	-	-	-	-	-	-	10.4	-	-	-	-	5760	-	978	-	**599**	-	<1	-	7	-	-	8	-	21,200	10	-	-	-	-	<2	-	-	8	-	-
BH028_0.3-0.5	BH028	0.3-0.5	16/08/2012	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	-	0.3	-	<0.1	-	<0.05	-	<0.1	-	-	<0.1	-	-	<0.1	-	-	<0.001	-	<0.1	-	-	-	-	0.2
BH028_0.3-0.5	BH028	0.3-0.5	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**1185**	-	-	-	<32.19	-	-	<20.17	-	-	75.71	-	-	**35.54**	-	<41.52	-	-	26.78	-	-
BH028_0.8-1.0	BH028	0.8-1	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**3832**	-	**<16.9**	-	**<131.9**	-	-	<18.23	-	-	<7.82	-	-	**<4.7**	-	<46.48	-	-	<11.02	-	-
BH029_0.0-0.2	BH029	0-0.2	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<16.1	-	**25.96**	-	**<13.54**	-	**<102.6**	-	-	<16.08	-	-	7.58	-	-	**<5.44**	-	<31.6	-	-	14.75	-	-
BH029_0.5-0.7	BH029	0.5-0.7	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<19.58	-	18.36	-	**<16.57**	-	**<109.5**	-	-	25.2	-	-	<6.71	-	-	**<6.71**	-	<39.98	-	-	12.62	-	-
BH030_0.0-0.2	BH030	0-0.2	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	107.8	-	**54.29**	-	**<13.02**	-	**<106.8**	-	-	<14.57	-	-	<4.38	-	-	**<4.98**	-	<30.44	-	-	<7.68	-	-
BH030_0.5-0.7	BH030	0.5-0.7	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<15.7	-	4.44	-	**<13.6**	-	**<112.3**	-	-	<16.03	-	-	<4.81	-	-	**<5.21**	-	<30.85	-	-	<6.36	-	-
BH030_1.5-1.7	BH030	1.5-1.7	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<15.25	-	<3.29	-	**<13.05**	-	**<107.2**	-	-	32.28	-	-	<4.59	-	-	**<4.91**	-	<30.98	-	-	<7.59	-	-
BH030_1.8-2.0	BH030	1.8-2	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<14.62	-	<3.22	-	**<12.85**	-	**<101.9**	-	-	<14.18	-	-	<5.64	-	-	**<4.53**	-	<29.28	-	-	6.04	-	-
BH031_0.0-0.2	BH031	0-0.2	15/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10,830	-	**4413**	-	**<28.12**	-	**<149**	-	-	<22.74	-	-	159.5	-	-	**34.12**	-	<50.7	-	-	30.74	-	-
BH031_0.5-0.7	BH031	0.5-0.7	15/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9164	-	**1386**	-	**<18.91**	-	**<137.4**	-	-	<21.54	-	-	171.1	-	-	**39.41**	-	<46.88	-	-	24.08	-	-
BH031_1.0-1.2	BH031	1-1.2	15/08/2012	Lab	-	-	-	-	-	-	-	-	24.2	-	-	-	-	-	-	9670	-	**5280**	-	<1	-	9	-	-	21	-	-	133	-	-	**58.3**	-	9	-	-	24	-	-
BH031_1.0-1.2	BH031	1-1.2	15/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4932	-	**3832**	-	**<16.9**	-	**<131.9**	-	-	<20.17	-	-	75.71	-	-	**35.54**	-	<41.52	-	-	26.78	-	-
BH031_1.8-2.0	BH031	1.8-2	15/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	125.2	-	**1180**	-	**<11.54**	-	**<79.59**	-	-	<12.38	-	-	25.4	-	-	**<4.7**	-	<24.11	-	-	9.86	-	-
BH032_0.0-0.2	BH032	0-0.2	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6405	-	**1644**	-	**<18.05**	-	**<128.2**	-	-	79	-	-	184	-	-	**25.73**	-	<43.1	-	-	35.69	-	-
BH032_0.3-0.5	BH032	0.3-0.5	14/08/2012	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH032_0.3-0.5	BH032	0.3-0.5	14/08/2012	Lab	-	-	-	-	-	-	-	-	35.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**78.8**	-	-	-	-	-	-	-
BH032_0.3-0.5	BH032	0.3-0.5	14/08/2012	Lab	-	-	-	-	-	-	-	-	35.9	-	-	-	-	3450	-	6070	-	**3620**	-	<1	-	34	-	-	**231**	-	17,600	**996**	-	-	-	-	<2	-	-	39	-	-
BH032_0.3-0.5	BH032	0.3-0.5	14/08/2012	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.5	-	3.1	-	14.4	-	<0.05	-	<0.1	-	0.2	-	-	-	0.1	-	-	0.0011	-	<0.1	-	-	-	-	0.4
BH032_0.3-0.5	BH032	0.3-0.5	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2482	-	**1086**	-	**<14.56**	-	**<115.3**	-	-	**354.8**	-	-	251.4	-	-	**28.4**	-	<35.12	-	-	26.89	-	-
BH032_1.0-1.2	BH032	1-1.2	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	870	-	**597**	-	**<12.48**	-	**<91.65**	-	-	**106.3**	-	-	111.2	-	-	**7.55**	-	<27.87	-	-	29.03	-	-
BH032_1.5-1.8	BH032	1.5-1.8	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<11.72	-	**67.38**	-	**<10.48**	-	**<70.14**	-	-	22.07	-	-	<4.79	-	-	**<3.43**	-	<21.98	-	-	<5.31	-	-
BH034_0.0-0.1	BH034	0-0.1	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<14.64	-	<3.08	-	**<12.78**	-	**<103.1**	-	-	<13.74	-	-	<5.56	-	-	**<4.6**	-	<29.51	-	-	<7.15	-	-
BH034_0.3-0.5	BH034	0.3-0.5	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<16.23	-	5.62	-	**<13.98**	-	**<108.8**	-	-	<15.73	-	-	<6.14	-	-	**<5.24**	-	<33.96	-	-	<8.72	-	-
BH034_0.7-0.9	BH034	0.7-0.9	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<16.99	-	5.25	-	**<27.71**	-	**<119.7**	-	-	<16.11	-	-	<6.56	-	-	**<5.51**	-	<36.08	-	-	13.74	-	-
BH039_0.0-0.2	BH039	0-0.2	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2485	-	**1262**	-	**<15.57**	-	**<118.4**	-	-	88.57	-	-	28.07	-	-	**19.06**	-	<37.79	-	-	24.58	-	-
BH039_0.5-0.7	BH039	0.5-0.7	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20.32	-	**221.2**	-	**<14.79**	-	**<112.9**	-	-	37.86	-	-	<6.98	-	-	**<6.17**	-	<35.02	-	-	15.18	-	-
BH039_1.0-1.2	BH039	1-1.2	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	444.4	-	**155**	-	**<14.58**	-	**<107.9**	-	-	28.05	-	-	10.23	-	-	**<5.73**	-	<35.68	-	-	18.58	-	-
BH039_1.5-1.7	BH039	1.5-1.7	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6494	-	**945.2**	-	**<18.18**	-	**<128.9**	-	-	39.14	-	-	33.29	-	-	**<7.41**	-	<44.44	-	-	30.82	-	-
BH039_2.0-2.2	BH039	2-2.2	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2967	-	**103.8**	-	**<26.46**	-	**<119.3**	-	-	<18.59	-	-	31.99	-	-	**<6.3**	-	<39.85	-	-	44.41	-	-
BH039_2.2-2.4	BH039	2.2-2.4	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<14.18	-	**53.55**	-	**<12.06**	-	**<81.92**	-	-	<12.02	-	-	5.44	-	-	**<4.11**	-	<26.88	-	-	10.51	-	-
BH040_0.0-0.2	BH040	0-0.2	15/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	350.8	-	**140.9**	-	**<13.58**	-	**<107.1**	-	-	**146.7**	-	-	81.11	-	-	**<5.72**	-	<31.53	-	-	59.08	-	-
BH040_0.3-0.5	BH040	0.3-0.5	15/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<16.23	-	4.51	-	**<13.95**	-	**<117.3**	-	-	<15.89	-	-	<6.2	-	-	**<5.4**	-	<33.53	-	-	<6.63	-	-
BH041_0.0-0.2	BH041	0-0.2	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	178.3	-	**49.99**	-	**<13.9**	-	**<119.3**	-	-	46.65	-	-	6.51	-	-	**<5.65**	-	<33.48	-	-	8.43	-	-
BH041_0.5-0.7	BH041	0.5-0.7	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	92.95	-	15.72	-	**<13.39**	-	**<496.8**	-	-	44.09	-	-	<4.7	-	-	**<4.94**	-	<32.55	-	-	<6.12	-	-
BH041_1.0-1.2	BH041	1-1.2	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22.13	-	17.68	-	**<12.93**	-	**<108.4**	-	-	16.57	-	-	<5.62	-	-	**<4.74**	-	<30.37	-	-	6.04	-	-
BH042_0.0-0.2	BH042	0-0.2	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16,490	-	**4982**	-	**<22.77**	-	**<152.7**	-	-	<27.71	-	-	103.3	-	-	**48.97**	-	<57.76	-	-	48.64	-	-
BH042_0.3-0.5	BH042	0.3-0.5	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4213	-	**1337**	-	**<16.24**	-	**<126.4**	-	-	30.48	-	-	262.9	-	-	**22.8**	-	<39.51	-	-	45.79	-	-
BH042_1.0-1.2	BH042	1-1.2	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	131.9	-	**770.8**	-	**<12.81**	-	**<98.43**	-	-	<13.63	-	-	71.35	-	-	**<5.38**	-	<29.52	-	-	18.86	-	-
BH042_1.5-1.7	BH042	1.5-1.7	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<11.3	-	16.15	-	**<10.44**	-	**<71.83**	-	-	<9.84	-	-	<2.99	-	-	**<3.28**	-	<21.39	-	-	<5.15	-	-
BH043_0.0-0.2	BH043	0-0.2	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9818	-	**4841**	-	**<18.93**	-	**<138.9**	-	-	<23.19	-	-	76.04	-	-	**28.76**	-	<48.14	-	-	29.49	-	-
BH043_0.3-0.5	BH043	0.3-0.5	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10,090	-	**2938**	-	**<18.35**	-	**<136.3**	-	-	49.31	-	-	140.7	-	-	**17.85**	-	<46.3	-	-	27.95	-	-
BH043_1.0-1.2	BH043	1-1.2	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	311.2	-	**528.3**	-	**<11.95**	-	**<85.15**	-	-	<12.44	-	-	50.02	-	-	**<4.99**	-	<26.13	-	-	9.03	-	-
BH043_1.5-1.7	BH043	1.5-1.7	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	353.6	-	**576**	-	**<11.17**	-	**<76.09**	-	-	<11.23	-	-	56.78	-	-	**<4.79**	-	<23.94	-	-	16.65	-	-
BH046_0.0-0.2	BH046	0-0.2	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<15.99	-	4.46	-	**<13.84**	-	**<109.4**	-	-	<15.04	-	-	<6.11	-	-	**<5.37**	-	<32.32	-	-	13.29	-	-
BH046_0.5-0.7	BH046	0.5-0.7	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<15.75	-	5.37	-	**<13.69**	-	**<107.1**	-	-	<14.94	-	-	<6.15	-	-	**<5.11**	-	<32	-	-	<6.36	-	-
BH047_0.0-0.2	BH047	0-0.2	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	146.1	-	**95.18**	-	**<13.86**	-	**<108.8**	-	-	50.52	-	-	<5.07	-	-	**<5.64**	-	<33.01	-	-	6.94	-	-
BH047_0.5-0.7	BH047	0.5-0.7	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<15.99	-	6.4	-	**<14.81**	-	**<89.9**	-	-	<15.78	-	-	<6.07	-	-	**<5.06**	-	<33.87	-	-	<6.37	-	-
BH050_0.0-0.2	BH050	0-0.2	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1173	-	**165.3**	-	**<31.98**	-	**<126.1**	-	-	**164.5**	-	-	66.02	-	-	**<6.29**	-	<36.89	-	-	**318.2**	-	-
BH050_0.5-0.7	BH050	0.5-0.7	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<21.25	-	<5.18	-	**<18.02**	-	**656.9**	-	-	**106.1**	-	-	23.29	-	-	**<9.15**	-	<46.85	-	-	**225.9**	-	-
BH050_1.0-1.2	BH050	1-1.2	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<16.04	-	**42.35**	-	**<16.89**	-	**<110.4**	-	-	35.98	-	-	<4.96	-	-	**<5.09**	-	<32.04	-	-	28.39	-	-
BH052_0.0-0.2	BH052	0-0.2	15/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13,650	-	**3917**	-	**<21.01**	-	**<144.9**	-	-	<24.72	-	-	58.31	-	-	**34.87**	-	<52.19	-	-	32.8	-	-
BH052_0.5-0.7	BH052	0.5-0.7	15/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13,470	-	**7019**	-	**<20.33**	-	**<143.9**	-	-	<24.72	-	-	125.1	-	-	**28.32**	-	<51.87	-	-	38.49	-	-
BH052_1.0-1.2	BH052	1-1.2	15/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<681	-	**1141**	-	**<12.51**	-	**<88.79**	-	-	<13.63	-	-	69.12	-	-	**<5.12**	-	<27.77	-	-	18.94	-	-
BH052_1.8-2.0	BH052	1.8-2	15/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2079	-	**2211**	-	**<14.68**	-	**<105.9**	-	-	31.31	-	-	489.4	-	-	**19.55**	-	<33.03	-	-	29.88	-	-
BH052_2.3-2.5	BH052	2.3-2.5	15/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	258.2	-	**698.6**	-	**<13.81**	-	**<111.5**	-	-	<15.84	-	-	52.51	-	-	**<5.97**	-	<32.59	-	-	16.86	-	-
BH052_2.8-3.0	BH052	2.8-3	15/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	65.03	-	**223.5**	-	**<13.56**	-	**<102.9**	-	-	<14.85	-	-	12.17	-	-	**<5.27**	-	<31.12	-	-	<8.02	-	-
BH053_0.0-0.2	BH053	0-0.2	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11,070	-	**11,930**	-	**<22.51**	-	**<142.2**	-	-	41.81	-	-	127.2	-	-	**43.54**	-	<54.23	-	-	39.21	-	-
BH053_0.3-0.5	BH053	0.3-0.5	14/08/2012	Lab	1.5	-	39	-	0.2	0.3	0.5	0.4	22.5	5.2	-	-	0.2	1370	-	5320	-	**3560**	-	<1	-	11	-	-	26	-	-	329	-	-	**35.8**	-	3	-	-	19	-	-

| | Unassigned | | Inorganics | | | | | | | | | | | | Metals | | | | | | | | | | | |

| | | | Unassigned | | Inorganics | | | | | | | | | | | Metals | | | | | | | | | | |

Table C2: Sediment Chemistry

	CEC	Exchangeable Calcium	Exchangeable Magnesium	Exchangeable Potassium	Exchangeable Sodium	Moisture	pH (Lab)	TOC	Total Aluminium	Leachable Aluminium	1M HCl Extractable Aluminium	Total Antimony	Leachable Antimony	1M HCl Extractable Antimony	Total Arsenic	Leachable Arsenic	1M HCl Extractable Arsenic	Total Cadmium	Leachable Cadmium	1M HCl Extractable Cadmium	Total Chromium (III+VI)	Leachable Chromium (III+VI)	1M HCl Extractable Chromium (III+VI)	1M HCl Extractable Cobalt	Total Copper	Leachable Copper	1M HCl Extractable Copper	Total Cyanide	Total Iron	1M HCl Extractable Iron	Total Lead	Leachable Lead	1M HCl Extractable Lead	1M HCl Extractable Manganese	Total Mercury	Leachable Mercury	Total Nickel	Leachable Nickel	1M HCl Extractable Nickel	1M HCl Extractable Selenium	1M HCl Extractable Silver	1M HCl Extractable Vanadium	Total Zinc	Leachable Zinc	1M HCl Extractable Zinc
	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	%	pH units	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	mg/kg	mg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	mg/kg
EQL	0.1	0.1	0.1	0.1	0.1	1	0.1	0.02	50	0.1	50	5	0.1	1	5	0.1	1	1	0.05	0.1	2	0.1	1	0.5	5	0.1	1	1	50	50	5	0.1	1	10	0.1	0.001	2	0.1	1	0.5	1	2	5	0.1	1
ANZECC (2000) Interim Sediment Quality Guidelines - Low												**2**		**2**	**20**		**20**	**1.5**		**1.5**	**80**		**80**		**65**		**65**				**50**		**50**			**0.15**	**21**		**21**	**21**	**1**		**200**		**200**
ANZECC (2000) Interim Sediment Quality Guidelines - High												25		25	70		70	10		10	370		370		270		270				220		220			1	52		52	52	3.7		410		410
10 times ANZECC (2000) Interim Sediment Quality Guidelines - High												250		250	700		700	100		100	3700		3700		2700		2700	500			2200		2200			10	520		520	520	37		4100		4100
30 times ANZECC (2000) Interim Sediment Quality Guidelines - High												750		750	2100		2100	300		300	11,100		11,100		8100		8100	1500			6600		6600			30	1560		1560	1560	111		12,300		12,300
Dutch Inervention																												50																	
Field_ID	**LocCode**	**Sample Depth**	**Sample Date**	**Source**																																										
SE001_0.0-0.1	SE001	0-0.1	14/08/2012	Lab	-	-	-	-	-	25.7	5.1	-	2180	-	-	**3980**	-	-	**1980**	-	-	<1	-	-	22	-	-	-	**574**	-	-	<1	-	-	**405**	-	-	-	**58.9**	-	<2	-	-	-	-	-	142	-	-
SE001_0.1-0.2	SE001	0.1-0.2	14/08/2012	Lab	-	-	-	-	-	39.3	4.8	-	-	-	-	**9260**	-	-	**5410**	-	-	<1	-	-	**112**	-	-	-	**491**	-	-	8	-	-	**1760**	-	-	-	**32.2**	-	<2	-	-	-	-	-	149	-	-
SE001_0.4-0.6	SE001	0.4-0.6	14/08/2012	Lab	-	-	-	-	-	65.9	-	-	9970	5.9	-	**274**	0.1	-	**293**	<0.1	-	<1	<0.05	-	20	<0.1	-	-	**136**	<0.1	-	-	6670	-	40	<0.1	-	-	**26**	<0.001	7	<0.1	-	-	-	-	42	6.8	-
SE002_0.0-0.1	SE002	0-0.1	14/08/2012	Lab	4.8	1.7	1.4	1.1	0.6	73.3	5	5.25	10,300	-	2300	**4440**	-	**1680**	**225**	-	**57.9**	<1	-	0.3	**1450**	-	61.8	0.8	**1900**	-	**1450**	2	-	5780	**1170**	-	**1010**	36	**87.6**	-	4	-	1.2	1.2	<1	15.9	145	-	53.2
SE002_0.0-0.1	SE002	0-0.1	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	**1750**	-	-	**35.82**	-	-	**<12.37**	-	-	**<91.97**	-	-	-	**760.1**	-	-	-	-	-	**412**	-	-	-	**15.64**	-	**<27.61**	-	-	-	-	-	50.5	-	-
SE002_0.3-0.5	SE002	0.3-0.5	14/08/2012	Lab	-	-	-	-	-	72.4	5.9	-	-	-	-	**1200**	-	-	**295**	-	-	**3**	-	-	**253**	-	-	-	**1100**	-	-	2	-	-	**216**	-	-	-	**9.8**	-	13	-	-	-	-	-	140	-	-
SE002_0.3-0.5	SE002	0.3-0.5	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	**<12.75**	-	-	**135.6**	-	-	**<10.88**	-	-	<75.91	-	-	-	20.95	-	-	-	-	-	<3.69	-	-	-	**<3.57**	-	**<22.82**	-	-	-	-	-	93.63	-	-
SE002_0.5-0.7	SE002	0.5-0.7	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	**<11.42**	-	-	**26.87**	-	-	**<10.47**	-	-	<73.94	-	-	-	<10.49	-	-	-	-	-	<4.76	-	-	-	**<3.29**	-	<20.9	-	-	-	-	-	12.15	-	-
SE003_0.0-0.1	SE003	0-0.1	14/08/2012	Lab	-	-	-	-	-	49.3	5.2	-	8510	-	-	**2120**	-	-	**176**	-	-	<1	-	-	**323**	-	-	-	**1040**	-	-	<1	-	-	**538**	-	-	-	**23.4**	-	5	-	-	-	-	-	63	-	-
SE003_0.2-0.4	SE003	0.2-0.4	14/08/2012	Lab	-	-	-	-	-	75.2	5	-	-	-	-	**959**	-	-	**813**	-	-	**6**	-	-	42	-	-	-	**1270**	-	-	2	-	-	44	-	-	-	**1.1**	-	**26**	-	-	-	-	-	**288**	-	-
SE004_0.0-0.1	SE004		16/08/2012	Lab	-	-	-	-	-	80.5	5	-	-	-	7550	**242**	-	**92.4**	**22**	-	11.7	<1	-	0.3	15	-	<1	1.4	**73**	-	50.4	2	-	7050	37	-	28.6	35	**0.2**	-	6	-	3.9	1.4	<1	40.3	74	-	70
SE005_0.0-0.1	SE005	0-0.1	16/08/2012	Lab	-	-	-	-	-	74.2	5.2	-	-	-	10,900	**188**	-	**96**	**83**	-	**28.3**	<1	-	0.4	15	-	3.5	1.4	**310**	-	37.8	<1	-	3840	**54**	-	25.5	22	**0.6**	-	6	-	2.6	1.3	<1	32.7	135	-	93.6
SE010_0.1-0.3	SE010	0.1-0.3	14/08/2012	Lab	-	-	-	-	-	47	4.9	-	10,800	-	-	**4210**	-	-	**1140**	-	-	<1	-	-	**115**	-	-	-	**1340**	-	-	**77**	-	-	**546**	-	-	-	**26.4**	-	16	-	-	-	-	-	58	-	-
SE010_0.6-0.8	SE010	0.6-0.8	14/08/2012	Lab	-	-	-	-	-	42.4	5.8	-	-	-	-	**49**	-	-	**29**	-	-	<1	-	-	10	-	-	-	8	-	-	1	-	-	9	-	-	-	**0.3**	-	3	-	-	-	-	-	<5	-	-
SE011_0.0-0.1	SE011	0-0.1	14/08/2012	Lab	6	2.4	1.9	1	0.6	45.7	5.8	5.94	5250	-	820	**4640**	-	**877**	**1020**	-	**139**	<1	-	<0.1	74	-	5.9	0.5	**247**	-	**160**	8	-	2870	**1230**	-	**703**	15	**56.7**	-	2	-	<1	0.7	<1	3.4	33	-	14.2
SE011_0.3-0.5	SE011		14/08/2012	Lab	-	-	-	-	-	30.6	5.2	-	-	-	-	**<5**	-	-	17	-	-	<1	-	-	10	-	-	-	8	-	-	<1	-	-	<5	-	-	-	<0.1	-	3	-	-	-	-	-	<5	-	-
SE012_0.0-0.1	SE012	0-0.1	14/08/2012	Lab	-	-	-	-	-	77.9	5.4	-	11,000	-	-	**9020**	-	-	**1390**	-	-	<1	-	-	**125**	-	-	-	**750**	-	-	19	-	-	**1790**	-	-	-	**55.6**	-	6	-	-	-	-	-	106	-	-
SE012_0.3-0.5	SE012	0.3-0.5	14/08/2012	Lab	-	-	-	-	-	70	5.2	-	-	-	-	**239**	-	-	**459**	-	-	<1	-	-	25	-	-	-	**229**	-	-	8	-	-	**127**	-	-	-	**1.4**	-	15	-	-	-	-	-	82	-	-
SE013_0.0-0.1	SE013	0-0.1	16/08/2012	Lab	-	-	-	-	-	66.5	4.5	-	6220	-	2660	**8900**	-	**972**	**1660**	-	**105**	<1	-	0.2	29	-	1.2	1.9	**230**	-	**144**	82	-	4520	**1500**	-	**415**	33	**48.6**	-	5	-	4.1	0.8	<1	16.8	73	-	43.6
SE013_0.3-0.5	SE013	0.3-0.5	16/08/2012	Lab	-	-	-	-	-	43.9	-	-	-	-	-	**28**	-	-	**74**	-	-	<1	-	-	13	-	-	-	13	-	-	-	-	-	12	-	-	-	**0.2**	-	4	-	-	-	-	-	10	-	-
SE014_0.0-0.05	SE014	0-0.05	15/08/2012	Lab	11	4.7	4.1	1.2	1	81.3	4.4	20.1	-	-	4950	**6640**	-	**2640**	**861**	-	**65.5**	<1	-	0.4	17	-	<1	3	**402**	-	**311**	66	-	8600	**931**	-	**693**	42	**20.3**	-	8	-	6.5	1.6	<1	25.8	**230**	-	83.1
SE014_0.2-0.4	SE014	0.2-0.4	15/08/2012	Lab	-	-	-	-	-	37.1	-	-	8320	5.1	-	**107**	1	-	**138**	0.6	-	<1	<0.05	-	10	<0.1	-	-	10	<0.1	-	-	3800	-	12	<0.1	-	-	-	<0.001	4	<0.1	-	-	-	-	12	9.1	-
SE020_0.0-0.1	SE020	0-0.1	14/08/2012	Lab	-	-	-	-	-	47.8	4.8	-	3680	-	-	**7450**	-	-	**985**	-	-	<1	-	-	**88**	-	-	-	**122**	-	-	235	-	-	**1270**	-	-	-	**60**	-	4	-	-	-	-	-	52	-	-
SE020_0.2-0.4	SE020	0.2-0.4	14/08/2012	Lab	-	-	-	-	-	54.6	5.4	-	-	-	-	**48**	-	-	**542**	-	-	<1	-	-	15	-	-	-	12	-	-	5	-	-	24	-	-	-	**0.5**	-	5	-	-	-	-	-	12	-	-
SE021_0.0-0.1	SE021	0-0.1	14/08/2012	Lab	20.2	7.9	8.1	0.6	3.5	43.4	4.4	14.8	-	-	770	**9570**	-	**1480**	**1260**	-	**111**	<1	-	0.2	24	-	3.1	0.8	**222**	-	**148**	61	-	3440	**1730**	-	**1010**	10	**73.3**	-	3	-	<1	0.7	<1	2.5	57	-	27.7
SE022_0.0-0.05	SE022	0-0.05	15/08/2012	Lab	-	-	-	-	-	75.9	4.9	-	18,400	-	7520	**2690**	-	**532**	**747**	-	**43.4**	<1	-	0.2	20	-	1	3.4	**88**	-	42.5	46	-	8010	**261**	-	**191**	52	**6.9**	-	12	-	6.2	1.9	<1	47.4	91	-	43.5
SE022_0.2-0.4	SE022	0.2-0.4	15/08/2012	Lab	-	-	-	-	-	50.7	-	-	-	-	-	**58**	-	-	**115**	-	-	<1	-	-	17	-	-	-	9	-	-	-	-	-	14	-	-	-	0.1	-	8	-	-	-	-	-	12	-	-
SE030_0.0-0.1	SE030	0-0.1	14/08/2012	Lab	6.5	2.9	1.7	0.7	1.2	39.1	5.6	2.5	3300	-	1160	**4720**	-	**1360**	**2530**	-	**1180**	<1	-	0.2	9	-	3.3	0.5	**120**	-	**122**	20	-	9340	**160**	-	**106**	21	**18.4**	-	<2	-	<1	0.5	<1	6.4	45	-	32.3
SE030_0.3-0.5	SE030	0.3-0.5	14/08/2012	Lab	-	-	-	-	-	24.2	7.2	-	-	-	-	**342**	-	-	**292**	-	-	<1	-	-	7	-	-	-	7	-	-	<1	-	-	19	-	-	-	**1.5**	-	2	-	-	-	-	-	10	-	-
SE031_0.0-0.1	SE031	0-0.1	14/08/2012	Lab	-	-	-	-	-	33.9	4.6	-	-	-	290	**5920**	-	**796**	**1210**	-	**286**	<1	-	<0.1	14	-	2.7	<0.5	44	-	33.8	46	-	2210	**761**	-	**399**	<10	**38.3**	-	<2	-	<1	<0.5	<1	<2	30	-	10.8
SE032_0.0-0.1	SE032	0-0.1	14/08/2012	Lab	-	-	-	-	-	41.6	-	-	-	1.2	-	-	8.8	-	-	3.8	-	-	<0.05	-	-	<0.1	-	-	-	<0.1	-	-	-	-	-	-	1.6	-	-	**151**	0.0082	-	<0.1	-	-	-	-	-	0.9	-
SE033_0.0-0.05	SE033	0-0.05	16/08/2012	Lab	8	2.9	2.4	1.5	1.2	-	-	10.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE040_0.3-0.5	SE040	0.3-0.5	14/08/2012	Lab	6.6	2	3.1	0.6	0.9	26.8	5.3	0.21	-	-	340	**34**	-	**33.3**	**57**	-	**23.9**	<1	-	<0.1	10	-	<1	<0.5	6	-	6.1	1	-	10,400	8	-	4.5	24	**0.2**	-	<2	-	<1	<0.5	<1	6.8	<5	-	6.7
SE041_0.0-0.05	SE041	0-0.05	14/08/2012	Lab	-	-	-	-	-	69.5	-	-	-	1.5	-	-	5.6	-	-	0.2	-	-	<0.05	-	-	<0.1	-	-	0.4	-	-	-	-	0.8	-	-	**62.6**	<0.001	-	<0.1	-	-	-	-	-	7.9	-
SE041_0.1-0.3	SE041	0.1-0.3	14/08/2012	Lab	-	-	-	-	-	50.1	-	-	4	-	-	-	1.3	-	-	<0.1	-	-	<0.05	-	-	<0.1	-	-	<0.1	-	-	-	-	<0.1	-	-	**0.3**	<0.001	-	<0.1	-	-	-	-	-	7.2	-
SE042_0.0-0.1	SE042	0-0.1	14/08/2012	Lab	-	-	-	-	-	78.3	-	-	-	-	-	**11,900**	-	-	**1430**	-	-	**2**	-	-	54	-	-	-	**980**	-	-	-	-	-	**3280**	-	-	-	**122**	-	9	-	-	-	-	-	**347**	-	-
SE042_0.2-0.4	SE042	0.2-0.4	14/08/2012	Lab	-	-	-	-	-	35.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.2**	-	-	-	-	-	-	-	-	-	-
SE042_0.2-0.4	SE042	0.2-0.4	14/08/2012	Lab	-	-	-	-	-	35.4	-	-	10,300	6.3	-	**43**	0.1	-	**115**	<0.1	-	<1	<0.05	-	12	<0.1	-	-	22	<0.1	-	-	4340	-	19	<0.1	-	-	-	<0.001	5	<0.1	-	-	-	-	44	5.1	-
SE043_0.1-0.3	SE043	0.1-0.3	15/08/2012	Lab	-	-	-	-	-	34.5	5.5	-	-	-	580	**10**	-	**7.4**	9	-	2.5	<1	-	<0.1	8	-	<1	<0.5	6	-	1.4	<1	-	600	7	-	2.6	<10	<0.1	-	2	-	<1	<0.5	<1	6.6	6	-	1.8
SE050_0.0-0.1	SE050	0-0.1	15/08/2012	Lab	-	-	-	-	-	14.5	4.3	-	990	-	-	**626**	-	-	**1370**	-	-	<1	-	-	4	-	-	-	47	-	-	<1	-	-	**69**	-	-	-	**1.9**	-	<2	-	-	-	-	-	20	-	-
SE050_0.2-0.4	SE050	0.2-0.4	15/08/2012	Lab	-	-	-	-	-	29.8	4.5	-	-	-	-	**4900**	-	-	**2030**	-	-	1	-	-	7	-	-	-	**274**	-	-	16	-	-	**446**	-	-	-	**39.8**	-	<2	-	-	-	-	-	32	-	-
SE050_0.4-0.6	SE050	0.4-0.6	15/08/2012	Lab	-	-	-	-	-	63.8	-	-	14,400	2.9	-	**37**	0.2	-	**1680**	0.1	-	<1	<0.05	-	15	<0.1	-	-	20	<0.1	-	-	11,600	-	15	<0.1	-	-	**0.3**	<0.001	6	<0.1	-	-	-	-	27	7	-
SE051_0.0-0.1	SE051	0-0.1	14/08/2012	Lab	-	-	-	-	-	34.7	4.4	-	-	-	450	**4820**	-	**471**	**2490**	-	**458**	<1	-	0.2	11	-	1.9	<0.5	**67**	-	41.7	4	-	1840	**696**	-	**365**	<10	**11.8**	-	<2	-	<1	<0.5	<1	<2	24	-	7.1
SE051_0.3-0.5	SE051	0.3-0.5	14/08/2012	Lab	-	-	-	-	-	30.9	5.4	-	-	-	-	**76**	-	-	**556**	-	-	<1	-	-	13	-	-	-	47	-	-	2	-	-	**64**	-	-	-	**5.1**	-	6	-	-	-	-	-	61	-	-
SE052_0.0-0.1	SE052	0-0.1	14/08/2012	Lab	-	-	-	-	-	17.7	4.9	-	-	-	190	**21**	-	**12.2**	**64**	-	16.3	<1	-	<0.1	4	-	<1	<0.5	16	-	4.8	<1	-	350	<5	-	2	<10	0.1	-	<2	-	<1	<0.5	<1	3.9	27	-	14.6
SE053_0.0-0.1	SE053	0-0.1	15/08/2012	Lab	-	-	-	-	-	23	-	-	-	-	4620	**15**	-	**3.8**	**91**	-	11	<1	-	0.1	6	-	2.2	<0.5	12	-	2.2	-	-	940	5	-	1.6	<10	<0.1	-	2	-	<1	0.8	<1	6.7	97	-	90.6
SE054_0.0-0.1	SE054	0-0.1	15/08/2012	Lab	-	-	-	-	-	58.1	-	-	-	-	2760	**311**	-	**135**	**179**	-	**27.2**	**3**	-	**2.1**	27	-	<1	0.8	**268**	-	**95.8**	-	-	2930	**136**	-	**78**	11	**1.5**	-	7	-	1.4	1.4	<1	23	**925**	-	**669**
SE055_0.0-0.1	SE055	0-0.1	15/08/2012	Lab	-	-	-	-	-	28.4	-	-	-	-	-	**6**	-	-	11	-	-	<1	-	-	3	-	-	-	35	-	-	-	-	-	14	-	-	-	<0.1	-	<2	-	-	-	-	-	**238**	-	-
SE056_0.05-0.15	SE056	0.05-0.15	15/08/2012	Lab	-	-	-	-	-	27.8	5.5	-	-	-	870	**8**	-	**6.1**	**31**	-	14.8	**8**	-	**6**	4	-	<1	<0.5	**415**	-	**334**	<1	-	2040	22	-	10.2	<10	<0.1	-	<2	-	<1	0.7	<1	2.6	**2150**	-	**1730**
SE057_0.2-0.4	SE057	0.2-0.4	16/08/2012	Lab	-	-	-	-	-	45.3	5.6	-	-	-	1570	**108**	-	**66.1**	**208**	-	**80.8**	**3**	-	1.4	30	-	1.5	0.9	**232**	-	**197**	4	-	4550	**88**	-	**86.1**	13	**0.7**	-	7	-	1.1	1	<1	14.9	**459**	-	**267**
SE060_0.0-0.1	SE060	0-0.1	15/08/2012	Lab	19.4	8.8	7.3	0.6	2.7	-	-	19.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE061_0.0-0.1	SE061	0-0.1	15/08/2012	Lab	13.3	5.8	5.7	0.4	1.4	43.8	6.4	1.69	-	-	820	**<5**	-	**3.9**	12	-	7.3	<1	-	<0.1	15	-	<1	<0.5	9	-	<1	<1	-	1470	7	-	<1	<10	0.1	-	6	-	<1	0.8	<1	14	21	-	5.1
SE062_0.0-0.1	SE062	0-0.1	15/08/2012	Lab	-	-	-	-	-	72.8	4.7	-	11,200	-	3950	**3120**	-	**1020**	**352**	-	**27.3**	**2**	-	**6.3**	28	-	<1	2.8	**767**	-	**131**	34	-	7750	**620**	-	**155**	36	**8.1**	-	10	-	5.3	1.1	<1	23.3	**577**	-	**512**
SE062_0.2-0.3	SE062	0.2-0.3	15/08/2012	Lab	-	-	-	-	-	30.3	5.7	-	4790	-	1190	**<5**	-	**2.9**	6	-	2.3	<1	-	<0.1	8	-	<1	0.5	6	-	3.2	<1	-	1250	5	-	4.4	<10	<0.1	-	3	-	<1	0.6	<1	10.7	<5	-	5
SE064_0.0-0.1	SE064	0-0.1	15/08/2012	Lab	17.2	6.3	6.8	0.4	3.6	84.8	5.3	17.3	-	-	6560	**4210**	-	**266**	**2230**	-	**74.6**	**2**	-	**1.6**	42	-	<1	4.4	**653**	-	**169**	<2	-	12,800	**449**	-	**87.4**	56	**4.4**	-	10	-	8.2	1.9	<1	42.5	**449**	-	**526**
SE064_0.2-0.3	SE064	0.2-0.3	15/08/2012	Lab	-	-	-	-	-	41.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-
SE064_0.2-0.3	SE064	0.2-0.3	15/08/2012	Lab	-	-	-	-	-	41.6	-	-	7010	12.2	-	**<5**	<0.1	-	8	<0.1	-	<1	<0.05	-	12	<0.1	-	-	13	<0.1	-	-	2870	-	9	<0.1	-	-	-	<0.001	4	<0.1	-	-	-	-	12	7.7	-
SE066_0.0-0.1	SE066	0-0.1	15/08/2012	Lab	-	-	-	-	-	79	5	-	-	-	3340	**130**	-	**90.9**	**286**	-	**4.8**	12	-	<1	3.2	**87**	-	**70.5**	4	-	6900	21	-	6.4	1	<1	17.2	**1130**	-	**953**
SE067_0.0-0.1	SE067	0-0.1	15/08/2012	Lab	-	-	-	-	-	84.2	-	-	-	1.2	-	-	0.6	-	-	0.1	-	-	<0.05	-	-	<0.1	-	-	<0.1	-	-	-	-	<0.1	-	-	-	**0.9**	<0.001	-	<0.1	-	-	-	-	-	1.4	-
SE068_0.0-0.1	SE068	0-0.1	15/08/2012	Lab	-	-	-	-	-	73.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.2**	-	-	-	-	-	-	-	-	-	-
SE068_0.0-0.1	SE068	0-0.1	15/08/2012	Lab	-	-	-	-	-	73.4	-	-	7700	1	-	**180**	1.1	-	**148**	0.3	-	**4**	<0.05	-	10	<0.1	-	-	**138**	<0.1	-	-	6610	-	31	<0.1	-	-	-	<0.001	7	<0.1	-	-	-	-	**624**	10.6	-
SE102_0.0-0.2	SE102	0-0.2	16/08/2012	Lab	-	-	-	-	-	75.2	-	-	-	-	-	**744**	-	-	18	-	-	<1	-	-	17	-	-	-	**708**	-	-	-	-	-	**74**	-	-	-	**0.3**	-	11	-	-	-	-	-	39	-	-
SE102_0.0-0.2	SE102	0-0.2	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	**117.1**	-	-	<3.64	-	-	**<11.06**	-	-	<78.58	-	-	-	**230.8**	-	-	-	-	-	**57.83**	-	-	-	**<3.72**	-	**<23.39**	-	-	-	-	-	<6.73	-	-
					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: Highlighted cells with a '<' symbol may not necessarily constitute an assessment criteria exceedance

Table C3: Soil and Sediment XRF/Laboratory Result Comparison Table

	Antimony (LAB)	Antimony (XRF)	RPD/Comment	Arsenic (LAB)	Arsenic (XRF)	RPD/Comment	Cadmium (LAB)	Cadmium (XRF)	RPD/Comment	Chromium (III+VI) (LAB)	Chromium (III+VI) (XRF)	RPD/Comment	Copper (LAB)	Copper (XRF)	RPD/Comment	Lead (LAB)	Lead (XRF)	RPD/Comment	Mercury (LAB)	Mercury (XRF)	RPD/Comment	Nickel (LAB)	Nickel (XRF)	RPD/Comment	Zinc (LAB)	Zinc (XRF)	RPD/Comment
	mg/kg	mg/kg	(%)	mg/kg	mg/kg	(%)	mg/kg	mg/kg	(%)	mg/kg	mg/kg	(%)	mg/kg	mg/kg	(%)	mg/kg	mg/kg	(%)	mg/kg	mg/kg	(%)	mg/kg	mg/kg	(%)	mg/kg	mg/kg	(%)
EQL	1	1		0.5	0.5		0.1	0.1		0.5	0.5		0.5	0.5		0.5	0.5		0.05	0.05		0.5	0.5		0.5	0.5	
Field_ID																											
BH001_0.3-0.5	3660	11,720	-105	1520	2913	-63	<1	<19.75	Both Non detect	7	<144.1	Lab low, XRF non detect	630	598.3	5	18	24.32	-30	38.3	51.42	-29	2	<53.16	Lab low, XRF non detect	30	44.63	-39
BH002_0.5-0.7	<5	<17.61	Both non detect	<5	33.72	Both Low	<1	<39.22	Both Non detect	11	<111	Lab low, XRF non detect	7	14.82	-72	6	<6.87	Both Low	<0.1	<5.8	Both Non detect	<2	<78.24	Both non detect	13	28.05	-73
BH004_0.0-0.2	4700	11,570	-84	1950	3931	-67	<1	<20.36	Both Non detect	18	<145.5	Lab low, XRF non detect	136	113.3	18	150	151.9	-1	61.2	48.49	23	<2	<50.18	Both non detect	47	59.34	-23
BH004_1.0-1.2	2050	5323	-89	1160	84.85	173	<1	<17.48	Both Non detect	16	<130.1	Lab low, XRF non detect	166	<19.81	Inconsistent	116	34.53	108	28.9	<7.2	Both Low	5	<41.87	Both low	95	52.87	57
BH006_0.0-0.3	1950	847.6	79	702	164.8	124	-	<35.73	Both Non detect	-	<105.5	-	-	458	-	-	<7.21	-	2.3	<6.12	Both Low	-	<37.94	-	-	58.68	-
BH020_0.0-0.2	59	<16.99	Both low	**58**	**42.56**	31	**11**	**<13.97**	b Low, XRF non det	**12**	**<275.6**	Lab low, XRF non detect	**724**	**174.7**	122	25	<5.48	Lab low, XRF non detect	0.6	**<5.52**	Lab low, XRF non detect	4	<34.14	Lab low, XRF non detect	**695**	43.91	176
BH022_0.5-0.7	544	489.7	11	**132**	**71.58**	59	<1	**<14.08**	Both Non detect	**9**	**<106.8**	Lab low, XRF non detect	29	**140.3**	-131	23	<5.48	Lab low, XRF non detect	0.3	**<5.53**	Lab low, XRF non detect	<2	<31.71	Both non detect	13	28	-73
BH023_0.0-0.2	13,200	4277	102	6860	1453	130	-	**<15.44**	-	-	**<22.85**	-	-	<17.18	-	-	35.57	-	146	28.26	135	-	<38.88	-	-	<10.02	-
BH023_0.5-0.7	8650	4260	68	4110	1461	95	-	**<15.48**	-	-	**<121.2**	-	-	<17.71	-	-	38.38	-	42.8	22.23	63	-	<37.35	-	-	9.74	-
BH024_0.3-0.5	6640	9228	-33	4050	2431	50	-	<19.08	Both Non detect	-	<128.2	-	-	531.6	-	-	656.7	-	-	42.34	-	-	<45.27	-	-	96.67	-
BH024_1.0-1.2	192	677.5	-112	130	652.5	-134	-	<13.95	Both Non detect	-	<102.8	-	-	2318	-	-	184.9	-	-	14.61	-	-	<31.07	-	-	35.7	-
BH024_2.0-2.2	31	<15.95	Both Low	33	78.47	-82	-	<13.55	Both Non detect	-	<102.8	-	-	96.38	-	-	11.15	-	-	<5.03	-	-	<31.61	-	-	30.73	-
BH028_0.0-0.2	12,600	-	-	5000	5259	-5	<1	-	-	**3**	**<24.81**	Lab low, XRF non detect	23	55.67	-83	11	25.02	-78	47.3	44.15	7	<2	209	Inconsistent	27	51.08	-62
BH028_0.3-0.5	978	-	-	599	1185	-66	<1	-	-	**7**	**<32.19**	Lab low, XRF non detect	8	27.82	-111	10	<10.23	Lab low, XRF non detect	30.6	**<12.08**	Lab low, XRF non detect	<2	83.61	Inconsistent	8	<13.71	Lab low, XRF non detect
BH031_1.0-1.2	9670	4932	65	5280	3832	32	<1	<16.9	Both Non detect	9	<131.9	Lab low, XRF non detect	21	<20.17	Both Low	133	75.71	55	58.3	35.54	49	9	<41.52	Lab low, XRF non detect	24	26.78	-11
BH032_0.3-0.5	6070	2482	84	3620	1086	108	<1	**<14.56**	Both Non detect	**34**	**<115.3**	Lab low, XRF non detect	**231**	**354.8**	-42	**996**	251.4	119	78.8	28.4	94	<2	<35.12	Both non detect	39	26.89	37
BH053_0.3-0.5	5320	14,470	-92	3560	3007	17	<1	**<22.98**	Both Non detect	**11**	**<143.8**	Lab low, XRF non detect	26	<24.94	Lab low, XRF non detect	329	216.4	41	35.8	32.35	10	3	<53.36	Lab low, XRF non detect	19	32.09	-51
BH053_1.5-1.7	150	670.5	-127	1330	596.7	76	<1	<11.74	Both Non detect	18	<81.96	Lab low, XRF non detect	22	<11.67	Both Low	25	36.05	-36	1.2	<5.28	Both Low	9	<25.01	Lab low, XRF non detect	14	<7.34	Both Low
BH053_3.2-3.5	23	<16.29	Both Low	80	69.44	14	<1	<13.75	Both Non detect	11	<112.1	Lab low, XRF non detect	<5	21.66	Both Low	14	<5.11	Both Low	0.4	<5.56	Both Low	<2	<33.03	Both non detect	<5	14.26	Both Low
BH056_0.3-0.5	<5	<16.2	Both non detect	<5	5.5	Both Low	-	<14.92	Both Non detect	-	<116.9	-	-	<14.96	-	-	<6.22	-	<0.1	<5.24	Both Low	-	<33.44	-	-	8.35	-
BH060_0.0-0.2	160	26.59	143	66	50.17	27	-	<12.83	Both Non detect	-	<98.01	-	-	37.3	-	-	<4.67	-	1.1	<5.01	Both Low	-	<29.94	-	-	29.61	-
BH064_0.0-0.2	<5	<16.42	Both non detect	<5	4.62	Both Low	-	<21.08	Both Non detect	-	<114.9	-	-	18.4	-	-	<5.3	-	<0.1	<5.39	Both Non detect	-	<33.86	-	-	26.72	-
BH064_0.3-0.5	<5	<17.29	Both non detect	7	11.22	-46	-	<14.76	Both Non detect	-	<109.7	-	-	26.54	-	-	<5.65	-	<0.1	<5.76	Both Non detect	-	<35.48	-	-	36.88	-
BH071_0.5-0.7	<5	<16.35	Both non detect	<5	13.55	Both Low	<1	<20.17	Both Non detect	4	<105.2	Lab low, XRF non detect	<5	<15.22	Both non detect	8	<5.33	Both Low	<0.1	<5.3	Both Non detect	<2	<33.97	Both non detect	8	12.04	-40
BH073_0.0-0.2	295	447.9	-41	496	<69.91	Inconsistent	-	<19.62	Both Non detect	-	<594.3	-	-	947.6	-	-	15580.00	-	47.5	14.96	104	-	<36.26	-	-	7674	-
BH073_0.5-0.7	405	30.15	172	416	282.2	38	-	<19.7	Both Non detect	-	<117.9	-	-	480.6	-	-	2746	-	57.8	8.8	147	-	<34.68	-	-	1004	-
BH073_1.0-1.2	72	<15.96	Both low	13	**76.23**	-142	<1	**<13.76**	Both Non detect	**11**	**<112.8**	Lab low, XRF non detect	**120**	**171.8**	-36	518	**623.5**	-18	0.8	**<5.57**	Lab low, XRF non detect	<2	<32.28	Both non detect	**305**	**406.5**	-29
BH074_0.8-1.0	<5	<15.49	Both non detect	<5	<2.69	Both non detect	-	<14.36	Both Non detect	-	<112.9	-	-	<14.63	-	-	<5.87	-	<0.1	<4.98	Both Non detect	-	<31.94	-	-	6.64	-
BH075_1.8-2.0	36	<12.93	Both Low	129	32.4	120	3	<11.61	Both Non detect	10	<82.77	Lab low, XRF non detect	30	<12.25	Both Low	17	<3.77	Both Low	0.2	<4.02	Both Low	3	<25.15	Lab low, XRF non detect	76	17.27	126
BH077_0.0-0.2	388	22.4	178	432	**107.3**	120	<1	**<13.05**	Both Non detect	**10**	**<103.2**	Lab low, XRF non detect	19	<14.92	Lab low, XRF non detect	80	<5.01	Both Low	**2**	**<5.13**	Lab low, XRF non detect	2	<29.99	Lab low, XRF non detect	10	12.26	-20
BH077_0.3-0.5	93	<13.7	Both Low	157	212	-30	<1	<11.72	Both Non detect	15	<84.81	Lab low, XRF non detect	28	22.28	23	24	38.87	-47	0.8	<4.14	Both Low	5	<24.94	Lab low, XRF non detect	9	7.28	21
BH077_1.0-1.2	36	93.58	-89	156	477.1	-101	<1	<13.83	Both Non detect	14	<111.3	Lab low, XRF non detect	10	17.09	-52	17	31.15	-59	0.6	<6.22	Both Low	3	<33.46	Lab low, XRF non detect	11	23.39	-72
BH077_1.5-1.7	882	107	157	2130	543.3	119	<1	<11.81	Both Non detect	17	<84.79	Lab low, XRF non detect	51	<12.56	Both Low	170	41.75	121	5.4	<4.87	Both Low	8	<25.19	Lab low, XRF non detect	33	7.55	126
BH077_2.0-2.2	144	<12.24	Inconsistent	**165**	**39.13**	123	<1	**<10.89**	Both Non detect	**20**	**<76.76**	Lab low, XRF non detect	22	<11.27	Lab low, XRF non detect	21	<3.85	Lab low, XRF non detect	0.8	**<3.67**	Lab low, XRF non detect	18	<22.64	Lab low, XRF non detect	15	<5.95	Lab low, XRF non detect
BH082_1.5-1.7	92	71.09	26	1510	139.2	166	-	**<11.41**	-	-	**<79.09**	-	-	<12.35	-	-	27.7	-	1.3	<4.11	Lab low, XRF non detect	-	<24.46	-	-	8.9	-
BH084_1.0-1.2	2730	550.2	133	518	105.7	132	-	<13.43	Both Non detect	-	<104.8	-	-	26.5	-	-	62.46	-	5.1	<5.45	Both Low	-	<32.04	-	-	19.28	-
BH084_1.5-1.7	3220	645.5	133	387	116.6	107	-	<11.62	Both Non detect	-	<80.22	-	-	<11.75	-	-	15.22	-	<0.1	<4.1	Both Non detect	-	<24.79	-	-	24.71	-
BH091_0.0-0.1	<5	<13.59	Both non detect	5	10.04	-67	-	<12.15	Both Non detect	-	<95.89	-	-	<13.59	-	-	<4.58	-	0.1	<4.3	Both low	-	<27.2	-	-	15.66	-
BH101_0.0-0.2	5400	664.8	156	2540	**128.7**	181	<1	**<13**	Both Non detect	**34**	**<96.62**	Lab low, XRF non detect	**272**	**151.8**	57	474	17.65	186	343	**<5.1**	Inconsistent	<2	<29.46	Both non detect	47	22.9	69
SE002_0.0-0.1	3060	1750	54	141	35.82	119	<1 - 0.3	<12.37	Both Non detect	61.8 - 1450	<91.97	Inconsistent	735	760.1	-3	1090	412	90	87.6	15.64	139	1.2 - 4	<27.61	Lab low, XRF non detect	99	50.5	65
SE002_0.3-0.5	1200	<12.75	Inconsistent	295	135.6	74	3	<10.88	Both Non detect	253	<75.91	Lab low, XRF non detect	1100	20.95	193	216	<3.69	Inconsistent	9.8	<3.57	Both Low	13	<22.82	Lab low, XRF non detect	140	93.63	40
SE102_0.0-0.2	744	117.1	146	18	<3.64	Both Low	<1	<11.06	Both Non detect	17	<78.58	Lab low, XRF non detect	708	230.8	102	74	57.83	25	0.3	<3.72	Both Low	11	<23.39	Lab low, XRF non detect	39	<6.73	Both Low

RPD >150%
Concentration exceeds adopted threshold
Concentration exceeds 10 x adopted threshold
Concentration exceeds 30 x adopted threshold

Note: Highlighted cells with a '<' symbol may not necessarily constitute an assessment criteria exceedance

Table C4: Particle Size Analysis- Soil and Sediment

					Particle Sizing												Soil Classification						
					+75um	+150um	+300um	+425um	+600um	+1180um	+2.36mm	+4.75mm	+9.5mm	+19.0mm	+37.5mm	+75.0mm	Clay (<2 um)	Silt (2-60 um)	Cobbles (>6cm)	Gravel (>2mm)	Sand (0.06-2.00 mm)	Lab Classification	Field Classification
					%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%		
EQL					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Field_ID	**LocCode**	**Matrix**	**Sample Depth**	**Sample Date**																			
BH014_0.0-0.1	BH014	Soil	0-0.1	15/08/2012	72	69	32	12	7	5	4	2	<1	<1	<1	<1	14	13	<1	4	69	clayey SAND	silty SAND
BH023_0.0-0.1	BH023	Soil	0-0.1	15/08/2012	77	73	26	6	1	<1	<1	<1	<1	<1	<1	<1	14	7	<1	<1	79	clayey SAND	SAND
BH031_0.0-0.2	BH031	Soil	0-0.2	15/08/2012	76	53	25	14	8	2	<1	<1	<1	<1	<1	<1	9	14	<1	<1	77	silty SAND	silty SAND
BH031_0.5-0.7	BH031	Soil	0.5-0.7	15/08/2012	72	47	20	10	5	<1	<1	<1	<1	<1	<1	<1	9	17	<1	<1	74	silty SAND	silty SAND
BH031_1.8-2.0	BH031	Soil	1.8-2	15/08/2012	20	12	6	4	2	1	<1	<1	<1	<1	<1	<1	36	44	<1	1	19	clayey SILT	clayey SILT
SE002_0.5-0.7	SE002	Sediment	0.5-0.7	14/08/2012	22	10	3	1	1	<1	<1	<1	<1	<1	<1	<1	36	41	<1	<1	23	clayey SILT	sandy CLAY
SE003_0.2-0.4	SE003	Sediment	0.2-0.4	16/08/2012	18	6	2	1	<1	<1	<1	<1	<1	<1	<1	<1	28	47	<1	<1	25	clayey SILT	SILT
SE004_0.2-0.3	SE004	Sediment	0.2-0.3	16/08/2012	20	11	3	2	1	<1	<1	<1	<1	<1	<1	<1	36	44	<1	<1	20	clayey SILT	silty CLAY
SE004_0.4-0.6	SE004	Sediment	0.4-0.6	16/08/2012	14	7	2	1	<1	<1	<1	<1	<1	<1	<1	<1	39	47	<1	<1	14	clayey SILT	SILT
SE011_0.7-0.9	SE011	Sediment	0.7-0.9	14/08/2012	12	8	5	5	4	3	<1	<1	<1	<1	<1	<1	63	25	<1	1	11	silty CLAY	CLAY, some silt
SE033_0.0-0.05	SE033	Sediment	0-0.05	15/08/2012	11	8	7	6	5	4	3	<1	<1	<1	<1	<1	55	30	<1	3	12	silty CLAY	silty CLAY
SE033_0.2-0.4	SE033	Sediment	0.2-0.4	15/08/2012	23	11	2	2	1	<1	<1	<1	<1	<1	<1	<1	24	54	<1	<1	22	clayey SILT	silty CLAY
SE033_0.4-0.6	SE033	Sediment	0.4-0.6	15/08/2012	9	8	6	5	5	3	1	<1	<1	<1	<1	<1	80	11	<1	1	8	silty CLAY	SILT
SE063_0.0-0.1	SE063	Sediment	0-0.1	15/08/2012	14	12	11	10	9	6	3	<1	<1	<1	<1	<1	68	12	<1	3	17	silty CLAY	SILT
SE063_0.2-0.3	SE063	Sediment	0.2-0.3	15/08/2012	6	4	2	2	2	1	<1	<1	<1	<1	<1	<1	57	36	<1	1	6	silty CLAY	sandy CLAY
SE063_0.4-0.6	SE063	Sediment	0.4-0.6	15/08/2012	9	8	7	6	6	4	2	<1	<1	<1	<1	<1	64	27	<1	2	7	silty CLAY	SILT

Table C5: Acid Sulfate Soil Analysis

		pH					Acidity Trail						Sulfur Trail				Calcium Values						Magnesium Values						Retained Acidity				*Acid Base Accounting*			
		pH KCl (23A)	pH OX (23B)	pH (F)	pH (Fox)	Reaction Rate	Titratable Actual Acidity (23F)	Titratable Peroxide Acidity (23G)	Titratable Sulfidic Acidity (23H)	sulfidic - Titratable Actual Acidity (s-23F)	sulfidic - Titratable Peroxide Acidity (s-23G)	sulfidic - Titratable Sulfidic Acidity (s-23H)	KCl Extractable Sulfur (23Ce)	Peroxide Sulfur (23De)	Peroxide Oxidisable Sulfur (23E)	acidity - Peroxide Oxidisable Sulfur (a-23E)	KCl Extractable Calcium (23Vh)	Peroxide Calcium (23Wh)	Acid Reacted Calcium (23X)	acidity - Acid Reacted Calcium (a-23X)	sulfidic - Acid Reacted Calcium (s-23X)	KCl Extractable Magnesium (23Sm)	Peroxide Magnesium (23Tm)	Acid Reacted Magnesium (23U)	Acidity - Acid Reacted Magnesium (a-23U)	sulfidic - Acid Reacted Magnesium (s-23U)	HCl Extractable Sulfur (20Be)	Net Acid Soluble Sulfur (20Je)	acidity - Net Acid Soluble Sulfur (a-20J)	sulfidic - Net Acid Soluble Sulfur (s-20J)	ANC Fineness Factor	Net Acidity (sulfur units)	Net Acidity (acidity units)	Liming Rate
		pH_Units	pH units	pH units	pH units	-	mole H+ / t	mole H+ / t	mole H+ / t	% pyrite S	% pyrite S	% pyrite S	% S	% S	% S	mole H	% Ca	% Ca	% Ca	mole H+ / t	% S	% Mg	% Mg	% Mg	mole H+ / t	% S	% S	% S	mole H+ / t	% pyrite S	-	% S	mole H+ / t	kg CaCO3/t
EQL		0.01	0.01	0.01	0.01	1	2	2	2	0.02	0.02	0.02	0.02	0.02	0.02	10	0.02	0.02	0.02	10	0.02	0.02	0.02	0.02	10	0.02	0.02	0.02	10	0.02	0.5	0.02	10	1
Field_ID	**Sample Date**																																			
BH031_0.0-0.2	15/08/2012	4.0	2.1	3.4	2.5	3	32	64	31	0.05	0.10	0.05	<0.02	0.05	0.05	29	<0.02	<0.02	<0.02	<10	<0.02	<0.02	<0.02	<0.02	<10	<0.02	0.02	0.02	11	<0.02	1.5	0.12	73	5
BH031_0.5-0.7	15/08/2012	4.8	1.9	3.8	0.9	3	12	547	536	<0.02	0.88	0.86	<0.02	0.84	0.84	522	<0.02	<0.02	<0.02	<10	<0.02	<0.02	<0.02	<0.02	<10	<0.02	-	-	-	-	1.5	0.86	534	40
BH031_1.8-2.0	15/08/2012	4.5	2.1	6.9	1.4	4	85	702	617	0.14	1.12	0.99	0.04	0.85	0.81	504	0.14	0.17	0.02	12	<0.02	0.03	0.04	<0.02	13	0.02	-	-	-	-	1.5	0.94	589	44
BH032_0.0-0.2	14/08/2012	4.6	3.2	5.9	2.3	2	19	153	<2	0.03	0.24	<0.02	<0.02	0.06	0.06	39	<0.02	<0.02	<0.02	<10	<0.02	<0.02	<0.02	<0.02	<10	<0.02	-	-	-	-	1.5	0.09	58	4
BH032_0.3-0.5	14/08/2012	4.4	2.6	6.3	1.4	2	38	151	<2	0.06	0.24	<0.02	<0.02	0.19	0.19	118	<0.02	<0.02	<0.02	<10	<0.02	<0.02	<0.02	<0.02	<10	<0.02	0.09	0.09	43	0.07	1.5	0.32	199	15
BH032_1.0-1.2	14/08/2012	5.5	2.7	7.1	1.5	2	18	352	334	0.03	0.56	0.54	0.03	0.50	0.48	297	0.14	0.18	0.03	16	0.02	0.08	0.09	<0.02	11	<0.02	-	-	-	-	1.5	0.50	315	24
BH054_0.0-0.2	14/08/2012	-	-	6.5	2.9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH054_0.7-0.9	14/08/2012	-	-	6.9	1.7	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH054_1.0-1.2	14/08/2012	-	-	6.7	1.2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE001_0.0-0.1	16/08/2012	-	-	6.7	1.9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE003_0.2-0.4	16/08/2012	4.5	2.4	-	-	-	56	356	300	0.09	0.57	0.48	<0.02	0.22	0.22	141	0.05	0.06	<0.02	<10	<0.02	0.04	0.05	<0.02	<10	<0.02	-	-	-	-	1.5	0.32	197	15
SE003_0.2-0.4	16/08/2012	-	-	5.9	1.8	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE004_0.0-0.1	16/08/2012	-	-	5.9	1.8	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE011_0.3-0.5	16/08/2012	-	-	5.7	1.8	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE013_0.3-0.5	16/08/2012	4.4	3.2	-	-	-	260	1010	746	0.42	1.61	1.20	0.03	0.54	0.50	313	0.10	0.12	<0.02	<10	<0.02	0.04	0.05	<0.02	<10	<0.02	0.08	0.04	20	0.03	1.5	0.95	594	44
SE013_0.3-0.5	16/08/2012	-	-	6.6	1.6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE031_0.5-0.7	16/08/2012	4.5	2.3	6.6	1.5	3	87	712	625	0.14	1.14	1.00	<0.02	0.43	0.43	268	0.13	0.15	0.02	12	<0.02	0.09	0.10	<0.02	<10	<0.02	-	-	-	-	1.5	0.57	355	27
SE050_0.0-0.1	16/08/2012	-	-	5.4	2.2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE050_0.2-0.4	16/08/2012	-	-	5.4	2.2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE054_0.1-0.3	16/08/2012	-	-	6.5	1.6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C6: Surface Water Chemistry

			Field					Inorganics							Alkalinity						Major Ions											
			Dissolved Oxygen (Field)	Electrical Conductivity (Field)	Oxygen Redox Potential (Field)	pH (Field)	Temp (Field)	Cyanide Total	Electrical conductivity *(lab)	pH (Lab)	Redox	TOC	Total Dissolved Solids	Total Suspended Solids	Alkalinity (total) as CaCO3	Alkalinity (Bicarbonate as CaCO3)	Alkalinity (Carbonate as CaCO3)	Alkalinity (Hydroxide) as CaCO3	Bicarbonate	Hardness as CaCO3	Calcium	Calcium (Filtered)	Chloride	Magnesium	Magnesium (Filtered)	Potassium	Potassium (Filtered)	Sodium	Sodium (Filtered)	Sulphate	Anions Total	Cations Total
			mg/L	uS/cm	mV	pH Units	oC	mg/L	uS/cm	pH Units	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L
EQL			0.1	100		0.01		0.004	1000	0.1	1	1	5	2	1	1	1	1	1	0.5	0.1	1	1	0.1	1	0.1	1	0.1	1	1	0.01	0.01
ANZECC 2000 FW Slightly-moderate disturbed system								0.007																								
10 times ANZECC 2000 FW Slightly-moderate disturbed system								0.07																								
30 times ANZECC 2000 FW Slightly-moderate disturbed system								0.21																								
ANZECC 2000 MW Slightly-moderate disturbed system								**0.004**																								
Field_ID	**LocCode**	**Sample Date**																														
1	DLWC97-SW1	30/04/1997	0.4	171	-	6.25	-	**0.027**	146	6	311	18	94	10	18	-	-	-	18	23	3.5	-	31	3.6	-	0.6	-	18	-	2	-	-
2	DLWC97-SW2	30/04/1997	1.2	117	-	6.01	-	**0.009**	94	5.7	314	29	68	47	16	-	-	-	16	21	3.3	-	18	3.2	-	1.3	-	17	-	<1	-	-
3	DLWC97-SW3	30/04/1997	3.5	146	-	5.94	-	**0.013**	139	5	335	10	90	8	3	-	-	-	3	16	2.8	-	32	2.3	-	2.2	-	22	-	10	-	-
4	DLWC97-SW4	30/04/1997	4.4	102	-	6.19	-	**0.018**	95	6.1	308	15	73	6	10	-	-	-	10	14	2.3	-	18	2.2	-	2	-	16	-	4	-	-
5	DLWC97-SW5	30/04/1997	5.1	103	-	6.1	-	**<0.005**	90	6	305	16	96	6	10	-	-	-	10	16	2.2	-	19	2.5	-	1.8	-	17	-	4	-	-
6	DLWC97-SW6	30/04/1997	3.9	121	-	6.12	-	**0.038**	93	5.9	316	15	74	6	9	-	-	-	9	13	2	-	19	2	-	1.5	-	14	-	8	-	-
7	DLWC97-SW7	30/04/1997	1	102	-	6.08	-	**0.033**	101	6.1	314	16	70	7	10	-	-	-	10	15	2.1	-	20	2.4	-	2.2	-	19	-	3	-	-
8	DLWC97-SW8	30/04/1997	3	100	-	6.08	-	**0.044**	90	6	324	15	80	9	9	-	-	-	9	16	2.4	-	18	2.4	-	2.3	-	17	-	8	-	-
9	DLWC97-SW9	30/04/1997	3	104	-	6.32	-	**0.007**	91	6	317	15	81	17	10	-	-	-	10	15	2.3	-	18	2.3	-	2.3	-	17	-	7	-	-
10	DLWC97-SW10	30/04/1997	3.2	113	-	6.4	-	**<0.005**	95	5.8	307	14	70	11	10	-	-	-	10	15	2.5	-	18	2.2	-	2	-	17	-	4	-	-
11	DLWC97-SW11	30/04/1997	1.8	105	-	5.98	-	**0.02**	96	6	332	15	86	8	9	-	-	-	9	14	2.1	-	20	2.1	-	2.1	-	17	-	10	-	-
12	DLWC97-SW12	30/04/1997	1.9	116	-	5.94	-	**0.029**	105	6	309	15	92	14	11	-	-	-	11	16	2.3	-	22	2.4	-	2.7	-	20	-	4	-	-
13	DLWC97-SW13	30/04/1997	5.4	149	-	6.09	-	**0.038**	123	6	304	20	115	10	11	-	-	-	11	17	2.6	-	29	2.6	-	3	-	24	-	2	-	-
14	DLWC97-SW14	30/04/1997	4.5	158	-	6.18	-	**0.011**	142	5.7	310	12	108	8	10	-	-	-	10	16	2.3	-	34	2.4	-	1.9	-	25	-	2	-	-
15	DLWC97-SW15	30/04/1997	0.9	229	-	6.04	-	**0.013**	218	5.7	312	9	128	7	13	-	-	-	13	16	2.3	-	54	2.6	-	0.8	-	44	-	4	-	-
16	DLWC97-SW16	30/04/1997	1.7	214	-	6.15	-	**0.016**	198	5.4	318	7	122	17	5	-	-	-	5	15	1.9	-	54	2.5	-	0.9	-	36	-	4	-	-
17	DLWC97-SW17	30/04/1997	0.9	256	-	5.95	-	**0.012**	249	5.9	290	11	162	3	12	-	-	-	12	28	3.6	-	67	4.5	-	1.6	-	46	-	3	-	-
18	DLWC97-SW18	30/04/1997	1.1	266	-	5.95	-	**0.008**	240	6.3	268	11	169	4	14	-	-	-	14	29	4	-	65	4.7	-	1.7	-	45	-	3	-	-
SW001	SW001	22/08/2012	2.46	168	241	5.4	12.8	<0.004	-	-	-	-	129	43	8	8	<1	<1	-	-	-	3	48	-	3	-	1	-	24	<1	1.51	1.47
SW002	SW002	22/08/2012	6.58	177	222	6.9	21.2	<0.004	-	-	-	-	126	9	9	9	<1	<1	-	-	-	3	44	-	3	-	1	-	23	<1	1.42	1.42
SW003	SW003	22/08/2012	6.8	137	207	5.5	19.6	<0.004	-	-	-	-	107	9	4	4	<1	<1	-	-	-	2	33	-	2	-	1	-	18	2	1.05	1.07
SW004	SW004	22/08/2012	6.96	128	198	6	16	<0.004	-	-	-	-	106	<5	4	4	<1	<1	-	-	-	2	32	-	2	-	1	-	18	2	1.02	1.07
SW005	SW005	22/08/2012	-	131	191	5.9	15.4	<0.004	-	-	-	-	104	6	4	4	<1	<1	-	-	-	2	32	-	2	-	1	-	18	2	1.02	1.07
SW006	SW006	22/08/2012	5.27	139	132	6.1	14.8	<0.004	-	-	-	-	105	8	7	7	<1	<1	-	-	-	2	36	-	2	-	1	-	20	2	1.2	1.16
SW007	SW007	22/08/2012	5.87	141	150	6.8	14.5	<0.004	-	-	-	-	112	8	6	6	<1	<1	-	-	-	2	36	-	2	-	1	-	20	1	1.16	1.16
SW008	SW008	22/08/2012	5.65	320	257	4.9	14	<0.004	-	-	-	-	194	15	<1	<1	<1	<1	-	-	-	4	101	-	6	-	1	-	48	5	2.95	2.81
SW009	SW009	22/08/2012	1.54	247	202	5.2	12.9	<0.004	-	-	-	-	157	6	1	1	<1	<1	-	-	-	5	67	-	6	-	2	-	36	20	2.33	2.36

Note: Highlighted cells with a '<' symbol may not necessarily constitute an assessment criteria exceedance

Table C6: Surface Water Chemistry

			Metals																					
			Aluminium	Aluminium (Filtered)	Antimony	Antimony (Filtered)	Arsenic	Arsenic (Filtered)	Cadmium	Cadmium (Filtered)	Chromium (III+VI)	Chromium (III+VI) (Filtered)	Copper	Copper (Filtered)	Iron	Iron (Filtered)	Lead	Lead (Filtered)	Manganese	Mercury	Mercury (Filtered)	Nickel	Nickel (Filtered)	Zinc	Zinc (Filtered)
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.01	0.01	0.001	0.001	0.001	0.001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.05	0.05	0.001	0.001	0.005	0.001	0.0001	0.001	0.001	0.005	0.005
ANZECC 2000 FW Slightly-moderate disturbed system			0.055	0.055	0.009	0.009	0.013	0.013	0.0002	0.0002	0.001	0.001	0.0014	0.0014			0.0034	0.0034	1.9	0.00006	0.00006	0.011	0.011	0.008	0.008
10 times ANZECC 2000 FW Slightly-moderate disturbed system			0.55	0.55	0.09	0.09	0.13	0.13	0.002	0.002	0.01	0.01	0.014	0.014			0.034	0.034	19	0.0006	0.0006	0.11	0.11	0.08	0.08
30 times ANZECC 2000 FW Slightly-moderate disturbed system			1.65	1.65	0.27	0.27	0.39	0.39	0.006	0.006	0.03	0.03	0.042	0.042			0.102	0.102	57	0.0018	0.0018	0.33	0.33	0.24	0.24
ANZECC 2000 MW Slightly-moderate disturbed system					**0.27**	**0.27**	**0.0045**	**0.0045**	**0.0007**	**0.0007**	**0.0044**	**0.0044**	**0.0013**	**0.0013**			**0.0044**	**0.0044**	**0.08**	**0.0001**	**0.0001**	**0.007**	**0.007**	**0.015**	**0.015**
Field_ID	**LocCode**	**Sample Date**																							
1	DLWC97-SW1	30/04/1997	0.38	-	<0.01	-	**0.005**	-	-	-	-	-	**<0.005**	-	8.4	-	**<0.01**	-	**0.132**	**<0.001**	-	-	-	-	-
2	DLWC97-SW2	30/04/1997	0.85	-	<0.01	-	**0.014**	-	-	-	-	-	**<0.005**	-	15	-	**<0.01**	-	**0.098**	**<0.001**	-	-	-	-	-
3	DLWC97-SW3	30/04/1997	0.16	-	0.15	-	**0.705**	-	-	-	-	-	**0.029**	-	2.7	-	**<0.01**	-	**0.13**	**<0.001**	-	-	-	-	-
4	DLWC97-SW4	30/04/1997	0.25	-	0.26	-	**0.456**	-	-	-	-	-	**0.08**	-	2.9	-	**0.006**	-	0.037	**<0.001**	-	-	-	-	-
5	DLWC97-SW5	30/04/1997	0.25	-	0.21	-	**0.276**	-	-	-	-	-	**0.055**	-	2.6	-	**<0.01**	-	0.037	**<0.001**	-	-	-	-	-
6	DLWC97-SW6	30/04/1997	0.26	-	0.22	-	**0.405**	-	-	-	-	-	**0.101**	-	2.9	-	**0.007**	-	0.041	**<0.001**	-	-	-	-	-
7	DLWC97-SW7	30/04/1997	0.19	-	0.09	-	**0.117**	-	-	-	-	-	**0.009**	-	1.8	-	**<0.01**	-	0.025	**<0.001**	-	-	-	-	-
8	DLWC97-SW8	30/04/1997	0.24	-	0.2	-	**0.294**	-	-	-	-	-	**0.122**	-	2.3	-	**0.008**	-	0.044	**<0.001**	-	-	-	-	-
9	DLWC97-SW9	30/04/1997	0.25	-	0.2	-	**0.394**	-	-	-	-	-	**0.142**	-	3.2	-	**0.009**	-	0.047	**<0.001**	-	-	-	-	-
10	DLWC97-SW10	30/04/1997	0.22	-	0.1	-	**0.236**	-	-	-	-	-	**0.055**	-	2.8	-	**0.009**	-	0.032	**<0.001**	-	-	-	-	-
11	DLWC97-SW11	30/04/1997	0.21	-	0.17	-	**0.194**	-	-	-	-	-	**0.014**	-	2.1	-	**<0.01**	-	0.039	**<0.001**	-	-	-	-	-
12	DLWC97-SW12	30/04/1997	0.14	-	0.11	-	**0.128**	-	-	-	-	-	**0.008**	-	1.9	-	**<0.01**	-	0.042	**<0.001**	-	-	-	-	-
13	DLWC97-SW13	30/04/1997	0.16	-	0.03	-	**0.058**	-	-	-	-	-	**0.005**	-	1.8	-	**<0.01**	-	0.032	**<0.001**	-	-	-	-	-
14	DLWC97-SW14	30/04/1997	0.11	-	0.02	-	**0.048**	-	-	-	-	-	**0.009**	-	1.9	-	**<0.01**	-	0.019	**<0.001**	-	-	-	-	-
15	DLWC97-SW15	30/04/1997	<0.05	-	<0.01	-	**0.021**	-	-	-	-	-	**0.008**	-	3.5	-	**<0.01**	-	0.04	**<0.001**	-	-	-	-	-
16	DLWC97-SW16	30/04/1997	0.09	-	<0.01	-	**0.053**	-	-	-	-	-	**<0.005**	-	4.4	-	**<0.01**	-	**0.092**	**<0.001**	-	-	-	-	-
17	DLWC97-SW17	30/04/1997	<0.05	-	<0.01	-	**0.037**	-	-	-	-	-	**0.005**	-	3.5	-	**<0.01**	-	**0.111**	**<0.001**	-	-	-	-	-
18	DLWC97-SW18	30/04/1997	<0.05	-	<0.01	-	**0.031**	-	-	-	-	-	**<0.005**	-	3.2	-	**<0.01**	-	**0.097**	**<0.001**	-	-	-	-	-
SW001	SW001	22/08/2012	0.36	0.09	0.022	0.01	**0.008**	<0.001	<0.0001	<0.0001	0.001	<0.001	**0.021**	0.001	5.38	0.54	0.001	<0.001	-	-	<0.0001	<0.001	<0.001	**0.016**	**0.018**
SW002	SW002	22/08/2012	0.19	0.11	0.171	0.145	**0.077**	**0.028**	<0.0001	<0.0001	0.001	<0.001	**0.011**	**0.008**	2.94	1.05	0.002	<0.001	-	-	<0.0001	<0.001	<0.001	**0.016**	**0.018**
SW003	SW003	22/08/2012	0.25	0.19	0.139	0.12	**0.171**	**0.118**	<0.0001	<0.0001	<0.001	<0.001	**0.017**	**0.012**	1.72	1.21	**0.005**	0.003	-	-	<0.0001	<0.001	<0.001	**0.026**	**0.032**
SW004	SW004	22/08/2012	0.22	0.19	0.116	0.139	**0.104**	**0.073**	<0.0001	<0.0001	<0.001	<0.001	**0.013**	**0.012**	1.57	1.09	**0.005**	0.003	-	-	<0.0001	<0.001	<0.001	**0.03**	**0.028**
SW005	SW005	22/08/2012	0.22	0.21	0.151	0.133	**0.092**	**0.071**	<0.0001	<0.0001	<0.001	<0.001	**0.014**	**0.012**	1.52	1.15	0.004	0.003	-	-	<0.0001	<0.001	<0.001	**0.032**	**0.031**
SW006	SW006	22/08/2012	0.24	0.18	0.083	0.073	**0.063**	**0.043**	<0.0001	<0.0001	<0.001	<0.001	**0.013**	**0.01**	1.74	1.05	**0.006**	0.003	-	-	<0.0001	<0.001	<0.001	**0.048**	**0.047**
SW007	SW007	22/08/2012	0.2	0.13	0.07	0.061	**0.056**	**0.038**	<0.0001	<0.0001	<0.001	<0.001	**0.012**	**0.008**	1.48	0.97	0.004	0.002	-	-	<0.0001	<0.001	<0.001	**0.041**	**0.025**
SW008	SW008	22/08/2012	0.09	0.06	0.244	0.155	**0.069**	**0.04**	<0.0001	<0.0001	<0.001	<0.001	**0.007**	**0.008**	0.54	0.32	0.002	0.002	-	-	<0.0001	0.003	0.003	**0.114**	**0.124**
SW009	SW009	22/08/2012	0.05	0.03	0.018	0.012	**0.016**	0.002	0.0006	0.0005	0.001	<0.001	**0.016**	**0.01**	0.81	0.13	<0.001	<0.001	-	-	<0.0001	<0.001	<0.001	**0.848**	**0.82**

Note: Highlighted cells with a '<' symbol may not necessarily constitute an assessment criteria exceedance

Table C7: Groundwater Chemistry

			Field					Inorganics							Alkalinity							Major Ions														
			Dissolved Oxygen (Field)	Electrical Conductivity (Field)	Oxygen Redox Potential (Field)	pH (Field)	Temp (Field)	Cyanide Total	Electrical conductivity *(lab)	pH (Lab)	Redox	TOC	Total Dissolved Solids	Total Suspended Solids	Alkalinity (total) as CaCO3	Alkalinity (Bicarbonate as CaCO3)	Alkalinity (Carbonate as CaCO3)	Alkalinity (Hydroxide) as CaCO3	Bicarbonate	Carbonate	Hardness as CaCO3	Calcium	Calcium (Filtered)	Chloride	Magnesium	Magnesium (Filtered)	Potassium	Potassium (Filtered)	Sodium	Sodium (Filtered)	Sulphate	Anions Total	Cations Total	Ionic Balance
			mg/L	uS/cm	mV	pH_Units	oC	mg/L	uS/cm	pH_Units	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	%
EQL								0.004	1	0.1	1	1	5	2	1	1	1	1	1		0.5	0.1	0.1	0.05	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.01	0.01	0.01
ANZECC 2000 FW Slightly-moderate disturbed system								0.007																												
10 times ANZECC 2000 FW Slightly-moderate disturbed system								0.07																												
30 times ANZECC 2000 FW Slightly-moderate disturbed system								0.21																												
ANZECC 2000 MW Slightly-moderate disturbed system								**0.004**																												
Field_ID	**WellCode**	**Sample Date**																																		
4	DLW97-GW4	1/05/1997	-	-	-	-	-	**0.184**	1160	6.4	164	86	858	14,300	267	-	-	-	267	-	130	14	-	213	23	-	8.5	-	222	-	12	-	-	-
6	DLW97-GW6	1/05/1997	-	-	-	-	-	**0.184**	1160	6.4	164	86	858	14,300	267	-	-	-	267	-	130	14	-	213	23	-	8.5	-	222	-	12	-	-	-
7	DLW97-GW7	1/05/1997	-	-	-	-	-	**0.104**	541	6.2	238	59	604	12,900	70	-	-	-	70	-	70	8.6	-	89	12	-	7	-	111	-	28	-	-	-
12	DLW97-GW12	1/05/1997	-	-	-	-	-	**<0.005**	382	6.3	246	65	321	19,400	91	-	-	-	91	-	108	20	-	73	14	-	1	-	57	-	<1	-	-	-
13	DLW97-GW13	1/05/1997	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-	-	-	-	103	15	-	-	16	-	8.2	-	86	-	-	-	-	-
GW004	DLW97-GW4	22/08/2012	1.12	387	163.6	4.46	16.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW006	DLW97-GW6	22/08/2012	0.68	1144	-50.8	6.28	17.8	**0.597**	-	-	-	-	970	1190	285	285	<1	<1	347.7	<1.2	-	-	12	184	-	20	-	8	-	194	<10	10.9	10.9	0.02
GW007	DLW97-GW7	22/08/2012	0.13	784	-37	6.32	15.3	**0.06**	-	-	-	-	560	356	172	172	<1	<1	209.8	<1.2	-	-	9	150	-	14	-	7	-	132	<1	7.67	7.52	0.99
GW013	DLW97-GW12	22/08/2012	0.71	755	-64	6.53	19	<0.004	-	-	-	-	412	408	160	160	<1	<1	195.2	<1.2	-	-	12	78	-	14	-	6	-	71	<1	5.4	5.22	1.6

Note: Highlighted cells with a '<' symbol may not necessarily constitute an assessment criteria exceedance

Table C7: Groundwater Chemistry

			Metals																						
			Aluminium	Aluminium (Filtered)	Antimony	Antimony (Filtered)	Arsenic	Arsenic (Filtered)	Cadmium	Cadmium (Filtered)	Chromium (III+VI)	Chromium (III+VI) (Filtered)	Copper	Copper (Filtered)	Iron	Iron (Filtered)	Lead	Lead (Filtered)	Manganese	Mercury	Mercury (Filtered)	Nickel	Nickel (Filtered)	Zinc	Zinc (Filtered)
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.005	0.001	0.001	0.001	0.001	0.001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.001	0.005	0.0001	0.0001	0.001	0.001	0.001	0.001
ANZECC 2000 FW Slightly-moderate disturbed system			0.055	0.055	0.009	0.009	0.013	0.013	0.0002	0.0002	0.001	0.001	0.0014	0.0014			0.0034	0.0034	1.9	0.00006	0.00006	0.011	0.011	0.008	0.008
10 times ANZECC 2000 FW Slightly-moderate disturbed system			0.55	0.55	0.09	0.09	0.13	0.13	0.002	0.002	0.01	0.01	0.014	0.014			0.034	0.034	19	0.0006	0.0006	0.11	0.11	0.08	0.08
30 times ANZECC 2000 FW Slightly-moderate disturbed system			1.65	1.65	0.27	0.27	0.39	0.39	0.006	0.006	0.03	0.03	0.042	0.042			0.102	0.102	57	0.0018	0.0018	0.33	0.33	0.24	0.24
ANZECC 2000 MW Slightly-moderate disturbed system					**0.27**	**0.27**	**0.0045**	**0.0045**	**0.0007**	**0.0007**	**0.0044**	**0.0044**	**0.0013**	**0.0013**			**0.0044**	**0.0044**	**0.08**	**0.0001**	**0.0001**	**0.007**	**0.007**	**0.015**	**0.015**
Field_ID	**WellCode**	**Sample Date**																							
4	DLW97-GW4	1/05/1997	9.7	-	**5.6**	-	**19**	-	-	-	-	-	**0.17**	-	27	-	**3**	-	**0.923**	**0.046**	-	-	-	-	-
6	DLW97-GW6	1/05/1997	9.7	-	**5.6**	-	**19**	-	-	-	-	-	**0.17**	-	27	-	**3**	-	**0.923**	**0.046**	-	-	-	-	-
7	DLW97-GW7	1/05/1997	6.5	-	**4.1**	-	**89**	-	-	-	-	-	**0.184**	-	21	-	**1.6**	-	**0.31**	**0.048**	-	-	-	-	-
12	DLW97-GW12	1/05/1997	3.2	-	**1**	-	**0.423**	-	-	-	-	-	**1.3**	-	30	-	**0.245**	-	**1.7**	**<0.001**	-	-	-	-	-
13	DLW97-GW13	1/05/1997	3.2	-	**4.4**	-	**21**	-	-	-	-	-	**0.465**	-	17	-	**0.573**	-	**0.781**	**0.019**	-	-	-	-	-
GW004	DLW97-GW4	22/08/2012	-	1.15	-	**1.17**	-	**5.56**	-	0.0001	-	**0.132**	-	**0.027**	-	9.05	-	**0.017**	-	-	<0.0001	-	**4.07**	-	**0.208**
GW006	DLW97-GW6	22/08/2012	-	2.19	-	**1.39**	-	**72.6**	-	<0.0001	-	**0.014**	-	**0.011**	-	37.4	-	**0.125**	-	-	**0.0026**	-	**0.013**	-	**0.063**
GW007	DLW97-GW7	22/08/2012	-	0.67	-	**1.45**	-	**37**	-	<0.0001	-	**0.006**	-	**0.006**	-	29.3	-	**0.02**	-	-	**0.0005**	-	**0.013**	-	**0.051**
GW013	DLW97-GW12	22/08/2012	-	0.05	-	**1.21**	-	**34.5**	-	<0.0001	-	**0.011**	-	**0.01**	-	90.5	-	0.002	-	-	**0.0002**	-	**0.022**	-	**0.074**

Note: Highlighted cells with a '<' symbol may not necessarily constitute an assessment criteria exceedance

Table C8: Brick Analysis

	Antimony	Arsenic	Cadmium	Chromium (III+VI)	Copper	Lead	Mercury	Nickel	Zinc
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL									
NEPM 1999 EIL (bold)		**20**	**3**	**1**	**100**	**600**	**1**	**60**	**200**
NEPM 1999 HIL E		200	40	200	2000	600	30	600	14000
NSW 2008 General Solid Waste (No Leaching)		100	20	100		100	4	40	
NSW 2008 Restricted Solid Waste (No Leaching)		400	80	400		400	16	160	
USEPA RES	310								

Field_ID	LocCode	Sample_Date	Data Source								
Brick001	Brick Stockpile	16/08/2012	XRF	<17.87	<8.74	**<15.23**	**<123.8**	<22.66	<5.76	**<6.34**	<38.12	94.18
Brick001	Brick Stockpile	16/08/2012	XRF	<17.56	<2.65	**<14.85**	**<125.2**	<17.61	<6.55	**<5.84**	<37.29	17.05
Brick001	Brick Stockpile	17/08/2012	XRF	<16.89	12.21	**<14.39**	**<130.8**	<17.43	<6.33	**<5.68**	<36.71	21.79
Brick001	Brick Stockpile	17/08/2012	Lab	<5	<5	<1	**6**	<5	<5	**3**	10	-
Brick002	Brick Stockpile	16/08/2012	XRF	<17.31	18.55	**<14.6**	**<125.3**	<17.51	8.71	**<5.97**	<37.15	35.6
Brick002	Brick Stockpile	17/08/2012	Lab	<5	7	<1	**11**	6	6	**6**	14	-
Brick003	Brick Stockpile	16/08/2012	XRF	<17.3	12.56	**<14.56**	**<114.6**	<17.55	5.87	**<6.15**	<37.42	45.21
Brick004	Brick Stockpile	16/08/2012	XRF	<18.31	10.91	**<15.4**	**<129.9**	<19	<7.06	**<6.45**	<40.03	31.49
Brick005	Brick Stockpile	16/08/2012	XRF	<16.25	4.45	**<13.86**	**<115.3**	<16.2	<4.81	**<5.4**	<34.19	19.1
Brick006	Brick Stockpile	16/08/2012	XRF	<17.8	10.24	**<15.12**	**<136**	<18.15	<6.79	**<6.06**	<38.65	16.28
Brick007	Brick Stockpile	16/08/2012	XRF	<17.69	9.44	**<14.9**	**<145.5**	<18.34	<5.49	**<6.06**	<37.45	24.34
Brick008	Brick Stockpile	16/08/2012	XRF	<16.74	10.46	**<14.31**	**<124.4**	<17.52	<5.08	**<5.89**	<36.18	17.61
Brick009	Brick Stockpile	16/08/2012	XRF	<17.81	<3.81	**<15.16**	**192.9**	15.43	<6.78	**<6.38**	<38.59	35.76
Brick010	Brick Stockpile	16/08/2012	XRF	<16.47	<3.5	**<14.09**	**<122.8**	<16.74	<6.27	**<5.6**	<34.81	24.22
Brick011	Brick Stockpile	16/08/2012	XRF	<17.98	9.18	**<15.27**	**<118.5**	15.95	<7.18	**<6.34**	<38.63	60.31
Brick012	Brick Stockpile	16/08/2012	XRF	<17.7	7.86	**<15.04**	**151.3**	18.29	<5.51	**<6.13**	<38.03	35.3
Brick013	Brick Stockpile	16/08/2012	XRF	<16.53	<2.29	**<14.09**	**<125.4**	<16.33	<5.24	**<5.4**	<35.03	7.82
Brick014	Brick Stockpile	16/08/2012	XRF	<16.92	4.26	**<14.44**	**<124.1**	<16.79	<6.31	**<5.69**	<35.33	27.31
Brick015	Brick Stockpile	16/08/2012	XRF	<17.25	5.9	**<14.63**	**<128.3**	<17.62	<6.04	**<5.82**	<36.8	15.45
Brick016	Brick Stockpile	16/08/2012	XRF	<18.18	7.22	**<15.39**	**<135.9**	23.65	9.38	**<6.45**	<38.79	43.9
Brick017	Brick Stockpile	16/08/2012	XRF	<17.34	6.31	**<14.75**	**<129.7**	<17.58	<5.41	**<6.06**	<36.67	28.39
Brick018	Brick Stockpile	16/08/2012	XRF	<16.78	6.09	**<14.26**	**<128.8**	<17.08	<6.32	**<5.74**	<35.77	18.31
Brick019	Brick Stockpile	16/08/2012	XRF	<17.22	5.58	**<14.68**	**<128.4**	<17.23	<6.52	**<5.84**	<36.71	25.23
Brick020	Brick Stockpile	16/08/2012	XRF	<18.16	9.05	**<15.28**	**<130**	17.7	<5.57	**<6.43**	<39.31	70.24
Brick021	Brick Stockpile	16/08/2012	XRF	<17.68	5.11	**<15.01**	**<130.1**	<18.41	<6.49	**<5.95**	<37.63	28.21
Brick022	Brick Stockpile	16/08/2012	XRF	<16.45	6.46	**<14.1**	**<117**	<16.46	<6.23	**<5.5**	<34.4	50.22
Brick023	Brick Stockpile	16/08/2012	XRF	<17.87	8.74	**<15.23**	**<123.8**	22.66	<5.76	**<6.34**	<38.12	94.18

Note: Highlighted cells with a '<' symbol may not necessarily constitute an assessment criteria exceedance

Table 9: SOIL QA/QC Data

SDG				ES1220305	ES1220305		ES1220305	ES1220305		ES1220305	ES1220305		ES1220305	ES1220305		ES1220305	ES1220305		ES1223062	ES1223062		ES1223062	ES1223062		ES1223062	ES1223062	
Field_ID				SE013_0.0-0.1	SEDUP04	RPD	SE050_0.0-0.1	SEDUP03	RPD	SE004_0.0-0.1	SEDUP05	RPD	BH004_1.0-1.2	BHDUP07	RPD	BH002_0.5-0.7	BHDUP06	RPD	BH032_0.3-0.5	BHDUP01	RPD	BH012_0.0-0.1	BHDUP08	RPD	SE032_0.0-0.1	SEDUP01	RPD
Sampled_Date				16/08/2012	16/08/2012		15/08/2012	15/08/2012		16/08/2012	16/08/2012		16/08/2012	16/08/2012		16/08/2012	16/08/2012		14/08/2012	14/08/2012		16/08/2012	16/08/2012		14/08/2012	14/08/2012	
Method_Type	ChemName	Units	EQL																								
1M HCl Extractable Metals	Aluminium	mg/kg	50							**7550.0**	**1400.0**	**137**															
	Antimony	mg/kg	1							**92.4**	**2.7**	**189**															
	Arsenic	mg/kg	1							**11.7**	**3.5**	**108**															
	Cadmium	mg/kg	0.1							**0.3**	**<0.1**	**100**															
	Chromium (III+VI)	mg/kg	1							<1.0	<1.0	0															
	Cobalt	mg/kg	0.5							**1.4**	**<0.5**	**95**															
	Copper	mg/kg	1							**50.4**	**2.2**	**183**															
	Iron	mg/kg	50							**7050.0**	**1120.0**	**145**															
	Lead	mg/kg	1							**28.6**	**2.9**	**163**															
	Manganese	mg/kg	10							**35.0**	**<10.0**	**111**															
	Nickel	mg/kg	1							**3.9**	**<1.0**	**118**															
	Silver	mg/kg	1							<1.0	<1.0	0															
	Vanadium	mg/kg	2							**40.3**	**10.7**	**116**															
	Zinc	mg/kg	1							**70.0**	**3.1**	**183**															
1M HCl Extractable Metals by ICPMS	Selenium	mg/kg	0.5							**1.4**	**0.6**	**80**															
Leachable Mercury by FIMS (leached)	Mercury (Filtered)	mg/l	0.001															0.0011	<0.001	10	<0.001	<0.001	0	**0.0082**	**<0.001**	**157**
Leachable Metals by ICPAES (leached)	Aluminium (Filtered)	mg/l	0.1															2.5	2.0	22	4.7	3.9	19	**1.2**	**8.4**	**150**
	Antimony (Filtered)	mg/l	0.1															3.1	2.5	21	<0.1	<0.1	0	**8.8**	**0.7**	**171**
	Arsenic (Filtered)	mg/l	0.1															14.4	19.2	29	<0.1	<0.1	0	**3.8**	**0.1**	**190**
	Cadmium (Filtered)	mg/l	0.05															<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Chromium (III+VI) (Filtered)	mg/l	0.1															<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Copper (Filtered)	mg/l	0.1															0.2	0.2	0	<0.1	<0.1	0	<0.1	<0.1	0
	Lead (Filtered)	mg/l	0.1															0.1	<0.1	0	<0.1	<0.1	0	**1.6**	**<0.1**	**176**
	Nickel (Filtered)	mg/l	0.1															<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Zinc (Filtered)	mg/l	0.1															0.4	0.4	0	0.9	0.8	12	**0.9**	**5.6**	**145**
Moisture Content	Moisture	%	1 (Primary): 0.5 (Interlab)	66.5	69.2	4	14.5	11.0	27	**80.5**	**32.8**	**84**	28.6	26.3	8	16.8	16.3	3	35.9	33.6	7	41.2	44.1	7	41.6	48.2	15
pH (1:5)	pH (Lab)	pH_Units	0.1	4.5	5.0	11	4.3	4.1	5	5.0	4.8	4															
TCLP for Non & Semivolatile Analytes (leached)	pH (after HCL)	pH_Units	0.1															1.9	1.8	5	1.9	1.9	0			
	pH (Final)	pH Unit	0.1															5.0	5.0	0	4.9	4.9	0	4.9	4.9	0
	pH (Initial)	pH_Units	0.1															6.9	6.6	4	5.8	5.7	2	4.1	6.0	38
	TCLP Fluid	-	1															1.0	1.0	0	1.0	1.0	0	1.0	1.0	0
Total Cyanide by Segmented Flow Analyser	Cyanide Total	mg/kg	1	**82.0**	**28.0**	**98**	<1.0	<1.0	0	**2.0**	**<1.0**	**67**															
Total Mercury by FIMS	Mercury	mg/kg	0.1 (Primary): 0.05 (Interlab)	**48.6**	**19.4**	**86**	1.9	2.3	19	**0.2**	**<0.1**	**67**	**28.9**	**1.3**	**183**	<0.1	<0.1	0	78.8	82.0	4	0.1	<0.1	0	**151.0**	**0.6**	**198**
Total Metals by ICP-AES	Aluminium	mg/kg	50 (Primary): 1 (Interlab)				990.0																				
	Antimony	mg/kg	5 (Primary): 3 (Interlab)	**8900.0**	**3770.0**	**81**	626.0	412.0	41	**242.0**	**<5.0**	**192**	2050.0	3290.0	46	<5.0	<5.0	0									
	Arsenic	mg/kg	5 (Primary): 3 (Interlab)	1660.0	1200.0	32	**1370.0**	**800.0**	**53**	**22.0**	**7.0**	**103**	**1160.0**	**126.0**	**161**	<5.0	5.0	0									
	Cadmium	mg/kg	1 (Primary): 0.3 (Interlab)	<1.0	<1.0	0	<1.0	<1.0	0	<1.0	<1.0	0	<1.0	<1.0	0	<1.0	<1.0	0									
	Chromium (III+VI)	mg/kg	2 (Primary): 0.3 (Interlab)	29.0	23.0	23	4.0	3.0	29	15.0	10.0	40	16.0	10.0	46	11.0	13.0	17									
	Copper	mg/kg	5 (Primary): 0.5 (Interlab)	230.0	377.0	48	**47.0**	**28.0**	**51**	**73.0**	**8.0**	**160**	**166.0**	**34.0**	**132**	7.0	7.0	0									
	Iron	mg/kg	2 (Primary): 0.3 (Interlab)																								
	Lead	mg/kg	5 (Primary): 1 (Interlab)	**1500.0**	**587.0**	**87**	69.0	61.0	12	**37.0**	**6.0**	**144**	**116.0**	**64.0**	**58**	6.0	5.0	18									
	Nickel	mg/kg	2 (Primary): 0.5 (Interlab)	5.0	6.0	18	<2.0	<2.0	0	6.0	4.0	40	**5.0**	**20.0**	**120**	<2.0	<2.0	0									
	Zinc	mg/kg	5 (Primary): 0.5 (Interlab)	73.0	79.0	8	20.0	12.0	50	**74.0**	**6.0**	**170**	95.0	82.0	15	13.0	15.0	14									

*RPDs have only been considered where a concentration is greater than 1 times the EQL.

**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (1-10 x EQL); 50 (10-30 x EQL); 50 (> 30 x EQL))

***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory

Trip Blanks

	Antimony	Arsenic
	mg/kg	mg/kg
EQL	5	5
ANZECC (2000) Interim Sediment Quality Guidelines - High	25	70
NEPM 1999 HIL E		200
USEPA RES	310	

Field_ID	Sampled_Date-Time	Matrix_Description		
TB01	6/08/2012	soil	<5	<5
TB02	6/08/2012	soil	<5	<5

Rinsate Samples

	Antimony	Arsenic
	mg/L	mg/L
EQL	0.001	0.001

Field_ID	Sampled_Date-Time		
RB01	15/08/2012	1.64	2.35
RB02	15/08/2012	1.24	3.59
RB03	16/08/2012	0.028	0.009
RB04	15/08/2012	0.013	0.005
RB05	16/08/2012	0.01	0.004

Table 9: SOIL QA/QC Data

SDG				ES1223935	ES1223935		ES1223935	ES1223935		ES1220305	Interlab_D		ES1220305	Interlab_D		ES1220305	Interlab_D		ES1220305	Interlab_D	
Field_ID				BH032_0.3-0.5	BHDUP01	RPD	BH012_0.0-0.1	BHDUP08	RPD	BH075_1.8-2.0	BHLABDUP01	RPD	BH004_0.0-0.2	BHLABDUP02	RPD	BH031_1.0-1.2	BHLABDUP03	RPD	SE050_0.0-0.1	SELABDUP01	RPD
Sampled_Date				14/08/2012	14/08/2012		16/08/2012	16/08/2012		15/08/2012	15/08/2012		16/08/2012	16/08/2012		15/08/2012	15/08/2012		15/08/2012	15/08/2012	
Method_Type	ChemName	Units	EQL																		
1M HCl Extractable Metals	Aluminium	mg/kg	50																		
	Antimony	mg/kg	1																		
	Arsenic	mg/kg	1																		
	Cadmium	mg/kg	0.1																		
	Chromium (III+VI)	mg/kg	1																		
	Cobalt	mg/kg	0.5																		
	Copper	mg/kg	1																		
	Iron	mg/kg	50																		
	Lead	mg/kg	1																		
	Manganese	mg/kg	10																		
	Nickel	mg/kg	1																		
	Silver	mg/kg	1																		
	Vanadium	mg/kg	2																		
	Zinc	mg/kg	1																		
1M HCl Extractable Metals by ICPMS	Selenium	mg/kg	0.5																		
Leachable Mercury by FIMS (leached)	Mercury (Filtered)	mg/l	0.001																		
Leachable Metals by ICPAES (leached)	Aluminium (Filtered)	mg/l	0.1																		
	Antimony (Filtered)	mg/l	0.1																		
	Arsenic (Filtered)	mg/l	0.1																		
	Cadmium (Filtered)	mg/l	0.05																		
	Chromium (III+VI) (Filtered)	mg/l	0.1																		
	Copper (Filtered)	mg/l	0.1																		
	Lead (Filtered)	mg/l	0.1																		
	Nickel (Filtered)	mg/l	0.1																		
	Zinc (Filtered)	mg/l	0.1																		
Moisture Content	Moisture	%	1 (Primary): 0.5 (Interlab)							39.4	40.0	2	9.2	9.7	5	24.2	24.0	1	14.5	12.0	19
pH (1:5)	pH (Lab)	pH_Units	0.1																4.3		
TCLP for Non & Semivolatile Analytes (leached)	pH (after HCL)	pH_Units	0.1																		
	pH (Final)	pH Unit	0.1																		
	pH (Initial)	pH_Units	0.1																		
	TCLP Fluid	-	1																		
Total Cyanide by Segmented Flow Analyser	Cyanide Total	mg/kg	1																<1.0		
Total Mercury by FIMS	Mercury	mg/kg	0.1 (Primary): 0.05 (Interlab)							0.2	0.18	11	61.2	42.0	37	**58.3**	**15.0**	**118**	**1.9**	**0.85**	**76**
Total Metals by ICP-AES	Aluminium	mg/kg	50 (Primary): 1 (Interlab)	3450.0	3120.0	10	13100.0	13400.0	2										990.0	840.0	16
	Antimony	mg/kg	5 (Primary): 3 (Interlab)	6070.0	6070.0	0	**<5.0**	**9.0**	**57**	36.0	55.0	42	4700.0	7800.0	50	9670.0	7100.0	31	**626.0**	**270.0**	**79**
	Arsenic	mg/kg	5 (Primary): 3 (Interlab)	3620.0	4000.0	10	16.0	12.0	29	**129.0**	**51.0**	**87**	1950.0	2200.0	12	5280.0	4700.0	12	**1370.0**	**450.0**	**101**
	Cadmium	mg/kg	1 (Primary): 0.3 (Interlab)	<1.0	<1.0	0	<1.0	<1.0	0	**3.0**	**0.5**	**143**	<1.0	0.4	0	<1.0	<0.3	0	<1.0	<0.3	0
	Chromium (III+VI)	mg/kg	2 (Primary): 0.3 (Interlab)	34.0	44.0	26	15.0	15.0	0	10.0	10.0	0	18.0	27.0	40	9.0	9.8	9	**4.0**	**1.4**	**96**
	Copper	mg/kg	5 (Primary): 0.5 (Interlab)	**231.0**	**111.0**	**70**	12.0	13.0	8	**30.0**	**52.0**	**54**	**136.0**	**250.0**	**59**	21.0	18.0	15	**47.0**	**22.0**	**72**
	Iron	mg/kg	2 (Primary): 0.3 (Interlab)	17600.0	21200.0	19	25400.0	29400.0	15												
	Lead	mg/kg	5 (Primary): 1 (Interlab)	996.0	1450.0	37	12.0	12.0	0	17.0	17.0	0	**150.0**	**73.0**	**69**	133.0	180.0	30	**69.0**	**39.0**	**56**
	Nickel	mg/kg	2 (Primary): 0.5 (Interlab)	<2.0	<2.0	0	5.0	5.0	0	3.0	2.3	26	<2.0	1.6	0	9.0	12.0	29	<2.0	<0.5	0
	Zinc	mg/kg	5 (Primary): 0.5 (Interlab)	39.0	42.0	7	8.0	9.0	12	**76.0**	**22.0**	**110**	47.0	70.0	39	24.0	25.0	4	20.0	18.0	11

*RPDs have only been considered where a concentration is greater than 1 times the EQL.
**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (1-10 x EQL); 50 (10-30 x EQL); 50 (> 30 x
***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row

Trip Blanks

	Antimony
	mg/kg
EQL	5
ANZECC (2000) Interim Sediment Quality Guidelines - High	25
NEPM 1999 HIL E	
USEPA RES	310

Field_ID	Sampled_Date-Time	Matrix_Description	
TB01	6/08/2012	soil	<5
TB02	6/08/2012	soil	<5

Table 10: WATER QA/QC Duplicate Data

			SDG	ES1220550	ES1220550		ES1220550	Interlab_D		
			Field_ID	SW003	SWDUP01	**RPD**	GW006	GWLABDUP01	**RPD**	
			Sampled_Date-Time	22/08/2012	22/08/2012		22/08/2012	22/08/2012		
Method_Type	ChemName	Units	EQL							
Alkalinity by PC Titrator	Alkalinity (total) as CaCO3	mg/l	1 (Primary): 50 (Interlab	4.0	4.0	0	285.0	300.0	5	
	Alkalinity (Bicarbonate as CaCO3)	mg/l	1	4.0	4.0	0				
	Alkalinity (Carbonate as CaCO3)	mg/l	1	<1.0	<1.0	0				
	Alkalinity (Hydroxide) as CaCO3	mg/l	1	<1.0	<1.0	0				
Chloride by Discrete Analyser	Chloride	mg/l	1 (Primary): 0.05 (Interla	33.0	33.0	0	184.0	170.0	8	
Dissolved Mercury by FIMS	Mercury (Filtered)	mg/l	0.0001	<0.0001	<0.0001	0				
Dissolved Metals by ICP-MS - Suite A	Aluminium (Filtered)	mg/l	0.01 (Primary): 0.001 (I	0.19	0.21	10	2.19	2.0	9	
	Antimony (Filtered)	mg/l	0.001	0.12	0.112	7	**1.39**	**5.1**	**114**	
	Arsenic (Filtered)	mg/l	0.001	0.118	0.116	2	**72.6**	**20.0**	**114**	
	Cadmium (Filtered)	mg/l	0.0001	<0.0001	<0.0001	0	<0.0001	<0.0001	0	
	Chromium (III+VI) (Filtered)	mg/l	0.001	<0.001	<0.001	0	0.014	0.013	7	
	Copper (Filtered)	mg/l	0.001	0.012	0.011	9	0.011	0.01	10	
	Iron (Filtered)	mg/l	0.05 (Primary): 0.005 (I	1.21	1.23	2	**37.4**	**6.1**	**144**	
	Lead (Filtered)	mg/l	0.001	0.003	0.003	0	0.125	0.16	25	
	Nickel (Filtered)	mg/l	0.001	<0.001	<0.001	0	0.013	0.01	26	
	Zinc (Filtered)	mg/l	0.005 (Primary): 0.001 (	0.032	0.031	3	**0.063**	**0.036**	**55**	
Ionic Balance by PCT DA and Turbi SO4 DA	Anions Total	meq/L	0.01	1.05	1.05	0				
	Cations Total	meq/L	0.01	1.07	1.07	0				
Major Cations - Dissolved	Calcium (Filtered)	mg/l	1 (Primary): 0.1 (Interlal	2.0	2.0	0	12.0	13.0	8	
	Magnesium (Filtered)	mg/l	1 (Primary): 0.1 (Interlal	2.0	2.0	0	20.0	21.0	5	
	Potassium (Filtered)	mg/l	1 (Primary): 0.2 (Interlal	1.0	1.0	0	8.0	8.5	6	
	Sodium (Filtered)	mg/l	1 (Primary): 0.1 (Interlal	18.0	18.0	0	194.0	190.0	2	
Sulfate (Turbidimetric) as SO4 2- by Discrete Anal	Sulphate	mg/l	1 (Primary): 0.1 (Interlal	2.0	2.0	0	**<10.0**	**29.0**	**97**	
Suspended Solids (High Level)	Total Suspended Solids	mg/l	5	9.0	9.0	0	**1190.0**	**15000.0**	**171**	
Total Cyanide By Discrete Analyser	Cyanide Total	mg/l	0.004 (Primary): 0.005 (	<0.004	<0.004	0	**0.597**	**1.3**	**74**	
Total Dissolved Solids (High Level)	Total Dissolved Solids	mg/l	10	107.0	106.0	1	970.0	960.0	1	
Total Metals by ICP-MS - Suite A	Aluminium	mg/l	0.01	0.25	0.25	0				
	Antimony	mg/l	0.001	0.139	0.154	10				
	Arsenic	mg/l	0.001	0.171	0.171	0				
	Cadmium	mg/l	0.0001	<0.0001	<0.0001	0				
	Chromium (III+VI)	mg/l	0.001	<0.001	<0.001	0				
	Copper	mg/l	0.001	0.017	0.014	19				
	Iron	mg/l	0.05	1.72	1.71	1				
	Lead	mg/l	0.001	0.005	0.006	18				
	Nickel	mg/l	0.001	<0.001	<0.001	0				
	Zinc	mg/l	0.005	0.026	0.03	14				

*RPDs have only been considered where a concentration is greater than 1 times the EQL.

**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (1-10 x EQL); 50 (10-30 x EQL); 50 (> 30 x EQL))

***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory

Appendix D - Aerial Photographs



1967

1973



1979

□□□□□□E□ □□ □□ □□T□□E□□ E□□□□T□□□□□ □□□□□□T



E□□□T□□□□□□



1989



1991

2009

□□□□□□□E□ □□ □□ □□T□□E□□ E□□□□□T□□ □□□□ □□□□□□□T

□□□□□□□E□ □□ □□ □□T□□E□□ E□□□□□T□□ □□□□ □□□□□□□T

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Appendix E - Borelogs

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH001

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: AS
Total Depth (m): 1.5
Diameter (mm): 150

Easting: 500866
Northing: 6625256
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	AS		BH001_0.0-0.2			silty GRAVEL Trace Cobbles,brown	D			0.00
										-0.30
			BH001_0.3-0.5			SILT Some Gravel, trace Cobbles,brown	D			0.30
										-0.70
			BH001_0.7-0.9			clayey SILT Trace Sand and Gravel,orange	M			0.70
										-1.00
1.0			BH001_1.0-1.2			silty CLAY Trace Sand,orange	M			1.00
										-1.50
										1.50
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH002

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: AS
Total Depth (m): 1.4
Diameter (mm): 150

Easting: 500865
Northing: 6625235
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING						LITHOLOGICAL DESCRIPTION			COMMENTS/	
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	AS		BH002_0.0-0.2			sandy SILT Trace Clay, trace Gravel (fine grained),brown	D			0.00
										-0.50
			BH002_0.5-0.7			silty CLAY Trace Sand,orange/ brown	D		BHDUP06	0.50
1.0			BH002_1.0-1.2							-1.20
	HA					CLAY Some Silt, trace Sand,orange/ brown	M			1.20
										-1.40
										1.40
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils
(VL) Very Loose
(L) Loose
(MD) Medium Dense
(D) Dense
(VD) Very Dense

Cohesive Soils
(VS) Very Soft
(S) Soft
(F) Firm
(ST) Stiff
(VST) Very Stiff
(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH003

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: AS
Total Depth (m): 1.2
Diameter (mm): 150

Easting: 500854
Northing: 6625193
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING						LITHOLOGICAL DESCRIPTION				
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	AS		BH003_0.0-0.2			sandy SILT Some Gravel (fine grained),brown	D/M			0.00
										-0.30
						silty CLAY Some Sand,brown	M			0.30
			BH003_0.5-0.7							-0.70
						clayey SILT Trace Sand,dark brown	W			0.70
1.0			BH003_1.0-1.2							-1.20
										1.20
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH004
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: AS
Total Depth (m): 2.2
Diameter (mm): 150

Easting: 500847
Northing: 6625160
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	AS		BH004_0.0-0.2			sandy SILT Trace Gravel (fine grained),brown	D		BHLABDUP02	0.00
			BH004_0.5-0.7							-0.70
						silty CLAY Some Sand,brown/ mottled grey	M			0.70
1.0			BH004_1.0-1.2			silty SAND dark grey	W			-1.00 1.00
	HA									-1.50
			BH004_1.5-1.7			clayey SILT Trace Sand,dark brown	W			1.50
2.0			BH004_2.0-2.2			silty CLAY Trace Gravel (decreasing with depth),orange/ brown	W			-2.00 2.00 -2.20
										2.20
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH005
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 2.2
Diameter (mm): 50

Easting: 500848
Northing: 6625138
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH005_0.0-0.2			silty SAND Trace Organic matter,dark brown	W			0.00 -0.10
						silty SAND brown	W			0.10
			BH005_0.3-0.5							
										-0.80
						sandy SILT grey/ mottled	W			0.80
1.0			BH005_1.0-1.2							
										-1.40
						SILT Trace Sand, Organic matter,dark brown	W			1.40
			BH005_1.5-1.8							
										-1.90
						sandy SILT brown	W			1.90
2.0			BH005_2.0-2.2							
										-2.20
										2.20
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:

D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose (L) Loose (MD) Medium Dense (D) Dense (VD) Very Dense

Cohesive Soils

(VS) Very Soft (S) Soft (F) Firm (ST) Stiff (VST) Very Stiff (H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH006

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 3/08/2012 to: 3/08/2012

Drill Co: GHD
Driller: JS
Rig Type: HA
Total Depth (m): 1
Diameter (mm): 50

Easting: 500824
Northing: 6625115
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING						LITHOLOGICAL DESCRIPTION				
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH006_0.0-0.3			sandy SILT brown/ grey	W			0.00
										-0.50
			BH006_0.5-0.8			SILT Trace Sand,grey	W		BHDUP06	0.50
1.0										-1.00 1.00
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH010

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 2
Diameter (mm): 50

Easting: 500864
Northing: 6625139
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		BH010_0.0-0.2			sandy SILT Organic matter,dark brown	W			0.00 -0.20
			BH010_0.3-0.5			silty SAND brown	W			0.20
1.0			BH010_1.0-1.2							-1.30
			BH010_1.5-1.8			sandy SILT Organic matter,dark brown	W			1.30
2.0										-2.00 2.00
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH011
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 500852
Northing: 6625112
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH011_0.0-0.2			silty CLAY Organic matter,grey	W			0.00 -0.20
			BH011_0.2-0.4			SILT Organic matter,dark brown	W			0.20 -0.40
			BH011_0.4-0.6			clayey SAND Gravel,dark grey	W			0.40 -0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH012
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 500845
Northing: 6625013
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH012_0.0-0.1			sandy SILT dark brown	M		BHDUP08	0.00
										-0.40
			BH012_0.4-0.6			sandy CLAY grey	W			0.40
										-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH014

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 500878
Northing: 6625064
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH014_0.0-0.1			silty SAND dark brown	M			0.00
										-0.40
			BH014_0.4-0.6			clayey SAND orange	M			0.40
										-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH020
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: AS
Total Depth (m): 1.2
Diameter (mm): 150

Easting: 500895
Northing: 6625259
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	AS		BH020_0.0-0.2			sandy SILT Some Clay,brown	M			0.00
			BH020_0.3-0.5							-0.80
1.0			BH020_1.0-1.2			sandy CLAY Trace Silt,orange	M			0.80 -1.20
										1.20
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH021

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.3
Diameter (mm): 50

Easting: 500886
Northing: 6625236
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH021_0.0-0.2			sandy SILT brown	D			0.00
										-0.30
						Auger Refusal, gravel and roots				0.30
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH022
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: AS
Total Depth (m): 0.8
Diameter (mm): 150

Easting: 500873
Northing: 6625212
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	AS		BH022_0.0-0.2			SILT Some Gravel, some Sand, trace Cobbles,brown	M			0.00
										-0.30
						clayey SILT Some Sand, trace Gravel,brown	M			0.30
			BH022_0.5-0.7							
										-0.80
						Auger Refusal- Cobbles				0.80
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH023
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 3/08/2012 to: 3/08/2012

Drill Co: GHD
Driller: JS
Rig Type: HA
Total Depth (m): 2
Diameter (mm): 50

Easting: 500899
Northing: 6625186
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH023_0.0-0.2			SAND Trace Silt,grey/ brown	M			0.00
										-0.50
			BH023_0.5-0.7			grey	W			0.50
1.0			BH023_1.0-1.3							-1.50
						SILT Trace Sand, Organic matter,black	W			1.50
			BH023_1.8-2.0							-2.00
2.0										2.00
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH024
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 4
Diameter (mm): 50

Easting: 500894
Northing: 6625143
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH024_0.0-0.2			silty SAND pale brown	W			0.00
										-0.30
			BH024_0.3-0.5			sandy SILT grey	W			0.30
										-0.90
1.0			BH024_1.0-1.2			sandy SILT Organic matter,brown	W			0.90
			BH024_1.5-1.8							
										-2.00
2.0			BH024_2.0-2.2			clayey SILT Trace Sand,grey	W			2.00
3.0										-3.60
						clayey SILT Some Gravel,grey	W			3.60
4.0										-4.00 4.00

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH027

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 500929
Northing: 6625080
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH027_0.0-0.1			silty SAND Organic matter,grey/ dark brown	W			0.00
			BH027_0.1-0.3							
										-0.40
			BH027_0.4-0.6			sandy CLAY mottled grey/ orange	M			0.40
										-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose	(D) Dense
(L) Loose	(VD) Very Dense
(MD) Medium Dense	

Cohesive Soils

(VS) Very Soft	(ST) Stiff
(S) Soft	(VST) Very Stiff
(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH028

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: AS
Total Depth (m): 1
Diameter (mm): 150

Easting: 500874
Northing: 6625286
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	AS		BH028_0.0-0.2			silty GRAVEL Trace Sand, Trace Cobbles,brown	D			0.00
										-0.30
			BH028_0.3-0.5			sandy SILT Some Gravel,brown	D/M			0.30
										-0.60
						silty CLAY Trace Sand,orange/ brown	M			0.60
			BH028_0.8-1.0							-1.00
1.0										1.00
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH029

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: AS
Total Depth (m): 0.7
Diameter (mm): 150

Easting: 500870
Northing: 6625300
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	AS		BH029_0.0-0.2			silty CLAY Some Sand and Gravel,yellow/ brown	M			0.00
			BH029_0.5-0.7							-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH030
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 2
Diameter (mm): 50

Easting: 500903
Northing: 6625217
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH030_0.0-0.2			silty SAND grey	D/M			0.00
			BH030_0.5-0.7							
1.0			BH030_1.5-1.7							-1.70
						clayey SILT dark brown	W			1.70
			BH030_1.8-2.0							-2.00
2.0										2.00
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH031
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 3
Diameter (mm): 50

Easting: 500917
Northing: 6625197
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH031_0.0-0.2			silty SAND grey	M			0.00
										-0.50
			BH031_0.5-0.7			brown/ grey	M			0.50
										-1.00
1.0			BH031_1.0-1.2			brown/ purple	M			1.00
										-1.50
						clayey SILT Trace Sand,dark brown	W			1.50
			BH031_1.8-2.0							
2.0										
										-3.00
3.0										3.00
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH032
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 1.8
Diameter (mm): 50

Easting: 500919
Northing: 6625151
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH032_0.0-0.2			silty SAND pale brown	W			0.00
										-0.30
			BH032_0.3-0.5			sandy SILT grey/ brown	W			0.30
1.0			BH032_1.0-1.2			SILT Trace Sand,brown	M			-1.00 1.00
			BH032_1.5-1.8							-1.80
										1.80
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose	(D) Dense
(L) Loose	(VD) Very Dense
(MD) Medium Dense	

Cohesive Soils

(VS) Very Soft	(ST) Stiff
(S) Soft	(VST) Very Stiff
(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH034
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.9
Diameter (mm): 50

Easting: 500968
Northing: 6625075
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH034_0.0-0.1			sandy SILT dark brown	M		BHDUP04	0.00
										-0.30
			BH034_0.3-0.5			sandy CLAY mottled grey/ orange	M			0.30
			BH034_07-0.9							-0.90
1.0										0.90
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH039
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: AS
Total Depth (m): 2.8
Diameter (mm): 150

Easting: 500876
Northing: 6625186
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	AS		BH039_0.0-0.2			sandy SILT Trace Clay and Gravel,brown	D			0.00
										-0.30
						silty CLAY Some Sand, trace Gravel,brown/ orange	M			0.30
			BH039_0.5-0.7							
										-0.90
1.0						brown	M			0.90
			BH039_1.0-1.2							
										-1.30
	HA					clayey SAND Some Silt,grey	W			1.30
			BH039_1.5-1.7							
2.0										
			BH039_2.0-2.2							
										-2.20
			BH039_2.2-2.4			clayey SILT Trace Sand,dark brown	W			2.20
										-2.40
						clayey SAND Some Silt,grey	W			2.40
										-2.80
										2.80
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH040

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 500918
Northing: 6625272
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		BH040_0.0-0.2			sandy SILT Trace Gravel (fine grained),brown	D/M			0.00
			BH040_0.3-0.5							-0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH041
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 1.2
Diameter (mm): 50

Easting: 500920
Northing: 6625231
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH041_0.0-0.2			silty SAND Trace Clay and Gravel,brown	M			0.00
			BH041_0.5-0.7							
1.0			BH041_1.0-1.2				W			-1.00 1.00 -1.20
										1.20
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:

D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH042

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 1.7
Diameter (mm): 50

Easting: 500939
Northing: 6625168
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING						LITHOLOGICAL DESCRIPTION				
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH042_0.0-0.2			silty SAND grey	M			0.00
										-0.30
			BH042_0.3-0.5			sandy SILT Trace Wood,grey	W			0.30
1.0										-1.00
			BH042_1.0-1.2			SILT Trace Sand,dark brown	M			1.00
			BH042_1.5-1.7							-1.70
										1.70
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH043
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 1.7
Diameter (mm): 50

Easting: 500950
Northing: 6625159
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH043_0.0-0.2			silty SAND brown	W			0.00
			BH043_0.3-0.5							
										-0.80
						sandy SILT grey	W			0.80 -1.00
1.0			BH043_1.0-1.2			SILT Trace Sand,dark brown	W			1.00
			BH043_1.5-1.7							-1.70
										1.70
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH046

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: AS
Total Depth (m): 0.7
Diameter (mm): 150

Easting: 500892
Northing: 6625291
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	AS		BH046_0.0-0.2			sandy SILT Trace Clay,brown	D			0.00
										-0.40
						silty CLAY Trace Sand,orange/ brown	D/M			0.40
			BH046_0.5-0.7							-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH047

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: AS
Total Depth (m): 0.7
Diameter (mm): 150

Easting: 500862
Northing: 6625276
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	AS		BH047_0.0-0.2			sandy SILT Trace Clay,brown	D			0.00
										-0.50
			BH047_0.5-0.7				D/M			0.50
										-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH050

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 1.2
Diameter (mm): 50

Easting: 500936
Northing: 6625239
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH050_0.0-0.2			sandy SILT grey	W			0.00
			BH050_0.2-0.4							-0.40
						sandy SILT Some Clay,dark brown	W			0.40
			BH050_0.5-0.7							-0.90
1.0			BH050_1.0-1.2			silty CLAY dark brown	W			0.90
										-1.20
										1.20
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH052

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 3
Diameter (mm): 50

Easting: 500954
Northing: 6625213
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH052_0.0-0.2			silty SAND grey/ brown	M			0.00
										-0.50
			BH052_0.5-0.7				W			0.50
										-0.80
						clayey SILT Trace Sand,grey	W			0.80
1.0			BH052_1.0-1.2						BHDUP03	
										-1.20
						dark brown				1.20
										-1.80
			BH052_1.8-2.0			clayey SILT Trace Sand,grey	W			1.80
2.0										
			BH052_2.3-2.5							
			BH052_2.8-3.0							
										-3.00
3.0										3.00
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils
(VL) Very Loose
(L) Loose
(MD) Medium Dense
(D) Dense
(VD) Very Dense

Cohesive Soils
(VS) Very Soft
(S) Soft
(F) Firm
(ST) Stiff
(VST) Very Stiff
(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH053
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 3.5
Diameter (mm): 50

Easting: 500967
Northing: 6625173
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		BH053_0.0-0.2			sandy SILT grey	M			0.00
			BH053_0.3-0.5							
										-1.00
1.0			BH053_1.0-1.2			SILT Trace Sand,dark brown	W			1.00
			BH053_1.5-1.7							-2.00
2.0			BH053_2.0-2.2			clayey SILT Trace Sand,grey	W			2.00
3.0			BH053_3.2-3.5							-3.50
										3.50
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH054

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 1.7
Diameter (mm): 50

Easting: 500957
Northing: 6625166
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING						LITHOLOGICAL DESCRIPTION				
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH054_0.0-0.2			silty SAND Crust at water level,brown	W			0.00
			BH054_0.3-0.5							
			BH054_0.7-0.9							-0.80
						sandy SILT grey	W			0.80 -1.00
1.0			BH054_1.0-1.2			SILT Trace Sand,dark brown	W			1.00
			BH054_1.5-1.7							-1.70
										1.70
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH056

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 500968
Northing: 6625286
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH056_0.0-0.2			silty SAND brown	D			0.00
										-0.30
			BH056_0.3-0.5			sandy SILT Some Clay,orange/ brown	M			0.30
										-0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils
(VL) Very Loose
(L) Loose
(MD) Medium Dense
(D) Dense
(VD) Very Dense

Cohesive Soils
(VS) Very Soft
(S) Soft
(F) Firm
(ST) Stiff
(VST) Very Stiff
(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH057

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 500967
Northing: 6625255
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH057_0.0-0.2			sandy SILT Trace Clay,dark brown	M			0.00
			BH057_0.3-0.5							-0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH060
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: n/a
Driller: JS
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 500949
Northing: 6625255
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH060_0.0-0.2			sandy SILT Some Gravel (approx. 3mm),brown	M		Possible fill material	0.00
			BH060_0.3-0.5							
										-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH061

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 500947
Northing: 6625280
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		BH061_0.0-0.2			sandy SILT Trace Clay,orange/ brown	M			0.00
			BH061_0.3-0.5							-0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH062

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 500942
Northing: 6625313
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		BH062_0.0-0.2			clayey SILT Some Sand,brown/ grey	M			0.00
			BH062_0.3-0.5							-0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose	(D) Dense
(L) Loose	(VD) Very Dense
(MD) Medium Dense	

Cohesive Soils

(VS) Very Soft	(ST) Stiff
(S) Soft	(VST) Very Stiff
(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH063
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 500975
Northing: 6625321
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH063_0.0-0.2			silty CLAY Some Sand,orange/ brown	M			0.00
			BH063_0.3-0.5							-0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH064

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 500980
Northing: 6625343
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH064_0.0-0.2			silty CLAY Trace Sand,brown	M			0.00
										-0.30
			BH064_0.3-0.5			silty CLAY Trace Sand,orange/ brown	M			0.30
										-0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose	(D) Dense
(L) Loose	(VD) Very Dense
(MD) Medium Dense	

Cohesive Soils

(VS) Very Soft	(ST) Stiff
(S) Soft	(VST) Very Stiff
(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH065

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 501003
Northing: 6625341
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		BH065_0.0-0.2			silty CLAY Trace Sand,brown	M			0.00
			BH065_0.3-0.5							-0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils
(VL) Very Loose
(L) Loose
(MD) Medium Dense
(D) Dense
(VD) Very Dense

Cohesive Soils
(VS) Very Soft
(S) Soft
(F) Firm
(ST) Stiff
(VST) Very Stiff
(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH066

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 500992
Northing: 6625305
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		BH066_0.0-0.2			sandy SILT Trace Clay,orange/ brown	M			0.00
			BH066_0.5-0.7							-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH067

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 501028
Northing: 6625327
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING						LITHOLOGICAL DESCRIPTION				
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH067_0.0-0.2			clayey SILT brown	M			0.00
										-0.50
			BH067_0.5-0.7			CLAY Some Silt,grey	M			0.50
										-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH069

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 500988
Northing: 6625271
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH069_0.0-0.2			sandy SILT Trace Clay,brown	M			0.00
			BH069_0.3-0.5							-0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH070

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 501021
Northing: 6625316
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		BH070_0.0-0.2			clayey SAND Mottled orange and grey/ brown	M			0.00
			BH070_0.5-0.7							-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH071

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 501071
Northing: 6625320
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH071_0.0-0.2			silty CLAY Some Sand,dark brown	M			0.00
			BH071_0.5-0.7							-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH072

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 501094
Northing: 6625331
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING						LITHOLOGICAL DESCRIPTION				
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH072_0.0-0.2			silty CLAY Some Sand,dark brown	W			0.00
										-0.40
						grey				0.40
			BH072_0.5-0.7							-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH073

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 1.2
Diameter (mm): 50

Easting: 501032
Northing: 6625306
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH073_0.0-0.2			clayey SAND brown/ grey	M			0.00
										-0.50
			BH073_0.5-0.7				W			0.50
1.0			BH073_1.0-1.2			sandy CLAY brown/ grey	W			-1.00 1.00
										-1.20 1.20
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH074

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 1
Diameter (mm): 50

Easting: 501025
Northing: 6625286
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH074_0.0-0.2			clayey SILT Some Sand,dark brown	M			0.00
										-0.80
			BH074_0.8-1.0			sandy CLAY Trace Silt,brown/ grey	M			0.80
1.0										-1.00 1.00
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils
(VL) Very Loose
(L) Loose
(MD) Medium Dense
(D) Dense
(VD) Very Dense

Cohesive Soils
(VS) Very Soft
(S) Soft
(F) Firm
(ST) Stiff
(VST) Very Stiff
(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH075
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 2
Diameter (mm): 50

Easting: 501012
Northing: 6625245
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH075_0.0-0.2			sandy SILT brown	D			0.00
										-0.70
						grey				0.70
1.0			BH075_1.0-1.2			Some Clay,brown				-1.00 1.00
										-1.50
							W			1.50
										-1.80
			BH075_1.8-2.0			dark brown			BHLABDUP01	1.80
2.0										-2.00 2.00
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH076

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 500991
Northing: 6625251
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		BH076_0.0-0.2			clayey SILT Some Sand, Organic matter,dark brown	W			0.00
			BH076_0.3-0.5							-0.40
						SAND Trace Silt,grey	W			0.40
										-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose	(D) Dense
(L) Loose	(VD) Very Dense
(MD) Medium Dense	

Cohesive Soils

(VS) Very Soft	(ST) Stiff
(S) Soft	(VST) Very Stiff
(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH077

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 2.2
Diameter (mm): 50

Easting: 500997
Northing: 6625216
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH077_0.0-0.2			sandy SILT grey	D/M			0.00 -0.10
						mottled brown	D			0.10
			BH077_0.3-0.5							-0.50
						clayey SILT Some Sand, Roots @ 0.8m,dark brown	M			0.50
1.0			BH077_1.0-1.2			CLAY Stiff,grey	M			-1.00 1.00
										-1.40
			BH077_1.5-1.7			SILT Trace Sand,dark brown	W			1.40
2.0			BH077_2.0-2.2			black				-2.00 2.00
										-2.20
3.0										2.20
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH078

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 1.7
Diameter (mm): 50

Easting: 501019
Northing: 6625227
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH078_0.0-0.2			SAND Trace Silt,pale grey	D/M			0.00
										-0.30
			BH078_0.3-0.5			silty SAND Organic matter,dark brown	M			0.30
										-1.00
1.0			BH078_1.0-1.2			sandy CLAY Trace Silt,dark brown	W			1.00
										-1.40
						clayey SILT Trace Sand,dark brown	W			1.40
			BH078_1.5-1.7							-1.70
										1.70
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils
(VL) Very Loose
(L) Loose
(MD) Medium Dense
(D) Dense
(VD) Very Dense

Cohesive Soils
(VS) Very Soft
(S) Soft
(F) Firm
(ST) Stiff
(VST) Very Stiff
(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH079

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 1
Diameter (mm): 50

Easting: 501042
Northing: 6625267
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH079_0.0-0.2			SAND Trace Silt,pale grey	M			0.00
										-0.80
			BH079_0.8-1.0			clayey SAND brown/ grey	M			0.80
1.0										-1.00 1.00
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH080

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 1.2
Diameter (mm): 50

Easting: 501059
Northing: 6625289
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH080_0.0-0.2			sandy CLAY mottled orange/ grey	M			0.00
										-1.00
1.0			BH080_1.0-1.2			silty SAND Some Clay,dark brown	M		BHDUP02	1.00
										-1.20
										1.20
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH081

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 1.8
Diameter (mm): 50

Easting: 501064
Northing: 6625271
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH081_0.0-0.2			clayey SAND Roots,brown	M			0.00
										-0.70
						CLAY mottled white/ orange	M			0.70
1.0										-1.00
			BH081_1.0-1.2			clayey SILT Trace Sand,dark brown	M			1.00
										-1.30
						CLAY mottled pale grey/ orange	M			1.30
										-1.50
						sandy CLAY grey	W			1.50
			BH081_1.6-1.8							-1.80
										1.80
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH082
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 1.7
Diameter (mm): 50

Easting: 501046
Northing: 6625229
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING						LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.			COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log		Moisture	Consistency		
						Ground Surface:				0.00
0.0	HA		BH082_0.0-0.2			CLAY mottled pale grey/ orange	D/M			0.00
			BH082_0.3-0.5							
1.0			BH082_1.0-1.2			SAND Some Silt, trace Clay,grey	W			-1.00 1.00 -1.20
			BH082_1.5-1.7			SILT Trace Sand,dark brown	M/W			1.20 -1.70
										1.70
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH083
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 1.7
Diameter (mm): 50

Easting: 501076
Northing: 6625232
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH083_0.0-0.2			silty SAND mottled brown	M			0.00
										-0.30
			BH083_0.3-0.5			clayey SILT Some Sand,dark brown	M			0.30
										-0.90
						SILT Trace Sand,dark brown	M			0.90 -1.00
1.0			BH083_1.0-1.2			silty CLAY Some Sand,brown	W			1.00
			BH083_1.5-1.7							-1.70
										1.70
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH084

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 1.7
Diameter (mm): 50

Easting: 501077
Northing: 6625256
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		BH084_0.0-0.2			sandy SILT Trace Clay,brown	D			0.00
										-0.50
			BH084_0.5-0.7			silty CLAY pale brown	M			0.50
										-1.00
1.0			BH084_1.0-1.2			clayey SILT Trace Sand,dark brown	W			1.00
										-1.40
			BH084_1.5-1.7			silty CLAY Trace Sand,dark brown	W			1.40
										-1.70
										1.70
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH091

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 501108
Northing: 6625107
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		BH091_0.0-0.1			SILT Some Clay,brown	M			0.00
			BH091_0.1-0.3							
			BH091_0.3-0.5							-0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose	(D) Dense
(L) Loose	(VD) Very Dense
(MD) Medium Dense	

Cohesive Soils

(VS) Very Soft	(ST) Stiff
(S) Soft	(VST) Very Stiff
(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH093

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 1
Diameter (mm): 50

Easting: 501133
Northing: 6625139
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH093_0.0-0.1			SILT Organic matter,dark brown	M			0.00
										-0.20
			BH093_0.2-0.4			silty CLAY dark grey	M			0.20
			BH093_0.4-0.6							
										-0.80
			BH093_0.8-1.0			silty CLAY grey	W			0.80
1.0										-1.00
										1.00
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH100

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 500848
Northing: 6625241
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		BH100_0.0-0.2			SILT Some Gravel,grey/ brown	D			0.00 -0.20
			BH100_0.3-0.5			silty CLAY Trace Gravel,orange/ brown	M			0.20 -0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH101

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: MK
Rig Type: HA
Total Depth (m): 1.2
Diameter (mm): 50

Easting: 500830
Northing: 6625169
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING						LITHOLOGICAL DESCRIPTION				
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH101_0.0-0.2			clayey SILT orange/ brown	W			0.00
										-0.50
			BH101_0.5-0.7			silty CLAY mottled orange/ grey/ brown	M			0.50
										-0.90
1.0			BH101_1.0-1.2			orange				0.90
										-1.20
										1.20
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose	(D) Dense
(L) Loose	(VD) Very Dense
(MD) Medium Dense	

Cohesive Soils

(VS) Very Soft	(ST) Stiff
(S) Soft	(VST) Very Stiff
(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE001
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 500894
Northing: 6625123
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE001_0.0-0.1			silty SAND brown	W			0.00 -0.10
			SE001_0.1-0.2			CLAY Trace Sand,grey	W			0.10 -0.20
						silty CLAY Trace sand, Organic matter,black	W			0.20
			SE001_0.4-0.6							
										-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE002
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 500896
Northing: 6625113
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE002_0.0-0.1			sandy SILT Organic matter,grey	W			0.00 -0.10
						CLAY Tr. Sand, Organic matter,black	W			0.10
			SE002_0.3-0.5							-0.50
			SE002_0.5-0.7			sandy CLAY Organic matter,dark grey	W			0.50 -0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE003
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 500911
Northing: 6625118
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE003_0.0-0.1			SILT Organic matter,grey	W			0.00
										-0.20
			SE003_0.2-0.4			SILT Organic matter,dark brown	W			0.20
										-0.40
			SE003_0.4-0.6			silty CLAY dark brown	W			0.40
										-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE004
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 500881
Northing: 6625094
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SEDUP05			SILT Organic matter,dark brown	W			0.00
										-0.20
			SE004_0.2-0.3			silty CLAY Organic matter,dark brown	W		SEDUP05	0.20 -0.30
							W			0.30
			SE004_0.4-0.6			SILT Organic matter,dark brown				-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE005
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.1
Diameter (mm): 50

Easting: 500918
Northing: 6625101
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE005_0.0-0.1			clayey SILT Organic matter,dark brown	W			0.00 -0.10
										0.10
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE010
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 1.4
Diameter (mm): 50

Easting: 500930
Northing: 6625143
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA					CLAY Some Silt, trace Sand,grey	W			0.00
			SE010_0.1-0.3							
										-0.60
			SE010_0.6-0.8			SILT Some Clay and Sand, Organic matter,black	W			0.60
1.0										-1.40
										1.40
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE011
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 1.1
Diameter (mm): 50

Easting: 500935
Northing: 6625135
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING						LITHOLOGICAL DESCRIPTION				
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE011_0.0-0.1			CLAY Some Silt, trace Sand,grey	W			0.00
										-0.20
						Organic matter,black				0.20
			SE011_0.3-0.5							
			SE011_0.7-0.9							
1.0										-1.10
										1.10
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE012
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 1.2
Diameter (mm): 50

Easting: 500942
Northing: 6625127
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE012_0.0-0.1			silty CLAY Trace Sand,grey	W			0.00 -0.10
						silty CLAY Trace Sand, Organic matter increasing with depth,black	W			0.10
			SE012_0.3-0.5							
1.0			SE012_1.0-1.2							-1.20
										1.20
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE013
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 500949
Northing: 6625120
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SEDUP04			SILT Some grey clay, Organic matter,black	W		SEDUP04	0.00
										-0.20
						silty CLAY Organic matter,dark brown	W			0.20
			SE013_0.3-0.5							-0.50
			SE013_0.5-0.7			SILT Organic matter,black	W			0.50
										-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE014
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 500972
Northing: 6625090
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE014_0.0-0.05			silty CLAY	W			0.00
						grey	W			
						SILT				-0.20
						Organic matter,dark brown	W			0.20
			SE014_0.2-0.4			silty CLAY				
						brown/ grey				-0.40
							W			0.40
			SE014_0.4-0.6			SILT				
						Organic matter,dark brown				-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE020
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 500974
Northing: 6625148
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE020_0.0-0.1			CLAY Trace Sand,grey	W			0.00 -0.10
						silty CLAY Trace Sand, Organic matter,black	W			0.10
			SE020_0.2-0.4							-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE021
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 500981
Northing: 6625143
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE021_0.0-0.1			silty CLAY Some Sand,grey	W			0.00 -0.10
						silty CLAY Organic matter,black	W			0.10
			SE021_0.3-0.5							
										-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE022
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 501015
Northing: 6625119
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE022_0.0-0.05			silty CLAY	W			0.00
						grey	W			
						SILT				-0.20
						Organic matter,dark brown	W			0.20
			SE022_0.2-0.4			silty CLAY				
						brown/ grey				-0.40
							W			0.40
			SE022_0.4-0.6			SILT				
						Organic matter,dark brown				-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE030

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 500980
Northing: 6625193
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		SE030_0.0-0.1			clayey SILT brown	W			0.00
										-0.20
						silty CLAY grey	W			0.20
			SE030_0.3-0.5							-0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE031
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 500989
Northing: 6625182
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE031_0.0-0.1			CLAY Trace Sand,grey	W			0.00
										-0.20
			SE031_0.2-0.4			silty CLAY Some Sand, Organic matter,black	W			0.20
			SE031_0.5-0.7							-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE032
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 500999
Northing: 6625175
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE032_0.0-0.1			silty CLAY Some Sand,grey	W			0.00 -0.10
			SE032_0.1-0.3			clayey SILT Some Sand, Organic matter,black	W		SEDUP01	0.10
										-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE033
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 501021
Northing: 6625185
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE033_0.0-0.05			silty CLAY	W			0.00
						grey	W			
						SILT				-0.20
						Organic matter,dark brown	W			0.20
			SE033_0.2-0.4			silty CLAY				
						brown/ grey				-0.40
							W			0.40
			SE033_0.4-0.6			SILT				
						Organic matter,dark brown				-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE040
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 501038
Northing: 6625212
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA					SILT Organic matter,dark brown	W			0.00 -0.20
			SE040_0.3-0.5			CLAY Trace Sand,grey	W			0.20 -0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE041
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 501041
Northing: 6625205
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE041_0.0-0.05			CLAY	W			0.00
						Some Sand,grey	W			
			SE041_0.1-0.3			silty CLAY Organic matter,black				
										-0.40
						clayey SILT Organic matter,black	W			0.40
			SE041_0.5-0.7							-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE042
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 501046
Northing: 6625195
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE042_0.0-0.1			silty CLAY grey	W			0.00 -0.10
						clayey SILT Organic matter,dark brown	W			0.10
			SE042_0.2-0.4							
										-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE043
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 501077
Northing: 6625201
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE043_0.0-0.1			SILT Organic,dark brown	W			0.00 -0.10
			SE043_0.1-0.3			sandy CLAY trace Silt,brown/ grey	W			0.10 -0.30
			SE043_0.3-0.5			SILT Organic,dark brown	W			0.30 -0.50
1.0										0.50
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE050
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 500971
Northing: 6625229
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE050_0.0-0.1			GRAVEL Some Sand,light brown	W		SEDUP03/ SELABDUP01	0.00
										-0.20
			SE050_0.2-0.4			silty CLAY grey	W			0.20
										-0.40
			SE050_0.4-0.6			SILT Organic matter,dark brown	W			0.40
										-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE051
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 500991
Northing: 6625234
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE051_0.0-0.1			silty CLAY Trace Sand,grey	W			0.00
										-0.20
						silty CLAY Some Sand, Organic matter,dark brown	W			0.20
			SE051_0.3-0.5							-0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE052

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 14/08/2012 to: 14/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.3
Diameter (mm): 50

Easting: 501003
Northing: 6625245
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE052_0.0-0.1			silty SAND grey	W			0.00
										-0.30
										0.30
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE053
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.1
Diameter (mm): 50

Easting: 501017
Northing: 6625253
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE053_0.0-0.1			sandy CLAY grey	W			0.00 -0.10
										0.10
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE054
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 501057
Northing: 6625252
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE054_0.0-0.1			silty CLAY grey	W		SEDUP02	0.00 -0.10
			SE054_0.1-0.3			sandy SILT brown	W			0.10 -0.30
						Organic matter	W			0.30
			SE054_0.4-0.6							-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE055
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.1
Diameter (mm): 50

Easting: 501049
Northing: 6625272
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE055_0.0-0.1			silty SAND grey	W			0.00 -0.10
										0.10
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE056
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.4
Diameter (mm): 50

Easting: 501039
Northing: 6625294
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE056_0.0-0.05			SILT	W			0.00
			SE056_0.05-0.15			Organic matter	W			-0.15
						silty SAND	W			0.15
			SE056_0.2-0.4			grey silty CLAY Some Sand,grey				-0.40
										0.40
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE057
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 501065
Northing: 6625302
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE057_0.0-0.1			CLAY Organic matter,black	W			0.00
										-0.20
			SE057_0.2-0.4			CLAY Trace Sand,brown/ grey	W			0.20
										-0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE060
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 501103
Northing: 6625215
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE060_0.0-0.1			silty CLAY Some Sand,brown/ grey	W			0.00
			SE060_0.2-0.4							-0.40
			SE060_0.5-0.7			GRAVEL Some Sand	W			0.40 -0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE061

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 501096
Northing: 6625230
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING						LITHOLOGICAL DESCRIPTION				
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE061_0.0-0.1			silty CLAY Some Sand,brown/ grey	W			0.00
			SE061_0.2-0.4							-0.40
			SE061_0.5-0.7			GRAVEL Some Sand	W			0.40 -0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE062
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 501098
Northing: 6625257
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE062_0.0-0.1			SILT Trace Sand, Organic matter,black	W			0.00
										-0.20
			SE062_0.2-0.3			sandy CLAY dark grey	W			0.20 -0.30
							W			0.30
			SE062_0.4-0.6			SILT Organic matter,black				-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE063
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 501117
Northing: 6625269
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE063_0.0-0.1			SILT Trace Sand, Organic matter,black	W			0.00
										-0.20
			SE063_0.2-0.3			sandy CLAY dark grey	W			0.20 -0.30
							W			0.30
			SE063_0.4-0.6			SILT Organic matter,black				-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE064
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 501125
Northing: 6625245
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE064_0.0-0.1			SILT Trace Sand, Organic matter,black	W			0.00
										-0.20
			SE064_0.2-0.3			sandy CLAY dark grey	W			0.20 -0.30
							W			0.30
			SE064_0.4-0.6			SILT Organic matter,black				-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE065
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 501153
Northing: 6625264
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE065_0.0-0.1			SILT Trace Sand, Organic matter,black	W			0.00
										-0.20
			SE065_0.2-0.3			sandy CLAY dark grey	W			0.20 -0.30
							W			0.30
			SE065_0.4-0.6			SILT Organic matter,black				-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE066
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 501138
Northing: 6625278
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE066_0.0-0.1			SILT Trace Sand, Organic matter,black	W			0.00
										-0.20
			SE066_0.2-0.3			sandy CLAY dark grey	W			0.20 -0.30
							W			0.30
			SE066_0.4-0.6			SILT Organic matter,black				-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE067
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 501173
Northing: 6625295
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE067_0.0-0.1			SILT Trace Sand, Organic matter,black	W			0.00
										-0.20
			SE067_0.2-0.3			sandy CLAY dark grey	W			0.20 -0.30
							W			0.30
			SE067_0.4-0.6			SILT Organic matter,black				-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE068
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 15/08/2012 to: 15/08/2012

Drill Co: GHD
Driller: BL/BJ
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 501193
Northing: 6625321
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL/BJ Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE068_0.0-0.1			SILT Trace Sand, Organic matter,black	W			0.00
										-0.20
			SE068_0.2-0.3			sandy CLAY dark grey	W			0.20 -0.30
							W			0.30
			SE068_0.4-0.6			SILT Organic matter,black				-0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE102
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 16/08/2012 to: 16/08/2012

Drill Co: GHD
Driller: JS
Rig Type: HA
Total Depth (m): 0.2
Diameter (mm): 50

Easting: 500829
Northing: 6625097
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: JS Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0			SE102_0.0-0.2			SILT Trace Clay and Sand,dark brown	W			0.00 -0.20
										0.20
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

Appendix F - Laboratory Reports

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1219239**	Page	: 1 of 3
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR BEN LUFFMAN	Contact	: Angelene Kumar
Address	: 230 HARBOUR DRIVE PO Box 1340 COFFS HARBOUR NSW, AUSTRALIA 2450	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: ben_luffman@ghd.com	E-mail	: angelene.kumar@alsglobal.com
Telephone	: +61 02 6650 5600	Telephone	: +61 2 8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61 2 8784 8555
Project	: 2216251-URUNGA	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: 158501	Date Samples Received	: 08-AUG-2012
Sampler	: JS	Issue Date	: 10-AUG-2012
Site	: ----		
		No. of samples received	: 4
Quote number	: SY/270/12	No. of samples analysed	: 3

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*
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			Client sample ID	BH006_0.0-0.3	BH23_0.0-0.2	BH23_0.5-0.7	----	----
			Client sampling date / time	03-AUG-2012 15:00	03-AUG-2012 15:00	03-AUG-2012 15:00	----	----
Compound	CAS Number	LOR	Unit	ES1219239-001	ES1219239-003	ES1219239-004	----	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	36.2	16.5	18.4	----	----
EG005T: Total Metals by ICP-AES								
Antimony	7440-36-0	5	mg/kg	1950	13200	8650	----	----
Arsenic	7440-38-2	5	mg/kg	702	6860	4110	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	2.3	146	42.8	----	----

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1220305**	Page	: 1 of 33
Amendment	: **1**		
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR BEN LUFFMAN	Contact	: Angelene Kumar
Address	: 230 HARBOUR DRIVE PO Box 1340 COFFS HARBOUR NSW, AUSTRALIA 2450	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: ben_luffman@ghd.com	E-mail	: angelene.kumar@alsglobal.com
Telephone	: +61 02 6650 5600	Telephone	: +61 2 8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61 2 8784 8555
Project	: 2216251	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 22-AUG-2012
Sampler	: JS	Issue Date	: 13-NOV-2012
Site	: HILLSIDE DR,URUNGA		
		No. of samples received	: 131
Quote number	: SY/270/12	No. of samples analysed	: 92

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*
		Newcastle
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Evie.Sidarta	Inorganic Chemist	Sydney Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Stafford Minerals - AY
Nanthini Coilparampil	Laboratory Manager - Inorganics	Sydney Inorganics
Sarah Millington	Senior Inorganic Chemist	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

- **EG005: Poor precision was obtained for some elements on sample ES1220305#18 due to sample heterogeneity. Results have been confirmed by re-extraction and reanalysis.**
- **EG005T: Poor precision was obtained for Aluminium on sample Es1220305#44 and for Copper on sample ES1220305#86 due to sample heterogeneity.**
- **It is recognised that total analyte concentration is less than (1M) HCl Extractable concentration for some samples. However, the difference is within experimental variation of the methods.**
- **Some of samples' IDs were changed after Brian's email request on 07/09/2012.**
- **This report has been amended following changes to the analytical data reported. The quality system is being utilised to resolve this issue. The specific data affected includes Arsenic result for sample 10 reported by EG005T analysis.**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	BH074_0.8-1.0	BH064_0.0-0.2	BH064_0.3-0.5	BH073_0.0-0.2	BH073_0.5-0.7
				Client sampling date / time	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
					ES1220305-001	ES1220305-002	ES1220305-003	ES1220305-004	ES1220305-005
EA002 : pH (Soils)									
pH Value	----	0.1	pH Unit		**5.0**	**5.6**	**5.3**	**3.2**	**3.4**
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		**12.5**	**24.5**	**22.0**	**10.5**	**14.9**
EG005T: Total Metals by ICP-AES									
Antimony	7440-36-0	5	mg/kg		<5	<5	<5	**295**	**405**
Arsenic	7440-38-2	5	mg/kg		<5	<5	**7**	**496**	**416**
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	**47.5**	**57.8**
EK026G: Total Cyanide By Discrete Analyser									
Total Cyanide	57-12-5	1	mg/kg		**1**	**1**	**1**	<1	<1

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BH056_0.3-0.5	BH075_1.8-2.0	BH060_0.0-0.2	BH82_1.5-1.7	BH034_0.0-0.1
Client sampling date / time				15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
				ES1220305-006	ES1220305-007	ES1220305-008	ES1220305-009	ES1220305-010
EA150: Particle Sizing								
+75µm	----	1	%	----	----	----	----	77
+150µm	----	1	%	----	----	----	----	73
+300µm	----	1	%	----	----	----	----	26
+425µm	----	1	%	----	----	----	----	6
+600µm	----	1	%	----	----	----	----	1
+1180µm	----	1	%	----	----	----	----	<1
+2.36mm	----	1	%	----	----	----	----	<1
+4.75mm	----	1	%	----	----	----	----	<1
+9.5mm	----	1	%	----	----	----	----	<1
+19.0mm	----	1	%	----	----	----	----	<1
+37.5mm	----	1	%	----	----	----	----	<1
+75.0mm	----	1	%	----	----	----	----	<1
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.0	----	4.6	5.6	3.0
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	11.6	39.4	12.0	66.2	16.6
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	----	----	----	14
Silt (2-60 µm)	----	1	%	----	----	----	----	7
Sand (0.06-2.00 mm)	----	1	%	----	----	----	----	79
Gravel (>2mm)	----	1	%	----	----	----	----	<1
Cobbles (>6cm)	----	1	%	----	----	----	----	<1
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	----	----	0.2
Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	----	0.5
Exchangeable Potassium	----	0.1	meq/100g	----	----	----	----	<0.1
Exchangeable Sodium	----	0.1	meq/100g	----	----	----	----	0.1
Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	----	0.9
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	----	----	----	410
Antimony	7440-36-0	5	mg/kg	<5	36	160	92	12400
Arsenic	7440-38-2	5	mg/kg	<5	129	66	1510	6900
Cadmium	7440-43-9	1	mg/kg	----	3	----	----	<1
Chromium	7440-47-3	2	mg/kg	----	10	----	----	3
Copper	7440-50-8	5	mg/kg	----	30	----	----	8
Lead	7439-92-1	5	mg/kg	----	17	----	----	138

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BH056_0.3-0.5	BH075_1.8-2.0	BH060_0.0-0.2	BH82_1.5-1.7	BH034_0.0-0.1
				Client sampling date / time: 15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
				ES1220305-006	ES1220305-007	ES1220305-008	ES1220305-009	ES1220305-010
EG005T: Total Metals by ICP-AES - Continued								
Nickel	7440-02-0	2	mg/kg	----	**3**	----	----	<2
Zinc	7440-66-6	5	mg/kg	----	**76**	----	----	**10**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	**0.2**	**1.1**	**1.3**	**68.6**
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	----	**2**	**9**	**16**
EN33: TCLP Leach								
Initial pH	----	0.1	pH Unit	----	----	----	----	**3.6**
Extraction Fluid Number	----	1	-	----	----	----	----	**1**
Final pH	----	0.1	pH Unit	----	----	----	----	**4.9**
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	----	----	----	----	**2.03**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BH014_0.0-0.1	BH071_0.5-0.7	BH091_0.0-0.1	BH002_0.5-0.7	BH004_1.0-1.2
				Client sampling date / time: 15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00
				ES1220305-011	ES1220305-012	ES1220305-013	ES1220305-014	ES1220305-015
EA150: Particle Sizing								
+75µm	----	1	%	72	----	----	----	----
+150µm	----	1	%	69	----	----	----	----
+300µm	----	1	%	32	----	----	----	----
+425µm	----	1	%	12	----	----	----	----
+600µm	----	1	%	7	----	----	----	----
+1180µm	----	1	%	5	----	----	----	----
+2.36mm	----	1	%	4	----	----	----	----
+4.75mm	----	1	%	2	----	----	----	----
+9.5mm	----	1	%	<1	----	----	----	----
+19.0mm	----	1	%	<1	----	----	----	----
+37.5mm	----	1	%	<1	----	----	----	----
+75.0mm	----	1	%	<1	----	----	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	4.7	5.4	5.1	----	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	34.8	21.3	28.2	16.8	28.6
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	14	----	----	----	----
Silt (2-60 µm)	----	1	%	13	----	----	----	----
Sand (0.06-2.00 mm)	----	1	%	69	----	----	----	----
Gravel (>2mm)	----	1	%	4	----	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	0.2	1.0	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	0.5	0.9	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	<0.1	0.2	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	0.2	0.2	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	1.0	2.2	----	----	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	4660	5440	----	----	----
Antimony	7440-36-0	5	mg/kg	7	<5	<5	<5	2050
Arsenic	7440-38-2	5	mg/kg	7	<5	5	<5	1160
Cadmium	7440-43-9	1	mg/kg	<1	<1	----	<1	<1
Chromium	7440-47-3	2	mg/kg	5	4	----	11	16
Copper	7440-50-8	5	mg/kg	<5	<5	----	7	166
Lead	7439-92-1	5	mg/kg	8	8	----	6	116

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BH014_0.0-0.1	BH071_0.5-0.7	BH091_0.0-0.1	BH002_0.5-0.7	BH004_1.0-1.2
				Client sampling date / time: 15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00
				ES1220305-011	ES1220305-012	ES1220305-013	ES1220305-014	ES1220305-015
EG005T: Total Metals by ICP-AES - Continued								
Nickel	7440-02-0	2	mg/kg	<2	<2	----	<2	**5**
Zinc	7440-66-6	5	mg/kg	<5	**8**	----	**13**	**95**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	**0.1**	<0.1	**28.9**
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	1	mg/kg	**2**	<1	**3**	----	----
EN33: TCLP Leach								
Initial pH	----	0.1	pH Unit	**4.8**	**5.7**	**5.1**	----	----
After HCl pH	----	0.1	pH Unit	----	**1.6**	**1.6**	----	----
Extraction Fluid Number	----	1	-	**1**	**1**	**1**	----	----
Final pH	----	0.1	pH Unit	**4.9**	**4.9**	**4.9**	----	----
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	**2.88**	**1.74**	----	----	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SE001_0.0-0.1	SE001_0.1-0.2	SE002_0.0-0.1	SE002_0.3-0.5	SE003_0.0-0.1
Client sampling date / time				14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
				ES1220305-016	ES1220305-017	ES1220305-018	ES1220305-019	ES1220305-020
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.1	4.8	5.0	5.9	5.2
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	25.7	39.3	73.3	72.4	49.3
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	1.7	----	----
Exchangeable Magnesium	----	0.1	meq/100g	----	----	1.4	----	----
Exchangeable Potassium	----	0.1	meq/100g	----	----	1.1	----	----
Exchangeable Sodium	----	0.1	meq/100g	----	----	0.6	----	----
Cation Exchange Capacity	----	0.1	meq/100g	----	----	4.8	----	----
EG005-SDH: 1M HCl-Extractable Metals by ICPAES								
Aluminium	7429-90-5	50	mg/kg	----	----	2300	----	----
Antimony	7440-36-0	1.0	mg/kg	----	----	1680	----	----
Arsenic	7440-38-2	1.0	mg/kg	----	----	57.9	----	----
Cadmium	7440-43-9	0.1	mg/kg	----	----	0.3	----	----
Cobalt	7440-48-4	0.5	mg/kg	----	----	0.8	----	----
Chromium	7440-47-3	1.0	mg/kg	----	----	61.8	----	----
Copper	7440-50-8	1.0	mg/kg	----	----	1450	----	----
Iron	7439-89-6	50	mg/kg	----	----	5780	----	----
Lead	7439-92-1	1.0	mg/kg	----	----	1010	----	----
Manganese	7439-96-5	10	mg/kg	----	----	36	----	----
Nickel	7440-02-0	1.0	mg/kg	----	----	1.2	----	----
Silver	7440-22-4	1.0	mg/kg	----	----	<1.0	----	----
Vanadium	7440-62-2	2.0	mg/kg	----	----	15.9	----	----
Zinc	7440-66-6	1.0	mg/kg	----	----	53.2	----	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	2180	----	10300	----	8510
Antimony	7440-36-0	5	mg/kg	3980	9260	4440	1200	2120
Arsenic	7440-38-2	5	mg/kg	1980	5410	225	295	176
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	3	<1
Chromium	7440-47-3	2	mg/kg	22	112	1450	253	323
Copper	7440-50-8	5	mg/kg	574	491	1900	1100	1040
Lead	7439-92-1	5	mg/kg	405	1760	1170	216	538
Nickel	7440-02-0	2	mg/kg	<2	<2	4	13	5
Zinc	7440-66-6	5	mg/kg	142	149	145	140	63
EG020-SDH: 1M HCl Extractable metals by ICPMS								
Selenium	7782-49-2	0.5	mg/kg	----	----	1.2	----	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SE001_0.0-0.1	SE001_0.1-0.2	SE002_0.0-0.1	SE002_0.3-0.5	SE003_0.0-0.1
				Client sampling date / time: 14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
				ES1220305-016	ES1220305-017	ES1220305-018	ES1220305-019	ES1220305-020
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**58.9**	**32.2**	**87.6**	**9.8**	**23.4**
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	**8**	**2**	**2**	<1
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	----	----	**5.25**	----	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	SE003_0.2-0.4	SE010_0.1-0.3	SE010_0.6-0.8	SE011_0.0-0.1	SE012_0.0-0.1
				Client sampling date / time	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
					ES1220305-021	ES1220305-022	ES1220305-023	ES1220305-024	ES1220305-026
EA002 : pH (Soils)									
pH Value	----	0.1	pH Unit		**5.0**	**4.9**	**5.8**	**5.8**	**5.4**
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		**75.2**	**47.0**	**42.4**	**45.7**	**77.9**
ED007: Exchangeable Cations									
Exchangeable Calcium	----	0.1	meq/100g		----	----	----	**2.4**	----
Exchangeable Magnesium	----	0.1	meq/100g		----	----	----	**1.9**	----
Exchangeable Potassium	----	0.1	meq/100g		----	----	----	**1.0**	----
Exchangeable Sodium	----	0.1	meq/100g		----	----	----	**0.6**	----
Cation Exchange Capacity	----	0.1	meq/100g		----	----	----	**6.0**	----
EG005-SDH: 1M HCl-Extractable Metals by ICPAES									
Aluminium	7429-90-5	50	mg/kg		----	----	----	**820**	----
Antimony	7440-36-0	1.0	mg/kg		----	----	----	**877**	----
Arsenic	7440-38-2	1.0	mg/kg		----	----	----	**139**	----
Cadmium	7440-43-9	0.1	mg/kg		----	----	----	<0.1	----
Cobalt	7440-48-4	0.5	mg/kg		----	----	----	**0.5**	----
Chromium	7440-47-3	1.0	mg/kg		----	----	----	**5.9**	----
Copper	7440-50-8	1.0	mg/kg		----	----	----	**160**	----
Iron	7439-89-6	50	mg/kg		----	----	----	**2870**	----
Lead	7439-92-1	1.0	mg/kg		----	----	----	**703**	----
Manganese	7439-96-5	10	mg/kg		----	----	----	**15**	----
Nickel	7440-02-0	1.0	mg/kg		----	----	----	<1.0	----
Silver	7440-22-4	1.0	mg/kg		----	----	----	<1.0	----
Vanadium	7440-62-2	2.0	mg/kg		----	----	----	**3.4**	----
Zinc	7440-66-6	1.0	mg/kg		----	----	----	**14.2**	----
EG005T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		----	**10800**	----	**5250**	**11000**
Antimony	7440-36-0	5	mg/kg		**959**	**4210**	**49**	**4640**	**9020**
Arsenic	7440-38-2	5	mg/kg		**813**	**1140**	**29**	**1020**	**1390**
Cadmium	7440-43-9	1	mg/kg		**6**	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		**42**	**115**	**10**	**74**	**125**
Copper	7440-50-8	5	mg/kg		**1270**	**1340**	**8**	**247**	**750**
Lead	7439-92-1	5	mg/kg		**44**	**546**	**9**	**1230**	**1790**
Nickel	7440-02-0	2	mg/kg		**26**	**16**	**3**	**2**	**6**
Zinc	7440-66-6	5	mg/kg		**288**	**58**	<5	**33**	**106**
EG020-SDH: 1M HCl Extractable metals by ICPMS									
Selenium	7782-49-2	0.5	mg/kg		----	----	----	**0.7**	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SE003_0.2-0.4	SE010_0.1-0.3	SE010_0.6-0.8	SE011_0.0-0.1	SE012_0.0-0.1
				Client sampling date / time: 14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
				ES1220305-021	ES1220305-022	ES1220305-023	ES1220305-024	ES1220305-026
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**1.1**	**26.4**	**0.3**	**56.7**	**55.6**
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	1	mg/kg	**2**	**77**	**1**	**8**	**19**
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	----	----	----	**5.94**	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SE012_0.3-0.5	SE013_0.3-0.5	SE060_0.0-0.1	SE033_0.0-0.05	SE102_0.0-0.2
				Client sampling date / time: 14-AUG-2012 15:00	16-AUG-2012 15:00	15-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00
				ES1220305-027	ES1220305-028	ES1220305-029	ES1220305-030	ES1220305-031
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**5.2**	----	----	----	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**70.0**	**43.9**	----	----	**75.2**
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	**8.8**	**2.9**	----
Exchangeable Magnesium	----	0.1	meq/100g	----	----	**7.3**	**2.4**	----
Exchangeable Potassium	----	0.1	meq/100g	----	----	**0.6**	**1.5**	----
Exchangeable Sodium	----	0.1	meq/100g	----	----	**2.7**	**1.2**	----
Cation Exchange Capacity	----	0.1	meq/100g	----	----	**19.4**	**8.0**	----
EG005T: Total Metals by ICP-AES								
Antimony	7440-36-0	5	mg/kg	**239**	**28**	----	----	**744**
Arsenic	7440-38-2	5	mg/kg	**459**	**74**	----	----	**18**
Cadmium	7440-43-9	1	mg/kg	<1	<1	----	----	<1
Chromium	7440-47-3	2	mg/kg	**25**	**13**	----	----	**17**
Copper	7440-50-8	5	mg/kg	**229**	**13**	----	----	**708**
Lead	7439-92-1	5	mg/kg	**127**	**12**	----	----	**74**
Nickel	7440-02-0	2	mg/kg	**15**	**4**	----	----	**11**
Zinc	7440-66-6	5	mg/kg	**82**	**10**	----	----	**39**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**1.4**	**0.2**	----	----	**0.3**
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	1	mg/kg	**8**	----	----	----	----
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	----	----	**19.4**	**10.3**	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	SEDUP04	SE020_0.0-0.1	SE020_0.2-0.4	SE021_0.0-0.1	SE030_0.0-0.1
				Client sampling date / time	16-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
					ES1220305-034	ES1220305-035	ES1220305-036	ES1220305-037	ES1220305-039
EA002 : pH (Soils)									
pH Value	----	0.1	pH Unit		5.0	4.8	5.4	4.4	5.6
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		69.2	47.8	54.6	43.4	39.1
ED007: Exchangeable Cations									
Exchangeable Calcium	----	0.1	meq/100g		----	----	----	7.9	2.9
Exchangeable Magnesium	----	0.1	meq/100g		----	----	----	8.1	1.7
Exchangeable Potassium	----	0.1	meq/100g		----	----	----	0.6	0.7
Exchangeable Sodium	----	0.1	meq/100g		----	----	----	3.5	1.2
Cation Exchange Capacity	----	0.1	meq/100g		----	----	----	20.2	6.5
EG005-SDH: 1M HCl-Extractable Metals by ICPAES									
Aluminium	7429-90-5	50	mg/kg		----	----	----	770	1160
Antimony	7440-36-0	1.0	mg/kg		----	----	----	1480	1360
Arsenic	7440-38-2	1.0	mg/kg		----	----	----	111	1180
Cadmium	7440-43-9	0.1	mg/kg		----	----	----	0.2	0.2
Cobalt	7440-48-4	0.5	mg/kg		----	----	----	0.8	0.5
Chromium	7440-47-3	1.0	mg/kg		----	----	----	3.1	3.3
Copper	7440-50-8	1.0	mg/kg		----	----	----	148	122
Iron	7439-89-6	50	mg/kg		----	----	----	3440	9340
Lead	7439-92-1	1.0	mg/kg		----	----	----	1010	106
Manganese	7439-96-5	10	mg/kg		----	----	----	10	21
Nickel	7440-02-0	1.0	mg/kg		----	----	----	<1.0	<1.0
Silver	7440-22-4	1.0	mg/kg		----	----	----	<1.0	<1.0
Vanadium	7440-62-2	2.0	mg/kg		----	----	----	2.5	6.4
Zinc	7440-66-6	1.0	mg/kg		----	----	----	27.7	32.3
EG005T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		----	3680	----	----	3300
Antimony	7440-36-0	5	mg/kg		3770	7450	48	9570	4720
Arsenic	7440-38-2	5	mg/kg		1200	985	542	1260	2530
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		23	88	15	24	9
Copper	7440-50-8	5	mg/kg		377	122	12	222	120
Lead	7439-92-1	5	mg/kg		587	1270	24	1730	160
Nickel	7440-02-0	2	mg/kg		6	4	5	3	<2
Zinc	7440-66-6	5	mg/kg		79	52	12	57	45
EG020-SDH: 1M HCl Extractable metals by ICPMS									
Selenium	7782-49-2	0.5	mg/kg		----	----	----	0.7	0.5

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SEDUP04	SE020_0.0-0.1	SE020_0.2-0.4	SE021_0.0-0.1	SE030_0.0-0.1
				Client sampling date / time: 16-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
				ES1220305-034	ES1220305-035	ES1220305-036	ES1220305-037	ES1220305-039
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**19.4**	**60.0**	**0.5**	**73.3**	**18.4**
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	1	mg/kg	**28**	**235**	**5**	**61**	**20**
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	----	----	----	**14.8**	**2.50**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SE030_0.3-0.5	SE031_0.0-0.1	SE040_0.3-0.5	SE042_0.0-0.1	SE050_0.0-0.1
				Client sampling date / time: 14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	15-AUG-2012 15:00
				ES1220305-040	ES1220305-041	ES1220305-042	ES1220305-043	ES1220305-044
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**7.2**	**4.6**	**5.3**	----	**4.3**
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**24.2**	**33.9**	**26.8**	**78.3**	**14.5**
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	**2.0**	----	----
Exchangeable Magnesium	----	0.1	meq/100g	----	----	**3.1**	----	----
Exchangeable Potassium	----	0.1	meq/100g	----	----	**0.6**	----	----
Exchangeable Sodium	----	0.1	meq/100g	----	----	**0.9**	----	----
Cation Exchange Capacity	----	0.1	meq/100g	----	----	**6.6**	----	----
EG005-SDH: 1M HCl-Extractable Metals by ICPAES								
Aluminium	7429-90-5	50	mg/kg	----	**290**	**340**	----	----
Antimony	7440-36-0	1.0	mg/kg	----	**796**	**33.3**	----	----
Arsenic	7440-38-2	1.0	mg/kg	----	**286**	**23.9**	----	----
Cadmium	7440-43-9	0.1	mg/kg	----	<0.1	<0.1	----	----
Cobalt	7440-48-4	0.5	mg/kg	----	<0.5	<0.5	----	----
Chromium	7440-47-3	1.0	mg/kg	----	**2.7**	<1.0	----	----
Copper	7440-50-8	1.0	mg/kg	----	**33.8**	**6.1**	----	----
Iron	7439-89-6	50	mg/kg	----	**2210**	**10400**	----	----
Lead	7439-92-1	1.0	mg/kg	----	**399**	**4.5**	----	----
Manganese	7439-96-5	10	mg/kg	----	<10	**24**	----	----
Nickel	7440-02-0	1.0	mg/kg	----	<1.0	<1.0	----	----
Silver	7440-22-4	1.0	mg/kg	----	<1.0	<1.0	----	----
Vanadium	7440-62-2	2.0	mg/kg	----	<2.0	**6.8**	----	----
Zinc	7440-66-6	1.0	mg/kg	----	**10.8**	**6.7**	----	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	----	----	----	**990**
Antimony	7440-36-0	5	mg/kg	**342**	**5920**	**34**	**11900**	**626**
Arsenic	7440-38-2	5	mg/kg	**292**	**1210**	**57**	**1430**	**1370**
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	**2**	<1
Chromium	7440-47-3	2	mg/kg	**7**	**14**	**10**	**54**	**4**
Copper	7440-50-8	5	mg/kg	**7**	**44**	**6**	**980**	**47**
Lead	7439-92-1	5	mg/kg	**19**	**761**	**8**	**3280**	**69**
Nickel	7440-02-0	2	mg/kg	**2**	<2	<2	**9**	<2
Zinc	7440-66-6	5	mg/kg	**10**	**30**	<5	**347**	**20**
EG020-SDH: 1M HCl Extractable metals by ICPMS								
Selenium	7782-49-2	0.5	mg/kg	----	<0.5	<0.5	----	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SE030_0.3-0.5	SE031_0.0-0.1	SE040_0.3-0.5	SE042_0.0-0.1	SE050_0.0-0.1
				Client sampling date / time: 14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	15-AUG-2012 15:00
				ES1220305-040	ES1220305-041	ES1220305-042	ES1220305-043	ES1220305-044
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**1.5**	**38.3**	**0.2**	**122**	**1.9**
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	**46**	**1**	----	<1
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	----	----	**0.21**	----	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SE050_0.2-0.4	SEDUP03	SE051_0.0-0.1	SE051_0.3-0.5	SE052_0.0-0.1
				Client sampling date / time: 15-AUG-2012 15:00	15-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
				ES1220305-045	ES1220305-046	ES1220305-047	ES1220305-048	ES1220305-049
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**4.5**	**4.1**	**4.4**	**5.4**	**4.9**
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**29.8**	**11.0**	**34.7**	**30.9**	**17.7**
EG005-SDH: 1M HCl-Extractable Metals by ICPAES								
Aluminium	7429-90-5	50	mg/kg	----	----	**450**	----	**190**
Antimony	7440-36-0	1.0	mg/kg	----	----	**471**	----	**12.2**
Arsenic	7440-38-2	1.0	mg/kg	----	----	**458**	----	**16.3**
Cadmium	7440-43-9	0.1	mg/kg	----	----	**0.2**	----	<0.1
Cobalt	7440-48-4	0.5	mg/kg	----	----	<0.5	----	<0.5
Chromium	7440-47-3	1.0	mg/kg	----	----	**1.9**	----	<1.0
Copper	7440-50-8	1.0	mg/kg	----	----	**41.7**	----	**4.8**
Iron	7439-89-6	50	mg/kg	----	----	**1840**	----	**350**
Lead	7439-92-1	1.0	mg/kg	----	----	**365**	----	**2.0**
Manganese	7439-96-5	10	mg/kg	----	----	<10	----	<10
Nickel	7440-02-0	1.0	mg/kg	----	----	<1.0	----	<1.0
Silver	7440-22-4	1.0	mg/kg	----	----	<1.0	----	<1.0
Vanadium	7440-62-2	2.0	mg/kg	----	----	<2.0	----	**3.9**
Zinc	7440-66-6	1.0	mg/kg	----	----	**7.1**	----	**14.6**
EG005T: Total Metals by ICP-AES								
Antimony	7440-36-0	5	mg/kg	**4900**	**412**	**4820**	**76**	**21**
Arsenic	7440-38-2	5	mg/kg	**2030**	**800**	**2490**	**556**	**64**
Cadmium	7440-43-9	1	mg/kg	**1**	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**7**	**3**	**11**	**13**	**4**
Copper	7440-50-8	5	mg/kg	**274**	**28**	**67**	**47**	**16**
Lead	7439-92-1	5	mg/kg	**446**	**61**	**696**	**64**	<5
Nickel	7440-02-0	2	mg/kg	<2	<2	<2	**6**	<2
Zinc	7440-66-6	5	mg/kg	**32**	**12**	**24**	**61**	**27**
EG020-SDH: 1M HCl Extractable metals by ICPMS								
Selenium	7782-49-2	0.5	mg/kg	----	----	<0.5	----	<0.5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**39.8**	**2.3**	**11.8**	**5.1**	**0.1**
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	1	mg/kg	**16**	<1	**4**	**2**	<1

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	SE053_0.0-0.1	SE054_0.0-0.1	SE055_0.0-0.1	SE056_0.05-0.15	SE057_0.2-0.4
				Client sampling date / time	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	16-AUG-2012 15:00
					ES1220305-050	ES1220305-051	ES1220305-052	ES1220305-053	ES1220305-054
EA002 : pH (Soils)									
pH Value	----	0.1	pH Unit		----	----	----	**5.5**	**5.6**
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		**23.0**	**58.1**	**28.4**	**27.8**	**45.3**
EG005-SDH: 1M HCl-Extractable Metals by ICPAES									
Aluminium	7429-90-5	50	mg/kg		**4620**	**2760**	----	**870**	**1570**
Antimony	7440-36-0	1.0	mg/kg		**3.8**	**135**	----	**6.1**	**66.1**
Arsenic	7440-38-2	1.0	mg/kg		**11.0**	**27.2**	----	**14.8**	**80.8**
Cadmium	7440-43-9	0.1	mg/kg		**0.1**	**2.1**	----	**6.0**	**1.4**
Cobalt	7440-48-4	0.5	mg/kg		<0.5	**0.8**	----	<0.5	**0.9**
Chromium	7440-47-3	1.0	mg/kg		**2.2**	<1.0	----	<1.0	**1.5**
Copper	7440-50-8	1.0	mg/kg		**2.2**	**95.8**	----	**334**	**197**
Iron	7439-89-6	50	mg/kg		**940**	**2930**	----	**2040**	**4550**
Lead	7439-92-1	1.0	mg/kg		**1.6**	**78.0**	----	**10.2**	**86.1**
Manganese	7439-96-5	10	mg/kg		<10	**11**	----	<10	**13**
Nickel	7440-02-0	1.0	mg/kg		<1.0	**1.4**	----	<1.0	**1.1**
Silver	7440-22-4	1.0	mg/kg		<1.0	<1.0	----	<1.0	<1.0
Vanadium	7440-62-2	2.0	mg/kg		**6.7**	**23.0**	----	**2.6**	**14.9**
Zinc	7440-66-6	1.0	mg/kg		**90.6**	**669**	----	**1730**	**267**
EG005T: Total Metals by ICP-AES									
Antimony	7440-36-0	5	mg/kg		**15**	**311**	**6**	**8**	**108**
Arsenic	7440-38-2	5	mg/kg		**91**	**179**	**11**	**31**	**208**
Cadmium	7440-43-9	1	mg/kg		<1	**3**	<1	**8**	**3**
Chromium	7440-47-3	2	mg/kg		**6**	**27**	**3**	**4**	**30**
Copper	7440-50-8	5	mg/kg		**12**	**268**	**35**	**415**	**232**
Lead	7439-92-1	5	mg/kg		**5**	**136**	**14**	**22**	**88**
Nickel	7440-02-0	2	mg/kg		**2**	**7**	<2	<2	**7**
Zinc	7440-66-6	5	mg/kg		**97**	**925**	**238**	**2150**	**459**
EG020-SDH: 1M HCl Extractable metals by ICPMS									
Selenium	7782-49-2	0.5	mg/kg		**0.8**	**1.4**	----	**0.7**	**1.0**
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	**1.5**	<0.1	<0.1	**0.7**
EK026G: Total Cyanide By Discrete Analyser									
Total Cyanide	57-12-5	1	mg/kg		----	----	----	<1	**4**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	SE061_0.0-0.1	SE005_0.0-0.1	SEDUP05	SE014_0.0-0.05	SE022_0.0-0.05
				Client sampling date / time	15-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
					ES1220305-055	ES1220305-056	ES1220305-057	ES1220305-058	ES1220305-059
EA002 : pH (Soils)									
pH Value	----	0.1	pH Unit		**6.4**	**5.2**	**4.8**	**4.4**	**4.9**
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		**43.8**	**74.2**	**32.8**	**81.3**	**75.9**
ED007: Exchangeable Cations									
Exchangeable Calcium	----	0.1	meq/100g		**5.8**	----	----	**4.7**	----
Exchangeable Magnesium	----	0.1	meq/100g		**5.7**	----	----	**4.1**	----
Exchangeable Potassium	----	0.1	meq/100g		**0.4**	----	----	**1.2**	----
Exchangeable Sodium	----	0.1	meq/100g		**1.4**	----	----	**1.0**	----
Cation Exchange Capacity	----	0.1	meq/100g		**13.3**	----	----	**11.0**	----
EG005-SDH: 1M HCl-Extractable Metals by ICPAES									
Aluminium	7429-90-5	50	mg/kg		**820**	**10900**	**1400**	**4950**	**7520**
Antimony	7440-36-0	1.0	mg/kg		**3.9**	**96.0**	**2.7**	**2640**	**532**
Arsenic	7440-38-2	1.0	mg/kg		**7.3**	**28.3**	**3.5**	**65.5**	**43.4**
Cadmium	7440-43-9	0.1	mg/kg		<0.1	**0.4**	<0.1	**0.4**	**0.2**
Cobalt	7440-48-4	0.5	mg/kg		<0.5	**1.4**	<0.5	**3.0**	**3.4**
Chromium	7440-47-3	1.0	mg/kg		<1.0	**3.5**	<1.0	<1.0	**1.0**
Copper	7440-50-8	1.0	mg/kg		<1.0	**37.8**	**2.2**	**311**	**42.5**
Iron	7439-89-6	50	mg/kg		**1470**	**3840**	**1120**	**8600**	**8010**
Lead	7439-92-1	1.0	mg/kg		<1.0	**25.5**	**2.9**	**693**	**191**
Manganese	7439-96-5	10	mg/kg		<10	**22**	<10	**42**	**52**
Nickel	7440-02-0	1.0	mg/kg		<1.0	**2.6**	<1.0	**6.5**	**6.2**
Silver	7440-22-4	1.0	mg/kg		<1.0	<1.0	<1.0	<1.0	<1.0
Vanadium	7440-62-2	2.0	mg/kg		**14.0**	**32.7**	**10.7**	**25.8**	**47.4**
Zinc	7440-66-6	1.0	mg/kg		**5.1**	**93.6**	**3.1**	**83.1**	**43.5**
EG005T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		----	----	----	----	**18400**
Antimony	7440-36-0	5	mg/kg		<5	**188**	<5	**6640**	**2690**
Arsenic	7440-38-2	5	mg/kg		**12**	**83**	**7**	**861**	**747**
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		**15**	**15**	**10**	**17**	**20**
Copper	7440-50-8	5	mg/kg		**9**	**310**	**8**	**402**	**88**
Lead	7439-92-1	5	mg/kg		**7**	**54**	**6**	**931**	**261**
Nickel	7440-02-0	2	mg/kg		**6**	**6**	**4**	**8**	**12**
Zinc	7440-66-6	5	mg/kg		**21**	**135**	**6**	**230**	**91**
EG020-SDH: 1M HCl Extractable metals by ICPMS									
Selenium	7782-49-2	0.5	mg/kg		**0.8**	**1.3**	**0.6**	**1.6**	**1.9**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SE061_0.0-0.1	SE005_0.0-0.1	SEDUP05	SE014_0.0-0.05	SE022_0.0-0.05
				Client sampling date / time: 15-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
				ES1220305-055	ES1220305-056	ES1220305-057	ES1220305-058	ES1220305-059
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**0.1**	**0.6**	<0.1	**20.3**	**6.9**
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	<1	<1	**66**	**46**
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	**1.69**	----	----	**20.1**	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	SE022_0.2-0.4	SE043_0.1-0.3	SE064_0.0-0.1	SE062_0.0-0.1	SE062_0.2-0.3
				Client sampling date / time	15-AUG-2012 15:00	15-AUG-2012 15:00	16-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
					ES1220305-060	ES1220305-061	ES1220305-062	ES1220305-063	ES1220305-064
EA002 : pH (Soils)									
pH Value	----	0.1	pH Unit		----	5.5	5.3	4.7	5.7
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		50.7	34.5	84.8	72.8	30.3
ED007: Exchangeable Cations									
Exchangeable Calcium	----	0.1	meq/100g		----	----	6.3	----	----
Exchangeable Magnesium	----	0.1	meq/100g		----	----	6.8	----	----
Exchangeable Potassium	----	0.1	meq/100g		----	----	0.4	----	----
Exchangeable Sodium	----	0.1	meq/100g		----	----	3.6	----	----
Cation Exchange Capacity	----	0.1	meq/100g		----	----	17.2	----	----
EG005-SDH: 1M HCl-Extractable Metals by ICPAES									
Aluminium	7429-90-5	50	mg/kg		----	580	6560	3950	1190
Antimony	7440-36-0	1.0	mg/kg		----	7.4	266	1020	2.9
Arsenic	7440-38-2	1.0	mg/kg		----	2.5	74.6	27.3	2.3
Cadmium	7440-43-9	0.1	mg/kg		----	<0.1	1.6	6.3	<0.1
Cobalt	7440-48-4	0.5	mg/kg		----	<0.5	4.4	2.8	0.5
Chromium	7440-47-3	1.0	mg/kg		----	<1.0	<1.0	<1.0	<1.0
Copper	7440-50-8	1.0	mg/kg		----	1.4	169	131	3.2
Iron	7439-89-6	50	mg/kg		----	600	12800	7750	1250
Lead	7439-92-1	1.0	mg/kg		----	2.6	87.4	155	4.4
Manganese	7439-96-5	10	mg/kg		----	<10	56	36	<10
Nickel	7440-02-0	1.0	mg/kg		----	<1.0	8.2	5.3	<1.0
Silver	7440-22-4	1.0	mg/kg		----	<1.0	<1.0	<1.0	<1.0
Vanadium	7440-62-2	2.0	mg/kg		----	6.6	42.5	23.3	10.7
Zinc	7440-66-6	1.0	mg/kg		----	1.8	526	512	5.0
EG005T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		----	----	----	11200	4790
Antimony	7440-36-0	5	mg/kg		58	10	4210	3120	<5
Arsenic	7440-38-2	5	mg/kg		115	9	2230	352	6
Cadmium	7440-43-9	1	mg/kg		<1	<1	2	2	<1
Chromium	7440-47-3	2	mg/kg		17	8	42	28	8
Copper	7440-50-8	5	mg/kg		9	6	653	767	6
Lead	7439-92-1	5	mg/kg		14	7	449	620	5
Nickel	7440-02-0	2	mg/kg		8	2	10	10	3
Zinc	7440-66-6	5	mg/kg		12	6	449	577	<5
EG020-SDH: 1M HCl Extractable metals by ICPMS									
Selenium	7782-49-2	0.5	mg/kg		----	<0.5	1.9	1.1	0.6

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SE022_0.2-0.4	SE043_0.1-0.3	SE064_0.0-0.1	SE062_0.0-0.1	SE062_0.2-0.3
				Client sampling date / time: 15-AUG-2012 15:00	15-AUG-2012 15:00	16-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
				ES1220305-060	ES1220305-061	ES1220305-062	ES1220305-063	ES1220305-064
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**0.1**	<0.1	**4.4**	**8.1**	<0.1
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	1	mg/kg	----	<1	<2	**34**	<1
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	----	----	**17.3**	----	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SE066_0.0-0.1	SE013_0.0-0.1	BH031_0.0-0.2	BH031_0.5-0.7	BH031_1.8-2.0
				Client sampling date / time: 15-AUG-2012 15:00	16-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
				ES1220305-065	ES1220305-066	ES1220305-067	ES1220305-068	ES1220305-069
EA150: Particle Sizing								
+75µm	----	1	%	----	----	76	72	20
+150µm	----	1	%	----	----	53	47	12
+300µm	----	1	%	----	----	25	20	6
+425µm	----	1	%	----	----	14	10	4
+600µm	----	1	%	----	----	8	5	2
+1180µm	----	1	%	----	----	2	<1	1
+2.36mm	----	1	%	----	----	<1	<1	<1
+4.75mm	----	1	%	----	----	<1	<1	<1
+9.5mm	----	1	%	----	----	<1	<1	<1
+19.0mm	----	1	%	----	----	<1	<1	<1
+37.5mm	----	1	%	----	----	<1	<1	<1
+75.0mm	----	1	%	----	----	<1	<1	<1
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.0	4.5	----	----	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	79.0	66.5	----	----	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	----	9	9	36
Silt (2-60 µm)	----	1	%	----	----	14	17	44
Sand (0.06-2.00 mm)	----	1	%	----	----	77	74	19
Gravel (>2mm)	----	1	%	----	----	<1	<1	1
Cobbles (>6cm)	----	1	%	----	----	<1	<1	<1
EG005-SDH: 1M HCl-Extractable Metals by ICPAES								
Aluminium	7429-90-5	50	mg/kg	3340	2660	----	----	----
Antimony	7440-36-0	1.0	mg/kg	90.9	972	----	----	----
Arsenic	7440-38-2	1.0	mg/kg	91.4	105	----	----	----
Cadmium	7440-43-9	0.1	mg/kg	4.8	0.2	----	----	----
Cobalt	7440-48-4	0.5	mg/kg	3.2	1.9	----	----	----
Chromium	7440-47-3	1.0	mg/kg	<1.0	1.2	----	----	----
Copper	7440-50-8	1.0	mg/kg	70.5	144	----	----	----
Iron	7439-89-6	50	mg/kg	6900	4520	----	----	----
Lead	7439-92-1	1.0	mg/kg	26.9	415	----	----	----
Manganese	7439-96-5	10	mg/kg	40	33	----	----	----
Nickel	7440-02-0	1.0	mg/kg	6.4	4.1	----	----	----
Silver	7440-22-4	1.0	mg/kg	<1.0	<1.0	----	----	----
Vanadium	7440-62-2	2.0	mg/kg	17.2	16.8	----	----	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SE066_0.0-0.1	SE013_0.0-0.1	BH031_0.0-0.2	BH031_0.5-0.7	BH031_1.8-2.0
				Client sampling date / time: 15-AUG-2012 15:00	16-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
				ES1220305-065	ES1220305-066	ES1220305-067	ES1220305-068	ES1220305-069
EG005-SDH: 1M HCl-Extractable Metals by ICPAES - Continued								
Zinc	7440-66-6	1.0	mg/kg	**953**	**43.6**	----	----	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	**6220**	----	----	----
Antimony	7440-36-0	5	mg/kg	**130**	**8900**	----	----	----
Arsenic	7440-38-2	5	mg/kg	**286**	**1660**	----	----	----
Cadmium	7440-43-9	1	mg/kg	**4**	<1	----	----	----
Chromium	7440-47-3	2	mg/kg	**12**	**29**	----	----	----
Copper	7440-50-8	5	mg/kg	**87**	**230**	----	----	----
Lead	7439-92-1	5	mg/kg	**21**	**1500**	----	----	----
Nickel	7440-02-0	2	mg/kg	**10**	**5**	----	----	----
Zinc	7440-66-6	5	mg/kg	**1130**	**73**	----	----	----
EG020-SDH: 1M HCl Extractable metals by ICPMS								
Selenium	7782-49-2	0.5	mg/kg	**1.0**	**0.8**	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**0.2**	**48.6**	----	----	----
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	1	mg/kg	**4**	**82**	----	----	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BH031_1.0-1.2	BHDUP07	BHDUP06	BH053_0.3-0.5	BH053_1.5-1.7
				Client sampling date / time: 15-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
				ES1220305-070	ES1220305-074	ES1220305-078	ES1220305-079	ES1220305-080
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	----	----	----	5.2	5.9
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	24.2	26.3	16.3	22.5	65.4
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	----	0.2	7.0
Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	0.3	7.7
Exchangeable Potassium	----	0.1	meq/100g	----	----	----	0.5	0.6
Exchangeable Sodium	----	0.1	meq/100g	----	----	----	0.4	3.8
Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	1.5	19.2
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	----	----	1370	17300
Antimony	7440-36-0	5	mg/kg	9670	3290	<5	5320	150
Arsenic	7440-38-2	5	mg/kg	5280	126	5	3560	1330
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	9	10	13	11	18
Copper	7440-50-8	5	mg/kg	21	34	7	26	22
Lead	7439-92-1	5	mg/kg	133	64	5	329	25
Nickel	7440-02-0	2	mg/kg	9	20	<2	3	9
Zinc	7440-66-6	5	mg/kg	24	82	15	19	14
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	58.3	1.3	<0.1	35.8	1.2
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	1	mg/kg	----	----	----	39	15
EN33: TCLP Leach								
Initial pH	----	0.1	pH Unit	----	----	----	5.8	6.0
After HCl pH	----	0.1	pH Unit	----	----	----	1.6	1.7
Extraction Fluid Number	----	1	-	----	----	----	1	1
Final pH	----	0.1	pH Unit	----	----	----	4.9	4.9
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	----	----	----	0.20	9.46

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BH053_3.2-3.5	BH001_0.3-0.5	BH024_0.3-0.5	BH024_1.0-1.2	BH024_2.0-2.2
				Client sampling date / time: 14-AUG-2012 15:00	16-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
				ES1220305-081	ES1220305-082	ES1220305-083	ES1220305-084	ES1220305-085
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.5	3.6	4.0	6.1	6.1
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	21.9	5.4	34.2	41.0	35.3
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	2.0	----	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	3.5	----	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	0.4	----	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	2.4	----	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	8.3	----	----	----	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	6780	2970	----	----	----
Antimony	7440-36-0	5	mg/kg	23	3660	6640	192	31
Arsenic	7440-38-2	5	mg/kg	80	1520	4050	130	33
Cadmium	7440-43-9	1	mg/kg	<1	<1	----	----	----
Chromium	7440-47-3	2	mg/kg	11	7	----	----	----
Copper	7440-50-8	5	mg/kg	<5	630	----	----	----
Lead	7439-92-1	5	mg/kg	14	18	----	----	----
Nickel	7440-02-0	2	mg/kg	<2	2	----	----	----
Zinc	7440-66-6	5	mg/kg	<5	30	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	0.4	38.3	----	----	----
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	<1	32	3	1
EN33: TCLP Leach								
Initial pH	----	0.1	pH Unit	8.2	----	4.7	6.1	6.1
After HCl pH	----	0.1	pH Unit	1.6	----	----	1.8	1.7
Extraction Fluid Number	----	1	-	1	----	1	1	1
Final pH	----	0.1	pH Unit	4.9	----	4.9	4.9	4.9
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	0.29	----	----	----	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BH004_0.0-0.2	BH077_0.3-0.5	BH077_1.0-1.2	BH077_1.5-1.7	BH084_1.0-1.2
				Client sampling date / time: 16-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	15-AUG-2012 15:00
				ES1220305-086	ES1220305-087	ES1220305-089	ES1220305-090	ES1220305-091
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	----	3.4	4.8	5.2	5.3
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	9.2	41.0	20.8	63.4	42.9
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	1.0	0.6	7.8	----
Exchangeable Magnesium	----	0.1	meq/100g	----	0.4	0.7	8.7	----
Exchangeable Potassium	----	0.1	meq/100g	----	0.4	0.4	0.7	----
Exchangeable Sodium	----	0.1	meq/100g	----	0.5	0.4	4.2	----
Cation Exchange Capacity	----	0.1	meq/100g	----	2.2	2.0	21.3	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	9100	10300	14500	----
Antimony	7440-36-0	5	mg/kg	4700	93	36	882	2730
Arsenic	7440-38-2	5	mg/kg	1950	157	156	2130	518
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	----
Chromium	7440-47-3	2	mg/kg	18	15	14	17	----
Copper	7440-50-8	5	mg/kg	136	28	10	51	----
Lead	7439-92-1	5	mg/kg	150	24	17	170	----
Nickel	7440-02-0	2	mg/kg	<2	5	3	8	----
Zinc	7440-66-6	5	mg/kg	47	9	11	33	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	61.2	0.8	0.6	5.4	5.1
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	1	mg/kg	----	1	<1	19	22
EN33: TCLP Leach								
Initial pH	----	0.1	pH Unit	----	3.8	4.5	6.0	5.9
After HCl pH	----	0.1	pH Unit	----	----	----	1.8	1.7
Extraction Fluid Number	----	1	-	----	1	1	1	1
Final pH	----	0.1	pH Unit	----	4.8	4.9	4.9	4.9
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	----	15.5	0.30	17.6	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	BH084_1.5-1.7	TB01 (AKA TRIP BLANK 8)	TB02 (AKA TRIP BLANK 9)	BRICK01	BRICK02
				Client sampling date / time	15-AUG-2012 15:00	06-AUG-2012 15:00	06-AUG-2012 15:00	17-AUG-2012 15:00	17-AUG-2012 15:00
					ES1220305-092	ES1220305-096	ES1220305-097	ES1220305-111	ES1220305-112
EA002 : pH (Soils)									
pH Value	----	0.1	pH Unit		**5.6**	----	----	----	----
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		**64.5**	----	----	**2.6**	**1.2**
EG005T: Total Metals by ICP-AES									
Antimony	7440-36-0	5	mg/kg		**3220**	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg		**387**	<5	<5	<5	**7**
Cadmium	7440-43-9	1	mg/kg		----	----	----	<1	<1
Chromium	7440-47-3	2	mg/kg		----	----	----	**6**	**11**
Copper	7440-50-8	5	mg/kg		----	----	----	<5	**6**
Lead	7439-92-1	5	mg/kg		----	----	----	<5	**6**
Nickel	7440-02-0	2	mg/kg		----	----	----	**3**	**6**
Zinc	7440-66-6	5	mg/kg		----	----	----	**10**	**14**
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	----	----	<0.1	<0.1
EK026G: Total Cyanide By Discrete Analyser									
Total Cyanide	57-12-5	1	mg/kg		**83**	----	----	----	----
EN33: TCLP Leach									
Initial pH	----	0.1	pH Unit		**5.9**	----	----	----	----
After HCl pH	----	0.1	pH Unit		**1.7**	----	----	----	----
Extraction Fluid Number	----	1	-		**1**	----	----	----	----
Final pH	----	0.1	pH Unit		**4.9**	----	----	----	----

Analytical Results

Sub-Matrix: SOIL				Client sample ID	SE004_0.0-0.1	SE011_0.3-0.5	----	----	----
				Client sampling date / time	16-AUG-2012 15:00	14-AUG-2012 15:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1220305-144	ES1220305-145	----	----	----
EA002 : pH (Soils)									
pH Value	----	0.1	pH Unit		5.0	5.2	----	----	----
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		80.5	30.6	----	----	----
EG005-SDH: 1M HCl-Extractable Metals by ICPAES									
Aluminium	7429-90-5	50	mg/kg		7550	----	----	----	----
Antimony	7440-36-0	1.0	mg/kg		92.4	----	----	----	----
Arsenic	7440-38-2	1.0	mg/kg		11.7	----	----	----	----
Cadmium	7440-43-9	0.1	mg/kg		0.3	----	----	----	----
Cobalt	7440-48-4	0.5	mg/kg		1.4	----	----	----	----
Chromium	7440-47-3	1.0	mg/kg		<1.0	----	----	----	----
Copper	7440-50-8	1.0	mg/kg		50.4	----	----	----	----
Iron	7439-89-6	50	mg/kg		7050	----	----	----	----
Lead	7439-92-1	1.0	mg/kg		28.6	----	----	----	----
Manganese	7439-96-5	10	mg/kg		35	----	----	----	----
Nickel	7440-02-0	1.0	mg/kg		3.9	----	----	----	----
Silver	7440-22-4	1.0	mg/kg		<1.0	----	----	----	----
Vanadium	7440-62-2	2.0	mg/kg		40.3	----	----	----	----
Zinc	7440-66-6	1.0	mg/kg		70.0	----	----	----	----
EG005T: Total Metals by ICP-AES									
Antimony	7440-36-0	5	mg/kg		242	<5	----	----	----
Arsenic	7440-38-2	5	mg/kg		22	17	----	----	----
Cadmium	7440-43-9	1	mg/kg		<1	<1	----	----	----
Chromium	7440-47-3	2	mg/kg		15	10	----	----	----
Copper	7440-50-8	5	mg/kg		73	8	----	----	----
Lead	7439-92-1	5	mg/kg		37	<5	----	----	----
Nickel	7440-02-0	2	mg/kg		6	3	----	----	----
Zinc	7440-66-6	5	mg/kg		74	<5	----	----	----
EG020-SDH: 1M HCl Extractable metals by ICPMS									
Selenium	7782-49-2	0.5	mg/kg		1.4	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		0.2	<0.1	----	----	----
EK026G: Total Cyanide By Discrete Analyser									
Total Cyanide	57-12-5	1	mg/kg		2	<1	----	----	----

Analytical Results

Sub-Matrix: **TCLP LEACHATE**

Compound	CAS Number	LOR	Unit	Client sample ID: BH034_0.0-0.1	BH014_0.0-0.1	BH071_0.5-0.7	BH091_0.0-0.1	BH053_0.3-0.5
				Client sampling date / time: 28-AUG-2012 12:00	28-AUG-2012 12:00	28-AUG-2012 12:00	28-AUG-2012 12:00	28-AUG-2012 12:00
				ES1220305-010	ES1220305-011	ES1220305-012	ES1220305-013	ES1220305-079
EG005C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**0.3**	**1.2**	**3.0**	**5.6**	**3.5**
Antimony	7440-36-0	0.1	mg/L	**10.5**	<0.1	<0.1	<0.1	**6.5**
Arsenic	7440-38-2	0.1	mg/L	**6.4**	<0.1	<0.1	<0.1	**16.2**
Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	**0.3**
Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	0.1	mg/L	**0.1**	**0.4**	**0.7**	**5.6**	**0.3**
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	**0.0026**	<0.0010	<0.0010	<0.0010	**0.0056**

Analytical Results

Sub-Matrix: **TCLP LEACHATE**

Compound	CAS Number	LOR	Unit	Client sample ID: BH053_1.5-1.7	BH053_3.2-3.5	BH024_0.3-0.5	BH024_1.0-1.2	BH024_2.0-2.2
				Client sampling date / time: 28-AUG-2012 12:00	28-AUG-2012 12:00	28-AUG-2012 12:00	28-AUG-2012 12:00	28-AUG-2012 12:00
				ES1220305-080	ES1220305-081	ES1220305-083	ES1220305-084	ES1220305-085
EG005C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**1.0**	**2.8**	**0.6**	**1.8**	**3.1**
Antimony	7440-36-0	0.1	mg/L	**4.7**	**0.5**	**0.8**	**2.2**	**0.4**
Arsenic	7440-38-2	0.1	mg/L	**0.4**	**0.9**	**1.4**	**1.3**	<0.1
Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	**0.2**	<0.1	<0.1
Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	0.1	mg/L	**0.8**	**0.1**	**0.2**	**5.2**	**5.7**
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

Analytical Results

Sub-Matrix: **TCLP LEACHATE**

Compound	CAS Number	LOR	Unit	Client sample ID: BH077_0.3-0.5	BH077_1.0-1.2	BH077_1.5-1.7	BH084_1.0-1.2	BH084_1.5-1.7
				Client sampling date / time: 28-AUG-2012 12:00	28-AUG-2012 12:00	28-AUG-2012 12:00	28-AUG-2012 12:00	28-AUG-2012 12:00
				ES1220305-087	ES1220305-089	ES1220305-090	ES1220305-091	ES1220305-092
EG005C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**2.4**	**0.9**	**1.0**	**2.3**	**1.9**
Antimony	7440-36-0	0.1	mg/L	**0.1**	**0.1**	**1.2**	**10.1**	**10.6**
Arsenic	7440-38-2	0.1	mg/L	<0.1	**0.4**	**0.2**	**1.1**	**0.3**
Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	<0.1	**0.1**	<0.1
Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	0.1	mg/L	**1.0**	**0.2**	**1.0**	**5.1**	**3.9**
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: RB01	RB02	RB03	RB04	RB05
				Client sampling date / time: 15-AUG-2012 15:00	15-AUG-2012 15:00	16-AUG-2012 15:00	15-AUG-2012 15:00	16-AUG-2012 15:00
				ES1220305-098	ES1220305-099	ES1220305-100	ES1220305-101	ES1220305-102
EG020T: Total Metals by ICP-MS								
Antimony	7440-36-0	0.001	mg/L	**1.64**	**1.24**	**0.028**	**0.013**	**0.010**
Arsenic	7440-38-2	0.001	mg/L	**2.35**	**3.59**	**0.009**	**0.005**	**0.004**

Certificate of Analysis

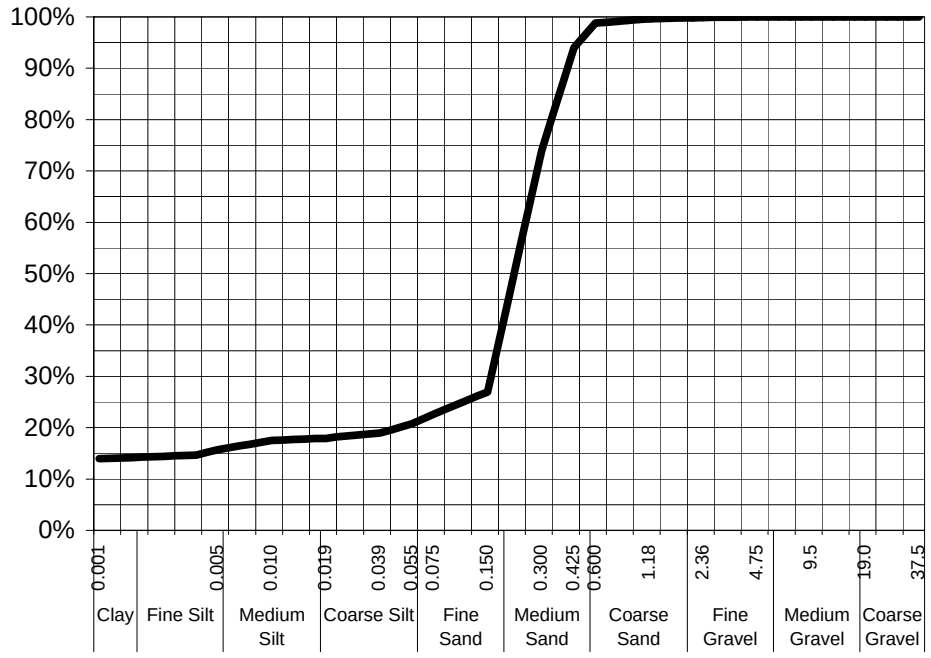
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pH 02 4968 9433
fax 02 4968 0349
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ALS Environmental

Newcastle, NSW

CLIENT:	Ben Luffman	**DATE REPORTED:**	31-Aug-2012
COMPANY:	GHD Pty Ltd	**DATE RECEIVED:**	22-Aug-2012
ADDRESS:	230 Harbour Drive PO Box 1340, Coffs Harbour NSW 2450	**REPORT NO:**	ES1220305-010 / PSD
PROJECT:	2216251	**SAMPLE ID:**	BH034_0.1

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	99%
0.425	94%
0.300	74%
0.150	27%
0.075	23%
Particle Size (microns)	
55	21%
39	19%
19	18%
10	18%
5	16%
4	15%
1	14%

Median Particle Size (mm)	0.150

Samples analysed as received.
Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 28-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand and silty clay

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
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Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

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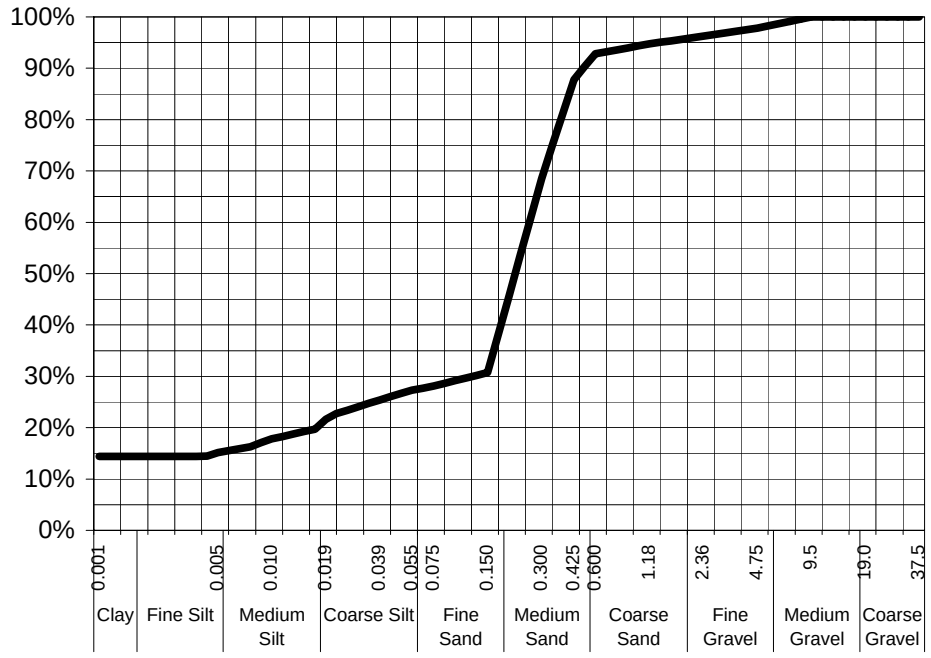
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Newcastle, NSW

CLIENT:	Ben Luffman	**DATE REPORTED:**	31-Aug-2012
COMPANY:	GHD Pty Ltd	**DATE RECEIVED:**	22-Aug-2012
ADDRESS:	230 Harbour Drive PO Box 1340, Coffs Harbour NSW 2450	**REPORT NO:**	ES1220305-011 / PSD
PROJECT:	2216251	**SAMPLE ID:**	BH014_0.1

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	98%
2.36	96%
1.18	95%
0.600	93%
0.425	88%
0.300	68%
0.150	31%
0.075	28%
Particle Size (microns)	
55	27%
39	25%
19	22%
10	18%
5	15%
4	14%
1	14%

Median Particle Size (mm)	0.150

Samples analysed as received.
Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:		**Analysed:**	28-Aug-12
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	Medium fine sand and silty clay	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.1/AS1289.3.6.3	**Hydrometer Type**	ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

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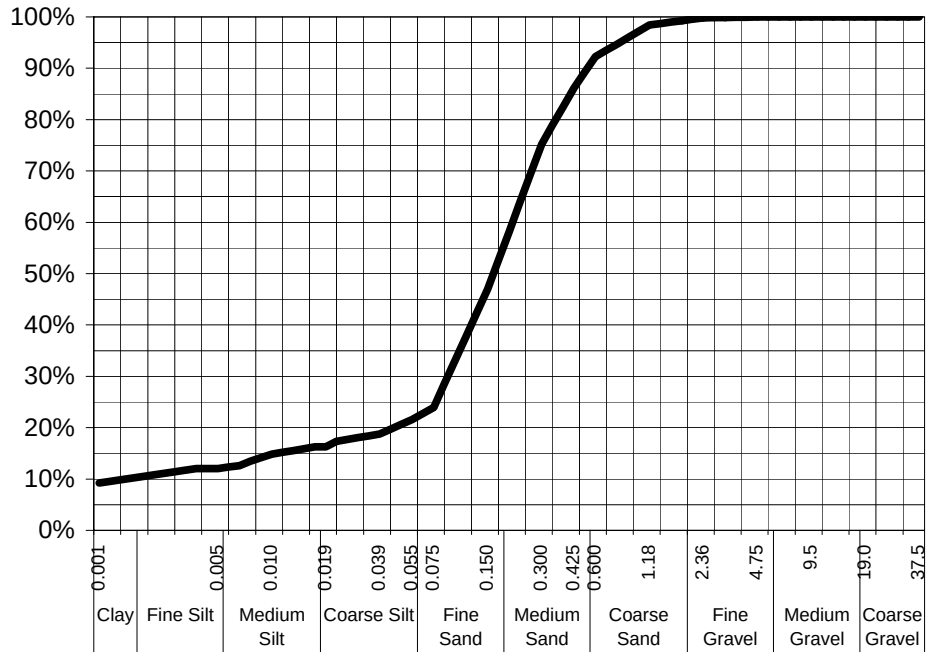
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CLIENT:	Ben Luffman	**DATE REPORTED:**	31-Aug-2012
COMPANY:	GHD Pty Ltd	**DATE RECEIVED:**	22-Aug-2012
ADDRESS:	230 Harbour Drive PO Box 1340, Coffs Harbour NSW 2450	**REPORT NO:**	ES1220305-067 / PSD
PROJECT:	2216251	**SAMPLE ID:**	BH031_0.0-0.2

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	98%
0.600	92%
0.425	86%
0.300	75%
0.150	47%
0.075	24%
Particle Size (microns)	
55	22%
39	19%
19	16%
10	15%
5	12%
4	12%
1	9%

Median Particle Size (mm)	0.150

Samples analysed as received.
Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 28-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand and silty clay

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

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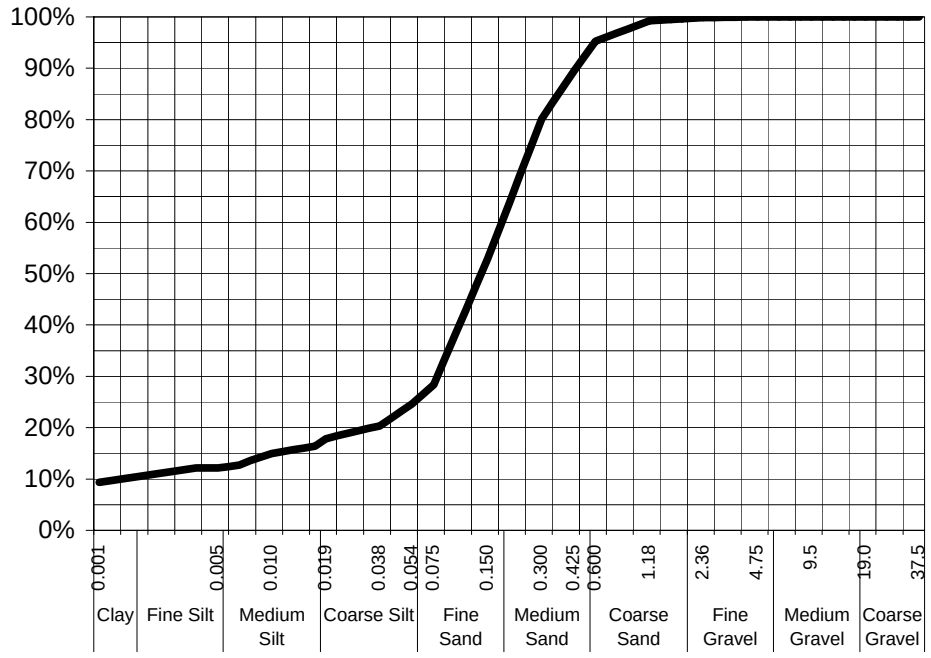
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Newcastle, NSW

CLIENT:	Ben Luffman	**DATE REPORTED:**	31-Aug-2012
COMPANY:	GHD Pty Ltd	**DATE RECEIVED:**	22-Aug-2012
ADDRESS:	230 Harbour Drive PO Box 1340, Coffs Harbour NSW 2450	**REPORT NO:**	ES1220305-068 / PSD
PROJECT:	2216251	**SAMPLE ID:**	BH031_0.5-0.7

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	99%
0.600	95%
0.425	89%
0.300	80%
0.150	53%
0.075	28%
Particle Size (microns)	
54	25%
38	20%
19	18%
10	15%
5	12%
4	12%
1	9%

Median Particle Size (mm)	0.113

Samples analysed as received.
Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 28-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Medium fine sand and silty clay

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

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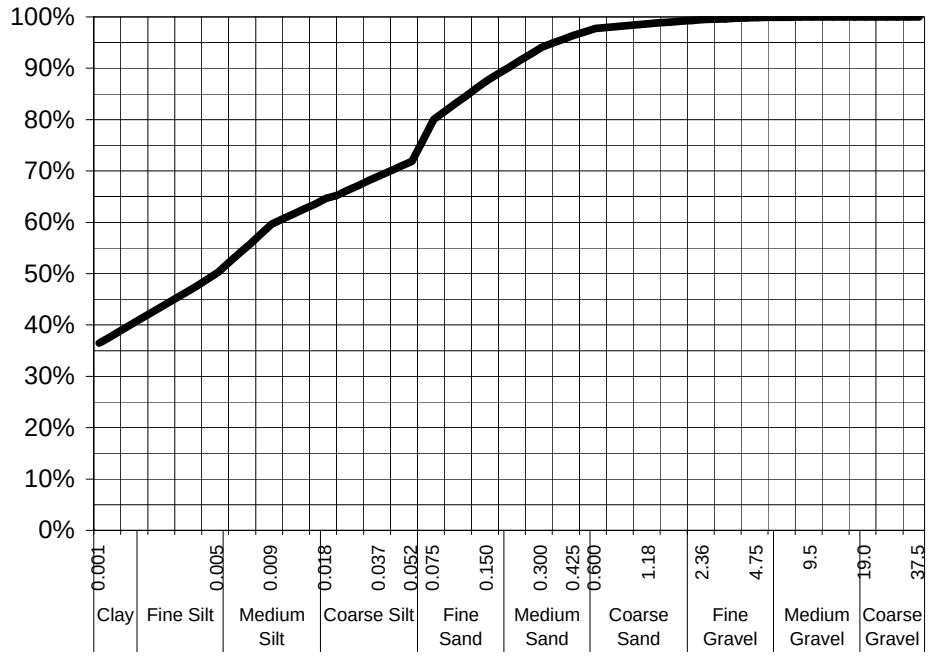
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samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Ben Luffman	**DATE REPORTED:**	31-Aug-2012
COMPANY:	GHD Pty Ltd	**DATE RECEIVED:**	22-Aug-2012
ADDRESS:	230 Harbour Drive PO Box 1340, Coffs Harbour NSW 2450	**REPORT NO:**	ES1220305-069 / PSD
PROJECT:	2216251	**SAMPLE ID:**	BH031_1.8-2.0

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	99%
1.18	99%
0.600	98%
0.425	96%
0.300	94%
0.150	88%
0.075	80%
Particle Size (microns)	
52	72%
37	69%
18	65%
9	60%
5	50%
3	48%
1	36%

Median Particle Size (mm)	0.005

Samples analysed as received.
Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 28-Aug-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Silty clay and medium fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

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Laboratory Supervisor, Newcastle
Authorised Signatory

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1220402**	Page	: 1 of 6
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR BEN LUFFMAN	Contact	: Angelene Kumar
Address	: 230 HARBOUR DRIVE PO Box 1340 COFFS HARBOUR NSW, AUSTRALIA 2450	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: ben_luffman@ghd.com	E-mail	: angelene.kumar@alsglobal.com
Telephone	: +61 02 6650 5600	Telephone	: +61 2 8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61 2 8784 8555
Project	: 2216251	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 22-AUG-2012
Sampler	: JS	Issue Date	: 28-AUG-2012
Site	: HILLSIDE DR,URUNGA		
		No. of samples received	: 19
Quote number	: SY/270/12	No. of samples analysed	: 19

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*
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils

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

- **ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme**
- **EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.**

Analytical Results

Sub-Matrix: SOIL			Client sample ID	SE001-0.1	SE003-0.3	SE011-0.4	SE013-0.4	SE031-0.5
			Client sampling date / time	16-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00
Compound	CAS Number	LOR	Unit	ES1220402-001	ES1220402-002	ES1220402-003	ES1220402-004	ES1220402-005
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**6.7**	**5.9**	**5.7**	**6.6**	**6.6**
pH (Fox)	----	0.1	pH Unit	**1.9**	**1.8**	**1.8**	**1.6**	**1.5**
Reaction Rate	----	1	-	**3**	**3**	**3**	**3**	**3**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	SE054-03	SEDUP04	SE050-0.1	SE050-0.3	SE004-0.1
				Client sampling date / time	16-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00
					ES1220402-006	ES1220402-007	ES1220402-008	ES1220402-009	ES1220402-010
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**6.5**	**6.5**	**5.4**	**5.4**	**5.9**
pH (Fox)	----	0.1	pH Unit		**1.6**	**1.6**	**2.2**	**2.2**	**1.8**
Reaction Rate	----	1	-		**3**	**3**	**2**	**2**	**3**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BH031_0.0-0.2	BH031_0.5-0.7	BH031_1.8-2.0	BH054_0.0-0.2	BH054_0.7-0.9
				Client sampling date / time: 15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
				ES1220402-011	ES1220402-012	ES1220402-013	ES1220402-014	ES1220402-015
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**3.4**	**3.8**	**6.9**	**6.5**	**6.9**
pH (Fox)	----	0.1	pH Unit	**2.5**	**0.9**	**1.4**	**2.9**	**1.7**
Reaction Rate	----	1	-	**3**	**3**	**4**	**3**	**2**

Analytical Results

Sub-Matrix: SOIL			Client sample ID	BH054_1.0-1.2	BH032_0.0-0.2	BH032_0.3-0.5	BH32_1.0-1.2	----
			Client sampling date / time	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	----
Compound	CAS Number	LOR	Unit	ES1220402-016	ES1220402-017	ES1220402-018	ES1220402-019	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**6.7**	**5.9**	**6.3**	**7.1**	----
pH (Fox)	----	0.1	pH Unit	**1.2**	**2.3**	**1.4**	**1.5**	----
Reaction Rate	----	1	-	**3**	**2**	**2**	**2**	----

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EB1225565**	Page	: 1 of 6
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR BEN LUFFMAN	Contact	: Angelene Kumar
Address	: 230 HARBOUR DRIVE PO Box 1340 COFFS HARBOUR NSW, AUSTRALIA 2450	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: ben_luffman@ghd.com	E-mail	: angelene.kumar@alsglobal.com
Telephone	: +61 02 6650 5600	Telephone	: +61 2 8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61 2 8784 8555
Project	: 2216251	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 26-SEP-2012
Sampler	: J. Simkus	Issue Date	: 05-OCT-2012
Site	: Hillside Dr, Urunga		
		No. of samples received	: 9
Quote number	: SY/270/12	No. of samples analysed	: 9

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*
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils

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

- **ASS: EA029 (SPOCAS): Excess ANC not required because pH OX less than 6.5.**
- **ASS: EA029 (SPOCAS): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from kg/t dry weight to kg/m3 in-situ soil, multiply reported results x wet bulk density of soil in t/m3.**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Compound	CAS Number	LOR	Unit	Client sample ID	BH031_0.0-0.2	BH031_0.5-0.7	BH031_1.8-2.0	BH032_0.0-0.2	BH032_0.3-0.5
				Client sampling date / time	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
					EB1225565-001	EB1225565-002	EB1225565-003	EB1225565-004	EB1225565-005
EA029-A: pH Measurements									
pH KCl (23A)	----	0.1	pH Unit		4.0	4.8	4.5	4.6	4.4
pH OX (23B)	----	0.1	pH Unit		2.1	1.9	2.1	3.2	2.6
EA029-B: Acidity Trail									
Titratable Actual Acidity (23F)	----	2	mole H+ / t		32	12	85	19	38
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t		64	547	702	153	151
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t		31	536	617	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S		0.05	<0.02	0.14	0.03	0.06
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S		0.10	0.88	1.12	0.24	0.24
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S		0.05	0.86	0.99	<0.02	<0.02
EA029-C: Sulfur Trail									
KCl Extractable Sulfur (23Ce)	----	0.02	% S		<0.02	<0.02	0.04	<0.02	<0.02
Peroxide Sulfur (23De)	----	0.02	% S		0.05	0.84	0.85	0.06	0.19
Peroxide Oxidisable Sulfur (23E)	----	0.02	% S		0.05	0.84	0.81	0.06	0.19
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t		29	522	504	39	118
EA029-D: Calcium Values									
KCl Extractable Calcium (23Vh)	----	0.02	% Ca		<0.02	<0.02	0.14	<0.02	<0.02
Peroxide Calcium (23Wh)	----	0.02	% Ca		<0.02	<0.02	0.17	<0.02	<0.02
Acid Reacted Calcium (23X)	----	0.02	% Ca		<0.02	<0.02	0.02	<0.02	<0.02
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t		<10	<10	12	<10	<10
sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S		<0.02	<0.02	<0.02	<0.02	<0.02
EA029-E: Magnesium Values									
KCl Extractable Magnesium (23Sm)	----	0.02	% Mg		<0.02	<0.02	0.03	<0.02	<0.02
Peroxide Magnesium (23Tm)	----	0.02	% Mg		<0.02	<0.02	0.04	<0.02	<0.02
Acid Reacted Magnesium (23U)	----	0.02	% Mg		<0.02	<0.02	<0.02	<0.02	<0.02
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t		<10	<10	13	<10	<10
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S		<0.02	<0.02	0.02	<0.02	<0.02
EA029-G: Retained Acidity									
HCl Extractable Sulfur (20Be)	----	0.02	% S		0.02	----	----	----	0.09
Net Acid Soluble Sulfur (20Je)	----	0.02	% S		0.02	----	----	----	0.09
acidity - Net Acid Soluble Sulfur (a-20J)	----	10	mole H+ / t		11	----	----	----	43
sulfidic - Net Acid Soluble Sulfur (s-20J)	----	0.02	% pyrite S		<0.02	----	----	----	0.07

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	BH031_0.0-0.2	BH031_0.5-0.7	BH031_1.8-2.0	BH032_0.0-0.2	BH032_0.3-0.5
			Client sampling date / time	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
Compound	CAS Number	LOR	Unit	EB1225565-001	EB1225565-002	EB1225565-003	EB1225565-004	EB1225565-005
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	**0.12**	**0.86**	**0.94**	**0.09**	**0.32**
Net Acidity (acidity units)	----	10	mole H+ / t	**73**	**534**	**589**	**58**	**199**
Liming Rate	----	1	kg CaCO3/t	**5**	**40**	**44**	**4**	**15**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	BH032_1.0-1.2	SE013_0.3-0.5	SE003_0.2-0.4	SE031_0.5-0.7	----
				Client sampling date / time	14-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	----
Compound	CAS Number	LOR	Unit		EB1225565-006	EB1225565-007	EB1225565-008	EB1225565-009	----
EA029-A: pH Measurements									
pH KCl (23A)	----	0.1	pH Unit		5.5	4.4	4.5	4.5	----
pH OX (23B)	----	0.1	pH Unit		2.7	3.2	2.4	2.3	----
EA029-B: Acidity Trail									
Titratable Actual Acidity (23F)	----	2	mole H+ / t		18	260	56	87	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t		352	1010	356	712	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t		334	746	300	625	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S		0.03	0.42	0.09	0.14	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S		0.56	1.61	0.57	1.14	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S		0.54	1.20	0.48	1.00	----
EA029-C: Sulfur Trail									
KCl Extractable Sulfur (23Ce)	----	0.02	% S		0.03	0.03	<0.02	<0.02	----
Peroxide Sulfur (23De)	----	0.02	% S		0.50	0.54	0.22	0.43	----
Peroxide Oxidisable Sulfur (23E)	----	0.02	% S		0.48	0.50	0.22	0.43	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t		297	313	141	268	----
EA029-D: Calcium Values									
KCl Extractable Calcium (23Vh)	----	0.02	% Ca		0.14	0.10	0.05	0.13	----
Peroxide Calcium (23Wh)	----	0.02	% Ca		0.18	0.12	0.06	0.15	----
Acid Reacted Calcium (23X)	----	0.02	% Ca		0.03	<0.02	<0.02	0.02	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t		16	<10	<10	12	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S		0.02	<0.02	<0.02	<0.02	----
EA029-E: Magnesium Values									
KCl Extractable Magnesium (23Sm)	----	0.02	% Mg		0.08	0.04	0.04	0.09	----
Peroxide Magnesium (23Tm)	----	0.02	% Mg		0.09	0.05	0.05	0.10	----
Acid Reacted Magnesium (23U)	----	0.02	% Mg		<0.02	<0.02	<0.02	<0.02	----
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t		11	<10	<10	<10	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S		<0.02	<0.02	<0.02	<0.02	----
EA029-G: Retained Acidity									
HCl Extractable Sulfur (20Be)	----	0.02	% S		----	0.08	----	----	----
Net Acid Soluble Sulfur (20Je)	----	0.02	% S		----	0.04	----	----	----
acidity - Net Acid Soluble Sulfur (a-20J)	----	10	mole H+ / t		----	20	----	----	----
sulfidic - Net Acid Soluble Sulfur (s-20J)	----	0.02	% pyrite S		----	0.03	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	BH032_1.0-1.2	SE013_0.3-0.5	SE003_0.2-0.4	SE031_0.5-0.7	----
			Client sampling date / time	14-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	----
Compound	CAS Number	LOR	Unit	EB1225565-006	EB1225565-007	EB1225565-008	EB1225565-009	----
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	----
Net Acidity (sulfur units)	----	0.02	% S	**0.50**	**0.95**	**0.32**	**0.57**	----
Net Acidity (acidity units)	----	10	mole H+ / t	**315**	**594**	**197**	**355**	----
Liming Rate	----	1	kg CaCO3/t	**24**	**44**	**15**	**27**	----

Certificate of Analysis

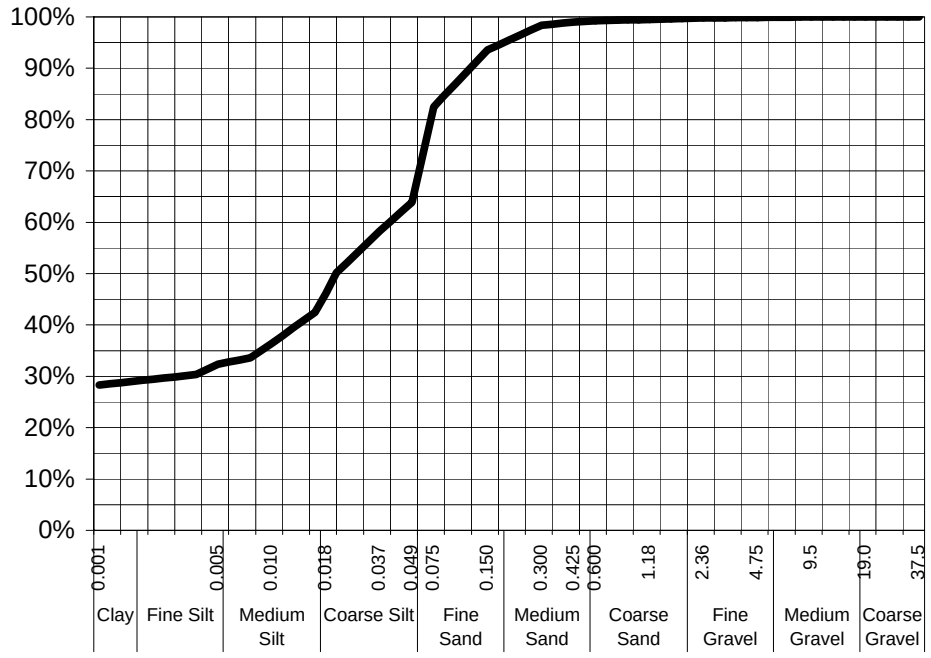
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samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Ben Luffman	**DATE REPORTED:**	4-Oct-2012
COMPANY:	GHD Pty Ltd	**DATE RECEIVED:**	26-Sep-2012
ADDRESS:	230 Harbour Drive PO Box 1340 Coffs Harbour, NSW 2450	**REPORT NO:**	ES1223062-025 / PSD
PROJECT:	2216251	**SAMPLE ID:**	SE003_0.2-0.4

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	99%
0.425	99%
0.300	98%
0.150	94%
0.075	82%
Particle Size (microns)	
49	64%
37	58%
18	46%
10	36%
5	32%
3	30%
1	28%

Median Particle Size (mm)	0.020

Samples analysed as received.
Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 2-Oct-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Silty clay and fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
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Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

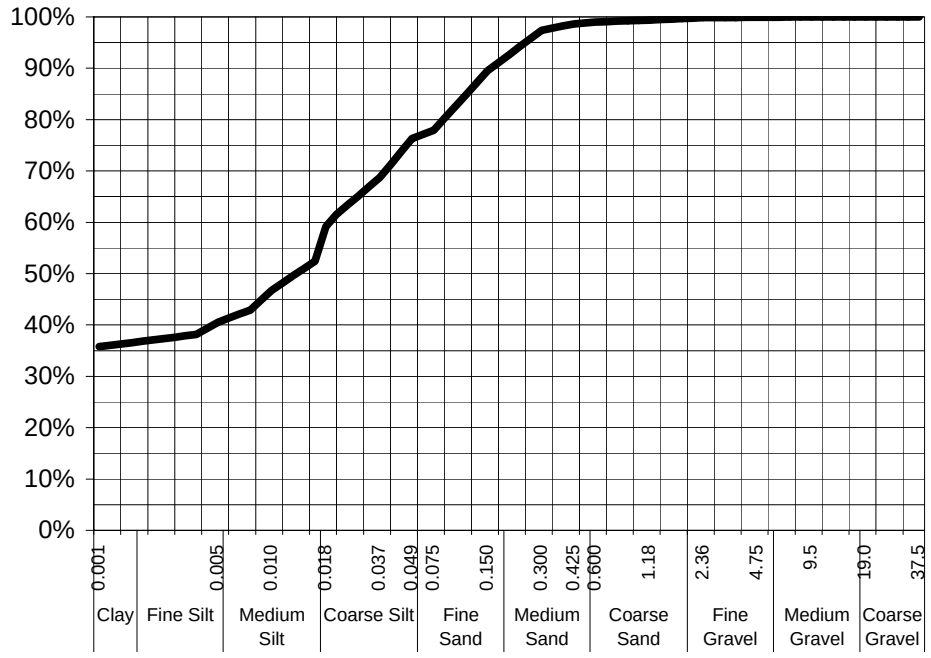
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ALS Environmental

Newcastle, NSW

CLIENT:	Ben Luffman	**DATE REPORTED:**	4-Oct-2012
COMPANY:	GHD Pty Ltd	**DATE RECEIVED:**	26-Sep-2012
ADDRESS:	230 Harbour Drive PO Box 1340 Coffs Harbour, NSW 2450	**REPORT NO:**	ES1223062-026 / PSD
PROJECT:	2216251	**SAMPLE ID:**	SE002_0.5-0.7

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	99%
0.600	99%
0.425	99%
0.300	97%
0.150	89%
0.075	78%
Particle Size (microns)	
49	76%
37	69%
18	59%
10	47%
5	41%
3	38%
1	36%

Median Particle Size (mm)	0.014

Samples analysed as received.
Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 2-Oct-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Silty clay and medium fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

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Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

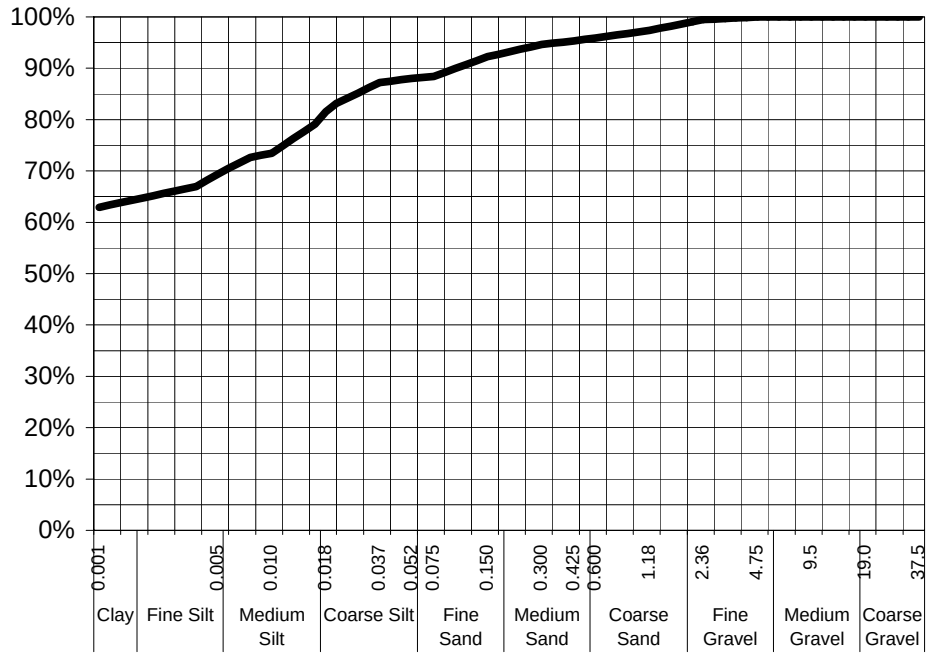
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ALS Environmental

Newcastle, NSW

CLIENT:	Ben Luffman	**DATE REPORTED:**	4-Oct-2012
COMPANY:	GHD Pty Ltd	**DATE RECEIVED:**	26-Sep-2012
ADDRESS:	230 Harbour Drive PO Box 1340 Coffs Harbour, NSW 2450	**REPORT NO:**	ES1223062-027 / PSD
PROJECT:	2216251	**SAMPLE ID:**	SE011_0.7-0.9

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	99%
1.18	97%
0.600	96%
0.425	95%
0.300	95%
0.150	92%
0.075	88%
Particle Size (microns)	
52	88%
37	87%
18	82%
10	73%
5	69%
4	67%
1	63%

Median Particle Size (mm)	<0.001

Samples analysed as received.
Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:		**Analysed:**	2-Oct-12
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	Silty clay and fine sand	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.1/AS1289.3.6.3	**Hydrometer Type**	ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

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Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

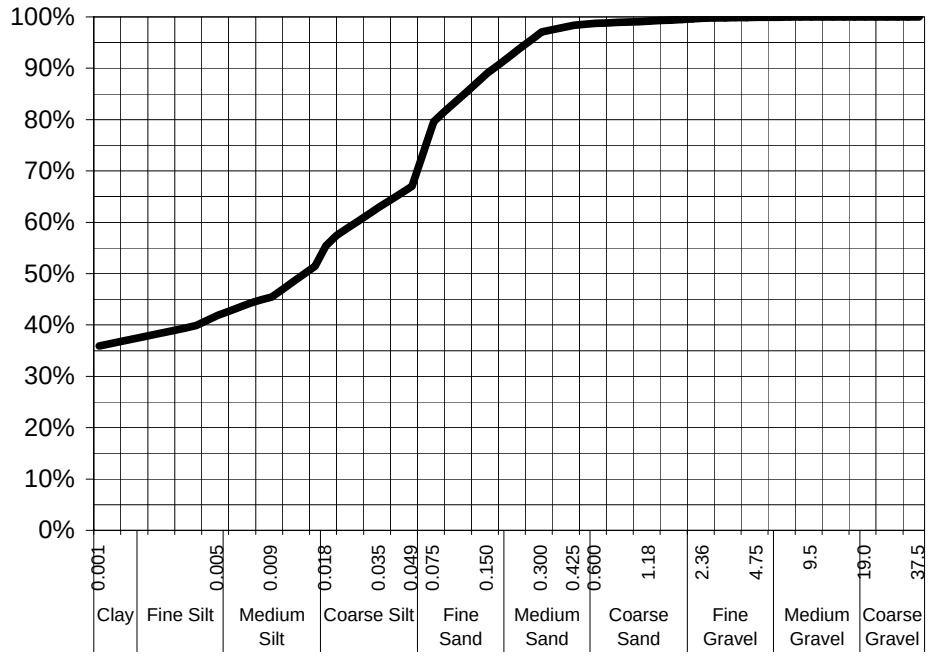
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ALS Environmental

Newcastle, NSW

CLIENT:	Ben Luffman	**DATE REPORTED:**	4-Oct-2012
COMPANY:	GHD Pty Ltd	**DATE RECEIVED:**	26-Sep-2012
ADDRESS:	230 Harbour Drive PO Box 1340 Coffs Harbour, NSW 2450	**REPORT NO:**	ES1223062-028 / PSD
PROJECT:	2216251	**SAMPLE ID:**	SE004_0.2-0.3

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	99%
0.600	99%
0.425	98%
0.300	97%
0.150	89%
0.075	80%
Particle Size (microns)	
49	67%
35	63%
18	55%
9	45%
5	42%
3	40%
1	36%

Median Particle Size (mm)	0.016

Samples analysed as received.
Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 2-Oct-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Silty clay and medium fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
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Hamish Murray
Laboratory Supervisor, Newcastle
Authorised Signatory

Certificate of Analysis

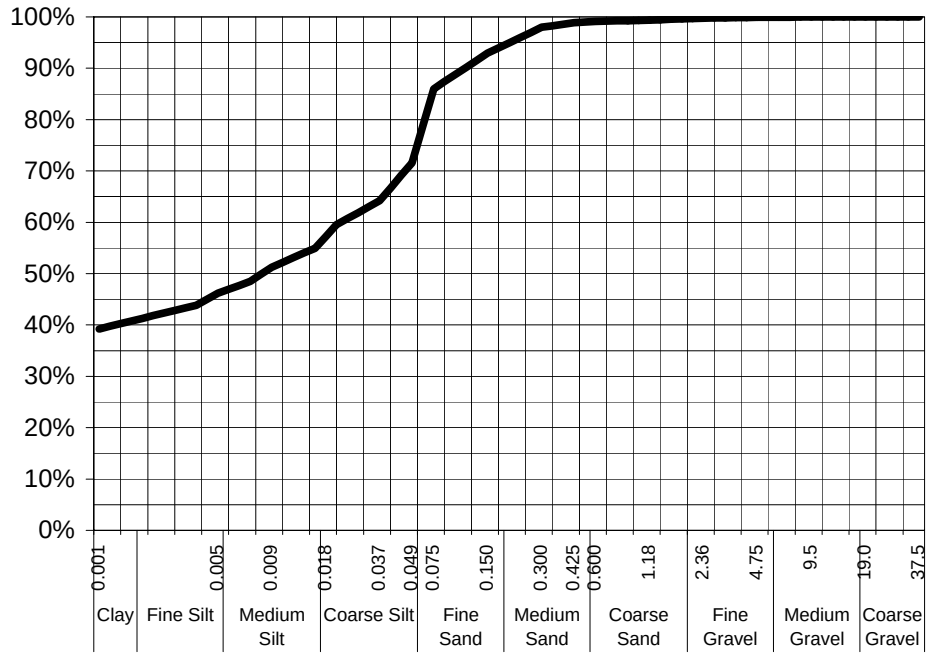
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pH 02 4968 9433
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Ben Luffman	**DATE REPORTED:**	4-Oct-2012
COMPANY:	GHD Pty Ltd	**DATE RECEIVED:**	26-Sep-2012
ADDRESS:	230 Harbour Drive PO Box 1340 Coffs Harbour, NSW 2450	**REPORT NO:**	ES1223062-029 / PSD
PROJECT:	2216251	**SAMPLE ID:**	SE004_0.4-0.6

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	99%
0.600	99%
0.425	99%
0.300	98%
0.150	93%
0.075	86%
Particle Size (microns)	
49	72%
37	64%
18	57%
9	51%
5	46%
3	44%
1	39%

Median Particle Size (mm)	0.009

Samples analysed as received.
Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 2-Oct-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Silty clay and fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

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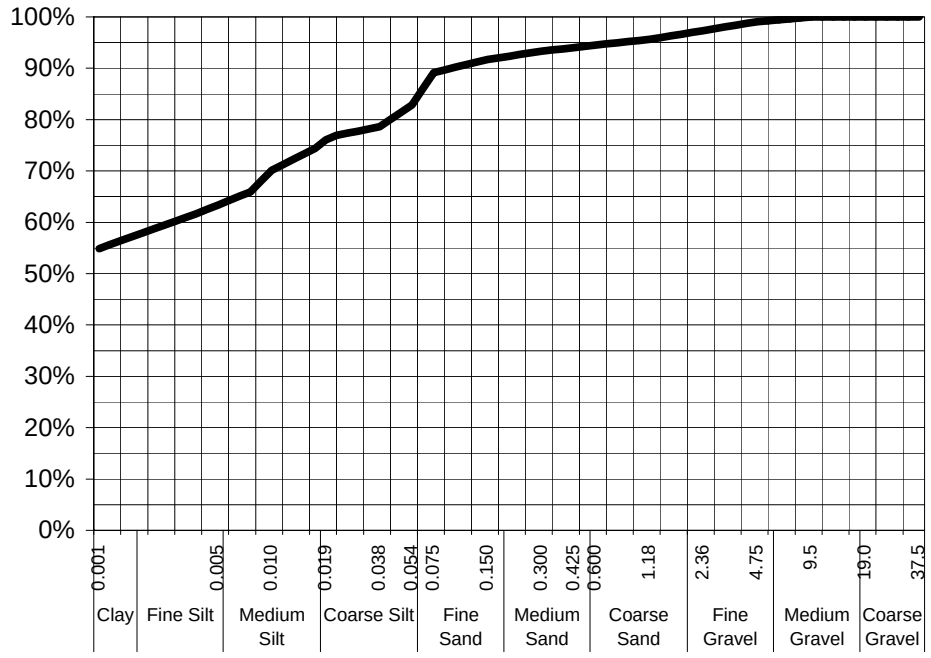
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Newcastle, NSW

CLIENT:	Ben Luffman	**DATE REPORTED:**	4-Oct-2012
COMPANY:	GHD Pty Ltd	**DATE RECEIVED:**	26-Sep-2012
ADDRESS:	230 Harbour Drive PO Box 1340 Coffs Harbour, NSW 2450	**REPORT NO:**	ES1223062-030 / PSD
PROJECT:	2216251	**SAMPLE ID:**	SE033_0.0-0.05

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	99%
2.36	97%
1.18	96%
0.600	95%
0.425	94%
0.300	93%
0.150	92%
0.075	89%
Particle Size (microns)	
54	83%
38	79%
19	76%
10	70%
5	63%
4	62%
1	55%

Median Particle Size (mm)	<0.001

Samples analysed as received.
Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 2-Oct-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Silty clay and fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

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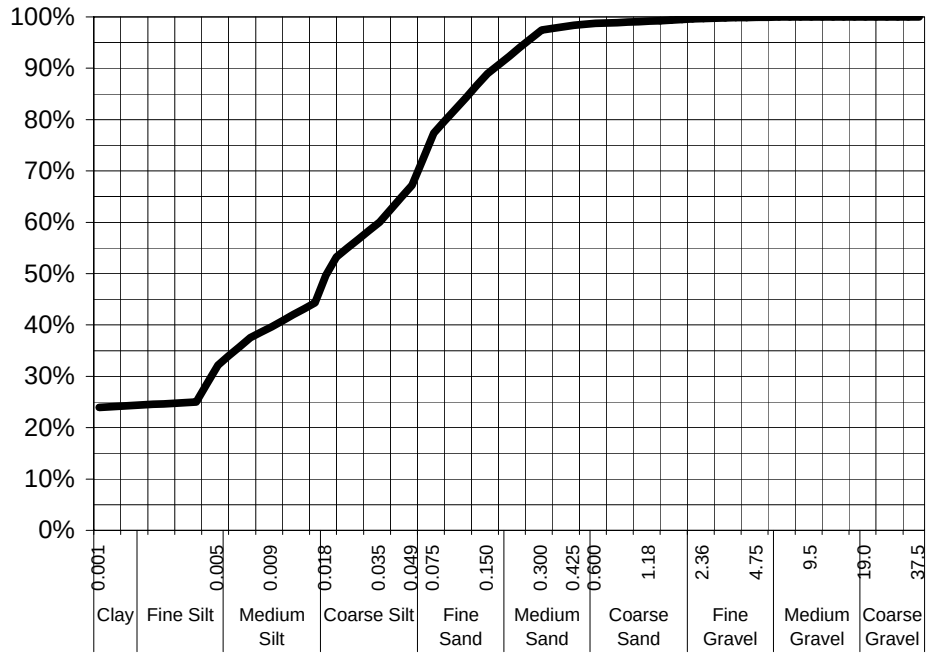
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Newcastle, NSW

CLIENT:	Ben Luffman	**DATE REPORTED:**	4-Oct-2012
COMPANY:	GHD Pty Ltd	**DATE RECEIVED:**	26-Sep-2012
ADDRESS:	230 Harbour Drive PO Box 1340 Coffs Harbour, NSW 2450	**REPORT NO:**	ES1223062-031 / PSD
PROJECT:	2216251	**SAMPLE ID:**	SE033_0.2-0.4

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	99%
0.600	99%
0.425	98%
0.300	97%
0.150	89%
0.075	77%
Particle Size (microns)	
49	67%
35	60%
18	50%
9	40%
5	32%
3	25%
1	24%

Median Particle Size (mm)	0.020

Samples analysed as received.
Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 2-Oct-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Silty clay and medium fine sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

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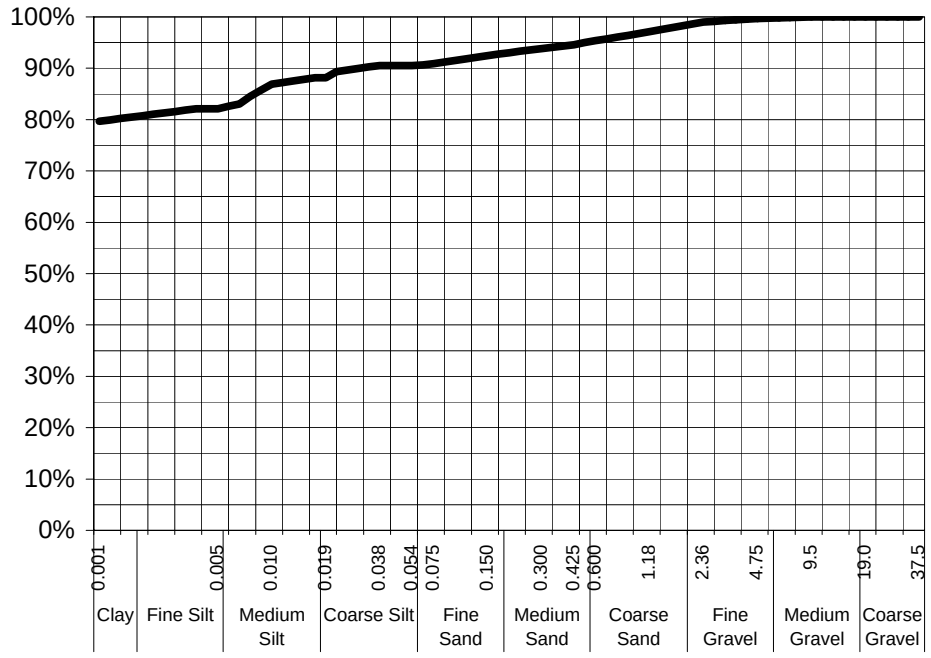
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Newcastle, NSW

CLIENT:	Ben Luffman	**DATE REPORTED:**	4-Oct-2012
COMPANY:	GHD Pty Ltd	**DATE RECEIVED:**	26-Sep-2012
ADDRESS:	230 Harbour Drive PO Box 1340 Coffs Harbour, NSW 2450	**REPORT NO:**	ES1223062-032 / PSD
PROJECT:	2216251	**SAMPLE ID:**	SE033_0.4-0.6

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	99%
1.18	97%
0.600	95%
0.425	95%
0.300	94%
0.150	92%
0.075	91%
Particle Size (microns)	
54	91%
38	91%
19	88%
10	87%
5	82%
3	82%
1	80%

Median Particle Size (mm)	<0.001

Samples analysed as received.
Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 2-Oct-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Silty clay

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

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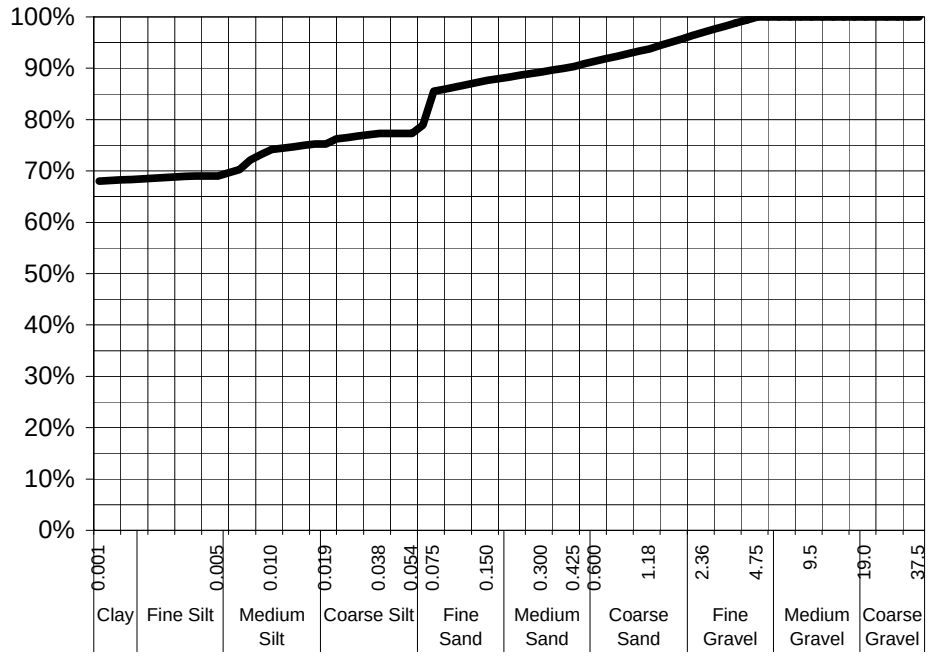
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Newcastle, NSW

CLIENT:	Ben Luffman	**DATE REPORTED:**	4-Oct-2012
COMPANY:	GHD Pty Ltd	**DATE RECEIVED:**	26-Sep-2012
ADDRESS:	230 Harbour Drive PO Box 1340 Coffs Harbour, NSW 2450	**REPORT NO:**	ES1223062-033 / PSD
PROJECT:	2216251	**SAMPLE ID:**	SE063_0.0-0.1

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	97%
1.18	94%
0.600	91%
0.425	90%
0.300	89%
0.150	88%
0.075	86%
Particle Size (microns)	
54	77%
38	77%
19	75%
10	74%
5	69%
3	69%
1	68%

Median Particle Size (mm)	<0.001

Samples analysed as received.
Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 2-Oct-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Silty clay and sand

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

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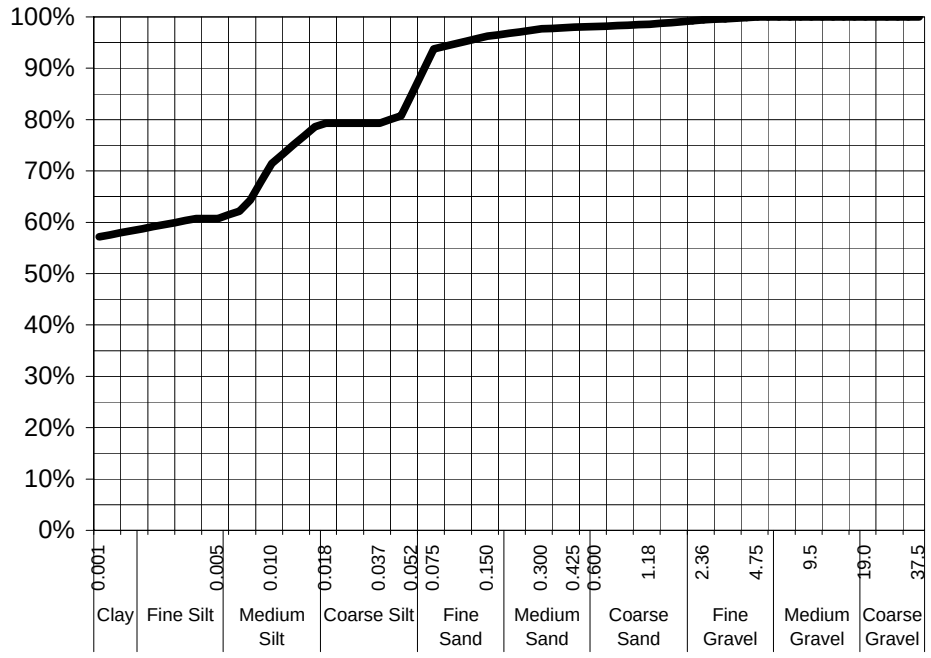
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Newcastle, NSW

CLIENT:	Ben Luffman	**DATE REPORTED:**	4-Oct-2012
COMPANY:	GHD Pty Ltd	**DATE RECEIVED:**	26-Sep-2012
ADDRESS:	230 Harbour Drive PO Box 1340 Coffs Harbour, NSW 2450	**REPORT NO:**	ES1223062-034 / PSD
PROJECT:	2216251	**SAMPLE ID:**	SE063_0.2-0.3

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	99%
1.18	99%
0.600	98%
0.425	98%
0.300	98%
0.150	96%
0.075	94%
Particle Size (microns)	
52	85%
37	79%
18	79%
10	71%
5	61%
3	61%
1	57%

Median Particle Size (mm)	<0.001

Samples analysed as received.
Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 2-Oct-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Silty clay

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

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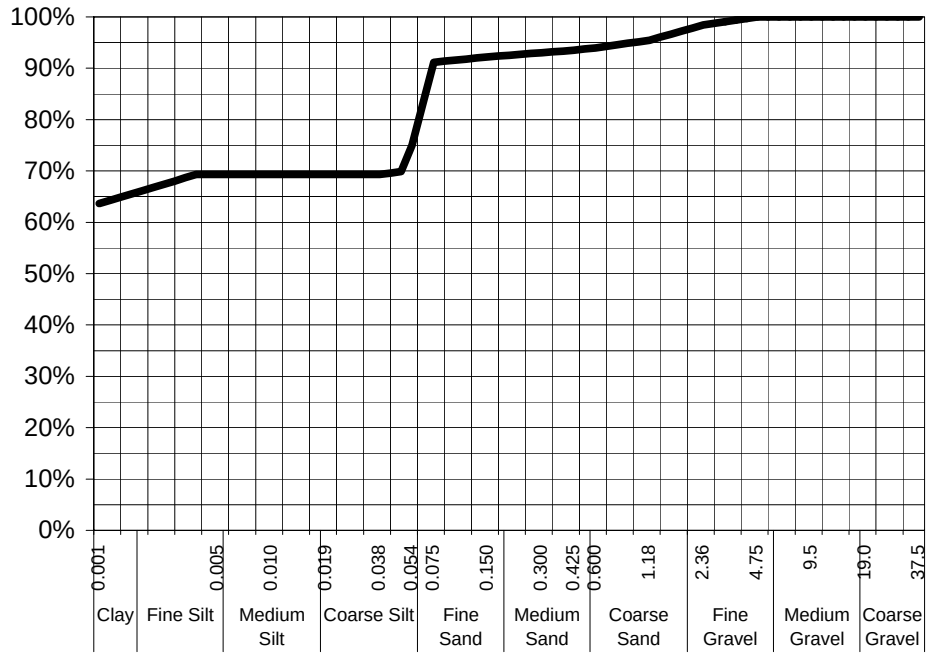
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fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Ben Luffman	**DATE REPORTED:**	4-Oct-2012
COMPANY:	GHD Pty Ltd	**DATE RECEIVED:**	26-Sep-2012
ADDRESS:	230 Harbour Drive PO Box 1340 Coffs Harbour, NSW 2450	**REPORT NO:**	ES1223062-035 / PSD
PROJECT:	2216251	**SAMPLE ID:**	SE063_0.4-0.6

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	98%
1.18	95%
0.600	94%
0.425	94%
0.300	93%
0.150	92%
0.075	91%
Particle Size (microns)	
54	75%
38	69%
19	69%
10	69%
5	69%
4	69%
1	64%

Median Particle Size (mm)	<0.001

Samples analysed as received.
Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client . Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Sample Comments:

Analysed: 2-Oct-12

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: Silty clay

Dispersion Method Shaker

Test Method: AS1289.3.6.1/AS1289.3.6.3

Hydrometer Type ASTM E100

Soil Particle Density (<2.36mm) 2.65 g/cm^3

NATA Accreditation: 825 Site: Newcastle
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Laboratory Supervisor, Newcastle
Authorised Signatory

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1223062**	Page	: 1 of 14
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR BEN LUFFMAN	Contact	: Angelene Kumar
Address	: 230 HARBOUR DRIVE PO Box 1340 COFFS HARBOUR NSW, AUSTRALIA 2450	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: ben_luffman@ghd.com	E-mail	: angelene.kumar@alsglobal.com
Telephone	: +61 02 6650 5600	Telephone	: +61 2 8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61 2 8784 8555
Project	: 2216251	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 26-SEP-2012
Sampler	: JS	Issue Date	: 04-OCT-2012
Site	: HILLSIDE DR, URUNGA		
		No. of samples received	: 35
Quote number	: SY/270/12	No. of samples analysed	: 35

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*
		Newcastle
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Evie.Sidarta	Inorganic Chemist	Sydney Inorganics
Wisam Marassa	Inorganics Coordinator	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

- **EG035: Positive mercury results have been confirmed by re-analysis.**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BH032_0.3-0.5	BHDUP01	BH012_0.0-0.1	BHDUP08	BH073_1.0-1.2
				Client sampling date / time: 14-AUG-2012 15:00	14-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	15-AUG-2012 15:00
				ES1223062-001	ES1223062-002	ES1223062-003	ES1223062-004	ES1223062-005
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**35.9**	**33.6**	**41.2**	**44.1**	**17.0**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**78.8**	**82.0**	**0.1**	<0.1	**0.8**
EN33: TCLP Leach								
Initial pH	----	0.1	pH Unit	**6.9**	**6.6**	**5.8**	**5.7**	**4.8**
After HCl pH	----	0.1	pH Unit	**1.9**	**1.8**	**1.9**	**1.9**	----
Extraction Fluid Number	----	1	-	**1**	**1**	**1**	**1**	**1**
Final pH	----	0.1	pH Unit	**5.0**	**5.0**	**4.9**	**4.9**	**4.9**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	BH077_0.0-0.2	BH077_2.0-2.2	BH101_0.0-0.2	BH022_0.5-0.7	BH028_0.0-0.2
				Client sampling date / time	14-AUG-2012 15:00	14-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00
					ES1223062-006	ES1223062-007	ES1223062-008	ES1223062-009	ES1223062-010
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		**17.1**	**72.5**	**27.2**	**18.4**	**5.2**
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		**2.0**	**0.8**	**343**	**0.3**	**47.3**
EN33: TCLP Leach									
Initial pH	----	0.1	pH Unit		**4.8**	**5.6**	**3.6**	**5.4**	**3.6**
After HCl pH	----	0.1	pH Unit		----	**2.0**	----	**1.9**	----
Extraction Fluid Number	----	1	-		**1**	**1**	**1**	**1**	**1**
Final pH	----	0.1	pH Unit		**4.9**	**5.0**	**4.9**	**5.0**	**4.9**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BH028_0.3-0.5	BH020_0.0-0.2	SE014_0.2-0.4	SE067_0.0-0.1	SE068_0.0-0.1
				Client sampling date / time: 16-AUG-2012 15:00	16-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
				ES1223062-011	ES1223062-012	ES1223062-013	ES1223062-014	ES1223062-015
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**10.4**	**13.6**	**37.1**	**84.2**	**73.4**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**30.6**	**0.6**	**0.2**	**0.9**	**0.2**
EN33: TCLP Leach								
Initial pH	----	0.1	pH Unit	**4.0**	**5.0**	**5.8**	**5.5**	**6.9**
After HCl pH	----	0.1	pH Unit	----	**1.8**	**1.9**	**1.9**	**1.7**
Extraction Fluid Number	----	1	-	**1**	**1**	**1**	**1**	**1**
Final pH	----	0.1	pH Unit	**5.0**	**5.0**	**4.9**	**4.9**	**4.9**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	SE064_0.2-0.3	SE001_0.4-0.6	SE042_0.2-0.4	SE041_0.0-0.05	SE041_0.1-0.3
				Client sampling date / time	15-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
					ES1223062-016	ES1223062-017	ES1223062-018	ES1223062-019	ES1223062-020
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		**41.6**	**65.9**	**35.4**	**69.5**	**50.1**
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		**0.1**	**26.0**	**0.2**	**62.6**	**0.3**
EN33: TCLP Leach									
Initial pH	----	0.1	pH Unit		**6.5**	**4.5**	**5.8**	**4.7**	**5.4**
After HCl pH	----	0.1	pH Unit		**1.7**	----	**1.7**	**1.7**	**1.7**
Extraction Fluid Number	----	1	-		**1**	**1**	**1**	**1**	**1**
Final pH	----	0.1	pH Unit		**4.9**	**4.9**	**4.9**	**4.9**	**4.9**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SE050_0.4-0.6	SE032_0.0-0.1	SEDUP01	SEDUP02	SE003_0.2-0.4
				Client sampling date / time: 15-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	15-AUG-2012 15:00	16-AUG-2012 15:00
				ES1223062-021	ES1223062-022	ES1223062-023	ES1223062-024	ES1223062-025
EA150: Particle Sizing								
+75µm	----	1	%	----	----	----	----	18
+150µm	----	1	%	----	----	----	----	6
+300µm	----	1	%	----	----	----	----	2
+425µm	----	1	%	----	----	----	----	1
+600µm	----	1	%	----	----	----	----	<1
+1180µm	----	1	%	----	----	----	----	<1
+2.36mm	----	1	%	----	----	----	----	<1
+4.75mm	----	1	%	----	----	----	----	<1
+9.5mm	----	1	%	----	----	----	----	<1
+19.0mm	----	1	%	----	----	----	----	<1
+37.5mm	----	1	%	----	----	----	----	<1
+75.0mm	----	1	%	----	----	----	----	<1
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	63.8	41.6	48.2	63.2	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	----	----	----	28
Silt (2-60 µm)	----	1	%	----	----	----	----	47
Sand (0.06-2.00 mm)	----	1	%	----	----	----	----	25
Gravel (>2mm)	----	1	%	----	----	----	----	<1
Cobbles (>6cm)	----	1	%	----	----	----	----	<1
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	0.3	151	0.6	1.6	----
EN33: TCLP Leach								
Initial pH	----	0.1	pH Unit	5.4	4.1	6.0	4.6	----
After HCl pH	----	0.1	pH Unit	1.8	----	1.7	----	----
Extraction Fluid Number	----	1	-	1	1	1	1	----
Final pH	----	0.1	pH Unit	4.9	4.9	4.9	4.9	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	SE002_0.5-0.7	SE011_0.7-0.9	SE004_0.2-0.3	SE004_0.4-0.6	SE033_0.0-0.05
				Client sampling date / time	14-AUG-2012 15:00	14-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	15-AUG-2012 15:00
					ES1223062-026	ES1223062-027	ES1223062-028	ES1223062-029	ES1223062-030
EA150: Particle Sizing									
+75µm	----	1	%		**22**	**12**	**20**	**14**	**11**
+150µm	----	1	%		**10**	**8**	**11**	**7**	**8**
+300µm	----	1	%		**3**	**5**	**3**	**2**	**7**
+425µm	----	1	%		**1**	**5**	**2**	**1**	**6**
+600µm	----	1	%		**1**	**4**	**1**	<1	**5**
+1180µm	----	1	%		<1	**3**	<1	<1	**4**
+2.36mm	----	1	%		<1	<1	<1	<1	**3**
+4.75mm	----	1	%		<1	<1	<1	<1	<1
+9.5mm	----	1	%		<1	<1	<1	<1	<1
+19.0mm	----	1	%		<1	<1	<1	<1	<1
+37.5mm	----	1	%		<1	<1	<1	<1	<1
+75.0mm	----	1	%		<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%		**36**	**63**	**36**	**39**	**55**
Silt (2-60 µm)	----	1	%		**41**	**25**	**44**	**47**	**30**
Sand (0.06-2.00 mm)	----	1	%		**23**	**11**	**20**	**14**	**12**
Gravel (>2mm)	----	1	%		<1	**1**	<1	<1	**3**
Cobbles (>6cm)	----	1	%		<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	SE033_0.2-0.4	SE033_0.4-0.6	SE063_0.0-0.1	SE063_0.2-0.3	SE063_0.4-0.6
				Client sampling date / time	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
					ES1223062-031	ES1223062-032	ES1223062-033	ES1223062-034	ES1223062-035
EA150: Particle Sizing									
+75µm	----	1	%		**23**	**9**	**14**	**6**	**9**
+150µm	----	1	%		**11**	**8**	**12**	**4**	**8**
+300µm	----	1	%		**2**	**6**	**11**	**2**	**7**
+425µm	----	1	%		**2**	**5**	**10**	**2**	**6**
+600µm	----	1	%		**1**	**5**	**9**	**2**	**6**
+1180µm	----	1	%		<1	**3**	**6**	**1**	**4**
+2.36mm	----	1	%		<1	**1**	**3**	<1	**2**
+4.75mm	----	1	%		<1	<1	<1	<1	<1
+9.5mm	----	1	%		<1	<1	<1	<1	<1
+19.0mm	----	1	%		<1	<1	<1	<1	<1
+37.5mm	----	1	%		<1	<1	<1	<1	<1
+75.0mm	----	1	%		<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%		**24**	**80**	**68**	**57**	**64**
Silt (2-60 µm)	----	1	%		**54**	**11**	**12**	**36**	**27**
Sand (0.06-2.00 mm)	----	1	%		**22**	**8**	**17**	**6**	**7**
Gravel (>2mm)	----	1	%		<1	**1**	**3**	**1**	**2**
Cobbles (>6cm)	----	1	%		<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: **TCLP LEACHATE**

Compound	CAS Number	LOR	Unit	Client sample ID: BH032_0.3-0.5	BHDUP01	BH012_0.0-0.1	BHDUP08	BH073_1.0-1.2
				Client sampling date / time: 14-AUG-2012 15:00	14-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	15-AUG-2012 15:00
				ES1223062-001	ES1223062-002	ES1223062-003	ES1223062-004	ES1223062-005
EG005C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**2.5**	**2.0**	**4.7**	**3.9**	**1.7**
Antimony	7440-36-0	0.1	mg/L	**3.1**	**2.5**	<0.1	<0.1	<0.1
Arsenic	7440-38-2	0.1	mg/L	**14.4**	**19.2**	<0.1	<0.1	<0.1
Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	7440-50-8	0.1	mg/L	**0.2**	**0.2**	<0.1	<0.1	**1.6**
Lead	7439-92-1	0.1	mg/L	**0.1**	<0.1	<0.1	<0.1	**11.6**
Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	0.1	mg/L	**0.4**	**0.4**	**0.9**	**0.8**	**4.8**
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	**0.0011**	<0.0010	<0.0010	<0.0010	<0.0010

Analytical Results

Sub-Matrix: **TCLP LEACHATE**

Compound	CAS Number	LOR	Unit	Client sample ID: BH077_0.0-0.2	BH077_2.0-2.2	BH101_0.0-0.2	BH022_0.5-0.7	BH028_0.0-0.2
				Client sampling date / time: 14-AUG-2012 15:00	14-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00
				ES1223062-006	ES1223062-007	ES1223062-008	ES1223062-009	ES1223062-010
EG005C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**3.4**	**4.0**	**1.2**	**6.2**	**0.6**
Antimony	7440-36-0	0.1	mg/L	<0.1	**0.4**	**6.1**	**1.7**	**4.2**
Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	**0.2**	**0.2**	**1.6**
Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	**0.5**	<0.1	<0.1
Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	0.1	mg/L	**0.3**	**1.5**	**0.1**	**0.7**	**0.1**
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010	<0.0010	**0.0011**	<0.0010	<0.0010

Analytical Results

Sub-Matrix: **TCLP LEACHATE**

Compound	CAS Number	LOR	Unit	Client sample ID: BH028_0.3-0.5	BH020_0.0-0.2	SE014_0.2-0.4	SE067_0.0-0.1	SE068_0.0-0.1
				Client sampling date / time: 16-AUG-2012 15:00	16-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	04-OCT-2012 12:00
				ES1223062-011	ES1223062-012	ES1223062-013	ES1223062-014	ES1223062-015
EG005C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**1.5**	**1.5**	**5.1**	**1.2**	**1.0**
Antimony	7440-36-0	0.1	mg/L	**0.3**	<0.1	**1.0**	**0.6**	**1.1**
Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	**0.6**	**0.1**	**0.3**
Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	7440-50-8	0.1	mg/L	<0.1	**1.1**	<0.1	<0.1	<0.1
Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	0.1	mg/L	**0.2**	**1.2**	**9.1**	**1.4**	**10.6**
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

Analytical Results

Sub-Matrix: **TCLP LEACHATE**

Compound	CAS Number	LOR	Unit	Client sample ID: SE064_0.2-0.3	SE001_0.4-0.6	SE042_0.2-0.4	SE041_0.0-0.05	SE041_0.1-0.3
				Client sampling date / time: 04-OCT-2012 12:00	04-OCT-2012 12:00	04-OCT-2012 12:00	04-OCT-2012 12:00	04-OCT-2012 12:00
				ES1223062-016	ES1223062-017	ES1223062-018	ES1223062-019	ES1223062-020
EG005C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**12.2**	**5.9**	**6.3**	**1.5**	**4.0**
Antimony	7440-36-0	0.1	mg/L	<0.1	**0.1**	**0.1**	**5.6**	**1.3**
Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	<0.1	**0.2**	<0.1
Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	<0.1	**0.4**	<0.1
Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	<0.1	**0.8**	<0.1
Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	0.1	mg/L	**7.7**	**6.8**	**5.1**	**7.9**	**7.2**
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

Analytical Results

Sub-Matrix: **TCLP LEACHATE**

Compound	CAS Number	LOR	Unit	Client sample ID: SE050_0.4-0.6	SE032_0.0-0.1	SEDUP01	SEDUP02	----
				Client sampling date / time: 04-OCT-2012 12:00	04-OCT-2012 12:00	04-OCT-2012 12:00	04-OCT-2012 12:00	----
				ES1223062-021	ES1223062-022	ES1223062-023	ES1223062-024	----
EG005C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**2.9**	**1.2**	**8.4**	**5.4**	----
Antimony	7440-36-0	0.1	mg/L	**0.2**	**8.8**	**0.7**	**3.4**	----
Arsenic	7440-38-2	0.1	mg/L	**0.1**	**3.8**	**0.1**	**0.6**	----
Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	----
Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	----
Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	<0.1	**0.2**	----
Lead	7439-92-1	0.1	mg/L	<0.1	**1.6**	<0.1	**0.2**	----
Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	----
Zinc	7440-66-6	0.1	mg/L	**7.0**	**0.9**	**5.6**	**9.4**	----
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010	**0.0082**	<0.0010	<0.0010	----

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1223935**	Page	: 1 of 6
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR BEN LUFFMAN	Contact	: Angelene Kumar
Address	: 230 HARBOUR DRIVE PO Box 1340 COFFS HARBOUR NSW, AUSTRALIA 2450	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: ben_luffman@ghd.com	E-mail	: angelene.kumar@alsglobal.com
Telephone	: +61 02 6650 5600	Telephone	: +61 2 8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61 2 8784 8555
Project	: 2216251	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: REBATCH OF ES1223062		
C-O-C number	: ----	Date Samples Received	: 08-OCT-2012
Sampler	: JS	Issue Date	: 10-OCT-2012
Site	: HILLSIDE DR, URUNGA		
		No. of samples received	: 19
Quote number	: SY/270/12	No. of samples analysed	: 19

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*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Evie.Sidarta	Inorganic Chemist	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**

Compound	CAS Number	LOR	Unit	Client sample ID: BH032_0.3-0.5	BHDUP01	BH012_0.0-0.1	BHDUP08	BH073_1.0-1.2
				Client sampling date / time: 14-AUG-2012 15:00	14-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	15-AUG-2012 15:00
				ES1223935-001	ES1223935-002	ES1223935-003	ES1223935-004	ES1223935-005
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**35.9**	**33.6**	**41.2**	**44.1**	**17.0**
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**3450**	**3120**	**13100**	**13400**	**8630**
Antimony	7440-36-0	5	mg/kg	**6070**	**6070**	<5	**9**	**72**
Iron	7439-89-6	50	mg/kg	**17600**	**21200**	**25400**	**29400**	**2720**
Arsenic	7440-38-2	5	mg/kg	**3620**	**4000**	**16**	**12**	**13**
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**34**	**44**	**15**	**15**	**11**
Copper	7440-50-8	5	mg/kg	**231**	**111**	**12**	**13**	**120**
Lead	7439-92-1	5	mg/kg	**996**	**1450**	**12**	**12**	**518**
Nickel	7440-02-0	2	mg/kg	<2	<2	**5**	**5**	<2
Zinc	7440-66-6	5	mg/kg	**39**	**42**	**8**	**9**	**305**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BH077_0.0-0.2	BH077_2.0-2.2	BH101_0.0-0.2	BH022_0.5-0.7	BH028_0.0-0.2
				Client sampling date / time: 14-AUG-2012 15:00	14-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00	16-AUG-2012 15:00
				ES1223935-006	ES1223935-007	ES1223935-008	ES1223935-009	ES1223935-010
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**17.1**	**72.5**	**27.2**	**18.4**	**5.2**
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**6180**	**16100**	**4100**	**5240**	**1150**
Antimony	7440-36-0	5	mg/kg	**388**	**144**	**5400**	**544**	**12600**
Iron	7439-89-6	50	mg/kg	**6660**	**8020**	**26000**	**24600**	**11000**
Arsenic	7440-38-2	5	mg/kg	**432**	**165**	**2540**	**132**	**5000**
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**10**	**20**	**34**	**9**	**3**
Copper	7440-50-8	5	mg/kg	**19**	**22**	**272**	**29**	**23**
Lead	7439-92-1	5	mg/kg	**80**	**21**	**474**	**23**	**11**
Nickel	7440-02-0	2	mg/kg	**2**	**18**	<2	<2	<2
Zinc	7440-66-6	5	mg/kg	**10**	**15**	**47**	**13**	**27**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: BH028_0.3-0.5	BH020_0.0-0.2	SE014_0.2-0.4	SE068_0.0-0.1	SE064_0.2-0.3
				Client sampling date / time: 16-AUG-2012 15:00	16-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00	15-AUG-2012 15:00
				ES1223935-011	ES1223935-012	ES1223935-013	ES1223935-014	ES1223935-015
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**10.4**	**13.6**	**37.1**	**73.4**	**41.6**
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**5760**	**7520**	**8320**	**7700**	**7010**
Antimony	7440-36-0	5	mg/kg	**978**	**59**	**107**	**180**	<5
Iron	7439-89-6	50	mg/kg	**21200**	**27400**	**3800**	**6610**	**2870**
Arsenic	7440-38-2	5	mg/kg	**599**	**58**	**138**	**148**	**8**
Cadmium	7440-43-9	1	mg/kg	<1	**11**	<1	**4**	<1
Chromium	7440-47-3	2	mg/kg	**7**	**12**	**10**	**10**	**12**
Copper	7440-50-8	5	mg/kg	**8**	**724**	**10**	**138**	**13**
Lead	7439-92-1	5	mg/kg	**10**	**25**	**12**	**31**	**9**
Nickel	7440-02-0	2	mg/kg	<2	**4**	**4**	**7**	**4**
Zinc	7440-66-6	5	mg/kg	**8**	**695**	**12**	**624**	**12**

Analytical Results

Sub-Matrix: SOIL			Client sample ID	SE001_0.4-0.6	SE042_0.2-0.4	SE041_0.1-0.3	SE050_0.4-0.6	----
			Client sampling date / time	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	15-AUG-2012 15:00	----
Compound	CAS Number	LOR	Unit	ES1223935-016	ES1223935-017	ES1223935-018	ES1223935-019	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	65.9	35.4	50.1	63.8	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	9970	10300	11000	14400	----
Antimony	7440-36-0	5	mg/kg	274	43	279	37	----
Iron	7439-89-6	50	mg/kg	6670	4340	7840	11600	----
Arsenic	7440-38-2	5	mg/kg	293	115	858	1680	----
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	----
Chromium	7440-47-3	2	mg/kg	20	12	12	15	----
Copper	7440-50-8	5	mg/kg	136	22	41	20	----
Lead	7439-92-1	5	mg/kg	40	19	12	15	----
Nickel	7440-02-0	2	mg/kg	7	5	8	6	----
Zinc	7440-66-6	5	mg/kg	42	44	120	27	----

ANALYTICAL REPORT

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Ben Luffman	Manager	Huong Crawford
Client	GHD Pty Ltd	Laboratory	SGS Alexandria Environmental
Address	(PO Box 1340, COFFS HARBOUR NSW 2450) 230 Harbour Drive COFFS HARBOUR NSW 2450	Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	(02) 6650 5613	Telephone	+61 2 8594 0400
Facsimile	(02) 6652 6021	Facsimile	+61 2 8594 0499
Email	ben.luffman@ghd.com.au	Email	au.environmental.sydney@sgs.com
Project	**2216251**	SGS Reference	**SE111292 R0**
Order Number	**Apply credit against invoice SY00100799**	Report Number	0000038525
Samples	4	Date Reported	28 Aug 2012
		Date Received	22 Aug 2012

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(4354).

SIGNATORIES



Dong Liang
Inorganics Metals Team Leader



Huong Crawford
Laboratory Manager



Ly Kim Ha
Organics Supervisor

Parameter	Units	LOR	Sample Number: SE111292.001 Sample Matrix: Soil Sample Date: 21 Aug 2012 Sample Name: SELABDUP1	SE111292.002 Soil 21 Aug 2012 BHLABDUP01	SE111292.003 Soil 21 Aug 2012 BHLABDUP02	SE111292.004 Soil 21 Aug 2012 BHLABDUP03
Total Recoverable Metals in Soil by ICPOES from EPA 200.8 Digest Method: AN040/AN320						
Aluminium, Al	mg/kg	1	**840**	-	-	-
Antimony, Sb	mg/kg	3	**270**	**55**	**7800**	**7100**
Arsenic, As	mg/kg	3	**450**	**51**	**2200**	**4700**
Cadmium, Cd	mg/kg	0.3	<0.3	**0.5**	**0.4**	<0.3
Chromium, Cr	mg/kg	0.3	**1.4**	**10**	**27**	**9.8**
Copper, Cu	mg/kg	0.5	**22**	**52**	**250**	**18**
Lead, Pb	mg/kg	1	**39**	**17**	**73**	**180**
Nickel, Ni	mg/kg	0.5	<0.5	**2.3**	**1.6**	**12**
Zinc, Zn	mg/kg	0.5	**18**	**22**	**70**	**25**
Mercury in Soil Method: AN312						
Mercury	mg/kg	0.05	**0.85**	**0.18**	**42**	**15**
Moisture Content Method: AN002						
% Moisture	%	0.5	**12**	**40**	**9.7**	**24**

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Mercury in Soil **Method: ME-(AU)-[ENV]AN312**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Mercury	LB025365	mg/kg	0.05	<0.05	4%	103%	91%

Total Recoverable Metals in Soil by ICPOES from EPA 200.8 Digest **Method: ME-(AU)-[ENV]AN040/AN320**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB025363	mg/kg	1	<1		102%	
Antimony, Sb	LB025363	mg/kg	3	<3		97%	
Arsenic, As	LB025363	mg/kg	3	<3	10%	95%	88%
Cadmium, Cd	LB025363	mg/kg	0.3	<0.3	0%	95%	92%
Chromium, Cr	LB025363	mg/kg	0.3	<0.3	4%	99%	93%
Copper, Cu	LB025363	mg/kg	0.5	<0.5	6%	97%	96%
Lead, Pb	LB025363	mg/kg	1	<1	6%	97%	88%
Nickel, Ni	LB025363	mg/kg	0.5	<0.5	0%	98%	95%
Zinc, Zn	LB025363	mg/kg	0.5	<0.5	14%	96%	29%

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN040	A portion of sample is digested with Nitric acid to decompose organic matter and Hydrochloric acid to complete the digestion of metals and then filtered for analsysis by ASS or ICP as per USEPA Method 200.8.
AN312	Mercury by Cold Vapour AAS in Soils: After digestion with nitric acid, hydrogen peroxide and hydrochloric acid, mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500

FOOTNOTES

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
*	This analysis is not covered by the scope of accreditation.
^	Performed by outside laboratory.
LOR	Limit of Reporting
↑↓	Raised or Lowered Limit of Reporting
QFH	QC result is above the upper tolerance
QFL	QC result is below the lower tolerance
-	The sample was not analysed for this analyte
NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: http://www.sgs.com.au.pv.sgsv3/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

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Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1220550**	Page	: 1 of 8
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR BEN LUFFMAN	Contact	: Angelene Kumar
Address	: 230 HARBOUR DRIVE PO Box 1340 COFFS HARBOUR NSW, AUSTRALIA 2450	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: ben_luffman@ghd.com	E-mail	: angelene.kumar@alsglobal.com
Telephone	: +61 02 6650 5600	Telephone	: +61 2 8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61 2 8784 8555
Project	: 2216251	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 24-AUG-2012
Sampler	: ----	Issue Date	: 30-AUG-2012
Site	: HILLSIDE DR, Urunga		
		No. of samples received	: 14
Quote number	: SY/270/12	No. of samples analysed	: 14

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*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Sarah Millington	Senior Inorganic Chemist	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

- **ED041G:LOR raised for SO4 analysis on sample ID(GW006) due to sample matrix.**
- **EG020: It is recognised that total concentration is less than dissolved for some metal analytes. However, the difference is within experimental variation of the methods.**
- **TDS by method EA-015 may bias high for sample #12 due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.**

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: SW001	SW002	SW003	SW004	SW005
Client sampling date / time				22-AUG-2012 15:00	22-AUG-2012 15:00	22-AUG-2012 15:00	22-AUG-2012 15:00	22-AUG-2012 15:00
				ES1220550-001	ES1220550-002	ES1220550-003	ES1220550-004	ES1220550-005
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	**129**	**126**	**107**	**106**	**104**
EA025: Suspended Solids								
Suspended Solids (SS)	----	5	mg/L	**43**	**9**	**9**	<5	**6**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**8**	**9**	**4**	**4**	**4**
Total Alkalinity as CaCO3	----	1	mg/L	**8**	**9**	**4**	**4**	**4**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	**2**	**2**	**2**
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**48**	**44**	**33**	**32**	**32**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**3**	**3**	**2**	**2**	**2**
Magnesium	7439-95-4	1	mg/L	**3**	**3**	**2**	**2**	**2**
Sodium	7440-23-5	1	mg/L	**24**	**23**	**18**	**18**	**18**
Potassium	7440-09-7	1	mg/L	**1**	**1**	**1**	**1**	**1**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.09**	**0.11**	**0.19**	**0.19**	**0.21**
Antimony	7440-36-0	0.001	mg/L	**0.010**	**0.145**	**0.120**	**0.139**	**0.133**
Arsenic	7440-38-2	0.001	mg/L	<0.001	**0.028**	**0.118**	**0.073**	**0.071**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.001**	**0.008**	**0.012**	**0.012**	**0.012**
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	**0.003**	**0.003**	**0.003**
Zinc	7440-66-6	0.005	mg/L	**0.018**	**0.018**	**0.032**	**0.028**	**0.031**
Iron	7439-89-6	0.05	mg/L	**0.54**	**1.05**	**1.21**	**1.09**	**1.15**
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.36**	**0.19**	**0.25**	**0.22**	**0.22**
Antimony	7440-36-0	0.001	mg/L	**0.022**	**0.171**	**0.139**	**0.116**	**0.151**
Arsenic	7440-38-2	0.001	mg/L	**0.008**	**0.077**	**0.171**	**0.104**	**0.092**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	**0.001**	**0.001**	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.021**	**0.011**	**0.017**	**0.013**	**0.014**
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: SW001	SW002	SW003	SW004	SW005
				Client sampling date / time: 22-AUG-2012 15:00	22-AUG-2012 15:00	22-AUG-2012 15:00	22-AUG-2012 15:00	22-AUG-2012 15:00
				ES1220550-001	ES1220550-002	ES1220550-003	ES1220550-004	ES1220550-005
EG020T: Total Metals by ICP-MS - Continued								
Lead	7439-92-1	0.001	mg/L	**0.001**	**0.002**	**0.005**	**0.005**	**0.004**
Zinc	7440-66-6	0.005	mg/L	**0.016**	**0.016**	**0.026**	**0.030**	**0.032**
Iron	7439-89-6	0.05	mg/L	**5.38**	**2.94**	**1.72**	**1.57**	**1.52**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**1.51**	**1.42**	**1.05**	**1.02**	**1.02**
Total Cations	----	0.01	meq/L	**1.47**	**1.42**	**1.07**	**1.07**	**1.07**

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: SW006	SW007	SW008	SW009	SWDUP01
				Client sampling date / time: 22-AUG-2012 15:00	22-AUG-2012 15:00	22-AUG-2012 15:00	22-AUG-2012 15:00	22-AUG-2012 15:00
				ES1220550-006	ES1220550-007	ES1220550-008	ES1220550-009	ES1220550-010
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	**105**	**112**	**194**	**157**	**106**
EA025: Suspended Solids								
Suspended Solids (SS)	----	5	mg/L	**8**	**8**	**15**	**6**	**9**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**7**	**6**	<1	**1**	**4**
Total Alkalinity as CaCO3	----	1	mg/L	**7**	**6**	<1	**1**	**4**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**2**	**1**	**5**	**20**	**2**
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**36**	**36**	**101**	**67**	**33**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**2**	**2**	**4**	**5**	**2**
Magnesium	7439-95-4	1	mg/L	**2**	**2**	**6**	**6**	**2**
Sodium	7440-23-5	1	mg/L	**20**	**20**	**48**	**36**	**18**
Potassium	7440-09-7	1	mg/L	**1**	**1**	**1**	**2**	**1**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.18**	**0.13**	**0.06**	**0.03**	**0.21**
Antimony	7440-36-0	0.001	mg/L	**0.073**	**0.061**	**0.155**	**0.012**	**0.112**
Arsenic	7440-38-2	0.001	mg/L	**0.043**	**0.038**	**0.040**	**0.002**	**0.116**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	**0.0005**	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.010**	**0.008**	**0.008**	**0.010**	**0.011**
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	**0.003**	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	**0.003**	**0.002**	**0.002**	<0.001	**0.003**
Zinc	7440-66-6	0.005	mg/L	**0.047**	**0.025**	**0.124**	**0.820**	**0.031**
Iron	7439-89-6	0.05	mg/L	**1.05**	**0.97**	**0.32**	**0.13**	**1.23**
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.24**	**0.20**	**0.09**	**0.05**	**0.25**
Antimony	7440-36-0	0.001	mg/L	**0.083**	**0.070**	**0.244**	**0.018**	**0.154**
Arsenic	7440-38-2	0.001	mg/L	**0.063**	**0.056**	**0.069**	**0.016**	**0.171**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	**0.0006**	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	**0.001**	<0.001
Copper	7440-50-8	0.001	mg/L	**0.013**	**0.012**	**0.007**	**0.016**	**0.014**
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	**0.003**	<0.001	<0.001

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: SW006	SW007	SW008	SW009	SWDUP01
				Client sampling date / time: 22-AUG-2012 15:00	22-AUG-2012 15:00	22-AUG-2012 15:00	22-AUG-2012 15:00	22-AUG-2012 15:00
				ES1220550-006	ES1220550-007	ES1220550-008	ES1220550-009	ES1220550-010
EG020T: Total Metals by ICP-MS - Continued								
Lead	7439-92-1	0.001	mg/L	**0.006**	**0.004**	**0.002**	<0.001	**0.006**
Zinc	7440-66-6	0.005	mg/L	**0.048**	**0.041**	**0.114**	**0.848**	**0.030**
Iron	7439-89-6	0.05	mg/L	**1.74**	**1.48**	**0.54**	**0.81**	**1.71**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**1.20**	**1.16**	**2.95**	**2.33**	**1.05**
Total Cations	----	0.01	meq/L	**1.16**	**1.16**	**2.81**	**2.36**	**1.07**

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	GW004	GW006	GW007	GW013	----
Client sample ID				GW004	GW006	GW007	GW013	----
Client sampling date / time				22-AUG-2012 15:00	22-AUG-2012 15:00	22-AUG-2012 15:00	22-AUG-2012 15:00	----
				ES1220550-011	ES1220550-012	ES1220550-013	ES1220550-014	----
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	----	**970**	**560**	**412**	----
EA025: Suspended Solids								
Suspended Solids (SS)	----	5	mg/L	----	**1190**	**356**	**408**	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	----	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	----	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	----	**285**	**172**	**160**	----
Total Alkalinity as CaCO3	----	1	mg/L	----	**285**	**172**	**160**	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	----	<10	<1	<1	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	----	**184**	**150**	**78**	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	----	**12**	**9**	**12**	----
Magnesium	7439-95-4	1	mg/L	----	**20**	**14**	**14**	----
Sodium	7440-23-5	1	mg/L	----	**194**	**132**	**71**	----
Potassium	7440-09-7	1	mg/L	----	**8**	**7**	**6**	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**1.15**	**2.19**	**0.67**	**0.05**	----
Antimony	7440-36-0	0.001	mg/L	**1.17**	**1.39**	**1.45**	**1.21**	----
Arsenic	7440-38-2	0.001	mg/L	**5.56**	**72.6**	**37.0**	**34.5**	----
Cadmium	7440-43-9	0.0001	mg/L	**0.0001**	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	**0.132**	**0.014**	**0.006**	**0.011**	----
Copper	7440-50-8	0.001	mg/L	**0.027**	**0.011**	**0.006**	**0.010**	----
Nickel	7440-02-0	0.001	mg/L	**4.07**	**0.013**	**0.013**	**0.022**	----
Lead	7439-92-1	0.001	mg/L	**0.017**	**0.125**	**0.020**	**0.002**	----
Zinc	7440-66-6	0.005	mg/L	**0.208**	**0.063**	**0.051**	**0.074**	----
Iron	7439-89-6	0.05	mg/L	**9.05**	**37.4**	**29.3**	**90.5**	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	**0.0026**	**0.0005**	**0.0002**	----
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	0.004	mg/L	----	**0.597**	**0.060**	<0.004	----
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	----	**10.9**	**7.67**	**5.40**	----
Total Cations	----	0.01	meq/L	----	**10.9**	**7.52**	----	----
Total Cations	----	0.01	meq/L	----	----	----	**5.22**	----

Analytical Results

Sub-Matrix: WATER			Client sample ID	GW004	GW006	GW007	GW013	----
			Client sampling date / time	22-AUG-2012 15:00	22-AUG-2012 15:00	22-AUG-2012 15:00	22-AUG-2012 15:00	----
Compound	CAS Number	LOR	Unit	ES1220550-011	ES1220550-012	ES1220550-013	ES1220550-014	----
EN055: Ionic Balance - Continued								
Ionic Balance	----	0.01	%	----	**0.02**	**0.99**	----	----
Ionic Balance	----	0.01	%	----	----	----	**1.60**	----

ANALYTICAL REPORT

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Ben Luffman	Manager	Huong Crawford
Client	GHD Pty Ltd	Laboratory	SGS Alexandria Environmental
Address	(PO Box 1340, COFFS HARBOUR NSW 2450) 230 Harbour Drive NSW 2450	Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	(02) 6650 5613	Telephone	+61 2 8594 0400
Facsimile	(02) 6652 6021	Facsimile	+61 2 8594 0499
Email	ben.luffman@ghd.com.au	Email	au.environmental.sydney@sgs.com
Project	**2216251 - Hillside Dr, Urunga**	SGS Reference	**SE111416 R0**
Order Number	(Not specified)	Report Number	0000038986
Samples	1	Date Reported	03 Sep 2012
		Date Received	27 Aug 2012

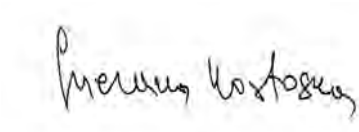
COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(4354).

SIGNATORIES



Dong Liang
Inorganics Metals Team Leader



Snezana Kostoska
Inorganics Chemist

Parameter	Units	LOR	Sample Number: SE111416.001 Sample Matrix: Water Sample Date: 22 Aug 2012 Sample Name: GWLABDUP01
Total Cyanide in water by Discrete Analyser (Aquakem) Method: AN077/AN287			
Total Cyanide	mg/L	0.005	**1.3**
Total Dissolved Solids (TDS) in water Method: AN113			
Total Dissolved Solids Dried at 180°C	mg/L	10	**960**
Total and Volatile Suspended Solids (TSS / VSS) Method: AN114			
Total Suspended Solids Dried at 105°C	mg/L	5	**15000**
Anions by Ion Chromatography in Water Method: AN245			
Chloride	mg/L	0.05	**170**
Sulphate, SO4	mg/L	0.1	**29**
Alkalinity Method: AN135			
Total Alkalinity as CaCO3	mg/L	5	**300**
Metals in Water (Dissolved) by ICPOES Method: AN320/AN321			
Calcium, Ca	mg/L	0.1	**13**
Magnesium, Mg	mg/L	0.1	**21**
Potassium, K	mg/L	0.2	**8.5**
Sodium, Na	mg/L	0.1	**190**
Trace Metals (Dissolved) in Water by ICPMS Method: AN318			
Aluminium, Al	µg/L	1	**2000**
Antimony, Sb	µg/L	1	**5100**
Arsenic, As	µg/L	1	**20000**
Cadmium, Cd	µg/L	0.1	<0.1
Chromium, Cr	µg/L	1	**13**
Copper, Cu	µg/L	1	**10**
Iron, Fe	µg/L	5	**6100**
Lead, Pb	µg/L	1	**160**
Nickel, Ni	µg/L	1	**10**
Zinc, Zn	µg/L	1	**36**

Parameter	Units	LOR	Sample Number: SE111416.001 Sample Matrix: Water Sample Date: 22 Aug 2012 Sample Name: GWLABDUP01
Trace Metals (Total) in Water by ICPMS Method: AN318			
Total Aluminium	µg/L	5	**42000**
Total Antimony	µg/L	1	**30000**
Total Arsenic	µg/L	1	**47000**
Total Cadmium	µg/L	0.1	**0.7**
Total Chromium	µg/L	1	**250**
Total Copper	µg/L	1	**420**
Total Iron	µg/L	5	**72000**
Total Lead	µg/L	1	**8500**
Total Nickel	µg/L	1	**65**
Total Zinc	µg/L	1	**170**
Mercury (dissolved) in Water Method: AN311/AN312			
Mercury	mg/L	0.0001	**0.0034**
Mercury (total) in Water Method: AN311/AN312			
Total Mercury	mg/L	0.0001	**0.17**

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Alkalinity Method: ME-(AU)-[ENV]AN135

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Alkalinity as CaCO3	LB025626	mg/L	5	<5	3%	115%

Anions by Ion Chromatography in Water Method: ME-(AU)-[ENV]AN245

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride	LB025582	mg/L	0.05	<0.05	0%	95%
Sulphate, SO4	LB025582	mg/L	0.1	<0.1		94%

Mercury (dissolved) in Water Method: ME-(AU)-[ENV]AN311/AN312

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Mercury	LB025745	mg/L	0.0001	<0.00010	0%	96%	94%

Mercury (total) in Water Method: ME-(AU)-[ENV]AN311/AN312

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Total Mercury	LB025746	mg/L	0.0001	<0.0001	NA

Metals in Water (Dissolved) by ICPOES Method: ME-(AU)-[ENV]AN320/AN321

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Calcium, Ca	LB025586	mg/L	0.1	<0.1	0%	98%
Magnesium, Mg	LB025586	mg/L	0.1	<0.1	1%	91%
Potassium, K	LB025586	mg/L	0.2	<0.2	1%	96%
Sodium, Na	LB025586	mg/L	0.1	<0.1	1%	99%

Total and Volatile Suspended Solids (TSS / VSS) Method: ME-(AU)-[ENV]AN114

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Total Suspended Solids Dried at 105°C	LB025664	mg/L	5	<5	96%

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Total Cyanide in water by Discrete Analyser (Aquakem) Method: ME-(AU)-[ENV]AN077/AN287

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Total Cyanide	LB025759	mg/L	0.005	<0.005	111%

Total Dissolved Solids (TDS) in water Method: ME-(AU)-[ENV]AN113

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Dissolved Solids Dried at 180°C	LB025665	mg/L	10	<10	7%	94 - 95%

Trace Metals (Dissolved) in Water by ICPMS Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Aluminium, Al	LB025684	µg/L	1	<1		90%
Antimony, Sb	LB025684	µg/L	1	<1		93%
Arsenic, As	LB025684	µg/L	1	<1	0%	86%
Cadmium, Cd	LB025684	µg/L	0.1	<0.1	0%	96%
Chromium, Cr	LB025684	µg/L	1	<1	0%	98%
Copper, Cu	LB025684	µg/L	1	<1	0%	92%
Iron, Fe	LB025684	µg/L	5	<5		86%
Lead, Pb	LB025684	µg/L	1	<1	0%	98%
Nickel, Ni	LB025684	µg/L	1	<1	0%	92%
Zinc, Zn	LB025684	µg/L	1	<1	25%	92%

Trace Metals (Total) in Water by ICPMS Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Aluminium	LB025685	µg/L	5	<5	5%	104%
Total Antimony	LB025685	µg/L	1	<1	3%	107%
Total Arsenic	LB025685	µg/L	1	<1	0%	96%
Total Cadmium	LB025685	µg/L	0.1	<0.1	1%	106%
Total Chromium	LB025685	µg/L	1	<1	4%	114%
Total Copper	LB025685	µg/L	1	<1	2%	104%
Total Iron	LB025685	µg/L	5	<5	1%	NA
Total Lead	LB025685	µg/L	1	<1	1%	112%
Total Nickel	LB025685	µg/L	1	<1	1%	107%
Total Zinc	LB025685	µg/L	1	<1	3%	102%

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN020	Unpreserved water sample is filtered through a 0.45µm membrane filter and acidified with nitric acid similar to APHA3030B.
AN022	The water sample is digested with Nitric Acid and made up to the original volume similar to APHA3030E.
AN077	Hydrogen cyanide is liberated from an acidified sample by distillation and purging with air. The hydrogen cyanide gas is then collected by passing it through a sodium hydroxide scrubbing solution. The scrubbing solution will then be analysed for cyanide by the appropriate method.
AN113	Total Dissolved Solids: A well-mixed filtered sample of known volume is evaporated to dryness at 180°C and the residue weighed. Approximate methods for correlating chemical analysis with dissolved solids are available. Reference APHA 2540 C.
AN114	Total Suspended and Volatile Suspended Solids: The sample is homogenised by shaking and a known volume is filtered through a pre-weighed GF/C filter paper and washed well with deionised water. The filter paper is dried and reweighed. The TSS is the residue retained by the filter per unit volume of sample. Reference APHA 2540 D. Internal Reference AN114
AN135	Alkalinity (and forms of) by Titration: The sample is titrated with standard acid to pH 8.3 (P titre) and pH 4.5 (T titre) and permanent and/or total alkalinity calculated. The results are expressed as equivalents of calcium carbonate or recalculated as bicarbonate, carbonate and hydroxide. Reference APHA 2320. Internal Reference AN135
AN135	Free and Total Carbon Dioxide may be calculated using alkalinity forms only when the samples TDS is <500mg/L. If TDS is >500mg/L free or total carbon dioxide cannot be reported. APHA4500CO2 D.
AN245	Anions by Ion Chromatography: A water sample is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO2, NO3 and SO4 are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B
AN287	A buffered distillate or water sample is treated with chloramine/barbituric acid reagents and the intensity of the colour developed is proportional to the cyanide concentration by Aquakem DA.
AN311/AN312	Mercury by Cold Vapour AAS in Waters: Mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320/AN321	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components.
AN320/AN321	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.

FOOTNOTES

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
*	This analysis is not covered by the scope of accreditation.
^	Performed by outside laboratory.
LOR	Limit of Reporting
↑↓	Raised or Lowered Limit of Reporting
QFH	QC result is above the upper tolerance
QFL	QC result is below the lower tolerance
-	The sample was not analysed for this analyte
NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here:
http://www.sgs.com.au.pv.sgsv3/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

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Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1219239**	Page	: 1 of 5
Client	: GHD PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR BEN LUFFMAN	Contact	: Angelene Kumar
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E-mail	: ben_luffman@ghd.com	E-mail	: angelene.kumar@alsglobal.com
Telephone	: +61 02 6650 5600	Telephone	: +61 2 8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61 2 8784 8555
Project	: 2216251-URUNGA	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: 158501	Date Samples Received	: 08-AUG-2012
Sampler	: JS	Issue Date	: 10-AUG-2012
Order number	: ----		
		No. of samples received	: 4
Quote number	: SY/270/12	No. of samples analysed	: 3

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

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

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							
Soil Glass Jar - Unpreserved (EA055-103)							
BH006_0.0-0.3, BH23_0.0-0.2, BH23_0.5-0.7	**03-AUG-2012**	**----**	----	----	**08-AUG-2012**	17-AUG-2012	✓
EG005T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T)							
BH006_0.0-0.3, BH23_0.0-0.2, BH23_0.5-0.7	**03-AUG-2012**	**08-AUG-2012**	30-JAN-2013	✓	**09-AUG-2012**	30-JAN-2013	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T)							
BH006_0.0-0.3, BH23_0.0-0.2, BH23_0.5-0.7	**03-AUG-2012**	**08-AUG-2012**	31-AUG-2012	✓	**09-AUG-2012**	31-AUG-2012	✓

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)							
Moisture Content	EA055-103	1	13	**7.7**	**10.0**	×	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS	EG035T	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Total Mercury by FIMS	EG035T	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Total Mercury by FIMS	EG035T	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Total Mercury by FIMS	EG035T	1	20	**5.0**	**5.0**	✓	ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	1	20	**5.0**	**5.0**	✓	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 (2010 Draft) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Total Metals by ICP-AES	EG005T	SOIL	(APHA 21st ed., 3120; USEPA SW 846 - 6010) (ICPAES) Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (1999) Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	AS 3550, APHA 21st ed., 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	USEPA 200.2 Mod. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (1999) Schedule B(3) (Method 202)

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 SW846 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.

- **No Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

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

Matrix: **SOIL**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
Moisture Content	1	13	7.7	10.0	NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1220305**	Page	: 1 of 18
Client	: GHD PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR BEN LUFFMAN	Contact	: Angelene Kumar
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Telephone	: +61 02 6650 5600	Telephone	: +61 2 8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61 2 8784 8555
Project	: 2216251	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: HILLSIDE DR,URUNGA		
C-O-C number	: ----	Date Samples Received	: 22-AUG-2012
Sampler	: JS	Issue Date	: 07-SEP-2012
Order number	: ----		
		No. of samples received	: 131
Quote number	: SY/270/12	No. of samples analysed	: 92

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

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

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
EA002 : pH (Soils)							
Soil Glass Jar - Unpreserved (EA002)							
SE001_0.0-0.1, SE001_0.1-0.2, SE002_0.0-0.1, SE002_0.3-0.5, SE003_0.0-0.1, SE003_0.2-0.4, SE010_0.1-0.3, SE010_0.6-0.8, SE011_0.0-0.1, SE012_0.0-0.1, SE012_0.3-0.5, SE020_0.0-0.1, SE020_0.2-0.4, SE021_0.0-0.1, SE030_0.0-0.1, SE030_0.3-0.5, SE031_0.0-0.1, SE040_0.3-0.5, SE051_0.0-0.1, SE051_0.3-0.5, SE052_0.0-0.1, BH053_0.3-0.5, BH053_1.5-1.7, BH053_3.2-3.5, BH024_0.3-0.5, BH024_1.0-1.2, BH024_2.0-2.2, BH077_0.3-0.5, BH077_1.0-1.2, BH077_1.5-1.7, SE011_0.3-0.5	**14-AUG-2012**	**24-AUG-2012**	21-AUG-2012	×	**24-AUG-2012**	25-AUG-2012	✓
Soil Glass Jar - Unpreserved (EA002)							
BH074_0.8-1.0, BH064_0.0-0.2, BH064_0.3-0.5, BH073_0.0-0.2, BH073_0.5-0.7, BH056_0.3-0.5, BH060_0.0-0.2, BH82_1.5-1.7, BH034_0.0-0.1, BH014_0.0-0.1, BH071_0.5-0.7, BH091_0.0-0.1, SE050_0.0-0.1, SE050_0.2-0.4, SEDUP03, SE056_0.05-0.15, SE061_0.0-0.1, SE014_0.0-0.05, SE022_0.0-0.05, SE043_0.1-0.3, SE064_0.0-0.1, SE062_0.0-0.1, SE062_0.2-0.3, SE066_0.0-0.1, BH084_1.0-1.2, BH084_1.5-1.7	**15-AUG-2012**	**24-AUG-2012**	22-AUG-2012	×	**24-AUG-2012**	25-AUG-2012	✓
Soil Glass Jar - Unpreserved (EA002)							
SEDUP04, SE057_0.2-0.4, SE005_0.0-0.1, SEDUP05, SE013_0.0-0.1, BH001_0.3-0.5, SE004_0.0-0.1	**16-AUG-2012**	**24-AUG-2012**	23-AUG-2012	×	**24-AUG-2012**	25-AUG-2012	✓

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)								
BRICK01,	BRICK02	**17-AUG-2012**	**----**	----	----	**29-AUG-2012**	31-AUG-2012	✓
Soil Glass Jar - Unpreserved (EA055-103)								
SE001_0.0-0.1,	SE001_0.1-0.2,	**14-AUG-2012**	**----**	----	----	**24-AUG-2012**	28-AUG-2012	✓
SE002_0.0-0.1,	SE002_0.3-0.5,							
SE003_0.0-0.1,	SE003_0.2-0.4,							
SE010_0.1-0.3,	SE010_0.6-0.8,							
SE011_0.0-0.1,	SE012_0.0-0.1,							
SE012_0.3-0.5,	SE020_0.0-0.1,							
SE020_0.2-0.4,	SE021_0.0-0.1,							
SE030_0.0-0.1,	SE030_0.3-0.5,							
SE031_0.0-0.1,	SE040_0.3-0.5,							
SE042_0.0-0.1,	SE051_0.0-0.1,							
SE051_0.3-0.5,	SE052_0.0-0.1,							
BH053_0.3-0.5,	BH053_1.5-1.7,							
BH053_3.2-3.5,	BH024_0.3-0.5,							
BH024_1.0-1.2,	BH024_2.0-2.2,							
BH077_0.3-0.5,	BH077_1.0-1.2,							
BH077_1.5-1.7,	SE011_0.3-0.5							
Soil Glass Jar - Unpreserved (EA055-103)								
BH074_0.8-1.0,	BH064_0.0-0.2,	**15-AUG-2012**	**----**	----	----	**24-AUG-2012**	29-AUG-2012	✓
BH064_0.3-0.5,	BH073_0.0-0.2,							
BH073_0.5-0.7,	BH056_0.3-0.5,							
BH075_1.8-2.0,	BH060_0.0-0.2,							
BH82_1.5-1.7,	BH034_0.0-0.1,							
BH014_0.0-0.1,	BH071_0.5-0.7,							
BH091_0.0-0.1,	SE050_0.0-0.1,							
SE050_0.2-0.4,	SEDUP03,							
SE053_0.0-0.1,	SE054_0.0-0.1,							
SE055_0.0-0.1,	SE056_0.05-0.15,							
SE061_0.0-0.1,	SE014_0.0-0.05,							
SE022_0.0-0.05,	SE022_0.2-0.4,							
SE043_0.1-0.3,	SE064_0.0-0.1,							
SE062_0.0-0.1,	SE062_0.2-0.3,							
SE066_0.0-0.1,	BH031_1.0-1.2,							
BH084_1.0-1.2,	BH084_1.5-1.7							
Soil Glass Jar - Unpreserved (EA055-103)								
BH002_0.5-0.7,	BH004_1.0-1.2,	**16-AUG-2012**	**----**	----	----	**24-AUG-2012**	30-AUG-2012	✓
SE013_0.3-0.5,	SE102_0.0-0.2,							
SEDUP04,	SE057_0.2-0.4,							
SE005_0.0-0.1,	SEDUP05,							
SE013_0.0-0.1,	BHDUP07,							
BHDUP06,	BH001_0.3-0.5,							
BH004_0.0-0.2,	SE004_0.0-0.1							

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
EA150: Particle Sizing								
Snap Lock Bag (EA150H)								
BH034_0.0-0.1,	BH014_0.0-0.1	**15-AUG-2012**	---	11-FEB-2013	----	**29-AUG-2012**	11-FEB-2013	✓
Soil Glass Jar - Unpreserved (EA150H)								
BH031_0.0-0.2, BH031_1.8-2.0	BH031_0.5-0.7,	**15-AUG-2012**	---	11-FEB-2013	----	**29-AUG-2012**	11-FEB-2013	✓
EA150: Soil Classification based on Particle Size								
Snap Lock Bag (EA150H)								
BH034_0.0-0.1,	BH014_0.0-0.1	**15-AUG-2012**	---	11-FEB-2013	----	**29-AUG-2012**	11-FEB-2013	✓
Soil Glass Jar - Unpreserved (EA150H)								
BH031_0.0-0.2, BH031_1.8-2.0	BH031_0.5-0.7,	**15-AUG-2012**	---	11-FEB-2013	----	**29-AUG-2012**	11-FEB-2013	✓
ED007: Exchangeable Cations								
Snap Lock Bag (ED007)								
BH014_0.0-0.1		**15-AUG-2012**	**29-AUG-2012**	12-SEP-2012	✓	**03-SEP-2012**	12-SEP-2012	✓
Soil Glass Jar - Unpreserved (ED007)								
SE002_0.0-0.1, SE021_0.0-0.1, SE040_0.3-0.5, BH053_1.5-1.7, BH077_0.3-0.5, BH077_1.5-1.7	SE011_0.0-0.1, SE030_0.0-0.1, BH053_0.3-0.5, BH053_3.2-3.5, BH077_1.0-1.2,	**14-AUG-2012**	**29-AUG-2012**	11-SEP-2012	✓	**03-SEP-2012**	11-SEP-2012	✓
Soil Glass Jar - Unpreserved (ED007)								
BH034_0.0-0.1, SE060_0.0-0.1, SE014_0.0-0.05,	BH071_0.5-0.7, SE061_0.0-0.1, SE064_0.0-0.1	**15-AUG-2012**	**29-AUG-2012**	12-SEP-2012	✓	**03-SEP-2012**	12-SEP-2012	✓
Soil Glass Jar - Unpreserved (ED007)								
SE033_0.0-0.05		**16-AUG-2012**	**29-AUG-2012**	13-SEP-2012	✓	**03-SEP-2012**	13-SEP-2012	✓
EG005C: Leachable Metals by ICPAES								
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG005C)								
BH034_0.0-0.1, BH071_0.5-0.7, BH053_0.3-0.5, BH053_3.2-3.5, BH024_1.0-1.2, BH077_0.3-0.5, BH077_1.5-1.7, BH084_1.5-1.7	BH014_0.0-0.1, BH091_0.0-0.1, BH053_1.5-1.7, BH024_0.3-0.5, BH024_2.0-2.2, BH077_1.0-1.2, BH084_1.0-1.2,	**28-AUG-2012**	**28-AUG-2012**	24-FEB-2013	✓	**28-AUG-2012**	24-FEB-2013	✓

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
EG005-SDH: 1M HCl-Extractable Metals by ICPAES							
Soil Glass Jar - Unpreserved (EG005-SDH) SE002_0.0-0.1, SE011_0.0-0.1, SE021_0.0-0.1, SE030_0.0-0.1, SE031_0.0-0.1, SE040_0.3-0.5, SE051_0.0-0.1, SE052_0.0-0.1	**14-AUG-2012**	**27-AUG-2012**	10-FEB-2013	✓	**30-AUG-2012**	10-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG005-SDH) SE053_0.0-0.1, SE054_0.0-0.1, SE056_0.05-0.15, SE061_0.0-0.1, SE014_0.0-0.05, SE022_0.0-0.05, SE043_0.1-0.3, SE064_0.0-0.1, SE062_0.0-0.1, SE062_0.2-0.3, SE066_0.0-0.1	**15-AUG-2012**	**27-AUG-2012**	11-FEB-2013	✓	**30-AUG-2012**	11-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG005-SDH) SE057_0.2-0.4, SE005_0.0-0.1, SEDUP05, SE013_0.0-0.1, SE004_0.0-0.1	**16-AUG-2012**	**27-AUG-2012**	12-FEB-2013	✓	**30-AUG-2012**	12-FEB-2013	✓

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
EG005T: Total Metals by ICP-AES							
Snap Lock Bag (EG005T)							
BRICK01, BRICK02	**17-AUG-2012**	**29-AUG-2012**	13-FEB-2013	✓	**29-AUG-2012**	13-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG005T)							
TB01 - (AKA TRIP BLANK 8)	**06-AUG-2012**	**28-AUG-2012**	02-FEB-2013	✓	**29-AUG-2012**	02-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG005T)							
TB02 - (AKA TRIP BLANK 9)	**06-AUG-2012**	**29-AUG-2012**	02-FEB-2013	✓	**29-AUG-2012**	02-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG005T)							
SE001_0.0-0.1, SE001_0.1-0.2, SE002_0.0-0.1, SE002_0.3-0.5, SE003_0.0-0.1, SE003_0.2-0.4, SE010_0.1-0.3, SE010_0.6-0.8, SE011_0.0-0.1, SE012_0.0-0.1, SE012_0.3-0.5, SE020_0.0-0.1, SE020_0.2-0.4, SE021_0.0-0.1, SE030_0.0-0.1, SE030_0.3-0.5, SE031_0.0-0.1, SE040_0.3-0.5, SE042_0.0-0.1	**14-AUG-2012**	**28-AUG-2012**	10-FEB-2013	✓	**28-AUG-2012**	10-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG005T)							
SE051_0.0-0.1, SE051_0.3-0.5, SE052_0.0-0.1, BH053_0.3-0.5, BH053_1.5-1.7, BH053_3.2-3.5, BH024_0.3-0.5, BH024_1.0-1.2, BH024_2.0-2.2, BH077_0.3-0.5, BH077_1.0-1.2, BH077_1.5-1.7	**14-AUG-2012**	**28-AUG-2012**	10-FEB-2013	✓	**29-AUG-2012**	10-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG005T)							
SE011_0.3-0.5	**14-AUG-2012**	**29-AUG-2012**	10-FEB-2013	✓	**29-AUG-2012**	10-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG005T)							
BH074_0.8-1.0, BH064_0.0-0.2, BH064_0.3-0.5, BH073_0.0-0.2, BH073_0.5-0.7, BH056_0.3-0.5, BH075_1.8-2.0, BH060_0.0-0.2	**15-AUG-2012**	**27-AUG-2012**	11-FEB-2013	✓	**28-AUG-2012**	11-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG005T)							
BH82_1.5-1.7, BH034_0.0-0.1, BH014_0.0-0.1, BH071_0.5-0.7, BH091_0.0-0.1	**15-AUG-2012**	**28-AUG-2012**	11-FEB-2013	✓	**28-AUG-2012**	11-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG005T)							
SE050_0.0-0.1, SE050_0.2-0.4, SEDUP03, SE053_0.0-0.1, SE054_0.0-0.1, SE055_0.0-0.1, SE056_0.05-0.15, SE061_0.0-0.1, SE014_0.0-0.05, SE022_0.0-0.05, SE022_0.2-0.4, SE043_0.1-0.3, SE064_0.0-0.1, SE062_0.0-0.1, SE062_0.2-0.3, SE066_0.0-0.1, BH031_1.0-1.2, BH084_1.0-1.2, BH084_1.5-1.7	**15-AUG-2012**	**28-AUG-2012**	11-FEB-2013	✓	**29-AUG-2012**	11-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG005T)							

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
EG005T: Total Metals by ICP-AES - Continued							
BH002_0.5-0.7, BH004_1.0-1.2, SE013_0.3-0.5, SE102_0.0-0.2, SEDUP04	**16-AUG-2012**	**28-AUG-2012**	12-FEB-2013	✓	**28-AUG-2012**	12-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG005T)							
SE057_0.2-0.4, SE005_0.0-0.1, SEDUP05, SE013_0.0-0.1, BHDUP07, BHDUP06, BH001_0.3-0.5, BH004_0.0-0.2	**16-AUG-2012**	**28-AUG-2012**	12-FEB-2013	✓	**29-AUG-2012**	12-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG005T)							
SE004_0.0-0.1	**16-AUG-2012**	**29-AUG-2012**	12-FEB-2013	✓	**29-AUG-2012**	12-FEB-2013	✓
EG020-SDH: 1M HCl Extractable metals by ICPMS							
Soil Glass Jar - Unpreserved (EG020-SDH)							
SE002_0.0-0.1, SE011_0.0-0.1, SE021_0.0-0.1, SE030_0.0-0.1, SE031_0.0-0.1, SE040_0.3-0.5, SE051_0.0-0.1, SE052_0.0-0.1	**14-AUG-2012**	**27-AUG-2012**	10-FEB-2013	✓	**27-AUG-2012**	10-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG020-SDH)							
SE053_0.0-0.1, SE054_0.0-0.1, SE056_0.05-0.15, SE061_0.0-0.1, SE014_0.0-0.05, SE022_0.0-0.05, SE043_0.1-0.3, SE064_0.0-0.1, SE062_0.0-0.1, SE062_0.2-0.3, SE066_0.0-0.1	**15-AUG-2012**	**27-AUG-2012**	11-FEB-2013	✓	**27-AUG-2012**	11-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG020-SDH)							
SE057_0.2-0.4, SE005_0.0-0.1, SEDUP05, SE013_0.0-0.1, SE004_0.0-0.1	**16-AUG-2012**	**27-AUG-2012**	12-FEB-2013	✓	**27-AUG-2012**	12-FEB-2013	✓
EG035C: Leachable Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035C)							
BH034_0.0-0.1, BH014_0.0-0.1, BH071_0.5-0.7, BH091_0.0-0.1, BH053_0.3-0.5, BH053_1.5-1.7, BH053_3.2-3.5, BH024_0.3-0.5, BH024_1.0-1.2, BH024_2.0-2.2, BH077_0.3-0.5, BH077_1.0-1.2, BH077_1.5-1.7, BH084_1.0-1.2, BH084_1.5-1.7	**28-AUG-2012**	**----**	----	----	**31-AUG-2012**	25-SEP-2012	✓

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
EG035T: Total Recoverable Mercury by FIMS								
Snap Lock Bag (EG035T)								
BRICK01,	BRICK02	**17-AUG-2012**	**29-AUG-2012**	14-SEP-2012	✓	**30-AUG-2012**	14-SEP-2012	✓
Soil Glass Jar - Unpreserved (EG035T)								
SE001_0.0-0.1,	SE001_0.1-0.2,	**14-AUG-2012**	**28-AUG-2012**	11-SEP-2012	✓	**28-AUG-2012**	11-SEP-2012	✓
SE002_0.0-0.1,	SE002_0.3-0.5,							
SE003_0.0-0.1,	SE003_0.2-0.4,							
SE010_0.1-0.3,	SE010_0.6-0.8,							
SE011_0.0-0.1,	SE012_0.0-0.1,							
SE012_0.3-0.5,	SE020_0.0-0.1,							
SE020_0.2-0.4,	SE021_0.0-0.1,							
SE030_0.0-0.1,	SE030_0.3-0.5,							
SE031_0.0-0.1,	SE040_0.3-0.5,							
SE042_0.0-0.1,	SE051_0.0-0.1,							
SE051_0.3-0.5,	SE052_0.0-0.1,							
BH053_0.3-0.5,	BH053_1.5-1.7,							
BH053_3.2-3.5,	BH077_0.3-0.5,							
BH077_1.0-1.2,	BH077_1.5-1.7							
Soil Glass Jar - Unpreserved (EG035T)								
SE011_0.3-0.5		**14-AUG-2012**	**29-AUG-2012**	11-SEP-2012	✓	**30-AUG-2012**	11-SEP-2012	✓
Soil Glass Jar - Unpreserved (EG035T)								
BH074_0.8-1.0,	BH064_0.0-0.2,	**15-AUG-2012**	**27-AUG-2012**	12-SEP-2012	✓	**28-AUG-2012**	12-SEP-2012	✓
BH064_0.3-0.5,	BH073_0.0-0.2,							
BH073_0.5-0.7,	BH056_0.3-0.5,							
BH075_1.8-2.0,	BH060_0.0-0.2							
Soil Glass Jar - Unpreserved (EG035T)								
BH82_1.5-1.7,	BH034_0.0-0.1,	**15-AUG-2012**	**28-AUG-2012**	12-SEP-2012	✓	**28-AUG-2012**	12-SEP-2012	✓
BH014_0.0-0.1,	BH071_0.5-0.7,							
BH091_0.0-0.1,	SE050_0.0-0.1,							
SE050_0.2-0.4,	SEDUP03,							
SE053_0.0-0.1,	SE054_0.0-0.1,							
SE055_0.0-0.1,	SE056_0.05-0.15,							
SE061_0.0-0.1,	SE014_0.0-0.05,							
SE022_0.0-0.05,	SE022_0.2-0.4,							
SE043_0.1-0.3,	SE064_0.0-0.1,							
SE062_0.0-0.1,	SE062_0.2-0.3,							
SE066_0.0-0.1,	BH031_1.0-1.2,							
BH084_1.0-1.2,	BH084_1.5-1.7							
Soil Glass Jar - Unpreserved (EG035T)								
BH002_0.5-0.7,	BH004_1.0-1.2,	**16-AUG-2012**	**28-AUG-2012**	13-SEP-2012	✓	**28-AUG-2012**	13-SEP-2012	✓
SE013_0.3-0.5,	SE102_0.0-0.2,							
SEDUP04,	SE057_0.2-0.4,							
SE005_0.0-0.1,	SEDUP05,							
SE013_0.0-0.1,	BHDUP07,							
BHDUP06,	BH001_0.3-0.5,							
BH004_0.0-0.2								
Soil Glass Jar - Unpreserved (EG035T)								
SE004_0.0-0.1		**16-AUG-2012**	**29-AUG-2012**	13-SEP-2012	✓	**30-AUG-2012**	13-SEP-2012	✓

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
EK026G: Total Cyanide By Discrete Analyser								
Soil Glass Jar - Unpreserved (EK026G)								
SE001_0.0-0.1,	SE001_0.1-0.2,	**14-AUG-2012**	**29-AUG-2012**	21-AUG-2012	×	**29-AUG-2012**	12-SEP-2012	✓
SE002_0.0-0.1,	SE002_0.3-0.5,							
SE003_0.0-0.1,	SE003_0.2-0.4,							
SE010_0.1-0.3,	SE010_0.6-0.8,							
SE011_0.0-0.1,	SE012_0.0-0.1,							
SE012_0.3-0.5,	SE020_0.0-0.1,							
SE020_0.2-0.4,	SE021_0.0-0.1,							
SE030_0.0-0.1,	SE030_0.3-0.5,							
SE031_0.0-0.1,	SE040_0.3-0.5,							
SE051_0.0-0.1,	SE051_0.3-0.5,							
SE052_0.0-0.1,	BH053_0.3-0.5,							
BH053_1.5-1.7,	BH053_3.2-3.5,							
BH024_0.3-0.5,	BH024_1.0-1.2,							
BH024_2.0-2.2,	BH077_0.3-0.5,							
BH077_1.0-1.2,	BH077_1.5-1.7,							
SE011_0.3-0.5								
Soil Glass Jar - Unpreserved (EK026G)								
BH074_0.8-1.0,	BH064_0.0-0.2,	**15-AUG-2012**	**29-AUG-2012**	22-AUG-2012	×	**29-AUG-2012**	12-SEP-2012	✓
BH064_0.3-0.5,	BH073_0.0-0.2,							
BH073_0.5-0.7,	BH056_0.3-0.5,							
BH060_0.0-0.2,	BH82_1.5-1.7,							
BH034_0.0-0.1,	BH014_0.0-0.1,							
BH071_0.5-0.7,	BH091_0.0-0.1,							
SE050_0.0-0.1,	SE050_0.2-0.4,							
SEDUP03,	SE056_0.05-0.15,							
SE061_0.0-0.1,	SE014_0.0-0.05,							
SE022_0.0-0.05,	SE043_0.1-0.3,							
SE064_0.0-0.1,	SE062_0.0-0.1,							
SE062_0.2-0.3,	SE066_0.0-0.1,							
BH084_1.0-1.2,	BH084_1.5-1.7							
Soil Glass Jar - Unpreserved (EK026G)								
SEDUP04,	SE057_0.2-0.4,	**16-AUG-2012**	**29-AUG-2012**	23-AUG-2012	×	**29-AUG-2012**	12-SEP-2012	✓
SE005_0.0-0.1,	SEDUP05,							
SE013_0.0-0.1,	BH001_0.3-0.5,							
SE004_0.0-0.1								
EN33: TCLP Leach								
Lab Split : Leach for Hg, Cr(VI) and other metal (EN33a)								
BH053_0.3-0.5,	BH053_1.5-1.7,	**14-AUG-2012**	**---**	11-SEP-2012	----	**28-AUG-2012**	11-SEP-2012	✓
BH053_3.2-3.5,	BH024_0.3-0.5,							
BH024_1.0-1.2,	BH024_2.0-2.2,							
BH077_0.3-0.5,	BH077_1.0-1.2,							
BH077_1.5-1.7								
Lab Split : Leach for Hg, Cr(VI) and other metal (EN33a)								
BH034_0.0-0.1,	BH014_0.0-0.1,	**15-AUG-2012**	**---**	12-SEP-2012	----	**28-AUG-2012**	12-SEP-2012	✓
BH071_0.5-0.7,	BH091_0.0-0.1,							
BH084_1.0-1.2,	BH084_1.5-1.7							

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
EP003: Total Organic Carbon (TOC) in Soil							
Pulp Bag (EP003) SE002_0.0-0.1, SE011_0.0-0.1, SE021_0.0-0.1, SE030_0.0-0.1, SE040_0.3-0.5, BH053_0.3-0.5, BH053_1.5-1.7, BH053_3.2-3.5, BH077_0.3-0.5, BH077_1.0-1.2, BH077_1.5-1.7	**14-AUG-2012**	**28-AUG-2012**	21-AUG-2012	×	**28-AUG-2012**	25-SEP-2012	✓
Pulp Bag (EP003) BH034_0.0-0.1, BH014_0.0-0.1, BH071_0.5-0.7, SE060_0.0-0.1, SE061_0.0-0.1, SE014_0.0-0.05	**15-AUG-2012**	**28-AUG-2012**	22-AUG-2012	×	**28-AUG-2012**	25-SEP-2012	✓
Pulp Bag (EP003) SE033_0.0-0.05, SE064_0.0-0.1	**16-AUG-2012**	**28-AUG-2012**	23-AUG-2012	×	**28-AUG-2012**	25-SEP-2012	✓

Matrix: **WATER**

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
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T) RB01, RB02, RB04	**15-AUG-2012**	**27-AUG-2012**	11-FEB-2013	✓	**27-AUG-2012**	11-FEB-2013	✓
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T) RB03, RB05	**16-AUG-2012**	**27-AUG-2012**	12-FEB-2013	✓	**27-AUG-2012**	12-FEB-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)							
1M HCl Extractable Metals	EG005-SDH	3	24	**12.5**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
1M HCl Extractable Metals by ICPMS	EG020-SDH	3	24	**12.5**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Exchangeable Cations	ED007	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Moisture Content	EA055-103	14	133	**10.5**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
pH (1:5)	EA002	7	66	**10.6**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide by Segmented Flow Analyser	EK026SF	7	64	**10.9**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS	EG035T	11	104	**10.6**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	12	120	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP003	2	19	**10.5**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
1M HCl Extractable Metals	EG005-SDH	2	24	**8.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
1M HCl Extractable Metals by ICPMS	EG020-SDH	2	24	**8.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Exchangeable Cations	ED007	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide by Segmented Flow Analyser	EK026SF	4	64	**6.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS	EG035T	6	104	**5.8**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	6	120	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP003	1	19	**5.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
1M HCl Extractable Metals	EG005-SDH	2	24	**8.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
1M HCl Extractable Metals by ICPMS	EG020-SDH	2	24	**8.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Exchangeable Cations	ED007	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide by Segmented Flow Analyser	EK026SF	4	64	**6.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS	EG035T	6	104	**5.8**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	6	120	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP003	1	19	**5.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
1M HCl Extractable Metals by ICPMS	EG020-SDH	2	24	**8.3**	**5.0**	✓	ALS QCS3 requirement
Total Cyanide by Segmented Flow Analyser	EK026SF	4	64	**6.3**	**5.0**	✓	ALS QCS3 requirement
Total Mercury by FIMS	EG035T	6	104	**5.8**	**5.0**	✓	ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	6	120	**5.0**	**5.0**	✓	ALS QCS3 requirement

Matrix: **WATER**

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)							
Leachable Mercury by FIMS	EG035C	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Leachable Metals by ICPAES	EG005C	2	15	**13.3**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-MS - Suite A	EG020A-T	4	36	**11.1**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							

Matrix: **WATER**

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 Control Samples (LCS) - Continued							
Leachable Mercury by FIMS	EG035C	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Leachable Metals by ICPAES	EG005C	1	15	**6.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-MS - Suite A	EG020A-T	3	39	**7.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Leachable Mercury by FIMS	EG035C	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Leachable Metals by ICPAES	EG005C	1	15	**6.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-MS - Suite A	EG020A-T	3	39	**7.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Leachable Mercury by FIMS	EG035C	1	20	**5.0**	**5.0**	✓	ALS QCS3 requirement
Leachable Metals by ICPAES	EG005C	1	15	**6.7**	**5.0**	✓	ALS QCS3 requirement
Total Metals by ICP-MS - Suite A	EG020A-T	2	36	**5.6**	**5.0**	✓	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
pH (1:5)	EA002	SOIL	(APHA 21st ed., 4500H+) pH is determined on soil samples after a 1:5 soil/water leach. This method is compliant with NEPM (1999) Schedule B(3) (Method 103)
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 (2010 Draft) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Particle Size Analysis (Sieving)	EA150	SOIL	Particle Size Analysis by Sieving according to AS1289.3.6.1 - 2009
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3 - 2003
Exchangeable Cations	ED007	SOIL	Rayment & Higginson (1992) Method 15A1. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM (1999) Schedule B(3) (Method 301)
Leachable Metals by ICPAES	EG005C	SOIL	APHA 21st ed., 3120; USEPA SW 846 - 6010 The ICPAES technique ionises leachate sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
1M HCl Extractable Metals	EG005-SDH	SOIL	APHA 21st ed., 3120; USEPA SW 846 - 6010. Metals are determined via ICPAES following weak acid extraction. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (1999) Schedule B(3). LORs per NAGD.
Total Metals by ICP-AES	EG005T	SOIL	(APHA 21st ed., 3120; USEPA SW 846 - 6010) (ICPAES) Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (1999) Schedule B(3)
1M HCl Extractable Metals by ICPMS	EG020-SDH	SOIL	APHA 21st ed., 3125; USEPA SW846 - 6020. Metals are determined via ICPMS following weak acid extraction. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector. Analyte list and LORs per NAGD.
Leachable Mercury by FIMS	EG035C	SOIL	AS 3550, APHA 21st ed. 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the TCLP solution. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Mercury by FIMS	EG035T	SOIL	AS 3550, APHA 21st ed., 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Total Cyanide by Segmented Flow Analyser	EK026SF	SOIL	APHA 4500-CN-O. Caustic leachates of soil samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Organic Carbon	EP003	SOIL	In-house C-IR17. Dried and pulverised sample is reacted with acid to remove inorganic Carbonates, then combusted in a LECO furnace in the presence of strong oxidants / catalysts. The evolved (Organic) Carbon (as CO2) is automaticaly measured by infra-red detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Preparation Methods	Method	Matrix	Method Descriptions
NaOH leach for CN in Soils	CN-PR	SOIL	In-house, APHA 4500 CN. Samples are extracted by end-over-end tumbling with NaOH.
Exchangeable Cations Preparation Method	ED007PR	SOIL	Rayment & Higginson (1992) method 15A1. A 1M NH4Cl extraction by end over end tumbling at a ratio of 1:20. There is no pretreatment for soluble salts. Extracts can be run by ICP for cations.
Digestion for Total Recoverable Metals in TCLP Leachate	EN25C	SOIL	USEPA SW846-3005 Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
TCLP for Non & Semivolatile Analytes	EN33a	SOIL	(USEPA SW846-1311, ALS QWI-EN/33) The TCLP procedure is designed to determine the mobility of both organic and inorganic analytes present in wastes. The standard TCLP leach is for non-volatile and Semivolatile test parameters.
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.
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	USEPA 200.2 Mod. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (1999) Schedule B(3) (Method 202)
1M HCl Extraction for Metals in Sediments (1 hour)	EN71	SOIL	In house, Allen (1993) Mod. 1g of sample is leached at room temperature for 1 hour in 10% hydrochloric acid. The resultant extract is filtered and bulked for analysis of extracted metals.
Digestion for Total Recoverable Metals	EN25	WATER	USEPA SW846-3005 Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)

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 SW846 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

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Duplicate (DUP) RPDs							
EG005-SDH: 1M HCl-Extractable Metals by ICPAES	ES1220305-018	SE002_0.0-0.1	**Arsenic**	7440-38-2	25.5 %	0-20%	**RPD exceeds LOR based limits**
EG005-SDH: 1M HCl-Extractable Metals by ICPAES	ES1220305-018	SE002_0.0-0.1	**Copper**	7440-50-8	31.5 %	0-20%	**RPD exceeds LOR based limits**
EG005T: Total Metals by ICP-AES	ES1220305-044	SE050_0.0-0.1	**Aluminium**	7429-90-5	20.9 %	0-20%	**RPD exceeds LOR based limits**
EG005T: Total Metals by ICP-AES	ES1220305-086	BH004_0.0-0.2	**Copper**	7440-50-8	29.8 %	0-20%	**RPD exceeds LOR based limits**
Matrix Spike (MS) Recoveries							
EG005T: Total Metals by ICP-AES	ES1220305-034	SEDUP04	**Arsenic**	7440-38-2	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
EG005T: Total Metals by ICP-AES	ES1220305-009	BH82_1.5-1.7	**Arsenic**	7440-38-2	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
EG005T: Total Metals by ICP-AES	ES1220305-044	SE050_0.0-0.1	**Arsenic**	7440-38-2	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Laboratory Control 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***
EA002 : pH (Soils)						

Matrix: **SOIL**

Method / Container / Client Sample ID(s)		Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA002 : pH (Soils) - Analysis Holding Time Compliance							
Soil Glass Jar - Unpreserved							
SE001_0.0-0.1,	SE001_0.1-0.2,	24-AUG-2012	21-AUG-2012	**3**	----	----	----
SE002_0.0-0.1,	SE002_0.3-0.5,						
SE003_0.0-0.1,	SE003_0.2-0.4,						
SE010_0.1-0.3,	SE010_0.6-0.8,						
SE011_0.0-0.1,	SE012_0.0-0.1,						
SE012_0.3-0.5,	SE020_0.0-0.1,						
SE020_0.2-0.4,	SE021_0.0-0.1,						
SE030_0.0-0.1,	SE030_0.3-0.5,						
SE031_0.0-0.1,	SE040_0.3-0.5,						
SE051_0.0-0.1,	SE051_0.3-0.5,						
SE052_0.0-0.1,	BH053_0.3-0.5,						
BH053_1.5-1.7,	BH053_3.2-3.5,						
BH024_0.3-0.5,	BH024_1.0-1.2,						
BH024_2.0-2.2,	BH077_0.3-0.5,						
BH077_1.0-1.2,	BH077_1.5-1.7,						
SE011_0.3-0.5							
Soil Glass Jar - Unpreserved							
BH074_0.8-1.0,	BH064_0.0-0.2,	24-AUG-2012	22-AUG-2012	**2**	----	----	----
BH064_0.3-0.5,	BH073_0.0-0.2,						
BH073_0.5-0.7,	BH056_0.3-0.5,						
BH060_0.0-0.2,	BH82_1.5-1.7,						
BH034_0.0-0.1,	BH014_0.0-0.1,						
BH071_0.5-0.7,	BH091_0.0-0.1,						
SE050_0.0-0.1,	SE050_0.2-0.4,						
SEDUP03,	SE056_0.05-0.15,						
SE061_0.0-0.1,	SE014_0.0-0.05,						
SE022_0.0-0.05,	SE043_0.1-0.3,						
SE064_0.0-0.1,	SE062_0.0-0.1,						
SE062_0.2-0.3,	SE066_0.0-0.1,						
BH084_1.0-1.2,	BH084_1.5-1.7						
Soil Glass Jar - Unpreserved							
SEDUP04,	SE057_0.2-0.4,	24-AUG-2012	23-AUG-2012	**1**	----	----	----
SE005_0.0-0.1,	SEDUP05,						
SE013_0.0-0.1,	BH001_0.3-0.5,						
SE004_0.0-0.1							
EK026G: Total Cyanide By Discrete Analyser							

Matrix: **SOIL**

Method / Container / Client Sample ID(s)		Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EK026G: Total Cyanide By Discrete Analyser - Analysis Holding Time Compliance							
Soil Glass Jar - Unpreserved							
SE001_0.0-0.1,	SE001_0.1-0.2,	29-AUG-2012	21-AUG-2012	**8**	----	----	----
SE002_0.0-0.1,	SE002_0.3-0.5,						
SE003_0.0-0.1,	SE003_0.2-0.4,						
SE010_0.1-0.3,	SE010_0.6-0.8,						
SE011_0.0-0.1,	SE012_0.0-0.1,						
SE012_0.3-0.5,	SE020_0.0-0.1,						
SE020_0.2-0.4,	SE021_0.0-0.1,						
SE030_0.0-0.1,	SE030_0.3-0.5,						
SE031_0.0-0.1,	SE040_0.3-0.5,						
SE051_0.0-0.1,	SE051_0.3-0.5,						
SE052_0.0-0.1,	BH053_0.3-0.5,						
BH053_1.5-1.7,	BH053_3.2-3.5,						
BH024_0.3-0.5,	BH024_1.0-1.2,						
BH024_2.0-2.2,	BH077_0.3-0.5,						
BH077_1.0-1.2,	BH077_1.5-1.7,						
SE011_0.3-0.5							
Soil Glass Jar - Unpreserved							
BH074_0.8-1.0,	BH064_0.0-0.2,	29-AUG-2012	22-AUG-2012	**7**	----	----	----
BH064_0.3-0.5,	BH073_0.0-0.2,						
BH073_0.5-0.7,	BH056_0.3-0.5,						
BH060_0.0-0.2,	BH82_1.5-1.7,						
BH034_0.0-0.1,	BH014_0.0-0.1,						
BH071_0.5-0.7,	BH091_0.0-0.1,						
SE050_0.0-0.1,	SE050_0.2-0.4,						
SEDUP03,	SE056_0.05-0.15,						
SE061_0.0-0.1,	SE014_0.0-0.05,						
SE022_0.0-0.05,	SE043_0.1-0.3,						
SE064_0.0-0.1,	SE062_0.0-0.1,						
SE062_0.2-0.3,	SE066_0.0-0.1,						
BH084_1.0-1.2,	BH084_1.5-1.7						
Soil Glass Jar - Unpreserved							
SEDUP04,	SE057_0.2-0.4,	29-AUG-2012	23-AUG-2012	**6**	----	----	----
SE005_0.0-0.1,	SEDUP05,						
SE013_0.0-0.1,	BH001_0.3-0.5,						
SE004_0.0-0.1							
EP003: Total Organic Carbon (TOC) in Soil							
Pulp Bag							
SE002_0.0-0.1,	SE011_0.0-0.1,	28-AUG-2012	21-AUG-2012	**7**	----	----	----
SE021_0.0-0.1,	SE030_0.0-0.1,						
SE040_0.3-0.5,	BH053_0.3-0.5,						
BH053_1.5-1.7,	BH053_3.2-3.5,						
BH077_0.3-0.5,	BH077_1.0-1.2,						
BH077_1.5-1.7							

Matrix: **SOIL**

Method / Container / Client Sample ID(s)		Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EP003: Total Organic Carbon (TOC) in Soil - Analysis Holding Time Compliance							
Pulp Bag							
BH034_0.0-0.1,	BH014_0.0-0.1,	28-AUG-2012	22-AUG-2012	**6**	----	----	----
BH071_0.5-0.7,	SE060_0.0-0.1,						
SE061_0.0-0.1,	SE014_0.0-0.05						
Pulp Bag							
SE033_0.0-0.05,	SE064_0.0-0.1	28-AUG-2012	23-AUG-2012	**5**	----	----	----

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.**

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1220402**	Page	: 1 of 5
Client	: GHD PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR BEN LUFFMAN	Contact	: Angelene Kumar
Address	: 230 HARBOUR DRIVE PO Box 1340 COFFS HARBOUR NSW, AUSTRALIA 2450	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: ben_luffman@ghd.com	E-mail	: angelene.kumar@alsglobal.com
Telephone	: +61 02 6650 5600	Telephone	: +61 2 8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61 2 8784 8555
Project	: 2216251	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: HILLSIDE DR,URUNGA		
C-O-C number	: ----	Date Samples Received	: 22-AUG-2012
Sampler	: JS	Issue Date	: 28-AUG-2012
Order number	: ----		
		No. of samples received	: 19
Quote number	: SY/270/12	No. of samples analysed	: 19

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

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

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
EA037: Ass Field Screening Analysis							
Snap Lock Bag (EA037) BH054_0.0-0.2, BH054_0.7-0.9, BH054_1.0-1.2, BH032_0.0-0.2, BH032_0.3-0.5, BH32_1.0-1.2	**14-AUG-2012**	**24-AUG-2012**	15-AUG-2012	×	**28-AUG-2012**	15-AUG-2012	×
Snap Lock Bag (EA037) BH031_0.0-0.2, BH031_0.5-0.7, BH031_1.8-2.0	**15-AUG-2012**	**24-AUG-2012**	16-AUG-2012	×	**28-AUG-2012**	16-AUG-2012	×
Snap Lock Bag (EA037) SE001-0.1, SE003-0.3, SE011-0.4, SE013-0.4, SE031-0.5, SE054-03, SEDUP04, SE050-0.1, SE050-0.3, SE004-0.1	**16-AUG-2012**	**24-AUG-2012**	17-AUG-2012	×	**28-AUG-2012**	17-AUG-2012	×

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)							
ASS Field Screening Analysis	EA037	3	23	**13.0**	**10.0**	✓	NEPM 1999 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
ASS Field Screening Analysis	* EA037	SOIL	Acid Sulfate Soils Laboratory Methods Guidelines, version 2.1 June 2004. As received samples are tested for pH field and pH fox and assessed for a reaction rating.

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 SW846 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
EA037: Ass Field Screening Analysis							
Snap Lock Bag							
BH054_0.0-0.2,	BH054_0.7-0.9,	24-AUG-2012	15-AUG-2012	**9**	28-AUG-2012	15-AUG-2012	**13**
BH054_1.0-1.2,	BH032_0.0-0.2,						
BH032_0.3-0.5,	BH32_1.0-1.2						
Snap Lock Bag							
BH031_0.0-0.2,	BH031_0.5-0.7,	24-AUG-2012	16-AUG-2012	**8**	28-AUG-2012	16-AUG-2012	**12**
BH031_1.8-2.0							
Snap Lock Bag							
SE001-0.1,	SE003-0.3,	24-AUG-2012	17-AUG-2012	**7**	28-AUG-2012	17-AUG-2012	**11**
SE011-0.4,	SE013-0.4,						
SE031-0.5,	SE054-03,						
SEDUP04,	SE050-0.1,						
SE050-0.3,	SE004-0.1						

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.**

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **EB1225565**	Page	: 1 of 7
Client	: GHD PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MR BEN LUFFMAN	Contact	: Angelene Kumar
Address	: 230 HARBOUR DRIVE PO Box 1340 COFFS HARBOUR NSW, AUSTRALIA 2450	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: ben_luffman@ghd.com	E-mail	: angelene.kumar@alsglobal.com
Telephone	: +61 02 6650 5600	Telephone	: +61 2 8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61 2 8784 8555
Project	: 2216251	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: Hillside Dr, Urunga		
C-O-C number	: ----	Date Samples Received	: 26-SEP-2012
Sampler	: J. Simkus	Issue Date	: 05-OCT-2012
Order number	: ----		
		No. of samples received	: 9
Quote number	: SY/270/12	No. of samples analysed	: 9

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

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

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
EA029-H: Acid Base Accounting							
80* dried soil (EA029) BH032_0.0-0.2, BH032_0.3-0.5, BH032_1.0-1.2	**14-AUG-2012**	**03-OCT-2012**	14-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
80* dried soil (EA029) BH031_0.0-0.2, BH031_0.5-0.7, BH031_1.8-2.0	**15-AUG-2012**	**03-OCT-2012**	15-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
80* dried soil (EA029) SE013_0.3-0.5, SE003_0.2-0.4, SE031_0.5-0.7	**16-AUG-2012**	**03-OCT-2012**	16-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
EA029-B: Acidity Trail							
80* dried soil (EA029) BH032_0.0-0.2, BH032_0.3-0.5, BH032_1.0-1.2	**14-AUG-2012**	**03-OCT-2012**	14-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
80* dried soil (EA029) BH031_0.0-0.2, BH031_0.5-0.7, BH031_1.8-2.0	**15-AUG-2012**	**03-OCT-2012**	15-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
80* dried soil (EA029) SE013_0.3-0.5, SE003_0.2-0.4, SE031_0.5-0.7	**16-AUG-2012**	**03-OCT-2012**	16-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
EA029-D: Calcium Values							
80* dried soil (EA029) BH032_0.0-0.2, BH032_0.3-0.5, BH032_1.0-1.2	**14-AUG-2012**	**03-OCT-2012**	14-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
80* dried soil (EA029) BH031_0.0-0.2, BH031_0.5-0.7, BH031_1.8-2.0	**15-AUG-2012**	**03-OCT-2012**	15-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
80* dried soil (EA029) SE013_0.3-0.5, SE003_0.2-0.4, SE031_0.5-0.7	**16-AUG-2012**	**03-OCT-2012**	16-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓

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
EA029-F: Excess Acid Neutralising Capacity							
80* dried soil (EA029) BH032_0.0-0.2, BH032_0.3-0.5, BH032_1.0-1.2	**14-AUG-2012**	**03-OCT-2012**	14-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
80* dried soil (EA029) BH031_0.0-0.2, BH031_0.5-0.7, BH031_1.8-2.0	**15-AUG-2012**	**03-OCT-2012**	15-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
80* dried soil (EA029) SE013_0.3-0.5, SE003_0.2-0.4, SE031_0.5-0.7	**16-AUG-2012**	**03-OCT-2012**	16-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
EA029-E: Magnesium Values							
80* dried soil (EA029) BH032_0.0-0.2, BH032_0.3-0.5, BH032_1.0-1.2	**14-AUG-2012**	**03-OCT-2012**	14-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
80* dried soil (EA029) BH031_0.0-0.2, BH031_0.5-0.7, BH031_1.8-2.0	**15-AUG-2012**	**03-OCT-2012**	15-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
80* dried soil (EA029) SE013_0.3-0.5, SE003_0.2-0.4, SE031_0.5-0.7	**16-AUG-2012**	**03-OCT-2012**	16-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
EA029-A: pH Measurements							
80* dried soil (EA029) BH032_0.0-0.2, BH032_0.3-0.5, BH032_1.0-1.2	**14-AUG-2012**	**03-OCT-2012**	14-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
80* dried soil (EA029) BH031_0.0-0.2, BH031_0.5-0.7, BH031_1.8-2.0	**15-AUG-2012**	**03-OCT-2012**	15-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
80* dried soil (EA029) SE013_0.3-0.5, SE003_0.2-0.4, SE031_0.5-0.7	**16-AUG-2012**	**03-OCT-2012**	16-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
EA029-G: Retained Acidity							
80* dried soil (EA029) BH032_0.0-0.2, BH032_0.3-0.5, BH032_1.0-1.2	**14-AUG-2012**	**03-OCT-2012**	14-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
80* dried soil (EA029) BH031_0.0-0.2, BH031_0.5-0.7, BH031_1.8-2.0	**15-AUG-2012**	**03-OCT-2012**	15-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
80* dried soil (EA029) SE013_0.3-0.5, SE003_0.2-0.4, SE031_0.5-0.7	**16-AUG-2012**	**03-OCT-2012**	16-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓

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
EA029-C: Sulfur Trail							
80* dried soil (EA029) BH032_0.0-0.2, BH032_0.3-0.5, BH032_1.0-1.2	**14-AUG-2012**	**03-OCT-2012**	14-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
80* dried soil (EA029) BH031_0.0-0.2, BH031_0.5-0.7, BH031_1.8-2.0	**15-AUG-2012**	**03-OCT-2012**	15-AUG-2013	✓	**03-OCT-2012**	01-JAN-2013	✓
80* dried soil (EA029) SE013_0.3-0.5, SE003_0.2-0.4, SE031_0.5-0.7	**16-AUG-2012**	**03-OCT-2012**	16-AUG-2013	✓	**03-OCT-2012**	01-JAN-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)							
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	2	15	**13.3**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	1	15	**6.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	1	15	**6.7**	**5.0**	✓	NEPM 1999 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
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	SOIL	Ahern et al 2004 - a suspension peroxide oxidation method following the 'sulfur trail' by determining the level of 1M KCL extractable sulfur and the sulfur level after oxidation of soil sulphides. The 'acidity trail' is followed by measurement of TAA, TPA and TSA. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.

Preparation Methods	Method	Matrix	Method Descriptions
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house

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 SW846 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.

- **No Analysis Holding Time Outliers exist.**

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.**

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1223062**	Page	: 1 of 9
Client	: GHD PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR BEN LUFFMAN	Contact	: Angelene Kumar
Address	: 230 HARBOUR DRIVE PO Box 1340 COFFS HARBOUR NSW, AUSTRALIA 2450	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: ben_luffman@ghd.com	E-mail	: angelene.kumar@alsglobal.com
Telephone	: +61 02 6650 5600	Telephone	: +61 2 8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61 2 8784 8555
Project	: 2216251	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: HILLSIDE DR, URUNGA		
C-O-C number	: ----	Date Samples Received	: 26-SEP-2012
Sampler	: JS	Issue Date	: 04-OCT-2012
Order number	: ----		
		No. of samples received	: 35
Quote number	: SY/270/12	No. of samples analysed	: 35

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

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

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							
Soil Glass Jar - Unpreserved (EA055-103) BH032_0.3-0.5, BHDUP01, BH077_0.0-0.2, BH077_2.0-2.2, SE001_0.4-0.6, SE042_0.2-0.4, SE041_0.0-0.05, SE041_0.1-0.3, SE032_0.0-0.1, SEDUP01	**14-AUG-2012**	**----**	----	----	**27-SEP-2012**	28-AUG-2012	×
Soil Glass Jar - Unpreserved (EA055-103) BH073_1.0-1.2, SE014_0.2-0.4, SE067_0.0-0.1, SE068_0.0-0.1, SE064_0.2-0.3, SE050_0.4-0.6, SEDUP02	**15-AUG-2012**	**----**	----	----	**27-SEP-2012**	29-AUG-2012	×
Soil Glass Jar - Unpreserved (EA055-103) BH012_0.0-0.1, BHDUP08, BH101_0.0-0.2, BH022_0.5-0.7, BH028_0.0-0.2, BH028_0.3-0.5, BH020_0.0-0.2	**16-AUG-2012**	**----**	----	----	**27-SEP-2012**	30-AUG-2012	×
EA150: Particle Sizing							
Soil Glass Jar - Unpreserved (EA150H) SE002_0.5-0.7, SE011_0.7-0.9	**14-AUG-2012**	**---**	10-FEB-2013	----	**03-OCT-2012**	10-FEB-2013	✓
Soil Glass Jar - Unpreserved (EA150H) SE033_0.0-0.05, SE033_0.2-0.4, SE033_0.4-0.6, SE063_0.0-0.1, SE063_0.2-0.3, SE063_0.4-0.6	**15-AUG-2012**	**---**	11-FEB-2013	----	**03-OCT-2012**	11-FEB-2013	✓
Soil Glass Jar - Unpreserved (EA150H) SE003_0.2-0.4, SE004_0.2-0.3, SE004_0.4-0.6	**16-AUG-2012**	**---**	12-FEB-2013	----	**03-OCT-2012**	12-FEB-2013	✓
EA150: Soil Classification based on Particle Size							
Soil Glass Jar - Unpreserved (EA150H) SE002_0.5-0.7, SE011_0.7-0.9	**14-AUG-2012**	**---**	10-FEB-2013	----	**03-OCT-2012**	10-FEB-2013	✓
Soil Glass Jar - Unpreserved (EA150H) SE033_0.0-0.05, SE033_0.2-0.4, SE033_0.4-0.6, SE063_0.0-0.1, SE063_0.2-0.3, SE063_0.4-0.6	**15-AUG-2012**	**---**	11-FEB-2013	----	**03-OCT-2012**	11-FEB-2013	✓
Soil Glass Jar - Unpreserved (EA150H) SE003_0.2-0.4, SE004_0.2-0.3, SE004_0.4-0.6	**16-AUG-2012**	**---**	12-FEB-2013	----	**03-OCT-2012**	12-FEB-2013	✓

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
EG005C: Leachable Metals by ICPAES							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG005C) SE068_0.0-0.1, SE064_0.2-0.3, SE001_0.4-0.6, SE042_0.2-0.4, SE041_0.0-0.05, SE041_0.1-0.3, SE050_0.4-0.6, SE032_0.0-0.1, SEDUP01, SEDUP02	**04-OCT-2012**	**04-OCT-2012**	02-APR-2013	✓	**04-OCT-2012**	02-APR-2013	✓
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG005C) BH032_0.3-0.5, BHDUP01, BH077_0.0-0.2, BH077_2.0-2.2	**14-AUG-2012**	**28-SEP-2012**	27-MAR-2013	✓	**28-SEP-2012**	27-MAR-2013	✓
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG005C) BH073_1.0-1.2, SE014_0.2-0.4, SE067_0.0-0.1	**15-AUG-2012**	**28-SEP-2012**	27-MAR-2013	✓	**28-SEP-2012**	27-MAR-2013	✓
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG005C) BH012_0.0-0.1, BHDUP08, BH101_0.0-0.2, BH022_0.5-0.7, BH028_0.0-0.2, BH028_0.3-0.5, BH020_0.0-0.2	**16-AUG-2012**	**28-SEP-2012**	27-MAR-2013	✓	**28-SEP-2012**	27-MAR-2013	✓
EG035C: Leachable Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035C) SE068_0.0-0.1, SE064_0.2-0.3, SE001_0.4-0.6, SE042_0.2-0.4, SE041_0.0-0.05, SE041_0.1-0.3, SE050_0.4-0.6, SE032_0.0-0.1, SEDUP01, SEDUP02	**04-OCT-2012**	**----**	----	----	**04-OCT-2012**	01-NOV-2012	✓
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035C) BH032_0.3-0.5, BHDUP01, BH077_0.0-0.2, BH077_2.0-2.2	**14-AUG-2012**	**----**	----	----	**02-OCT-2012**	11-SEP-2012	×
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035C) BH073_1.0-1.2, SE014_0.2-0.4, SE067_0.0-0.1	**15-AUG-2012**	**----**	----	----	**02-OCT-2012**	12-SEP-2012	×
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035C) BH012_0.0-0.1, BHDUP08, BH101_0.0-0.2, BH022_0.5-0.7, BH028_0.0-0.2, BH028_0.3-0.5, BH020_0.0-0.2	**16-AUG-2012**	**----**	----	----	**02-OCT-2012**	13-SEP-2012	×

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
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T) BH032_0.3-0.5, BHDUP01, BH077_0.0-0.2, BH077_2.0-2.2, SE001_0.4-0.6, SE042_0.2-0.4, SE041_0.0-0.05, SE041_0.1-0.3, SE032_0.0-0.1, SEDUP01	**14-AUG-2012**	**28-SEP-2012**	11-SEP-2012	×	**28-SEP-2012**	11-SEP-2012	×
Soil Glass Jar - Unpreserved (EG035T) BH073_1.0-1.2, SE014_0.2-0.4, SE067_0.0-0.1, SE068_0.0-0.1, SE064_0.2-0.3, SE050_0.4-0.6, SEDUP02	**15-AUG-2012**	**28-SEP-2012**	12-SEP-2012	×	**28-SEP-2012**	12-SEP-2012	×
Soil Glass Jar - Unpreserved (EG035T) BH012_0.0-0.1, BHDUP08, BH101_0.0-0.2, BH022_0.5-0.7, BH028_0.0-0.2, BH028_0.3-0.5, BH020_0.0-0.2	**16-AUG-2012**	**28-SEP-2012**	13-SEP-2012	×	**28-SEP-2012**	13-SEP-2012	×
EN33: TCLP Leach							
Lab Split : Leach for Hg, Cr(VI) and other metal (EN33a) SE001_0.4-0.6, SE042_0.2-0.4, SE041_0.0-0.05, SE041_0.1-0.3, SE032_0.0-0.1, SEDUP01	**14-AUG-2012**	**---**	11-SEP-2012	----	**03-OCT-2012**	11-SEP-2012	×
Lab Split : Leach for Hg, Cr(VI) and other metal (EN33a) BH032_0.3-0.5, BHDUP01, BH077_0.0-0.2, BH077_2.0-2.2	**14-AUG-2012**	**---**	11-SEP-2012	----	**28-SEP-2012**	11-SEP-2012	×
Lab Split : Leach for Hg, Cr(VI) and other metal (EN33a) SE068_0.0-0.1, SE064_0.2-0.3, SE050_0.4-0.6, SEDUP02	**15-AUG-2012**	**---**	12-SEP-2012	----	**03-OCT-2012**	12-SEP-2012	×
Lab Split : Leach for Hg, Cr(VI) and other metal (EN33a) BH073_1.0-1.2, SE014_0.2-0.4, SE067_0.0-0.1	**15-AUG-2012**	**---**	12-SEP-2012	----	**28-SEP-2012**	12-SEP-2012	×
Lab Split : Leach for Hg, Cr(VI) and other metal (EN33a) BH012_0.0-0.1, BHDUP08, BH101_0.0-0.2, BH022_0.5-0.7, BH028_0.0-0.2, BH028_0.3-0.5, BH020_0.0-0.2	**16-AUG-2012**	**---**	13-SEP-2012	----	**28-SEP-2012**	13-SEP-2012	×

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)							
Moisture Content	EA055-103	3	25	**12.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS	EG035T	4	35	**11.4**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Total Mercury by FIMS	EG035T	2	35	**5.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Total Mercury by FIMS	EG035T	2	35	**5.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Total Mercury by FIMS	EG035T	2	35	**5.7**	**5.0**	✓	ALS QCS3 requirement

Matrix: **WATER**

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)							
Leachable Mercury by FIMS	EG035C	4	34	**11.8**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Leachable Metals by ICPAES	EG005C	4	28	**14.3**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Leachable Mercury by FIMS	EG035C	2	34	**5.9**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Leachable Metals by ICPAES	EG005C	2	28	**7.1**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Leachable Mercury by FIMS	EG035C	2	34	**5.9**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Leachable Metals by ICPAES	EG005C	2	28	**7.1**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Leachable Mercury by FIMS	EG035C	2	34	**5.9**	**5.0**	✓	ALS QCS3 requirement
Leachable Metals by ICPAES	EG005C	2	28	**7.1**	**5.0**	✓	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 (2010 Draft) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3 - 2003
Leachable Metals by ICPAES	EG005C	SOIL	APHA 21st ed., 3120; USEPA SW 846 - 6010 The ICPAES technique ionises leachate sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Leachable Mercury by FIMS	EG035C	SOIL	AS 3550, APHA 21st ed. 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the TCLP solution. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Mercury by FIMS	EG035T	SOIL	AS 3550, APHA 21st ed., 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
TCLP for Non & Semivolatile Analytes	EN33a	SOIL	(USEPA SW846-1311, ALS QWI-EN/33) The TCLP procedure is designed to determine the mobility of both organic and inorganic analytes present in wastes. The standard TCLP leach is for non-volatile and Semivolatile test parameters.
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	USEPA 200.2 Mod. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (1999) Schedule B(3) (Method 202)

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 SW846 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

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EG005C: Leachable Metals by ICPAES	ES1223062-016	SE064_0.2-0.3	**Zinc**	7440-66-6	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control 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 / Container / Client Sample ID(s)		Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA055: Moisture Content							
Soil Glass Jar - Unpreserved							
BH032_0.3-0.5, BH077_0.0-0.2, SE001_0.4-0.6, SE041_0.0-0.05, SE032_0.0-0.1,	BHDUP01, BH077_2.0-2.2, SE042_0.2-0.4, SE041_0.1-0.3, SEDUP01	----	----	----	27-SEP-2012	28-AUG-2012	**30**
Soil Glass Jar - Unpreserved							
BH073_1.0-1.2, SE067_0.0-0.1, SE064_0.2-0.3, SEDUP02	SE014_0.2-0.4, SE068_0.0-0.1, SE050_0.4-0.6,	----	----	----	27-SEP-2012	29-AUG-2012	**29**
Soil Glass Jar - Unpreserved							
BH012_0.0-0.1, BH101_0.0-0.2, BH028_0.0-0.2, BH020_0.0-0.2	BHDUP08, BH022_0.5-0.7, BH028_0.3-0.5,	----	----	----	27-SEP-2012	30-AUG-2012	**28**
EG035C: Leachable Mercury by FIMS							

Matrix: **SOIL**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EG035C: Leachable Mercury by FIMS - Analysis Holding Time Compliance						
Clear Plastic Bottle - Nitric Acid; Unfiltered BH032_0.3-0.5, BHDUP01, BH077_0.0-0.2, BH077_2.0-2.2	----	----	----	02-OCT-2012	11-SEP-2012	**21**
Clear Plastic Bottle - Nitric Acid; Unfiltered BH073_1.0-1.2, SE014_0.2-0.4, SE067_0.0-0.1	----	----	----	02-OCT-2012	12-SEP-2012	**20**
Clear Plastic Bottle - Nitric Acid; Unfiltered BH012_0.0-0.1, BHDUP08, BH101_0.0-0.2, BH022_0.5-0.7, BH028_0.0-0.2, BH028_0.3-0.5, BH020_0.0-0.2	----	----	----	02-OCT-2012	13-SEP-2012	**19**
EG035T: Total Recoverable Mercury by FIMS						
Soil Glass Jar - Unpreserved BH032_0.3-0.5, BHDUP01, BH077_0.0-0.2, BH077_2.0-2.2, SE001_0.4-0.6, SE042_0.2-0.4, SE041_0.0-0.05, SE041_0.1-0.3, SE032_0.0-0.1, SEDUP01	28-SEP-2012	11-SEP-2012	**17**	28-SEP-2012	11-SEP-2012	**17**
Soil Glass Jar - Unpreserved BH073_1.0-1.2, SE014_0.2-0.4, SE067_0.0-0.1, SE068_0.0-0.1, SE064_0.2-0.3, SE050_0.4-0.6, SEDUP02	28-SEP-2012	12-SEP-2012	**16**	28-SEP-2012	12-SEP-2012	**16**
Soil Glass Jar - Unpreserved BH012_0.0-0.1, BHDUP08, BH101_0.0-0.2, BH022_0.5-0.7, BH028_0.0-0.2, BH028_0.3-0.5, BH020_0.0-0.2	28-SEP-2012	13-SEP-2012	**15**	28-SEP-2012	13-SEP-2012	**15**
EN33: TCLP Leach						
Lab Split : Leach for Hg, Cr(VI) and other metal SE001_0.4-0.6, SE042_0.2-0.4, SE041_0.0-0.05, SE041_0.1-0.3, SE032_0.0-0.1, SEDUP01	----	----	----	03-OCT-2012	11-SEP-2012	**22**
Lab Split : Leach for Hg, Cr(VI) and other metal BH032_0.3-0.5, BHDUP01, BH077_0.0-0.2, BH077_2.0-2.2	----	----	----	28-SEP-2012	11-SEP-2012	**17**
Lab Split : Leach for Hg, Cr(VI) and other metal SE068_0.0-0.1, SE064_0.2-0.3, SE050_0.4-0.6, SEDUP02	----	----	----	03-OCT-2012	12-SEP-2012	**21**
Lab Split : Leach for Hg, Cr(VI) and other metal BH073_1.0-1.2, SE014_0.2-0.4, SE067_0.0-0.1	----	----	----	28-SEP-2012	12-SEP-2012	**16**

Matrix: **SOIL**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EN33: TCLP Leach - Analysis Holding Time Compliance						
Lab Split : Leach for Hg, Cr(VI) and other metal						
BH012_0.0-0.1, BHDUP08, BH101_0.0-0.2, BH022_0.5-0.7, BH028_0.0-0.2, BH028_0.3-0.5, BH020_0.0-0.2	----	----	----	28-SEP-2012	13-SEP-2012	**15**

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.**

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1223935**	Page	: 1 of 5
Client	: GHD PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR BEN LUFFMAN	Contact	: Angelene Kumar
Address	: 230 HARBOUR DRIVE PO Box 1340 COFFS HARBOUR NSW, AUSTRALIA 2450	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: ben_luffman@ghd.com	E-mail	: angelene.kumar@alsglobal.com
Telephone	: +61 02 6650 5600	Telephone	: +61 2 8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61 2 8784 8555
Project	: 2216251	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: HILLSIDE DR, URUNGA		
C-O-C number	: ----	Date Samples Received	: 08-OCT-2012
Sampler	: JS	Issue Date	: 10-OCT-2012
Order number	: REBATCH OF ES1223062		
		No. of samples received	: 19
Quote number	: SY/270/12	No. of samples analysed	: 19

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

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

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							
Lab Split: Managed Moisture for Dry Weight Det. (EA055-103) BH032_0.3-0.5, BHDUP01, BH077_0.0-0.2, BH077_2.0-2.2, SE001_0.4-0.6, SE042_0.2-0.4, SE041_0.1-0.3	**14-AUG-2012**	**----**	----	----	**09-OCT-2012**	10-FEB-2013	✓
Lab Split: Managed Moisture for Dry Weight Det. (EA055-103) BH073_1.0-1.2, SE014_0.2-0.4, SE068_0.0-0.1, SE064_0.2-0.3, SE050_0.4-0.6	**15-AUG-2012**	**----**	----	----	**09-OCT-2012**	11-FEB-2013	✓
Lab Split: Managed Moisture for Dry Weight Det. (EA055-103) BH012_0.0-0.1, BHDUP08, BH101_0.0-0.2, BH022_0.5-0.7, BH028_0.0-0.2, BH028_0.3-0.5, BH020_0.0-0.2	**16-AUG-2012**	**----**	----	----	**09-OCT-2012**	12-FEB-2013	✓
EG005T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T) BH032_0.3-0.5, BHDUP01, BH077_0.0-0.2, BH077_2.0-2.2, SE001_0.4-0.6, SE042_0.2-0.4, SE041_0.1-0.3	**14-AUG-2012**	**09-OCT-2012**	10-FEB-2013	✓	**09-OCT-2012**	10-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG005T) BH073_1.0-1.2, SE014_0.2-0.4, SE068_0.0-0.1, SE064_0.2-0.3, SE050_0.4-0.6	**15-AUG-2012**	**09-OCT-2012**	11-FEB-2013	✓	**09-OCT-2012**	11-FEB-2013	✓
Soil Glass Jar - Unpreserved (EG005T) BH012_0.0-0.1, BHDUP08, BH101_0.0-0.2, BH022_0.5-0.7, BH028_0.0-0.2, BH028_0.3-0.5, BH020_0.0-0.2	**16-AUG-2012**	**09-OCT-2012**	12-FEB-2013	✓	**09-OCT-2012**	12-FEB-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)							
Moisture Content	EA055-103	2	19	**10.5**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	4	36	**11.1**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Total Metals by ICP-AES	EG005T	2	36	**5.6**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Total Metals by ICP-AES	EG005T	2	36	**5.6**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Total Metals by ICP-AES	EG005T	2	36	**5.6**	**5.0**	✓	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 (2010 Draft) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Total Metals by ICP-AES	EG005T	SOIL	(APHA 21st ed., 3120; USEPA SW 846 - 6010) (ICPAES) Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (1999) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	USEPA 200.2 Mod. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (1999) Schedule B(3) (Method 202)

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 SW846 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.

- **No Analysis Holding Time Outliers exist.**

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.**

STATEMENT OF QA/QC PERFORMANCE

SE111292 R0

CLIENT DETAILS

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Project	**2216251**
Order Number	**Apply credit against invoice SY00100799**
Samples	4

LABORATORY DETAILS

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SGS Reference	SE111292 R0
Report Number	0000038516
Date Reported	28 Aug 2012

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS Environmental Services' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document and was supplied by the Client.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met with the exception of the following:

Matrix Spike	Total Recoverable Metals in Soil by ICPOES from EPA 200.8 Digest	1 item

SAMPLE SUMMARY

Sample counts by matrix	4 Soils	Type of documentation received	COC
Date documentation received	22/8/2012	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	3.4°C
Sample container provider	Other Lab	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice Bricks	Samples clearly labelled	Yes
Complete documentation received	Yes		

HOLDING TIME SUMMARY

SE111292 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Mercury in Soil

Method: ME-(AU)-[ENV]AN312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
SELABDUP1	SE111292.001	LB025365	21 Aug 2012	22 Aug 2012	18 Sep 2012	22 Aug 2012	18 Sep 2012	23 Aug 2012
BHLABDUP01	SE111292.002	LB025365	21 Aug 2012	22 Aug 2012	18 Sep 2012	22 Aug 2012	18 Sep 2012	23 Aug 2012
BHLABDUP02	SE111292.003	LB025365	21 Aug 2012	22 Aug 2012	18 Sep 2012	22 Aug 2012	18 Sep 2012	23 Aug 2012
BHLABDUP03	SE111292.004	LB025365	21 Aug 2012	22 Aug 2012	18 Sep 2012	22 Aug 2012	18 Sep 2012	23 Aug 2012

Moisture Content

Method: ME-(AU)-[ENV]AN002

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
SELABDUP1	SE111292.001	LB025382	21 Aug 2012	22 Aug 2012	04 Sep 2012	23 Aug 2012	28 Aug 2012	27 Aug 2012
BHLABDUP01	SE111292.002	LB025382	21 Aug 2012	22 Aug 2012	04 Sep 2012	23 Aug 2012	28 Aug 2012	27 Aug 2012
BHLABDUP02	SE111292.003	LB025382	21 Aug 2012	22 Aug 2012	04 Sep 2012	23 Aug 2012	28 Aug 2012	27 Aug 2012
BHLABDUP03	SE111292.004	LB025382	21 Aug 2012	22 Aug 2012	04 Sep 2012	23 Aug 2012	28 Aug 2012	27 Aug 2012

Total Recoverable Metals in Soil by ICPOES from EPA 200.8 Digest

Method: ME-(AU)-[ENV]AN040/AN320

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
SELABDUP1	SE111292.001	LB025363	21 Aug 2012	22 Aug 2012	17 Feb 2013	22 Aug 2012	17 Feb 2013	23 Aug 2012
BHLABDUP01	SE111292.002	LB025363	21 Aug 2012	22 Aug 2012	17 Feb 2013	22 Aug 2012	17 Feb 2013	23 Aug 2012
BHLABDUP02	SE111292.003	LB025363	21 Aug 2012	22 Aug 2012	17 Feb 2013	22 Aug 2012	17 Feb 2013	23 Aug 2012
BHLABDUP03	SE111292.004	LB025363	21 Aug 2012	22 Aug 2012	17 Feb 2013	22 Aug 2012	17 Feb 2013	23 Aug 2012

SURROGATES

SE111292 R0

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Mercury in Soil — Method: ME-(AU)-[ENV]AN312

Sample Number	Parameter	Units	LOR	Result
LB025365.001	Mercury	mg/kg	0.05	<0.05

Total Recoverable Metals in Soil by ICPOES from EPA 200.8 Digest — Method: ME-(AU)-[ENV]AN040/AN320

Sample Number	Parameter	Units	LOR	Result
LB025363.001	Aluminium, Al	mg/kg	1	<1
	Antimony, Sb	mg/kg	3	<3
	Arsenic, As	mg/kg	3	<3
	Cadmium, Cd	mg/kg	0.3	<0.3
	Chromium, Cr	mg/kg	0.3	<0.3
	Copper, Cu	mg/kg	0.5	<0.5
	Lead, Pb	mg/kg	1	<1
	Nickel, Ni	mg/kg	0.5	<0.5
	Zinc, Zn	mg/kg	0.5	<0.5

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Mercury in Soil

Method: ME-(AU)-[ENV]AN312

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE111306.004	LB025365.014	Mercury	mg/kg	0.05	0.022470752	60.0232991456	74	4

Total Recoverable Metals in Soil by ICPOES from EPA 200.8 Digest

Method: ME-(AU)-[ENV]AN040/AN320

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE111306.003	LB025363.014	Arsenic, As	mg/kg	3	8.798903125	17.9594376489	66	10
		Cadmium, Cd	mg/kg	0.3	0.044883941	00.0567483798	200	0
		Chromium, Cr	mg/kg	0.3	8.967428437	29.3786904569	33	4
		Copper, Cu	mg/kg	0.5	2.581642812	42.7290530685	49	6
		Lead, Pb	mg/kg	1	7.872013908	58.3312355056	42	6
		Nickel, Ni	mg/kg	0.5	0.263765327	60.3055484424	200	0
		Zinc, Zn	mg/kg	0.5	2.635233071	33.0391356914	48	14

LABORATORY CONTROL SAMPLES

SE111292 R0

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Mercury in Soil

Method: ME-(AU)-[ENV]AN312

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB025365.002	Mercury	mg/kg	0.05	0.21	0.2	70 - 130	103

Total Recoverable Metals in Soil by ICPOES from EPA 200.8 Digest

Method: ME-(AU)-[ENV]AN040/AN320

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB025363.002	Aluminium, Al	mg/kg	1	51	50	80 - 120	102
	Antimony, Sb	mg/kg	3	48	50	80 - 120	97
	Arsenic, As	mg/kg	3	48	50	80 - 120	95
	Cadmium, Cd	mg/kg	0.3	48	50	80 - 120	95
	Chromium, Cr	mg/kg	0.3	50	50	80 - 120	99
	Copper, Cu	mg/kg	0.5	49	50	80 - 120	97
	Lead, Pb	mg/kg	1	48	50	80 - 120	97
	Nickel, Ni	mg/kg	0.5	49	50	80 - 120	98
	Zinc, Zn	mg/kg	0.5	48	50	80 - 120	96

MATRIX SPIKES

SE111292 R0

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub -sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Mercury in Soil

Method: ME-(AU)-[ENV]AN312

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE111276.026	LB025365.004	Mercury	mg/kg	0.05	0.20	0.01590669642	0.2	91

Total Recoverable Metals in Soil by ICPOES from EPA 200.8 Digest

Method: ME-(AU)-[ENV]AN040/AN320

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE111276.025	LB025363.004	Arsenic, As	mg/kg	3	47	2.89734193786	50	88
		Cadmium, Cd	mg/kg	0.3	46	0.26764555226	50	92
		Chromium, Cr	mg/kg	0.3	61	14.56640976331	50	93
		Copper, Cu	mg/kg	0.5	61	13.2036895956(	50	96
		Lead, Pb	mg/kg	1	70	26.0228296351(	50	88
		Nickel, Ni	mg/kg	0.5	52	4.87633012820	50	95
		Zinc, Zn	mg/kg	0.5	220	100.7142135108	50	29 ⑨

MATRIX SPIKE DUPLICATES

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here:
http://www.au.sgs.com/sgs-mp-au-env-qu-022-qa-qc-plan-en-11.pdf

*	Non-accredited analysis.
-	Sample not analysed for this analyte.
^	Analysis performed by external laboratory.

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.

①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
†	Refer to Analytical Report comments for further information.

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Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1220550**	Page	: 1 of 8
Client	: GHD PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR BEN LUFFMAN	Contact	: Angelene Kumar
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Telephone	: +61 02 6650 5600	Telephone	: +61 2 8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61 2 8784 8555
Project	: 2216251	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: HILLSIDE DR, Urunga		
C-O-C number	: ----	Date Samples Received	: 24-AUG-2012
Sampler	: ----	Issue Date	: 30-AUG-2012
Order number	: ----		
		No. of samples received	: 14
Quote number	: SY/270/12	No. of samples analysed	: 14

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

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **WATER**

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
EA015: Total Dissolved Solids							
Clear Plastic Bottle - Natural (EA015H)							
SW001, SW002, SW003, SW004, SW005, SW006, SW007, SW008, SW009, SWDUP01, GW006, GW007, GW013	**22-AUG-2012**	**----**	----	----	**29-AUG-2012**	29-AUG-2012	✓
EA025: Suspended Solids							
Clear Plastic Bottle - Natural (EA025H)							
SW001, SW002, SW003, SW004, SW005, SW006, SW007, SW008, SW009, SWDUP01, GW006, GW007, GW013	**22-AUG-2012**	**----**	----	----	**28-AUG-2012**	29-AUG-2012	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
SW001, SW002, SW003, SW004, SW005, SW006, SW007, SW008, SW009, SWDUP01, GW006, GW007, GW013	**22-AUG-2012**	**---**	05-SEP-2012	----	**28-AUG-2012**	05-SEP-2012	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G)							
SW001, SW002, SW003, SW004, SW005, SW006, SW007, SW008, SW009, SWDUP01, GW006, GW007, GW013	**22-AUG-2012**	**---**	19-SEP-2012	----	**27-AUG-2012**	19-SEP-2012	✓

Matrix: **WATER**

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
ED045G: Chloride Discrete analyser							
Clear Plastic Bottle - Natural (ED045G)							
SW001, SW002, SW003, SW004, SW005, SW006, SW007, SW008, SW009, SWDUP01, GW006, GW007, GW013	**22-AUG-2012**	**---**	19-SEP-2012	----	**27-AUG-2012**	19-SEP-2012	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Natural (ED093F)							
SW001, SW002, SW003, SW004, SW005, SW006, SW007, SW008, SW009, SWDUP01, GW006, GW007, GW013	**22-AUG-2012**	**---**	29-AUG-2012	----	**27-AUG-2012**	29-AUG-2012	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
SW001, SW002, SW003, SW004, SW005, SW006, SW007, SW008, SW009, SWDUP01, GW004, GW006, GW007, GW013	**22-AUG-2012**	**---**	18-FEB-2013	----	**27-AUG-2012**	18-FEB-2013	✓
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T)							
SW001, SW002, SW003, SW004, SW005, SW006, SW007, SW008, SW009, SWDUP01	**22-AUG-2012**	**27-AUG-2012**	18-FEB-2013	✓	**27-AUG-2012**	18-FEB-2013	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)							
SW001, SW002, SW003, SW004, SW005, SW006, SW007, SW008, SW009, SWDUP01, GW004, GW006, GW007, GW013	**22-AUG-2012**	**---**	19-SEP-2012	----	**28-AUG-2012**	19-SEP-2012	✓

Matrix: **WATER**

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
EK026G: Total Cyanide By Discrete Analyser							
Clear Plastic Bottle - NaOH (EK026G)							
SW001, SW002, SW003, SW004, SW005, SW006, SW007, SW008, SW009, SWDUP01, GW006, GW007, GW013	**22-AUG-2012**	**26-AUG-2012**	05-SEP-2012	✓	**26-AUG-2012**	05-SEP-2012	✓

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: **WATER**

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)							
Alkalinity by PC Titrator	ED037-P	4	40	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	2	15	**13.3**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	4	39	**10.3**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Suspended Solids (High Level)	EA025H	2	19	**10.5**	**9.5**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide By Discrete Analyser	EK026G	4	40	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	4	33	**12.1**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-MS - Suite A	EG020A-T	2	19	**10.5**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	2	40	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	15	**6.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	2	39	**5.1**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Suspended Solids (High Level)	EA025H	1	19	**5.3**	**4.8**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide By Discrete Analyser	EK026G	2	40	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	4	33	**12.1**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-MS - Suite A	EG020A-T	1	19	**5.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	15	**6.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	2	39	**5.1**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Suspended Solids (High Level)	EA025H	1	19	**5.3**	**4.8**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide By Discrete Analyser	EK026G	2	40	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	2	33	**6.1**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-MS - Suite A	EG020A-T	1	19	**5.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	20	**5.0**	**5.0**	✓	ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	15	**6.7**	**5.0**	✓	ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.0**	**5.0**	✓	ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.0**	**5.0**	✓	ALS QCS3 requirement
Total Cyanide By Discrete Analyser	EK026G	2	40	**5.0**	**5.0**	✓	ALS QCS3 requirement
Total Metals by ICP-MS - Suite A	EG020A-T	1	19	**5.3**	**5.0**	✓	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
Total Dissolved Solids (High Level)	EA015H	WATER	In-House, APHA 21st ed., 2540C A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Suspended Solids (High Level)	EA025H	WATER	In-House, APHA 21st ed., 2540D A gravimetric procedure employed to determine the amount of `non-filterable` residue in a aqueous sample. The prescribed GFC (1.2um) filter is rinsed with deionised water, oven dried and weighed prior to analysis. A well-mixed sample is filtered through a glass fibre filter (1.2um). The residue on the filter paper is dried at 104+/-2C . This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Alkalinity by PC Titrator	ED037-P	WATER	APHA 21st ed., 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	APHA 21st ed., 4500-SO4 Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Chloride by Discrete Analyser	ED045G	WATER	APHA 21st ed., 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	Major Cations is determined based on APHA 21st ed., 3120; USEPA SW 846 - 6010 The ICPAES technique ionises the 0.45um filtered sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2) Sodium Absorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2) Hardness parameters are calculated based on APHA 21st ed., 2340 B. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Mercury by FIMS	EG035F	WATER	AS 3550, APHA 21st ed. 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45 um filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Cyanide By Discrete Analyser	EK026G	WATER	APHA 21st ed., 4500-CN-C & N Total Cyanide is determined from aqueous solutions after distillation with sulphuric acid. The resultant distillate is then captured in a caustic absorber solution followed by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	APHA 21st Ed. 1030F. The Ionic Balance is calculated based on the major Anions and Cations. The major anions include Alkalinity, Chloride and Sulfate which determined by PCT and DA. The Cations are determined by Turbi SO4 by DA. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)

Preparation Methods	Method	Matrix	Method Descriptions
Total Cyanide	EK026-PR	WATER	APHA 21st ed., 4500 CN- C&N. The sample is distilled with H2SO4 releasing all bound cyanides as HCN. The CN is trapped in a caustic solution, and quanitified by colourimetry on FIA. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Digestion for Total Recoverable Metals	EN25	WATER	USEPA SW846-3005 Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)

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 SW846 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.

- **No Analysis Holding Time Outliers exist.**

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.**

STATEMENT OF QA/QC PERFORMANCE

SE111416 R0

CLIENT DETAILS

Contact	Ben Luffman
Client	GHD Pty Ltd
Address	(PO Box 1340, COFFS HARBOUR NSW 2450) 230 Harbour Drive NSW 2450
Telephone	(02) 6650 5613
Facsimile	(02) 6652 6021
Email	ben.luffman@ghd.com.au
Project	**2216251 - Hillside Dr, Urunga**
Order Number	(Not specified)
Samples	1

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
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Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	SE111416 R0
Report Number	0000038987
Date Reported	03 Sep 2012

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS Environmental Services' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document and was supplied by the Client.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met with the exception of the following:

Extraction Date	Alkalinity	1 item
Analysis Date	Alkalinity	1 item

SAMPLE SUMMARY

Sample counts by matrix	1 Water	Type of documentation received	COC
Date documentation received	27/8/2012	Samples received in good order	Yes
Samples received without headspace	**No**	Sample temperature upon receipt	2.5°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice	Samples clearly labelled	Yes
Complete documentation received	Yes		

HOLDING TIME SUMMARY

SE111416 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Alkalinity

Method: ME-(AU)-[ENV]AN135

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
GWLABDUP01	SE111416.001	LB025626	22 Aug 2012	27 Aug 2012	23 Aug 2012	28 Aug 2012†	23 Aug 2012	28 Aug 2012†

Anions by Ion Chromatography in Water

Method: ME-(AU)-[ENV]AN245

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
GWLABDUP01	SE111416.001	LB025582	22 Aug 2012	27 Aug 2012	19 Sep 2012	28 Aug 2012	19 Sep 2012	30 Aug 2012

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311/AN312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
GWLABDUP01	SE111416.001	LB025745	22 Aug 2012	27 Aug 2012	19 Sep 2012	30 Aug 2012	19 Sep 2012	31 Aug 2012

Mercury (total) in Water

Method: ME-(AU)-[ENV]AN311/AN312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
GWLABDUP01	SE111416.001	LB025746	22 Aug 2012	27 Aug 2012	19 Sep 2012	30 Aug 2012	19 Sep 2012	03 Sep 2012

Metals in Water (Dissolved) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
GWLABDUP01	SE111416.001	LB025586	22 Aug 2012	27 Aug 2012	18 Feb 2013	28 Aug 2012	18 Feb 2013	28 Aug 2012

Total and Volatile Suspended Solids (TSS / VSS)

Method: ME-(AU)-[ENV]AN114

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
GWLABDUP01	SE111416.001	LB025664	22 Aug 2012	27 Aug 2012	29 Aug 2012	29 Aug 2012	05 Sep 2012	03 Sep 2012

Total Cyanide in water by Discrete Analyser (Aquakem)

Method: ME-(AU)-[ENV]AN077/AN287

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
GWLABDUP01	SE111416.001	LB025759	22 Aug 2012	27 Aug 2012	05 Sep 2012	30 Aug 2012	05 Sep 2012	31 Aug 2012

Total Dissolved Solids (TDS) in water

Method: ME-(AU)-[ENV]AN113

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
GWLABDUP01	SE111416.001	LB025665	22 Aug 2012	27 Aug 2012	29 Aug 2012	29 Aug 2012	29 Aug 2012	29 Aug 2012

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
GWLABDUP01	SE111416.001	LB025684	22 Aug 2012	27 Aug 2012	18 Feb 2013	29 Aug 2012	18 Feb 2013	30 Aug 2012

Trace Metals (Total) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
GWLABDUP01	SE111416.001	LB025685	22 Aug 2012	27 Aug 2012	18 Feb 2013	29 Aug 2012	18 Feb 2013	30 Aug 2012

SURROGATES

SE111416 R0

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Alkalinity

Method: ME-(AU)-[ENV]AN135

Sample Number	Parameter	Units	LOR	Result
LB025626.001	Total Alkalinity as CaCO3	mg/L	5	<5

Anions by Ion Chromatography in Water

Method: ME-(AU)-[ENV]AN245

Sample Number	Parameter	Units	LOR	Result
LB025582.001	Chloride	mg/L	0.05	<0.05
	Sulphate, SO4	mg/L	0.1	<0.1

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311/AN312

Sample Number	Parameter	Units	LOR	Result
LB025745.001	Mercury	mg/L	0.0001	<0.00010

Mercury (total) in Water

Method: ME-(AU)-[ENV]AN311/AN312

Sample Number	Parameter	Units	LOR	Result
LB025746.001	Total Mercury	mg/L	0.0001	<0.0001

Metals in Water (Dissolved) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

Sample Number	Parameter	Units	LOR	Result
LB025586.001	Calcium, Ca	mg/L	0.1	<0.1
	Magnesium, Mg	mg/L	0.1	<0.1
	Potassium, K	mg/L	0.2	<0.2
	Sodium, Na	mg/L	0.1	<0.1

Total Cyanide in water by Discrete Analyser (Aquakem)

Method: ME-(AU)-[ENV]AN077/AN287

Sample Number	Parameter	Units	LOR	Result
LB025759.001	Total Cyanide	mg/L	0.005	<0.005

Total Dissolved Solids (TDS) in water

Method: ME-(AU)-[ENV]AN113

Sample Number	Parameter	Units	LOR	Result
LB025665.001	Total Dissolved Solids Dried at 180°C	mg/L	10	<10
LB025665.008	Total Dissolved Solids Dried at 180°C	mg/L	10	<10

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result
LB025684.001	Aluminium, Al	µg/L	1	<1
	Antimony, Sb	µg/L	1	<1
	Arsenic, As	µg/L	1	<1
	Cadmium, Cd	µg/L	0.1	<0.1
	Chromium, Cr	µg/L	1	<1
	Copper, Cu	µg/L	1	<1
	Iron, Fe	µg/L	5	<5
	Lead, Pb	µg/L	1	<1
	Nickel, Ni	µg/L	1	<1
	Zinc, Zn	µg/L	1	<1

Trace Metals (Total) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result
LB025685.001	Total Aluminium	µg/L	5	<5
	Total Antimony	µg/L	1	<1
	Total Arsenic	µg/L	1	<1
	Total Cadmium	µg/L	0.1	<0.1
	Total Chromium	µg/L	1	<1
	Total Copper	µg/L	1	<1
	Total Lead	µg/L	1	<1
	Total Nickel	µg/L	1	<1
	Total Zinc	µg/L	1	<1

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Alkalinity

Method: ME-(AU)-[ENV]AN135

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE111416.001	LB025626.004	Total Alkalinity as CaCO3	mg/L	5	300	290	17	3

Anions by Ion Chromatography in Water

Method: ME-(AU)-[ENV]AN245

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE111398.001	LB025582.004	Chloride	mg/L	0.05	<0.05	<0.05	200	0

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311/AN312

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE111470.021	LB025745.014	Mercury	µg/L	0.0001	<0.00010	<0.00010	200	0

Metals in Water (Dissolved) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE111416.001	LB025586.006	Calcium, Ca	mg/L	0.1	13	13	17	0
		Magnesium, Mg	mg/L	0.1	21	21	15	1
		Potassium, K	mg/L	0.2	8.5	8.5	17	1
		Sodium, Na	mg/L	0.1	190	190	15	1

Total Dissolved Solids (TDS) in water

Method: ME-(AU)-[ENV]AN113

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE111382.004	LB025665.007	Total Dissolved Solids Dried at 180°C	mg/L	10	19400	18000	15	7

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE111445.005	LB025684.012	Arsenic, As	µg/L	1	0.294	0.329	200	0
		Cadmium, Cd	µg/L	0.1	-0.003	-0.003	200	0
		Chromium, Cr	µg/L	1	0.311	0.281	200	0
		Copper, Cu	µg/L	1	0.398	0.373	200	0
		Lead, Pb	µg/L	1	0.031	0.019	200	0
		Nickel, Ni	µg/L	1	-0.026	-0.022	200	0
		Zinc, Zn	µg/L	1	1.413	1.1	95	25

Trace Metals (Total) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE111416.001	LB025685.004	Total Aluminium	µg/L	5	42000	40000	15	5
		Total Antimony	µg/L	1	30000	31000	15	3
		Total Arsenic	µg/L	1	47000	47000	15	0
		Total Cadmium	µg/L	0.1	0.7	0.7	29	1
		Total Chromium	µg/L	1	250	260	15	4
		Total Copper	µg/L	1	420	410	15	2
		Total Iron	µg/L	5	72000	71000	15	1
		Total Lead	µg/L	1	8500	8400	15	1
		Total Nickel	µg/L	1	65	64	17	1
		Total Zinc	µg/L	1	170	160	16	3

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Alkalinity

Method: ME-(AU)-[ENV]AN135

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB025626.002	Total Alkalinity as CaCO3	mg/L	5	68	59.5	80 - 120	115

Anions by Ion Chromatography in Water

Method: ME-(AU)-[ENV]AN245

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB025582.002	Chloride	mg/L	0.05	19	20	80 - 120	95
	Sulphate, SO4	mg/L	0.1	19	20	80 - 120	94

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311/AN312

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB025745.002	Mercury	mg/L	0.0001	0.0076	0.008	80 - 120	96

Metals in Water (Dissolved) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB025586.002	Calcium, Ca	mg/L	0.1	2.0	2	80 - 120	98
	Magnesium, Mg	mg/L	0.1	1.8	2	80 - 120	91
	Potassium, K	mg/L	0.2	19	20	80 - 120	96
	Sodium, Na	mg/L	0.1	2.0	2	80 - 120	99

Total and Volatile Suspended Solids (TSS / VSS)

Method: ME-(AU)-[ENV]AN114

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB025664.002	Total Suspended Solids Dried at 105°C	mg/L	5	96	100	80 - 120	96

Total Cyanide in water by Discrete Analyser (Aquakem)

Method: ME-(AU)-[ENV]AN077/AN287

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB025759.002	Total Cyanide	mg/L	0.005	0.028	0.025	80 - 120	111

Total Dissolved Solids (TDS) in water

Method: ME-(AU)-[ENV]AN113

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB025665.002	Total Dissolved Solids Dried at 180°C	mg/L	10	278	293	80 - 120	95
LB025665.009	Total Dissolved Solids Dried at 180°C	mg/L	10	275	293	80 - 120	94

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB025684.002	Aluminium, Al	µg/L	1	18	20	80 - 120	90
	Antimony, Sb	µg/L	1	19	20	80 - 120	93
	Arsenic, As	µg/L	1	17	20	80 - 120	86
	Cadmium, Cd	µg/L	0.1	19	20	80 - 120	96
	Chromium, Cr	µg/L	1	20	20	80 - 120	98
	Copper, Cu	µg/L	1	18	20	80 - 120	92
	Iron, Fe	µg/L	5	17	20	80 - 120	86
	Lead, Pb	µg/L	1	20	20	80 - 120	98
	Nickel, Ni	µg/L	1	18	20	80 - 120	92
	Zinc, Zn	µg/L	1	18	20	80 - 120	92

Trace Metals (Total) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB025685.002	Total Aluminium	µg/L	5	20	20	80 - 120	104
	Total Antimony	µg/L	1	20	20	80 - 120	107
	Total Arsenic	µg/L	1	18	20	80 - 120	96
	Total Cadmium	µg/L	0.1	20	20	80 - 120	106
	Total Chromium	µg/L	1	22	20	80 - 120	114
	Total Copper	µg/L	1	20	20	80 - 120	104
	Total Lead	µg/L	1	21	20	80 - 120	112
	Total Nickel	µg/L	1	20	20	80 - 120	107
	Total Zinc	µg/L	1	20	20	80 - 120	102

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub -sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Mercury (dissolved) in Water — **Method: ME-(AU)-[ENV]AN311/AN312**

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE111381.001	LB025745.004	Mercury	mg/L	0.0001	0.0075	<0.0001	0.008	94

MATRIX SPIKE DUPLICATES

SE111416 R0

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here:
http://www.au.sgs.com/sgs-mp-au-env-qu-022-qa-qc-plan-en-11.pdf

*	Non-accredited analysis.
-	Sample not analysed for this analyte.
^	Analysis performed by external laboratory.

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.

①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
†	Refer to Analytical Report comments for further information.

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service, available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any other holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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CHAIN OF CUSTODY

ALS Environmental — ALS Laboratory: please tick →

ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsenviro.com
BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsenviro.com
GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 4971 5600 E: gladstone@alsglobal.com
MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: makay@alsglobal.com
MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsenviro.com
MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
NEWCASTLE 5 Rosegum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsenviro.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@alsenviro.com
☑ SYDNEY 277 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsenviro.com
TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsenviro.com
WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: GHD
OFFICE: COFFS HARBOUR
PROJECT: 22162S1 - URUNGA
PURCHASE ORDER NUMBER:
PROJECT MANAGER: BEN LUFFMAN — CONTACT PH: 0266505600

TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g. Ultra Trace Organics)
☐ Standard TAT (List due date):
☑ Non Standard or urgent TAT (List due date): Reqd 10/8/12

ALS QUOTE NO.: SY-270-12

COC SEQUENCE NUMBER (Circle)
COC: (1) 2 3 4 5 6 7
OF: (1) 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle)
Custody Seal Intact? Yes No N/A
Free ice / frozen ice bricks present upon receipt? Yes No N/A
Random Sample Temperature on Receipt: °C
Other comment:

SAMPLER: J. SIMKUS — SAMPLER MOBILE: 0404 542 354
COC emailed to ALS? (YES / (NO) — EDD FORMAT (or default):
Email Reports to (will default to PM if no other addresses are listed):
Email Invoice to (will default to PM if no other addresses are listed):

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
BRIAN CORK	David		
DATE/TIME: 3/8/10 3pm	DATE/TIME: 8/8 0827	DATE/TIME:	DATE/TIME:

COMMENTS/ SPECIAL HANDLING/STORAGE OR DISPOSAL: → ben.luffman@ghd.com, brian.cork@ghd.com

ALS USE	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 CONTAINERS	As, Sb	Hg	hold							Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	BH006_0.0-0.3	3/8/12	S			✓	✓								
2	BH006_0.5-0.8							✓							
3	BH034_23_0.0-0.2					✓	✓								
4	BH034_23_0.5-0.7					✓	✓								
~~5~~	~~BH034_1.0-1.3~~							✓							
~~6~~	~~BH034_1.8-2.0~~	↓	↓					✓							
				TOTAL		3	3	3							

TAT

Environmental Division Sydney
Work Order
ES1219239
Telephone : +61-2-8784 8555

158501

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 - Ai
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 Sp
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.

Impact Zone

Soil

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~ NTLEAP@GHD.COM
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER Type / Code	Total bottles	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EP003 (TOC)	EA002 (pH (1:5))	Hold
1	BH074_0.8-1.0	soil	15/8		JAR	jar	✓	✓		✓		✓	
2	BH064_0.0-0.2		15/8		JAR	jar	✓	✓		✓		✓	
3	BH064_0.3-0.5		↓		JAR	↓	✓	✓		✓		✓	
4	BH073_0.0-0.2		15/8		JAR	jar	✓	✓		✓		✓	
5	BH073_0.5-0.7		↓		JAR	↓	✓	✓		✓		✓	
6	BH056_0.3-0.5		15/8		JAR	jar	✓	✓		✓		✓	
7	BH075_1.8-2.0				JAR	jar	✓		✓				
8	BH060_0.0-0.2		15/8		JAR	jar	✓	✓		✓		✓	
9	BH82_1.5-1.7		14/8		JAR	jar	✓	✓		✓		✓	

Environmental Division
Sydney
Work Order
ES1220305

Telephone : +61-2-8784 8555

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

Soil

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~ NTLEAP@GHD.COM
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

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COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG005ST (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
10	BH034-0.1	soil	15/8			Jar+bags	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		
11	BH014-0.1		16/8			Jar+2bags	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]		✓		
12	BH071 0.5-0.7		15/8			Jar	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		
13	BH091-0.1		15/8			Jar		✓	✓		✓	✓	✓						✓		
14	BH002_0.5-0.7		16/8			Jar		✓		✓											
15	BH004_1.0-1.2		↓			Jar+bag		✓		✓											

SAMPLE INFORMATION (note: S = Soil, W=Water)

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Seal'

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

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COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG0085T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
16	SE001-0.1	soil				Jar+Bag	✓	✓	✓	✓					✓		✓		
17	SE001-0.2					Jar													
18	SE002-0.1						✓				✓	✓	✓	✓					
19	SE002-0.4																		
20	SE003-0.1						✓												
21	SE003-0.3					Jar+Bag									✓				
22	SE010-0.2					Jar	✓												
23	SE010-0.7																		
24	SE011-0.1										✓	✓	✓	✓					
28	SE011-0.4					Jar+Bag									✓				
26	SE012-0.1					Jar	✓												
27	SE012-0.4					Jar													

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0900	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

Seal

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG0085T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
28	SE013-0.4	Soil				Bag/Jar		✓	✓						✓				
29	SE060-0.1					Jar						✓	✓	✓					
30	SE033-0.05					Jar						✓	✓	✓					
	[illegible]						✓	✓	✓	✓	✓						✓		
31	SE102-0-0.2							✓	✓										
32	SE031-[illegible]0.5					Bag									✓				
	[illegible]																		
33	SE054-03					Jar									✓				

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Dan	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: AL	Time: 09a	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

Sed'

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM) Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG0085T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
	~~SE03 - 0.1~~	#(double up on COC				*	—	✓	✓	✓							✓		
34	SEDUP04	Soil				Jar + bag		✓	✓	✓					✓		✓		
35	~~SE02~~ SE020 - 0.1	|				Jar	✓	|	|	|									
36	SE020 - 0.4	|				|													
37	SE021 - 0.1	|				|					✓	✓	✓	✓					
38	SE021 - 0.3	|				|													
39	SE030 - 0.1	|				|	✓				✓	✓	✓	✓					
40	SE030 - 0.4	|				|													
41	SE031 - 0.1	|				|					✓								
42	SE040 - 0.4	|				|		|		✓	✓	✓	✓	✓			✓		
43	SE042 - 0.1	|				|		|											
44	SE050 - 0.1	|				Jar + bags	✓	✓	✓	✓					✓		✓		

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: AUS	Time: 0860	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

Sed'

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0 404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG0085T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
45	SE050 - 0.3	soil				Jar+bag		✓	✓	✓					✓		✓		
46	SEDUP03									✓							✓		
47	SE051 - 0.1									✓	✓						✓		
48	SE051 - 0.4									✓							✓		
49	SE052 - 0.1									✓	✓						✓		
50	SE053 - 0.1					Jar+bag					✓								
51	SE054 - 0.1										✓								
52	SE055 - 0.1																		
53	SE056 - 0.1									✓	✓						✓		
54	SE057 - 0.3									✓	✓						✓		
55	SE061 - 0.1									✓	✓	✓	✓	✓			✓		
	Blank							↓	↓										

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0900	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved: VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Sed'

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE: 0266505600
PROJECT ID: 2216251	EMAIL: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG0085T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
	~~SE004~~ SE004-0.1	SO,1				Jar+bag	✓	✓	✓	✓	✓				✓		✓		
56	SE005-0.1	|				Jar		|	|	✓	✓						✓		
57	SE005P05	|				Jar+bag		|	|	✓	✓						✓		
58	SE014-0.1	|				Jar		|	|	✓	✓	✓	✓	✓			✓		
59	SE022-0.1	|				|	✓	|	|	✓	✓						✓		
60	SE022-0.3	|				|		|	|									
61	SE043-0.3	|				|		|	|	✓	✓						✓		
62	SE064-0.1	|				|		|	|	✓	✓	✓	✓	✓			✓		
63	SE062-0.1	|				|	✓	|	|	✓	✓						✓		
64	SE062-0.3	|				|	✓	|	|	✓	✓						✓		
65	SE066-0.1	|				|		↓	↓	✓	✓						✓		
66	SE013-0.1	↓				↓	✓			✓	✓						✓		

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0800	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Source Zone Soil

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles	EG005ST (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
67	BH031_0.0-0.2	soil	15/8			bag/jar										✓	✓			
68	BH031_0.5-0.7	"	"			"										✓	✓			
69	BH031_1.8-2.0	"	"			"										✓	✓			
70	BH031_1.0-1.2	"	"			"		✓		✓										
71	BH054_0.0-0.2	"	14/8			bag											✓			
72	BH054_0.7-0.9	"	"			"											✓			
73	BH054_1.0-1.2	"	"			"											✓			
74	BHDUP07	"	16/8					✓		✓										
75	BH032_0.0-0.2	"	14/8			bag											✓			
76	BH032_0.3-0.5	"	"			"											✓			
77	BH32_1.0-1.2	"	"			"											✓			
78	BHDUP06	"	16/8			#		✓		✓										

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Source Zone So:1

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com; brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

ALS Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG005T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
79	BH053_0.3-0.5	soil	14/8			Jar	✓	✓		✓	✓	✓	✓	✓	✓				✓	
80	BH053_1.5-1.7						✓	✓		✓	✓	✓	✓	✓	✓				✓	
81	BH053_3.2-3.5						✓	✓		✓	✓	✓	✓	✓	✓				✓	
82	BH001_0.3-0.5		16/8			Jar + ASS	✓	✓	✓	✓	✓								✓	
83	BH024_0.3-0.5		14/8			Jar		✓			✓	✓	✓						✓	
84	BH024_1.0-1.2							✓			✓	✓	✓						✓	
85	BH024_2.0-2.2							✓			✓	✓	✓						✓	
86	BH004_0.0-0.2		16/8					✓		✓										
	"	V																		

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Dan J	22/8	Con' Note No:
Of: GHD	Time:	Of: AU	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Impact Zone Soil

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0 404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0 266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005ST (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles															
P7	BH077_0.3-0.5	soil	14/8			Jar	✓	✓		✓	✓	✓	✓	✓	✓				✓		
88	BH077_0.5-0.7						✓	✓		✓	✓	✓	✓	✓	✓				✓		
89	BH077_1.0-1.2						✓	✓		✓	✓	✓	✓	✓	✓				✓		
90	BH077_1.5-1.7						✓	✓		✓	✓	✓	✓	✓	✓				✓		
91	BH084_1.0-1.2		15/8			Jar		✓	✓		✓	✓	✓						✓		
92	BH084_1.5-1.7							✓	✓		✓	✓	✓						✓		
93	BH078_0.3-0.5		14/8			Jar	✓	✓		✓	✓	✓	✓						✓		
94	BH078_1.0-1.2						✓	✓		✓	✓	✓	✓						✓		
95	BH078_1.5-1.7						✓	✓		✓	✓	✓	✓						✓		

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: AUS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Blanks (Soil) + Rinsates (water)

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE: 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (If different to report) ~~ben.luffman@ghd.com~~
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

ALS Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles														
96	TB01 (aka Trip Blank)	soil	6/8				✓													
97	TB02 (aka Trip Blank)	soil	6/8				✓													
	~~RBX1~~ RB01	W																		
	~~RBX2~~ RB02	"																		
	~~RBX3~~ RB03	"																		
	~~RBX4~~ RB04	"																		
	~~RBX5~~ RB05	"																		
98	RB01	water	15/8				Analyse for total As & Sb													
99	RB02	"	15/8				"													
100	RB03	"	16/8				"													
101	RB04	"	16/8				"													
102	RB05	"	16/8				✓													

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Dan J	22/8	Con' Note No:
Of: GHD	Time:	Of: AL	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Stockpiles + Bricks

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

ALS Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG005ST (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
103	SP01A	Soil	17/8		Jar & Bag															✓	
104	SP01B	↓	↓		Jar + Bag															↓	
105	SP02				↓																
106	SP03																				
107	SPDUP01																				
108	PA01	Frag			Bag																
109	PA02	↓			↓																
110	PA03																				
111	BRICK01					*		✓		✓	[redacted]										Please crush *
112	BRICK02	↓	↓		↓	*		✓		✓	[redacted]										Please crush *

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved. VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

PASS

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	**ANALYSIS REQUIRED including SUITES** (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG005ST (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
113	BH001 - 0.0 - 0.2	S				Bag														✓
114	BH001_ 0.7 - 0.9																			
115	BH001 1 - 1.2																			
116	BH002_ 1.0 - 1.2																			
117	BH002_ 1.2 - 1.4																			
118	BH003_ 0.5 - 0.7																			
119	BH003_ 1.0 - 1.2																			
120	BH011_ 0.1 -																			
121	BH011_ 0.3																			
122	BH011_ 0.5																			
123	BH020 - 0.0 - 0.2																			
124	BH020_ 0.3 - 0.5																			

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Dan	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved. VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

PASS.

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG0085T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
125	BH020 - 1.0 - 1.2	S				Bag														✓
126	BH028 - 0.3 - 0.5																			
127	BH028 - 0.8 - 1.0																			
128	BH029 - 0.5 - 0.7																			
129	BH039 - 0.5 - 0.7																			
130	BH046 - 0.5 - 0.7																			
131	BH047 - 0.0 - 0.2																			
132	BH022 - 0.5 - 0.7																			
133	BH050 - 0.2 - 0.4																			
134	BH052 - 0.0 - 0.2																			
135	BH052 - 0.5 - 0.7																			
136	BH052 - 1.8 - 2.8	↓				↓														↓

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Daniel	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

Sed'

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG0085T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
137	BH054-2.0-2.2	S				Bag													✓
138	BH052-2.3-2.5																		
139	SE001-0.4																		
140	SE014-0.4																		
	~~SE016-0.4~~																		
141	SE021-0.4																		
142	SE050-0.5																		
143	SEDUP04																		

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0800	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

Impact Zone

Soil

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~ NTLEAP@GHD.COM
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY:
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
1	BH074_0.8-1.0	soil	15/8		JAR	jar	✓	✓		✓								✓	
2	BH064_0.0-0.2		15/8		JAR	jar	✓	✓		✓								✓	
3	BH064_0.3-0.5		↓		JAR	↓	✓	✓		✓								✓	
4	BH073_0.0-0.2		15/8		JAR	jar	✓	✓		✓								✓	
5	BH073_0.5-0.7		↓		JAR	↓	✓	✓		✓								✓	
6	BH056_0.3-0.5		15/8		JAR	jar	✓	✓		✓								✓	
7	BH075_1.8-2.0				JAR	jar	✓		✓										
8	BH060_0.0-0.2		15/8		JAR	jar	✓	✓		✓								✓	
9	BH82_1.5-1.7		14/8		JAR	jar	✓	✓		✓								✓	

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

Environmental Division
Sydney
Work Order
ES1220305

Telephone : +61-2-8784 8555

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

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 = Amber Glass Preserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 = Ethanol Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

Standard Lab / Split WO
By / Date:
Courier:
PO / Internal Sheet

AUSTRALIAN LABORATORY SERVICES P/L

Subcon / Forward Lab / Split WO
Lab / Analysis: TOC / CEC @ Brisbane
Organised By / Date: PEO / New Castle
Relinquished By / Date: 22/8/12
Connote / Shipment:
WO No: ES1220305
Attach by PO / Internal Sheet:

ES1220305 COC Page 1 of 1

Soil

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 0404542354

PHONE 0266505600

EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~ NTLEAP@GHD.COM

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY

COOLER SEAL (circle appropriate)

Intact: Yes No N/A

SAMPLE TEMPERATURE

CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles	EG035T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
10	BH034-0.1	soil	15/8			Jar+bags	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	
11	BH014-0.1		16/8			Jar+2bags	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]		✓	
12	BH071205.07		15/8			Jar	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	
13	BH091-0.1		15/8			Jar		✓	✓		✓	✓	✓						✓	
14	BH002_0.5-0.7		16/8			Jar		✓		✓										
15	BH004_1.0-1.2		↓			Jar+bag		✓		✓										

RELINQUISHED BY:

Name: J. Simkus	Date: 21/8/12
Of: GHD	Time:
Name:	Date:
Of:	Time:

RECEIVED BY

Name: David	22/8
Of: ALS	0800
Name:	
Of:	

METHOD OF SHIPMENT

Con' Note No:

Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Jed'

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (As)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hot extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold	
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles														
16	SE001-0.1	soil				Jar+Bag	✓	✓	✓	✓					✓		✓			
17	SE001-0.2					Jar														
18	SE002-0.1						✓				✓	✓	✓	✓						
19	SE002-0.4																			
20	SE003-0.1						✓													
21	SE003-0.3					Jar+Bag									✓					
22	SE010-0.2					Jar	✓													
23	SE010-0.7																			
24	SE011-0.1										✓	✓	✓	✓						
~~25~~	SE011-0.4					Jar+Bag									✓					
26	SE012-0.1					Jar	✓													
27	SE012-0.4					Jar														

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0900	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

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; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.*

Seal

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 02 66505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG0085T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/H50-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
28	SE013-0.4	Soil				Bag, Jar		✓	✓						✓				
29	SE060-0.1					Jar						✓	✓	✓					
30	SE033-0.05					Jar						✓	✓	✓					
	~~SE047~~						✓	✓	✓	✓	✓						✓		
31	SE102-0-0.2							✓	✓										
~~ZMW~~	SE031-~~0.0~~0.5					Bag									✓				
	~~SE047~~																		
~~NB~~	SE054-03					Jar									✓				

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: AU	Time: 08:00	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.*

Sed 1

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	**ANALYSIS REQUIRED including SUITES** (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
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Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG0085T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
	SE013 - 0.1	# (double up on COC				*		✓	✓	✓							✓		
34	SEDUP04	Soil				Jar + bag		✓	✓	✓					✓		✓		
35	~~SE012~~ SE020 - 0.1					Jar	✓												
36	SE020 - 0.4																		
37	SE021 - 0.1										✓	✓	✓	✓					
38	SE021 - 0.3																		
39	SE030 - 0.1						✓				✓	✓	✓	✓					
40	SE030 - 0.4																		
41	SE031 - 0.1										✓								
42	SE040 - 0.4									✓	✓	✓	✓	✓			✓		
43	SE042 - 0.1																		
44	SE050 - 0.1					Jar + bags	✓	✓	✓	✓					✓		✓		

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0806	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.*

Sed'

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG0085T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
45	SE050 - 0.3	soil				Jar+bag		✓	✓	✓					✓		✓		
46	SEDUP03	"				"				✓							✓		
47	SE051 - 0.1	"				"				✓	✓						✓		
48	SE051 - 0.4	"				"				✓							✓		
49	SE052 - 0.1	"				"				✓	✓						✓		
50	SE053 - 0.1	"				Jar+bag					✓								
51	SE054 - 0.1	"				"					✓								
52	SE055 - 0.1	"				"													
53	SE056 - 0.1	"				"				✓	✓						✓		
54	SE057 - 0.3	"				"				✓	✓						✓		
55	SE061 - 0.1	"				"				✓	✓	✓	✓	✓			✓		
	BLANK	"				"		↓	↓										

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0800	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved: VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.*

AUSTRALIAN LABORATORY SERVICES P/L

Sed'

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected", Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hid extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
	~~SE066~~ SE064-0.1	soil				Jar+bag	✓	✓	✓	✓	✓				✓		✓		
56	SE065 - 0.1					Jar				✓	✓						✓		
57	SE005					Jar+bag	✓			✓	✓						✓		
58	SE014 - 0.1					Jar				✓	✓	✓	✓	✓			✓		
59	SE022 - 0.1						✓			✓	✓						✓		
60	SE022 - 0.3																		
61	SE043 - 0.3									✓	✓						✓		
62	SE064 - 0.1									✓	✓	✓	✓	✓			✓		
63	SE062 - 0.1						✓			✓	✓						✓		
64	SE062 - 0.3						✓			✓	✓						✓		
65	SE066 - 0.1									✓	✓						✓		
66	SE013 - 0.1						✓			✓	✓						✓		

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0800	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.*

Source Zone Soil

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

ALS Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005ST (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles															
67	BH031_0.0-0.2	soil	15/8			bag/jar										✓	✓				
68	BH031_0.5-0.7	↓	↓			↓										✓	✓				
69	BH031_1.8-2.0	↓	↓			↓										✓	✓				
70	BH031_1.0-1.2	↓	↓			↓		✓		✓											
71	BH054_0.0-0.2	↓	14/8			bag											✓				
72	BH054_0.7-0.9	↓	↓			↓											✓				
73	BH054_1.0-1.2	↓	↓			↓											✓				
74	BHDUP07	↓	16/8			↓		✓		✓											
75	BH032_0.0-0.2	↓	14/8			bag											✓				
76	BH032_0.3-0.5	↓	↓			↓											✓				
77	BH32_1.0-1.2	↓	↓			↓											✓				
78	BHDUP06	↓	16/8			↓		✓		✓											

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Dan J	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Source Zone So:1

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD

SAMPLER: J. Simkus

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

MOBILE: 0404542354

PROJECT MANAGER (PM): Ben Luffman

PHONE: 0266505600

PROJECT ID: 2216251

EMAIL REPORT TO: ben.luffman@ghd.com; brian.cork@ghd.com

SITE: Hillside Dr, Urunga P.O. NO.:

EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY

COOLER SEAL (circle appropriate)

Intact: Yes No N/A

SAMPLE TEMPERATURE

CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles														
79	BH053_0.3-0.5	soil	14/8			Jar	✓	✓		✓	✓	✓	✓	✓	✓				✓	
80	BH053_1.5-1.7	"	"			"	✓	✓		✓	✓	✓	✓	✓	✓				✓	
81	BH053_3.2-3.5	"	↓			↓	✓	✓		✓	✓	✓	✓	✓	✓				✓	
		"																		
82	BH001_0.3-0.5	"	16/8			Jar + bag	✓	✓	✓	✓	✓								✓	
^		"																		
83	BH024_0.3-0.5	"	14/8			Jar		✓			✓	✓	✓						✓	
84	BH024_1.0-1.2	"	"			"		✓			✓	✓	✓						✓	
85	BH024_2.0-2.2	"	↓			↓		✓			✓	✓	✓						✓	
		"																		
86	BH004_0.0-0.2	"	16/8					✓		✓										
	"	✓																		

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Impact zone Soil

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0 404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0 266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (As, Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles														
87	BH077_0.3-0.5	soil	14/8			Jar	✓	✓		✓	✓	✓	✓	✓	✓				✓	
88	BH077_0.5-0.7						✓	✓		✓	✓	✓	✓	✓	✓				✓	
89	BH077_1.0-1.2						✓	✓		✓	✓	✓	✓	✓	✓				✓	
90	BH077_1.5-1.7		↓			↓	✓	✓		✓	✓	✓	✓	✓	✓				✓	
91	BH084_1.0-1.2		15/8			Jar		✓	✓		✓	✓	✓						✓	
92	BH084_1.5-1.7		↓			↓		✓	✓		✓	✓	✓						✓	
93	BH078_0.3-0.5		14/8			Jar	✓	✓		✓	✓	✓	✓						✓	
94	BH078_1.0-1.2		↓			↓	✓	✓		✓	✓	✓	✓						✓	
95	BH078_1.5-1.7		↓			↓	✓	✓		✓	✓	✓	✓						✓	

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: AUS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Blanks (Soil) + Rinsates (water)

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

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PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles															
96	TB01 (aka Trip Blank)	soil	6/8					✓													
97	TB02 (aka Trip blank)	soil	6/8					✓													
	~~RB01~~ RB01	W																			
	~~RB02~~ RB02																				
	~~RB03~~ RB03																				
	~~RB04~~ RB04																				
	~~RB05~~ RB05																				
98	RB01	water	15/8				Analyse for total As & Sb														
99	RB02		15/8																		
100	RB03		16/8																		
101	RB04		16/8																		
102	RB05	✓	16/8					✓													

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Dan J	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0900	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

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; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Stockpiles + Bricks

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg))	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles														
103	SP01A	soil	17/8		Jar ~~Bag~~														✓	
104	SP01B	"	"		Jar ~~Bag~~														"	
105	SP02	"	"		"														"	
106	SP03	"	"		"														"	
107	SPDUP01	"	"		"														"	
108	PA01	Frag	"		Bag														"	
109	PA02	"	"		"														"	
110	PA03	"	"		"														✓	
111	BRICK01	"	"		"	*	✓		✓	[redacted]										Please crush *
112	BRICK02	"	"		"	*	✓		✓	[redacted]										Please crush *

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0900	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved. VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

PASS

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG0085T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles															
113	BH001 - 0.0 - 0.2	S				Bag														✓	
114	BH001_ 0.7 - 0.9																				
115	BH001 1 - 1.2																				
116	BH002_ 1.0 - 1.2																				
117	BH002_ 1.2 - 1.4																				
118	BH003_ 0.5 - 0.7																				
119	BH003_ 1.0 - 1.3																				
120	BH011_ 0.1 -																				
121	BH011_ 0.3																				
122	BH011_ 0.5																				
123	BH020 - 0.0 - 0.2																				
124	BH020_ 0.3 - 0.5																				

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved. VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

PASS

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG035T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
125	BH020 - 1.0 - 1.2	S				Bag														✓	
126	BH028 - 0.3 - 0.5																				
127	BH028 - 0.8 - 1.0																				
128	BH029 - 0.5 - 0.7																				
129	BH039 - 0.5 - 0.7																				
130	BH046 - 0.5 - 0.7																				
131	BH047 - 0.0 - 0.2																				
132	BH022 - 0.5 - 0.7																				
133	BH050 - 0.2 - 0.4																				
134	BH052 - 0.0 - 0.2																				
135	BH052 - 0.5 - 0.7																				
136	BH052 - 1.8 - 2.8	↓				↓														↓	

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Seal

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (If different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	**ANALYSIS REQUIRED including SUITES** (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
137	BH054-2.0-2.2	S				Bag													✓
138	BH052-2.3-2.5																		
139	SE001-0.4																		
140	SE014-0.4																		
	~~SE016-0.4~~																		
141	SE021-0.4																		
142	SE050-0.5																		
143	SEDUP04																		

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0800	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

Impact Zone

Soil

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~ NTLEAP@GHD.COM
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG005T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
1	BH074_0.8-1.0	soil	15/8		JAR	Jar		✓	✓		✓								✓	
2	BH064_0.0-0.2		15/8		JAR	Jar		✓	✓		✓								✓	
3	BH064_0.3-0.5		↓		JAR	↓		✓	✓		✓								✓	
4	BH073_0.0-0.2		15/8		JAR	Jar		✓	✓		✓								✓	
5	BH073_0.5-0.7		↓		JAR	↓		✓	✓		✓								✓	
6	BH056_0.3-0.5		15/8		JAR	Jar		✓	✓		✓								✓	
7	BH075_1.8-2.0				JAR	Jar		✓		✓										
8	BH060_0.0-0.2		15/8		JAR	Jar		✓	✓		✓								✓	
9	BH82_1.5-1.7		14/8		JAR	Jar		✓	✓		✓								✓	

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

Environmental Division
Sydney
Work Order
ES1220305

Telephone : +61-2-8784 8555

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

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; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Standard Lab / Split WO
Name:
Of:
By / Date:
By / Date:
Courier: AUSTRALIAN LABORATORY SERVICES P/L
PO / Internal Sheet

Subcon / Formal Lab / Split WO split into ES
Lab / Analysis: TOC / CEC @ Brisbane.
Organised By / Date: New Castle
Relinquished By / Date:
Connote / Split ES1220305 COC Page 1 of 1
WO No: ES1220305
Attach by PO / Internal Sheet:
Brick 01 | Brick 02 sent to Orange for crushing

Soil

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~ NTLEAP@GHD.COM
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005ST (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles															
10	BH034-0.1	soil	15/8			Jar+bag	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		
11	BH014-0.1		16/8			Jar+bag	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		
12	BH071205.07		15/8			Jar	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		
13	BH091-0.1		15/8			Jar		✓	✓		✓	✓	✓						✓		
14	BH002_0.5-0.7		16/8			Jar		✓		✓											
15	BH004_1.0-1.2		✓			Jar+bag		✓		✓											

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

Jed'

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: - 0 404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0 266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG008ST (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
16	SE001-0.1	soil				Jar+bag	✓	✓	✓	✓					✓		✓		
17	SE001-0.2					Jar													
18	SE002-0.1						✓				✓	✓	✓	✓					
19	SE002-0.4																		
20	SE003-0.1						✓												
21	SE003-0.3					Jar+bag									✓				
22	SE010-0.2					Jar	✓												
23	SE010-0.7																		
24	SE011-0.1										✓	✓	✓	✓					
145	SE011-0.4					Jar+Bag									✓				
26	SE012-0.1					Jar	✓												
27	SE012-0.4					Jar													

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0900	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Sed!

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 02 66505600
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SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG008ST (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
28	SE013-0.4	soil				Bag/Jar		✓	✓						✓				
29	SE060-0.1					Jar						✓	✓	✓					
30	SE033-0.05					Jar						✓	✓	✓					
	[illegible]						✓	✓	✓	✓	✓						✓		
31	SE102-0-0.2							✓	✓										
[illegible]	SE031-[illegible]0.5					Bag									✓				
	[illegible]																		
[illegible]	SE054-03					Jar									✓				

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: AU	Time: 0900	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Sed'

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
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RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY:
COOLER SEAL (circle appropriate):
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles	EG005T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
~~SE013-0.1~~	~~SE013-0.1~~	~~(double up on COC~~				~~1~~	—	✓	✓	✓						~~✓~~	✓		
34	SEDUP04	Soil				Jar+bag		✓	✓	✓					✓		✓		
35	~~SE012~~ SE020-0.1	|				Jar	✓												
36	SE020-0.4	|				|													
37	SE021-0.1	|				|					✓	✓	✓	✓					
SNR 38	SE021-0.3	|				|													
39	SE030-0.1	|				|	✓				✓	✓	✓	✓					
40	SE030-0.4	|				|													
41	SE031-0.1	|				|					✓								
42	SE040-0.4	|				|				✓	✓	✓	✓	✓			✓		
43	SE042-0.1	|				|													
44	SE050-0.1	|				Jar+bags	✓	✓	✓	✓					✓		✓		

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: AUS	Time: 0860	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Sed 1

CHAIN OF CUSTODY DOCUMENTATION

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Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG088ST (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
45	SE050 - 0.3	soil				Jar+bag		✓	✓	✓					✓		✓		
46	SEDUP 03									✓							✓		
47	SE051 - 0.1									✓	✓						✓		
48	SE051 - 0.4									✓							✓		
49	SE052 - 0.1									✓	✓						✓		
50	SE053 - 0.1					Jar+bag					✓								
51	SE054 - 0.1										✓								
52	SE055 - 0.1																		
53	SE056 - 0.1									✓	✓						✓		
54	SE057 - 0.3									✓	✓						✓		
55	SE061 - 0.1									✓	✓	✓	✓	✓			✓		
	Blank	↓						↓	↓										

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: AU	Time: 08:00	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.*

AUSTRALIAN LABORATORY SERVICES P/L

Sed'

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	Ek026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
144	~~SE004~~ SE004-0.1	S	0.1			Jar+bag	✓	✓	✓	✓	✓				✓		✓		
56	SE005-0.1					Jar				✓	✓						✓		
57	~~SE005~~ SE005					Jar+bag				✓	✓						✓		
58	SE014-0.1					Jar				✓	✓	✓	✓	✓			✓		
59	SE022-0.1						✓			✓	✓						✓		
66	SE022-0.3																		
61	SE043-0.3									✓	✓						✓		
62	SE064-0.1									✓	✓	✓	✓	✓			✓		
63	SE062-0.1						✓			✓	✓						✓		
64	SE062-0.3						✓			✓	✓						✓		
65	SE066-0.1									✓	✓						✓		
66	SE013-0.1						✓			✓	✓						✓		

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0900	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Source Zone Soil

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles															
67	BH031_0.0-0.2	soil	15/8			bag/jar										✓	✓				
69	BH031_0.5-0.7	"	"			"										✓	✓				
69	BH031_1.8-2.0	"	"			"										✓	✓				
70	BH031_1.0-1.2	"	"			"		✓		✓											
71	BH054_0.0-0.2	"	14/8			bag											✓				
72	BH054_0.7-0.9	"	"			"											✓				
73	BH054_1.0-1.2	"	"			"											✓				
74	BHDUP07	"	16/8					✓		✓											
75	BH032_0.0-0.2	"	14/8			bag											✓				
76	BH032_0.3-0.5	"	"			"											✓				
77	BH32_1.0-1.2	"	"			"											✓				
78	BHDUP06	"	16/8					✓		✓											

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

Source Zone Soil

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com; brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles															
79	BH053_0.3-0.5	soil	14/8			Jar	✓	✓		✓	✓	✓	✓	✓	✓		✓		✓		
80	BH053_1.5-1.7		↓			↓	✓	✓		✓	✓	✓	✓	✓	✓				✓		
81	BH053_3.2-3.5		↓			↓	✓	✓		✓	✓	✓	✓	✓	✓				✓		
82	BH001_0.3-0.5		16/8			Jar + Bag	✓	✓	✓	✓	✓								✓		
^																					
83	BH024_0.3-0.5		14/8			Jar		✓			✓	✓	✓						✓		
84	BH024_1.0-1.2		↓			↓		✓			✓	✓	✓						✓		
85	BH024_2.0-2.2		↓			↓		✓			✓	✓	✓						✓		
86	BH004_0.0-0.2		16/8					✓		✓											
		V																			

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Dan J	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Impact zone Soil

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0 404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0 266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles															
P7	BH077_0.3-0.5	soil	14/8			Jar	✓	✓		✓	✓	✓	✓	✓	✓				✓		
SNR	BH077_0.5-0.7						✓	✓		✓	✓	✓	✓	✓	✓				✓		
94	BH077_1.0-1.2						✓	✓		✓	✓	✓	✓	✓	✓				✓		
90	BH077_1.5-1.7						✓	✓	✓	✓	✓	✓	✓	✓	✓				✓		
91	BH084_1.0-1.2		15/8			Jar		✓	✓		✓	✓	✓						✓		
92	BH084_1.5-1.7							✓	✓		✓	✓	✓1						✓		
SNR	BH078_0.3-0.5		14/8			Jar	✓	✓		✓	✓	✓	✓						✓		
SNR	BH078_1.0-1.2						✓	✓		✓	✓	✓	✓						✓		
SNR	BH078_1.5-1.7						✓	✓		✓	✓	✓	✓						✓		

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Dawn	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

Blanks (Soil) + Rinsates (water)

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG0085T (All)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes
96	TB01 (aka Trip Blank)	soil	6/8					✓													
97	TB02 (aka Trip Blank)	soil	6/8					✓													
	~~RB01~~ RB01	W																			
	~~RB02~~ RB02	|																			
	~~RB03~~ RB03	|																			
	~~RB04~~ RB04	|																			
	~~RB05~~ RB05	|																			
98	RB01	water	15/8				Analyse for total As & Sb														
99	RB02	|	15/8				|														
100	RB03	|	16/8				|													
101	RB04	|	16/8				|													
102	RB05	V	16/8				V														

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Devi	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Stockpiles + Bricks

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005ST (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles															
103	SP01A	Soil	17/8		Jar+Bag															✓	
104	SP01B	"	"		Jar+Bag															"	
105	SP02	"	"		"															"	
106	SP03	"	"		"															"	
107	SPDUP01	"	"		"															"	
108	PA01	Frag	"		Bag															"	
109	PA02	"	"		"															"	
110	PA03	"	"		"															"	
111	BRICK01	"	"		"	*		✓		✓	[redacted]										Please crush *
112	BRICK02	"	"		"	*		✓		✓	[redacted]										Please crush *

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0900	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved. VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

PASS

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No:

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG005T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
113	BH001 - 0.0 - 0.2	S				Bag														✓	
114	BH001_ 0.7 - 0.9																				
115	BH001_ 1 - 1.2																				
116	BH002_ 1.0 - 1.2																				
117	BH002_ 1.2 - 1.4																				
118	BH003_ 0.5 - 0.7																				
119	BH003_ 1.0 - 1.2																				
120	BH011_ 0.1 -																				
121	BH011_ 0.3																				
122	BH011_ 0.5																				
123	BH020 - 0.0 - 0.2																				
124	BH020_ 0.3 - 0.5																			✓	

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Dan	22/8	Con' Note No:
Of: GHD	Time:	Of: Ds	08:00	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

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; V = VOA Vial HCl Preserved, VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

PASS

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005ST (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles															
121	BH020 - 1.0 - 1.2	S				Bag														✓	
121	BH028 - 0.3 - 0.5																				
127	BH028 - 0.8 - 1.0																				
128	BH029 - 0.5 - 0.7																				
129	BH039 - 0.5 - 0.7																				
130	BH046 - 0.5 - 0.7																				
131	BH047 - 0.0 - 0.2																				
132	BH022 - 0.5 - 0.7																				
133	BH050 - 0.2 - 0.4																				
134	BH052 - 0.0 - 0.2																				
135	BH052 - 0.5 - 0.7																				
136	BH052 - 1.8 - 2.8																				

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: AJ	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
137	BH054-2.0-2.2	S				Bag													✓
138	BH052-2.3-2.5																		
139	SE001-0.4																		
140	SE014-0.4																		
	~~SE016-0.4~~																		
141	SE021-0.4																		
142	SE050-0.5																		
143	SEDUP04																		

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Dan J	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0800	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.*

AUSTRALIAN LABORATORY SERVICES P/L

Impact Zone Soil

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE: 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~ NTLEAP@GHD.COM
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE:
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG0085T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles														
1	BH074_0.8-1.0	soil	15/8		JAR	Jar		✓	✓		✓								✓	
2																				
3	BH064_0.0-0.2		15/8		JAR	Jar		✓	✓		✓								✓	
4	BH064_0.3-0.5		↓		JAR	↓		✓	✓		✓								✓	
5																				
6	BH073_0.0-0.2		15/8		JAR	Jar		✓	✓		✓								✓	
7	BH073_0.5-0.7		↓		JAR	↓		✓	✓		✓								✓	
8																				
9	BH056_0.3-0.5		15/8		JAR	Jar		✓	✓		✓								✓	
10	BH075_1.8-2.0				JAR	Jar		✓		✓										
11	BH060_0.0-0.2		15/8		JAR	Jar		✓	✓		✓								✓	
12	BH82_1.5-1.7	✓	14/8		JAR	Jar		✓	✓		✓								✓	

Environmental Division Sydney
Work Order
ES1220402

Telephone : +61-2-8784 8555

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	08:00	Subcon / Forward Lab / Split WO
Name:	Date:	Name:		Lab / Analysis: ASS / Bulk Comp. (only).
Of:	Time:	Of:		Organised By / Date: SMH ES1220305
				Relinquished By / Date:
				Connote / Courier:
				WO No: ES1220402
				Attach By PO / Internal Sheet:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Soil

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~ NTLEAP@GHD.COM
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE °C
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005ST (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles															
10	BH034-0.1	soil	15/8			Jar+bags	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		
11	BH014-0.1		16/8			Jar+2bag	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		
12	BH071_0.5-0.7		15/8			Jar	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		
13	BH091-0.1		15/8			Jar		✓	✓		✓	✓	✓						✓		
14	BH002_0.5-0.7		16/8			Jar		✓		✓											
15	BH004_1.0-1.2		↓			Jar+bag		✓		✓											

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	08:00	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Dec'

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga

RESULTS REQUIRED (Date): standard

NO.:

E NO.: SY/270/12

HANDLING / STORAGE OR DIPOSAL:

SAMPLER: J. Simkus

MOBILE: 0404542354

PHONE 0266505600

EMAIL ben.luffman@ghd.com, brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY

COOLER SEAL (circle appropriate)

Intact: Yes No N/A

SAMPLE TEMPERATURE

CHILLED: Yes No

COMMENTS /

SAMPLE INFORMATION (note: S = Soil, W=Water)

CONTAINER INFORMATION

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

	ALS ID	SAMPLE ID	MATRIX	DAT	Type / Code	Total bottles	EG005T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hid extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
1	16	SE001-0.1	soil			Jar+Bag	✓	✓	✓	✓					✓		✓		
	17	SE001-0.2				Jar													
	18	SE002-0.1					✓				✓	✓	✓	✓					
	19	SE002-0.4																	
	20	SE003-0.1					✓												
2	21	SE003-0.3				Jar+Bag									✓				
	22	SE010-0.2				Jar	✓												
	23	SE010-0.7																	
	24	SE011-0.1									✓	✓	✓	✓					
3	25	SE011-0.4				Jar+Bag									✓				
	26	SE012-0.1				Jar	✓												
	27	SE012-0.4				Jar													

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0900	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

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; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 02 66505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

	SAMPLE INFORMATION (note: S = Soil, W=Water)				CONTAINER INFORMATION		EG005T (As)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold	
	ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
4	29	SE013-0.4	soil				Bag/Jar		✓	✓						✓				
	29	SE060-0.1					Jar						✓	✓	✓					
	30	SE033-0.05					Jar						✓	✓	✓					
		~~SE047~~	~~~~	~~~~	~~~~	~~~~	~~~~	~~~~	~~~~	~~~~	~~~~	~~~~	~~~~	~~~~	~~~~	~~~~	~~~~	~~~~	~~~~	
	31	SE102-0-0.2							✓	✓										
5	32	SE031-0.5					Bag									✓				
		~~SE047~~																		
6	33	SE054-03					Jar									✓				

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0900	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Sed 1

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM). Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG005T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
	~~SE03 - 0.1~~	# (double up on COC				*	—	✓	✓	✓							✓		
7	~~39~~ SEDUP01	Soil				Jar + bag		✓	✓	✓					✓		✓		
	~~35~~ ~~SE020~~ SE020 - 0.1					Jar	✓												
	~~36~~ SE020 - 0.4																		
	~~37~~ SE021 - 0.1										✓	✓	✓	✓					
	~~38~~ SE021 - 0.3																		
	~~39~~ SE030 - 0.1						✓				✓	✓	✓	✓					
	~~40~~ SE030 - 0.4																		
	~~41~~ SE031 - 0.1										✓								
	~~42~~ SE040 - 0.4									✓	✓	✓	✓	✓			✓		
	~~43~~ SE042 - 0.1																		
8	~~44~~ SE050 - 0.1					Jar + bags	✓	✓	✓	✓					✓		✓		

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: AUS	Time: 08~~30~~	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

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; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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.

AUSTRALIAN LABORATORY SERVICES P/L

Sed 1

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	**ANALYSIS REQUIRED including SUITES** (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (As)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (incl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles														
9	SE050 - 0.3	soil				Jar+bag		✓	✓	✓					✓		✓			
	SEDUP 03									✓							✓			
	SE051 - 0.1									✓	✓						✓			
	SE051 - 0.4									✓							✓			
	SE052 - 0.1									✓	✓						✓			
	SE053 - 0.1					Jar+bag					✓									
	SE054 - 0.1										✓									
	SE055 - 0.1																			
	SE056 - 0.1									✓	✓						✓			
	SE057 - 0.3									✓	✓						✓			
	SE061 - 0.1									✓	✓	✓	✓	✓			✓			
	[illegible]							↓	↓											

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0900	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved: VS = VOA Vial Sulphuric Preserved; 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.

AUSTRALIAN LABORATORY SERVICES P/L

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL: (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE:
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)				CONTAINER INFORMATION		EG005T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hd extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles												
10	SE064-0.1	S				Jar+bag	✓	✓	✓	✓	✓				✓		✓		
59	SE035 - 0.1					Jar				✓	✓						✓		
58	SE005					Jar+bag				✓	✓						✓		
57	SE014 - 0.1					Jar				✓	✓	✓	✓	✓			✓		
56	SE022 - 0.1						✓			✓	✓						✓		
66	SE022 - 0.3																		
61	SE043 - 0.3									✓	✓						✓		
67	SE064 - 0.1									✓	✓	✓	✓	✓			✓		
63	SE062 - 0.1						✓			✓	✓						✓		
64	SE062 - 0.3						✓			✓	✓						✓		
65	SE066 - 0.1									✓	✓						✓		
46	SE013 - 0.1						✓			✓	✓						✓		

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0800	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

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; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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.

AUSTRALIAN LABORATORY SERVICES P/L

Source Zone Soil

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW
PROJECT MANAGER (PM): Ben Luffman
PROJECT ID: 2216251
SITE: Hillside Dr, Urunga P.O. NO.:
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus
MOBILE: 0404542354
PHONE 0266505600
EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

	ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles	EG0085T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
11	67	BH031_0.0-0.2	soil	15/8			bag/jar										✓	✓			
12	69	BH031_0.5-0.7		↓			↓										✓	✓			
13	84	BH031_1.8-2.0		↓			↓										✓	✓			
	76	BH031_1.0-1.2		↓			↓		✓		✓										
14	77	BH054_0.0-0.2		14/8			bag											✓			
15	83	BH054_0.7-0.9		↓			↓											✓			
16	78	BH054_1.0-1.2		↓			↓											✓			
	74	BHDUP07		16/8					✓		✓										
17	57	BH032_0.0-0.2		14/8			bag											✓			
18	86	BH032_0.3-0.5		↓			↓											✓			
19	77	BH32_1.0-1.2		↓			↓											✓			
	78	BHDUP06		16/8			#		✓		✓										

RELINQUISHED BY:

Name: J. Simkus	Date: 21/8/12
Of: GHD	Time:
Name:	Date:
Of:	Time:

RECEIVED BY

Name: David	22/8
Of: ALS	08:00
Name:	
Of:	

METHOD OF SHIPMENT

Con' Note No:	
Transport Co:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Source Zone Soil

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 0404542354

PHONE 0266505600

EMAIL REPORT TO: ben.luffman@ghd.com;-brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com

FOR LABORATORY USE ONLY

COOLER SEAL (circle appropriate)

Intact: Yes No N/A

SAMPLE TEMPERATURE

CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION: Type / Code	CONTAINER INFORMATION: Total bottles	EG005T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
79	BH053_0.3-0.5	soil	14/8			Jar	✓	✓		✓	✓	✓	✓	✓	✓				✓		
80	BH053_1.5-1.7						✓	✓		✓	✓	✓	✓	✓	✓				✓		
81	BH053_3.2-3.5						✓	✓		✓	✓	✓	✓	✓	✓				✓		
82	BH001_0.3-0.5		16/8			Jar + bag	✓	✓	✓	✓	✓								✓		
83	BH024_0.3-0.5		14/8			Jar		✓			✓	✓	✓						✓		
84	BH024_1.0-1.2							✓			✓	✓	✓						✓		
85	BH024_2.0-2.2							✓			✓	✓	✓						✓		
86	BH004_0.0-0.2		16/8					✓		✓											
	"	V																			

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Dan J	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0830	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

Impact Zone Soil

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 0 404542354

PHONE 0 266505600

EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~

FOR LABORATORY USE ONLY

COOLER SEAL (circle appropriate)

Intact: Yes No N/A

SAMPLE TEMPERATURE

CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG035ST (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles														
87	BH077_0.3-0.5	soil	14/8			Jar	✓	✓		✓	✓	✓	✓	✓	✓				✓	
88	BH077_0.5-0.7	"	"			"	✓	✓		✓	✓	✓	✓	✓	✓				✓	
89	BH077_1.0-1.2	"	"			"	✓	✓		✓	✓	✓	✓	✓	✓				✓	
90	BH077_1.5-1.7	"	↓			↓	✓	✓		✓	✓	✓	✓	✓	✓				✓	
91	BH084_1.0-1.2	"	15/8			Jar		✓	✓		✓	✓	✓						✓	
92	BH084_1.5-1.7	"	↓			↓		✓	✓		✓	✓	✓/						✓	
93	BH078_0.3-0.5	"	14/8			Jar	✓	✓		✓	✓	✓	✓						✓	
94	BH078_1.0-1.2	"	"			"	✓	✓		✓	✓	✓	✓						✓	
95	BH078_1.5-1.7	"	↓			↓	✓	✓		✓	✓	✓	✓						✓	

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Blanks (Soil) + Rinsates (water)

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216261	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)				CONTAINER INFORMATION		EG020B5T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles														
97	TB01 (aka Trip Blank)	soil	6/8				✓													
97	TB02 (aka Trip Blank)	soil	6/8				✓													
	~~RB01~~ RB01	W																		
	~~RB02~~ RB02																			
	~~RB03~~ RB03																			
	~~RB04~~ RB04																			
	~~RB05~~ RB05																			
98	RB01	water	15/8				Analyse for total As & Sb													
99	RB02		15/8																	
100	RB03		16/8																	
101	RB04		16/8																	
102	RB05		16/8																	

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: D... J	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Stockpiles + Bricks

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 0404542354

PHONE 0266505600

EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~

FOR LABORATORY USE ONLY

COOLER SEAL: (circle appropriate)

Intact: Yes No N/A

SAMPLE TEMPERATURE

CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG005ST (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
103	SP01A	soil	17/8		Jar														✓	
104	SP01B	"	"		Jar / Bag														"	
105	SP02	"	"		"														"	
106	SP03	"	"		"														"	
107	SPDUP01	"	"		"														"	
108	PA01	Frag	"		Bag														"	
109	PA02	"	"		"														"	
110	PA03	"	"		"														"	
111	BRICK01	"	"		"	*		✓		✓	[redacted]									Please crush *
112	BRICK02	"	"		"	*		✓		✓	[redacted]									Please crush *

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Daniel	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0900	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved. VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

PASS

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN69 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles														
113	BH001 - 0.0 - 0.2	S				Bag														✓
114	BH001_ 0.7 - 0.9																			
115	BH001 1 - 1.2																			
116	BH002_ 1.0 - 1.2																			
117	BH002_ 1.2 - 1.4																			
118	BH003_ 0.5 - 0.7																			
119	BH003_ 1.0 - 1.2																			
120	BH011_ 0.1 -																			
121	BH011_ 0.3																			
122	BH011_ 0.5																			
123	BH020 - 0.0 - 0.2																			
124	BH020_ 0.3 - 0.5																			✓

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved, VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

PASS

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD

SAMPLER: J. Simkus

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

MOBILE: 0404542354

PROJECT MANAGER (PM): Ben Luffman

PHONE 0266505600

PROJECT ID: 2216251

EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com

SITE: Hillside Dr, Urunga P.O. NO.:

EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles	EG035ST (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
42	BH020 - 1.0 - 1.2	S				Bag														✓
121	BH028 - 0.3 - 0.5																			
127	BH028 - 0.8 - 1.0																			
128	BH029 - 0.5 - 0.7																			
129	BH039 - 0.5 - 0.7																			
130	BH046 - 0.5 - 0.7																			
131	BH047 - 0.0 - 0.2																			
132	BH022 - 0.5 - 0.7																			
133	BH050 - 0.2 - 0.4																			
134	BH052 - 0.0 - 0.2																			
135	BH052 - 0.5 - 0.7																			
136	BH052 - 1.8 - 2.8	↓				↓														↓

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (If different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG0085T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles														
139	BH054-2.0-2.2	S				Bag													✓	
139	BH052-2.3-2.5																			
139	SE001-0.4																			
141	SE014-0.4																			
	~~SE016-0.4~~																			
141	SE021-0.4																			
142	SE030-0.5																			
143	SEDUP04	↓				↓													↓	

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0900	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Impact zone Soil

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (If different to report) ~~ben.luffman@ghd.com~~ NTLEAP@GHD.COM
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles														
1	BH074_0.8-1.0	soil	15/8		JAR	jar		✓	✓		✓								✓	
2	BH064_0.0-0.2		15/8		JAR	jar		✓	✓		✓								✓	
3	BH064_0.3-0.5		↓		JAR	↓		✓	✓		✓								✓	
4	BH073_0.0-0.2		15/8		JAR	jar		✓	✓		✓								✓	
5	BH073_0.5-0.7		↓		JAR	↓		✓	✓		✓								✓	
6	BH056_0.3-0.5		15/8		JAR	jar		✓	✓		✓								✓	
7	BH075_1.8-2.0				JAR	jar		✓		✓										
8	BH060_0.0-0.2		15/8		JAR	jar		✓	✓		✓								✓	
9	BH82_1.5-1.7		14/8		JAR	jar		✓	✓		✓								✓	

Environmental Division Sydney
Work Order
ES1220402

Telephone : +61-2-8784 8555

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0830	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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.

Soil

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 0404542354

PHONE 0266505600

EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~ NTLEAP@GHD.COM

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG005T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
10	BH034-0.1	soil	15/8			Jar+bag	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	
11	BH014-0.1		16/8			Jar+2bag	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]		✓	
12	BH071205.07		15/8			Jar	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	
13	BH091-0.1		15/8			Jar		✓	✓		✓	✓	✓						✓	
14	BH002_0.5-0.7		16/8			Jar		✓		✓										
15	BH004_1.0-1.2		↓			Jar+bag		✓		✓										

SAMPLE INFORMATION (note: S = Soil, W=Water)

RELINQUISHED BY:

Name: J. Simkus	Date: 21/8/12
Of: GHD	Time:
Name:	Date:
Of:	Time:

RECEIVED BY

Name: David	22/8
Of: ALS	0800
Name:	
Of:	

METHOD OF SHIPMENT

Con' Note No:

Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga

RESULTS REQUIRED (Date): standard

NO.:

E NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 0404542354

PHONE 0266505600

EMAIL ben.luffman@ghd.com, brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report)

FOR LABORATORY USE ONLY

COOLER SEAL (circle appropriate)

Intact: Yes No N/A

SAMPLE TEMPERATURE

CHILLED: Yes No

COMMENTS /

ANDLING / STORAGE OR DIPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)

CONTAINER INFORMATION

	ALS ID	SAMPLE ID	MATRIX	DAT	Type / Code	Total bottles	EG005T (As)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
1	76	SE001-0.1	soil			Jar+Bag	✓	✓	✓	✓					✓		✓		
	77	SE001-0.2				Jar													
	78	SE002-0.1					✓				✓	✓	✓	✓					
	79	SE002-0.4																	
	80	SE003-0.1					✓												
2	81	SE003-0.3				Jar+Bag									✓				
	82	SE010-0.2				Jar	✓												
	83	SE010-0.7																	
	84	SE011-0.1									✓	✓	✓	✓					
3	85	SE011-0.4				Jar+Bag									✓				
	86	SE012-0.1				Jar	✓												
	87	SE012-0.4				Jar													

RELINQUISHED BY:

Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8
Of: GHD	Time:	Of: AL>	Time: 0900
Name:	Date:	Name:	Date:
Of:	Time:	Of:	Time:

RECEIVED BY

METHOD OF SHIPMENT

Con' Note No:

Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

Seoil

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW
PROJECT MANAGER (PM): Ben Luffman
PROJECT ID: 2216251
SITE: Hillside Dr, Urunga P.O. NO.:
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus
MOBILE: 0404542354
PHONE: 02 66505600
EMAIL: ben.luffman@ghd.com, brian.cork@ghd.com
EMAIL INVOICE TO: (if different to report)
ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected", Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles														
28	SE013-0.4	SO				Bag/Jar		✓	✓						✓					
29	SE060-0.1					Jar						✓	✓	✓						
30	SE033-0.05					Jar						✓	✓	✓						
	~~SE DUP~~						✓	✓	✓	✓	✓						✓			
31	SE102-0-0.2							✓	✓											
32	SE031-[illegible]0.5					Bag									✓					
	~~SE RPT~~																			
33	SE054-03					Jar									✓					

4
5
6

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Daniel	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0900	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Sed 1

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM). Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 0404542354

PHONE 0266505600

EMAIL ben.luffman@ghd.com, brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report)

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY

COOLER SEAL (circle appropriate)

Intact: Yes No N/A

SAMPLE TEMPERATURE

CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles	EG008ST (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
	~~SE003 - 0.1~~	~~S~~ (double up on COC				~~X~~		✓	✓	✓							✓		
7 31	SEDUP04	Soil				Jar + bag		✓	✓	✓					✓		✓		
85	~~SE020~~ SE020 - 0.1					Jar	✓												
36	SE020 - 0.4																		
39	SE021 - 0.1										✓	✓	✓	✓					
38	SE021 - 0.3																		
34	SE030 - 0.1						✓				✓	✓	✓	✓					
49	SE030 - 0.4																		
48	SE031 - 0.1										✓								
44	SE040 - 0.4									✓	✓	✓	✓	✓			✓		
43	SE042 - 0.1																		
8 44	SE050 - 0.1					Jar + bags	✓	✓	✓	✓					✓		✓		

RELINQUISHED BY:

Name: J. Simkus	Date: 21/8/12	Name: Daniel	Date: 22/8
Of: GHD	Time:	Of: AU	Time: 0800
Name:	Date:	Name:	Date:
Of:	Time:	Of:	Time:

RECEIVED BY

METHOD OF SHIPMENT

Con' Note No:

Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

Sed 1

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 0 404542354

PHONE 0266505600

EMAIL ben.luffman@ghd.com, brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report)

FOR LABORATORY USE ONLY

COOLER SEAL (circle appropriate)

Intact: Yes No N/A

SAMPLE TEMPERATURE:

CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	Container Type / Code	Container Total bottles	EG008ST (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
9	SE050 - 0.3	soil				Jar+bag		✓	✓	✓					✓		✓		
	SEDUP 03									✓							✓		
	SE051 - 0.1									✓	✓						✓		
	SE051 - 0.4									✓							✓		
	SE052 - 0.1									✓	✓						✓		
	SE053 - 0.1					Jar+bag					✓								
	SE054 - 0.1										✓								
	SE055 - 0.1																		
	SE056 - 0.1									✓	✓						✓		
	SE057 - 0.3									✓	✓						✓		
	SE061 - 0.1									✓	✓	✓	✓	✓			✓		
	Blank																		

RELINQUISHED BY:

Name: J. Simkus	Date: 21/8/12
Of: GHD	Time:
Name:	Date:
Of:	Time:

RECEIVED BY

Name: David	Date: 22/8
Of: ALS	Time: 08:00
Name:	Date:
Of:	Time:

METHOD OF SHIPMENT

Con' Note No:

Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved: VS = VOA Vial Sulphuric Preserved; 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.

AUSTRALIAN LABORATORY SERVICES P/L

Sed'

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG008ST (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hd extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
10	~~SE064-0.1~~ SE064-0.1	SOIL				Jar+bag	✓	✓	✓	✓	✓				✓		✓		
57	SE055-0.1					Jar				✓	✓						✓		
58	SE005					Jar+bag	✓			✓	✓						✓		
59	SE014-0.1					Jar				✓	✓	✓	✓	✓			✓		
59	SE022-0.1						✓			✓	✓						✓		
60	SE022-0.3																		
61	SE043-0.3									✓	✓						✓		
62	SE064-0.1									✓	✓	✓	✓	✓			✓		
63	SE062-0.1						✓			✓	✓						✓		
64	SE062-0.3						✓			✓	✓						✓		
65	SE066-0.1							✓	✓	✓	✓						✓		
66	SE013-0.1						✓			✓	✓						✓		

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0900	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.*

AUSTRALIAN LABORATORY SERVICES P/L

Source Zone So.1

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW
PROJECT MANAGER (PM): Ben Luffman
PROJECT ID: 2216251
SITE: Hillside Dr, Urunga P.O. NO.:
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus
MOBILE: 0404542354
PHONE 0266505600
EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes / No / N/A
SAMPLE TEMPERATURE
CHILLED: Yes / No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG005T (As,Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EA150/150-H (PSA)	EA037 (ASS field screen)
67	BH031_0.0-0.2	soil	15/8			bag/jar			✓	✓
69	BH031_0.5-0.7	↓	↓			↓			✓	✓
84	BH031_1.8-2.0	↓	↓			↓			✓	✓
76	BH031_1.0-1.2	↓	↓			↓	✓	✓		
71	BH054_0.0-0.2	↓	14/8			bag				✓
73	BH054_0.7-0.9	↓	↓			↓				✓
76	BH054_1.0-1.2	↓	↓			↓				✓
74	BHDUP07	↓	16/8			↓	✓	✓		
77	BH032_0.0-0.2	↓	14/8			bag				✓
86	BH032_0.3-0.5	↓	↓			↓				✓
79	BH32_1.0-1.2	↓	↓			↓				✓
88	BHAP06	↓	16/8			↓	✓	✓		

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Source Zone So:1

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 0404542354

PHONE 0266505600

EMAIL REPORT TO: ben.luffman@ghd.com; brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com

ALS Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY

COOLER SEAL (circle appropriate)

Intact: Yes No N/A

SAMPLE TEMPERATURE

CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG005ST (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
79	BH053_0.3-0.5	soil	14/8			jar	✓	✓		✓	✓	✓	✓	✓	✓				✓	
80	BH053_1.5-1.7						✓	✓		✓	✓	✓	✓	✓	✓				✓	
81	BH053_3.2-3.5						✓	✓		✓	✓	✓	✓	✓	✓				✓	
82	BH001_0.3-0.5		16/8			Jar + bag	✓	✓	✓	✓	✓								✓	
83	BH024_0.3-0.5		14/8			jar		✓			✓	✓	✓						✓	
84	BH024_1.0-1.2							✓			✓	✓	✓						✓	
85	BH024_2.0-2.2							✓			✓	✓	✓						✓	
86	BH004_0.0-0.2		16/8					✓		✓										
		V																		

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

RELINQUISHED BY:

Name: J. Simkus Date: 21/8/12

Of: GHD Time:

Name: Date:

Of: Time:

RECEIVED BY

Name: Dan J Date: 22/8

Of: ALS Time: 0800

Name: Date:

Of: Time:

METHOD OF SHIPMENT

Con' Note No:

Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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.

AUSTRALIAN LABORATORY SERVICES P/L

Impact zone Soil

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 0 404542354

PHONE 0 266505600

EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE:
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
87	BH077_0.3-0.5	soil	14/8			Jar	✓	✓	✓	✓	✓	✓	✓	✓				✓	
88	BH077_0.5-0.7						✓	✓	✓	✓	✓	✓	✓	✓				✓	
89	BH077_1.0-1.2						✓	✓	✓	✓	✓	✓	✓	✓				✓	
90	BH077_1.5-1.7		↓			↓	✓	✓	✓	✓	✓	✓	✓	✓				✓	
91	BH084_1.0-1.2		15/8			Jar		✓	✓		✓	✓	✓					✓	
92	BH084_1.5-1.7		↓			↓		✓	✓		✓	✓	✓1					✓	
93	BH078_0.3-0.5		14/8			Jar	✓	✓		✓	✓	✓	✓					✓	
94	BH078_1.0-1.2						✓	✓		✓	✓	✓	✓					✓	
95	BH078_1.5-1.7		↓			↓	✓	✓		✓	✓	✓	✓					✓	

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	
Of: GHD	Time:	Of: ALS	0800	Con' Note No:
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

Blanks (Soil) + Rinsates (water)

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate) Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG035T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
96	TB01 (aka Trip Blank)	soil	6/8					✓												
97	TB02 (aka Trip Blank)	soil	6/8					✓												
	~~RB01~~ RB01	W																		
	~~RB02~~ RB02	"																		
	~~RB03~~ RB03	"																		
	~~RB04~~ RB04	"																		
	~~RB05~~ RB05	"																		
98	RB01	water	15/8				Analyse for total As & Sb													
99	RB02	"	15/8				"													
100	RB03	"	16/8				"													
101	RB04	"	16/8				"													
102	RB05	"	16/8				"													

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Dan J	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Stockpiles + Bricks

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005ST (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles															
103	SP01A	soil	17/8		Jar															✓	
104	SP01B	↓	↓		Jar															↓	
105	SP02	↓	↓		↓															↓	
106	SP03	↓	↓		↓															↓	
107	SPDUP01	↓	↓		↓															↓	
108	PA01	Frag	↓		Bag															↓	
109	PA02	↓	↓		↓															↓	
110	PA03	↓	↓		↓															✓	
111	BRICK01	↓	↓		↓	*		✓		✓	[redacted]										Please crush *
112	BRICK02	↓	↓		↓	*		✓		✓	[redacted]										Please crush *

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: Daniel	22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	0900	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved. VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

PASS

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY:
COOLER SEAL (circle appropriate):
Intact: Yes No N/A
SAMPLE TEMPERATURE:
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles															
113	BH001 - 0.0 - 0.2	S				Bag														✓	
114	BH001 - 0.7 - 0.9																				
115	BH001 1 - 1.2																				
116	BH002 - 1.0 - 1.2																				
117	BH002 1.2 - 1.4																				
118	BH003 0.5 - 0.7																				
119	BH003 1.0 - 1.3																				
120	BH011 - 0.1 -																				
121	BH011 - 0.3																				
122	BH011 - 0.5																				
123	BH020 - 0.0 - 0.2																				
124	BH020 - 0.3 - 0.5																			4	

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	22/8	Con' Note No:
Of: GHD	Time:	Of: AL	0800	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved, VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

PASS.

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 0404542354

PHONE 0266505600

EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG005T (Al)	EG005T (As,Sb)	EG035T (Hg)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
120	BH020 - 1.0-1.2	S				Bag														✓
121	BH028 - 0.3-0.5																			
122	BH028 - 0.8-1.0																			
123	BH029 - 0.5-0.7																			
124	BH039 - 0.5-0.7																			
125	BH046 - 0.5-0.7																			
126	BH047 - 0.0-0.2																			
127	BH022 - 0.5-0.7																			
128	BH050 - 0.2-0.4																			
129	BH052 - 0.0-0.2																			
130	BH052 - 0.5-0.7																			
131	BH052 - 1.8-2.8	↓				↓														↓

RELINQUISHED BY:

Name: J. Simkus	Date: 21/8/12	Name: David	22/8
Of: GHD	Time:	Of: AU	0800
Name:	Date:	Name:	
Of:	Time:	Of:	

RECEIVED BY

METHOD OF SHIPMENT

Con' Note No:

Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 404542354

PHONE 266505600

EMAIL ben.luffman@ghd.com, brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report)

FOR LABORATORY USE ONLY

COOLER SEAL (circle appropriate)

Intact: Yes No N/A

SAMPLE TEMPERATURE

CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG005T (Al)	EG005T (Sb)	S-2 (Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	EK026 (CN)	EG005-SDH (Hcl extractable metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))		Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
137	BH054-2.0-2.2	S				Bag													✓
138	BH052-2.3-2.5																		
139	SE001-0.4																		
140	SE014-0.4																		
	~~SE016-0.4~~																		
141	SE021-0.4																		
142	SE050-0.5																		
143	SEDUP04																		✓

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: J. Simkus	Date: 21/8/12	Name: David	Date: 22/8	Con' Note No:
Of: GHD	Time:	Of: ALS	Time: 0800	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 404542354

PHONE 266505600

EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact Yes No N/A
SAMPLE TEMPERATURE
CHILLED Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG035F (Hg)	EG020F Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Al, Sb, Fe)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
1	BH032_0.3-0.5	S	14/8/12			jar	x			x								
2	BHDUP01	S	"				x			x								
3	BH012_0.0-0.1	S	16/8/12				x			x								
4	BHDUP08	S	"				x			x								
5	BH073_1.0-1.2	S	15/8/12				x			x								
6	BH077_0.0-0.2	S	14/8/12				x			x								
7	BH077_2.0-2.2	S	"				x			x								
8	BH101_0.0-0.2	S	16/8/12				x			x								
9	BH022_0.5-0.7	S	"				x			x								
10	BH028_0.0-0.2	S	"				x			x								
11	BH028_0.3-0.5	S	"				x			x								
12	BH020_0.0-0.2	S	"				x			x								

Environmental Division
Sydney
Work Order
ES1223062

Telephone : +61-2-8784 8555

RELINQUISHED BY:

Name: B. Cork Date:25/09/2012
Of: GHD Time: 14:00
Name: Date:
Of: Time:

RECEIVED BY

Name: Frank 26-9-12
Of: ALS 0810
Name:
Of:

METHOD OF SHIPMENT

Con' Note No:
Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 404542354

PHONE 266505600

EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com

FOR LABORATORY USE ONLY

COOLER SEAL (circle appropriate)

Intact: Yes No N/A

SAMPLE TEMPERATURE

CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG035F (Hg)	EG020F Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Al, Sb, Fe)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles												
13	SE014_0.2-0.4	S	15/8/12			jar	x			x								
14	SE067_0.0-0.1	S	"				x			x								
15	SE068_0.0-0.1	S	"				x			x								
16	SE064_0.2-0.3	S	"				x			x								
17	SE001_0.4-0.6	S	14/8/12				x			x								
18	SE042_0.2-0.4	S	"				x			x								
19	SE041_0.0-0.05	S	"				x			x								
20	SE041_0.1-0.3	S	"				x			x								
21	SE050_0.4-0.6	S	15/8/12				x			x								
22	SE032_0.0-0.1	S	14/8/12				x			x								
23	SEDUP01	S	"				x			x								
24	SEDUP02	S	15/8/12				x			x								

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: B. Cork	Date: 25/09/2012	Name: Frank	26-9-12	Con' Note No:
Of: GHD	Time: 14:00	Of: ALS	0810	
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 404542354

PHONE 266505600

EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

ALS ID	SAMPLE ID	MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG035F (Hg)	EG020F- Metals Suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Al, Sb, Fe)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
25	SE003_0.2-0.4	S	16/8/12			Jar								x					
26	SE002_0.5-0.7	S	14/8/12											x					
27	SE011_0.7-0.9	S	"											x					
28	SE004_0.2-0.3	S	16/8/12											x					
29	SE004_0.4-0.6	S	"											x					
30	SE033_0.0-0.05	S	15/8/12											x					
31	SE033_0.2-0.4	S	"											x					
32	SE033_0.4-0.6	S	"											x					
33	SE063_0.0-0.1	S	"											x					
34	SE063_0.2-0.3	S	"											x					
35	SE063_0.4-0.6	S	"											x					

RELINQUISHED BY:

Name: B. Cork	Date:25/09/2012
Of: GHD	Time: 14:00
Name:	Date:
Of:	Time:

RECEIVED BY

Name:	Frank	26-9-12
Of:	ALS	0810
Name:		
Of:		

METHOD OF SHIPMENT

Con' Note No:

Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	**ANALYSIS REQUIRED including SUITES** (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate) Intact: Yes / No / N/A
SAMPLE TEMPERATURE
CHILLED: Yes / No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG035F (Hg)	EG020F Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn,Al, Sb, Fe)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
1	BH031_0.0-0.2	S	15/8/12			bag	ES1220402-011									x			Already held by ALS
2	BH031_0.5-0.7	S	"				ES1220402-012									x			
3	BH031_1.8-2.0	S	"				ES1220402-013					S706				x			
4	BH032_0.0-0.2	S	14/8/12				ES1220402-017									x			
5	BH032_0.3-0.5	S	"				ES1220402-018									x			
6	BH032_1.0-1.2	S	"				ES1220402-019									x			
7	SE013_0.3-0.5	S	16/8/12				~~ES1220402-005~~				ES1220305-28					x			
8	SE003_0.2-0.4	S	"				~~ES1220402-004~~				ES1220305-21					x			
9	SE031_0.5-0.7	S	~~14/8/12~~	16/8	12-		ES1220402-007				S706					x			

Environmental Division Brisbane
Work Order
EB1225565

Telephone : +61-7-3243 722

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: B. Cork	Date:25/09/2012	Name:		Con' Note No:
Of: GHD	Time: 14:00	Of:		
Name:	Date:	Name:		Transport Co:
Of:	Time:	Of:		

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY DOCUMENTATION

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 404542354

PHONE 266505600

EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com

EMAIL INVOICE TO: (if different to report) ben.luffman@ghd.com

Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID		MATRIX	DATE	Time	CONTAINER INFORMATION Type / Code	Total bottles	EG035F (Hg)	EG020F Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Al, Sb, Fe)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold
1	BH032_0.3-0.5	1	S						x										
2	BHDUP01	2	S						x										
3	BH012_0.0-0.1	3	S						x										
4	BHDUP08	4	S						x										
5	BH073_1.0-1.2	5	S						x										
6	BH077_0.0-0.2	6	S						x										
7	BH077_2.0-2.2	7	S						x										
8	BH101_0.0-0.2	8	S						x										
9	BH022_0.5-0.7	9	S						x										
10	BH028_0.0-0.2	10	S						x										
11	BH028_0.3-0.5	11	S						x										
12	BH020_0.0-0.2	12	S						x										

Environmental Division
Sydney
Work Order
ES1223935

Telephone : +61-2-8784 8555

RELINQUISHED BY:

Name: B. Cork	Date:25/09/2012
Of: GHD	Time:
Name:	Date:
Of:	Time:

RECEIVED BY

Name: Fadi	8/10/12
Of: ALS	3:30pm
Name:	
Of:	

METHOD OF SHIPMENT

Con' Note No:

Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 404542354

PHONE 266505600

EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com

EMAIL INVOICE TO: (If different to report) ben.luffman@ghd.com

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY

COOLER SEAL (circle appropriate)

Intact: Yes No N/A

SAMPLE TEMPERATURE

CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG035F (Hg)	EG020F Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Al, Sb, Fe)	EK026 (CN)	EN 33 (TCLP for metals)	EN60 (ASLP for metals)	EP003 (TOC)	ED007 (CEC)	EA150/150-H (PSA)	EA037 (ASS field screen)	EA029 (SPOCAS)	EA002 (pH (1:5))	Hold	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
13	SE014_0.2-0.4	S						X											
9	SE067_0.0-0.1	S	Empty	Jar				X											
14	SE068_0.0-0.1	S						X											
15	SE064_0.2-0.3	S						X											
16	SE001_0.4-0.6	S						X											
17	SE042_0.2-0.4	S						X											
9	SE041_0.0-0.05	S	Empty	Jar				X											
18	SE041_0.1-0.3	S						X											
19	SE050_0.4-0.6	S						X											
12	SE032_0.0-0.1	S	Empty	Jar				X											
20	SEDUP01	S	Empty	Jar				X											
20	SEDUP02	S	Empty	Jar				X											

RELINQUISHED BY:

Name: B. Cork	Date:25/09/2012
Of: GHD	Time:
Name:	Date:
Of:	Time:

RECEIVED BY

Name: Tash	9/10/12
Of: ALS	3:30pm
Name:	
Of:	

METHOD OF SHIPMENT

Con' Note No:

Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Fadi Soro

Fadi
8/10/9
3:30pm

From: Angelene Kumar
Sent: Monday, 8 October 2012 2:52 PM
To: Wael Saleh; Fadi Soro
Cc: Jacob Waugh
Subject: FW: Additional Analysis_Urunga
Attachments: COC - ALS_08_10_2012 submission.xls

Importance: High

Hi Fadi,

Can you please re-batch workorder ES1223062.Client requires additional analysis on a 2 day TAT.

Samples are in trays S78-S79.

Wael,

Can you please have the samples logged in for analysis of metals only for a 2 day TAT.

Thanks

*How was your customer experience? **Please send us your feedback** (click link)*

Kind regards,

Angelene Kumar
PROJECT MANAGER

ALS | Environmental Division

Address
277-289 Woodpark Road
Smithfield, NSW, 2164

PHONE +61 2 8784 8555
FAX +61 2 8784 8500

Winner of the inaugural CARE Award 2011 - Sustainable Technology & Innovation:
Reduction in Sample Volumes - Improving quality, safety, efficiency and sustainability in environmental practices



www.alsglobal.com

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From: Brian Cork [mailto:Brian.Cork@ghd.com]
Sent: Monday, 8 October 2012 11:52 AM
To: Angelene Kumar
Subject: Additional Analysis_Urunga

Hi Angelene,

Regarding these samples for ALSE Workorder : ES1223062. Are there enough samples left to run the standard metals suite as outlined in the attached COC?

I am just waiting to see if I have approval to run shorter turn around times.

Regards

Brian Cork
Senior Environmental Engineer
GHD
T: +61 2 6650 5666 | V: 225666 | M: +61 43903 7488| E: brian.cork@ghd.com
230 Harbour Drive, Coffs Harbour, NSW, 2450, Australia | http://www.ghd.com/
Water | Energy & Resources | Environment | Property & Buildings | Transportation

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SW

Subcon / Forward Lab / Split WO
Lab / Analysis: SGS
Organised By / Date:
Relinquished By / Date:
Courier:
WO No:
Attach By PO / Interim Sheet:

CHAIN OF CUSTODY DOCUMENTATION

ALS
Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE: 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~ NTLEAP@GHD.COM
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG020F (dissolved metals (As, Cd, Cr, Cu, Ni, Pb, Zn, Al, Sb, Fe))	EG020T (Total Metals) Same as dissolved as per Ben.	EG035F (Hg)	EK026G (CN)	EA015H (TDS)	EA025H (TSS)	NT-1 (Major Cations)	NT-2 (Major Anions)					Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
1	SW001	W	22/8		P, N, ~~V~~, S, H	5	X	X	X	X	X	X	X	X					
2	SW002																		
3	SW003																		
4	SW004																		
5	SW005																		
6	SW006																		
7	SW007																		
8	SW008																		
9	SW009																		
10	SWDUP01																		

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Of: GHD	Time:	Of: ALS	Time: 0930	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

Groundwater

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD	SAMPLER: J. Simkus
ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW	MOBILE: 0404542354
PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~ NTLEAP@GHD.COM
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG020F (dissolved metals (As, Cd, Cr, Cu, Ni, Pb, Zn, Al, Sb, Fe))	EG035F (Hg)	EK026G (CN)	EA015H (TDS)	EA025H (TSS)	NT-1 (Major Cations)	NT-2 (Major Anions)						Hold
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles													
11	GW004	W	22/8		P, N, ~~V~~, S, H	5 4*	X	X	X	X	X	X	X						
12	GW006																		
13	GW007																		
14	GW013																		
	GWLABDUP01																		

Discussed sample GW004 with Ben & ALS will only analyse dissolved metals
J.w 24/8/12

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

Insufficient sample...
Metals priority, (~~total~~ & dissolved)
total not needed on 'GW' samples.

Please fwd to SGS for above analysis — w/ reference — "apply credit against invoice — $400160799"

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Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

SW

CHAIN OF CUSTODY DOCUMENTATION

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PROJECT MANAGER (PM): Ben Luffman	PHONE 0266505600
PROJECT ID: 2216251	EMAIL REPORT TO: ben.luffman@ghd.com, brian.cork@ghd.com
SITE: Hillside Dr, Urunga P.O. NO.:	EMAIL INVOICE TO: (if different to report) ~~ben.luffman@ghd.com~~ NTLEAP@GHD.COM
RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

ALS Australian Laboratory Services Pty Ltd

FOR LABORATORY USE ONLY
COOLER SEAL: (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles	EG020F (dissolved metals (As, Cd, Cr, Cu, Ni, Pb, Zn, Al, Sb, Fe))	EG020T (Total Metals)	EG035F (Hg)	EK026G (CN)	EA015H (TDS)	EA025H (TSS)	NT-1 (Major Cations)	NT-2 (Major Anions)	Hold
1	SW001	W	22/8		P, N, VS, S, H	5	X	X	X	X	X	X	X	X	
2	SW002														
3	SW003														
4	SW004														
5	SW005														
6	SW006														
7	SW007														
8	SW008														
9	SW009														
10	SWDUP01														

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Of: GHD	Time:	Of: ALS	Time: 0930	
Name:	Date:	Name:	Date:	Transport Co:
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Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

AUSTRALIAN LABORATORY SERVICES P/L

Groundwater

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: GHD

ADDRESS / OFFICE: 230 Harbour Drive Coffs Harbour, NSW

PROJECT MANAGER (PM): Ben Luffman

PROJECT ID: 2216251

SITE: Hillside Dr, Urunga P.O. NO.:

RESULTS REQUIRED (Date): standard QUOTE NO.: SY/270/12

SAMPLER: J. Simkus

MOBILE: 0404542354

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ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

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Intact: Yes No N/A

SAMPLE TEMPERATURE

CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:

Notes: e.g. Highly contaminated samples
e.g. "High PAHs expected".
Extra volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		EG020F (dissolved metals (As, Cd, Cr, Cu, Ni, Pb, Zn, Al, Sb, Fe))	EG035F (Hg)	EK026G (CN)	EA015H (TDS)	EA025H (TSS)	NT-1 (Major Cations)	NT-2 (Major Anions)	Hold	
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles									
11	GW004	W	22/8		P, N, ~~V~~, S, H	5 4*	X	X	X	X	X	X	X		Insufficient sample... Metals priority, (total & dissolved)
12	GW006														
13	GW007														
14	GW013														
	GWLABDUP01														

Please fwd to SGS for above analysis — w/ reference — "apply credit against invoice - SY00160799"

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Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; 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 Bad for Acid Sulphate Soils; B = Unpreserved Bag.

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1	B. Cork	I. Gregson		I. Gregson		10/12/12

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Appendix D Supplementary Investigation Report



NSW Catchment and Lands- Crown Lands

Former Antimony Processing Plant- Urunga NSW

Detailed Investigation Report Addendum One- Supplementary Sampling Results

February 2013

Executive summary

A supplementary sampling program was completed at the site of a former antimony processing facility located at Hillside Drive, Urunga, NSW to address data gaps identified in the Detailed Investigation Report (DIR) for that site. The data was to assist in the definition of the area requiring remediation and the development of the Remediation Action Plan.

The investigation incorporated data from the DIR and a field investigation comprising an additional ten soil and 14 sediment sample locations as well as samples from a soil stockpile and two solidified cores of waste concentrate (referred to as 'mercury plugs') that were identified following completion of the detailed investigation report.

Results from the supplementary sampling and analysis were used to update the Conceptual Site Model that was developed in the DIR. Changes were made regarding the horizontal extent of the impact on the soil such that it:

- Includes moderate impact downgradient of the 'mercury plugs'.
- Includes a portion of the vegetated area between the former ore stockpile area and the tailings area.
- Does not extend beyond the boundary fence to the west of the former processing facility.
- Extends approximately 30 m west of the site boundary, south of the former processing area, but is not fully delineated in the south western portion of the site.

Changes to the CSM were made regarding the extent of the impact on the sediment such that it:

- Extends further to the south east of the tailings deposit than interpreted in the DIR.
- Shows impact in the base of the 'L' Shaped canal to be generally less than that outside of the canal.
- Is of a similar area but of a lesser magnitude in the area to the east of the 'L Shaped' canal than interpreted in the DIR.

Revised estimates of the volumes of impacted soil and sediment were as follows:

Soil (adopted assessment criteria 310 mg/kg antimony, 200 mg/kg arsenic)

- 5,800 m^3 exceeding 30 times the adopted assessment criteria.
- 14,000 m^3 (encompassing the volumes above) exceeding 10 times the adopted assessment criteria.
- 28,300 m^3 (encompassing the volumes above) exceeding the adopted assessment criteria.

Sediment (adopted assessment criteria 25 mg/kg antimony, 70 mg/kg arsenic)

- 2,600 m^3 exceeding 30 times the adopted assessment criteria.
- 4,600 m^3 (encompassing the volumes above) exceeding 10 times the adopted assessment criteria.
- 10,200 m^3 (encompassing the volumes above) exceeding the adopted assessment criteria.

Results from the stockpile (Stockpile 4) indicated relatively minor exceedances of the adopted health based assessment criteria for antimony and arsenic only.

Results from the two 'mercury plugs' indicated significantly elevated concentrations of antimony (up to 41,900 mg/kg), mercury (up to 5,840 mg/kg) and arsenic (up to 1,660 mg/kg).

Abbreviations

As	Arsenic
CN	Cyanide
CSM	Conceptual Site Model
Cr	Chromium
Cu	Copper
DIR	Detailed Investigation Report
DIR-SS	Detailed Investigation Report- Supplementary Sampling
DQO	Data Quality Objectives
EIL	Environmental Investigation Level
EPA	NSW Environment Protection Authority
EQL	Estimated Quantitation Limit
Hg	Mercury
HIL	Health Investigation Level
ISQG	Interim Sediment Quality Guideline
m	Metres
mbgs	Metres below ground surface
mg/kg	Milligrams per Kilogram
µg/L	Micrograms per Litre (generally equivalent to parts per billion)
NATA	National Association of Testing Authorities
NSW	New South Wales
OH&S or OHS	Occupational Health and Safety
Pb	Lead
PIR	Preliminary Investigation Report
PQL	Practical Quantitation Limit
RPD	Relative Percent Difference
QA	Quality Assurance
QC	Quality Control
RAP	Remediation Action Plan
Sb	Antimony
SCS	Soil Conservation Service
USCS	Unified Soil Classification System

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1. Introduction

1.1 Background

The Soil Conservation Service (SCS) has been engaged by NSW Catchment & Lands - Crown Lands (Crown Lands) to project manage the rehabilitation of a former antimony processing facility located at Hillside Drive, Urunga, NSW (the Site). GHD Pty Ltd (GHD) has been engaged to undertake a series of tasks relating to that project including

- A Preliminary Investigation Report (PIR), which has previously been completed[1] and included a data gap analysis and proposed Sampling Analysis and Quality Plan.
- A Detailed Investigation Report (DIR), which has previously been completed[2].
- A Remediation Action Plan (RAP).

Following a review of the DIR, additional sampling requirements were identified as outlined in Section 1.2 below. Those requirements have been addressed in this Detailed Investigation Report- Supplementary Sampling (DIR-SS) Report which is presented as an addendum to the DIR.

1.2 Scope and Objectives

The scope of the DIR-SS was defined in a proposal approved by the SCS (GHD 2012c) and is outlined in Section 2 below. The specific objectives of the DIR-SS were to:

- Address data gaps identified in the DIR. These included additional sampling points to define the extent and distribution of contaminants (as shown in Table 1).
- Provide an analysis of an additional soil stockpile and 'mercury plugs' identified after the completion of the DIR.
- Refine the Conceptual Site Model (CSM) developed in the DIR.

This report provides supplementary data for the DIR and assists in the definition of the area requiring remediation and the development the RAP.

[1] GHD 2012a. Former Antimony Processing Plant- Urunga, NSW. Preliminary Investigation Report. Prepared for NSW Catchment and Lands- Crown Lands, July 2012. GHD reference 2216251/15184

[2] GHD 2012b. Former Antimony Processing Plant- Urunga, NSW. Detailed Investigation Report. Prepared for NSW Catchment and Lands- Crown Lands, December 2012. GHD reference 2216251/15352

2. Detailed Investigation- Supplementary Sampling Methodology

The DIR-SS methodology was based on that used in the DIR, which was reviewed and approved by the NSW Environmental Protection Authority (EPA). A summary of the rationale and details of the sampling are provided in the following subsections.

2.1 Sampling Locations

2.1.1 Soil and Sediment

Ten soil and 14 sediment boreholes were advanced to enable an additional assessment of soil and sediment lithology and chemical parameters. Rationales for sampling locations are presented in Table 1. Generally, locations were selected to provide supplementary data to better delineate the impacted areas and provide a sampling density suitable for calculating impacted soil and sediment volume data required for the RAP. Soil and sediment sampling locations are presented in Figures 1 to 5, Appendix A.

Table 1 Supplementary Sampling Location Rationale

Area Description	Area Characteristics	Supplementary Sampling Locations
Between former ore stockpile and process areas	Limited data. Lack of vegetation suggests significant impact.	BH007
South west of processing plant and tailings area.	Little data regarding impact on neighbouring property and south western boundary. Assessment of soil in the vicinity of the 'mercury plugs' required to assess migration of contaminants.	BH102, BH103, BH104, BH105, BH106, BH107
Vegetated area between ore stockpile area and tailings area.	Dense vegetation, no indication of impact. Limited sampling.	BH085, BH086, BH087
Extremity of wetland to south east of tailings deposit.	Limited data. Significant impact exceeding 30 x sediment criteria in central area but vegetation does not show significant impact. Further delineation of extent and degree of contamination to assess remediation requirements.	SE015, SE023, SE024, SE035, SE036, SE045, SE103, SE104,
Wetland east of 'L Shaped' canal.	Limited data. Significant impact exceeding 30 x sediment criteria noted but vegetation does not show significant impact.	SE069, SE070, SE072
Base of 'L Shaped' canal	Little data. Significant depth likely to limit potential exposure. Further delineation of extent and degree of contamination to assess remediation requirements.	SE034, SE044. SE071

2.1.2 Stockpile

Two samples were taken from soil stockpile of unknown origin (SP004) to assess the levels of contamination within the stockpile which may govern the remediation options.

2.1.3 Mercury Plugs

Three samples were taken from two solidified cores of waste concentrate (referred to as 'mercury plugs') identified following the completion of the DIR to assess the levels of contaminants which may govern disposal options.

2.2 Sampling Methodology

2.2.1 General

All site work during the supplementary sampling program was completed by GHD staff on December 10 to 12, 2012. Sampling methodology as outlined in the DIR was followed during the DIR-SS including:

- Health, Safety and Environment.
- Underground service location.
- Sample location recording.
- Field documentation.
- Equipment calibration.
- Photographic records.
- Quality assurance and quality control protocols.
- Sample handling, labelling and chain of custody.

No field analysis was conducted.

2.2.2 Soil

Soil boreholes were advanced using a hand auger. Sampling was conducted as follows:

- Boreholes were advanced to the proposed investigation depth.
- Samples were collected from each discrete strata unit.
- Soils were logged according to the Unified Soil Classification System (USCS), making observations of evidence of contamination (staining or odours), as appropriate.

Borehole logs were prepared for each soil borehole location showing lithology, moisture content, sampling depths and final depth. Borelogs are presented in Appendix D.

Upon completion of drilling, the boreholes were backfilled with soil cuttings, generally replaced in the same depth order as excavated. Care was taken to avoid backfilling uncontaminated portions of the borehole with any cuttings that were potentially contaminated.

2.2.3 Sediment

Sediment samples were collected using a specifically designed, sediment sampling, push tube device which was operated from a canoe or by foot (using waders). Sample cores were divided according to observable characteristics with depth, to allow separate analysis and assessment of shallower and deeper sediments and any underlying residual soils (if present).

2.2.4 Stockpile

The stockpile was sampled using a hand auger, following similar protocols to that used for the soil sampling. Two samples were taken from one location, in the centre of the stockpile, near surface and from material from further within the stockpile. The stockpile measured approximately 4 x 3 x 0.7 m.

2.2.5 Mercury Plugs

Samples were collected from each of the 'mercury plugs' using a hammer. Samples were collected that had minimal exposure to air. Deeper samples were not taken due to Health and Safety concerns.

2.3 Analytical Schedule

The analytical schedule used in the DIR-SS is presented in Table 2.

Table 2 Analytical Schedule

Sampling area/ sample name	Analysis	Rationale
Soil boreholes (BH007, BH085, BH086, BH087, BH102, BH104, BH106, BH107)	Sb, As	Identified, indicator contaminants of concern from DIR.
Soil boreholes (BH103, BH105)	Sb, As, Al, Cd, Cr, Cu, Fe, Pb, Hg, Ni, Zn	Identified, indicator contaminants of concern from DIR plus additional metals due to proximity to 'mercury plugs'.
Sediment boreholes (SE015, SE023, SE024, SE034, SE035, SE036, SE044, SE045, SE069, SE070, SE071, SE072, SE103, SE104)	1M HCl Extractable Sb and As.	Identified, indicator contaminants of concern from DIR. Extractable metals deemed to provide greatest assessment of ecological impact.
Stockpile (SP004)	Sb, As, Al, Cd, Cr, Cu, Fe, Pb, Hg, Ni, Zn	To assess the levels of contamination within the stockpile which may govern the remediation options
Mercury plugs (MP001 and MP002)	Sb, As, Al, Cd, Cr, Cu, Fe, Pb, Hg, Ni, Zn	To assess the levels contaminants within the 'mercury plugs' which may govern the disposal options.

2.4 Assessment Criteria

Assessment criteria outlined in the DIR were used in the DIR-SS.

2.5 Quality Assurance/ Quality Control

All fieldwork and laboratory analysis was conducted following the Quality Assurance/Quality Control (QA/QC) protocols outlined in the DIR with the exception of the use of rinsate sampling and trip blanks which were not used.

3. Supplementary Sampling Results

A summary of supplementary sampling results, along with the updated, interpreted impact extent are presented in Figures 1 to 5, Appendix A. Photographs showing site conditions during sampling are presented in Appendix B. Chemical analysis results are presented in tabular form in Appendix C. Borehole logs are presented in Appendix D. Laboratory results are presented in Appendix E.

3.1 Soil

3.1.1 Lithology

Soil lithology was consistent with that noted in the DIR.

3.1.2 Chemical Analysis

A summary of the impact of contaminants on the soil, based on the supplementary sampling results includes:

- To the west of the former processing area:
  - Where sampled (BH104, BH106, BH107), the impact does not extend beyond the boundary fence.
  - The impact along the western boundary (BH101 (from DIR), BH103, BH105) is limited to a depth of approximately 0.5 metres below ground surface (mbgs).
- In the vicinity of the 'mercury plugs' (BH103 and BH105):
  - The soil downgradient of the 'plugs' was moderately impacted by antimony and arsenic with one exceedance of the adopted assessment criteria (HIL E) for mercury (BH105), to a depth of approximately 0.3 mbgs.
- In the south western portion of the Site:
  - Impact was noted to a depth of at least 0.5 mbgs, approximately 30 m west of the Site boundary (BH102). This sample was taken at the edge of the wetland during a relatively dry period. During seasonal fluctuations, the borehole location would be inundated and hence likely subject to similar contaminant transport vectors (e.g. suspended sediment or dissolved in water) as the wetland area adjacent to the tailings deposit.
  - Further sampling would be required to delineate the extent of the impact to the soil in this area.
- In the area between the former ore stockpile area and the former processing area:
  - Impact exceeded ten times the adopted assessment criteria to a depth of approximately 0.3 mbgs (BH007).
- In the vegetated area between ore stockpile area and tailings area (former gravel processing area):
  - The extent of impact was noted to extend into the north western portion of the vegetated area (BH085 and BH086) with minor exceedances of the adopted threshold criteria.
  - The vertical extent of the impact was noted to be to approximately 0.2 mbgs.
  - The concentrations of contaminants in the south eastern portion of the vegetated area (BH030, BH087, BH041), were less than the adopted threshold criteria.

3.2 Sediment

3.2.1 Lithology

In summary, observations relating to sediment lithology include:

- Sediment lithology was generally consistent with that noted in the DIR.
- The grey layer that is interpreted to be sediment from the tailings deposit was evident in the area adjacent to the tailings deposit (SE023) but more difficult to discern with increasing distance from the tailings deposit, in all directions.
- Clay was noted at a depth of approximately 0.05 to 0.35 mbgs in the base of the 'L' Shaped canal (SE034, SE044 and SE071). The depth of water at the time of sampling, in the 'L' Shaped canal varied from approximately 2.4 to 2.7 m.

3.2.2 Chemical Analysis

In summary, the supplementary sampling results for antimony in the sediment showed that:

- The interpreted extent of impact in the area to the south-west of the tailing deposit (SE103 and SE104) was confirmed to be similar to that interpreted in the DIR.
- The extent of impact to the south east of the tailings deposit:
  - Was confirmed to exceed 30 times the assessment criteria to a depth of approximately 0.3 mbgs (SE023) but was found to extend further east (SE035) than interpreted in the DIR.
  - Was found to have an impact exceeding ten times the adopted assessment criteria that extended further east (SE036) than interpreted in the DIR.
  - Was found to have an interpreted impact exceeding the adopted threshold criteria that extended to the southern perimeter of the wetland (SE015, SE024, SE045). The depth of impact in this area was interpreted to be approximately 0.1 mbgs, based on samples taken during the DIR.
- The impact to the east of the 'L' Shaped canal was confirmed to exceed ten times the assessment criteria (SE069, SE070, SE072). This data also reduced the interpreted extent of the area exceeding 30 times the assessment criteria (SE062, from the DIR).
- The impact in the base of the 'L' Shaped canal (SE034, SE044, SE071) was generally less than that outside of the canal.

In summary, the supplementary sampling results for arsenic in the sediment showed that the interpreted extent of the impact in the DIR was confirmed with the exception of:

- The samples taken from the base of the 'L' Shaped canal which were less than the adopted assessment criteria.
- The area to the east of the 'L' Shaped canal which was noted to exceed the assessment criteria but be below ten times the assessment criteria.

3.3 Stockpile

One stockpile (Stockpile 4, photo 10, Appendix B) was identified following completion of the DIR. The stockpile measured approximately 4 x 3 x 0.7 m and contained soil material of unknown origin. The soil from the stockpile was analysed for metals. Results (Table C1, Appendix C) indicate relatively minor exceedances of the adopted assessment criteria for antimony and arsenic only. The metal concentrations and COCs in the stockpile were similar to

those found in the surrounding area, indicating the stockpile may have been created via scraping of surface material in that area.

3.4 Mercury plugs

Two 'mercury plugs' were identified following completion of the DIR and are shown in Photos 11 and 12, Appendix B. The 'plugs' are approximately 1.2 m in diameter and approximately 0.7 to 1.5 m in height. Anecdotal information suggests the plugs were formed by the collection of waste concentrate in steel drums or cylinders within the processing plant. The drums or steel cylinders have since corroded completely away. The location of the plugs is shown in Figure 2, Appendix A.

Analytical results, presented in Table C1, Appendix C show:

- Antimony concentrations up to 41,900 mg/kg.
- Mercury concentrations up to 5,840 mg/kg.
- Arsenic concentrations up to 1,660 mg/kg.
- Other analytes concentrations less than the adopted assessment criteria.
- Relatively consistent analyte concentrations in the four locations sampled.

As noted in Section 3.1.2, the soil downgradient of these 'plugs' was moderately impacted by antimony and arsenic with one exceedance of the adopted assessment criteria (HIL E) for mercury (BH105), to a depth of approximately 0.3 mbgs.

3.5 Data Quality Analysis

3.5.1 Field QA/QC Programme

All fieldwork was conducted in general accordance with standard GHD Field Operation Procedure and QA/QC program used in the DIR including decontamination procedures, sample identification procedures, information requirements for soil bore logs, chain of custody information and sample duplicate frequency.

3.5.2 Precision

Results for Relative Percent Differences (RPDs) between duplicate samples are presented in Table C3, Appendix C.

RPDs were less than 35% for all samples with the exception of antimony (SEDUP21) and arsenic (SEDUP20). The results were consistent with the degree of variability found in the DIR and are likely due to the non-homogenous nature of the soil and sediment.

Given the non-homogenous nature of the soil and sediment; the duplicate data indicates that the field QA/QC is of an acceptable quality for the assessment of the soil and sediment in relation to impacts from the historic site activities and the development of remediation options.

3.5.3 Accuracy

The National Association of Testing Authorities (NATA) certified laboratory QA/QC sheets, as presented in Appendix E, refer to a QC program comprising the analysis of spikes, method blanks, surrogates, holding times and duplicate samples.

No QA/QC non-compliances were noted in the laboratory reports.

Based on a review of the laboratory QA / QC data, it is considered that the analytical results are reasonably representative of analyte concentrations at the time of the investigation.

4. Updated Conceptual Site Model

The following Updated CSM has been developed, based on information obtained from the CSM in the DIR and data obtained from the results presented in Section 0.

Details regarding the following factors were not changed from the CSM in the DIR:

- Site Description.
- Vertical extent of contamination in the soil or sediment.
- Hydrology.
- Hydrogeology.
- Groundwater and surface water contamination levels.
- Contaminants of Concern.
- Key contaminant properties.
- Contaminant media and fate.
- Exposure pathways.
- Contaminant receptors.
- Contaminant concentration/time relationship.

CSM characteristics that have been updated as a result of the supplementary investigation results are summarised in the following subsections.

4.1 Contaminant Delineation

The updated, interpreted extent of the contamination in the soil and sediment is presented in Figures 1 to 5, Appendix A.

Changes to the CSM were made regarding the horizontal extent of the impact on the soil such that it:

- Includes moderate impact downgradient of the ‘mercury plugs’.
- Includes a portion of the vegetated area between the former ore stockpile area and the tailings area.
- Does not extend beyond the boundary fence to the west of the former processing facility.
- Extends approximately 30 m west of the site boundary, south of the former processing area, but is not fully delineated in the south western portion of the site.

Changes to the CSM were made regarding the extent of the impact on the sediment such that it:

- Extends further to the south east of the tailings deposit than interpreted in the DIR.
- Shows impact in the base of the ‘L’ Shaped canal to be generally less than that outside of the canal. This suggests that the canal was excavated after the main migration of impact into the wetland as previously suggested in the DIR.
- Is of a similar area but of a lesser magnitude in the area to the east of the ‘L Shaped’ canal than interpreted in the DIR.

4.2 Estimated Volume of Impacted Soil and Sediment

Based on the supplementary sampling results, updated estimated volumes of impacted soil and sediment are shown in Figures 6 and 7. As in the DIS, the results are deemed to be conservative in that the vertical extent of the impact was based on limited data (being samples that were advanced to a depth where no impact was identified) and it was assumed that contaminant impacts at the perimeter of an impacted area were at the same depth of impact noted at locations within and adjacent to that perimeter, rather than tapering up to the surface from those locations.

5. Conclusion

A supplementary sampling program was completed at the site of a former antimony processing facility located at Hillside Drive, Urunga, NSW to address data gaps identified in the DIR for that site. The data was to assist in the definition of the area requiring remediation and the development the RAP.

The investigation incorporated data from the DIR and a field investigation comprising an additional ten soil and 14 sediment sample locations as well as samples from a soil stockpile and two 'mercury plugs' that were identified following completion of the DIR.

Results from the supplementary sampling and analysis were used to update the CSM that was developed in the DIR. Changes were made regarding the horizontal extent of the impact on the soil such that it:

- Includes moderate impact downgradient of the 'mercury plugs'.
- Includes a portion of the vegetated area between the former ore stockpile area and the tailings area.
- Does not extend beyond the boundary fence to the west of the former processing facility.
- Extends approximately 30 m west of the site boundary, south of the former processing area, but is not fully delineated in the south western portion of the site.

Changes to the CSM were made regarding the extent of the impact on the sediment such that it:

- Extends further to the south east of the tailings deposit than interpreted in the DIR.
- Shows impact in the base of the 'L' Shaped canal to be generally less than that outside of the canal.
- Is of a similar area but of a lesser magnitude in the area to the east of the 'L Shaped' canal than interpreted in the DIR.

Revised estimates of the volumes of impacted soil and sediment were as follows:

Soil (adopted assessment criteria 310 mg/kg antimony, 200 mg/kg arsenic)

- 5,800 m^3 exceeding 30 times the adopted assessment criteria.
- 14,000 m^3 (encompassing the volumes above) exceeding 10 times the adopted assessment criteria.
- 28,300 m^3 (encompassing the volumes above) exceeding the adopted assessment criteria.

Sediment (adopted assessment criteria 25 mg/kg antimony, 70 mg/kg arsenic)

- 2,600 m^3 exceeding 30 times the adopted assessment criteria.
- 4,600 m^3 (encompassing the volumes above) exceeding 10 times the adopted assessment criteria.
- 10,200 m^3 (encompassing the volumes above) exceeding the adopted assessment criteria.

Results from the stockpile (Stockpile 4) indicated relatively minor exceedances of the adopted health based assessment criteria for antimony and arsenic only.

Results from the two 'mercury plugs' indicated significantly elevated concentrations of antimony (up to 41,900 mg/kg), mercury (up to 5,840 mg/kg) and arsenic (up to 1,660 mg/kg).

6. Limitations

This report: has been prepared by GHD for NSW Catchment and Lands- Crown Lands and may only be used and relied on by NSW Catchment and Lands- Crown Lands for the purpose agreed between GHD and the NSW Catchment and Lands- Crown Lands as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than NSW Catchment and Lands- Crown Lands arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report in part on the basis of information provided by various third parties. GHD has not independently verified or checked beyond the agreed scope of work and does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

This Report should be read in full and no excerpts are taken to be representative of the findings of this Report.

7. References

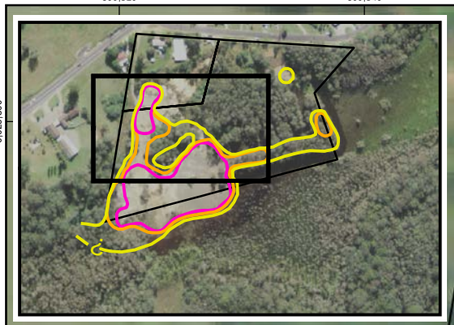
GHD 2012a. Former Antimony Processing Plant- Urunga, NSW. Preliminary Investigation Report. Prepared for NSW Catchment and Lands- Crown Lands, GHD Document 15184. July 2012.

GHD 2012b. Former Antimony Processing Plant- Urunga, NSW. Detailed Investigation Report. Prepared for NSW Catchment and Lands- Crown Lands, GHD Document 15352. December 2012.

GHD 2012c. Urunga Antimony Processing Plant Investigation and Remediation Additional Sampling and Analysis Fee Proposal, presented to Soil Conservation Service. GHD Document 15424. December 2012.

Appendices

Appendix A - Figures



Legend

Samples

- (Value less than assessment criteria
- Value exceeds assessment criteria
- ! Value exceeds 10X assessment criteria
- ! Value exceeds 30X assessment criteria
- Interpreted extent of impact exceeding assessment criteria
- Interpreted extent of impact exceeding 10X assessment criteria
- Interpreted extent of impact exceeding 30X assessment criteria
- Approx. Wetland Boundary

BH028		Sb	As
0-0.2	L	12,600	**5000**
0.3-0.5	L	978	**599**
0.8-1	X	-	13.67

BH001		Sb	As
0-0.2	X	12,250	**3416**
0.3-0.5	L	3660	**1520**
0.7-0.9	X	<415	**26.86**
1-1.2	X	239.4	**200.3**

DLWC97-S2		Sb	As
0.15-0.25	L	3410	**478**

BH040		Sb	As
0-0.2	X	350.8	**140.9**
0.3-0.5	X	<16.23	4.51

BH085		Sb	As
0-0.1	L	506	**184**

BH050		Sb	As
0-0.2	X	1173	**165.3**
0.5-0.7	X	<21.25	<5.18
1-1.2	X	<16.04	**42.35**

BH021		Sb	As
0-0.2	X	2842	**790.7**

BH002		Sb	As
0-0.2	X	2053	**264.9**
0.5-0.7	L	<5	<5
1-1.2	X	20.62	14.48

BH086		Sb	As
0.1	L	767	**171**

BH087		Sb	As
0-0.1	L	156	**44**
0.3-0.4	L	75	**20**

BH007		Sb	As
0-0.1	L	3140	**1370**
0.3-0.5	L	37	**21**

BH052		Sb	As
0-0.2	X	13,650	**3917**
0.5-0.7	X	13,470	**7019**
1-1.2	X	<681	**1141**
1.8-2	X	2079	**2211**
2.3-2.5	X	258.2	**698.6**
2.8-3	X	65.03	**223.5**

DECC08May-S015		Sb	As
0-0.01	X	1388	**291**

BH077		Sb	As
0-0.2	L	388	**432**
0.3-0.5	L	93	**157**
1-1.2	L	36	**156**
1.5-1.7	L	882	**2130**
2-2.2	L	144	**165**

BH022		Sb	As
0-0.2	X	1000	**232.8**
0.5-0.7	L	544	**132**

BH031		Sb	As
0-0.2	X	10,830	**4413**
0.5-0.7	X	9164	**1386**
1-1.2	L	9670	**5280**
1.8-2	X	125.2	**1180**

DLWC97-S3		Sb	As
0.2-0.3	L	6150	**6250**
0.8-0.9	L	6550	**3610**
1.9-2	L	2	6.6

DECC08May-S014		Sb	As
0-0.01	X	19,100	**7170**

DLWC97-S16		Sb	As
0.16-0.26	L	32	**1870**
0.55-0.65	L	110	**233**
0.75-0.85	L	12,400	**9820**

BH104		Sb	As
0-0.1	L	169	**24**
0.3-0.5	L	65	15

BH003		Sb	As
0-0.2	X	9378	**1152**
0.5-0.7	X	<16.78	8.01
1-1.2	X	<15.62	<3.5

DECC08May-S012		Sb	As
0-0.01	X	12,160	**6226**

DECC08May-S013		Sb	As
0-0.01	X	21,850	**10,260**

DLWC95-S9		Sb	As
0-0.1	L	7843	**5041**

DLWC97-S4		Sb	As
0.28-0.38	L	6780	**5950**
1-1.1	L	9020	**6970**
1.2-1.3	L	3110	**1980**

DECC08May-S011		Sb	As
0-0.01	X	12,450	**9193**

DLWC97-S19		Sb	As
0-0.1	L	360	**309**

BH029 BH066 Coffey04-SA7 DECC08Nov-S004 Coffey04-SA6 BH046 Coffey04-SA5 BH056 Coffey04-SA4 DECC08Nov-S003 BH061 DECC08Nov-S007 BH047 DLWC97-S1 DECC08Nov-S001 DECC08Nov-S002 BH069 BH020 SP004 BH060 BH057 DECC08Nov-S008 BH076 BH100 BH041 BH030 SP01A SP01B SP002

500,820 500,840 500,860 500,880 500,900 500,920 500,940 500,960 500,980 501,000

6,625,300 6,625,280 6,625,260 6,625,240 6,625,220 6,625,200

1:500 Paper Size A3

0 2.5 5 10 15 20

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

O

Sample Ident. — BH028 | Sb | As | 0-0.2 | L | 12,600 | 5000 | 0.3-0.5 | L | 978 | 599 | 0.8-1 | X | - | 13.67 — Antimony conc. (mg/kg); Arsenic conc. (mg/kg); Sample depth; Data source X=XRF L=Laboratory

- Value less than assessment criteria
- Value exceeds assessment criteria
- Value exceeds 10X assessment criteria
- Value exceeds 30X assessment criteria
- Supplementary sampling location
- Property Boundary

GHD

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga NSW
Supplementary Investigation Report

Job Number 22-16251
Revision A
Date 11 Feb 2013

Soil Sampling Locations with Antimony and Arsenic Concentrations (NW Portion)

Figure 01

G:\22\16251\GIS\GIS_from_Bne_jvc\Maps\Deliverables\Supplementary Investigation\22_16251_01_SoilNWportion_revB.mxd

© 2013. Whilst every care has been taken to prepare this map, GHD, DECC ,DLWC ,Coffey,DPI make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: DPI, Aerials, 2012. DWLC, Bores/1995,1997. Coffey, Bores/2004. DECC, Bores/2008. GHD,Bores,Wetland Boundary,(Digitized)/2012. Created by:sldouglas

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BH104		Sb	As
0-0.1	L	169	**24**
0.3-0.5	L	65	15

BH003		Sb	As
0-0.2	X	9378	**1152**
0.5-0.7	X	<16.78	8.01
1-1.2	X	<15.62	<3.5

DLWC95-S9		Sb	As
0-0.1	L	7843	**5041**

DECC08May-S011		Sb	As
0-0.01	X	12,450	**9193**

BH031		Sb	As
0-0.2	X	10,830	**4413**
0.5-0.7	X	9164	**1386**
1-1.2	L	9670	**5280**
1.8-2	X	125.2	**1180**

DECC08May-S013		Sb	As
0-0.01	X	21,850	**10,260**

DLWC97-S4		Sb	As
0.28-0.38	L	6780	**5950**
1-1.1	L	9020	**6970**
1.2-1.3	L	3110	**1980**

DECC08May-S012		Sb	As
0-0.01	X	12,160	**6226**

DECC08Nov-S013		Sb	As
0-0.01	X	340,800	**39,410**

DECC08May-S010		Sb	As
0-0.01	X	9245	**4191**

BH023		Sb	As
0-0.1	6900	L 12,400	**69,000**
0-0.2	X	4277	**1453**
0.5-0.7	L	8650	**4110**

DECC08May-S016		Sb	As
0-0.01	X	11,990	**3368**

DLWC97-S5		Sb	As
0.07-0.17	L	4980	**8740**
0.5-0.6	L	5170	**3340**
1-1.1	L	5920	**2130**

DLWC95-S10		Sb	As
0-0.1	L	10,590	**7582**
0.2-0.3	L	5882	**6352**
0.7-0.8	L	1186	**3648**

DLWC97-S7		Sb	As
0.27-0.37	L	2560	**3000**
1-1.1	L	943	**891**

BH106		Sb	As
0-0.1	L	82	14

DLWC97-S10		Sb	As
0.4-0.5	L	58	**36**
1-1.1	L	1370	**236**
1.5-1.6	L	3280	**77**

DLWC97-S11		Sb	As
0.2-0.3	L	4660	**1850**
1-1.1	L	566	**47**
1.4-1.5	L	2480	**1160**

BH039		Sb	As
0-0.2	X	2485	**1262**
0.5-0.7	X	20.32	**221.2**
1-1.2	X	444.4	**155**
1.5-1.7	X	6494	**945.2**
2-2.2	X	2967	**103.8**
2.2-2.4	X	<14.18	**53.55**

DLWC95-S8		Sb	As
0.3-0.36	L	7157	**4262**
0.7-0.8	L	1029	**279**

DECC08Nov-S012		Sb	As
0-0.01	X	20,250	**3097**

DLWC95-S1		Sb	As
0-0.1	L	9020	**2671**
0.4-0.5	L	7059	**3596**
0.6-0.7	L	9020	**4897**

BH053		Sb	As
0-0.2	X	11,070	**11,930**
0.3-0.5	L	5320	**3560**
1-1.2	X	569.3	**726.7**
1.5-1.7	L	150	**1330**
2-2.2	X	825.3	**568.4**
3.2-3.5	L	23	**80**

BH101		Sb	As
0-0.2	L	5400	**2540**
0.5-0.7	X	71.23	**34**
1-1.2	X	56.77	13.56

DLWC97-S8		Sb	As
0.05-0.15	L	2340	**1550**
1.5-1.6	L	32	**25**

DECC08May-S004		Sb	As
0-0.01	X	24,200	**7536**

DECC08May-S003		Sb	As
0-0.01	X	26,000	**5980**

DLWC97-S9		Sb	As
0.2-0.3	L	7360	**1510**
1.15-1.25	L	32	12

BH004		Sb	As
0-0.2	L	4700	**1950**
0.5-0.7	X	<17.01	<3.8
1-1.2	L	2050	**1160**
1.5-1.7	X	218.6	**76.3**
2-2.2	X	56.49	**43.78**

DECC08May-S001		Sb	As
0-0.01	X	6813	**1866**

DECC08May-S002		Sb	As
0-0.01	X	12,680	**4557**

DECC08May-S005		Sb	As
0-0.01	X	26,490	**5914**

DLWC97-S17		Sb	As
0-0.1	L	7990	**5080**

BH103		Sb	As
0-0.1	L	4120	**343**
0.3-0.5	L	17	**442**

DECC08Nov-S009		Sb	As
0-0.01	X	17,960	**3381**

DLWC97-S13		Sb	As
0.2-0.3	L	4760	**2410**
0.7-0.8	L	56	**26**

DECC08May-S006		Sb	As
0-0.01	X	46,330	**14,030**

DLWC95-S3		Sb	As
1.1-1.2	L	69	**37**
0.2-0.3	L	2745	**1194**
0.65-0.75	L	7647	**306**
0.8-0.85	L	549	**332**

DLWC97-S14		Sb	As
0.1-0.2	L	3640	**929**

DECC08May-S007		Sb	As
0-0.01	X	12,590	**4126**

BH054		Sb	As
0-0.2	X	11,960	**1019**
0.3-0.5	X	13,710	**2085**
1-1.2	X	484.5	**483.6**
1.5-1.7	X	<12.9	**86.59**

BH107		Sb	As
0-0.1	L	60	**23**
0.2-0.3	L	22	16

DECC08May-S008		Sb	As
0-0.01	X	12,800	**2935**

DLWC95-S2		Sb	As
0-0.1	L	7843	**3527**
0.2-0.3	L	5784	**3048**
0.4-0.5	L	10,490	**3022**
0.5-0.55	L	48	**45**
0.8-1	L	15	**485**

BH105		Sb	As
0-0.1	L	1190	**279**
0.3-0.5	L	134	18

DECC08May-S009		Sb	As
0-0.01	X	20,720	**3005**

DLWC97-S18		Sb	As
0-0.1	L	4260	**3430**

BH043		Sb	As
0-0.2	X	9818	**4841**
0.3-0.5	X	10,090	**2938**
1-1.2	X	311.2	**528.3**
1.5-1.7	X	353.6	**576**

BH010		Sb	As
0-0.2	X	509.1	**191.6**
0.3-0.5	X	4479	**83.45**
1-1.2	X	<16.01	3.82
1.5-1.8	X	<15.5	6.05

BH032		Sb	As
0-0.2	X	6405	**1644**
0.3-0.5	L	6070	**3620**
1-1.2	X	870	**597**
1.5-1.8	X	<11.72	**67.38**

BH042		Sb	As
0-0.2	X	16,490	**4982**
0.3-0.5	X	4213	**1337**
1-1.2	X	131.9	**770.8**
1.5-1.7	X	<11.3	16.15

DLWC95-S6		Sb	As
0-0.1	L	6569	**2869**
0.15-0.2	L	3137	**738**
0.4-0.5	L	17,160	**1229**

BH024		Sb	As
0-0.2	X	10,150	**2397**
0.3-0.5	L	6640	**4050**
1-1.2	L	192	**130**
1.5-1.8	X	<11.67	**277.3**
2-2.2	L	31	**33**

DECC08Nov-S010		Sb	As
0-0.01	X	15,970	**4878**

DLWC95-S4		Sb	As
0-0.1	L	11,670	**2910**
0.4-0.48	L	1863	**655**
0.8-0.9	L	9118	**1557**

DLWC97-S6		Sb	As
0.24-0.34	L	3330	**3120**
0.55-0.65	L	4020	**1590**
0.9-1	L	960	**629**

DLWC95-S7		Sb	As
0-0.1	L	549	**184**
0.2-0.3	L	169	**82**
0.6-0.7	L	11,180	**266**
0.7-0.8	L	6275	**504**

DECC08Nov-S011		Sb	As
0-0.01	X	922	**87**

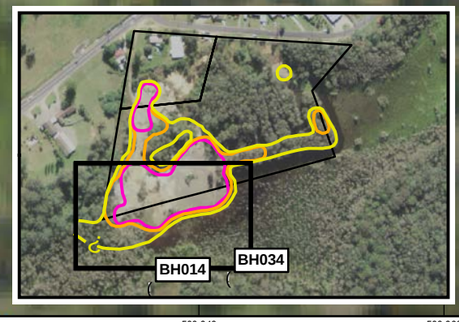
DLWC97-S12		Sb	As
0.1-0.2	L	475	**36**
0.7-0.8	L	2830	**60**

BH102		Sb	As
0-0.1	L	1830	**30**
0.3-0.5	L	632	**88**

BH006		Sb	As
0-0.3	L	1950	**702**

DLWC95-S5		Sb	As
0-0.1	L	2010	**197**

BH005		Sb	As
0-0.2	X	<19.47	19.09
0.3-0.5	X	3312	**372.6**
1-1.2	X	4206	**278.9**
1.5-1.8	X	1197	**367.6**
2-2.2	X	99.63	**149.6**



Legend

Samples

- (Value less than assessment criteria
- ! Value exceeds assessment criteria
- ! Value exceeds 10X assessment criteria
- ! Value exceeds 30X assessment criteria
- Interpreted extent of impact exceeding assessment criteria
- Interpreted extent of impact exceeding 10X assessment criteria
- Interpreted extent of impact exceeding 30X assessment criteria
- Approx. Wetland Boundary

1:500 Paper Size A3

0 2.5 5 10 15 20

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

0

Sample Ident. — BH028 | Sb | As | — Antimony conc. (mg/kg)

BH028		Sb	As
0-0.2	L	12,600	**5000**
0.3-0.5	L	978	**599**
0.8-1	X	-	13.67

Arsenic conc. (mg/kg)

Sample depth — Data source X=XRF, L=Laboratory

- Value less than assessment criteria
- Value exceeds assessment criteria
- Value exceeds 10X assessment criteria
- Value exceeds 30X assessment criteria
- Supplementary sampling location
- Property Boundary

GHD

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga NSW
Supplementary Investigation Report

Job Number 22-16251
Revision A
Date 11 Feb 2013

Soil Sampling Locations with Antimony and Arsenic Concentrations (SE Portion)

Figure 02

G:\22\16251\GIS\GIS_from_Bne_jvc\Maps\Deliverables\Supplementary Investigation\22_16251_02_SoilSWportion_revB.mxd

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Data source: DPI, Aerials, 2012. DWLC, Bores/1995,1997. Coffey, Bores/2004. DECC, Bores/2008. GHD,Bores,Wetland Boundary,(Digitized)/2012. Created by:sldouglas

230 Harbour Drive Coffs Harbour NSW 2450 **T** 61 2 6650 5600 **F** 61 2 6652 6021 **E** cfsmail@ghd.com **W** www.ghd.com.au

501,020 501,040 501,060 501,080 501,100 501,120 501,140 501,160 501,180 501,200

6,625,320 6,625,300 6,625,280 6,625,260 6,625,240 6,625,220

BH070 BH071 DLWC97-S21 BH080 BH074 BH081 BH079 BH075 DLWC97-S20

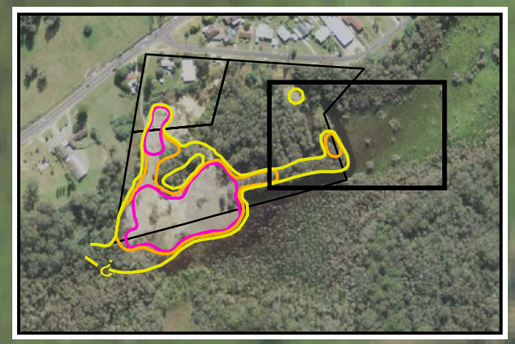
BH073		Sb	As
0-0.2	L	295	**496**
0.5-0.7	L	405	**416**
1-1.2	L	72	13

BH084		Sb	As
0-0.2	X	<15.44	10.73
0.5-0.7	X	<15.76	8.1
1-1.2	L	2730	**518**
1.5-1.7	L	3220	**387**

BH083		Sb	As
0-0.2	X	<16.17	17.31
0.3-0.5	X	<15.15	6.11
1-1.2	X	790.3	**215.5**
1.5-1.7	X	<12.1	**162.6**

BH082		Sb	As
0-0.2	X	<15.5	5.1
0.3-0.5	X	<16.24	10.45
1-1.2	X	<15.59	9.29
1.5-1.7	L	92	**1510**

BH078		Sb	As
0-0.2	X	<15.02	11.97
0.3-0.5	X	619.4	**140.5**
1-1.2	X	944.6	**431.6**
1.5-1.7	X	<13.22	**53.14**



Legend

Samples

- (Value less than assessment criteria
- ! Value exceeds assessment criteria
- ! Value exceeds 10X assessment criteria
- ! Value exceeds 30X assessment criteria
- Interpreted extent of impact exceeding assessment criteria
- Interpreted extent of impact exceeding 10X assessment criteria
- Interpreted extent of impact exceeding 30X assessment criteria
- Approx. Wetland Boundary

1:500 Paper Size A3

0 2.5 5 10 15 20

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

O

Sample Ident. — BH028 | Sb | As — Antimony conc. (mg/kg) — Arsenic conc. (mg/kg)

BH028		Sb	As
0-0.2	L	12,600	**5000**
0.3-0.5	L	978	**599**
0.8-1	X	-	13.67

Sample depth — Data source X=XRF L=Laboratory

- Value less than assessment criteria
- Value exceeds assessment criteria
- Value exceeds 10X assessment criteria
- Value exceeds 30X assessment criteria
- Property Boundary

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Supplementary Investigation Report

Job Number 22-16251
Revision A
Date 11 Feb 2013

Soil Sampling Locations with Antimony and Arsenic Concentrations (Eastern Portion) Figure 03

G:\22\16251\GIS\GIS_from_Bne_jvc\Maps\Deliverables\Supplementary Investigation\22_16251_03_SoilEstportion_revB.mxd

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Legend

- Leachable Antimony - Value less than assessment criteria
- Extractable Antimony - Value less than assessment criteria
- Extractable Antimony - Value exceeds assessment criteria
- Extractable Antimony - Value exceeds 10X assessment criteria
- Extractable Antimony - Value e xceeds 30X assessment criteria
- Total Antimony - Value less than assessment criteria
- Total Antimony - Value exceeds assessment criteria
- Total Antimony - Value exceeds 10X assessment criteria
- Total Antimony - Value exceeds 30X assessment criteria
- Interpreted extent of sediment exceeding assessment criteria
- Interpreted extent of sediment exceeding 10X assessment criteria
- Interpreted extent of sediment exceeding 30X assessment criteria
- Approx. Wetland Boundary
- Property Boundary

SE068 SE057 SE056 SE067 SE069 SE070 SE066 SE055 SE071 SE062 SE053 SE054 SE052 SE072 SE064 SE051 SE050 SE061 SE044 SE040 SE041 SE043 SE034 SE042 SE030 SE045 SE031 SE032 SE035 SE036 SE010 SE021 SE023 SE011 SE012 SE001 SE013 SE003 SE022 SE002 SE005 SE024 SE102 SE103 SE004 SE015 SE104 SE014

1:1,250 Paper Size A3

0 5 10 20 30 40 50

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

O

NOTE:
Concentrations shown for the shallowest sample only (generally 0.0m to 0.1m)

SE XXX Supplementary Sediment Sampling Location

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga NSW
Supplementary Investigation Report

Job Number	22-16251
Revision	A
Date	11 Feb 2013

Sediment Antimony Concentrations

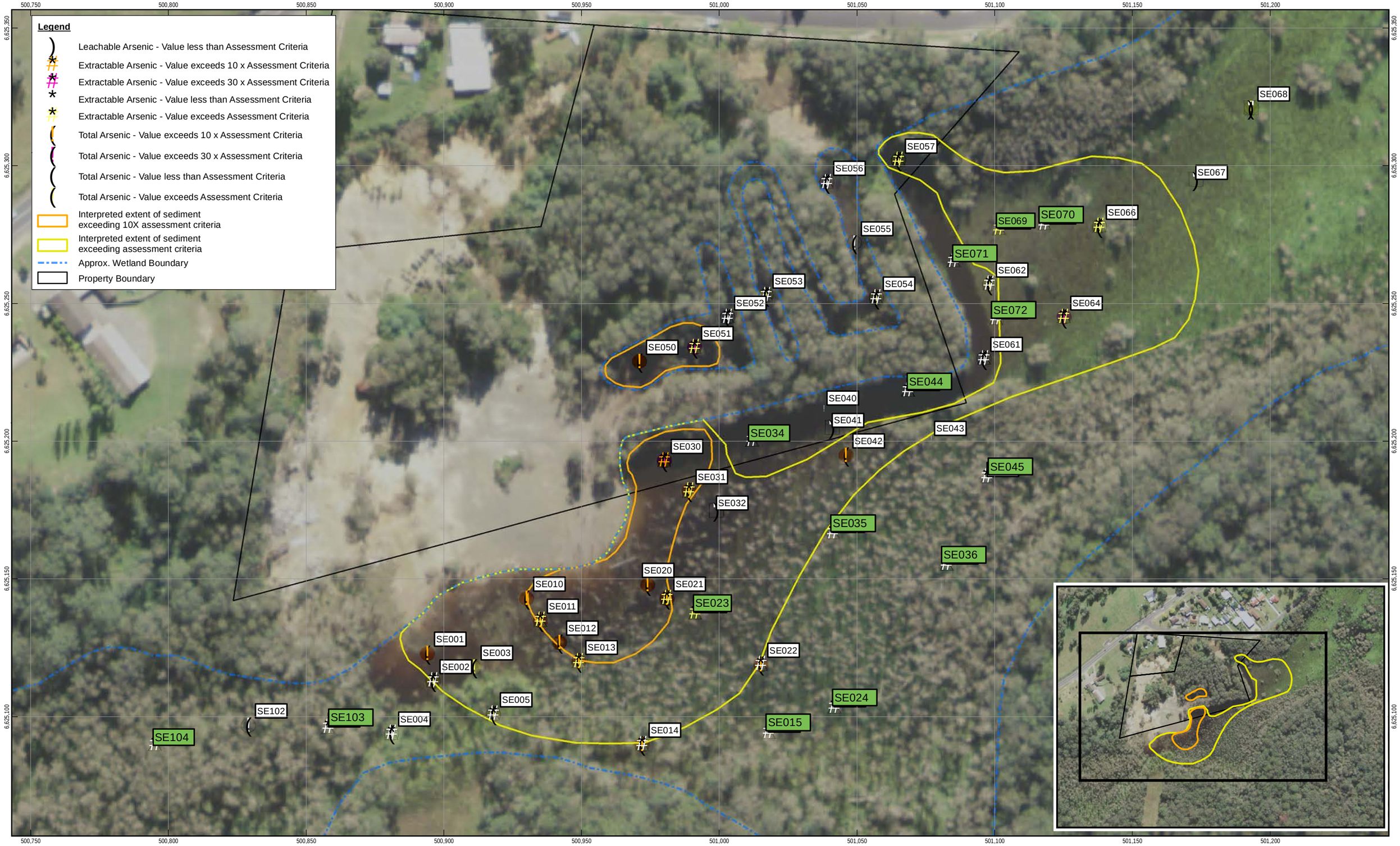
Figure 04

G:\22\16251\GIS\GIS_from_Bne_jvc\Maps\Deliverables\Supplementary Investigation\22_16251_04_SedimentAntimony_revB.mxd

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0 5 10 20 30 40 50

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

O

NOTE:
Concentrations shown for the shallowest sample only (generally 0.0m to 0.1m)

SE XXX Supplementary Sediment Sampling Location

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Former Antimony Processing Plant, Urunga NSW
Supplementary Investigation Report

Job Number	22-16251
Revision	A
Date	11 Feb 2013

Sediment Arsenic Concentrations

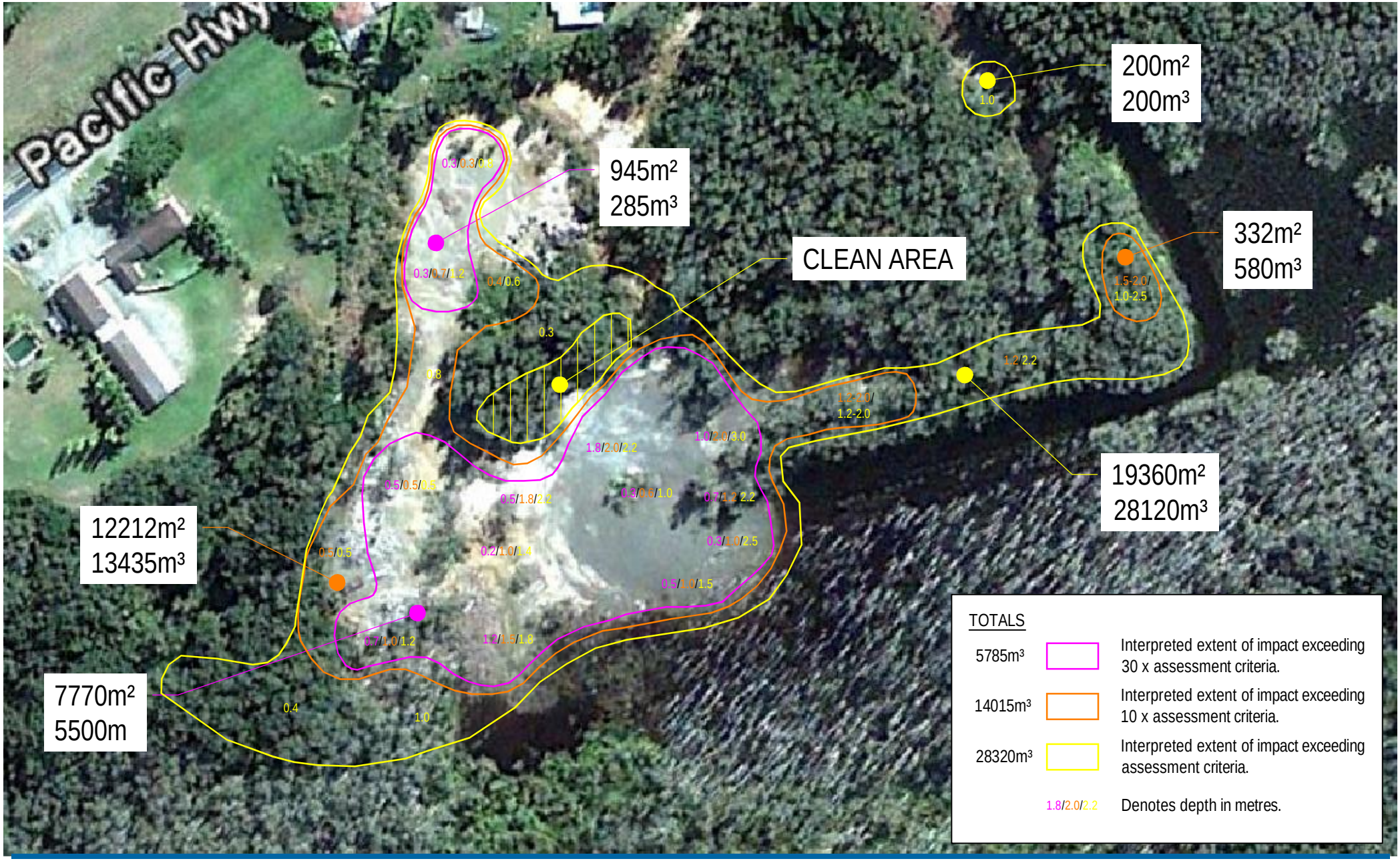
Figure 05

G:\22\16251\GIS\GIS_from_Bne_jvc\Maps\Deliverables\Supplementary Investigation\22_16251_05_SedimentArsenic_revB.mxd

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Data source: DPI, Aerials, 2012. DWLC, Bores/1995,1997. Coffey, Bores/2004. DECC, Bores/2008. GHD,Bores,Wetland Boundary,(Digitized)/2012. Created by:sldouglas

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N

NSW Catchment & Lands - Crown Lands
Former Antimony Processing Plant - Urunga
Detailed Investigation Report

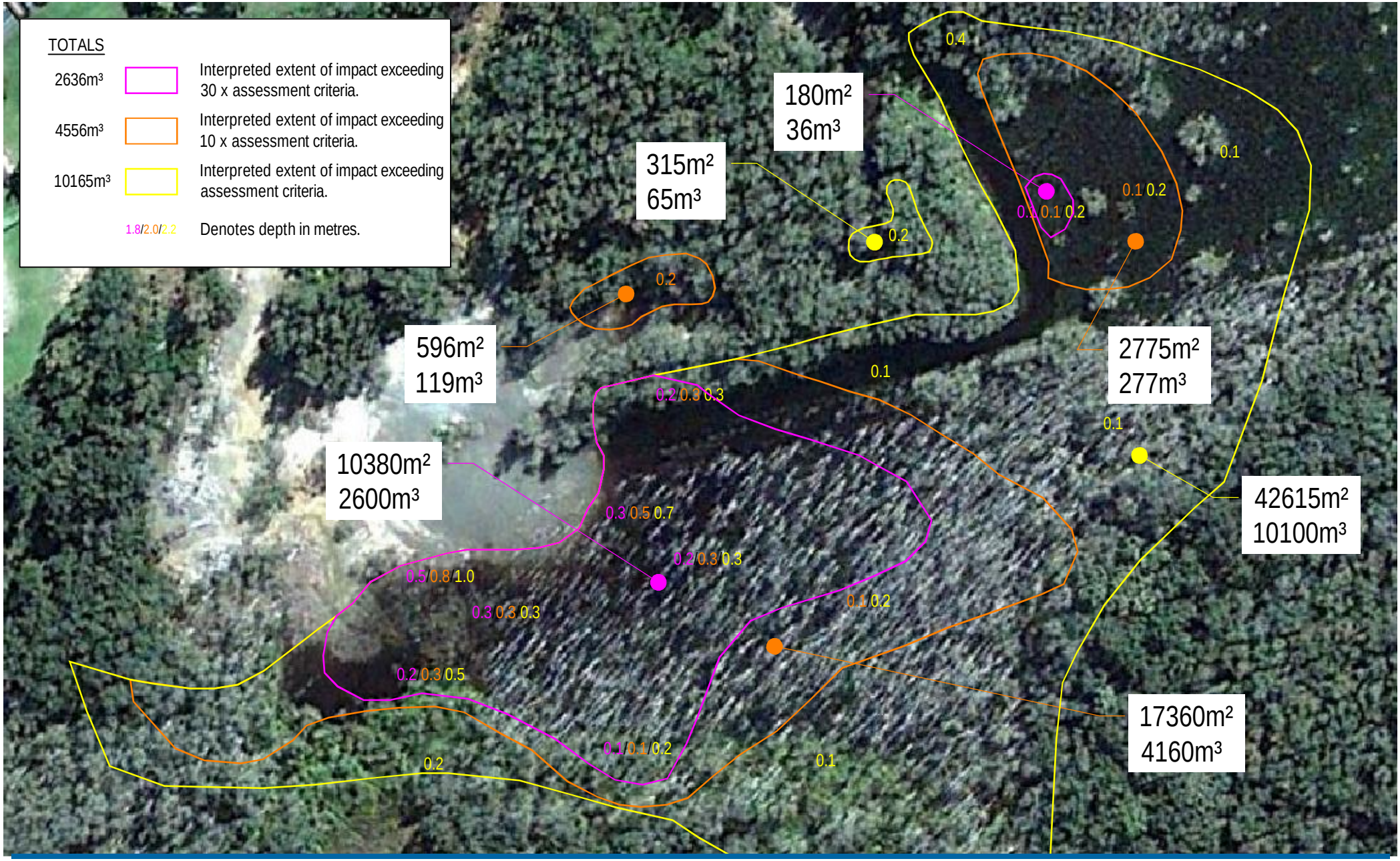
Estimated Area & Volume of Impacted Soil

Job Number 22-16251
Revision A
Date Oct 2012

Figure 6

230 Harbour Drive Coffs Harbour NSW 2450 Australia T 61 2 6650 5600 F 61 2 6650 5601 E cfsmail@ghd.com W www.ghd.com

Plot Date: 24 January 2013 - 1:44 PM Plotted by: Ian Gould Cad File No: G:\22\16251\CADD\Drawings\22-16251-FIG 1 & 2.dwg



N

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NSW Catchment & Lands - Crown Lands
Former Antimony Processing Plant - Urunga
Detailed Investigation Report
Estimated Area & Volume of Impacted Sediment

Job Number 22-16251
Revision A
Date Oct 2012

Figure 7

230 Harbour Drive Coffs Harbour NSW 2450 Australia T 61 2 6650 5600 F 61 2 6650 5601 E cfsmail@ghd.com W www.ghd.com

Plot Date: 24 January 2013 - 2:31 PM Plotted by: Ian Gould Cad File No: G:\22\16251\CADD\Drawings\22-16251-FIG 1 & 2.dwg

Appendix B - Photographs



Photo 1: Site conditions during sampling, looking east across the tailings deposit



Photo 2: Looking east, along the 'L" Shaped Canal



Photo 3: South east of the 'L' Shaped canal



Photo 4: Wetland south of tailings deposit



Photo 5: Wetland east of 'L' Shaped canal



Photo 6: Sediment lithology at SE034 showing grey clay layer underlying organic matter and silty clay



Photo 7: Sample location SE070



Photo 8: Sample location SE103



Photo 9: Sample location BH107, west of boundary fence



Photo 10: Stockpile 4



Figure 11: 'Mercury Plug' MP001



Figure 12: 'Mercury Plug' MP002

Appendix C - Tables

Table C1: Soil and Stockpile Chemistry

				Inorganics	Metals										
				Moisture	Aluminium	Antimony	Arsenic	Cadmium	Chromium (III+VI)	Copper	Iron	Lead	Mercury	Nickel	Zinc
				%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL				1	50	5	5	1	2	5	50	5	0.1	2	5
NEPM 1999 EIL							**20**	**3**	**1**	**100**		**600**	**1**	**60**	**200**
NEPM 1999 HIL E							200	40	200	2000		600	30	600	14000
USEPA RES						310									
10 times HIL E/USEPA RES						3100	2000	400	2000	20,000		6000	300	6000	140,000
30 times HIL E/USEPA RES						9300	6000	1200	6000	60,000	0	18,000	900	18,000	420,000
Field_ID	**LocCode**	**Sample Depth**	**Sampled Date**												
BH007_0.0-0.1	BH007	0-0.1	11/12/2012	4.9	-	3140	**1370**	-	-	-	-	-	-	-	-
BH007_0.3-0.5	BH007	0.3-0.5	11/12/2012	8.6	-	37	**21**	-	-	-	-	-	-	-	-
BH085_0.0-0.1	BH085	0-0.1	10/12/2012	2.8	-	506	**184**	-	-	-	-	-	-	-	-
BH086_0.0_0.1	BH086	0.1	10/12/2012	3.3	-	767	**171**	-	-	-	-	-	-	-	-
BH087_0.0-0.1	BH087	0-0.1	10/12/2012	2.8	-	156	**44**	-	-	-	-	-	-	-	-
BH087_0.3-0.4	BH087	0.3-0.4	10/12/2012	3.4	-	75	**20**	-	-	-	-	-	-	-	-
BH102_0.0-0.1	BH102	0-0.1	11/12/2012	74.8	-	1830	**30**	-	-	-	-	-	-	-	-
BH102_0.3-0.5	BH102	0.3-0.5	11/12/2012	57.4	-	632	**88**	-	-	-	-	-	-	-	-
BH103_0.0-0.1	BH103	0-0.1	11/12/2012	59.4	3550	4120	**343**	<1	**34**	**272**	4440	40	**4.2**	<2	26
BH103_0.3-0.5	BH103	0.3-0.5	11/12/2012	24.6	6760	17	**442**	<1	**38**	**161**	131,000	31	**8.4**	<2	30
BH104_0.0-0.1	BH104	0-0.1	11/12/2012	14.6	-	169	**24**	-	-	-	-	-	-	-	-
BH104_0.3-0.5	BH104	0.3-0.5	11/12/2012	12.3	-	65	15	-	-	-	-	-	-	-	-
BH105_0.0-0.1	BH105	0-0.1	11/12/2012	40.7	8270	1190	**279**	<1	**78**	**380**	12,700	40	**98.4**	<2	27
BH105_0.3-0.5	BH105	0.3-0.5	11/12/2012	15.2	5970	134	18	<1	**8**	20	6430	11	**22.2**	3	32
BH106_0.0-0.1	BH106	0-0.1	11/12/2012	10.6	-	82	14	-	-	-	-	-	-	-	-
BH107_0.0-0.1	BH107	0-0.1	11/12/2012	13.2	-	60	**23**	-	-	-	-	-	-	-	-
BH107_0.2-0.3	BH107	0.2-0.3	11/12/2012	10.2	-	22	16	-	-	-	-	-	-	-	-
MP001A	Mercury Plug 1		11/12/2012	16.7	<50	39,100	**956**	<1	**<2**	8	970	<5	**3800**	<2	47
MP001B	Mercury Plug 1		11/12/2012	17.6	<50	41,900	**521**	<1	**<2**	<5	650	<5	**5840**	<2	32
MP002A	Mercury Plug 2		11/12/2012	10.4 - 11.2	<50	36,900	**554**	<1	**<2**	<5	590	<5	**2440**	<2	26
MP002B	Mercury Plug 2		11/12/2012	10.4 - 11.2	<50	41,000	**1660**	<1	**<2**	61	24,100	<5	**4680**	<2	99
SP004_0.0-0.1	Stockpile 4	0-0.1	10/12/2012	11.4	5350	565	**241**	<1	**16**	66	33,300	139	**4.6**	3	120
SP004_0.1-0.2	Stockpile 4	0.1-0.2	10/12/2012	7.2	5170	409	**452**	<1	**11**	77	19,200	50	**4.1**	4	143

Table C2: Sediment Chemistry

				Inorganics	Metals	
				Moisture	1M HCl Extractable Antimony	1M HCl Extractable Arsenic
				%	mg/kg	mg/kg
EQL				1	1	1
ANZECC (2000) Interim Sediment Quality Guidelines - High					25	70
ANZECC (2000) Interim Sediment Quality Guidelines - Low					**2**	**20**
10 times ANZECC (2000) Interim Sediment Quality Guidelines - High					250	700
30 times ANZECC (2000) Interim Sediment Quality Guidelines - High					750	2100
Field_ID	**LocCode**	**Sample_Depth**	**Sampled Date**			
SE015_0.0-0.1	SE015	0-0.1	10/12/2012	76.8	**211**	**20**
SE023_0.0-0.1	SE023	0-0.1	10/12/2012	79.7	**1590**	**96**
SE023_0.1-0.25	SE023	0.1-0.25	10/12/2012	74.2	**45.6**	**37.5**
SE024_0.0-0.1	SE024	0-0.1	10/12/2012	76.7	**95.2**	**29.1**
SE034_0.0-0.15	SE034	0-0.15	10/12/2012	76.3	**616**	**62.6**
SE035_0.0-0.1	SE035	0-0.1	10/12/2012	79	**1580**	**55.1**
SE036_0.0-0.2	SE036	0-0.2	10/12/2012	85.8	**413**	**23**
SE044_0.0-0.05	SE044	0-0.05	10/12/2012	63.5	**198**	**56.2**
SE045_0.0-0.2	SE045	0-0.2	10/12/2012	75.7	**240**	17.8
SE069_0.0-0.15	SE069	0-0.15	10/12/2012	84.9	**439**	**348**
SE070_0.0-0.3	SE070	0-0.3	10/12/2012	74.4	**394**	**27.9**
SE071_0.0-0.15	SE071	0-0.15	10/12/2012	51.6	**57.8**	**36.8**
SE072_0.0-0.3	SE072	0-0.3	10/12/2012	85	**682**	**25.8**
SE103_0.05-0.1	SE103	0.05-0.1	10/12/2012	75.9	**467**	**32.5**
SE103_0.1-0.3	SE103	0.1-0.3	10/12/2012	43.1	**87.6**	3.5
SE104_0.0-0.1	SE104	0-0.1	10/12/2012	73.1	**14.2**	6.5

Table C3: QA/QC Results

SDG			ES1229225	ES1229225		ES1229225	ES1229225		ES1229225	ES1229225	
Field_ID			BH007_0.0-0.1	BHDUP 20	**RPD**	SE103_0.05-0.1	SEDUP 21	**RPD**	SE104_0.0-0.1	SEDUP 20	**RPD**
Sampled_Date-Time			11/12/2012	11/12/2012		10/12/2012	10/12/2012		10/12/2012	10/12/2012	
Chem_Group	**ChemName**	**Units**	**EQL**								
Inorganics	Moisture	%	1	4.9	6.2	23	75.9	80.0	5	73.1	70.6	3
Metals	Antimony	mg/kg	5	3140.0	3190.0	2						
	Antimony	mg/kg	1				**467.0**	**1030.0**	**75**	14.2	10.2	33
	Arsenic	mg/kg	5	1370.0	1420.0	4						
	Arsenic	mg/kg	1				32.5	40.6	22	**6.5**	**2.0**	**106**

*RPDs have only been considered where a concentration is greater than 1 times the EQL.

**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (1-10 x EQL); 50 (10-30 x EQL); 50 (> 30 x EQL))

***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory

Filter: SDG in('ES1229225')

Appendix D - Borelogs

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH007

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 11/12/2012 to: 11/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 1
Diameter (mm): 50

Easting: 500858
Northing: 6625215
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		BH007_0.0-0.1			silty GRAVEL Trace sand, brown.	D		BHDUP20	0.00 -0.10
						sandy CLAY Trace silt, trace gravel, brown.	M			0.10
			BH007_0.3-0.5							-0.40
						CLAY Trace silt, trace sand, mottled orange/brown.	M			0.40
			BH007_0.5-0.7							
			BH007_0.8-1.0							-1.00
1.0										1.00
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH085
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BL
Rig Type: HA
Total Depth (m): 0.4
Diameter (mm): 50

Easting: 500907
Northing: 6625246
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH085_0.0-0.1			SAND Some gravel, trace silt, brown.	D		Trace roots.	0.00 -0.10
						SILT Some sand, trace gravel, grey.	D			0.10
			BH085_0.2-0.3							-0.40
										0.40
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose	(D) Dense
(L) Loose	(VD) Very Dense
(MD) Medium Dense	

Cohesive Soils

(VS) Very Soft	(ST) Stiff
(S) Soft	(VST) Very Stiff
(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH086
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BL
Rig Type: HA
Total Depth (m): 0.1
Diameter (mm): 50

Easting: 500898
Northing: 6625234
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH086_0.0-0.1			SAND Trace silt, trace gravel, brown.	D			0.00 -0.10
						Refusal.				0.10
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH087

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BL
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 500894
Northing: 6625217
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BL Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH087_0.0-0.1			SAND Some Gravel, trace silt, brown/white.	D			0.00
										-0.20
						SILT Some sand, trace gravel, brown.	D			0.20
			BH087_0.3-0.4							
										-0.50
			BH087_0.5-0.6			silty CLAY Trace sand, orange.	M			0.50
										-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:

D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose
(L) Loose
(MD) Medium Dense
(D) Dense
(VD) Very Dense

Cohesive Soils

(VS) Very Soft
(S) Soft
(F) Firm
(ST) Stiff
(VST) Very Stiff
(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH102
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 11/12/2012 to: 11/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 1
Diameter (mm): 50

Easting: 500796
Northing: 6625130
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH102_0.0-0.1			SILT Dark brown. Some clay.	W		Organic matter	0.00 -0.10 0.10
			BH102_0.3-0.5							-0.80
			BH102_0.8-1.0			silty CLAY Grey/brown.	W			0.80 -1.00
1.0										1.00
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:

D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH103

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 11/12/2012 to: 11/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 500828
Northing: 6625158
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH103_0.0-0.1			SILT Dark brown.	M		Organic matter	0.00 -0.10
						silty CLAY Grey/brown.	M			0.10 -0.30
			BH103_0.3-0.5			CLAY Trace silt, orange/white.	M			0.30
			BH103_0.5-0.7							-0.70
						Refusal on roots.				0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:

D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose
(L) Loose
(MD) Medium Dense
(D) Dense
(VD) Very Dense

Cohesive Soils

(VS) Very Soft
(S) Soft
(F) Firm
(ST) Stiff
(VST) Very Stiff
(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH104

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 11/12/2012 to: 11/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 500830
Northing: 6625194
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		BH104_0.0-0.1			SILT Trace gravel, trace clay, trace sand, brown.	D		Trace roots.	0.00
			BH104_0.3-0.5							-0.50
						Refusal on roots.				0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:

D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH105

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 11/12/2012 to: 11/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 1
Diameter (mm): 50

Easting: 500828
Northing: 6625152
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH105_0.0-0.1			clayey SILT Brown, mottled orange.	M		Organic matter	0.00
										-0.20
						CLAY Trace silt, some gravel, mottled orange and brown	M/W			0.20
			BH105_0.3-0.5							
										-0.60
						Mottled grey and orange .				0.60
			BH105_0.7-0.9							
										-1.00
1.0										1.00
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:

D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose
(L) Loose
(MD) Medium Dense
(D) Dense
(VD) Very Dense

Cohesive Soils

(VS) Very Soft
(S) Soft
(F) Firm
(ST) Stiff
(VST) Very Stiff
(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH106

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 11/12/2012 to: 11/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 500819
Northing: 6625186
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		BH106_0.0-0.1			clayey SILT Trace sand, trace gravel, brown.	D			0.00
										-0.30
			BH106_0.3-0.5			No gravel.				0.30
										-0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: BH107
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 11/12/2012 to: 11/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.3
Diameter (mm): 50

Easting: 500823
Northing: 6625155
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		BH107_0.0-0.1			SILT Trace gravel, trace clay, trace sand, light brown.	D		Trace roots.	0.00
			BH107_0.2-0.3							-0.30
						Refusal on roots.				0.30
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:

D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE015

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.4
Diameter (mm): 50

Easting: 501017
Northing: 6625094
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		SE015_0.0-0.1			sandy SILT Brown.	W		Organic matter	0.00 -0.10
			SE015_0.1-0.2			silty CLAY Trace sand, dark brown.	W		Some organic matter	0.10 -0.20
			SE015_0.2-0.3			CLAY Trace silt, brown/grey.	W			0.20 -0.30
						silty CLAY Brown.	W			0.30 -0.40
										0.40
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose	(D) Dense
(L) Loose	(VD) Very Dense
(MD) Medium Dense	

Cohesive Soils

(VS) Very Soft	(ST) Stiff
(S) Soft	(VST) Very Stiff
(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE023
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 500991
Northing: 6625137
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE023_0.0-0.1			sandy SILT Dark brown.	W		Organic matter	0.00
			SE023_0.1-0.25				W M		Roots and organic matter.	-0.25
						silty CLAY Grey.				0.25
			SE023_0.3-0.5			silty CLAY Dark brown.			Trace organic matter.	
						CLAY Trace silt, brown.				-0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE024

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 501041
Northing: 6625103
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE024_0.0-0.1			sandy SILT Dark brown.	W		Organic matter	0.00 -0.10
			SE024_0.1-0.2			silty CLAY Trace sand, dark brown.	M		Organic matter.	0.10 -0.20
			SE024_0.2-0.25				M			0.20
			SE024_0.3-0.5			CLAY Trace silt, brown/grey.	M		Trace organic matter	-0.40
						silty CLAY Brown.				0.40
1.0						Grey/brown, trace sand.				
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose	(D) Dense
(L) Loose	(VD) Very Dense
(MD) Medium Dense	

Cohesive Soils

(VS) Very Soft	(ST) Stiff
(S) Soft	(VST) Very Stiff
(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE034
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.4
Diameter (mm): 50

Easting: 501011
Northing: 6625200
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING						LITHOLOGICAL DESCRIPTION				
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE034_0.0-0.15			silty CLAY Black.	W			0.00 -0.15
			SE034_0.15-0.25			sandy CLAY Brown, fine grained sand.	W		Trace organic matter	0.15 -0.25
			SE034_0.25-0.40			CLAY Mottled orange/grey/brown, firm.	M			0.25 -0.40
										0.40
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:

D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE035

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.5
Diameter (mm): 50

Easting: 501041
Northing: 6625167
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE035_0.0-0.1			sandy SILT Brown/grey.	W		Organic matter	0.00 -0.10
							W		Some organic matter.	0.10
			SE035_0.15-0.25			silty CLAY Brown.	M		Trace organic matter.	-0.25
							M			0.25
			SE035_0.3-0.5			CLAY Brown/grey.				
						silty CLAY Dark brown.				-0.50
										0.50
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose	(D) Dense
(L) Loose	(VD) Very Dense
(MD) Medium Dense	

Cohesive Soils

(VS) Very Soft	(ST) Stiff
(S) Soft	(VST) Very Stiff
(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE036
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.7
Diameter (mm): 50

Easting: 501082
Northing: 6625155
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE036_0.0-0.2			sandy SILT Brown.	W		Organic matter.	0.00 -0.20
			SE036_0.2-0.3			silty CLAY Brown.	W		Some organic matter	0.20 -0.30
			SE036_0.3-0.4			CLAY Trace silt, trace sand, brown/grey.	M		Trace organic matter	0.30 -0.40
						CLAY Trace silt, dark brown.	M			0.40 -0.70
										0.70
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE044
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.06
Diameter (mm): 50

Easting: 501068
Northing: 6625218
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE044_0.0-0.05			silty CLAY Brown.	W			0.00
						CLAY Mottled orange/grey/brown, stiff.				
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		**Cohesive Soils**	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE045
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 501097
Northing: 6625187
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		SE045_0.0-0.2			sandy SILT Brown.	W		Organic matter	0.00 -0.20
						silty CLAY Trace sand, brown.	W		Trace organic matter	0.20
			SE045_0.25-0.40			CLAY Trace silt, trace sand, grey/brown.	M		Trace organic matter	-0.40
			SE045_0.4-0.6			silty CLAY Dark brown.			Some organic matter	0.40 -0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:

D	Dry
M	Moist
W	Wet

Consistency:

Granular Soils

(VL) Very Loose	(D) Dense
(L) Loose	(VD) Very Dense
(MD) Medium Dense	

Cohesive Soils

(VS) Very Soft	(ST) Stiff
(S) Soft	(VST) Very Stiff
(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE069
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.6
Diameter (mm): 50

Easting: 501101
Northing: 6625277
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE069_0.0-0.15			sandy SILT Brown.	W		Organic matter	0.00 -0.15
			SE069_0.15_0.3			silty CLAY Brown	W		Some organic matter.	0.15 -0.30
			SE069_0.3-0.4			CLAY Some sand, trace silt, grey/brown.	W			0.30 -0.40
						silty CLAY	W			0.40 -0.60
										0.60
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose	(D) Dense
(L) Loose	(VD) Very Dense
(MD) Medium Dense	

Cohesive Soils

(VS) Very Soft	(ST) Stiff
(S) Soft	(VST) Very Stiff
(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE070
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.65
Diameter (mm): 50

Easting: 501117
Northing: 6625279
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE070_0.0-0.3			sandy SILT Brown.	W		Organic matter	0.00 -0.30
			SE070_0.3-0.4			silty CLAY Brown.	W		Some organic matter	0.30 -0.40
			SE070_0.4-0.6			CLAY Trace silt, grey/brown	M		Trace organic matter	0.40 -0.50
						Trace sand, brown.				0.50 -0.65
										0.65
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose	(D) Dense
(L) Loose	(VD) Very Dense
(MD) Medium Dense	

Cohesive Soils

(VS) Very Soft	(ST) Stiff
(S) Soft	(VST) Very Stiff
(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE071
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.4
Diameter (mm): 50

Easting: 501085
Northing: 6625265
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE071_0.0-0.15			silty CLAY Dark brown.	W W			0.00 -0.15
			SE071_0.15-0.3			CLAY Grey.			Trace organic matter	0.15 -0.30
						silty CLAY Brown.	W M			0.30
						clayey SAND Grey.				
						CLAY Mottled orange/grey/brown.				
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:

D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE072
Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.65
Diameter (mm): 50

Easting: 501100
Northing: 6625244
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
						Ground Surface:				0.00
0.0	HA		SE072_0.0-0.3			sandy SILT Brown.	W		Organic matter	0.00 -0.30
			SE072_0.3-0.4			silty CLAY Dark brown.	M		Trace organic matter	0.30 -0.40
			SE072_0.4-0.5			CLAY Trace silt, grey/brown.	M		Trace organic matter	0.40 -0.50
			SE072_0.5-0.65			silty CLAY Brown.	M/W		Some organic matter	0.50 -0.65
										0.65
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils
(VL) Very Loose (L) Loose (MD) Medium Dense (D) Dense (VD) Very Dense

Cohesive Soils
(VS) Very Soft (S) Soft (F) Firm (ST) Stiff (VST) Very Stiff (H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE103

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.4
Diameter (mm): 50

Easting: 500858
Northing: 6625096
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA					sandy SILT	W		Organic matter	0.00
			SE103_0.05-0.1			Brown.	W		SEDUP21, trace organic matter.	
			SE103_0.1-0.3			CLAY	W		Some organic matter	
						Trace silt, brown				-0.30
						silty CLAY				0.30
						Brown.				
						Dark brown.				
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:
D Dry
M Moist
W Wet

Consistency:

Granular Soils		Cohesive Soils	
(VL) Very Loose	(D) Dense	(VS) Very Soft	(ST) Stiff
(L) Loose	(VD) Very Dense	(S) Soft	(VST) Very Stiff
(MD) Medium Dense		(F) Firm	(H) Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SE104

Page: 1 of 1

Client: NSW Catchment and Lands - Crown Land
Project: Urunga Antimony RAP
Project No.: 2216251
Location:
Date Drilled: 10/12/2012 to: 10/12/2012

Drill Co: GHD
Driller: BC
Rig Type: HA
Total Depth (m): 0.4
Diameter (mm): 50

Easting: 500795
Northing: 6625090
Grid Ref: GDA94_MGA_zone_56
Elevation: 0
Logged by: BC Checked by: BC

DRILLING					Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water						
						Ground Surface:				0.00
0.0	HA		SE104_0.0-0.1			sandy SILT Brown.	W W		SEDUP20, Organic matter	0.00
						silty CLAY Brown.	W			-0.20
			SE104_0.2-0.3							0.20 -0.30
						CLAY Trace silt, grey/brown.			Trace organic matter.	0.30 -0.40
						Dark Brown CLAY				0.40
1.0										
2.0										
3.0										
4.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:

RW(x)	Rotary Wash	PSC(x)	Percussion Simultanous Casing
RT(x)	Rotary Triple Tube	AS	Augering - Solid Flight
PC(x)	Percussion Cable Tool	AH	Augering - Hollow Flight
PD(x)	Percussion Down Hole	H	Hand Augering

Where "x" is flushing medium: (W) Water, (M) Mud, (A) Air, (F) Foam.

Moisture Abbreviations:

D Dry
M Moist
W Wet

Consistency:

Granular Soils

(VL) Very Loose (L) Loose (MD) Medium Dense (D) Dense (VD) Very Dense

Cohesive Soils

(VS) Very Soft (S) Soft (F) Firm (ST) Stiff (VST) Very Stiff (H) Hard

Appendix E - Laboratory Reports

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1229225**	Page	: 1 of 11
Amendment	: **1**		
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR BEN LUFFMAN	Contact	: Angelene Kumar
Address	: 230 HARBOUR DRIVE PO Box 1340 COFFS HARBOUR NSW, AUSTRALIA 2450	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: ben_luffman@ghd.com	E-mail	: angelene.kumar@alsglobal.com
Telephone	: +61 02 6650 5600	Telephone	: +61 2 8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61 2 8784 8555
Project	: 2216251	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 12-DEC-2012
Sampler	: B CORK	Issue Date	: 08-JAN-2013
Site	: ----		
		No. of samples received	: 73
Quote number	: SY/270/12	No. of samples analysed	: 42

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*
Evie.Sidarta	Inorganic Chemist	Sydney Inorganics
Raymond Commodor	Instrument Chemist	Sydney Inorganics
Shobhna Chandra	Metals Coordinator	Sydney Inorganics
Wisam Marassa	Inorganics Coordinator	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

- **EG005: Poor precision was obtained for Antimony on sample ES1229225#19 due to sample heterogeneity. Results have been confirmed by re-extraction and reanalysis.**
- **EG005: Poor precision was obtained for Zinc and Lead on sample ES1229375#45 due to sample heterogeneity. Results have been confirmed by re-extraction and reanalysis**
- **EG005-SDH: Poor precision was obtained for Antimony and Arsenic on sample ES1229225#29 due to sample heterogeneity.**
- **EG005T: Poor precision and poor spike recovery was obtained for some elements on sample ES229225 #39due to sample heterogeneity. Results have been confirmed by re-extraction and reanalysis**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	BH007_0.0-0.1	BH007_0.3-0.5	BH087_0.0-0.1	BH087_0.3-0.4	BH086_0.0_0.1
				Client sampling date / time	11-DEC-2012 15:00	11-DEC-2012 15:00	10-DEC-2012 15:00	10-DEC-2012 15:00	10-DEC-2012 15:00
Compound	CAS Number	LOR	Unit		ES1229225-001	ES1229225-002	ES1229225-003	ES1229225-004	ES1229225-005
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		4.9	8.6	2.8	3.4	3.3
EG005T: Total Metals by ICP-AES									
Antimony	7440-36-0	5	mg/kg		3140	37	156	75	767
Arsenic	7440-38-2	5	mg/kg		1370	21	44	20	171

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	BH085_0.0-0.1	BH102_0.0-0.1	BH102_0.3-0.5	BHDUP 20	BH103_0.0-0.1
				Client sampling date / time	10-DEC-2012 15:00	11-DEC-2012 15:00	11-DEC-2012 15:00	11-DEC-2012 15:00	11-DEC-2012 15:00
Compound	CAS Number	LOR	Unit		ES1229225-006	ES1229225-007	ES1229225-008	ES1229225-009	ES1229225-010
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		2.8	74.8	57.4	6.2	59.4
EG005T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		----	----	----	----	3550
Antimony	7440-36-0	5	mg/kg		506	1830	632	3190	4120
Arsenic	7440-38-2	5	mg/kg		184	30	88	1420	----
Iron	7439-89-6	50	mg/kg		----	----	----	----	4440
Arsenic	7440-38-2	5	mg/kg		----	----	----	----	343
Cadmium	7440-43-9	1	mg/kg		----	----	----	----	<1
Chromium	7440-47-3	2	mg/kg		----	----	----	----	34
Copper	7440-50-8	5	mg/kg		----	----	----	----	272
Lead	7439-92-1	5	mg/kg		----	----	----	----	40
Nickel	7440-02-0	2	mg/kg		----	----	----	----	<2
Zinc	7440-66-6	5	mg/kg		----	----	----	----	26
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		----	----	----	----	4.2

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Client sample ID	BH103_0.3-0.5	BH104_0.0-0.1	BH104_0.3-0.5	BH105_0.0-0.1	BH105_0.3-0.5
				Client sampling date / time	11-DEC-2012 15:00	11-DEC-2012 15:00	11-DEC-2012 15:00	11-DEC-2012 15:00	11-DEC-2012 15:00
					ES1229225-011	ES1229225-012	ES1229225-013	ES1229225-014	ES1229225-015
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		**24.6**	**14.6**	**12.3**	**40.7**	**15.2**
EG005T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		**6760**	----	----	**8270**	**5970**
Antimony	7440-36-0	5	mg/kg		**17**	**169**	**65**	**1190**	**134**
Arsenic	7440-38-2	5	mg/kg		----	**24**	**15**	----	----
Iron	7439-89-6	50	mg/kg		**131000**	----	----	**12700**	**6430**
Arsenic	7440-38-2	5	mg/kg		**442**	----	----	**279**	**18**
Cadmium	7440-43-9	1	mg/kg		<1	----	----	<1	<1
Chromium	7440-47-3	2	mg/kg		**38**	----	----	**78**	**8**
Copper	7440-50-8	5	mg/kg		**161**	----	----	**380**	**20**
Lead	7439-92-1	5	mg/kg		**31**	----	----	**40**	**11**
Nickel	7440-02-0	2	mg/kg		<2	----	----	<2	**3**
Zinc	7440-66-6	5	mg/kg		**30**	----	----	**27**	**32**
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		**8.4**	----	----	**98.4**	**22.2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	BH106_0.0-0.1	BH107_0.0-0.1	BH107_0.2-0.3	SE015_0.0-0.1	SE023_0.0-0.1
				Client sampling date / time	11-DEC-2012 15:00	11-DEC-2012 15:00	11-DEC-2012 15:00	10-DEC-2012 15:00	10-DEC-2012 15:00
Compound	CAS Number	LOR	Unit		ES1229225-016	ES1229225-017	ES1229225-018	ES1229225-019	ES1229225-020
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		10.6	13.2	10.2	76.8	79.7
EG005-SDH: 1M HCl-Extractable Metals by ICPAES									
Antimony	7440-36-0	1.0	mg/kg		----	----	----	211	1590
Arsenic	7440-38-2	1.0	mg/kg		----	----	----	20.0	96.0
EG005T: Total Metals by ICP-AES									
Antimony	7440-36-0	5	mg/kg		82	60	22	----	----
Arsenic	7440-38-2	5	mg/kg		14	23	16	----	----

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)

				Client sample ID	SE023_0.1-0.25	SE024_0.0-0.1	SE034_0.0-0.15	SE035_0.0-0.1	SE036_0.0-0.2
				Client sampling date / time	10-DEC-2012 15:00	10-DEC-2012 15:00	10-DEC-2012 15:00	10-DEC-2012 15:00	10-DEC-2012 15:00
Compound	*CAS Number*	*LOR*	*Unit*		**ES1229225-021**	**ES1229225-022**	**ES1229225-023**	**ES1229225-024**	**ES1229225-025**
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		**74.2**	**76.7**	**76.3**	**79.0**	**85.8**
EG005-SDH: 1M HCl-Extractable Metals by ICPAES									
Antimony	7440-36-0	1.0	mg/kg		**45.6**	**95.2**	**616**	**1580**	**413**
Arsenic	7440-38-2	1.0	mg/kg		**37.5**	**29.1**	**62.6**	**55.1**	**23.0**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	SE044_0.0-0.05	SE045_0.0-0.2	SE069_0.0-0.15	SE070_0.0-0.3	SE071_0.0-0.15
				Client sampling date / time	10-DEC-2012 15:00	10-DEC-2012 15:00	10-DEC-2012 15:00	10-DEC-2012 15:00	10-DEC-2012 15:00
Compound	CAS Number	LOR	Unit		ES1229225-026	ES1229225-027	ES1229225-028	ES1229225-029	ES1229225-030
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		63.5	75.7	84.9	74.4	51.6
EG005-SDH: 1M HCl-Extractable Metals by ICPAES									
Antimony	7440-36-0	1.0	mg/kg		198	240	439	394	57.8
Arsenic	7440-38-2	1.0	mg/kg		56.2	17.8	348	27.9	36.8

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	SE072_0.0-0.3	SE103_0.05-0.1	SEDUP 21	SE103_0.1-0.3	SE104_0.0-0.1
				Client sampling date / time	10-DEC-2012 15:00	10-DEC-2012 15:00	10-DEC-2012 15:00	10-DEC-2012 15:00	10-DEC-2012 15:00
Compound	CAS Number	LOR	Unit		ES1229225-031	ES1229225-032	ES1229225-033	ES1229225-034	ES1229225-035
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		85.0	75.9	80.0	43.1	73.1
EG005-SDH: 1M HCl-Extractable Metals by ICPAES									
Antimony	7440-36-0	1.0	mg/kg		682	467	1030	87.6	14.2
Arsenic	7440-38-2	1.0	mg/kg		25.8	32.5	40.6	3.5	6.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	SEDUP 20	SP004_0.0-0.1	SP004_0.1-0.2	MP001A	MP002B
				Client sampling date / time	10-DEC-2012 15:00	10-DEC-2012 15:00	10-DEC-2012 15:00	11-DEC-2012 15:00	11-DEC-2012 15:00
Compound	CAS Number	LOR	Unit		ES1229225-036	ES1229225-037	ES1229225-038	ES1229225-039	ES1229225-040
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		70.6	11.4	7.2	16.7	11.2
EG005-SDH: 1M HCl-Extractable Metals by ICPAES									
Antimony	7440-36-0	1.0	mg/kg		10.2	----	----	----	----
Arsenic	7440-38-2	1.0	mg/kg		2.0	----	----	----	----
EG005T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		----	5350	5170	<50	<50
Antimony	7440-36-0	5	mg/kg		----	565	409	39100	36900
Iron	7439-89-6	50	mg/kg		----	33300	19200	970	24100
Arsenic	7440-38-2	5	mg/kg		----	241	452	956	1660
Cadmium	7440-43-9	1	mg/kg		----	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		----	16	11	<2	<2
Copper	7440-50-8	5	mg/kg		----	66	77	8	61
Lead	7439-92-1	5	mg/kg		----	139	50	<5	<5
Nickel	7440-02-0	2	mg/kg		----	3	4	<2	<2
Zinc	7440-66-6	5	mg/kg		----	120	143	47	99
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		----	4.6	4.1	3800	2440

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	MP001B	MP002B	----	----	----
			Client sampling date / time	11-DEC-2012 15:00	11-DEC-2012 15:00	----	----	----
Compound	CAS Number	LOR	Unit	ES1229225-072	ES1229225-073	----	----	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	17.6	10.4	----	----	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	<50	<50	----	----	----
Antimony	7440-36-0	5	mg/kg	41900	41000	----	----	----
Iron	7439-89-6	50	mg/kg	650	590	----	----	----
Arsenic	7440-38-2	5	mg/kg	521	554	----	----	----
Cadmium	7440-43-9	1	mg/kg	<1	<1	----	----	----
Chromium	7440-47-3	2	mg/kg	<2	<2	----	----	----
Copper	7440-50-8	5	mg/kg	<5	<5	----	----	----
Lead	7439-92-1	5	mg/kg	<5	<5	----	----	----
Nickel	7440-02-0	2	mg/kg	<2	<2	----	----	----
Zinc	7440-66-6	5	mg/kg	32	26	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	5840	4680	----	----	----

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1229225**	Page	: 1 of 6
Amendment	: **1**		
Client	: GHD PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR BEN LUFFMAN	Contact	: Angelene Kumar
Address	: 230 HARBOUR DRIVE PO Box 1340 COFFS HARBOUR NSW, AUSTRALIA 2450	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: ben_luffman@ghd.com	E-mail	: angelene.kumar@alsglobal.com
Telephone	: +61 02 6650 5600	Telephone	: +61 2 8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61 2 8784 8555
Project	: 2216251	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 12-DEC-2012
Sampler	: B CORK	Issue Date	: 08-JAN-2013
Order number	: ----		
		No. of samples received	: 73
Quote number	: SY/270/12	No. of samples analysed	: 42

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

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

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								
Soil Glass Jar - Unpreserved (EA055-103)								
BH087_0.0-0.1,	BH087_0.3-0.4,	**10-DEC-2012**	**----**	----	----	**17-DEC-2012**	24-DEC-2012	✓
BH086_0.0_0.1,	BH085_0.0-0.1,							
SE015_0.0-0.1,	SE023_0.0-0.1,							
SE023_0.1-0.25,	SE024_0.0-0.1,							
SE034_0.0-0.15,	SE035_0.0-0.1,							
SE036_0.0-0.2,	SE044_0.0-0.05,							
SE045_0.0-0.2,	SE069_0.0-0.15,							
SE070_0.0-0.3,	SE071_0.0-0.15,							
SE072_0.0-0.3,	SE103_0.05-0.1,							
SEDUP 21,	SE103_0.1-0.3,							
SE104_0.0-0.1,	SEDUP 20,							
SP004_0.0-0.1,	SP004_0.1-0.2							
Soil Glass Jar - Unpreserved (EA055-103)								
BH007_0.0-0.1,	BH007_0.3-0.5,	**11-DEC-2012**	**----**	----	----	**17-DEC-2012**	25-DEC-2012	✓
BH102_0.0-0.1,	BH102_0.3-0.5,							
BHDUP 20,	BH103_0.0-0.1,							
BH103_0.3-0.5,	BH104_0.0-0.1,							
BH104_0.3-0.5,	BH105_0.0-0.1,							
BH105_0.3-0.5,	BH106_0.0-0.1,							
BH107_0.0-0.1,	BH107_0.2-0.3,							
MP001A,	MP002B,							
MP001B,	MP002B							

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
EG005-SDH: 1M HCl-Extractable Metals by ICPAES								
Soil Glass Jar - Unpreserved (EG005-SDH)								
SE015_0.0-0.1,	SE023_0.0-0.1,	**10-DEC-2012**	**17-DEC-2012**	08-JUN-2013	✓	**18-DEC-2012**	08-JUN-2013	✓
SE023_0.1-0.25,	SE024_0.0-0.1,							
SE034_0.0-0.15,	SE035_0.0-0.1,							
SE036_0.0-0.2,	SE044_0.0-0.05,							
SE045_0.0-0.2,	SE069_0.0-0.15,							
SE070_0.0-0.3,	SE071_0.0-0.15,							
SE072_0.0-0.3,	SE103_0.05-0.1,							
SEDUP 21,	SE103_0.1-0.3,							
SEDUP 20,								
SE104_0.0-0.1								
EG005T: Total Metals by ICP-AES								
Soil Glass Jar - Unpreserved (EG005T)								
BH087_0.0-0.1,	BH087_0.3-0.4,	**10-DEC-2012**	**15-DEC-2012**	08-JUN-2013	✓	**17-DEC-2012**	08-JUN-2013	✓
BH086_0.0_0.1,	BH085_0.0-0.1,							
SP004_0.0-0.1,	SP004_0.1-0.2							
Soil Glass Jar - Unpreserved (EG005T)								
BH007_0.0-0.1,	BH007_0.3-0.5,	**11-DEC-2012**	**15-DEC-2012**	09-JUN-2013	✓	**17-DEC-2012**	09-JUN-2013	✓
BH102_0.0-0.1,	BH102_0.3-0.5,							
BHDUP 20,	BH103_0.0-0.1,							
BH103_0.3-0.5,	BH104_0.0-0.1,							
BH104_0.3-0.5,	BH105_0.0-0.1,							
BH105_0.3-0.5,	BH106_0.0-0.1,							
BH107_0.0-0.1,	BH107_0.2-0.3,							
MP001A,	MP002B,							
MP001B,	MP002B							
EG035T: Total Recoverable Mercury by FIMS								
Soil Glass Jar - Unpreserved (EG035T)								
SP004_0.0-0.1,	SP004_0.1-0.2	**10-DEC-2012**	**15-DEC-2012**	07-JAN-2013	✓	**17-DEC-2012**	07-JAN-2013	✓
Soil Glass Jar - Unpreserved (EG035T)								
BH103_0.0-0.1,	BH103_0.3-0.5,	**11-DEC-2012**	**15-DEC-2012**	08-JAN-2013	✓	**17-DEC-2012**	08-JAN-2013	✓
BH105_0.0-0.1,	BH105_0.3-0.5,							
MP001A,	MP002B,							
MP001B,	MP002B							

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)							
1M HCl Extractable Metals	EG005-SDH	2	18	**11.1**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Moisture Content	EA055-103	6	57	**10.5**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS	EG035T	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	4	39	**10.3**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
1M HCl Extractable Metals	EG005-SDH	1	18	**5.6**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS	EG035T	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	2	39	**5.1**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
1M HCl Extractable Metals	EG005-SDH	1	18	**5.6**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS	EG035T	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	2	39	**5.1**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Total Mercury by FIMS	EG035T	1	20	**5.0**	**5.0**	✓	ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	2	39	**5.1**	**5.0**	✓	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 (2010 Draft) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
1M HCl Extractable Metals	EG005-SDH	SOIL	APHA 21st ed., 3120; USEPA SW 846 - 6010. Metals are determined via ICPAES following weak acid extraction. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (1999) Schedule B(3). LORs per NAGD.
Total Metals by ICP-AES	EG005T	SOIL	(APHA 21st ed., 3120; USEPA SW 846 - 6010) (ICPAES) Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (1999) Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	AS 3550, APHA 21st ed., 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	USEPA 200.2 Mod. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (1999) Schedule B(3) (Method 202)
1M HCl Extraction for Metals in Sediments (1 hour)	EN71	SOIL	In house, Allen (1993) Mod. 1g of sample is leached at room temperature for 1 hour in 10% hydrochloric acid. The resultant extract is filtered and bulked for analysis of extracted metals.

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

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Duplicate (DUP) RPDs							
EG005-SDH: 1M HCl-Extractable Metals by ICPAES	ES1229225-029	SE070_0.0-0.3	**Antimony**	7440-36-0	21.2 %	0-20%	**RPD exceeds LOR based limits**
EG005-SDH: 1M HCl-Extractable Metals by ICPAES	ES1229225-019	SE015_0.0-0.1	**Antimony**	7440-36-0	103 %	0-20%	**RPD exceeds LOR based limits**
EG005-SDH: 1M HCl-Extractable Metals by ICPAES	ES1229225-029	SE070_0.0-0.3	**Arsenic**	7440-38-2	23.0 %	0-20%	**RPD exceeds LOR based limits**
EG005T: Total Metals by ICP-AES	ES1229225-010	BH103_0.0-0.1	**Arsenic**	7440-38-2	42.4 %	0-20%	**RPD exceeds LOR based limits**
EG005T: Total Metals by ICP-AES	ES1229225-010	BH103_0.0-0.1	**Chromium**	7440-47-3	36.1 %	0-20%	**RPD exceeds LOR based limits**
EG005T: Total Metals by ICP-AES	ES1229375-045	Anonymous	**Lead**	7439-92-1	39.2 %	0-20%	**RPD exceeds LOR based limits**
EG005T: Total Metals by ICP-AES	ES1229375-045	Anonymous	**Zinc**	7440-66-6	48.2 %	0-20%	**RPD exceeds LOR based limits**
Matrix Spike (MS) Recoveries							
EG005T: Total Metals by ICP-AES	ES1229225-039	MP001A	**Arsenic**	7440-38-2	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
EG005T: Total Metals by ICP-AES	ES1229225-010	BH103_0.0-0.1	**Arsenic**	7440-38-2	267 %	70-130%	**Recovery greater than upper data quality objective**
EG035T: Total Recoverable Mercury by FIMS	ES1229225-010	BH103_0.0-0.1	**Mercury**	7439-97-6	Not Determined	----	**Matrix spike recovery not determined due to sample matrix interference.**

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

- **No Analysis Holding Time Outliers exist.**

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.**

CHAIN OF CUSTODY

ALS Laboratory: please tick →

Sydney 277 Woodpark Rd Smithfield NSW 2164 Ph 02 8784 8555 F samples.sydney@alsenviro.com
Newcastle: 5 Rosegum Rd Warabrook NSW 2304 Ph 02 4958 9630 E samples.newcastle@alsenviro.com
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Townsville: 14-15 Desma Ct, Bohle QLD 4818 Ph 07 4796 0600 E samples.townsville@alsenviro.com
Melbourne: 24 Westall Rd Springvale VIC 3171 Ph 03 8549 9600 F samples.melbourne@alsenviro.com
Adelaide: 21 Burma Rd, Pooraka SA 5095 Ph 08 8359 0890 E adelaide@alsenviro.com
Perth: 10 Hod Way, Malaga WA 6090 Ph 08 9209 7655 E samples.perth@alsenviro.com
Launceston: 27 Wellington St, Launceston TAS 7250 Ph 03 6331 2158 E launceston@alsenviro.com

CLIENT: GHD	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) Custody seal intact? Yes / No / N/A; Cooling Method: Ice / Ice Pack / None; Frozen / Frozen with ice / Chilled / Ambient; Random Sample Temperature on Receipt: °C; Other comments:
OFFICE: Coffs Harbour		☐ Non Standard or urgent TAT (List due date):	
PROJECT: 22162511	ALS QUOTE NO.: SY/270/12	COC SEQUENCE NUMBER (Circle) COC: 1 2 3 4 5 6 7 OF: 1 2 3 4 5 6 7	
ORDER NUMBER:			
PROJECT MANAGER: Ben Huffman	CONTACT PH: 02 6650 5613		
SAMPLER: B. Cork	SAMPLER MOBILE:	RELINQUISHED BY: B. Cork	RECEIVED BY: David
COC emailed to ALS? (YES / NO)	EDD FORMAT (or default):	DATE/TIME: 12/12/12	DATE/TIME: 12/12 0815
Email Reports to (will default to PM if no other addresses are listed): ben.huffman@ghd.com		RELINQUISHED BY:	RECEIVED BY:
Email Invoice to (will default to PM if no other addresses are listed):		DATE/TIME:	DATE/TIME:

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	Antimony	Arsenic	Mold						Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	BH007_0.0-0.1	11/12/12	Soil		1	✓	✓							
2	BH007_0.3-0.5	↓	↓		↓	✓	✓							
(41)	BH007_0.5-0.7							✓						
(42)	BH007_0.8-1.0							✓						
3	BH090_0.0-0.1	10/12/12				✓	✓							
4	BH090_0.3-0.4	↓				✓	✓							
(43)	BH090_0.5-0.6							✓						
5	BH091_0.0-0.1					✓	✓							
6	BH092_0.0-0.1					✓	✓							
(44)	BH092_0.2-0.3	↓						✓						
7	BH102_0.0-0.1	11/12/12				✓	✓							
8	BH102_0.3-0.5	↓	↓		↓	✓	✓							
				TOTAL										

Environmental Division Sydney

Work Order

ES1229225

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.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

Sydney: 277 Woodpark Rd Smithfield NSW 2164 Ph 02 8784 8555 E samples.sydney@alsenviro.com
Newcastle: 5 Kingpin Rd Wallsend NSW 2287 Ph 02 4968 9433 E samples.newcastle@alsenviro.com
Brisbane: 32 Shand St Stafford QLD 4053 Ph 07 3243 7222 E samples.brisbane@alsenviro.com
Townsville: 14-15 Desma Ct Bohle QLD 4818 Ph 07 4796 0600 E samples.townsville@alsenviro.com
Melbourne: 24 Westall Rd Springvale VIC 3171 Ph 03 8549 9600 E samples.melbourne@alsenviro.com
Adelaide: 21 Burma Rd Pooraka SA 5095 Ph 08 8359 0890 E samples.adelaide@alsenviro.com
Perth: 10 Hod Way, Malaga WA 6090 Ph 08 9209 7655 E samples.perth@alsenviro.com
Launceston: 27 Wellington St, Launceston TAS 7250 Ph 03 6331 7258 E launceston@alsenviro.com

CLIENT: GHD

OFFICE: Coffs Harbour

PROJECT: 22162511

ORDER NUMBER:

PROJECT MANAGER: Ben Luffman CONTACT PH: 02 6650 5613

SAMPLER: SAMPLER MOBILE:

COC emailed to ALS? (YES / NO) EDD FORMAT (or default):

Email Reports to (will default to PM if no other addresses are listed): ben.luffman@ghd.com

Email Invoice to (will default to PM if no other addresses are listed):

TURNAROUND REQUIREMENTS: ☑ Standard TAT (List due date):

(Standard TAT may be longer for some tests e.g., Ultra Trace Organics) ☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: SY/270/12

COC SEQUENCE NUMBER (Circle)

COC: 1 (2) 3 4 5 6 7

OF: 1 2 3 4 5 (6) 7

FOR LABORATORY USE ONLY (Circle)

Custody seal intact Yes No N/A

Cooling Method: Ice Gel Ice Pack None

Frozen ice bricks present upon receipt Yes No

Cooling Initiated

Random sample temperature at receipt

Other comments:

RELINQUISHED BY: B. Colk DATE/TIME: 12/12/12

RECEIVED BY: David DATE/TIME: 12/12 09h

RELINQUISHED BY: DATE/TIME:

RECEIVED BY: DATE/TIME:

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	Antimony	Arsenic	11 metals	Gold					Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
BH102 (45)	BH102_0.8-1.0	11/12/12	Soil		1				✓					
9	BHDUP20					✓	✓							
10	BH103_0.0-0.1							✓						
11	BH103_0.3-0.5							✓						
(46)	BH103_0.5-0.7								✓					
12	BH104_0.0-0.1					✓	✓							
13	BH104_0.3-0.5					✓	✓							
14	BH105_0.0-0.1							✓						
15	BH105_0.3-0.5							✓						
(47)	BH105_0.7-0.9								✓					
16	BH106_0.0-0.1					✓	✓							
(48)	BH106_0.3-0.5								✓					
					TOTAL									

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CHAIN OF CUSTODY

ALS Laboratory: please tick →

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: : Brisbane: 32 Shand St. Stafford QLD 4053 Ph 07 3243 7222 E samples.brisbane@alsenviro.com
: : Townsville: 14-15 Desma Ct. Bohle QLD 4818 Ph 07 4796 0600 E samples.townsville@alsenviro.com
: : Melbourne: 24 Westall Rd Springvale VIC 3171 Ph 03 8549 9600 E samples.melbourne@alsenviro.com
: : Adelaide: 21 Burma Rd, Pooraka SA 5095 Ph 08 8359 0890 E adelaide@alsenviro.com
: Perth: 10 Hod Way, Malaga WA 6090 Ph 08 9209 7655 E: samples.perth@alsenviro.com
: Launceston: 27 Wellington St, Launceston TAS 7250 Ph 03 6331 2158 E launceston@alsenviro.com

CLIENT: GHD	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) Custody Seal Intact? Yes / No / N/A; Cooling Method: Ice / Ice Pack / None; Cooler Temperature on Receipt (°C); Any Quarantine / Classified Samples Identified? Yes / No; Other comments:
OFFICE: Coffs Harbour		☐ Non Standard or urgent TAT (List due date):	
PROJECT: 22162S1	ALS QUOTE NO.: SY/270/12	COC SEQUENCE NUMBER (Circle) COC: 1 2 3 4 5 6 7	
ORDER NUMBER:		OF: 1 2 3 4 5 6 7	
PROJECT MANAGER: Ben Huffman	CONTACT PH: 02 6650 5613		
SAMPLER:	SAMPLER MOBILE:	RELINQUISHED BY: B. Cork	RECEIVED BY: Dan J
COC emailed to ALS? (YES / NO)	EDD FORMAT (or default):	DATE/TIME: 12/12/12	DATE/TIME: 12/12 0815
Email Reports to (will default to PM if no other addresses are listed): ben.huffman@ghd.com		RELINQUISHED BY:	RECEIVED BY:
Email Invoice to (will default to PM if no other addresses are listed):		DATE/TIME:	DATE/TIME:

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	Antimony	Arsenic	Extractable Sb	Extractable As	hold				Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
17	BH107_0.0-0.1	11/12/12	Soil		1	✓	✓							
18	BH107_0.2-0.3	↓	↓			✓	✓							
19	SE015_0.0-0.1	10/12/12	Sed					✓	✓					
(49)	SE015_0.1-0.3									✓				
(50)	SE015_0.2-0.3									✓				
20	SE023_0.0-0.1							✓	✓					
21	SE023_0.1-0.25							✓	✓					
(51)	SE023_0.3-0.5									✓				
22	SE024_0.0-0.1							✓	✓					
(52)	SE024_0.1-0.2									✓				
(53)	SE024_0.2-0.25									✓				
(54)	SE024_0.3-0.5	↓	↓		↓					✓				
				TOTAL										

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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.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

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Townsville: 14-15 Desma Ct, Bohle QLD 4818 Ph 07 4796 0600 E samples.townsville@alsenviro.com
Melbourne: 24 Westall Rd Springvale VIC 3171 Ph 03 8549 9600 E samples.melbourne@alsenviro.com
Adelaide: 21 Burma Rd, Pooraka SA 5095 Ph 08 8359 0890 E adelaide@alsenviro.com
Perth: 10 Hod Way, Malaga WA 6090 Ph 08 9209 7655 E samples.perth@alsenviro.com
Launceston: 27 Wellington St, Launceston TAS 7250 Ph 03 6331 2458 E launceston@alsenviro.com

CLIENT: GHD	TURNAROUND REQUIREMENTS: ☑ Standard TAT (List due date):	FOR LABORATORY USE ONLY (Circle)	
OFFICE: Coffs Harbour	(Standard TAT may be longer for some tests e.g. Ultra Trace Organics) ☐ Non Standard or urgent TAT (List due date):	Custody seal intact	Yes / No / N/A
PROJECT: 22/6.25 1	ALS QUOTE NO.: S4/270/12	Free of headspace/bubble >5mm in VOA vials	Yes / No / N/A
ORDER NUMBER:	COC SEQUENCE NUMBER (Circle) COC: 1 2 3 4 5 6 7	Received Chilled	Yes / No
PROJECT MANAGER: Ben Luffman	CONTACT PH: 02 6650 5613 OF: 1 2 3 4 5 6 7	Random Samples Temperature on receipt	°C
SAMPLER:	SAMPLER MOBILE:	Other comments:	
COC emailed to ALS? (YES / NO)	EDD FORMAT (or default):		
Email Reports to (will default to PM if no other addresses are listed): ben.luffman@ghd.com			
Email Invoice to (will default to PM if no other addresses are listed):			

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
B. Cook	Dan J		
DATE/TIME: 12/12/12	DATE/TIME: 12/12 0851	DATE/TIME:	DATE/TIME:

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	Extractable S6	Extractable AS	Hold						Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
23	SE034_0.0-0.15	10/12/12	Soil		1	✓	✓	✓						
(53)	SE034_0.15-0.25							✓						
(58)	SE034_0.25-0.40							✓						
24	SE035_0.0-0.1					✓	✓							
(55)	SE035_0.15-0.25							✓						
(58)	SE035_0.3-0.5							✓						
25	SE036_0.0-0.2					✓	✓							
(54)	SE036_0.2-0.3							✓						
(60)	SE036_0.3-0.4							✓						
26	SE044_0.0-0.05					✓	✓							
27	SE045_0.0-0.2					✓	✓							
(61)	SE045_0.25-0.40							✓						
(62)	SE045_0.4-0.6							✓						
					TOTAL									

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CHAIN OF CUSTODY

ALS Laboratory: please tick →

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: Brisbane 32 Shand St Stafford QLD 4053 Ph 07 3243 7222 E samples.brisbane@alsenviro.com
: Townsville 14-15 Desma Ct Bohle QLD 4818 Ph 07 4796 0600 E samples.townsville@alsenviro.com
: Melbourne 24 Westall Rd Springvale VIC 3171 Ph 03 8549 9600 E samples.melbourne@alsenviro.com
: Adelaide 21 Burma Rd, Pooraka SA 5095 Ph 08 8359 0890 E samples.adelaide@alsenviro.com
: Perth 10 Hod Way, Malaga WA 6090 Ph 08 9209 7655 E samples.perth@alsenviro.com
: Launceston 27 Wellington St, Launceston TAS 7250 Ph 03 6331 2158 E launceston@alsenviro.com

CLIENT: GHD	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: Coffs Harbour		☐ Non Standard or urgent TAT (List due date):	
PROJECT: 22162511	ALS QUOTE NO.: EM/270/12	COC SEQUENCE NUMBER (Circle) COC: 1 2 3 4 (5) 6 7 OF: 1 2 3 4 5 (6) 7	
ORDER NUMBER:			
PROJECT MANAGER: Ben Huffman	CONTACT PH: 02 6650 5613		
SAMPLER:	SAMPLER MOBILE:	RELINQUISHED BY: B. Cook	RECEIVED BY: Dan J
COC emailed to ALS? (YES / NO)	EDD FORMAT (or default):	DATE/TIME: 12/12/12	DATE/TIME: 12/12 0815
Email Reports to (will default to PM if no other addresses are listed): ben.huffman@ghd.com		RELINQUISHED BY:	RECEIVED BY:
Email Invoice to (will default to PM if no other addresses are listed):		DATE/TIME:	DATE/TIME:

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	Antimony	Arsenic	Extractable Sb	Extractable As	hold				Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
28	SE069_0.0-0.15	10/12/12	Soil		1			✓	✓					Potentially
(67)	SE069_0.15-0.3									✓				V. High Contam
(64)	SE069_0.3-0.4									✓				
29	SE070_0.0-0.3							✓	✓					
(63)	SE070_0.3-0.4									✓				
(66)	SE070_0.4-0.6									✓				
30	SE071_0.0-0.15							✓	✓					
(69)	SE071_0.15-0.3									✓				
31	SE072_0.0-0.3							✓	✓					
(68)	SE072_0.3-0.4									✓				
(69)	SE072_0.4-0.5									✓				
(70)	SE072_0.5-0.65									✓				
					TOTAL									

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.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

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Adelaide: 21 Burma Rd, Pooraka SA 5095 Ph 08 8359 0890 E samples.adelaide@alsenviro.com
Perth 10 Hod Way, Malaga WA 6090 Ph 08 9209 7655 E samples.perth@alsenviro.com
Launceston: 27 Wellington St, Launceston TAS 7250 Ph 03 6331 2158 E launceston@alsenviro.com

CLIENT: GHD

OFFICE: Coffs Harbour

PROJECT: 2216251

ORDER NUMBER:

PROJECT MANAGER: Ben Luffman

CONTACT PH: 02 6650 5613

SAMPLER:

SAMPLER MOBILE:

COC emailed to ALS? (YES / NO)

EDD FORMAT (or default):

Email Reports to (will default to PM if no other addresses are listed): ben.luffman@ghd.com

Email Invoice to (will default to PM if no other addresses are listed):

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)

☑ Standard TAT (List due date):

☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: SY/270/12

COC SEQUENCE NUMBER (Circle)

COC: 1 2 3 4 5 6 7

OF: 1 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle)

Custody seal intact on receipt: Yes No

Frozen ice bricks present upon receipt: Yes No

Random Sample Temperature on Receipt:

Cooling Method:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
B. Cook	David		
DATE/TIME: 12/12/12	DATE/TIME: 12/12	DATE/TIME:	DATE/TIME:

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	Antimony	Arsenic	11 metals	Extractable Sb	Extractable As	hold			Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
32	SE103_0.05-0.1	10/12/12	Sed		1				✓	✓				. Potentially high Contaminated
33	SEDUP21								✓	✓				
34	SE103_0.1-0.3								✓	✓				
35	SE104_0.0-0.1								✓	✓				
36	SEDUP20								✓	✓				
71	SE104_0.2-0.3										✓			
37	SP004_0.0-0.1		Soil					✓						
38	SP004_0.1-0.2							✓						
39	MP001	11/12/12						✓						V. High Contam
40	MP002							✓						V. High Contam
														Possibly Mercury.
				TOTAL										

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.

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Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
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0	B. Cork	B. Luffman		I. Gregson		11.02.13

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Appendix E Remediation Action Plan



NSW Trade and Investment - Crown Lands

Former Antimony Processing Plant- Urunga NSW

Remedial Action Plan

Revision 1

September 2014

Abbreviations

ASSMAC	Acid Sulfate Soils Management Advisory Committee
ASSMP	Acid Sulfate Soils Management Plan
As	Arsenic
BSC	Bellingen Shire Council
CEMP	Construction Environmental Management Plan
CLM Act	Contaminated Land Management Act
CSM	Conceptual Site Model
COC	Contaminant of Concern
CQA	Construction Quality Assurance
Cr	Chromium
DECCW	NSW Department of Environment, Climate Change and Water (former, now the OEH)
DLWC	Department of Land and Water Conservation
EIL	Environmental Investigation Level
EMP	Environmental Management Plan
EPA	NSW Environment Protection Authority
HIL	Health Investigation Level
ISQG	Interim Sediment Quality Guideline
m	Metres
mbgs	Metres below ground surface
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Litre
NATA	National Association of Testing Authorities
NEPM	National Environmental Protection Measure
NSW	New South Wales
OCP	Organochlorine Pesticides
OEH	Office of Environment and Heritage
PAHs	Polynuclear Aromatic hydrocarbons
PASS	Potential Acid Sulfate Soil
Pb	Lead
PBIL	Phytotoxicity Based Investigation Levels

PCBs	Polychlorinated Biphenyls
PMF	Probable Maximum Flood
PQL	Practical Quantitation Limit
RAP	Remedial Action Plan
RPD	Relative Percent Difference
SOP	Standard Operating Procedure
QA	Quality Assurance
QC	Quality Control
Sb	Antimony
SCS	Soil Conservation Service
SEPP	State Environmental Planning Policy
SWMP	Soil and Water Management Plan
SWMS	Safe Work Method Statement
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total petroleum hydrocarbons
WHS	Workplace Health and Safety
XRF	X-Ray Fluorescence

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Appendices

Appendix A Summary Results

Appendix B Remediation Concepts

Appendix C Risk Assessment

1. Introduction

The Soil Conservation Service (SCS) has been engaged by NSW Catchment & Lands - Crown Lands (Crown Lands) to project manage the rehabilitation of a former antimony processing facility located at Hillside Drive, Urunga, NSW (the Site). GHD has been engaged to undertake a series of tasks relating to that project including:

- A Preliminary Investigation Report, which has previously been completed (GHD 2012a).
- Detailed Investigation Reports, which have previously been completed (GHD 2012b and GHD 2013).
- A Remedial Action Plan (RAP), which is this document.

1.1 Project background

The Site is located at Urunga, NSW, to the south east of the Pacific Highway and adjoining a State Environmental Planning Policy (SEPP) 14 wetland as illustrated in Figure 1-1 and Figure 1-2. The Site comprises part of Lot 1 and Lot 2 DP 874874, part of Lot 7062 DP 1108434 and part of Lot 253 DP 46013. All lots are Crown land.

The Site was a former antimony processing plant, which operated between 1969 and 1974, and was abandoned in 1974 without clean up or remedial work. Tailings and mill waste water were discharged onto the wetland foreshore area during the plant operations. A tailings deposit approximately 1 hectare (ha) in extent fans out into the adjoining wetland. The tailings and adjoining environment are contaminated by a range of heavy metals, particularly arsenic, antimony and mercury. A belt of dead *Melaleuca* trees characterises the periphery of the tailings deposit. The tailings area is devoid of vegetation, and is periodically inundated by flood water and/or surface runoff.

A partial clean-up of surface debris and waste materials on the former antimony processing site has been carried out by Entech Industries (Entech) in 2011, however no remediation or management of soil or tailings contamination has occurred.

A series of canals lies to the east of the tailings area. The wetland discharges into Station Creek, and Urunga Lagoon at the mouth of the Kalang River in Urunga.

Under the provisions of the Contaminated Land Management Act 1997 (CLM Act), a Management Order (No. 20111405) applies to Lot 253 DP 46013 (NSW EPA 2011). A Declaration of remediation site (No. 21020, Area 1089) applies to Lot 1 and Lot 2, DP 874874 and Lot 253 DP46013 (NSW EPA 2002). A portion of Lot 1 DP 874874 was removed from remediation area 1089 by means of a Notice to End Remediation Declaration in November 2005 (NSW EPA 2005). This was reflected in a Notice to Amend Management Order issued on 22 May 2012 (NSW EPA 2012a) which applied to the entire site (i.e. Part of Lot 1 in DP874874, Lot 2 in DP874874 and Lot 253 in DP46013) following the land transfer from Harry Ross Tickner to the State (Crown Lands).The dates for each milestone of the Management Order were successively revised in further Notices to Amend Management Order issued on 26 September 2012 (NSW EPA 2012b) and 21 May 2014 (NSW EPA 2014).

It is evident from previous investigations and the additional data obtained by GHD that significant contaminant impact is present in soils (including tailings and waste stockpiles) on the Site, sediment in adjoining areas, groundwater on the Site and surface water on and adjoining the Site. Section 1.3.4 summarises the extent, nature, exposure pathways and impacts relevant to the identified contamination. The remaining questions dealt with in this RAP are the extent and means of remediation or management that will be applied to minimise the future impact of the contaminants.

501,000 502,000 503,000

6,626,000

6,625,000

KALANG RIVER
FITZROY STREET
COOPERS LANE
ORARA STREET
BONVILLE STREET
MINERVA LANE
MORGO STREET
NEWRY STREET
CRESCENT STREET
PANORAMA PARADE
SOUTH STREET
PILOT STREET
HIGH STREET
HILLSIDE DRIVE
PACIFIC HIGHWAY
RALEIGH
KALANG RIVER
BELLINGER RIVER
MYLESTOM
BELLINGER RIVER
PACIFIC OCEAN
URUNGA
Urunga Lagoon
Wetland
Urunga Antimony Contaminated Site
NORTH COAST RAILWAY
CEMETERY ROAD
HUNGRY HEAD ROAD

QUEENSLAND
NEW SOUTH WALES
Locality Map

1:8,000 (at A3)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- North Coast Railway Line
- Contours
- SEPP14 Wetland
- WaterFeature
- Site Boundary

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NSW Catchment and Lands- Crown Lands
Former Antimony Processing Plant, Urunga NSW

Job Number	22-16251
Revision	0
Date	7 Apr 2014

Site Location Features - Overview

Figure 1-1

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1:1,500 (at A3)

0 10 20 40 60 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

Flood Levels - BSC Flood Risk Maps (2008)

- 100 Year
- Probable Maximum Flood (PMF)
- Waters Edge (August 2012)
- Lidar Contours
- Lot
- SEPP14 Wetland
- Site Boundary

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NSW Catchment and Lands- Crown Lands
Former Antimony Processing Plant, Urunga NSW

Job Number	22-16251
Revision	2
Date	7 Apr 2014

Site Location Features - Detailed

Figure 1-2

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Remediation requirements and options have been discussed previously, including in:

- *Part 2 Urunga Contaminated Site Remediation Options* (DLWC 1997a).
- A Site visit and inception meeting that was held on 9 May 2012 and attended by representatives from:
  - GHD
  - NSW Environmental Protection Authority (EPA)
  - Bellingen Shire Council (BSC)
  - Crown Lands
  - Soil Conservation Service
- Urunga Antimony Processing Plant Contaminated Site - Project Application & Preliminary Environmental Assessment (SCS, 2012).

1.2 Objectives and scope

The objectives of the remediation are to:

- Achieve compliance with the Management Order 20111405.
- Remediate the contamination at the Site so that any further impact on the adjacent wetland and receiving environment is minimised, and to allow the Site to be opened to public access without unacceptable risk to human health.

The specific objectives of the RAP as presented in EPA Management Order 20111405 and corresponding scope include:

- Prepare a RAP to remediate the harm caused and being caused by the significant contamination of the land. The RAP must:
  - Provide a detailed consideration of the remedial options nominated by the EPA from those outlined in the investigation report plus any other options put forward in writing by the EPA.
  - Nominate the preferred remedial option and provide reasoning.
  - Provide sufficient detail in the RAP to enable it to be implemented by a remediation contractor. This should include but not be limited to:
    - An estimation of the volume of material required for remediation.
    - Detailed characterisation of the nature of the material requiring remediation.
    - Figures, maps and/or plans showing with precision the locations of the material requiring remediation and the methods and design of any remedial system.
    - Detailed descriptions of any remedial technologies to be utilised.
    - A contingency plan, should the nominated remedial method fail.

Submit the RAP to the EPA for review and approval.

1.3 Contact details

Listed below are the various parties involved in the remediation, and their respective contact details.

1.3.1 Project manager

Responsible, as Owner's Representative, for funding and directing remediation towards the agreed goals.

Name: Clayton Colmer

Company: Soil Conservation Service

Telephone: 02 6650 3143

Mobile: 0437 013 126

1.3.2 Site manager

Represents the remediation contractor. Responsible for the required civil works, including all measures required to protect worker and public health and the environment during the works.

Name: TBC

Company: TBC

Telephone: TBC

Mobile: TBC

1.3.3 Environmental representative

May be engaged by the remediation contractor. Responsible for overall direction of environmental work associated with the remediation. Responsible for monitoring of work areas for environmental purposes and advising the Project Manager and site manager of appropriate actions on the basis of observations, sampling and analysis.

Name: TBC

Company: TBC

Telephone: TBC

Mobile: TBC

1.3.4 Environmental consultant

Independent from contractor. Responsible for guidance on the extent of remediation works, collection and analysis of validation and characterisation samples and advising the Project Manager of appropriate actions on the basis of observations, sampling and analysis.

Name: TBC

Company: TBC

Telephone: TBC

Mobile: TBC

2. Background

2.1 Previous investigations

Previous investigations undertaken at the Site include:

- DMR 1977. *Urunga Mineral Processing Plant Investigation*. Department of Mineral Resources Mines Inspection Branch.
- SPCC 1984. *Water Quality in the Bellingen and Kalang Rivers*. State Pollution Control Commission, Northern Rivers Study No. 2.
- Hicks 1993, *Investigation of Trace Metal Concentrations in Urunga Lagoon*. Bachelor Degree Thesis, The University of New England- Northern Rivers.
- DLWC 1995. *Assessment of Contaminated Crown Land at Urunga*. Department of Land and Water Conservation.
- DLWC 1997a. *Part 1 Urunga Contaminated Site Background and Results.* Department of Land and Water Conservation.
- DLWC 1997b. *Part 2 Urunga Contaminated Site Remediation Options.* Department of Land and Water Conservation.
- DLWC 2002 *Wasteland to Wetland. Evaluation of Options for Remediation of the Former Antimony Processing Plant at Urunga, NSW*. NSW Department of Land and Water Conservation, Resource Analysis Unit North Coast.
- Repath, P and Body, M 2003. *Flora and Fauna Evaluation for the Urunga Antimony Contaminated Site: An inventory assessment for an EIS*.
- Coffey 2004. *Validation Assessment of Stripped Area*.
- DMR 2004, NSW. *Abandoned Minesite Database. Urunga Mineral Preparation Plant.* Department of Mineral Resources.
- NSW EPA 2008. *Former Antimony Processing Plant Soil Sampling Results*. Environmental Protection Authority.
- SCS 2012. *Urunga Antimony Processing Plant. Contaminated Site - Project Application & Preliminary Environmental Assessment* Prepared for NSW Department of Planning. Soil Conservation Service.
- GHD (July, 2012a). *Former Antimony Processing Plant, Urunga, NSW – Preliminary Investigation Report*.
- GHD (December, 2012b). *Former Antimony Processing Plant, Urunga, NSW – Detailed Investigation Report*.
- GHD (February, 2013). *Former Antimony Processing Plant, Urunga, NSW – Detailed Investigation Report Addendum One – Supplementary Sampling Results*.

2.2 Conceptual site model

A conceptual site model (CSM) was presented in the Detailed Investigation Report (GHD, 2012b) and, where relevant to remediation, is summarised in the following subsections.

2.3 Site description

Site features are presented in Figure 1-2. In general, the Site consists of:

- A disturbed area incorporating the various features associated with the former antimony processing facility that is largely devoid of vegetation.
- A tailings area of approximately one hectare that is devoid of vegetation, extending from the former processing area into an adjacent, SEPP 14 wetland (no. 354).
- A generally forested area adjacent to the SEPP 14 wetland that contains at least 24 endangered or vulnerable fauna species.
- Surface material consisting of imported fill and tailings.
- Some remaining infrastructure consisting mainly of foundations of the former processing facility and loading ramps.
- Several remaining stockpiles of ore, rubbish and bricks.
- An 'L' shaped canal that has apparently been excavated from the wetland.
- A series of 'S' shaped canals.
- Visually impacted *melaleuca* trees in the wetland area, adjacent to the tailings deposit.

2.3.1 Soils

Reference to the Macksville Nambucca 1:100,000 Soil Landscape Map indicates the bedrock slopes above the mill at the site are in the Pine Creek (pn) landscape being gravelly red kurosols. The low footslopes above the tailings area are mottled grey red clays of the Bowra Creek (ba) soil landscape. The wetland area below the tailings is predominantly permeable acid peats and impermeable grey humic clays of the Charlmont (ch) soil landscape group (typically wetlands). This soil type generally contains high sulphide content presumably in both organic and inorganic forms (SCS, 2012).

The soils in the vicinity of the tailing deposit are considered to be acid sulfate soils. The preparation of a detailed management plan and development consent would be required for works that disturb the soil in that area. Acid sulfate soils generate acid where pyritic material is exposed to oxygen. Increased acidity may, in turn, exacerbate the mobilisation of metal contaminants.

In general, the lithology in the vicinity of the tailings consists of silty sand (tailings) to approximately 1.5 m depth overlaying approximately 1 m of clayey silt (described by DLWC as peat) and then silty clay from approximately 2.5 m below ground surface (bgs).

2.3.2 Hydrology

The Site sits between the footslope of a small ridge to the north and west and the SEPP 14 wetland to the south and east. Several small drainage lines meander through the site from the small catchment. Flood waters (BSC 2008) are shown to periodically inundate the Site (Figure 1-2) with the Probable Maximum Flood (PMF) level inundating the tailings, former gravel processing area and the canal systems. The PMF level does not cover the full extent of the former processing area. No tidal influence was noted during the field investigation program; however long period tidal influences may periodically inundate portions of the tailings during different hydrological conditions. Aerial photographs and anecdotal evidence from different times of the year indicate a significant seasonal fluctuation in the water level in the wetland.

2.3.3 Hydrogeology

Groundwater onsite ranged from approximately 0.4 to 1.4 m below ground surface (mbgs) and is interpreted to discharge into the wetland. Groundwater has only been investigated within the tailings area. The tailings material and underlying peat are expected to be highly permeable and hence the contaminants are likely to have high groundwater connectivity. Characteristics of deeper groundwater or groundwater flow into the site are not known.

2.4 Contaminants of concern

Several potential contaminant sources have been identified at the site including the tailings deposits, ore stockpiles, incidental contaminants, fill material, excavated sediments (from the creation of the canals) and any exposed, acid sulfate soils.

Based on a comparison of the historic results (compiled in GHD 2012a) and current analyte concentrations (from GHD 2012b and GHD 2013) with the adopted assessment criteria:

- Antimony and arsenic were evident as the key Contaminants of Concern (COCs). In nearly all cases, where one of the less significant COCs was present in significant concentrations, more significant concentrations of either antimony or arsenic were present. As a result, these analytes were deemed to be representative indicator analytes and the governing contaminants.
- Elevated aluminium and iron concentrations were noted throughout the site, including background samples. Due to the lack of applicable assessment criteria and elevated background levels, these analytes were not considered COCs.
- Chromium and nickel concentrations exceeded the adopted threshold criteria in sediment and groundwater. They were deemed to be COCs but are unlikely to govern remediation.
- Zinc concentrations were less than the adopted threshold criteria in soil, sediment and surface water but exceeded criteria for some of the groundwater sampling locations. Due to the relatively low concentrations and conservative assessment criteria, zinc was not considered a COC.
- Copper and lead concentrations were noted to exceed the adopted assessment criteria in the sediment, surface water and groundwater. They were deemed to be COCs but are unlikely to govern remediation.
- Elevated mercury concentrations were noted in all media and were noted to generally correlate with antimony and arsenic concentrations. Mercury is considered to be a COC.
- Cyanide was noted to be relatively low in soil, slightly elevated in some sediments and groundwater but absent in the surface water. Cyanide is hence considered a COC but is unlikely to govern remediation.
- Incidental contaminants may also be present on the Site (especially in the residual stockpiles), including:
  - Total Petroleum Hydrocarbons (TPH).
  - Polynuclear, Aromatic Hydrocarbons (PAH).
  - Organochlorine Pesticides (OCP).
  - Polychlorinated Biphenyls (PCB).
  - Asbestos.

A summary of the results is presented in the tables in Appendix A.

2.5 Contaminant delineation

2.5.1 Lateral extent

The interpreted extent of the contamination in the soil and sediment is presented in Figure 2-1 and Figure 2-2. The extent of impact in the surface water and groundwater is presented in Figure 2-3 and Figure 2-4, respectively. The data indicate considerable impact in the tailings and sediments, moderate contamination in the groundwater (given limited data) and a lesser degree of impact to the surface water quality.

The lateral extent of the impact in the soil can be summarised as:

- Roughly correlating with the absence of vegetation.
- Including the tailings deposit, former processing area and portions of the former unprocessed ore stockpiling area.
- Extending into the SW corner of the site, near the wetland, however the extent of this impact has not been fully delineated. Delineation would entail further sampling in the neighbouring property.
- Extending along the embankment in the vicinity of the 'L' shaped canal, at a depth of 1 to 1.7 mbgs. It is possible that impacted sediment and soil was excavated from the location of the 'L' shaped canal during canal and embankment construction. Clean soil from deeper within the profile beneath the 'L' shaped canal may have been placed over the impacted/ excavated sediment.
- Not extending into the NE portion of the site with the exception of an area of unknown disturbance, to the north of the 'L' Shaped canal. This area showed elevated antimony, arsenic and copper concentrations to a depth of approximately 1 mbgs.
- Not extending to the southern side of the wetland.

The lateral extent of the impact in the sediment can be summarised as:

- Showing highest levels of impact adjacent to the tailings deposit, extending approximately 50 m downstream of the tailing deposit and adjacent to the north eastern portion of the 'L' shaped canal. This is interpreted to reflect the distribution of sediment that would be expected from flood events transporting sediment downstream. The impacted sediments to the north east of the 'L' shaped canal may be as a result of deposition in an 'eddy' that would be present during high flow events, or may have been deposited by a former flow path prior to construction of the 'L' shaped canal, or dumped there during construction of the 'L' shaped canal.
- Including the western portion of the 'S' shaped canals.
- Including the south eastern portion of the 'S' shaped canals, suggesting a possible impact from the area of unknown disturbance in the vicinity of the NE portion of the site.

Insufficient data was available to accurately delineate sediment impact to the south east of the site, adjacent to the southern shore of the wetland. This data gap is deemed unlikely to affect decisions regarding the extent of remediation as the technical and commercial feasibility of remediation in that area would be limited, and the net environmental benefit (i.e. marginal degree of improvement vs extent of disturbance required) would be low.

2.5.2 Vertical extent

The interpreted vertical extent of the impact in the soil is presented in Figure 2-1. Depths vary from approximately 0.8 mbgs to 2.5 mbgs, as follows:

- The depth of contaminated soil extended to 1.2 mbgs in the NW portion of the Site.
- In the location of the former processing plant on the western boundary of the site, contaminated soil extended to a depth of 0.5 mbgs.
- Within the tailings deposit the depth of contaminated soil ranged from 1 mbgs to 3 mbgs.
- The north east area of unknown disturbance contained contaminated soil to a depth of 1 mbgs.
- The bund adjacent to the 'L' shaped canal had contaminated soil at a depth of between 1 mbgs and 2.5 mbgs, however, from the surface to 1 mbgs, the concentration of contaminants was less than the adopted criteria. This suggests contaminated soil, excavated from the 'L' shaped canal, was covered by clean soil.

As shown in Figure 2-2, impacts in the sediment range from about 0.5 mbgs near the tailings to 0.1 mbgs on the south of the wetland. The greatest antimony and arsenic concentrations were generally noted in the surface sediment (0-0.1 mbgs).

2.6 Estimated volume of impacted soil and sediment

Estimated volumes of impacted soil and sediment are shown in Table 4-2. It is conservatively estimated that approximately 28,175 m^3 of material has been impacted and 286 tonnes of antimony (and a similar mass of arsenic) is remaining onsite. Approximately 84% of the antimony and a similar proportion of arsenic is within the tailings deposit. The basis of these calculations is discussed in Section 4.3.

2.7 Contaminant concentration/time relationship

Concentrations of COCs in the soil recorded in this investigation were within a similar order of magnitude (given differences in sampling and analysis methods) as those recorded in the historical investigations. This implies concentrations have remained relatively constant over the sampling period.

2.8 Other site features

2.8.1 Stockpiles

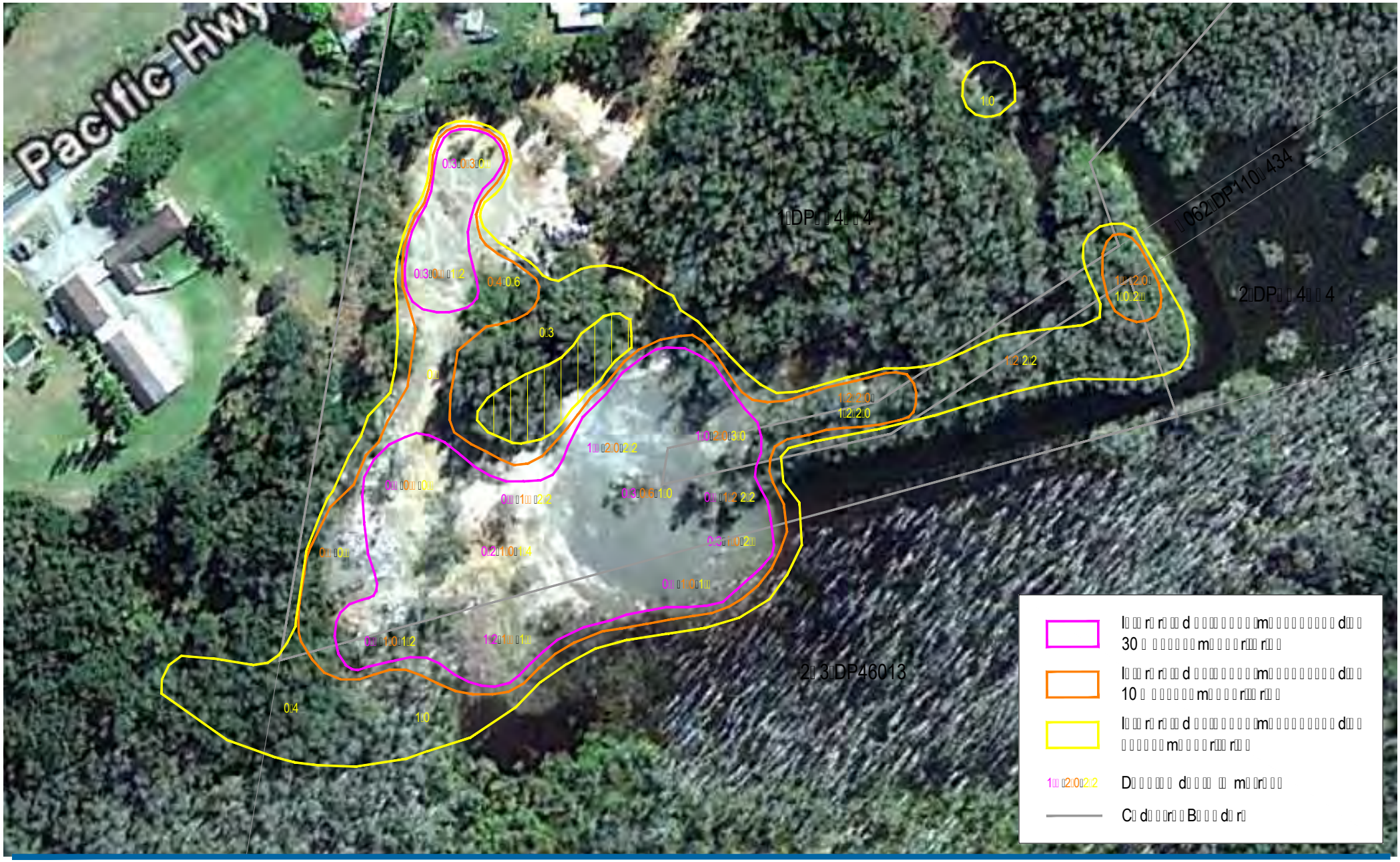
The stockpiles consisted mainly of ore material and soil with some debris including metal and potential asbestos containing material. The metal and COCs concentrations in the stockpiles were similar to those found in the tailings deposit.

2.8.2 Bricks

The bricks stockpiled in the northern portion of the site did not contain metal concentrations beyond background levels and no metal concentrations exceeded the thresholds for general solid waste. The bricks could hence be disposed as general solid waste or reused.

2.8.3 Mercury plugs

Two 'mercury plugs' were identified immediately west of the processing area. The analytical results show the mercury plugs to contain elevated concentrations of antimony, mercury and arsenic. Soil downgradient of these 'plugs' was moderately impacted by antimony and arsenic with one exceedance of the adopted assessment criteria for mercury to a depth of approximately 0.3 mbgs.



N

0 10 20 30 40 0m

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NSW Catchment & Lands - Crown Lands
Former Antimony Processing Plant - Urunga
RAP

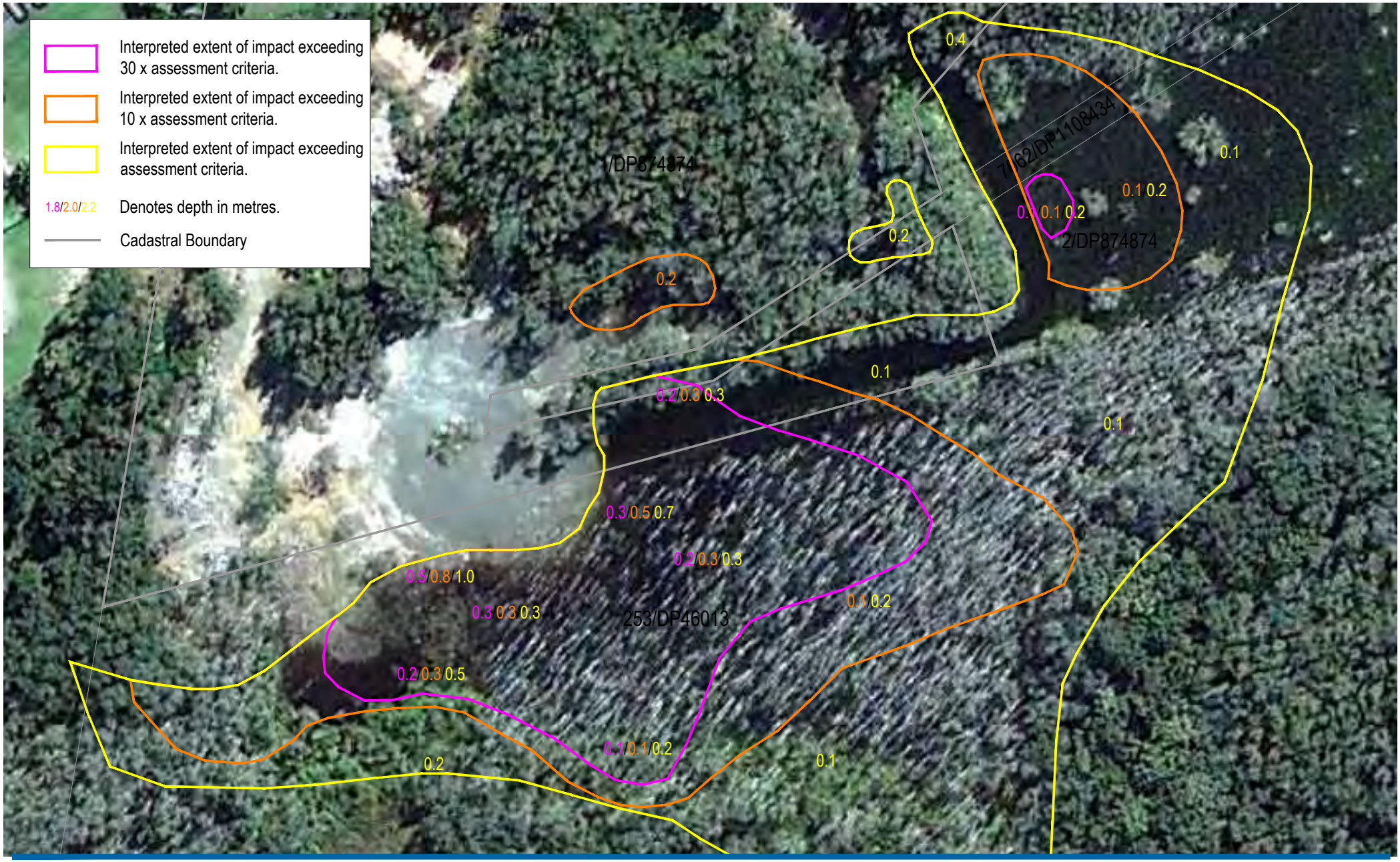
Estimated Area & Volume of Impacted Soil

Job Number 22-16251
Revision A
Date NOV.2013

Figure 2-1

230 Harbour Drive Coffs Harbour NSW 2450 Australia T 61 2 6650 5600 F 61 2 6650 5601 E cfsmail@ghd.com W www.ghd.com

Plot Date: 3 April 2014 - 12:39 PM Plotted by: Ian Gould Cad File No: G:\22\16251\CADD\Drawings\22-16251-FIG RAP.dwg



N

0 10 20 30 40 50m

GHD

NSW Catchment & Lands - Crown Lands
Former Antimony Processing Plant - Urunga
RAP

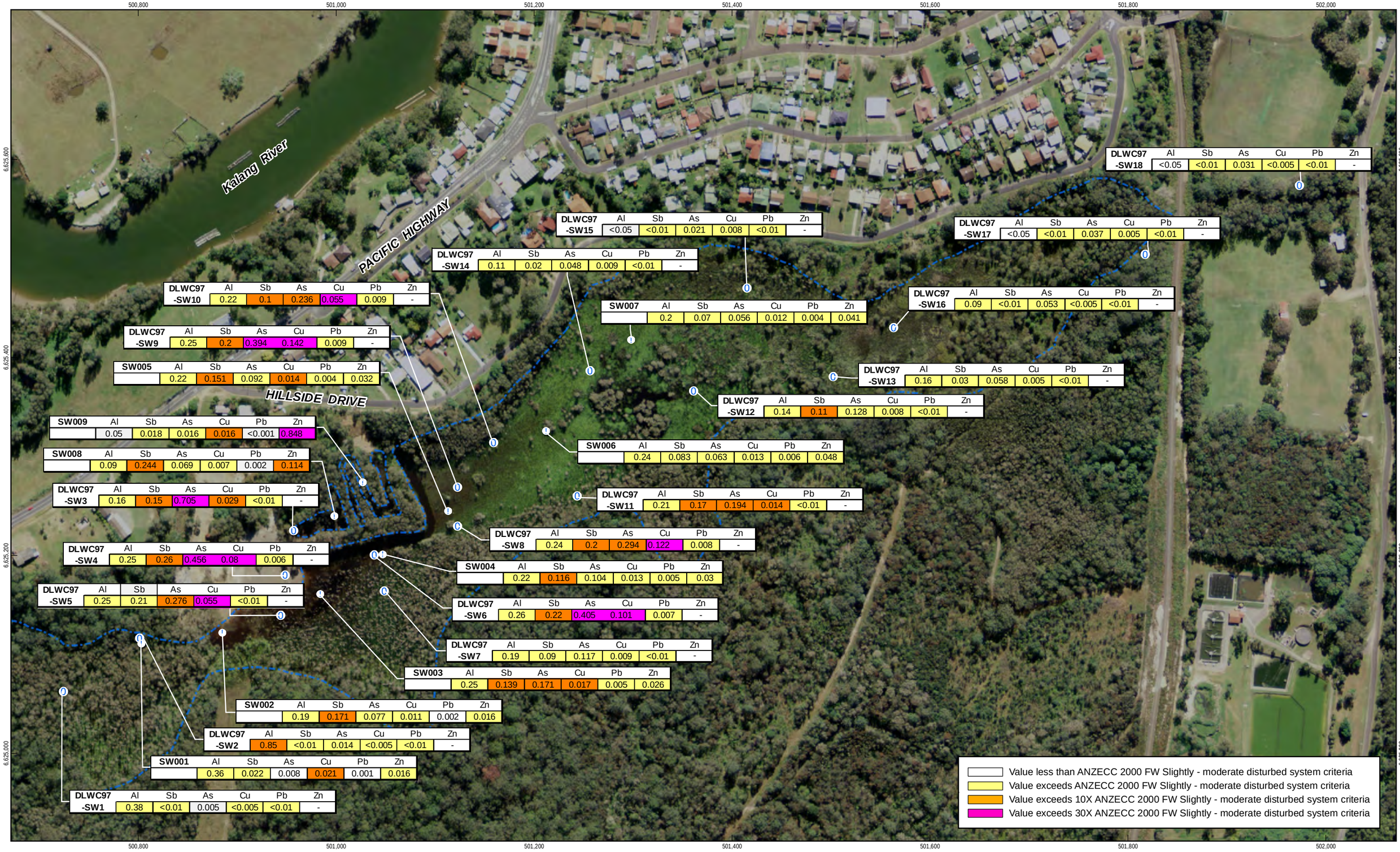
Estimated Area & Volume of Impacted Sediment

Job Number	22-16251
Revision	A
Date	NOV.2013

Figure 2-2

230 Harbour Drive Coffs Harbour NSW 2450 Australia **T** 61 2 6650 5600 **F** 61 2 6650 5601 **E** cfsmail@ghd.com **W** www.ghd.com

Plot Date: 3 April 2014 - 12:38 PM Plotted by: Ian Gould Cad File No: G:\22\16251\CADD\Drawings\22-16251-FIG RAP.dwg



1:3,500 Paper Size A3

0 25 50 100 150 200

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Legend

- ! Water Sampling Location (2012)
- 0 Water Sampling Location (1997)
- Approx. Wetland Boundary
- 0.25 Total metal concentration (mg/L)

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga NSW
RAP

Job Number	22-16251
Revision	A
Date	06 Dec 2012

Surface Water Sampling Locations

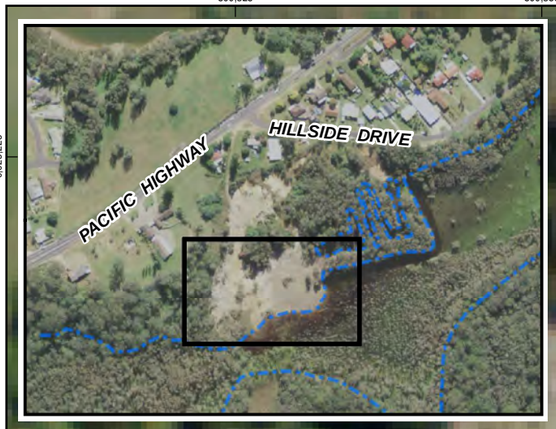
Figure 2-3

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Data source: DPI, Aerials, 2012. Created by:ihamilton

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DLWC97-GW4	Al	Sb	As	Cu	Pb	Ni	Hg	Zn
1997- Total	9.7	5.6	19	0.17	3	-	0.046	-
2012- Filtered	1.15	1.17	5.56	0.027	0.017	4.07	<0.0001	0.208

DLWC97-GW7	Al	Sb	As	Cu	Pb	Ni	Hg	Zn
1997- Total	6.5	4.1	89	0.184	1.6	-	0.048	-
2012- Filtered	0.67	1.45	37	0.006	0.02	0.013	0.0005	0.051

DLWC97-GW13	Al	Sb	As	Cu	Pb	Ni	Hg	Zn
1997- Total	3.2	4.4	21	0.465	0.573	-	0.019	-

DLWC97-GW6	Al	Sb	As	Cu	Pb	Ni	Hg	Zn
1997- Total	9.7	5.6	19	0.17	3	-	0.046	-
2012- Filtered	2.19	1.39	72.6	0.011	0.125	0.013	0.0026	0.063

DLWC97-GW12	Al	Sb	As	Cu	Pb	Ni	Hg	Zn
1997- Total	3.2	1	0.423	1.3	0.245	-	<0.001	-
2012- Filtered	0.05	1.21	34.5	0.01	0.002	0.022	0.0002	0.074

Value less than ANZECC 2000 FW Slightly - moderate disturbed system criteria
Value exceeds ANZECC 2000 FW Slightly - moderate disturbed system criteria
Value exceeds 10X ANZECC 2000 FW Slightly - moderate disturbed system criteria
Value exceeds 30X ANZECC 2000 FW Slightly - moderate disturbed system criteria

1:500 Paper Size A3

0 2.5 5 10 15 20 25

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

Legend

U Groundwater Sampling Location

Approx. Wetland Boundary

3.2 Metal concentration (mg/L)

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga NSW
RAP

Job Number	22-16251
Revision	A
Date	06 Dec 2012

Groundwater Sampling Locations

Figure 2-4

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3. Treatment trials

Hazmat Services Pty Ltd (Hazmat) and Bairad (Prescience) Pty Ltd have completed treatment trials on nine samples from different areas of the Site. The treatment trials indicated that the material could be immobilised and achieve pH stabilisation appropriate for long term landfill disposal.

Full details of the treatment trials were not available to GHD, and GHD has been advised that the exact reagent regime and treatment methodology are proprietary and commercial in confidence. It is understood that the treatment for off-site disposal (if required) would be subject to a Specific Immobilisation Approval (SIA) approved by the EPA. The EPA has confirmed that they will review and approve an appropriate treatment process and methodology for on-site containment. This will be described in the Quality Control Plan that will be submitted prior to works commencing (see Section 5.5).

4. Remediation options assessment

4.1 General

A contaminated site, as defined by the "Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites" (ANZECC/NHMRC, 1992), is a site at which hazardous substances occur at concentrations above background levels, and where assessment (with reference to appropriate criteria) indicates it poses, or is likely to pose, an immediate or long term hazard to human health or the environment. ANZECC/NHMRC (1992) describes a number of principles of contaminated site management, including the following:

- Contaminated site management strategies should reflect the need to protect all segments of the environment both biological and physical.
- The fundamental goal of contaminated site clean-up should be to render a site acceptable and safe for a long term continuation of its existing use and to maximise to the extent practicable the potential future uses of the site.
- Wherever human health is at risk, either on or off-site, or the off-site environment is at risk, a contaminated site should be cleaned up to the extent necessary in order to minimise such risks in both the short and long terms. However, in cases where there is no threat to human health and the environment is not at risk, it may be appropriate to clean-up the site to some lesser degree, and in some cases to accept a strategy of containing contaminants on the site or using planning controls to limit site use. Considerations of technical feasibility and of net social benefit should always play a part in influencing the clean up strategy for a particular site.
- Clean-up should not proceed if the process is likely to create a greater adverse effect than leaving the site undisturbed.

Environmental and Human Health Risk is based on exposure to potential hazards and is defined as:

- Risk = Hazard x Exposure.
- The elimination of risk can be achieved by the removal of the hazard and/or the exposure pathway. Remediation commonly involves removal of the hazard, while risk management involves removal of the exposure pathway but the hazard may remain. Exposure pathways to contaminated material can be managed by any physical action and/or management plan which prevents exposure to contaminants, such as planning controls, management controls, and/or site remediation.
- A planning control is any means to control future change of end use and associated demolition/construction activities, and could take the form of leasing/selling arrangements to specific planning legislation controls. For example if contaminated soil is buried/capped in a particular zone, that zone may be designated to have a particular land use e.g. public open space or roadways. This enables the material to be placed in less sensitive land use areas (e.g. under roadways) within land used for more sensitive purposes such as residential.

A risk based remediation/management strategy consistent with the strategy outlined in ANZECC/NHMRC (1992) is considered appropriate for the remediation of contaminated soils and sediments on the site. The general objective of the remediation will be to remove, manage or remediate areas of contamination that present an unacceptable risk to human health or the environment under the proposed land use scenarios.

Where contaminated material is to be removed, it will be remediated to the extent practical, subject to consideration of risk and economic factors and consistent with the net environmental benefits of the overall site remediation. Assessment of the risk associated with remaining contamination will be based on the assessment criteria described in Section 6 of this RAP.

GHD notes that the scope of previous assessments and this RAP have not allowed for a site-specific risk assessment, and the assessment criteria described in Section 6 are investigation levels, which the NEPM 1999 (NEPC 2013) describes as the concentrations of a contaminant above which further appropriate investigation and evaluation are required. The NEPM (Schedule B1) notes that investigation and screening levels are not clean-up or response levels, and the use of investigation and screening levels as default remediation criteria may result in unnecessary remediation and increased development costs, unnecessary disturbance to the site and local environment, and potential waste of valuable landfill space.

The NEPM 1999 (NEPC 2013) Schedules B4 and B5 note that exceedance of investigation levels would typically prompt a site-specific risk assessment and the development of site-specific risk-based criteria for comparison with site data. The processes for health risk assessment (HRA) and ecological risk assessment (ERA) are similar, differing primarily in the pathways and receptors involved. The NEPM 1999 (NEPC 2013) acknowledges that more detailed stages of risk assessment are more time consuming and costly, and notes that where no further assessment is proposed, a clear and transparent explanation should be provided.

In this instance, it is considered that the main function of a site specific risk assessment would be to establish concentrations of the COCs that would result in a particular level of impact/species protection at the periphery of the areas of contamination. Concentrations of COCs in the most significantly impacted areas of the Site are clearly above the relevant assessment criteria and are having an evident impact on the environment (and hence clearly require remediation or management). Even with site specific risk assessment, there would still be some uncertainty as to acceptable concentrations of COCs at the periphery of the impacted area, and other factors such as the cost and net environmental benefit of extending the area of remediation are likely to have greater influence on the decision process than a more precise understanding of the level of risk. This RAP has therefore concentrated primarily on evaluating the most appropriate remediation methodology to manage the most significant areas of impact, with decisions on the subsequent extent of remediation in peripheral areas to be made in consultation with the stakeholders. Decisions are to be based on a range of factors that will influence the remediation works as described further in the following sections of this RAP.

4.2 Remediation objectives

The intention of Crown Lands is to use the site as Public Open Space. Considering this proposed land use and the location of the site (adjoining a SEPP 14 wetland and upstream of Urunga Lagoon), the following remediation objectives should be met:

- Remediation should enable the site to be safely opened to public access, without unacceptable risk to health from contamination.
- Remediation should result in final landforms that facilitate beneficial use of the site as public open space, and satisfy relevant stakeholders to the maximum practical extent.
- Remaining contamination should not present any unacceptable risks to the environment.
- Remediation works should not cause greater environmental or health impacts than would occur if the contamination is left in place.
- Concentrations of contaminants should be below appropriate health-based assessment criteria in surface soils and soils likely to be disturbed during use of the site (taking into account potential redevelopment works).

- Concentrations of contaminants exceeding ecological investigation levels must not be placed in a location or manner that could reasonably be expected to exacerbate existing risks of potential impact to ecological receptors.
- Remediation must be able to be completed within the funding available for the work.
- Remediation must meet the requirements of EPA Management Order 20111405.

The adopted remediation activity must also:

- Be cost effective to ensure maximum reduction in bio-available contaminants over the long term.
- Consider the latest approaches to stabilisation of the key contaminants of concern.
- Allow for the impact of periodic flooding and tidal influence at the site.
- Favour solutions that separate contaminated material from water within the hydrological zones.
- Effectively manage acid sulfate soils (ASS).
- Be in compliance with all relevant Commonwealth, State and Local legislation.

The decision process governing remediation should also consider the final land form and land use. For instance, management measures or institutional controls may be an effective means of controlling risks in some areas, if these are compatible with long-term beneficial use of the area. These considerations are likely to be specific to each particular area of the Site. GHD considers that effective planning and a clear vision of the final land form and use will result in the most cost effective remediation as well as the best outcome for rehabilitation of the site. The involvement of key stakeholders at the remediation planning stage will be essential to this outcome.

For the purposes of this RAP, the primary target for remediation is the tailings deposit. Consideration will be given to remediation of sediments and other areas of contamination, if practical.

Further details as to how the contamination will physically be removed from excavations, including details on shoring/battering and dewatering of excavations will be included in a Construction Environmental Management Plan (CEMP) to be prepared prior to construction activities.

Details of the remediation works required to achieve these objectives are described in Section 5.

4.3 Areas requiring remediation

Figure 2-1 and Figure 2-2 show the interpreted extent of significant contamination on the site that has been identified by investigations to date. There are some isolated areas outside the interpreted extent of impact where contamination exceeds the adopted criteria by less than 10 times, however these areas are considered to present a relatively low risk to health or the environment, and existing impact is not evident in these areas (eg. vegetation is healthy). Given the remediation objectives and constraints, it is not considered that remediation of such areas is warranted.

Conversely, there are some areas (eg. former ore stockpiling / site access in the northern portion of the site) where significant contamination has not been identified but remaining impacts are evident. These areas will require some form of rehabilitation if only for aesthetic reasons, although remediation per se (eg. to prevent unacceptable health risks) is not required.

Within the interpreted extent of impact, a balance will be required to address the remediation objectives. The cost of remediation and the impacts incurred during the remediation works will need to be weighed up against the impacts and risks of leaving areas of contamination in place. Without prejudicing the decisions for any particular area, as general guidance it is proposed that areas will not warrant remediation where the following conditions apply:

- Contamination is present at concentrations less than relevant health investigation levels (on a statistical basis for the subject area) and/or the potential for exposure is acceptably low.
- Contamination concentrations are nominally less than 10 times the ecological investigation levels, or higher exceedences are relatively isolated in extent and in an area where there would be a high risk of ecological impact by remediation activities.
- The area is physically stable and has a good cover of viable vegetation.
- Extensive disturbance of the area would be required to remove or treat the contamination.

A discussion of areas potentially requiring remediation is presented in Table 4-1 along with conservative estimates of the volume of material contaminated and the mass of antimony in each area. The locations of the areas defined in the table are presented in Figure 4-1. Table 4-2 presents the volumes and mass of antimony[1] in more detail, along with the cumulative volume and mass of antimony removed by remediating the areas in order of the greatest mass (generally corresponding to the highest contaminant concentrations) to the least. Figure 4-2 illustrates the cumulative effect and the diminishing returns after the main areas of contamination have been remediated.

'Conservative' and 'optimistic' estimates of volumes of material and mass of antimony were calculated for each area as a basis for reviewing options with the stakeholders. The volumes of material with concentrations greater than 30 times and greater than 10 times the guideline have also been calculated for areas A and B, as shown in Table 4-2. The conservative volumes have been calculated by assuming the identified impact extends to the depth identified as having a lower concentration (e.g. where concentrations of 30 times and 10 times the guideline were identified at depths of 1.5 and 2.0 m respectively, the soil with 30 times impact was assumed to extend to a depth of 2.0 m). The optimistic estimate has been calculated by assuming the identified impact extended only to the minimum depth of identified impact (e.g. where concentrations of 30 times and 10 times the guideline were identified at depths of 1.5 and 2.0 m respectively, the soil with 30 times impact was considered to extend only to a depth of 1.5 m). The conservative and optimistic depths of impact were then multiplied by the area to provide the volume. The volumes were multiplied by the average contaminant concentration from the samples from within each area and sub area (i.e. greater than 30x and greater than 10x the guideline) to give the mass of antimony.

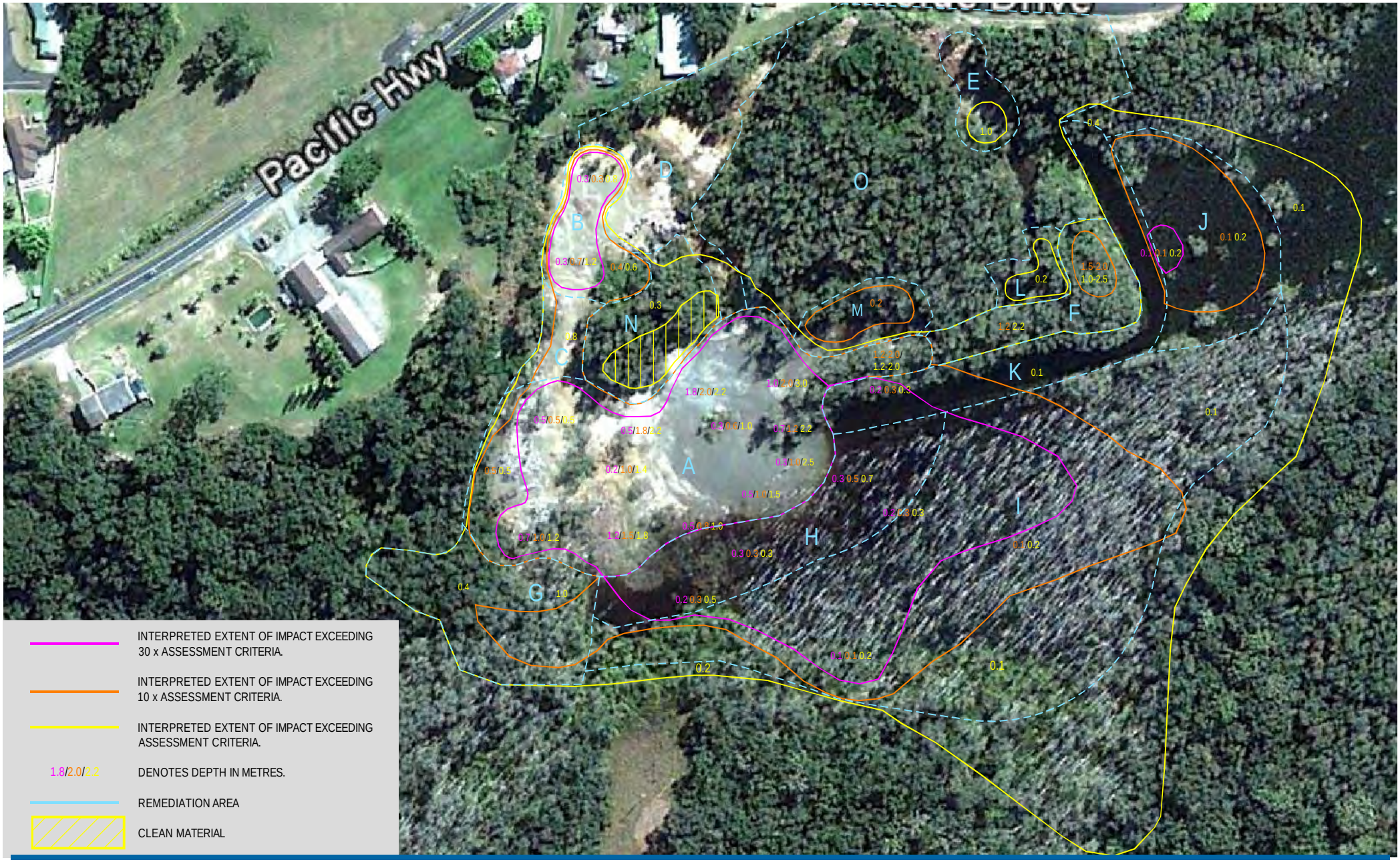
[1] For simplicity, only antimony data has been illustrated; however the arsenic concentrations and mass are closely related to those of antimony, and are adequately illustrated by the antimony data.

Table 4-1 Remediation areas

Area	Description	Characteristics	Area (m^2)	Estimated Contaminated Volume (m^3)	Estimated Mass of Antimony (tonnes)	Comment
A	Main tailings and former processing area	Significant contamination, exceeding 30 x HIL E in most of area. Contains tailings, remnant stockpiles and miscellaneous contamination / waste materials. Little or no vegetation. Groundwater exceeds ANZECC criteria by more than 30 times.	10,300	19,000	240	Requires remediation. Extent is relatively insensitive to selected clean-up levels, as there is a relatively quick cut-off to lower levels at boundaries of area.
B	Former ore stockpile area	Significant contamination, exceeding 30 x HIL E. Level area with little or no vegetation.	1,730	1,170	13	Requires remediation. Extent may vary somewhat, but not expected to have significant effect on overall volumes or remediation strategy.
C	Between ore stockpile and process area	Level area with little or no vegetation.	700	580	2	Requires remediation. The extent is relatively shallow and may vary laterally, but not expected to have significant effect on overall volumes or remediation strategy.
D	Former site access area	Relatively well characterised, no significant contamination. Little vegetation, likely because area has been excavated to bedrock.	3,430	<1	<1	Will require rehabilitation for aesthetic reasons.
E	North eastern disturbed area	Some contamination less than 10 x HIL E, XRF data indicates significant lead and zinc contamination. No vegetation. Drainage pathway. Likely source of impact to north end of S shaped canals and north end of L shaped canal (elevated zinc).	900	200	<1	Likely to require remediation subject to further characterisation. Will require rehabilitation for aesthetic reasons.
F	Panhandle adjoining L shaped canal	Contamination exceeds 10 x HIL E at some locations, at former ground level generally beneath at least 0.5 m 'clean' soil. Vegetation is healthy. Boundary between Area A and Area F to	1,950	970	5	Low risk to health or environment due to relatively limited extent (likely previously impacted natural soils) and lack of exposure to contamination. Could be managed by installing a boardwalk through this area, also making use of the physical

Area	Description	Characteristics	Area (m^2)	Estimated Contaminated Volume (m^3)	Estimated Mass of Antimony (tonnes)	Comment
		be determined.				characteristics for beneficial future use of the site.
G	South west of processing plant and tailings area.	Contamination exceeds criteria and extends into adjacent property. Extend of contamination extends to at least 0.5 mbgs and additional work required to delineate lateral extent. Area is extensively vegetated.	3,400	280	<1	Remediation likely to be required, subject to further delineation to define extent and degree of contamination, including on adjacent property. Extent of remediation will need to be determined.
H	Wetland adjoining south of tailings area.	Significant impact exceeding 30 x HIL E and 30 x sediment criteria. Surface water exceeds ANZECC criteria by more than 10 times. Significant impact to vegetation apparent. Boundary between Area H and Area I to be determined. Further delineation of extent and degree and ecology / ecotoxicology studies (eg. field survey) recommended to aid decisions on extent of remediation.	4,000	1,930	11	Remediation considered to be required, extent will require consideration of cost, impacts during remediation vs risks associated with leaving contamination in place. Boundary between Area H and Area I to be determined.
I	Southern side of wetland.	Significant impact exceeding 30 x sediment criteria, but vegetation does not show as significant impact as Area H.	18,800	2,280	10	May not warrant remediation due to considerations of cost and impacts during remediation vs risks associated with leaving contamination in place.
J	Wetland east of L shaped canal.	Significant impact exceeding 30 x sediment criteria. Vegetation does not show significant impact. Further delineation of extent and degree and ecology / ecotoxicology studies recommended to aid decisions on extent of remediation.	3,800	350	1	May not warrant remediation due to considerations of cost and impacts during remediation vs risks associated with leaving contamination in place.
K	L shaped canal	Areas of contamination adjacent to tailings but less than adjacent wetland sediments. Significant depth likely to limit potential exposure.	3,300	520	2	Likely no remediation. Uncertainties subject to further sampling and possibly ecotox survey.

Area	Description	Characteristics	Area (m^2)	Estimated Contaminated Volume (m^3)	Estimated Mass of Antimony (tonnes)	Comment
L	SE corner of S shaped canal	Elevated As, Sb and Zn with respect to sediment criteria and EILs, but not significantly above HIL E. No apparent impact, well vegetated, low potential for migration offsite.	660	60	<1	No remediation proposed.
M	Western end of S shaped canals.	Adjoins tailings area, apparent impact from migration of sediments from tailings area. Sb and As greater than 10 times HIL E and sediment criteria, little vegetation, potential for exposure.	1,125	120	<1	Remediate in conjunction with Area A.
N	Vegetated area between ore stockpile area and tailings area.	The extent of impact was noted to extend into the north western portion of the vegetated area. Contamination extended to approximately 0.2 mbgs.	2,140	635	1	Remediate the northern western portion in conjunction with Area B and C.
O	North eastern portion of site.	Mainly densely vegetated, no significant signs of impact, relatively well characterised, contaminant concentrations less than 10 x HIL E and in most cases less than EILs.	15,550	0	0	No remediation proposed.



NSW Catchment & Lands - Crown Lands
Former Antimony Processing Plant - Urunga
RAP

REMEDIATION AREAS

Job Number 22-16251
Revision A
Date NOV.2013

Figure 4-1

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Plot Date: 28 November 2013 - 12:56 PM Plotted by: Mika Kama Cad File No: G:\22\16251\CADD\Drawings\22-16251-FIG RAP.dwg

Table 4-2 Volume and mass of antimony by remediation area

Area	Estimated Volume of Soil (m^3)	Estimated Mass of Antimony (tonnes)	Cumulative Volume of Soil (m^3)	Cumulative Mass of Antimony (tonnes)	Cumulative Mass of Antimony Removed (% of overall mass of Antimony identified onsite)
A (30x)[1]	9854	189	9854	189	66
A (10x)[2]	4910	44	14764	233	82
A (>Guideline)[3]	4319	7	19083	240	84
B (30x)[1]	474	9	19557	249	87
B (10x)[2]	692	4	20249	253	89
C	579	2	20828	255	89
D	<1	<1	20828	255	89
H	1929	11	22757	266	93
I	2280	10	25037	276	97
E	202	<1	25239	276	97
G	280	<1	25519	277	97
M	119	<1	25638	277	97
F	969	5	26607	282	99
N	635	1	27424	283	99
K	517	2	27759	285	100
J	353	1	28112	286	100
L	63	<1	28175	286	100
O	<1	<1	28175	286	100

[1] This relates to material that has a concentration of antimony 30 times or greater than the guidelines.

[2] This relates to material that has a concentration of antimony between 10 times and 30 times greater than the guidelines.

[3] This relates to material that has a concentration of antimony between the guideline and 10 times greater than the guidelines.

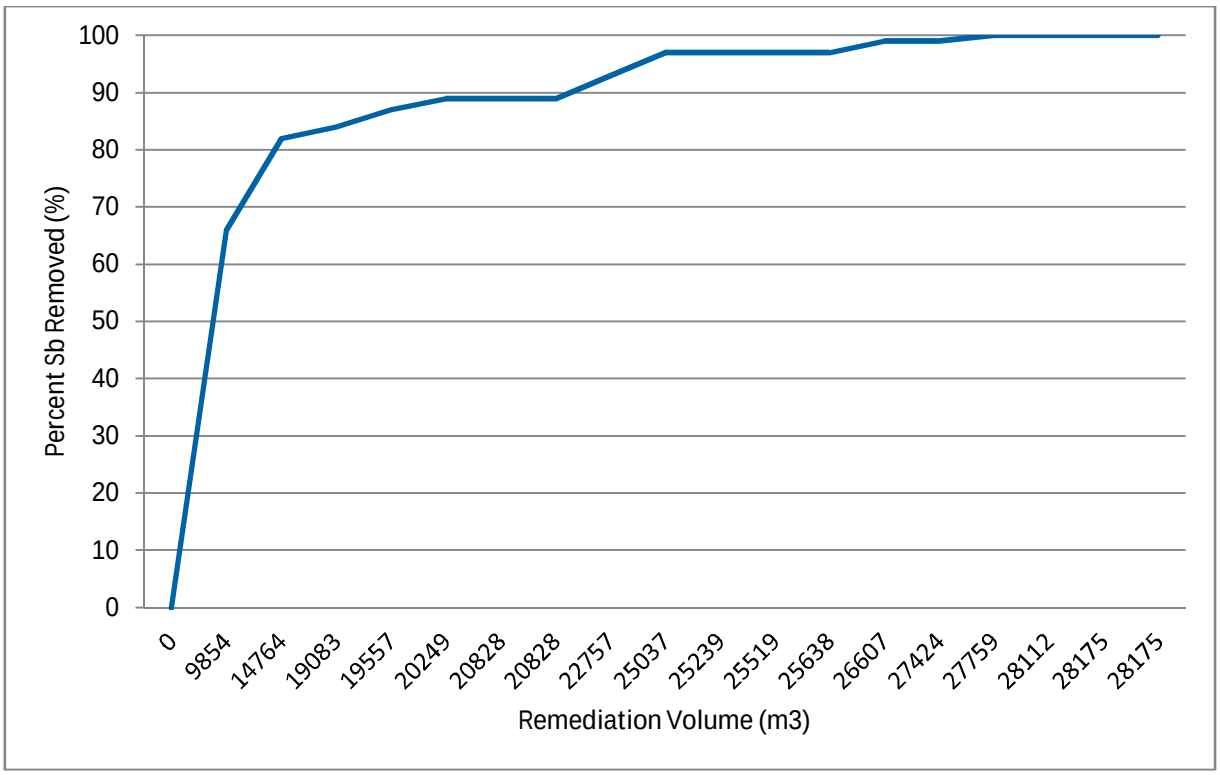


Figure 4-2 Proportion of antimony removed compared to the volume of material removed

4.3.1 Summary

In summary, Area A is considered the priority for remediation due to the concentration and mass of contamination plus its proximity to the edge of the wetland. Remediating this area would remove approximately 84% of the overall amount of contamination identified onsite. Extending the remediation area to include Areas B, C and H would increase the overall mass of antimony removed from the site to 266 tonnes or 93% of the total amount identified onsite. These areas could be remediated relatively easily and with minimal impact. Area I also has a relatively large volume and mass of contamination but access would be difficult and the impact of remediation versus the benefit needs to be considered.

Contamination exists at Areas F, J, K, M and N but there is limited volume and most areas are covered in vegetation or under water. Area M could be relatively easily remediated but the cost and damage caused by remediating the other areas may be greater than the benefits.

Area G is not as contaminated as other areas and is heavily vegetated, but may require remediation because part of the area is offsite.

It is also recommended that Areas D and E be rehabilitated during the remediation because access is readily available and it would improve the aesthetics of the site.

No remediation is considered necessary at Areas L and O.

4.4 Technical and policy considerations

The EPA's preferred order of options for site remediation and management, in accordance with policy described in ANZECC/NHMRC (1992) and DEC (2006), is as follows:

- On-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level.
- Off-site treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site.

If these options cannot be implemented, then other options that should be considered include:

- Removal of contaminated soil to an approved site or facility, followed, where necessary, by replacement with clean fill.
- Consolidation and isolation of the soil on-site by containing within a properly designed barrier.

The NEPC (2013) reverses the preferred order of the last two points. Considerations of sustainability and the Waste Avoidance and Resource Recovery (WARR) Act (1997) also support avoiding off-site disposal.

For on-site containment of contamination, whether in a dedicated cell or as part of site development, the EPA requires containment to achieve the following:

- Maximise the long-term engineering security of the works, and, where applicable, minimise the potential for leachate formation and/or volatilisation.
- Exclude the erection of structures on the capped or contained area that may result in risk of harm to the public health or the environment.
- Include a notification mechanism to ensure that the capped or contained areas are protected from any unintentional or uncontrolled disturbance that could breach the integrity of the physical barrier.

4.5 Identified remediation options

Four broad options for remediating the site have currently been identified. The remediation options relate to those areas identified for remediation in Table 4-1 and Figure 4-1.

The four remediation options are briefly explained below and illustrated in Appendix B.

While a single remediation strategy may be selected for the overall works, it is likely that a combination of strategies may be applicable to some areas of the site (i.e. outside the main remediation area), particularly in areas where a management, rather than intrusive remediation approach, is considered to be more appropriate (following the considerations described elsewhere in this report). For instance, there will be some off-site disposal (of miscellaneous materials) regardless of the overall preferred option; potentially some contaminated sediments could be capped in situ to minimise disturbance; and management of contaminated land adjoining the site may be appropriate for Area G.

The option of 'Do Nothing' was not considered appropriate due to the identified, current impact resulting in a lack of vegetation in the vicinity of the tailings deposit and potential risk associated with further, potential mobilisation of impacted soil, sediment and water. However, this may apply to "fringe" areas of the site, as noted above.

4.5.1 Option 1 - Off-site reprocessing or disposal without treatment

This option would involve the removal of source material, long haul transport, and off-site reprocessing and disposal at an appropriate ore processing facility. The processing facility considered during the assessment was Hillgrove Mine (near Armidale NSW) because it is the closest antimony processing area to the Site hence minimising transport cost. Hillgrove Mine has infrastructure to process similar minerals, although the tailings dam at the facility would likely need to be upgraded to accommodate the additional material.

An alternative option i.e. Option 1B, is the disposal of the untreated material at an appropriately licenced landfill able to accept the untreated material. The landfills investigated were in south-east Queensland because NSW does not have landfills licenced to accept much of the untreated material.

The main tasks involved with these options, would include:

- Site and access establishment.
- Removing existing infrastructure and rubbish.
- Installing environmental management controls (eg water, soil, clearing limits).
- Excavation of material.
- Haulage of material to reprocessing site or landfill.
- Reprocessing or disposal at landfill.
- Rehabilitation of excavation area.

4.5.2 Option 2 - Off-site disposal

The off-site disposal option would involve removal of source material, treatment on-site or off-site, long haul transport, and disposal to a licensed facility (Grafton Landfill) within a containment cell or isolated (segregated) portion of the landfill.

The main tasks involved in this option would include:

- Site and access establishment.
- Removing existing infrastructure and rubbish.
- Installing environmental management controls (eg water, soil, clearing limits).
- Excavation of material.
- Treatment of material.
- Possible establishment of a containment cell at the landfill.
- Haulage to landfill.
- Rehabilitation of excavation area.

4.5.3 Option 3 - On-site disposal

The onsite disposal option would involve removal of source material, possible treatment on-site (Option 3A) or onsite containment without treatment (Option 3B), short haul transport for disposal to a containment cell on-site.

The main tasks involved in this option would include:

- Additional investigations to better define design constraints / parameters for this option.
- Site and access establishment.

- Removing existing infrastructure and rubbish.
- Installing environmental management controls (eg water, soil, clearing limits).
- Excavation of material.
- Possible treatment of material.
- Establishment of an on-site containment cell.
- Placement of material in containment cell.
- Rehabilitation of excavation area.
- Monitoring of groundwater and surface water quality.

4.5.4 Option 4 - In-situ containment

In-situ containment would involve leaving the source material in place (Option 4A), possibly with stabilisation or treatment (Option 4B), and construction of a containment system in-situ to prevent direct exposure or mobilisation and separate contaminated material from surface and ground waters.

The main tasks involved in this option would include:

- Additional investigations to better define design constraints / parameters for this option.
- Site and access establishment.
- Removing existing infrastructure and rubbish.
- Installing environmental management controls (eg water, soil, clearing limits).
- Possible treatment of material.
- Establishment in-situ containment cell.
- Monitoring of groundwater and surface water quality.

4.6 Remediation constraints and limitations

Remediation activities will be constrained by factors including:

- Long term feasibility.
- Technical feasibility.
- Data gaps.
- Cost.
- Site characteristics.
- Availability of Appropriate Disposal Sites (for excavation and off-site disposal).
- Implementation timeframe.
- Contractor availability.
- Resource availability (e.g. backfill).
- Legislative requirements.
- Ongoing monitoring requirements.
- Ongoing liabilities.
- WHS requirements.

- Community acceptance.
- Environmental considerations.

4.6.1 Remediation option comparison

A preliminary evaluation of these factors for the various remediation options is presented in Table 4-3.

Table 4-3 Remediation option comparison

Constraint	Off-site Reprocessing	Off-site Disposal	On-site Disposal	In-situ Containment
Long term reliability (in relation to the site)	Good – material permanently removed from site	Good – material permanently removed from site	Moderate – depends on containment design	Low – Moderate – depends on containment design
Technical feasibility	Good – proven technologies	Good – established methodology	Moderate – reasonably established methodology	Moderate– reasonably established methodology
Data gaps (excluding those relating to extent of remediation)	Whether material is cost effective to reprocess	Minimal (based on successful completion of immobilisation trials)	Geotechnical and groundwater data at disposal site	Geotechnical and groundwater data at disposal site
Relative cost	Low – High – reprocessing is relatively low but transport and disposal costs make disposal at hazardous waste landfill a high cost option.	High – particularly if landfill levies apply. Also treatment and transport costs.	Moderate – depends on treatment and containment design.	Low - Moderate– depends on treatment and containment design.
Site Characteristics	Moderate – requires replacement fill	Moderate – requires replacement fill	Low – Moderate – space on site is limited for a containment cell, still requires replacement fill	Moderate – siting not ideal for in-situ containment, but no replacement fill required
Disposal site availability	Unknown – depends on reprocessing site	Satisfactory	Good (available, subject to other constraints)	Good (available, subject to other constraints)
Resource availability (eg backfill)	Good if timing coincides with major transport civil works	Good if timing coincides with major transport civil works	Good if timing coincides with major transport civil works	Good – less backfill required
Contractor Availability	Potential issues due to lack of processing facilities in a position to accept the material	Good	Good	Good
Legislative requirements	Satisfactory if existing processing plant can accept	Satisfactory – existing waste management regulatory framework	Potential Issues associated with long term liability and management.	Potential Issues associated with long term liability and management.
Timeframe	Satisfactory	Satisfactory	Satisfactory	Satisfactory
Ongoing Monitoring or management requirements	Minimal for site. Liability passes to reprocessing site's disposal facility. (High off-site)	Minimal for site. Disposal facility managed in conjunction with requirements for rest of disposal site.	Moderate to High – to maintain and monitor integrity of containment.	High– to maintain and monitor integrity of containment.
Ongoing liability	Minimal for site. Liability	Minimal for site. Disposal facility	Moderate – High –	Moderate – High–

Constraint	Off-site Reprocessing	Off-site Disposal	On-site Disposal	In-situ Containment
	passes to reprocessing site's disposal facility. (Moderate - High for off-site).	managed in conjunction with requirements for rest of disposal site. (Low for off-site).	contaminated material remains on site.	contaminated material remains on site.
WHS	Moderate risk – limited to civil works on site	Moderate – High – civil works and treatment on site.	Moderate – High – civil works and treatment on site.	Moderate – High – civil works and treatment on site.
Likely Community acceptance	Low – strong community concerns in relation to any re-processing, due to publicised impacts from mining areas	Good	Low – Moderate – depending on containment design.	Low – Moderate – depending on containment design.
Potential short–term environmental impacts from remediation (surface water, groundwater, ecological, air quality, noise, traffic, visual amenity, heritage)	Moderate negative impact due to site disturbance, transport.	Moderate negative impact due to site disturbance, transport.	Low - Moderate negative impact due to site disturbance, containment cell construction, reduced transport.	Low negative impact due to reduced site disturbance, reduced transport.
Potential long-term environmental impacts (surface water, groundwater, ecological, air quality, noise, traffic, visual amenity, heritage)	Low risk on site. Need assurance that reprocessing site will be appropriately managed.	Low risk – contamination removed from site, to managed waste disposal facility.	Moderate risk – depending on containment design.	Moderate to high risk – depending on containment design.
Sustainability	Good (recovery of minerals, treatment of contaminated material, but off-set by haulage requirements).	Low - Moderate (treatment, use of landfill space, moderate haulage requirements).	Moderate (minimal haulage, greater containment cell construction requirements, moderate risk of future requirements).	Moderate (minimal disturbance, minimal haulage, higher risk of future requirements).

Note: The governing / main differentiating constraints for each option are highlighted in yellow (negative constraints) or green (positive constraints / differentiators).

4.6.2 Remediation options summary

Essentially, all options can be designed to meet the remediation objectives, with the main differences (apart from cost) being whether the most-contaminated material is removed from site (and liability for long-term management passes to other parties), or whether it remains on site, and the degree of certainty that it will be securely contained on site with no unacceptable adverse long term impacts.

The risks associated with on-site containment options are further examined in Table 4-4 below, with comparison against the existing situation as a “baseline” risk scenario. The basis of assigning risks is described in Appendix C.

Table 4-4 Risk assessment of on-site containment options

Scenario	Status Quo	In-situ containment without treatment	In-situ containment with treatment	Engineered Containment Cell with treatment	Engineered Containment Cell without treatment
Direct Exposure to Contamination	Currently no control to direct exposure. Significant on-site impacts are evident which require major works to restore function of site. Rectification works >$1M.	Cap would prevent exposure except in exceptional circumstances. Untreated waste could result in significant consequence if contamination is exposed.	Cap would prevent exposure except in exceptional circumstances. Treated waste would result in less serious (eg. moderate) consequence if contamination is exposed.	Cap would prevent exposure except in exceptional circumstances. Treated waste would result in less serious (eg. moderate) consequence if contamination is exposed.	Cap would prevent exposure except in exceptional circumstances. Untreated waste could result in significant consequence if contamination is exposed.
	A 1 V	E 2 M	E 3 L	E 3 L	D 2 M
Leachate migration direct from material, via surface water or via groundwater	Currently no control on generation or migration of leachate. Significant effects are present (contributions by leachate unknown but likely to dissipate through dilution – sediment migration likely more critical), regulatory action required.	Without treatment, the material would still be highly leachable, and migration to some degree is likely to occur. Potential migration would be limited by the capping and underlying geology. Impacts could possibly be moderate. More detailed hydrogeological investigations may increase confidence in a lower risk, subject to design and construction details.	Treatment of the material will reduce the chance of leachate migration, although migration to some degree could still occur. Potential migration would be limited by the capping and underlying geology. Impacts unlikely to be as high as moderate. (Possibly minor – same risk ranking). More detailed hydrogeological investigations may increase confidence in a lower risk, subject to design and construction details.	The material would be treated, and in an engineered containment system. Any more than insignificant migration would be highly unlikely to occur except in system failure – further examined below.	Without treatment, the material would still be highly leachable, and migration to some degree may occur. Potential migration would be limited by containment in the engineered cell.
	A 2 V	C 3 M	D 3 M	E 4 L	D 3 M

Scenario	Status Quo	In-situ containment without treatment	In-situ containment with treatment	Engineered Containment Cell with treatment	Engineered Containment Cell without treatment
Migration of contaminated tailings / sediments through direct erosion or release	Currently occurring, no protective measures. Impacts considered Significant to Severe (main impacts presumably from past migration, but almost certainly ongoing).	Containment will prevent migration of contaminated material. Failure mechanisms examined separately below. If discharge of untreated sediments occurred, consequences could be significant.	Containment will prevent migration of contaminated material. Failure mechanisms examined separately below. Discharge of treated sediments unlikely to exceed moderate.	Containment will prevent migration of contaminated material. Failure mechanisms examined separately below. Discharge of treated sediments unlikely to exceed minor given further distance of containment cell from wetland.	Containment will prevent migration of contaminated material. Failure mechanisms examined separately below. Discharge of treated sediments unlikely to exceed minor given further distance of containment cell from wetland.
	A 1 V	E 2 M	L 3 L	E 4 L	E 4 L
Loss of containment	No present containment. Situation captured above.	Mechanisms captured below.	Mechanisms captured below.	Mechanisms captured below.	Mechanisms captured below.
Stabilisation is or becomes ineffective	No present stabilisation. Situation captured above.	No stabilisation. Risks taken as equivalent to worst case above.	Stabilisation is expected to be effective for geological periods.	Stabilisation is expected to be effective for geological periods.	No stabilisation. Risks taken as equivalent to worst case above.
		C 3 M	E 3 L	E 3 L	C 3 M
Failure of leachate collection systems	No present containment. Situation captured above.	No leachate collection system	No leachate collection system	Failure of leachate collection system could result in a built up of leachate and greater risk if released. Failure unlikely if properly designed and installed.	Failure of leachate collection system could result in a built up of leachate and greater risk if released. Failure unlikely if properly designed and installed.
				E 3 L	E 3 L
Release of leachate through liner.	No present containment. Situation captured above.	No liner. Situation captured by leachate migration scenario above.	No liner. Situation captured by leachate migration scenario above.	Assuming leachate collection system does not fail. Some release likely, but consequence expected to be negligible.	Assuming leachate collection system does not fail. Some release likely, and consequence could be greater because of the lack of treatment.
				B 5 L	B 4 M

Scenario	Status Quo	In-situ containment without treatment	In-situ containment with treatment	Engineered Containment Cell with treatment	Engineered Containment Cell without treatment
Failure of cap – small scale leaks	No present containment. Situation captured above.	Small scale leaks / infiltration likely, causing leachate. Risk of migration as above. Untreated waste increases likely consequence to moderate (depending on hydrogeology and design – see leachate migration scenario above).	Small scale leaks / infiltration likely, causing leachate. Risk of migration as above. Treated waste reduces likely consequence to minor (depending on hydrogeology and design – see leachate migration scenario above).	Small scale leaks / infiltration likely, causing leachate, but will be captured by liner / leachate system reducing likely consequence. Treated waste also reduces likely consequence to minor.	Small scale leaks / infiltration likely, causing leachate, but will be captured by liner / leachate system reducing likely consequence.
		C 3 M	C 4 M	D 4 L	D 3 M
Failure of cap – large scale erosion	No present containment. Situation captured above.	Containment cell within flood zone. Large scale erosion unlikely, but consequence could be significant. Hydrology study / capping design may reduce risk.	Containment cell within flood zone. Large scale erosion unlikely, but consequence could be significant. Hydrology study / capping design may reduce risk.	Containment cell above flood zone, insignificant catchment. Damage highly unlikely, although if it occurred, consequence could be significant.	Containment cell above flood zone, insignificant catchment. Damage highly unlikely, although if it occurred, consequence could be significant.
		D 2 M	D 2 M	E 2 M	E 2 M
Unplanned disturbance to cell	No present containment. Situation captured above.	Unlikely with adequate site management. Exposure to untreated contamination could result in moderate impact.	Unlikely with adequate site management. Exposure to treated contamination more likely to result in minor impact.	Unlikely with adequate site management. Exposure to treated contamination more likely to result in minor impact.	Unlikely with adequate site management. Exposure to untreated contamination could result in moderate impact.
		D 3 M	D 2 L	D 2 L	D 3 M
Flood damage to containment	No present containment. Situation captured above.	As above.	As above.	As above.	As above.

Scenario	Status Quo	In-situ containment without treatment	In-situ containment with treatment	Engineered Containment Cell with treatment	Engineered Containment Cell without treatment
Batter instability	No present containment. Situation captured above.	Cell situated in area of low potential energy (eg. low elevation). Instability highly unlikely, with appropriate geotech input to design and construction.	Cell situated in area of low potential energy (eg. low elevation). Instability highly unlikely, with appropriate geotech input to design and construction.	Larger batter required to contain volume of waste. Instability unlikely with proper geotech input to design and construction. Consequence could be moderate to significant if failure occurred.	Larger batter required to contain volume of waste. Instability unlikely with proper geotech input to design and construction. Consequence could be moderate to significant if failure occurred.
		E 3 L	E 3 L	D 3 M	D 3 M
Mass movement – slumping	No present containment. Situation captured above.	Cell situated in area of low potential energy (eg. low elevation). Slumping unlikely, subject to geotech review.	Cell situated in area of low potential energy (eg. low elevation). Slumping highly unlikely, subject to geotech review. (Treated mass more stable).	Cell situated in area of higher potential energy. Slumping highly unlikely, subject to geotech review. (Treated mass more stable).	Cell situated in area of higher potential energy. Slumping highly unlikely, subject to geotech review.
		D 3 M	E 3 L	E 3 L	E 3 L
Mass movement – sliding	No present containment. Situation captured above.	Cell situated in area of low potential energy (eg. low elevation). Sliding unlikely, subject to geotech review. Has nowhere to slide, consequences minor.	Cell situated in area of low potential energy (eg. low elevation). Sliding highly unlikely, subject to geotech review. (Treated mass more stable).	Cell situated in area of higher potential energy. Sliding unlikely, subject to geotech review. (Treated mass more stable). Has further to slide – consequences moderate.	Cell situated in area of higher potential energy. Sliding unlikely, subject to geotech review. Has further to slide – consequences moderate.
		D 4 L	E 4 L	D 3 M	D 3 M
Liquifaction (eg seismic)	No present containment. Situation captured above. (Unlikely to be any worse).	Possible for untreated contamination. Consequences unlikely to be higher than moderate.	Highly unlikely for treated contamination, subject to geotech review. Consequences unlikely to be higher than moderate.	Highly unlikely for treated contamination, subject to geotech review. Consequences be significant given higher elevation of site.	Possible for untreated contamination. Consequences could be significant given higher elevation of site.
		C 3 M	E 3 L	E 2 M	C 2 H

Scenario	Status Quo	In-situ containment without treatment			In-situ containment with treatment			Engineered Containment Cell with treatment			Engineered Containment Cell without treatment		
Mass movement – settlement	No present containment. Situation captured above.	Untreated sediment possibly will settle, resulting in cap damage / maintenance requirements			Treated sediment unlikely to settle (subject to placement), resulting in cap damage / maintenance requirements. Geotech review may reduce to highly unlikely.			Treated sediment unlikely to settle (subject to placement), resulting in cap damage / maintenance requirements. Geotech review may reduce to highly unlikely.			Untreated sediment will possibly settle, resulting in cap damage / maintenance requirements		
		C	3	M	D	3	M	D	3	M	C	3	M
Effects on local hydrology (flooding)	No present containment. Situation captured above.	Capping likely to increase elevation of contaminated area, possible it may have some effect on local hydrology – subject to flood study.			Capping likely to increase elevation of contaminated area, possible it may have some effect on local hydrology – subject to flood study.			Cell above flood zone, highly unlikely to have any effect on local hydrology.			Cell above flood zone, highly unlikely to have any effect on local hydrology.		
		C	4	M	C	4	M	E	4	L	E	4	L

4.6.3 Onsite containment options summary

Table 4-4 indicates the “Status Quo” option presents a “very high” risk to direct exposure, migration, human health and the environment. This option is considered unacceptable, as is reflected by the EPA having issued a management order for the site.

“In-situ containment without treatment” reduces the risk to “medium” for most of the scenarios considered, with some risks reduced to “low”. The risk level for some scenarios may be reduced further subject to the outcome of more detailed investigations and design. Due to the nature of the material (unconsolidated, leachable and toxic) and its exposure to the local hydrology (i.e. groundwater and flooding), this option still presents some “medium” risks to direct exposure, migration, human health and the environment.

The “in-situ containment with treatment” option reduces the risks further, as a result of treatment decreasing the leachability and increasing the physical stability of the material. Most scenarios are considered to present a low risk, although there are some scenarios that are still considered to present a “medium” risk due to the exposure of the material to the local hydrology (i.e. groundwater and flooding).

The “engineered containment cell without treatment” also reduces the risk compared to the “in-situ containment without treatment” but presents a slightly greater risk than the “in-situ containment with treatment option”. This is mainly due to the instability of an engineered containment cell and the untreated material combined with the potentially severe consequence caused by the release of untreated material or leachate.

The “engineered containment cell with treatment” presents the lowest risk option for on-site management of the contaminated material. This option would stabilise the material and reduce its exposure to the local hydrology. However, this option does still present some “medium” risk scenarios which are associated with potential failure of the engineered cell. It is considered that these risks can be reduced to “low” with appropriate detailed design of the containment cell.

4.7 Cost estimate

The project has limited funding available to undertake the remediation works. To better understand the costs associated with each option, a detailed cost estimate was prepared by SCS. The cost estimate included all four main options plus their sub options. It also looked at a further five scenarios where 100%, 99%, 97%, 84% and 66% of contamination was removed. Table 4-5 provides a summary of the cost estimate (based on conservative quantity calculations as described in Section 4.3) and also presents how many tonnes of antimony are removed per million dollars. This provides an indication of the value for money.

The scenarios with less than 100% removal of contamination acknowledge that some areas of contamination would remain onsite. For scenarios approaching 97% or greater removal, the areas to remain onsite are considered to pose limited risk and remediation would not be practical due to access constraints and potential environmental damage.

GHD notes that these costs have been developed by SCS and are not warranted by GHD. The potential exists for remediation costs to be greater than the estimates provided, due to factors such as the heterogeneous nature of contamination distribution at the site, the inherent difficulties in defining quantities of contamination and the possibility of contamination being uncovered during remediation that was not apparent from the site investigations. GHD understands that the cost estimates have been compiled from estimated quantities (including time / productivity data) and available unit rates known to SCS or considered reasonably applicable, and the scope has not been costed by commercial tender. Tendered costs may vary from these estimates.

Table 4-5 Cost estimate summary

Option	Description	100% Removal (all Areas)		99% Removal (As 97% plus Areas F & N)		97% Removal (Areas A, B, C, D, E, G, H, I, M)		84% Removal (All Area A)		66% Removal (Area A 30x)	
		$M	t/$M	$M	t/$M	$M	t/$M	$M	t/$M	$M	t/$M
1A	Isolate, excavate, long haul transport, disposal at mining facility at Hillgrove	$6.4	44.7	$6.1	46.4	$5.9	46.9	$4.3	55.8	$3.0	63.0
1B	Isolate, excavate, long haul transport, treatment & disposal at hazardous waste landfill Ipswich	$20.5	14	$19.7	14.4	$18.7	14.8	$13.5	17.8	$7.7	24.5
2	Isolate, excavate, treatment, long haul transport, disposal as general waste landfill with leach ate control, Grafton	$24.2	11.8	$23.2	12.2	$21.1	13.1	$16.1	14.9	$9.2	20.5
3A	Isolate, excavate, treatment, short haul, monocell onsite	$9.0	31.8	$8.4	33.7	$8.1	34.2	$6.2	38.7	$4.4	43.0
3B	Isolate, excavate, short haul, hazardous waste monocell onsite	$6.3	45.4	$5.8	48.8	$5.7	48.6	$4.5	53.3	$3.4	55.6
4A	Isolate, construct containment cell in-situ	$4.3	66.5	$4.1	69.0	$4.0	69.3	$3.0	80.0	$2.4	78.8
4B	Isolate, construct containment cell in-situ, treat and dispose in-situ	$7.3	39.2	$7.0	40.4	$6.7	41.3	$5.2	46.2	$3.7	51.1

Orange highlighting indicates highest cost and lowest mass of contamination removed per dollar.

Green highlighting indicates lowest cost and greatest mass of contamination removed per dollar.

4.7.1 Summary

The remediation costs presented in Table 4-5 range from approximately $2.4 million to over $24 million. Costs for all options are directly related to volumes remediated, and exhibit diminishing returns as illustrated in Figure 4-2. Option 4A (insitu containment without treatment) is the cheapest for all scenarios, followed by Option 1A (disposal at Hillgrove Mine) and Option 3B (onsite disposal without treatment). Options 4B (insitu containment with treatment) and 3A (onsite disposal with treatment) are the next least expensive options respectively.

In regards to cost per tonne of contamination removed, the 84% removal scenario for Option 4A presents the best value for money. With the exception of the 84% scenario for Option 4A, value for money decreases with the greater volumes remediated (by reason of greater areas of disturbance and lower concentrations of contamination as volumes remediated are increased). Option 4A provides the best value for money for all scenarios and even when remediating 100% of the contamination, this option provides better value (i.e. greater mass of contamination managed per $) than any of the other options, for all the scenarios presented.

4.8 Remediation option summary

4.8.1 Option 1 - Off-site reprocessing

Option 1A – Off-site reprocessing

Off-site reprocessing was considered a desirable outcome because it would remove the contamination from the site, and would recover resources (eg. gold and antimony) from the contaminated material that could be sold to offset the costs of processing. While the concentration of valuable metals available for extraction is not sufficient to justify the cost of transport and processing, the cost of this option is reasonable compared to the other options.

However, due to the limited resource recovery potential, no processor has been found that is willing to take the material. The on-going off-site liability relating to the management of the residual contaminated material inherited by the reprocessing plant is also considered undesirable. There were also strong community concerns and public opinion against any reprocessing facilities receiving the material, arising in part from previous discharges to the environment from off-site antimony mining and processing facilities.

Option 1B – Off-site disposal at hazardous waste landfill

The transport and disposal of the material to a hazardous waste landfill at Ipswich was assessed. This option was initially considered a possibility because it removed the material from Site to a contained location but ultimately the transport and disposal costs combined to make this the second most expensive option.

4.8.2 Option 2 - Off-site disposal

Off-site disposal provides the advantages of limiting the on-going liability and risk. It would remove the contamination from the site using an established waste management process and facilities, and thus offers a high level of reliability and is also likely to be acceptable to the community. The cost associated with this option is its most significant disadvantage, particularly if landfill levies apply (although these levies may be considered representative of the costs of cell construction and ongoing monitoring that are borne by the landfill facility). The cost of extraction, treatment, transport and disposal means this option is the most expensive. Depending on funding, the cost of this option would limit the area that can be remediated.

4.8.3 Option 3 - On-site disposal

Option 3A – Treat and dispose on-site

On-site disposal is technically similar to the off-site disposal option, however the contamination would remain on site, and there would be on-going liability and risks which may not be acceptable to the community. The site constraints and technical feasibility, especially in the long term, are also limitations associated with this option. The main advantage of this option, compared to off-site disposal, is the lower cost because it would avoid the transport and disposal fees. However the construction costs (which would be related to the degree of on-going liability and risk) as well as the on-going management and monitoring required for this option would offset some of the cost savings of the remediation works. Further understanding of site conditions (groundwater and geotechnical) would be required for a robust design of on-site containment.

Option 3B – On-site disposal without treatment

The advantages and disadvantages of this option are similar to Option 3A. It is less expensive than Option 3A but also presents more risks because the material is not treated.

4.8.4 In-situ containment

Option 4A – In-situ containment without treatment

In-situ containment is considered to be the lowest cost and best value for money option, with the least impact during remediation and requiring the least off-site resources, but would also entail the greatest on-going liability and risk. This option may not be favourable due to the associated risk. Additional investigations (in particular groundwater and geotechnical) would be required to determine the viability of this option and the technical details required for adequate in-situ containment. The additional investigations, combined with the greater on-going management and monitoring required for this option would offset some of the cost savings of the remediation works. This option may also be considered a medium term solution until more funding is available in the future or new technologies provide more cost effective, onsite treatment options.

Option 4B – In-situ containment with treatment

The “in-situ containment with treatment” option would be similar to Option 4A but treating the material reduces the risks. However, this option would be more expensive than Option 4A and a similar cost as Options 3A and 3B which have a similar or lower risk.

4.1 Recommended remediation option

Option 3A – Treat and Dispose Onsite for the 97% scenario, was agreed to as the preferred option by the stakeholders including BSC, Crown Lands, EPA and SCS. This option would remove the material, immobilise the most leachable materials and place it in a containment cell onsite. This option was considered to be the most appropriate form of remediation when considering the above constraints, especially:

- Cost
- Long term reliability
- Site characteristics
- Ongoing liability
- Ongoing management
- Environmental impact

More details on the recommended remediation methodology, including contingencies for contaminated material remaining on-site, are outlined below in Section 5.

5. Remediation methodology

5.1 Overview of remediation methodology

As mentioned above, the adopted remediation option is 3A – Onsite Disposal with Treatment. Treatment requirements would vary depending on the degree of contamination, leachability and physical characteristics (eg. soil type) of the excavated material. The 97% scenario adopted would remove the contamination from Areas A, B, C, D, E, G (part), H, I (part) and M, as shown on Figure 4-1. The extent of excavation within Areas I and G would be limited to where healthy vegetation commences. This is consistent with the decision process for selecting remediation areas as discussed in Section 4.3. The nominated extent of remediation totals approximately 2.8 hectares in area and 25,000 m^3 in volume.

An overview of remediation methodology was completed by SCS (2012) and is summarised in the following subsections.

5.1.1 Disturbance activities

Remediation will involve the following activities that will result in disturbance to the environment:

- Excavating contaminated material within the wetland for the purpose of bulk removal.
- Construction of the containment cell.
- Landform earthworks across the site to divert uncontaminated clean water away from the site and control the flow of surface water across the contaminated site.
- Importing clean material for engineering purposes including construction of impervious containment cell, surface capping, void filling, land reshaping or habitat purposes.
- Dewatering of surface or groundwater which enters the excavation works.
- Installing groundwater bores for the purpose of monitoring before and after the remediation works.
- Clearing and re-use or disposal of vegetation (both native regeneration and weeds), for the purpose of extracting underlying contaminated material.

5.2 Site establishment

The remediation works would be subject to key management plans including:

- Occupational Health and Safety Management Plan.
- Construction Environmental Management Plan (CEMP).
- Soil and Water Management Plan (SWMP).
- Traffic Management Plan (TMP).
- Waste Management Plan (WMP).
- Acid Sulfate Soil Management Plan (ASSMP).

Site establishment would also require:

- Establishing access to, from and within the site.
- Setup site compound.
- Full perimeter of security fencing (to water's edge).
- Appropriate warning signs related to construction and hazardous waste.

- Disposal of residual building waste including old processing mill structures and stockpiles.

5.3 Water management

Stormwater and groundwater management will be required including:

- Implement erosion and sediment controls in accordance with Urban Stormwater Manual Volume 1 7 2 (Blue Book) and IECA Guidelines.
- Install perimeter controls of contaminated area in the wetland.
- Separation and diversion of uncontaminated stormwater away or through the site.
- Management of stormwater and dewatering from the remediation areas which will include a sediment basin to allow treatment before discharge (if required). Discharge of water from the remediation or treatment areas will be avoided if possible, with water to be managed within the remediation areas by return to excavations where dewatering is no longer required, or used for dust suppression / moisture control of stockpiles and material to be placed in the containment cell.
- Setup washdown bay that drains to sediment basin.
- Remediation design to allow for flooding and expected climate change water level increases.
- Minimising inflow groundwater into sections of excavations, using temporary barriers (eg. sheet piling), if required.
- Locating any on-site containment areas away from groundwater influences.

More detail on the water management would be provided in the CEMP.

5.4 Excavation

5.4.1 Excavation extent

Decisions regarding the lateral extent of the excavation will be based on factors considered in Section 4.3 and site observations of ecological conditions. The decision will be made by the Project Manager, in consultation with an experienced ecologist and independent consultant. The decision making process will be documented to demonstrate that a sensible, transparent and defensible decision making process has been applied. Factors governing the decision making process will include the following:

- Previously identified levels of impact
- Vegetation cover extent and condition
- Human health considerations (access, depth, likelihood of dust creation)
- Proximity to water including groundwater, surface water, drainage paths, the wetland and potential flood inundation areas
- Ability of environmental controls to contain potential negative environmental impacts (e.g. sedimentation)
- Net environmental benefit (i.e. benefit vs impacts of the additional extent of excavation).

If areas of contamination not previously identified are found during the works, consultation with the EPA may be required and procedures followed as outlined in Section 8.6.

Excavation limits will be set up using a digital terrain model for upload to construction plant.

5.4.2 Excavation methodology

Excavators or backhoes will be used for all excavation operations involving contaminated soil.

All excavations undertaken within the contaminated areas will be conducted under supervision of a suitably qualified environmental representative to ensure all contamination and remediation works is appropriately managed. An independent environmental consultant will guide and verify the extent of remediation works, as discussed in Section 1.3.

Staging of the remediation works across the site will be detailed in the CEMP but the following sequence of steps should be followed prior to commencing the excavation operations in areas of identified contamination:

- The environmental consultant will brief the Site Manager in the field on the following:
  - The boundaries of the area to be excavated.
  - The expected depth of excavation.
  - The manner in which excavation works will be monitored and verified.
- The Site Manager, in consultation with the Project Manager, environmental representative and environmental consultant, will reach agreement on the following:
  - Environmental protection / management measures to be put in place.
  - The manner in which materials are to be excavated.
  - The area where stockpiling of material can take place.
- Prior to commencement of excavations within the wetland foreshores, the Site Manager shall ensure that a suitable barrier is installed around the perimeter of the works to separate clean and dirty water. Further details on sediment controls around excavations will be provided in the CEMP.
- The Site Manager shall ensure that at all times the sides of the excavation are stable, and provide support to the surrounding ground and infrastructure.
- The Site Manager shall ensure all excavation works are undertaken in a manner that will minimise the mixing of different material types, i.e. contaminated and clean material.
- Based on the known hydrogeological characteristics of the site it is expected that groundwater seepage will be encountered for all works in the wetland foreshores (including the main tailings dump) , and localised dewatering may be required. Any dewatering activities must be undertaken in accordance with the CEMP prepared for the site including specific requirements of the ASSMP and the SWMP. Excavations will continue beneath the water table to the extent practical, if required.
- Prior to demobilisation of any plant, the Site Manager shall ensure that plant and equipment is cleaned and decontaminated.

5.4.3 Validation sampling

The validation sampling protocol for the remedial operations is detailed in Section 7.

5.5 Treatment

The most leachable materials will be immobilised and there will be some treatment / stabilisation of less contaminated materials. The material to be treated would principally be those areas greater than 10 times the assessment criteria, shown on Figure 4-1, with consideration of soil type and leachability characteristics.

The treatment would be based on the results of the treatment trials. The remediation contractor shall utilise the initial stages of the full scale treatment process to verify the effectiveness of the treatment methodology.

The treatment process is likely to involve:

- Preparation of a drainage pad to assist in dewatering excavated material prior to treatment. Leachate would be directed to the sediment basin.
- Stockpiling excavated material according to the concentration of contamination.
- Blending of reagents with the contaminated material in layers using appropriate plant.
- Verification sampling and analysis.

The contractor shall undertake process control / verification testing, at a sufficient rate (to be agreed with the environmental consultant and EPA) to verify the representativeness of sampling (including batch control), and compliance with immobilization requirements, including ASLP (water leachability) and MEP (multiple extraction procedure) testing. The environmental consultant may take quality control samples.

Treatment and testing shall be carried out in accordance with a quality control plan, to be provided by the Site Manager prior to commencement of works, for review and agreement by the EPA.

5.6 Containment cell

A containment cell will be constructed on site approximately in the location shown on Figure 5-1. The configuration of the containment cell would be confirmed during detailed design but the objectives would be to:

- Provide secure long-term containment of contaminated material without unacceptable environmental impact or health risk.
- Minimise ongoing management requirements by the land holder (eg. avoid long-term leachate management requirements).
- Provide a final containment cell landform that is appropriate for the future use of the site.
- Provide the most cost-effective containment that will meet the above objectives, to maximise the budget that is available for remediation (eg. excavation, treatment and containment) of contamination at the site.

Construction of the containment cell is likely to consist of:

- Excavation and installation of diversion drains. The excavated material, if suitable, may be used to backfill the excavation remaining from the removal of the contaminated material.
- Construction of impermeable layer, possibly including synthetic liner and leachate drain.
- Filling with contaminated material.
- Construction of an impermeable cap, possibly including synthetic liner.
- Reshape and revegetate the surface to be consistent with the surrounding area.

The EPA has confirmed that they will review and approve an appropriate methodology for on-site containment. This will be described in the final design and Construction Quality Assurance (CQA) Plan that will be submitted prior to works commencing.

5.7 Backfill and landforming

Excavations may be left as voids (or be partially filled) if this is consistent with the original bathymetry of the site and is not detrimental to the final landform. Other excavations will require backfill with soil that is deemed suitable for the final land use. Where materials are to be imported, they will be tested to verify classification as Virgin Excavated Natural Material (VENM) or Excavated Natural Material (ENM).

On completion of the excavation and subsequent validation approval, the excavation will be backfilled with validated material. Validation requirements are detailed in Section 7.

Earth materials will require placement in accordance with engineering specifications, landscaping plans and erosion and sediment control.

5.8 Disposal of soils, mercury plugs and refuse

Where soil and refuse wastes are to be removed from site, they must be classified for waste disposal purposes, and disposed in accordance with the requirements of *the Protection of the Environment Operations Amendment (Scheduled Activities and Waste) Regulation 2008* made under the *POEO Act 1997*, and *NSW DECC, 2009*.

An experienced environmental professional should be engaged to oversee the classification of the waste and minimise the potential for cross contamination of waste streams. The Site Manager shall ensure its transport and disposal at an appropriately licensed landfill.

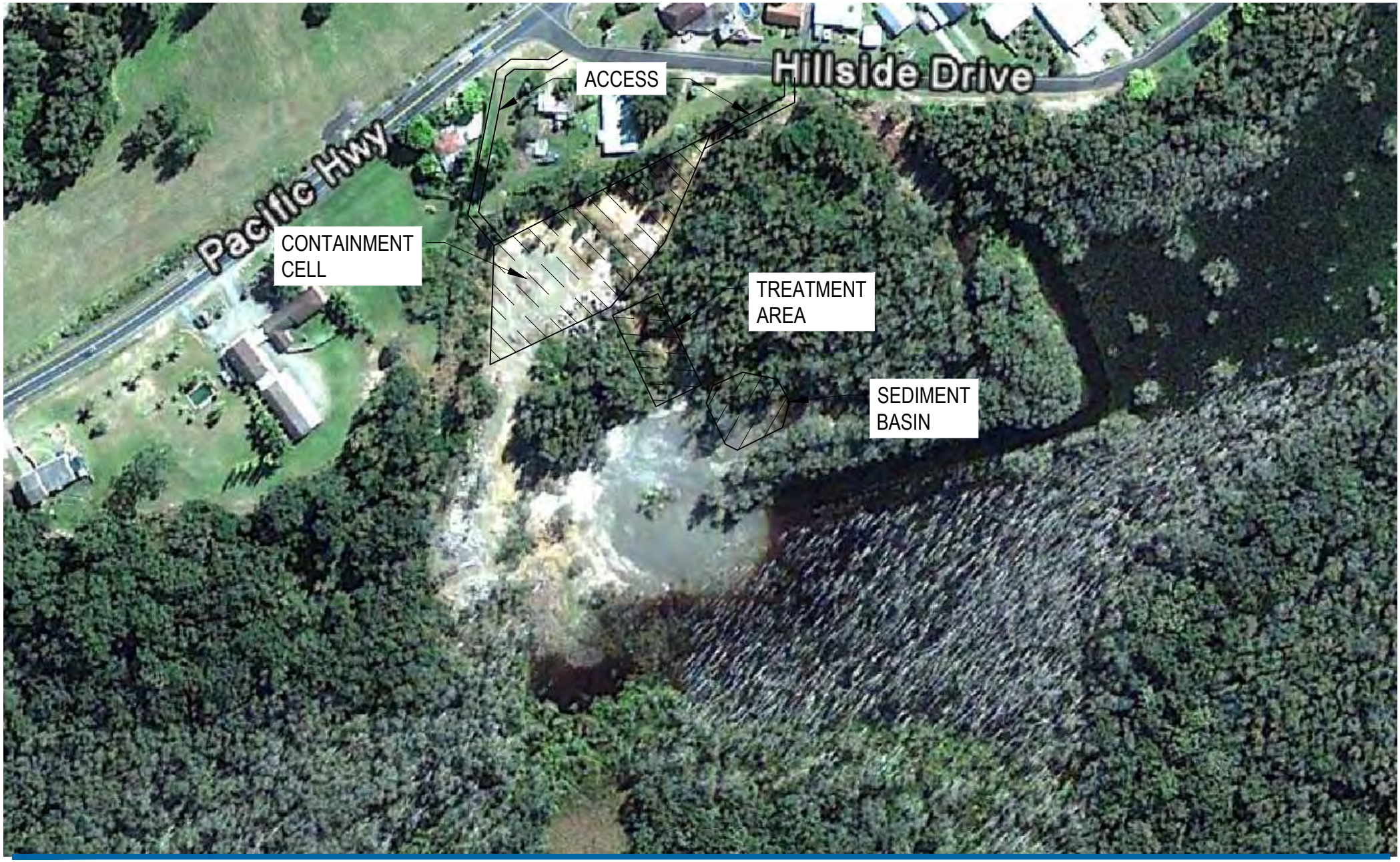
Further details regarding material handling and disposal will be documented in the CEMP including measures to:

- Minimise cross contamination by any arsenic and antimony contaminated material (soil, sediments, tails, ores and dusts) with any remediated or clean materials (validated areas, imported fill, existing vegetation, surface water or treated materials).
- Minimise the quantity of materials to be removed from the site.
- Decontaminate and validate any material to be removed from site for recycling or reuse.
- Minimise the potential for imported fill to require offsite disposal.

The Site Manager shall ensure that wastes arising from the works are removed and disposed of in accordance with the requirements of the NSW EPA and WorkCover Authority, together with the relevant legislative requirements, namely:

- Work Health and Safety Act, 2011 and Regulations, 2011.
- Contaminated Land Management Act, 1997 and Regulations, 2008.
- Protection of the Environment Operations Act, 1997 and Regulations, 2008.

Building and demolition waste generated from the project (e.g. bricks, concrete, metal, and timber) is expected to classify as General Solid Waste (non-putrescible). These materials will be recycled or re-used where possible. This waste should be stockpiled separately from other waste and further advice sought prior to off-site disposal to landfill if required.



N

0 20 40 60m

SCALE 1:2000 AT ORIGINAL SIZE

NSW Catchment & Lands - Crown Lands
Former Antimony Processing Plant - Urunga
Detailed Investigation Report

CONTAINMENT CELL LOCATION

Job Number	22-16251
Revision	A
Date	MAR 2014

Figure 5-1

230 Harbour Drive Coffs Harbour NSW 2450 Australia **T** 61 2 6650 5600 **F** 61 2 6650 5601 **E** cfsmail@ghd.com **W** www.ghd.com

Plot Date: 3 April 2014 - 12:40 PM Plotted by: Ian Gould Cad File No: G:\22\16251\CADD\Drawings\22-16251-FIG 1 & 2.dwg

5.9 Environmental monitoring and ongoing management

Option 3A will result in contaminated material remaining onsite. This will present some environmental risks that will need to be assessed, monitored and managed. The requirements of the ongoing monitoring and management of the site will be documented in a Long Term Environmental Management Plan (EMP). The Long Term EMP will be a stand-alone document that includes, as a minimum:

- Site Description
- Site History
- Description of Remediation and Containment
- Risk Assessment
- Management
  - Leachate management
  - Erosion control
  - Revegetation
- Monitoring:
  - Groundwater
  - Surface Water
  - Revegetation
- Contingency Plan

6. Assessment criteria

6.1 Framework

The framework for contamination assessment is based on guidelines “made or approved”, by the NSW EPA under Section 105 of the *Contaminated Land Management Act, 1997*. These guidelines include, but are not limited to the following:

- NSW OEH, Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites, 2011.
- DECC, Contaminated Sites: Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997, June 2009.
- DEC, Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination, 2007.
- DEC, Contaminated Sites: Guidelines for NSW Site Auditor Scheme. 2006.
- ANZECC, National Water Quality Management Strategy, Paper No. 4, Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), 2000.
- NEPC, National Environment Protection (Assessment of Site Contamination) Measure (NEPM), 1999, as amended by the National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1), herein referred to as the NEPM.
- NSW EPA, Contaminated Sites: Sampling Design Guidelines, 1995.
- ANZECC/NHMRC, Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites, 1992.

Additional regulatory guidelines used for classification of waste material for off-site disposal (including the bricks) includes:

- DECCW 2009, Waste Classification Guidelines, December 2009.

Where relevant criteria were not contained in the above guidelines, reference was made to other guideline documents, including the following:

- MHSPE 1994, Environmental Quality Objectives in the Netherlands.
- USEPA 2004, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual.
- USEPA 2014, Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites.

The assessment criteria (thresholds) against which the project analytical data have been compared are outlined in the following subsections.

As noted in Section 4.1, investigation and screening levels (i.e. the assessment criteria described below) are not clean-up or response levels, and the use of investigation and screening levels as default remediation criteria may result in unnecessary remediation and increased development costs, unnecessary disturbance to the site and local environment, and potential waste of valuable landfill space.

6.2 Soil assessment criteria

The adopted soil assessment criteria are presented in Table 6-1. The rationale for the criteria is provided in the Detailed Investigation Report and is summarised as follows.

Health based criteria

Health-based soil Investigation Levels (HILs) are provided for a range of different exposure settings, which are based on the nature of the use(s) for which the site is currently used and/or it's approved use(s). As the future use of the Site is likely to be as a reserve, the most applicable default exposure setting is considered to be NEHF E- Parks, Recreational, Open space as published in NSW DEC (2006). These criteria correspond with NEPM HIL (C) from NEPC (2013) and are herein referred to as HIL (C).

Ecological investigation levels

Ecological Investigation Levels (EILs) are presented in NEPC (2013). The EILs have been developed by CSIRO using data from various Australasian databases, the Australian National Biosolids Research Program and supplemented by data from the US EPA ecotoxicology database where necessary. The methodology is based on a species sensitivity distribution (SSD) approach, which considers the physicochemical properties of soil and contaminants and the capacity of the local ecosystem to accommodate increases in contaminant levels (referred to as the 'added contaminant limit' or ACL) above ambient background. Where insufficient data is available for the SSD method to be used, a more conservative method using an assessment factor approach may be adopted.

EILs have been developed for three generic land use settings:

- areas of ecological significance.
- urban residential areas and public open space.
- commercial and industrial land uses.

The EILs have also been given, where sufficient data permitted, for sites with fresh (<2 years) and aged (≥2 years) contamination.

DEC 2006 includes Provisional Phytotoxicity Based Investigation Levels (PBILs) which relate to the potential uptake of contaminants that may result in adverse, phytotoxic impacts on sensitive plant species. These are generally equivalent to the NEPC (2013) EILs. NSW DEC 2006 notes, however that the PBILs have significant limitations because phytotoxicity depends on soil and species parameters in ways that are not fully understood.

The EILs provided in Table 6-1 below are for aged contamination in areas of ecological significance. They are intended for use as a screening guide only and may be assumed to apply to sandy loam soils, or soils of a similar texture, for pH 6-8.

Antimony

No criteria are given in NEPC 2013 for antimony. As outlined in the Preliminary Investigation Report, the following assessment criteria have been used for the assessment of antimony concentrations:

- ANZECC/NH&MRC (1992) Environmental Investigation level - 20 mg/kg.
- USEPA (2004) Residential - 310 mg/kg.

It is noted that the 'USEPA (2004) Residential' criterion as referred to above is actually a typographical error (the value should have been 31 mg/kg), which was inadvertently adopted (instead of the USEPA 2004 Industrial criterion of 410 mg/kg or an intermediate site specific

criterion) at the Preliminary Investigation stage of the investigations. GHD has subsequently reviewed the antimony criteria in consultation with the EPA to assess the implications of this error, as discussed below.

The current (2014) USEPA Regional Screening Levels (RSLs) are essentially the same as the 2004 Preliminary Remediation Goals (PRGs), except the industrial RSL is now 470 mg/kg. A residential criterion (31 mg/kg) is considered inappropriately conservative for the site exposure setting as it is now and as it will be following the proposed remediation.

Similar to HILs as described in the NEPM, the USEPA notes that RSLs are used for site "screening" and as initial clean-up goals, if applicable, and that RSLs are not de facto clean-up standards and should not be applied as such. The RSL's role in site "screening" is to help identify areas, contaminants, and conditions that require further federal [USEPA] attention at a particular site. Generally, at sites where contaminant concentrations fall below RSLs, no further action or study is warranted under the USEPA Superfund program, so long as the exposure assumptions at a site match those taken into account by the RSL calculations. Chemical concentrations above the RSL would not automatically designate a site as "dirty" or trigger a response action; however, exceeding a RSL suggests that further evaluation of the potential risks by site contaminants is appropriate.

Giving due consideration to the above, GHD has used the NEPM spreadsheet tool (NEPC 2013) to derive site specific criteria for antimony as summarised below.

Key input parameters were as follows:

- Toxicity Oral Reference Dose 0.0004 mg/kg/d (USEPA IRIS – consistent with that used by USEPA 2014).
- Gastro intestinal (GI) Absorption factor 0.15 (USEPA 2014). Antimony is reported to be slow at absorption in the gastrointestinal system.
- Background intake 0%. The WHO publishes information on antimony in the environment and indicates that exposure through food is very low, and domestic water (based on analysis of waste water) is practically free of antimony (WHO 2014).
- No dermal absorption factor published, therefore exposure through dermal pathway is not deemed significant (see below).
- No inhalation toxicity reference value published, therefore exposure through dust inhalation pathway is not deemed significant (see below).

Exposure through dermal exposure (skin) and inhalation of dust do not significantly contribute to the overall risk and therefore may be excluded from the calculation of the HIL. As an example, zinc is a similar situation where the dermal absorption factor (DAF) is 0.001 (typical of most metals) and the air toxicity is the same as the oral toxicity, adjusted for an inhalation rate of 20 m^3/day and body weight of 70 kg for an adult. The HIL Spreadsheet shows that the pathway-specific HIL for the oral pathway in this example is 36 times more stringent than the dermal pathway, and nearly 10000 times more stringent than the inhalation pathway. On this basis it may be concluded that the dermal and inhalation exposure routes do not significantly contribute to health risk for exposure to antimony.

Using the HIL Spreadsheet, with the standard assumptions for the HIL C exposure setting (open space, recreational), the derived antimony health-based criterion is 120 mg/kg.

It must be understood that the NEPM definition of HIL C includes a variety of exposure scenarios such as parks and playgrounds (including sandpits), recreational areas and playing fields that are fully accessible to the public and where the public may potentially spend a significant amount of time. This land use scenario assumes that the open space areas are in

areas where young children may have supervised access and use the area outside of the home environment for frequent short periods of time (up to 2 hours a day, 7 days a week). Other users may include older children and adults who may visit the area frequently for a range of recreational purposes. These open space areas may contain lawns, gardens, vegetated areas and walkways, with some limited areas of hardstand and some areas of exposed soil.

The NEPM notes that Scenario HIL C does not directly apply to undeveloped public open space such as urban bushland and reserves, where the potential for exposure (and frequency of exposure) is lower and which should be subject to a site-specific assessment.

The default HIL C exposure scenario is considered overly conservative for Urunga, which will be more of a passive recreational area (eg. no playgrounds, likely to be infrequent use, children would be under supervision due to natural hazards from ticks, snakes, waterways etc.). A report prepared for the US Army Corps of Engineers, *Remedial Investigation Report, Iron Mountain Road Ranges* (Shaw Environmental, May 2009) which deals with antimony contamination (a co-contaminant with lead at many firing ranges) presents the following basis for exposure in open space areas at that site, where the nature of the likely open space use is considered to be generally similar to that at Urunga:

- Adult and young child under supervision: In December 2008 the US Army and its contractor, U.S. Fish and Wildlife Service, EPA, and the Alabama Department of Environmental Management (ADEM) and its contractor, judged that a youth would have more opportunity for recreational activities, than an adult with adult responsibilities or a young child (0- through 6-year-old) who is likely to be dependent on an adult caretaker. It was therefore judged that a young child is likely to visit a similar recreational site much less than older individuals.

On this basis, two scenarios have been considered in the derivation of appropriate investigation criteria for antimony at the Urunga site:

- Scenario 1. Adults and young child (0-6 years old) under supervision. Exposure occurs during weekends (2 hours per day, 2 days per week).
- Scenario 2. Older child (8-11 years old) with no supervision who enters the site every day (2 hours per day, 7 days per week).

Scenario 2 differs from the default HIL C in that the body weight for the older child is higher than for the young child. The default body weight of the young child represents a 2-3 year old of 15 kg. The Australian Exposures Handbook (EnHealth, 2012) Section 2.2 presents weight ranges for different age groups. For older children 8 to 11 years, a mean body weight of 37 kg is presented.

The derived criteria for antimony are as follows:

- Scenario 1 (adult and young child): 420 mg/kg
- Scenario 2 (older child): 300 mg/kg.

The limiting scenario for this exposure setting is the older child exposed every day, with a derived criterion of 300 mg/kg.

On the basis of this derivation, GHD considers an appropriate health investigation level for antimony in soil at the Urunga site is 300 mg/kg, which is essentially the same as the 310 mg/kg criterion which was adopted in the preceding stages of investigation and assessment.

At the request of the EPA and NSW Health, GHD also considered the implications of adopting a more conservative criterion of 120 mg/kg, equivalent to the default HIL C exposure setting. Examination of all investigation data for samples which exceeded 120 mg/kg but didn't exceed 310 mg/kg, and also for samples which exceeded or didn't exceed ten times this criteria

(corresponding to the factors used in the previous assessments and development of remediation areas and volumes) found that consideration of the lower HIL C of 120 mg/kg for antimony has no effect on the exceedence boundaries illustrated on the figures, and no significant effect on the proposed extent or volumes of remediation. Only one location (BH100 – adjoining the west of Area B/C, and which may be encompassed by the containment cell works) lies outside a nominated remediation area, and the only area where the extent of remediation may be affected is Area G, where further delineation is already noted as being required (see Table 4-1), and contamination may extend past the western boundary of the site.

On the basis of these considerations, GHD has adopted the following antimony criteria for the remediation and validation of the site (noting again that use of investigation levels is a conservative measure, as discussed previously):

- ANZECC/NH&MRC (1992) Environmental Investigation level - 20 mg/kg.
- HIL for 'bushland' open space / recreational area' – 300 m/kg (essentially the same as the HIL of 310 used in previous investigations and assessment), which is considered applicable to the majority of the site.
- HIL C – 120 mg/kg in areas where there is a particular potential for more frequent exposure by young children.

Acid sulfate soils

Potential acid sulfate soils were assessed by comparison with criteria outlined in:

- *Acid Sulfate Soils Assessment* (ASSMAC) Guidelines (Ahern et al. 1998).
- *Queensland Acid Sulfate Soil Technical Manual- Soil Management Guidelines* (Dear et al. 2002).

Table 6-1 Adopted Soil Assessment Criteria

Analyte	Units	NEPM 2013 HIL C	NEPM 2013 EIL
Antimony[1]	mg/kg	120 - 310	20
Arsenic	mg/kg	300	40
Cadmium	mg/kg	90	-
Chromium (III+VI)[2]	mg/kg	300	60-130[4]
Cyanide Total[3]	mg/kg	240	-
Copper	mg/kg	17,000	30-270
Lead	mg/kg	600	470
Manganese	mg/kg	19,000	-
Mercury[5]	mg/kg	80	-
Nickel	mg/kg	1,200	5-95

[1] Previously adopted criteria for antimony were 20 mg/kg (ANZECC/NH&MRC 1992) and 310 mg/kg (incorrect adoption of USEPA Res (2004)). Site specific criteria have been developed equivalent to HIL C of 120 mg/kg (applicable to areas where significant exposure by children is plausible) and 300 mg/kg (essentially the same as the previously used 310 mg/kg) for a bushland recreational setting considered more applicable to the majority of the site.

[2] Chromium analysed as Total Chromium. Criteria for Cr (VI) used as a conservative screening measure, although chromium is considered unlikely to be present in hexavalent form.

[3] HIL for free cyanide used as a conservative measure.

[4] Range depending on pH and cation exchange capacity

[5] Inorganic mercury

6.3 Sediment assessment criteria

The adopted sediment assessment criteria for selected analytes are presented in Table 6-2. As outlined in the Preliminary Investigation Report, the criteria for most analytes were from the ANZECC /ARMCANZ (2000) Sediment Quality Guidelines (ISQG).

No criteria was available from ANZECC /ARMCANZ (2000) for cyanide. The Dutch intervention values (MHSPE 1994) for sediment of 20 mg/kg for free cyanide and 50 mg/kg for complex cyanides, have been adopted in this case.

The influence of site-specific conditions on contaminant bioavailability and toxicity to benthic invertebrates is a key consideration in the environmental risk assessment process. This is particularly relevant for contaminants with complex speciation chemistries such as arsenic (Irving et al 2008). However, Irving et al (2008) found sublethal toxicities of both arsenite (As(III)) and arsenate (As(V)) to be similar and not significantly affected by changes in DO. Accordingly, total arsenic concentrations were considered to be relevant for the site assessment.

Following an assessment of the results presented in the Detailed Investigation Report (GHD, 2012b), it was deemed that extractable and/or leachable concentrations were more applicable in a comparison with the assessment criteria as it provides a greater indication of the bioavailability of the contaminants of concern (COC).

Total organic carbon (TOC) was also used to normalise the amount of COC per gram of organic-carbon.

Table 6-2 Adopted sediment assessment criteria

Analyte	Units	ISQG- Low	ISQG- High
Antimony	mg/kg	2	25
Arsenic	mg/kg	20	70
Cadmium	mg/kg	1.5	10
Chromium	mg/kg	80	370
Copper	mg/kg	65	270
Cyanide	mg/kg	20	50
Lead	mg/kg	50	220
Mercury	mg/kg	0.15	1
Nickel	mg/kg	21	52
Zinc	mg/kg	200	410

6.4 Water assessment criteria

For the purpose of the RAP, surface and groundwater quality will be compared to the assessment criteria outlined in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000). Although limited, the data indicates the receiving environment contains freshwater (brackish water is considered to have an EC of 800-1600 uS/cm (Environment Australia, 2002)), hence the guidelines for Freshwater were applied.

As the Site is deemed to be a 'slightly to moderately disturbed system', the 95% level of protection of species has been identified as being applicable in conjunction with the 99% level for selected analytes deemed to have a bioaccumulative effect.

Table 6-3 Adopted Water Assessment Criteria

Analyte	Units	ANZECC 2000 Fresh Water Slightly-moderate disturbed system
Aluminium	mg/L	0.05
Antimony	mg/L	0.009
Arsenic	mg/L	0.013
Cadmium	mg/L	0.0002
Chromium (III)[1]	mg/L	0.00331
Chromium (VI)	mg/L	0.001
Copper	mg/L	0.0014
Cyanide Total	mg/L	0.007
Lead	mg/L	0.0034
Mercury (inorganic)[2]	mg/L	0.00006
Mercury (methyl)	Mg/L	ID2
Nickel	mg/L	0.011

1 A moderate reliability trigger value for chromium (III) of 3.3 µg/L for freshwater was derived, using the statistical distribution method with 95% protection and an ACR of 77.6.

2 There were Insufficient Data (ID) to derive trigger values for methyl mercury. The 99% protection levels for organic mercury are recommended for slightly-moderately disturbed systems as a precaution for bioaccumulation.

6.4.1 Water Quality Monitoring During Remediation

As explained in Section 5.3, the water will be managed via a series of detention basins and will be treated to achieve the below requirements:

- Total Suspended Solids - 50mg/L
- pH - 6.5-8.5
- Oil and grease – visible

Surface water quality will be monitored adjoining and downgradient of remediation work areas using field parameters and observations (including turbidity) to monitor the effectiveness of the sediment and surface water control measures implemented during the remediation works. Details of the monitoring program will be provided in the CEMP.

6.5 Imported fill

Imported fill will be certified clean fill (e.g. Virgin Excavated Natural Material – VENM or Excavated Natural Material – ENM) validated suitable for use as fill material in accordance with section 4.1.2 of the Sampling Design Guidelines (EPA 1995). Samples shall be collected and analysed at a rate equivalent to that specified in the ENM exemption 2012, and at least three samples from any particular fill source.

In order to avoid importation of contamination to the site, fill judged suitable for use will have TPH, BTEX, heavy metals, OCP/PCBs and PAHs concentrations below the criteria in the Excavated Natural Material exemption 2012.

7. Validation

Adoption of the Option 3A and 97% scenario for remediation acknowledges that some contaminated material will remain *insitu*. Therefore "validation" of the remediation works will be based more on verification that the extent of remediation is consistent with the principles for nominating the remediation areas (as described in Section 4.3), rather than a traditional process of sampling and analysis to verify compliance with the adopted assessment criteria. The basis for this is that the site has been sufficiently characterised so that the areas of contamination are relatively accurately delineated and the extent of remediation can be largely predetermined prior to excavation. The relatively small volumes of contamination that would be addressed by iterative validation sampling and excavation are expected to be relatively insignificant, and the remediation works will be more efficient without this process, allowing more remediation to be undertaken for the available budget. This will also minimise the duration the excavations must remain open, and minimise dewatering and water treatment requirements.

Due to the above mentioned considerations, the following approach will be used to guide the extent of remediation.

- Excavation works will be supervised by an appropriately qualified and experienced independent environmental consultant, familiar with the characteristics of the site.
- Vertical limits of excavation will be based primarily on consideration of previous data, particularly the depth of contaminated soil in the respective identified areas, relationship between soil type (observable characteristics such as texture and colour) and field screening limits of excavation with a portable XRF (based on relationships established in GHD 2012b).
- Lateral limits of excavation as discussed in Section 5.4.1.

A "validation" process per se is not proposed; rather decisions will be made during the works based on these procedures, and in consultation with SCS and the EPA where required. For the nominated remediation areas, previous data and field screening data will be compared with the decision process described below, subject to practical limitations to excavation extent.

As noted in Sections 4.1 and 6.1, the assessment criteria described in Section 6 are not clean-up or response levels, but have been used as an initial basis for assessment of the extent and degree of contamination. The basis for the proposed extent of remediation is described in Section 4.3, and consistent with these principles, the following decision process will be used for guidance within the remediation areas.

7.1 Decision process

7.1.1 Soils

The HIL C and EIL assessment criteria for the contaminants of potential concern on the site are listed in Table 6-1.

Subject to the considerations described in Section 4.3 and above, areas of contamination will be deemed to be successfully remediated if:

- The arithmetic average[2] 95% UCLAVG concentration for contamination in soils remaining after excavation is less than the HIL C assessment criteria and nominally less than 10

[2] Note: it is not proposed to use the 95% UCLav concentration in this decision process because of the inherent conservatism of the assessment criteria, and as sufficient samples may not be available in each remediation area to provide meaningful statistical data.

times the EILs. Given the considerations noted above, the target clean-up levels will be 300 mg/kg for antimony and arsenic, and 80 mg/kg for mercury (the latter based on previous data).

- No single sample concentration is greater than 2.5 times the relevant criteria.

In areas where there is a significant potential for more frequent exposure to soils by young children, consideration will also be given to the HIL C of 120 mg/kg for antimony, on the same basis as above.

These criteria will be applied to the base and walls of each area of active remediation, noting that there are likely to be areas of the Site where evidence (XRF or aesthetic data) suggests that contamination remains and an ongoing management approach will be required.

The minimum target depths to which remediation and validation apply for each area will be set out in the CEMP.

7.1.2 Sediments

Remediation of areas of deeper aqueous sediments is not proposed. Areas of wetland adjoining the tailings area are known to be seasonally dry, and it would be inconsistent to attempt to remediate these areas to a lower clean-up level than the source areas, given the additional impact on the environment that would be incurred if this was the case (i.e. through physical disturbance of a large area of the wetland).

Subject to the considerations described in Section 4.3 and above, it is therefore proposed to adopt a target clean-up level of approximately 10 times the ISQG-High shown in Table 6-2, which is generally equivalent to the 300 mg/kg target for antimony and arsenic, but with a lower target of 10 mg/kg for mercury (the latter based on previous data).

7.1.3 Environmental risk

Use of the nominated clean-up levels described above is considered to be protective of human health, but may leave some residual risk to the localised environment. Hence some more sensitive species may not be fully protected, however the reduced contaminant load is expected to result in a net improvement to the surrounding environment, in particular as a reduction in migration of contaminants via sediment, surface water or groundwater.

As discussed in Section 5.4.1, the lateral extent of the excavation will be identified for easy detection by the operators. Decisions in regard to the extent will be based on factors considered in Section 4.3 and site observations of ecological conditions including potential phytotoxicity effects and vegetation quality. As discussed in Section 4.3, extending remediation areas to remove contamination exceeding EILs / ISQGs would not represent an effective balance to address the remediation objectives. In these areas of secondary impact, the physical stability and cover of viable vegetation will be considered adequate to prevent further impact. In the areas that will be excavated, if concentrations significantly exceeding EILs / ISQGs will be left in situ, supplementary remediation measures (such as covering with a layer of clean soil) would be considered to address potential ecological impacts, if relevant to the final land form.

Potential migration of soils or sediments during the remediation will be managed by erosion control measures.

7.1.4 Aesthetic criteria

Aesthetic considerations (odours, staining, vegetation cover) will also be taken into account when validating areas of remediation. Areas exhibiting objectionable odours or absence of viable vegetation cover relating to site contamination will not be considered satisfactorily remediated.

7.2 Validation methodology

7.2.1 Sample identification

As explained above, in addition to use of existing data and field observations of soil characteristics, the vertical extent or base of the excavation and the lateral extent or walls of the excavation will be screened on site to characterise the material remaining.

Validation samples will be identified using a “V” suffix. The depth will also be recorded as part of the sample number (e.g. 1V-0.0), where the depth component represents the shallowest part of the sample interval. Any imported materials will be identified with a “C” suffix for characterisation samples.

A detailed sample register will be kept, recording the sample number, date sampled, location, depth interval, field observations (including soil description) and field measurements (e.g. XRF measurements). Duplicate samples will be recorded in the register, as will subsequent validation samples where these are needed to re-validate an area which has not met the assessment criteria and has had further remediation.

Field sketches will be prepared showing the area and locations sampled.

7.2.2 Validation of excavations

Sampling procedures

XRF procedures will be used to assist in assessing any residual contamination present in an excavation. XRF procedures will be detailed in the CEMP.

Validation sampling will be undertaken by an appropriately qualified environmental consultant to verify that the site has been remediated in accordance with the principles described in this RAP.

All fieldwork will be undertaken in general accordance with GHD’s Standard Field Operating Procedures (SOP). The following procedures will be followed for all sampling work:

- New disposable nitrile gloves will be used for the collection of each sample.
- Samples will be placed in laboratory-supplied bottles appropriate for the analysis required.
- Samples will be stored in a dedicated container for transport to the project analytical laboratory with chain of custody documentation. Where required for appropriate preservation of samples prior to laboratory analysis, ice will be used.
- Samples will be submitted to the project laboratory to enable sufficient time for extraction and analysis within specified holding times.
- All sampling equipment will be thoroughly decontaminated (in accordance with written procedures) to mitigate cross contamination occurs between sampling locations. Sampling equipment will be washed with Decon 90 (or an equivalent solution) and then rinsed in tap water and then deionised water prior to and after the collection of each individual sample.
- QA/QC sampling as outlined in Section 7.3. Duplicate samples will be used to assess the precision and accuracy of results. Rinsate blanks will be used to assess the adequacy of decontamination and potential for cross contamination of samples due to sampling methodology, and trip blanks will be used to assess the potential for cross contamination from containers, transportation or laboratory methodology.

Sampling frequency

Validation sampling will generally involve the following:

- One sample per 10 linear metres from the sides of each excavation, with at least one sample from each side of any single excavation.
- One sample per 100 m^2 from the base of each excavation (based on a 10 x 10 m grid, or at least one sample per 10 lineal metres of trench), with at least one base sample from any single excavation.
- Aesthetic considerations will be based on observations (e.g. odour, discolouration, vegetation) made by the environmental consultant during excavations.
- Photographic evidence will be taken of validation prior to backfilling.

Field logbook and sample documentation

Written logs will be maintained for all field activities. These logs will cover general field observations and give an account of daily works and events.

General notes will include:

- Works completed including start and end time.
- Weather conditions, including wind direction.
- Any background odour.
- Presence of dust.
- Results of any field testing.
- Data and rationale in regard to the lateral and vertical extent of the excavation.
- Instrument calibration results.
- Sample details including: time and date, sample, identification number and location, procedures used in sample collection, and instrument readings.
- Any on-site calibration checks.
- Description of conditions surrounding the sampling location.
- Observable characteristics of samples taken.
- Decontamination procedures and health and safety monitoring.

A register of all samples will be maintained. Depending on the level of detail required (generally related to depth of sampling), sample descriptions will either be recorded on the sample register or on specific field logs for each sampling location.

A copy of the field logbooks, sample registers and log sheets will be retained in the hard and electronic job file.

Sample labels

Samples will be labelled on adhesive labels using indelible ink. The following information will be included on the sample labels:

- Job number.
- Sample identification number.
- Date (and time, for water samples) of sampling.

Each sample will be assigned an individual sample identification number with the following format:

VA_001_0.5-0.7, where

- V = Validation.
- A = Excavation area.
- 001 = Sample number.
- 0.5-0.7 = The sampling depth or interval at which the sample was taken below the ground surface.

Quality control sample labelling system to be used is as follows:

- Field duplicate samples: VDUP001, VDUP002 etc.
- Inter laboratory duplicate sample: LABDUP001, LABDUP002 etc.
- Trip blanks: TB001, TB002, etc.
- Rinsate blanks: RB001, RB002, etc.

Chain of custody forms

Chain of custody procedures are used to track samples, discourage tampering, and provide a sampling summary. Chain of custody forms include general information about the location of the activity and the members of the sampling team, as well as specific information about the type of sample, sample location, number of sample containers from each station and comments.

Chain of custody forms will be completed in the field and used in conjunction with investigation logs to confirm the samples collected.

Chain of custody documentation will include:

- Site identification.
- Name of the sampler.
- Sample numbers.
- Nature of the sample.
- Collection date.
- Signature of sampler or field manager.
- Departure time from site.
- Dispatch courier(s).

Samples will be checked against the sample register and the Chain of custody prior to dispatch from the site. A copy of the Chain of custody will be retained by GHD and is sent to file as a record of samples sent and analyses requested.

7.2.3 Analytical test methods and detection limits

In general, laboratory analysis will be conducted in accordance with the standard test methods outlined in Schedule B(3) of the NEPM (2013) for soils. The practical quantitation limits (PQLs) will be set at a level below the relevant assessment criteria.

The above documents describe the methods preferred by the NSW EPA. However, laboratories in Australia may not all follow these methods precisely. In particular the sample preparation methods may be significantly different. Some analysis methodology may also be slightly different for some of the analyses.

In all cases, the selected laboratories will be required to be NATA registered for the analyses performed, and NATA registration will take precedence over the laboratory's ability to perform the analyses precisely to the methodology described in the above documents.

7.3 QA/QC requirements

7.3.1 Field programme QA/QC

All fieldwork will be conducted in general accordance with GHD's SOP, which are aimed at collecting environmental samples using uniform and systematic methods, as required by GHD's QA system. Key requirements of these procedures are as follows:

- Appropriately trained and experienced staff will conduct and document site activities using photographs and notes on standard field forms such as daily site records and sampling logs.
- Decontamination procedures - including the use of new disposable gloves for the collection of each sample, decontamination of sampling equipment between each sampling location (using DECON 90/N) and the use of dedicated sampling containers provided by the laboratory.
- Logging procedures - all samples are described using a recognised system.
- Calibration procedures - all field monitoring equipment is appropriately calibrated.
- Documentation and Chain of Custody information as outlined in section 7.2.2.
- Collection of samples for laboratory analysis at an approximate rate of 10% of field screening samples, to verify the relationship between screening and laboratory analysis.
- Collection of duplicate and triplicate samples for QA/QC purposes. GHD proposes 5% split duplicates and 5% blind replicate samples on the basis of the NEPM (2013). This is also consistent with requirements of ANZECC / ARMCANZ 2000 Australian Guidelines for Water Quality Monitoring and Reporting. This would apply for all samples collected for laboratory analysis. Where possible, both blind and split samples would be collected from the same location as the primary sample (e.g. duplicate and triplicate) to enable further evaluation of variability at the one location.

Field quality control procedures to be used during the project include the collection and analysis of the following:

- Field Duplicates: Comprise a single sample that is divided into two separate sampling containers. Both samples are sent anonymously to the project laboratory. Blind duplicates provide an indication of the analytical precision of the laboratory, but are inherently influenced by other factors such as sampling techniques and sample media heterogeneity.

  Field duplicate samples are to be collected at a rate of at least 5%.
- Inter-laboratory duplicates: Identical to a blind duplicate, except that the primary sample is sent to the primary project laboratory and the duplicate is sent to a secondary (check) laboratory.

  Inter laboratory (triplicate) samples are to be collected at a rate of at least 5%.
- Rinsate Blank: Final rinse water used in the decontamination of equipment will be collected and submitted for analysis. Rinsate blanks provide an indication of efficiency of the decontamination methodology and techniques employed in the decontamination of sampling equipment between each sampling event, and are an indicator of potential cross contamination between sampling locations.

One rinsate blank sample will be collected per day as required.

- Trip Blank: A sample of laboratory supplied deionised water is bottled and accompanies the other samples over the course of the fieldworks and submitted to the laboratory for analyses. Trip blanks provide an indication of contamination introduced during sample transport and handling (including by sample containers), and also whether the testing laboratory is reporting “false positives”.

  One trip blank sample will be collected for each batch during the investigation, and will be submitted to the primary testing laboratory.

7.3.2 Laboratory programme QA/QC

All analyses will be carried out by NATA accredited laboratories, using analytical methodology consistent with the requirements of relevant guidelines. Where practical, analytical methodology will be selected that provides a Practical Quantitation Limit (PQL) low enough for comparison with the adopted assessment criteria.

The primary project laboratory will use its internal procedures and NATA accredited methods in accordance with their quality assurance system. GHD will ensure that the laboratory analytical methods and limits of reporting are acceptable for analysis required.

Laboratory quality control procedures used during the project will include:

- Laboratory duplicate samples: Duplicate sub samples collected by the laboratory from one sample submitted for analytical testing at a rate equivalent to one in twenty samples per analytical batch, or one sample per batch if less than twenty samples are analysed in a batch. A laboratory duplicate provides data on the analytical precision and reproducibility of the test result.
- Spiked Samples: An authentic field sample is spiked by adding an aliquot of known concentration of the target analyte(s) prior to sample extraction and analysis. A spike documents the effect of the sample matrix on the extraction and analytical techniques. Spiked samples are to be analysed for each batch where samples are analysed for organic chemicals of concern.
- Certified Reference Standards: A reference standard of known (certified) concentration is analysed along with a batch of samples. The Certified Reference Standard (CRS) or Laboratory Control Spike provides an indication of the analytical accuracy and the precision of the test method and is used for inorganic analyses.
- Surrogate Standard/Spikes: These are organic compounds which are similar to the analyte of interest in terms of chemical composition, extractability, and chromatographic conditions (retention time), but which are not normally found in environmental samples. These surrogate compounds are spiked into blanks, standards and samples submitted for organic analyses by gas-chromatographic techniques prior to sample extraction. Surrogate Standard/Spikes provide a means of checking that no gross errors have occurred during any stage of the test method leading to significant analyte loss.
- Laboratory Blank: Usually an organic or aqueous solution that is as free as possible of analytes of interest to which is added all the reagents, in the same volume, as used in the preparation and subsequent analysis of the samples. The reagent blank is carried through the complete sample preparation procedure and contains the same reagent concentrations in the final solution as in the sample solution used for analysis. The reagent blank is used to correct for possible contamination resulting from the preparation or processing of the sample.

The individual testing laboratories will conduct an assessment of the laboratory QC program, internally; however the results will also be independently reviewed and assessed by GHD.

Laboratory duplicate samples should return RPDs within the NEPM acceptance criteria of ±30%. Percent recovery is used to assess spiked samples and surrogate standards. Percent recovery; although dependent on the type of analyte tested, concentrations of analytes and sample matrix; should normally range from about 70-130%. Method (laboratory) blanks should return analyte concentrations as 'not detected'.

7.4 Material treatment and containment cell verification

As discussed in Section 5.5, a quality control plan will be developed to verify the treatment of contaminated materials prior to placement in the containment cell. Testing will incorporate QA/QC measures as described above.

As part of final design of the containment cell, a Construction Quality Assurance Plan (CQA Plan) will be developed to verify that construction of the containment cell is undertaken in accordance with the design and specifications.

Verification of the treatment process and construction of the containment cell will be included in a Remediation and Validation report documenting the works undertaken.

8. Remediation works management

8.1 Responsibilities

Those responsible for the implementation of the RAP have been outlined in Section 1.3 and are as follows:

- Project Manager (PM).
- Site Manager (SM).
- Environmental Representative (ER).
- Environmental Consultant (EC).

The following requirements are intended to be read in conjunction with a CEMP that will be prepared prior to remediation activities, as discussed in Section 9.

8.2 Site control

8.2.1 Site access

The SM shall ensure that the site is securely fenced and designated work areas (excavation, stockpiles and treatment areas) are adequately controlled to prevent unauthorised persons from accessing the work areas. This includes preventing access to excavations or stockpiles, and subsequently gaining direct access to contaminated soils, or to areas of operating machinery.

Before entering the site, all personnel must report to the SM. All personnel within the site will be required to meet the applicable personal protective equipment (PPE) requirements (refer to Section 8.3), and all workers must have undertaken Occupational Health and Induction Training.

All visitors and on-site workers will be required to complete a site safety and environmental induction and consequently acknowledge understanding of the site Health, Safety and Environmental Management procedures prior to commencement of any activity on the site.

8.2.2 Notification

All persons entering the site must be made aware that a CEMP and RAP exist in relation to the contaminated soil and waste material present on-site. This should be included during the general site induction process.

Anyone ordering or requiring intrusive works or disturbance of the site including vehicular access, must notify the staff member or subcontractor concerned of the CEMP and RAP and the requirement that the staff member or subcontractor complete the site ground works induction form.

Subcontractors should be provided with a copy of this RAP and the CEMP when quotes or tenders are sought from them for works that may cause site disturbance.

8.2.3 Induction

It is the responsibility of the PM to ensure that all visitors and on-site workers complete a site specific induction as discussed in Section 8.2.1. In regard to issues associated with contaminated soil and waste materials, the induction process should address the requirements of this RAP including (but not limited to) the following topics:

- Identification of the type and locations (area and depth) of identified contamination.

- Identification of hazards associated with contaminated soil and waste materials and risk control measures.
- Regulatory requirements or codes of practice relevant to identified hazards.
- Site specific safety rules for contamination and hazardous building materials.
- Accident, emergency and evacuation procedures for incidents involving contamination and hazardous building materials, and knowledge of any associated equipment on-site.

8.2.4 Records

For each person likely to be exposed to a hazardous substance, records must be kept for the following:

- All risk assessment reports indicating a need for atmospheric monitoring or health surveillance, and records of the results of any atmospheric monitoring or health surveillance—for at least 30 years after the date of the last entry in them.
- A record of all induction or other training.
- A copy of relevant statements of WHS induction training, or a statement indicating that the PM is satisfied that the relevant WHS induction training has been undertaken.
- A brief description of the site-specific training undertaken by the person.

8.2.5 Control of subcontractors

Subcontractors whose work will be performed on-site, or who otherwise could be exposed to health and safety hazards, will be required to adopt the provisions of this RAP and the CEMP and will be advised of potential safety and environmental issues on-site during site-specific induction training. This induction will include the environmental and occupational health and safety responsibilities, requirements and controls for all subcontractors working on-site. All subcontractor activities will be monitored by the PM to ensure compliance with the requirements of this plan.

Subcontractors shall be solely responsible for the health and safety of their employees and shall comply with all applicable laws and regulations. All contractors and subcontractors are responsible for:

- Providing their own personal protective equipment.
- Preparing site specific safe work method statements for work they are undertaking.
- Training their employees in accordance with applicable laws.
- Providing health and medical surveillance and obtaining medical approvals for their employees.
- Ensuring their employees are advised of and meet the minimum requirements of the RAP, the CEMP and any other additional measures required by their site activities.
- Designating their own Site Safety Representative.

8.3 Recommended personal protective equipment

All personnel will be required to wear appropriate PPE when working on the site. In relation to contamination, the following items of PPE are recommended:

- Long Sleeve Drill Shirt.
- Long Drill Pants.

- Disposable coveralls (when working in direct contact with contaminated soils/groundwater).
- Chemical Resistant Safety Boots.
- Disposable Nitrile Gloves (when working in direct contact with contaminated soils/groundwater).
- Safety glasses/goggles.
- Dust mask (during dust generating activities).

Disposable gloves and coveralls should be disposed of after use or when deemed necessary. Heavily stained work clothes and other items of PPE should also be disposed or laundered by an appropriate industrial laundering facility. Potentially contaminated clothing will not be taken home for laundering.

Further site specific PPE may be identified as a requirement for site workers following the completion of site safety assessment.

8.4 Acid sulfate soils

Any works that involves the disturbance of acid sulphate soils (ASS) must be undertaken in accordance with the ASSMP prepared for the Site.

8.5 Erosion/sediment control and run-off control

All site works shall be undertaken in accordance with the Soil and Water Management Plan (SWMP) prepared for the Site. The PM shall provide the specific details of the erosion and sediment control measures, and will be responsible for their implementation and maintenance throughout the construction works.

8.6 Contingency plan (unexpected finds)

The presence of previously unidentified types of contaminants, may be identified during works by observation of any unusual physical/sensory characteristics of the impacted soil or groundwater.

The following outlines some of the unexpected situations that may arise:

- Unexpected discovery of hazardous building materials (HBMs) such as asbestos containing materials.
- Contaminants in addition to the type already identified on-site may be encountered (e.g.drums and material with visual or olfactory evidence of contamination).
- Contaminated material in addition to the type already identified on-site may fail the NSW EPA Waste Classification Guidelines, and not be acceptable for disposal.
- Side effects of site works such as unacceptable levels of odour, noise, dust, and surface runoff may be generated.

The PM should be notified if such impacts are noted. Should any unexpected situations be encountered, the following procedures should be followed:

- Stop work and make the area secure
- Notify the PM (who will consult with the EPA, if required)
- Follow the procedures listed below:

If potential asbestos containing material is observed**,** then the excavation area should be isolated and managed as per the procedures listed in Section 5.

If this can be carried out in a manner consistent with the RAP, potentially contaminated material may be excavated and placed into leak-proof skip bins or separately stockpiled in a secure location on strong impermeable plastic sheeting to prevent the contamination of the underlying soils and covered with plastic sheeting, which should be securely fitted. The stockpile should be surrounded by adequate sedimentation control to collect runoff and prevent overland stormwater flow from affecting the base of the stockpile. Potentially contaminated materials from different parts of the site should not be mixed, but should be segregated into separate stockpiles for each type of material excavated. Access to the stockpiles of potentially contaminated material should be limited by keeping within the existing site fences or alternatively temporary fencing be placed around the stockpiles. Stockpiles or skip bins should be covered to prevent rainfall from saturating the material and/or generating leachate.

When the potentially contaminated material has been removed, the area from which this material was excavated should also be isolated. Further excavation or other construction work should not occur in that area until advice from a suitably qualified environmental consultant is provided confirming that any contaminated material has been removed and that the area has been suitably remediated.

The location from which potentially contaminated materials is excavated and the location of the stockpile of excavated material should be recorded on a site plan. This should include an outline of the lateral and vertical extent of the potentially contaminated materials (i.e. area and depth) and the volume of material excavated should be estimated and recorded.

A suitably qualified environmental consultant should assess the potentially contaminated material and prepare a report advising whether the material is contaminated at levels exceeding the NSW EPA endorsed guidelines for reuse on-site and/or whether the material needs to be disposed of as waste, and the classification of that waste.

When the contaminated material is assessed as being unsuitable for reuse on the site, then the area where the material was excavated will require validation by the environmental consultant to demonstrate that no unsuitable material remains in the excavated area. If the laboratory analysis of the validation samples collected from the excavated area reports concentrations of contaminants above that suitable for the proposed land use (i.e. open space), then additional contaminated material will need to be removed until the excavation is validated as suitable, or alternative management means uses will need to be determined.

8.7 Review of RAP

This RAP will require review and updating following any significant changes in characteristics of the site, including those resulting from unexpected finds. The RAP should be reviewed and updated if required should these works be significantly delayed or postponed.

9. Protection of the environment and community

A major factor of the remediation operation shall involve the installation and maintenance of environmental protection and pollution control measures. These measures shall be designed to achieve the following objectives:

- Protection of the surrounding environment during all phases of remediation works.
- Protection of the local community during all phases of the remediation works.
- The containment of all contaminated and potentially contaminated materials (soils, sludges, run-off etc) to the site.

The CEMP will be prepared to address and incorporate these measures as applicable to all active remediation works. The CEMP shall include the following activities:

- Hours of Operation.
- Containing Contaminated Material.
- Soil and Water Management.
- Stockpiles.
- Vehicle Access.
- Dewatering.
- Noise.
- Vibration.
- Air Quality.
- Dust and Particulate Control.
- Odour Control.
- Environmental Protection and Pollution Control Contingency Plan.

10. Health and safety

Workplace Health and Safety (WH&S) is a necessity on all remediation projects to ensure the health and safety of all personnel working/visiting the site. Therefore work shall be carried out in accordance with a Site Specific Health and Safety Plan. The Site Manager shall prepare a site specific WH&S Plan for the remediation works, addressing as a minimum the requirements of this RAP, and shall appoint a Site Safety Officer for the duration of the works.

It is the responsibility of the contractor to take all necessary practicable actions to safeguard the safety and health of all employees and subcontractors while they are on the site. The aim of the WH&S Plan shall be to provide and maintain safety standards and practices, which offer the highest practical degree of personal protection, based on current knowledge.

All work undertaken shall be performed in accordance with the provisions of the relevant legislation, and any other relevant regulations or directions issued by regulatory authorities.

The Site Specific Health and Safety Plan shall cover the following aspects:

- Induction of personnel.
- Hazard locations and identification.
- Description of exposure pathways and personnel protection requirements.
- Location of all underground/aboveground services.
- Work practice procedures, within the designated contaminated zones.
- Monitoring protocols to identify a potentially hazardous practice.
- Emergency response information and procedures.
- Incident reporting.

A number of exposure pathways exist which could potentially result in on-site workers/visitors to the site or surrounding residences being exposed to the contamination. These potential exposure pathways include:

- Inhalation of contaminants in the form of dust or vapours.
- Ingestion of contaminated soil.
- Dermal absorption of contaminants through skin contact.

The Site Safety Officer shall ensure that these and any other potential exposure pathways are controlled.

11. Community consultation

Consultation with the community has been undertaken at various phases throughout the site investigation. Consultation activities have included:

- A public meeting held at the Urunga Golf Club.
- Meetings with interested community groups (e.g. Urunga Chamber of Commerce, Community Groups, Bellingen Environment Centre, Bellingen Shire Council).
- Media releases which were then converted to newspaper articles.
- Direct liaison (meetings and written correspondence) with relevant stakeholders.

In general, community feedback indicated there was very little opposition to the Proposal as a remediation project is considered to offer significant benefits to the community through reduced potential health risks, improved environmental conditions, short term employment opportunities and restored recreational and visual amenity.

Community consultation would continue throughout the Environmental Impact Statement (EIS) process and the remediation works.

Any enquires made by members of the public to worker on site during remediation should be directed to the PM.

12. Regulatory requirements

This RAP has been prepared with consideration of relevant guidelines and policy, in particular:

- Guidelines for Consultants Reporting on Contaminated Sites (OEH 2011).
- Protection of the Environment Operations Act 1997.
- Protection of the Environment (Waste) Regulations 2005.
- Other guidelines made or approved by EPA under s.51 of the CLM Act 1997 have been referred to in this RAP, as listed in Section 4.4.

Other relevant regulatory requirements are outlined below. The PM shall be responsible for ensuring the remediation works are carried out in accordance with regulatory requirements.

12.1 State Environmental Planning Policy (State and Regional Development) 2011

The aims of this Policy are as follows:

(a) to identify development that is State significant development,

(b) to identify development that is State significant infrastructure and critical State significant infrastructure, and

(c) to confer functions on joint regional planning panels to determine development applications.

Schedule 1 (Clause 24) of the Policy describes the types of remediation that are considered state significant.

Clause 24 'Remediation of contaminated land':

(1) Development for the purpose of remediation of land that is category 1 remediation work on significantly contaminated land if the work is required to be carried out under the Contaminated Land Management Act 1997 by a management order that requires:

(a) the taking of action of the kind referred to in section 16 (d) or (g) of that Act, or

(b) the preparation of a plan of management that provides for the taking of any such action.

The proposed remediation is subject to this Policy by virtue of Management Order 20111405, which requires the remediation of the site. The Minister is, therefore, the determining authority.

12.2 State Environmental Planning Policy No 55 – Remediation of Land

The aims and objectives of *State Environmental Planning Policy No. 55 – Remediation of Land* (SEPP 55) are to provide a state-wide planning approach to potentially contaminated land. It also promotes the remediation of contaminated land to reduce the risk of harm.

SEPP 55 aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment.

Clause 8 of SEPP 55 outlines the types of remediation that requires consent and those that do not. Category 1 remediation works require consent. Pursuant to Clause 9, a category 1 remediation work is a remediation work (not being a work to which clause 14 (b) applies) that is:

(a) designated development, or

(b) carried out or to be carried out on land declared to be a critical habitat, or

(c) likely to have a significant effect on a critical habitat or a threatened species, population or ecological community, or

(d) development for which another State environmental planning policy or a regional environmental plan requires development consent, or

(e) carried out or to be carried out in an area or zone to which any classifications to the following effect apply under an environmental planning instrument:

(i) coastal protection,

(ii) conservation or heritage conservation,

(iii) habitat area, habitat protection area, habitat or wildlife corridor,

(iv) environment protection,

(v) escarpment, escarpment protection or escarpment preservation,

(vi) floodway,

(vii) littoral rainforest,

(viii) nature reserve,

(ix) scenic area or scenic protection,

(x) wetland, or

(f) carried out or to be carried out on any land in a manner that does not comply with a policy made under the contaminated land planning guidelines by the council for any local government area in which the land is situated (or if the land is within the unincorporated area, the Western Lands Commissioner).

According to Clause 9 of the SEPP, the proposed remediation is considered Category 1 remediation works as it will be undertaken within an environmental protection zone pursuant to Bellingen LEP 2010, hence consent is required.

12.3 State Environmental Planning Policy No 14—Coastal Wetlands

The aim of SEPP 14 is to ensure that the coastal wetlands are preserved and protected in the environmental and economic interests of the State.

Clause 7(1) requires consent for the following activities on land mapped as SEPP 14:

a) Clearing

b) constructing a levee

c) draining

d) filling

The Proposal is located adjacent to, and may include some works within a SEPP 14 wetland (no. 354). As the Proposal includes clearing, drainage and potentially filling, consent is required from the consent authority. As the proposal is considered State significant development the Minister would be the consent authority.

12.4 Environmental Planning and Assessment Act

The provisions of the EP&A Act govern development within the State of NSW. The approval pathway for assessment and determination of development is dependent on which part of the Act applies.

The Proposal falls under Part 4 of the EP&A Act, through the application of Clause 9 of *State Environmental Planning Policy No 55 (Remediation of Land)* and therefore development consent is required. The development is also considered State Significant Development according to Clause 8 of *State Environmental Planning Policy (State and Regional Development).* Accordingly, the Minister is the consent authority.

An Environmental Impact Statement is required to provide the Minister and other determining authorities with information on matters affecting or likely to affect the environment and to comply with the requirements of the EP&A Act. Contaminated Land Management (CLM) Act 1997.

The CLM Act 1997 is administered by the EPA and local Councils. It provides a regime for investigation and, where appropriate remediation of land affected by contamination that poses a significant risk of harm to human health or the environment. The CLM Act specifies responsibilities for managing contaminated land and the role of the EPA in the assessment of contamination and the supervision of the investigation, remediation and management of contaminated sites. NSW has a comprehensive suite of guidelines relating to assessment and management of contamination, administered under the CLM Act *1997* and the *Protection of the Environment Operations* (POEO) Act 1997.

Under Section 14 of the CLM Act, the EPA has issued a Management Order 20111405 for the remediation of the site.

12.5 Protection of the Environment Operations (POEO) Act 1997

The requirements of the POEO Act 1997, and associated schedules and regulations, are relevant to the remedial phase of the project. The objectives of the Act include to protect, restore and enhance the quality of the environment in NSW, having regard to the need to maintain ecologically sustainable development (ESD).

The POEO Act includes requirements not to pollute waters, to prevent or minimise air pollution, to maintain and operate plant in a proper and efficient condition/manner and to deal with materials in a proper and efficient manner to minimise noise impacts, and to minimise and manage wastes. The Act also requires notification to the EPA when a pollution incident occurs that causes or threatens material harm to the environment.

The provisions of the POEO Act relating to the pollution of waters and waste disposal are particularly relevant to the proposal and would need to be considered during the remediation work.

Environmental Protection Licences are issued under the POEO Act. Under Schedule 43 'Types of licences' of the POEO Act:

'Environment protection licences may be issued for the following purposes:

(a) to authorise the carrying out of scheduled development work at any premises, as required under section 47,

(b) to authorise the carrying out of scheduled activities at any premises, as required under section 48,

(c) to authorise the carrying out of scheduled activities not related to premises, as required under section 49,

(d) to control the carrying out of non-scheduled activities for the purpose of regulating water pollution resulting from any such activity, as referred to in section 122.'

Schedule 1 'Scheduled Activities', Clause 15 'Contaminated soil treatment' of the POEO Act states:

(1) This clause applies to contaminated soil treatment, meaning the on site or off site treatment of contaminated soil (including, in either case, incineration or storage of contaminated soil but excluding excavation for treatment at another site).

(2) The activity to which this clause applies is declared to be a scheduled activity if:

(a) in any case, it has the capacity to treat more than 1,000 cubic metres per year of contaminated soil received from off site, or

(b) where it treats contaminated soil originating exclusively on site, it has a capacity:

–(i) to incinerate more than 1,000 cubic metres per year of contaminated soil, or

–(ii) to treat (otherwise than by incineration) and store more than 30,000 cubic metres of contaminated soil, or

–(iii) to disturb more than an aggregate area of 3 hectares of contaminated soil.

As the Proposal includes the excavation of less than 30,000 cubic metres of contaminated soil and would disturb less than 3 hectares of contaminated land, an EPL is not required.

12.6 Water Management (WM) Act 2000

The *WM Act 2000* aims to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations.

The WM Act also provides for the preparation of water management plans, which contain much of the detail necessary for the operation of the Act. Water Management Plans address matters such as water sharing, water use, drainage and floodplain management and water source protection. The Site is located within the *Water Sharing Plan for the Bellinger River Area Unregulated and Alluvial Water Sources 2008*.

A Controlled Activity Approval (CAA) under the WM Act is required for certain types of developments and activities that are carried out in or near a river, lake or estuary. In accordance with clause 39A of the *Water Management Regulations 2004*, Public authorities and local councils are exempt from a CAA, pursuant to Section 344 (1) (a) of the WM Act in relation to all controlled activities that they carry out in, on or under waterfront land. Accordingly, a CAA would not be required for the Project.

12.7 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) is administered by the Department of Primary Industries and its objectives are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations.

Pursuant to Section 199 of the FM Act, '*a public authority (other than a local government authority) must, before it carries out or authorises the carrying out of dredging or reclamation work:*

(a) give the Minister written notice of the proposed work, and

(b) consider any matters concerning the proposed work that are raised by the Minister within 28 days after the giving of the notice (or such other period as is agreed between the Minister and the public authority).'

Written notice of the proposed remediation would need to be given to the Minister because the Proposal involves excavating material from water land.

Part 7A of the FM Act provides for threatened species conservation including measures to:

- Conserve biological diversity of fish and marine vegetation
- Prevent the extinction and promote the recovery of threatened species
- Provide for the listing of threatened species for the purposes of this Part

Threatened species, populations are listed in Schedules 4, 4a and 5 of the FM Act.

13. Conclusions and recommendations

13.1 Conclusions

As a result of former antimony ore processing activities at the site, significant contaminant impact is present in soils (including tailings and waste stockpiles) on the site, sediment in adjoining areas, groundwater on the site and surface water on and adjoining the site. Antimony and arsenic have been identified as the key contaminants of concern and govern remediation requirements. Other metals (including mercury) were identified as less significant contaminants of concern, but are unlikely to govern remediation requirements.

There are lesser quantities of incidental contaminants on the site which also need to be addressed as part of the remediation works, primarily associated with residual stockpiles and waste materials in the former processing area.

The areas of most significant impact have been identified by previous investigations. A set of remediation objectives has been agreed with key stakeholders (SCS, Crown Lands, EPA and BSC), to define the desired outcomes and constraints of the remediation works. Based on achieving a balance between the cost of remediation and the impacts incurred during the remediation works against the impacts and risks of leaving areas of contamination in place, areas have been identified for remediation. The nominated extent of remediation totals approximately 2.8 hectares in area and 25,000 m^3 in volume.

The costs, risks and benefits of a number of remediation options were examined, including off-site reprocessing of tailings, off-site disposal to licensed landfill, on-site containment in an engineered containment cell, and on-site in situ containment. Based on a review of feasible remediation options by the key stakeholders, the preferred remediation option is on-site treatment and disposal which will remove the material from the most impacted areas, immobilise the most leachable material and place it in a containment cell onsite.

While this approach will entail long-term management of the contaminated material on the site, the lower cost compared with the off-site disposal options will enable a greater area and volume of the impacted areas to be remediated. There will also be less impacts associated with transport of contaminated material from the site. The most significant areas of contamination will be removed and isolated from potential exposure and the risks of ongoing migration of contaminants will be minimised.

It is estimated that approximately 97% of the mass of contamination can be remediated and managed by means of this remediation approach, within the budget that is understood to be available for the works. The remaining areas of contamination are considered to present a relatively low risk to health or the environment, and existing impact is not evident in these areas (eg. vegetation is healthy). Given the remediation objectives and constraints (including the high risk of ecological impact that would be incurred by remediation activities in these areas for relatively little gain in removal of contamination), it is not considered that remediation of the remaining areas is warranted.

An EIS (GHD 2014) has been prepared as the remediation falls under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), through the application of Clause 9 of *State Environmental Planning Policy No 55 (Remediation of Land). D*evelopment consent is therefore required. The Proposal is also considered State Significant Development under Section 89C of the EP&A Act by virtue of Clause 8 of *State Environmental Planning Policy (State and Regional Development) 2011*. Pursuant to Section 78A(8A) of EP&A Act , an EIS is required to accompany a development application to the Minister for Planning and Infrastructure for the Proposal.

13.2 Recommendations

The following information is required prior to the commencement of remediation works:

- The EIS (GHD 2014) which contains details relating to:
  - The Director Generals requirements.
  - Required agency approvals.
  - Community and agency consultation.
  - Mitigation measures.
- A Construction Environmental Management Plan (CEMP) detailing the remediation methodology and work sequence and incorporating an acid sulphate management plan (ASSMP), soil and water management plan (SWMP), traffic management plan (TMP) and waste management plan (WMP). The CEMP should be prepared by the parties responsible for carrying out the remediation works, and subject to approval by the appropriate regulators.
- An Occupational Health and Safety management plan for the remediation works.
- A treatment process for contaminated materials approved by the EPA, and a quality control plan to verify the treatment of contaminated materials.
- Geotechnical and hydrogeological investigations of the containment cell area.
- Detailed design of the containment cell and a Construction Quality Assurance (CQA) Plan for construction of the cell.

The remediation works should be guided and verified by an independent environmental consultant, who should prepare a Remediation and Validation report documenting the works that are carried out.

A long term environmental management plan (EMP) will be required for the ongoing management and maintenance of the containment cell.

14. Limitations

This Remedial Action Plan (RAP) for the Former Antimony Processing Plant - Urunga NSW (the "Report"):

- has been prepared by GHD Pty Ltd ("GHD") for NSW Trade and Investment - Crown Lands
- may be used and relied on by NSW Trade and Investment - Crown Lands
- may be used by and provided to the NSW EPA and the relevant planning authority for the purpose of meeting statutory obligations in accordance with the relevant sections of the CLM Act 1997 or the Environment Planning and Assessment (EP&A) Act 1979
- may only be used for the purpose as stated in Section 1.2 of the Report (and must not be used for any other purpose)

GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than NSW Trade and Investment - Crown Lands arising in connection with this report. To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the RAP are excluded unless they are expressly stated to apply in this RAP.

The services undertaken by GHD in connection with preparing this Report:

- were limited to those specifically detailed in Section 1.2 of this Report and GHD proposal "Urunga Antinomy Contaminated Site – Remedial Action Plan – Fee Proposal. 2 May 2012. 22\0906390\WP\15134.doc".
- were undertaken in accordance with current professional practice and by reference to relevant environmental regulatory authority and industry standards, guidelines and assessment criteria in existence as at the date of this RAP and any previous site investigation and assessment reports referred to in the RAP.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by various third parties. GHD has not independently verified or checked beyond the agreed scope of work and does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

This RAP is based solely on the investigations and findings contained in the reports referenced in the RAP (Section 15) and on the conditions encountered and information reviewed at the time of each referenced report. This RAP should be read in conjunction with the referenced reports. It is also subject to all the limitations and recommendations in the referenced reports.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

This Report should be read in full and no excerpts are taken to be representative of the findings of this Report.

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Appendices

Appendix A Summary Results

Soil Chemistry

| | | | | | Unassigned | | Inorganics | | | | | | | | | | | | Metals | | | | | | | | | | | |

| | | | Unassigned | | Inorganics | | | | | | | | | | | Metals | | | | | | | | | | |

| | Unassigned | | Inorganics | | | | | | | | | | | Metals | | | | | | | | | | |

| | Unassigned | | Inorganics | | | | | | | | | | | | Metals | | | | | | | | | | | |

| | | | Unassigned | | Inorganics | | | | | | | | | | | Metals | | | | | | | | | | |

Sediment Chemistry

	CEC	Exchangeable Calcium	Exchangeable Magnesium	Exchangeable Potassium	Exchangeable Sodium	Moisture	pH (Lab)	TOC	Total Aluminium	Leachable Aluminium	1M HCl Extractable Aluminium	Total Antimony	Leachable Antimony	1M HCl Extractable Antimony	Total Arsenic	Leachable Arsenic	1M HCl Extractable Arsenic	Total Cadmium	Leachable Cadmium	1M HCl Extractable Cadmium	Total Chromium (III+VI)	Leachable Chromium (III+VI)	1M HCl Extractable Chromium (III+VI)	1M HCl Extractable Cobalt	Total Copper	Leachable Copper	1M HCl Extractable Copper	Total Cyanide	Total Iron	1M HCl Extractable Iron	Total Lead	Leachable Lead	1M HCl Extractable Lead	1M HCl Extractable Manganese	Total Mercury	Leachable Mercury	Total Nickel	Leachable Nickel	1M HCl Extractable Nickel	1M HCl Extractable Selenium	1M HCl Extractable Silver	1M HCl Extractable Vanadium	Total Zinc	Leachable Zinc	1M HCl Extractable Zinc
	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	%	pH units	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	mg/kg	mg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	mg/kg
EQL	0.1	0.1	0.1	0.1	0.1	1	0.1	0.02	50	0.1	50	5	0.1	1	5	0.1	1	1	0.05	0.1	2	0.1	1	0.5	5	0.1	1	1	50	50	5	0.1	1	10	0.1	0.001	2	0.1	1	0.5	1	2	5	0.1	1
ANZECC (2000) Interim Sediment Quality Guidelines - Low												**2**		**2**	**20**		**20**	**1.5**		**1.5**	**80**		**80**		**65**		**65**				**50**		**50**			**0.15**	**21**		**21**	**21**	**1**		**200**		**200**
ANZECC (2000) Interim Sediment Quality Guidelines - High												25		25	70		70	10		10	370		370		270		270				220		220			1	52		52	52	3.7		410		410
10 times ANZECC (2000) Interim Sediment Quality Guidelines - High												250		250	700		700	100		100	3700		3700		2700		2700	500			2200		2200			10	520		520	520	37		4100		4100
30 times ANZECC (2000) Interim Sediment Quality Guidelines - High												750		750	2100		2100	300		300	11,100		11,100		8100		8100	1500			6600		6600			30	1560		1560	1560	111		12,300		12,300
Dutch Inervention																												50																		
Field_ID	**LocCode**	**Sample Depth**	**Sample Date**	**Source**																																											
SE001_0.0-0.1	SE001	0-0.1	14/08/2012	Lab	-	-	-	-	-	25.7	5.1	-	2180	-	-	**3980**	-	-	**1980**	-	-	<1	-	-	22	-	-	-	**574**	-	-	<1	-	-	**405**	-	-	-	**58.9**	-	<2	-	-	-	-	-	142	-	-
SE001_0.1-0.2	SE001	0.1-0.2	14/08/2012	Lab	-	-	-	-	-	39.3	4.8	-	-	-	-	**9260**	-	-	**5410**	-	-	<1	-	-	**112**	-	-	-	**491**	-	-	8	-	-	**1760**	-	-	-	**32.2**	-	<2	-	-	-	-	-	149	-	-
SE001_0.4-0.6	SE001	0.4-0.6	14/08/2012	Lab	-	-	-	-	-	65.9	-	-	9970	5.9	-	**274**	0.1	-	**293**	<0.1	-	<1	<0.05	-	20	<0.1	-	-	**136**	<0.1	-	-	6670	-	40	<0.1	-	-	**26**	<0.001	7	<0.1	-	-	-	-	42	6.8	-
SE002_0.0-0.1	SE002	0-0.1	14/08/2012	Lab	4.8	1.7	1.4	1.1	0.6	73.3	5	5.25	10,300	-	2300	**4440**	-	**1680**	**225**	-	**57.9**	<1	-	0.3	**1450**	-	61.8	0.8	**1900**	-	**1450**	2	-	5780	**1170**	-	**1010**	36	**87.6**	-	4	-	1.2	1.2	<1	15.9	145	-	53.2
SE002_0.0-0.1	SE002	0-0.1	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	**1750**	-	-	**35.82**	-	-	**<12.37**	-	-	**<91.97**	-	-	-	**760.1**	-	-	-	-	-	**412**	-	-	-	**15.64**	-	**<27.61**	-	-	-	-	-	50.5	-	-
SE002_0.3-0.5	SE002	0.3-0.5	14/08/2012	Lab	-	-	-	-	-	72.4	5.9	-	-	-	-	**1200**	-	-	**295**	-	-	**3**	-	-	**253**	-	-	-	**1100**	-	-	2	-	-	**216**	-	-	-	**9.8**	-	13	-	-	-	-	-	140	-	-
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SE002_0.5-0.7	SE002	0.5-0.7	14/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	**<11.42**	-	-	**26.87**	-	-	**<10.47**	-	-	<73.94	-	-	-	<10.49	-	-	-	-	-	<4.76	-	-	-	**<3.29**	-	<20.9	-	-	-	-	-	12.15	-	-
SE003_0.0-0.1	SE003	0-0.1	14/08/2012	Lab	-	-	-	-	-	49.3	5.2	-	8510	-	-	**2120**	-	-	**176**	-	-	<1	-	-	**323**	-	-	-	**1040**	-	-	<1	-	-	**538**	-	-	-	**23.4**	-	5	-	-	-	-	-	63	-	-
SE003_0.2-0.4	SE003	0.2-0.4	14/08/2012	Lab	-	-	-	-	-	75.2	5	-	-	-	-	**959**	-	-	**813**	-	-	**6**	-	-	42	-	-	-	**1270**	-	-	2	-	-	44	-	-	-	**1.1**	-	**26**	-	-	-	-	-	**288**	-	-
SE004_0.0-0.1	SE004		16/08/2012	Lab	-	-	-	-	-	80.5	5	-	-	-	7550	**242**	-	**92.4**	**22**	-	11.7	<1	-	0.3	15	-	<1	1.4	**73**	-	50.4	2	-	7050	37	-	28.6	35	**0.2**	-	6	-	3.9	1.4	<1	40.3	74	-	70
SE005_0.0-0.1	SE005	0-0.1	16/08/2012	Lab	-	-	-	-	-	74.2	5.2	-	-	-	10,900	**188**	-	**96**	**83**	-	**28.3**	<1	-	0.4	15	-	3.5	1.4	**310**	-	37.8	<1	-	3840	**54**	-	25.5	22	**0.6**	-	6	-	2.6	1.3	<1	32.7	135	-	93.6
SE010_0.1-0.3	SE010	0.1-0.3	14/08/2012	Lab	-	-	-	-	-	47	4.9	-	10,800	-	-	**4210**	-	-	**1140**	-	-	<1	-	-	**115**	-	-	-	**1340**	-	-	**77**	-	-	**546**	-	-	-	**26.4**	-	16	-	-	-	-	-	58	-	-
SE010_0.6-0.8	SE010	0.6-0.8	14/08/2012	Lab	-	-	-	-	-	42.4	5.8	-	-	-	-	**49**	-	-	**29**	-	-	<1	-	-	10	-	-	-	8	-	-	1	-	-	9	-	-	-	**0.3**	-	3	-	-	-	-	-	<5	-	-
SE011_0.0-0.1	SE011	0-0.1	14/08/2012	Lab	6	2.4	1.9	1	0.6	45.7	5.8	5.94	5250	-	820	**4640**	-	**877**	**1020**	-	**139**	<1	-	<0.1	74	-	5.9	0.5	**247**	-	**160**	8	-	2870	**1230**	-	**703**	15	**56.7**	-	2	-	<1	0.7	<1	3.4	33	-	14.2
SE011_0.3-0.5	SE011		14/08/2012	Lab	-	-	-	-	-	30.6	5.2	-	-	-	-	**<5**	-	-	17	-	-	<1	-	-	10	-	-	-	8	-	-	<1	-	-	<5	-	-	-	<0.1	-	3	-	-	-	-	-	<5	-	-
SE012_0.0-0.1	SE012	0-0.1	14/08/2012	Lab	-	-	-	-	-	77.9	5.4	-	11,000	-	-	**9020**	-	-	**1390**	-	-	<1	-	-	**125**	-	-	-	**750**	-	-	19	-	-	**1790**	-	-	-	**55.6**	-	6	-	-	-	-	-	106	-	-
SE012_0.3-0.5	SE012	0.3-0.5	14/08/2012	Lab	-	-	-	-	-	70	5.2	-	-	-	-	**239**	-	-	**459**	-	-	<1	-	-	25	-	-	-	**229**	-	-	8	-	-	**127**	-	-	-	**1.4**	-	15	-	-	-	-	-	82	-	-
SE013_0.0-0.1	SE013	0-0.1	16/08/2012	Lab	-	-	-	-	-	66.5	4.5	-	6220	-	2660	**8900**	-	**972**	**1660**	-	**105**	<1	-	0.2	29	-	1.2	1.9	**230**	-	**144**	82	-	4520	**1500**	-	**415**	33	**48.6**	-	5	-	4.1	0.8	<1	16.8	73	-	43.6
SE013_0.3-0.5	SE013	0.3-0.5	16/08/2012	Lab	-	-	-	-	-	43.9	-	-	-	-	-	**28**	-	-	**74**	-	-	<1	-	-	13	-	-	-	13	-	-	-	-	-	12	-	-	-	**0.2**	-	4	-	-	-	-	-	10	-	-
SE014_0.0-0.05	SE014	0-0.05	15/08/2012	Lab	11	4.7	4.1	1.2	1	81.3	4.4	20.1	-	-	4950	**6640**	-	**2640**	**861**	-	**65.5**	<1	-	0.4	17	-	<1	3	**402**	-	**311**	66	-	8600	**931**	-	**693**	42	**20.3**	-	8	-	6.5	1.6	<1	25.8	**230**	-	83.1
SE014_0.2-0.4	SE014	0.2-0.4	15/08/2012	Lab	-	-	-	-	-	37.1	-	-	8320	5.1	-	**107**	1	-	**138**	0.6	-	<1	<0.05	-	10	<0.1	-	-	10	<0.1	-	-	3800	-	12	<0.1	-	-	-	<0.001	4	<0.1	-	-	-	-	12	9.1	-
SE020_0.0-0.1	SE020	0-0.1	14/08/2012	Lab	-	-	-	-	-	47.8	4.8	-	3680	-	-	**7450**	-	-	**985**	-	-	<1	-	-	**88**	-	-	-	**122**	-	-	235	-	-	**1270**	-	-	-	**60**	-	4	-	-	-	-	-	52	-	-
SE020_0.2-0.4	SE020	0.2-0.4	14/08/2012	Lab	-	-	-	-	-	54.6	5.4	-	-	-	-	**48**	-	-	**542**	-	-	<1	-	-	15	-	-	-	12	-	-	5	-	-	24	-	-	-	**0.5**	-	5	-	-	-	-	-	12	-	-
SE021_0.0-0.1	SE021	0-0.1	14/08/2012	Lab	20.2	7.9	8.1	0.6	3.5	43.4	4.4	14.8	-	-	770	**9570**	-	**1480**	**1260**	-	**111**	<1	-	0.2	24	-	3.1	0.8	**222**	-	**148**	61	-	3440	**1730**	-	**1010**	10	**73.3**	-	3	-	<1	0.7	<1	2.5	57	-	27.7
SE022_0.0-0.05	SE022	0-0.05	15/08/2012	Lab	-	-	-	-	-	75.9	4.9	-	18,400	-	7520	**2690**	-	**532**	**747**	-	**43.4**	<1	-	0.2	20	-	1	3.4	**88**	-	42.5	46	-	8010	**261**	-	**191**	52	**6.9**	-	12	-	6.2	1.9	<1	47.4	91	-	43.5
SE022_0.2-0.4	SE022	0.2-0.4	15/08/2012	Lab	-	-	-	-	-	50.7	-	-	-	-	-	**58**	-	-	**115**	-	-	<1	-	-	17	-	-	-	9	-	-	-	-	-	14	-	-	-	0.1	-	8	-	-	-	-	-	12	-	-
SE030_0.0-0.1	SE030	0-0.1	14/08/2012	Lab	6.5	2.9	1.7	0.7	1.2	39.1	5.6	2.5	3300	-	1160	**4720**	-	**1360**	**2530**	-	**1180**	<1	-	0.2	9	-	3.3	0.5	**120**	-	**122**	20	-	9340	**160**	-	**106**	21	**18.4**	-	<2	-	<1	0.5	<1	6.4	45	-	32.3
SE030_0.3-0.5	SE030	0.3-0.5	14/08/2012	Lab	-	-	-	-	-	24.2	7.2	-	-	-	-	**342**	-	-	**292**	-	-	<1	-	-	7	-	-	-	7	-	-	<1	-	-	19	-	-	-	**1.5**	-	2	-	-	-	-	-	10	-	-
SE031_0.0-0.1	SE031	0-0.1	14/08/2012	Lab	-	-	-	-	-	33.9	4.6	-	-	-	290	**5920**	-	**796**	**1210**	-	**286**	<1	-	<0.1	14	-	2.7	<0.5	44	-	33.8	46	-	2210	**761**	-	**399**	<10	**38.3**	-	<2	-	<1	<0.5	<1	<2	30	-	10.8
SE032_0.0-0.1	SE032	0-0.1	14/08/2012	Lab	-	-	-	-	-	41.6	-	-	-	1.2	-	-	8.8	-	-	3.8	-	-	<0.05	-	-	<0.1	-	-	-	<0.1	-	-	-	-	-	-	1.6	-	-	**151**	0.0082	-	<0.1	-	-	-	-	-	0.9	-
SE033_0.0-0.05	SE033	0-0.05	16/08/2012	Lab	8	2.9	2.4	1.5	1.2	-	-	10.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE040_0.3-0.5	SE040	0.3-0.5	14/08/2012	Lab	6.6	2	3.1	0.6	0.9	26.8	5.3	0.21	-	-	340	**34**	-	**33.3**	**57**	-	**23.9**	<1	-	<0.1	10	-	<1	<0.5	6	-	6.1	1	-	10,400	8	-	4.5	24	**0.2**	-	<2	-	<1	<0.5	<1	6.8	<5	-	6.7
SE041_0.0-0.05	SE041	0-0.05	14/08/2012	Lab	-	-	-	-	-	69.5	-	-	-	1.5	-	-	5.6	-	-	0.2	-	-	<0.05	-	-	<0.1	-	-	0.4	-	-	-	-	0.8	-	-	**62.6**	<0.001	-	<0.1	-	-	-	-	-	7.9	-
SE041_0.1-0.3	SE041	0.1-0.3	14/08/2012	Lab	-	-	-	-	-	50.1	-	-	4	-	-	-	1.3	-	-	<0.1	-	-	<0.05	-	-	<0.1	-	-	<0.1	-	-	-	-	<0.1	-	-	**0.3**	<0.001	-	<0.1	-	-	-	-	-	7.2	-
SE042_0.0-0.1	SE042	0-0.1	14/08/2012	Lab	-	-	-	-	-	78.3	-	-	-	-	-	**11,900**	-	-	**1430**	-	-	**2**	-	-	54	-	-	-	**980**	-	-	-	-	-	**3280**	-	-	-	**122**	-	9	-	-	-	-	-	**347**	-	-
SE042_0.2-0.4	SE042	0.2-0.4	14/08/2012	Lab	-	-	-	-	-	35.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.2**	-	-	-	-	-	-	-	-	-	-
SE042_0.2-0.4	SE042	0.2-0.4	14/08/2012	Lab	-	-	-	-	-	35.4	-	-	10,300	6.3	-	**43**	0.1	-	**115**	<0.1	-	<1	<0.05	-	12	<0.1	-	-	22	<0.1	-	-	4340	-	19	<0.1	-	-	-	<0.001	5	<0.1	-	-	-	-	44	5.1	-
SE043_0.1-0.3	SE043	0.1-0.3	15/08/2012	Lab	-	-	-	-	-	34.5	5.5	-	-	-	580	**10**	-	**7.4**	9	-	2.5	<1	-	<0.1	8	-	<1	<0.5	6	-	1.4	<1	-	600	7	-	2.6	<10	<0.1	-	2	-	<1	<0.5	<1	6.6	6	-	1.8
SE050_0.0-0.1	SE050	0-0.1	15/08/2012	Lab	-	-	-	-	-	14.5	4.3	-	990	-	-	**626**	-	-	**1370**	-	-	<1	-	-	4	-	-	-	47	-	-	<1	-	-	**69**	-	-	-	**1.9**	-	<2	-	-	-	-	-	20	-	-
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SE050_0.4-0.6	SE050	0.4-0.6	15/08/2012	Lab	-	-	-	-	-	63.8	-	-	14,400	2.9	-	**37**	0.2	-	**1680**	0.1	-	<1	<0.05	-	15	<0.1	-	-	20	<0.1	-	-	11,600	-	15	<0.1	-	-	**0.3**	<0.001	6	<0.1	-	-	-	-	27	7	-
SE051_0.0-0.1	SE051	0-0.1	14/08/2012	Lab	-	-	-	-	-	34.7	4.4	-	-	-	450	**4820**	-	**471**	**2490**	-	**458**	<1	-	0.2	11	-	1.9	<0.5	**67**	-	41.7	4	-	1840	**696**	-	**365**	<10	**11.8**	-	<2	-	<1	<0.5	<1	<2	24	-	7.1
SE051_0.3-0.5	SE051	0.3-0.5	14/08/2012	Lab	-	-	-	-	-	30.9	5.4	-	-	-	-	**76**	-	-	**556**	-	-	<1	-	-	13	-	-	-	47	-	-	2	-	-	**64**	-	-	-	**5.1**	-	6	-	-	-	-	-	61	-	-
SE052_0.0-0.1	SE052	0-0.1	14/08/2012	Lab	-	-	-	-	-	17.7	4.9	-	-	-	190	**21**	-	**12.2**	**64**	-	16.3	<1	-	<0.1	4	-	<1	<0.5	16	-	4.8	<1	-	350	<5	-	2	<10	0.1	-	<2	-	<1	<0.5	<1	3.9	27	-	14.6
SE053_0.0-0.1	SE053	0-0.1	15/08/2012	Lab	-	-	-	-	-	23	-	-	-	-	4620	**15**	-	**3.8**	**91**	-	11	<1	-	0.1	6	-	2.2	<0.5	12	-	2.2	-	-	940	5	-	1.6	<10	<0.1	-	2	-	<1	0.8	<1	6.7	97	-	90.6
SE054_0.0-0.1	SE054	0-0.1	15/08/2012	Lab	-	-	-	-	-	58.1	-	-	-	-	2760	**311**	-	**135**	**179**	-	**27.2**	**3**	-	**2.1**	27	-	<1	0.8	**268**	-	**95.8**	-	-	2930	**136**	-	**78**	11	**1.5**	-	7	-	1.4	1.4	<1	23	**925**	-	**669**
SE055_0.0-0.1	SE055	0-0.1	15/08/2012	Lab	-	-	-	-	-	28.4	-	-	-	-	-	**6**	-	-	11	-	-	<1	-	-	3	-	-	-	35	-	-	-	-	-	14	-	-	-	<0.1	-	<2	-	-	-	-	-	**238**	-	-
SE056_0.05-0.15	SE056	0.05-0.15	15/08/2012	Lab	-	-	-	-	-	27.8	5.5	-	-	-	870	**8**	-	**6.1**	**31**	-	14.8	**8**	-	**6**	4	-	<1	<0.5	**415**	-	**334**	<1	-	2040	22	-	10.2	<10	<0.1	-	<2	-	<1	0.7	<1	2.6	**2150**	-	**1730**
SE057_0.2-0.4	SE057	0.2-0.4	16/08/2012	Lab	-	-	-	-	-	45.3	5.6	-	-	-	1570	**108**	-	**66.1**	**208**	-	**80.8**	**3**	-	1.4	30	-	1.5	0.9	**232**	-	**197**	4	-	4550	**88**	-	**86.1**	13	**0.7**	-	7	-	1.1	1	<1	14.9	**459**	-	**267**
SE060_0.0-0.1	SE060	0-0.1	15/08/2012	Lab	19.4	8.8	7.3	0.6	2.7	-	-	19.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE061_0.0-0.1	SE061	0-0.1	15/08/2012	Lab	13.3	5.8	5.7	0.4	1.4	43.8	6.4	1.69	-	-	820	**<5**	-	**3.9**	12	-	7.3	<1	-	<0.1	15	-	<1	<0.5	9	-	<1	<1	-	1470	7	-	<1	<10	0.1	-	6	-	<1	0.8	<1	14	21	-	5.1
SE062_0.0-0.1	SE062	0-0.1	15/08/2012	Lab	-	-	-	-	-	72.8	4.7	-	11,200	-	3950	**3120**	-	**1020**	**352**	-	**27.3**	**2**	-	**6.3**	28	-	<1	2.8	**767**	-	**131**	34	-	7750	**620**	-	**155**	36	**8.1**	-	10	-	5.3	1.1	<1	23.3	**577**	-	**512**
SE062_0.2-0.3	SE062	0.2-0.3	15/08/2012	Lab	-	-	-	-	-	30.3	5.7	-	4790	-	1190	**<5**	-	**2.9**	6	-	2.3	<1	-	<0.1	8	-	<1	0.5	6	-	3.2	<1	-	1250	5	-	4.4	<10	<0.1	-	3	-	<1	0.6	<1	10.7	<5	-	5
SE064_0.0-0.1	SE064	0-0.1	15/08/2012	Lab	17.2	6.3	6.8	0.4	3.6	84.8	5.3	17.3	-	-	6560	**4210**	-	**266**	**2230**	-	**74.6**	**2**	-	**1.6**	42	-	<1	4.4	**653**	-	**169**	<2	-	12,800	**449**	-	**87.4**	56	**4.4**	-	10	-	8.2	1.9	<1	42.5	**449**	-	**526**
SE064_0.2-0.3	SE064	0.2-0.3	15/08/2012	Lab	-	-	-	-	-	41.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-
SE064_0.2-0.3	SE064	0.2-0.3	15/08/2012	Lab	-	-	-	-	-	41.6	-	-	7010	12.2	-	**<5**	<0.1	-	8	<0.1	-	<1	<0.05	-	12	<0.1	-	-	13	<0.1	-	-	2870	-	9	<0.1	-	-	-	<0.001	4	<0.1	-	-	-	-	12	7.7	-
SE066_0.0-0.1	SE066	0-0.1	15/08/2012	Lab	-	-	-	-	-	79	5	-	-	-	3340	**130**	-	**90.9**	**286**	-	**9.4**	**4**	-	**4.8**	12	-	<1	3.2	**87**	-	**70.5**	4	-	6900	21	-	26.9	40	**0.2**	-	10	-	6.4	1	<1	17.2	**1130**	-	**953**
SE067_0.0-0.1	SE067	0-0.1	15/08/2012	Lab	-	-	-	-	-	84.2	-	-	-	1.2	-	-	0.6	-	-	0.1	-	-	<0.05	-	-	<0.1	-	-	-	<0.1	-	-	-	-	<0.1	-	-	**0.9**	<0.001	-	<0.1	-	-	-	-	-	1.4	-
SE068_0.0-0.1	SE068	0-0.1	15/08/2012	Lab	-	-	-	-	-	73.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.2**	-	-	-	-	-	-	-	-	-	-
SE068_0.0-0.1	SE068	0-0.1	15/08/2012	Lab	-	-	-	-	-	73.4	-	-	7700	1	-	**180**	1.1	-	**148**	0.3	-	**4**	<0.05	-	10	<0.1	-	-	**138**	<0.1	-	-	6610	-	31	<0.1	-	-	-	<0.001	7	<0.1	-	-	-	-	**624**	10.6	-
SE102_0.0-0.2	SE102	0-0.2	16/08/2012	Lab	-	-	-	-	-	75.2	-	-	-	-	-	**744**	-	-	18	-	-	<1	-	-	17	-	-	-	**708**	-	-	-	-	-	**74**	-	-	-	**0.3**	-	11	-	-	-	-	-	39	-	-
SE102_0.0-0.2	SE102	0-0.2	16/08/2012	XRF	-	-	-	-	-	-	-	-	-	-	-	**117.1**	-	-	<3.64	-	-	**<11.06**	-	-	<78.58	-	-	-	**230.8**	-	-	-	-	-	**57.83**	-	-	-	**<3.72**	-	**<23.39**	-	-	-	-	-	<6.73	-	-
					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: Highlighted cells with a '<' symbol may not necessarily constitute an assessment criteria exceedance

Soil and Sediment XRF/Laboratory Result Comparison Table

	Antimony (LAB)	Antimony (XRF)	RPD/Comment	Arsenic (LAB)	Arsenic (XRF)	RPD/Comment	Cadmium (LAB)	Cadmium (XRF)	RPD/Comment	Chromium (III+VI) (LAB)	Chromium (III+VI) (XRF)	RPD/Comment	Copper (LAB)	Copper (XRF)	RPD/Comment	Lead (LAB)	Lead (XRF)	RPD/Comment	Mercury (LAB)	Mercury (XRF)	RPD/Comment	Nickel (LAB)	Nickel (XRF)	RPD/Comment	Zinc (LAB)	Zinc (XRF)	RPD/Comment
	mg/kg	mg/kg	(%)	mg/kg	mg/kg	(%)	mg/kg	mg/kg	(%)	mg/kg	mg/kg	(%)	mg/kg	mg/kg	(%)	mg/kg	mg/kg	(%)	mg/kg	mg/kg	(%)	mg/kg	mg/kg	(%)	mg/kg	mg/kg	(%)
EQL	1	1		0.5	0.5		0.1	0.1		0.5	0.5		0.5	0.5		0.5	0.5		0.05	0.05		0.5	0.5		0.5	0.5	
Field_ID																											
BH001_0.3-0.5	3660	11,720	-105	1520	2913	-63	<1	<19.75	Both Non detect	7	<144.1	Lab low, XRF non detect	630	598.3	5	18	24.32	-30	38.3	51.42	-29	2	<53.16	Lab low, XRF non detect	30	44.63	-39
BH002_0.5-0.7	<5	<17.61	Both non detect	<5	33.72	Both Low	<1	<39.22	Both Non detect	11	<111	Lab low, XRF non detect	7	14.82	-72	6	<6.87	Both Low	<0.1	<5.8	Both Non detect	<2	<78.24	Both non detect	13	28.05	-73
BH004_0.0-0.2	4700	11,570	-84	1950	3931	-67	<1	<20.36	Both Non detect	18	<145.5	Lab low, XRF non detect	136	113.3	18	150	151.9	-1	61.2	48.49	23	<2	<50.18	Both non detect	47	59.34	-23
BH004_1.0-1.2	2050	5323	-89	1160	84.85	173	<1	<17.48	Both Non detect	16	<130.1	Lab low, XRF non detect	166	<19.81	Inconsistent	116	34.53	108	28.9	<7.2	Both Low	5	<41.87	Both low	95	52.87	57
BH006_0.0-0.3	1950	847.6	79	702	164.8	124	-	<35.73	Both Non detect	-	<105.5	-	-	458	-	-	<7.21	-	2.3	<6.12	Both Low	-	<37.94	-	-	58.68	-
BH020_0.0-0.2	59	<16.99	Both low	**58**	**42.56**	31	**11**	**<13.97**	o Low, XRF non det	**12**	**<275.6**	Lab low, XRF non detect	**724**	**174.7**	122	25	<5.48	Lab low, XRF non detect	0.6	**<5.52**	Lab low, XRF non detect	4	<34.14	Lab low, XRF non detect	**695**	43.91	176
BH022_0.5-0.7	544	489.7	11	**132**	**71.58**	59	<1	**<14.08**	Both Non detect	**9**	**<106.8**	Lab low, XRF non detect	29	**140.3**	-131	23	<5.48	Lab low, XRF non detect	0.3	**<5.53**	Lab low, XRF non detect	<2	<31.71	Both non detect	13	28	-73
BH023_0.0-0.2	13,200	4277	102	6860	1453	130	-	**<15.44**	-	-	**<22.85**	-	-	<17.18	-	-	35.57	-	146	28.26	135	-	<38.88	-	-	<10.02	-
BH023_0.5-0.7	8650	4260	68	4110	1461	95	-	**<15.48**	-	-	**<121.2**	-	-	<17.71	-	-	38.38	-	42.8	22.23	63	-	<37.35	-	-	9.74	-
BH024_0.3-0.5	6640	9228	-33	4050	2431	50	-	<19.08	Both Non detect	-	<128.2	-	-	531.6	-	-	656.7	-	-	42.34	-	-	<45.27	-	-	96.67	-
BH024_1.0-1.2	192	677.5	-112	130	652.5	-134	-	<13.95	Both Non detect	-	<102.8	-	-	2318	-	-	184.9	-	-	14.61	-	-	<31.07	-	-	35.7	-
BH024_2.0-2.2	31	<15.95	Both Low	33	78.47	-82	-	<13.55	Both Non detect	-	<102.8	-	-	96.38	-	-	11.15	-	-	<5.03	-	-	<31.61	-	-	30.73	-
BH028_0.0-0.2	12,600	-	-	5000	5259	-5	<1	-	-	**3**	**<24.81**	Lab low, XRF non detect	23	55.67	-83	11	25.02	-78	47.3	44.15	7	<2	209	Inconsistent	27	51.08	-62
BH028_0.3-0.5	978	-	-	599	1185	-66	<1	-	-	**7**	**<32.19**	Lab low, XRF non detect	8	27.82	-111	10	<10.23	Lab low, XRF non detect	30.6	**<12.08**	Lab low, XRF non detect	<2	83.61	Inconsistent	8	<13.71	Lab low, XRF non detect
BH031_1.0-1.2	9670	4932	65	5280	3832	32	<1	<16.9	Both Non detect	9	<131.9	Lab low, XRF non detect	21	<20.17	Both Low	133	75.71	55	58.3	35.54	49	9	<41.52	Lab low, XRF non detect	24	26.78	-11
BH032_0.3-0.5	6070	2482	84	3620	1086	108	<1	**<14.56**	Both Non detect	**34**	**<115.3**	Lab low, XRF non detect	**231**	**354.8**	-42	**996**	251.4	119	78.8	28.4	94	<2	<35.12	Both non detect	39	26.89	37
BH053_0.3-0.5	5320	14,470	-92	3560	3007	17	<1	**<22.98**	Both Non detect	**11**	**<143.8**	Lab low, XRF non detect	26	<24.94	Lab low, XRF non detect	329	216.4	41	35.8	32.35	10	3	<53.36	Lab low, XRF non detect	19	32.09	-51
BH053_1.5-1.7	150	670.5	-127	1330	596.7	76	<1	<11.74	Both Non detect	18	<81.96	Lab low, XRF non detect	22	<11.67	Both Low	25	36.05	-36	1.2	<5.28	Both Low	9	<25.01	Lab low, XRF non detect	14	<7.34	Both Low
BH053_3.2-3.5	23	<16.29	Both Low	80	69.44	14	<1	<13.75	Both Non detect	11	<112.1	Lab low, XRF non detect	<5	21.66	Both Low	14	<5.11	Both Low	0.4	<5.56	Both Low	<2	<33.03	Both non detect	<5	14.26	Both Low
BH056_0.3-0.5	<5	<16.2	Both non detect	<5	5.5	Both Low	-	<14.92	Both Non detect	-	<116.9	-	-	<14.96	-	-	<6.22	-	<0.1	<5.24	Both Low	-	<33.44	-	-	8.35	-
BH060_0.0-0.2	160	26.59	143	66	50.17	27	-	<12.83	Both Non detect	-	<98.01	-	-	37.3	-	-	<4.67	-	1.1	<5.01	Both Low	-	<29.94	-	-	29.61	-
BH064_0.0-0.2	<5	<16.42	Both non detect	<5	4.62	Both Low	-	<21.08	Both Non detect	-	<114.9	-	-	18.4	-	-	<5.3	-	<0.1	<5.39	Both Non detect	-	<33.86	-	-	26.72	-
BH064_0.3-0.5	<5	<17.29	Both non detect	7	11.22	-46	-	<14.76	Both Non detect	-	<109.7	-	-	26.54	-	-	<5.65	-	<0.1	<5.76	Both Non detect	-	<35.48	-	-	36.88	-
BH071_0.5-0.7	<5	<16.35	Both non detect	<5	13.55	Both Low	<1	<20.17	Both Non detect	4	<105.2	Lab low, XRF non detect	<5	<15.22	Both non detect	8	<5.33	Both Low	<0.1	<5.3	Both Non detect	<2	<33.97	Both non detect	8	12.04	-40
BH073_0.0-0.2	295	447.9	-41	496	<69.91	Inconsistent	-	<19.62	Both Non detect	-	<594.3	-	-	947.6	-	-	15580.00	-	47.5	14.96	104	-	<36.26	-	-	7674	-
BH073_0.5-0.7	405	30.15	172	416	282.2	38	-	<19.7	Both Non detect	-	<117.9	-	-	480.6	-	-	2746	-	57.8	8.8	147	-	<34.68	-	-	1004	-
BH073_1.0-1.2	72	<15.96	Both low	13	**76.23**	-142	<1	**<13.76**	Both Non detect	**11**	**<112.8**	Lab low, XRF non detect	**120**	**171.8**	-36	518	**623.5**	-18	0.8	**<5.57**	Lab low, XRF non detect	<2	<32.28	Both non detect	**305**	**406.5**	-29
BH074_0.8-1.0	<5	<15.49	Both non detect	<5	<2.69	Both non detect	-	<14.36	Both Non detect	-	<112.9	-	-	<14.63	-	-	<5.87	-	<0.1	<4.98	Both Non detect	-	<31.94	-	-	6.64	-
BH075_1.8-2.0	36	<12.93	Both Low	129	32.4	120	3	<11.61	Both Non detect	10	<82.77	Lab low, XRF non detect	30	<12.25	Both Low	17	<3.77	Both Low	0.2	<4.02	Both Low	3	<25.15	Lab low, XRF non detect	76	17.27	126
BH077_0.0-0.2	388	22.4	178	432	**107.3**	120	<1	**<13.05**	Both Non detect	**10**	**<103.2**	Lab low, XRF non detect	19	<14.92	Lab low, XRF non detect	80	<5.01	Both Low	**2**	**<5.13**	Lab low, XRF non detect	2	<29.99	Lab low, XRF non detect	10	12.26	-20
BH077_0.3-0.5	93	<13.7	Both Low	157	212	-30	<1	<11.72	Both Non detect	15	<84.81	Lab low, XRF non detect	28	22.28	23	24	38.87	-47	0.8	<4.14	Both Low	5	<24.94	Lab low, XRF non detect	9	7.28	21
BH077_1.0-1.2	36	93.58	-89	156	477.1	-101	<1	<13.83	Both Non detect	14	<111.3	Lab low, XRF non detect	10	17.09	-52	17	31.15	-59	0.6	<6.22	Both Low	3	<33.46	Lab low, XRF non detect	11	23.39	-72
BH077_1.5-1.7	882	107	157	2130	543.3	119	<1	<11.81	Both Non detect	17	<84.79	Lab low, XRF non detect	51	<12.56	Both Low	170	41.75	121	5.4	<4.87	Both Low	8	<25.19	Lab low, XRF non detect	33	7.55	126
BH077_2.0-2.2	144	<12.24	Inconsistent	**165**	**39.13**	123	<1	**<10.89**	Both Non detect	**20**	**<76.76**	Lab low, XRF non detect	22	<11.27	Lab low, XRF non detect	21	<3.85	Lab low, XRF non detect	0.8	**<3.67**	Lab low, XRF non detect	18	<22.64	Lab low, XRF non detect	15	<5.95	Lab low, XRF non detect
BH082_1.5-1.7	92	71.09	26	1510	139.2	166	-	**<11.41**	-	-	**<79.09**	-	-	<12.35	-	-	27.7	-	1.3	<4.11	Lab low, XRF non detect	-	<24.46	-	-	8.9	-
BH084_1.0-1.2	2730	550.2	133	518	105.7	132	-	<13.43	Both Non detect	-	<104.8	-	-	26.5	-	-	62.46	-	5.1	<5.45	Both Low	-	<32.04	-	-	19.28	-
BH084_1.5-1.7	3220	645.5	133	387	116.6	107	-	<11.62	Both Non detect	-	<80.22	-	-	<11.75	-	-	15.22	-	<0.1	<4.1	Both Non detect	-	<24.79	-	-	24.71	-
BH091_0.0-0.1	<5	<13.59	Both non detect	5	10.04	-67	-	<12.15	Both Non detect	-	<95.89	-	-	<13.59	-	-	<4.58	-	0.1	<4.3	Both low	-	<27.2	-	-	15.66	-
BH101_0.0-0.2	5400	664.8	156	2540	**128.7**	181	<1	**<13**	Both Non detect	**34**	**<96.62**	Lab low, XRF non detect	**272**	**151.8**	57	474	17.65	186	343	**<5.1**	Inconsistent	<2	<29.46	Both non detect	47	22.9	69
SE002_0.0-0.1	3060	1750	54	141	35.82	119	<1 - 0.3	<12.37	Both Non detect	61.8 - 1450	<91.97	Inconsistent	735	760.1	-3	1090	412	90	87.6	15.64	139	1.2 - 4	<27.61	Lab low, XRF non detect	99	50.5	65
SE002_0.3-0.5	1200	<12.75	Inconsistent	295	135.6	74	3	<10.88	Both Non detect	253	<75.91	Lab low, XRF non detect	1100	20.95	193	216	<3.69	Inconsistent	9.8	<3.57	Both Low	13	<22.82	Lab low, XRF non detect	140	93.63	40
SE102_0.0-0.2	744	117.1	146	18	<3.64	Both Low	<1	<11.06	Both Non detect	17	<78.58	Lab low, XRF non detect	708	230.8	102	74	57.83	25	0.3	<3.72	Both Low	11	<23.39	Lab low, XRF non detect	39	<6.73	Both Low

RPD >150%
Concentration exceeds adopted threshold
Concentration exceeds 10 x adopted threshold
Concentration exceeds 30 x adopted threshold

Note: Highlighted cells with a '<' symbol may not necessarily constitute an assessment criteria exceedance

Particle Size Analysis- Soil and Sediment

					Particle Sizing												Soil Classification						
					+75um	+150um	+300um	+425um	+600um	+1180um	+2.36mm	+4.75mm	+9.5mm	+19.0mm	+37.5mm	+75.0mm	Clay (<2 um)	Silt (2-60 um)	Cobbles (>6cm)	Gravel (>2mm)	Sand (0.06-2.00 mm)	Lab Classification	Field Classification
					%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%		
EQL					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Field_ID	**LocCode**	**Matrix**	**Sample Depth**	**Sample Date**																			
BH014_0.0-0.1	BH014	Soil	0-0.1	15/08/2012	72	69	32	12	7	5	4	2	<1	<1	<1	<1	14	13	<1	4	69	clayey SAND	silty SAND
BH023_0.0-0.1	BH023	Soil	0-0.1	15/08/2012	77	73	26	6	1	<1	<1	<1	<1	<1	<1	<1	14	7	<1	<1	79	clayey SAND	SAND
BH031_0.0-0.2	BH031	Soil	0-0.2	15/08/2012	76	53	25	14	8	2	<1	<1	<1	<1	<1	<1	9	14	<1	<1	77	silty SAND	silty SAND
BH031_0.5-0.7	BH031	Soil	0.5-0.7	15/08/2012	72	47	20	10	5	<1	<1	<1	<1	<1	<1	<1	9	17	<1	<1	74	silty SAND	silty SAND
BH031_1.8-2.0	BH031	Soil	1.8-2	15/08/2012	20	12	6	4	2	1	<1	<1	<1	<1	<1	<1	36	44	<1	1	19	clayey SILT	clayey SILT
SE002_0.5-0.7	SE002	Sediment	0.5-0.7	14/08/2012	22	10	3	1	1	<1	<1	<1	<1	<1	<1	<1	36	41	<1	<1	23	clayey SILT	sandy CLAY
SE003_0.2-0.4	SE003	Sediment	0.2-0.4	16/08/2012	18	6	2	1	<1	<1	<1	<1	<1	<1	<1	<1	28	47	<1	<1	25	clayey SILT	SILT
SE004_0.2-0.3	SE004	Sediment	0.2-0.3	16/08/2012	20	11	3	2	1	<1	<1	<1	<1	<1	<1	<1	36	44	<1	<1	20	clayey SILT	silty CLAY
SE004_0.4-0.6	SE004	Sediment	0.4-0.6	16/08/2012	14	7	2	1	<1	<1	<1	<1	<1	<1	<1	<1	39	47	<1	<1	14	clayey SILT	SILT
SE011_0.7-0.9	SE011	Sediment	0.7-0.9	14/08/2012	12	8	5	5	4	3	<1	<1	<1	<1	<1	<1	63	25	<1	1	11	silty CLAY	CLAY, some silt
SE033_0.0-0.05	SE033	Sediment	0-0.05	15/08/2012	11	8	7	6	5	4	3	<1	<1	<1	<1	<1	55	30	<1	3	12	silty CLAY	silty CLAY
SE033_0.2-0.4	SE033	Sediment	0.2-0.4	15/08/2012	23	11	2	2	1	<1	<1	<1	<1	<1	<1	<1	24	54	<1	<1	22	clayey SILT	silty CLAY
SE033_0.4-0.6	SE033	Sediment	0.4-0.6	15/08/2012	9	8	6	5	5	3	1	<1	<1	<1	<1	<1	80	11	<1	1	8	silty CLAY	SILT
SE063_0.0-0.1	SE063	Sediment	0-0.1	15/08/2012	14	12	11	10	9	6	3	<1	<1	<1	<1	<1	68	12	<1	3	17	silty CLAY	SILT
SE063_0.2-0.3	SE063	Sediment	0.2-0.3	15/08/2012	6	4	2	2	2	1	<1	<1	<1	<1	<1	<1	57	36	<1	1	6	silty CLAY	sandy CLAY
SE063_0.4-0.6	SE063	Sediment	0.4-0.6	15/08/2012	9	8	7	6	6	4	2	<1	<1	<1	<1	<1	64	27	<1	2	7	silty CLAY	SILT

Acid Sulfate Soil Analysis

		pH					Acidity Trail						Sulfur Trail				Calcium Values						Magnesium Values						Retained Acidity				*Acid Base Accounting*			
		pH KCl (23A)	pH OX (23B)	pH (F)	pH (Fox)	Reaction Rate	Titratable Actual Acidity (23F)	Titratable Peroxide Acidity (23G)	Titratable Sulfidic Acidity (23H)	sulfidic - Titratable Actual Acidity (s-23F)	sulfidic - Titratable Peroxide Acidity (s-23G)	sulfidic - Titratable Sulfidic Acidity (s-23H)	KCl Extractable Sulfur (23Ce)	Peroxide Sulfur (23De)	Peroxide Oxidisable Sulfur (23E)	acidity - Peroxide Oxidisable Sulfur (a-23E)	KCl Extractable Calcium (23Vh)	Peroxide Calcium (23Wh)	Acid Reacted Calcium (23X)	acidity - Acid Reacted Calcium (a-23X)	sulfidic - Acid Reacted Calcium (s-23X)	KCl Extractable Magnesium (23Sm)	Peroxide Magnesium (23Tm)	Acid Reacted Magnesium (23U)	acidity - Acid Reacted Magnesium (a-23U)	sulfidic - Acid Reacted Magnesium (s-23U)	HCl Extractable Sulfur (20Be)	Net Acid Soluble Sulfur (20Je)	acidity - Net Acid Soluble Sulfur (a-20J)	sulfidic - Net Acid Soluble Sulfur (s-20J)	ANC Fineness Factor	Net Acidity (sulfur units)	Net Acidity (acidity units)	Liming Rate
		pH_Units	pH units	pH units	pH units	-	mole H+ / t	mole H+ / t	mole H+ / t	% pyrite S	% pyrite S	% pyrite S	% S	% S	% S	mole H	% Ca	% Ca	% Ca	mole H+ / t	% S	% Mg	% Mg	% Mg	mole H+ / t	% S	% S	% S	mole H+ / t	% pyrite S	-	% S	mole H+ / t	kg CaCO3/t
EQL		0.01	0.01	0.01	0.01	1	2	2	2	0.02	0.02	0.02	0.02	0.02	0.02	10	0.02	0.02	0.02	10	0.02	0.02	0.02	0.02	10	0.02	0.02	0.02	10	0.02	0.5	0.02	10	1
Field_ID	**Sample Date**																																			
BH031_0.0-0.2	15/08/2012	4.0	2.1	3.4	2.5	3	32	64	31	0.05	0.10	0.05	<0.02	0.05	0.05	29	<0.02	<0.02	<0.02	<10	<0.02	<0.02	<0.02	<0.02	<10	<0.02	0.02	0.02	11	<0.02	1.5	0.12	73	5
BH031_0.5-0.7	15/08/2012	4.8	1.9	3.8	0.9	3	12	547	536	<0.02	0.88	0.86	<0.02	0.84	0.84	522	<0.02	<0.02	<0.02	<10	<0.02	<0.02	<0.02	<0.02	<10	<0.02	-	-	-	-	1.5	0.86	534	40
BH031_1.8-2.0	15/08/2012	4.5	2.1	6.9	1.4	4	85	702	617	0.14	1.12	0.99	0.04	0.85	0.81	504	0.14	0.17	0.02	12	<0.02	0.03	0.04	<0.02	13	0.02	-	-	-	-	1.5	0.94	589	44
BH032_0.0-0.2	14/08/2012	4.6	3.2	5.9	2.3	2	19	153	<2	0.03	0.24	<0.02	<0.02	0.06	0.06	39	<0.02	<0.02	<0.02	<10	<0.02	<0.02	<0.02	<0.02	<10	<0.02	-	-	-	-	1.5	0.09	58	4
BH032_0.3-0.5	14/08/2012	4.4	2.6	6.3	1.4	2	38	151	<2	0.06	0.24	<0.02	<0.02	0.19	0.19	118	<0.02	<0.02	<0.02	<10	<0.02	<0.02	<0.02	<0.02	<10	<0.02	0.09	0.09	43	0.07	1.5	0.32	199	15
BH032_1.0-1.2	14/08/2012	5.5	2.7	7.1	1.5	2	18	352	334	0.03	0.56	0.54	0.03	0.50	0.48	297	0.14	0.18	0.03	16	0.02	0.08	0.09	<0.02	11	<0.02	-	-	-	-	1.5	0.50	315	24
BH054_0.0-0.2	14/08/2012	-	-	6.5	2.9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH054_0.7-0.9	14/08/2012	-	-	6.9	1.7	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH054_1.0-1.2	14/08/2012	-	-	6.7	1.2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE001_0.0-0.1	16/08/2012	-	-	6.7	1.9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE003_0.2-0.4	16/08/2012	4.5	2.4	-	-	-	56	356	300	0.09	0.57	0.48	<0.02	0.22	0.22	141	0.05	0.06	<0.02	<10	<0.02	0.04	0.05	<0.02	<10	<0.02	-	-	-	-	1.5	0.32	197	15
SE003_0.2-0.4	16/08/2012	-	-	5.9	1.8	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE004_0.0-0.1	16/08/2012	-	-	5.9	1.8	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE011_0.3-0.5	16/08/2012	-	-	5.7	1.8	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE013_0.3-0.5	16/08/2012	4.4	3.2	-	-	-	260	1010	746	0.42	1.61	1.20	0.03	0.54	0.50	313	0.10	0.12	<0.02	<10	<0.02	0.04	0.05	<0.02	<10	<0.02	0.08	0.04	20	0.03	1.5	0.95	594	44
SE013_0.3-0.5	16/08/2012	-	-	6.6	1.6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE031_0.5-0.7	16/08/2012	4.5	2.3	6.6	1.5	3	87	712	625	0.14	1.14	1.00	<0.02	0.43	0.43	268	0.13	0.15	0.02	12	<0.02	0.09	0.10	<0.02	<10	<0.02	-	-	-	-	1.5	0.57	355	27
SE050_0.0-0.1	16/08/2012	-	-	5.4	2.2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE050_0.2-0.4	16/08/2012	-	-	5.4	2.2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE054_0.1-0.3	16/08/2012	-	-	6.5	1.6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Surface Water Chemistry

			Field					Inorganics							Alkalinity						Major Ions											
			Dissolved Oxygen (Field)	Electrical Conductivity (Field)	Oxygen Redox Potential (Field)	pH (Field)	Temp (Field)	Cyanide Total	Electrical conductivity *(lab)	pH (Lab)	Redox	TOC	Total Dissolved Solids	Total Suspended Solids	Alkalinity (total) as CaCO3	Alkalinity (Bicarbonate as CaCO3)	Alkalinity (Carbonate as CaCO3)	Alkalinity (Hydroxide) as CaCO3	Bicarbonate	Hardness as CaCO3	Calcium	Calcium (Filtered)	Chloride	Magnesium	Magnesium (Filtered)	Potassium	Potassium (Filtered)	Sodium	Sodium (Filtered)	Sulphate	Anions Total	Cations Total
			mg/L	uS/cm	mV	pH Units	oC	mg/L	uS/cm	pH Units	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L
EQL			0.1	100		0.01		0.004	1000	0.1	1	1	5	2	1	1	1	1	1	0.5	0.1	1	1	0.1	1	0.1	1	0.1	1	1	0.01	0.01
ANZECC 2000 FW Slightly-moderate disturbed system								0.007																							
10 times ANZECC 2000 FW Slightly-moderate disturbed system								0.07																							
30 times ANZECC 2000 FW Slightly-moderate disturbed system								0.21																							
ANZECC 2000 MW Slightly-moderate disturbed system								**0.004**																							
Field_ID	**LocCode**	**Sample Date**																													
1	DLWC97-SW1	30/04/1997	0.4	171	-	6.25	-	**0.027**	146	6	311	18	94	10	18	-	-	-	18	23	3.5	-	31	3.6	-	0.6	-	18	-	2	-	-
2	DLWC97-SW2	30/04/1997	1.2	117	-	6.01	-	**0.009**	94	5.7	314	29	68	47	16	-	-	-	16	21	3.3	-	18	3.2	-	1.3	-	17	-	<1	-	-
3	DLWC97-SW3	30/04/1997	3.5	146	-	5.94	-	**0.013**	139	5	335	10	90	8	3	-	-	-	3	16	2.8	-	32	2.3	-	2.2	-	22	-	10	-	-
4	DLWC97-SW4	30/04/1997	4.4	102	-	6.19	-	**0.018**	95	6.1	308	15	73	6	10	-	-	-	10	14	2.3	-	18	2.2	-	2	-	16	-	4	-	-
5	DLWC97-SW5	30/04/1997	5.1	103	-	6.1	-	**<0.005**	90	6	305	16	96	6	10	-	-	-	10	16	2.2	-	19	2.5	-	1.8	-	17	-	4	-	-
6	DLWC97-SW6	30/04/1997	3.9	121	-	6.12	-	**0.038**	93	5.9	316	15	74	6	9	-	-	-	9	13	2	-	19	2	-	1.5	-	14	-	8	-	-
7	DLWC97-SW7	30/04/1997	1	102	-	6.08	-	**0.033**	101	6.1	314	16	70	7	10	-	-	-	10	15	2.1	-	20	2.4	-	2.2	-	19	-	3	-	-
8	DLWC97-SW8	30/04/1997	3	100	-	6.08	-	**0.044**	90	6	324	15	80	9	9	-	-	-	9	16	2.4	-	18	2.4	-	2.3	-	17	-	8	-	-
9	DLWC97-SW9	30/04/1997	3	104	-	6.32	-	**0.007**	91	6	317	15	81	17	10	-	-	-	10	15	2.3	-	18	2.3	-	2.3	-	17	-	7	-	-
10	DLWC97-SW10	30/04/1997	3.2	113	-	6.4	-	**<0.005**	95	5.8	307	14	70	11	10	-	-	-	10	15	2.5	-	18	2.2	-	2	-	17	-	4	-	-
11	DLWC97-SW11	30/04/1997	1.8	105	-	5.98	-	**0.02**	96	6	332	15	86	8	9	-	-	-	9	14	2.1	-	20	2.1	-	2.1	-	17	-	10	-	-
12	DLWC97-SW12	30/04/1997	1.9	116	-	5.94	-	**0.029**	105	6	309	15	92	14	11	-	-	-	11	16	2.3	-	22	2.4	-	2.7	-	20	-	4	-	-
13	DLWC97-SW13	30/04/1997	5.4	149	-	6.09	-	**0.038**	123	6	304	20	115	10	11	-	-	-	11	17	2.6	-	29	2.6	-	3	-	24	-	2	-	-
14	DLWC97-SW14	30/04/1997	4.5	158	-	6.18	-	**0.011**	142	5.7	310	12	108	8	10	-	-	-	10	16	2.3	-	34	2.4	-	1.9	-	25	-	2	-	-
15	DLWC97-SW15	30/04/1997	0.9	229	-	6.04	-	**0.013**	218	5.7	312	9	128	7	13	-	-	-	13	16	2.3	-	54	2.6	-	0.8	-	44	-	4	-	-
16	DLWC97-SW16	30/04/1997	1.7	214	-	6.15	-	**0.016**	198	5.4	318	7	122	17	5	-	-	-	5	15	1.9	-	54	2.5	-	0.9	-	36	-	4	-	-
17	DLWC97-SW17	30/04/1997	0.9	256	-	5.95	-	**0.012**	249	5.9	290	11	162	3	12	-	-	-	12	28	3.6	-	67	4.5	-	1.6	-	46	-	3	-	-
18	DLWC97-SW18	30/04/1997	1.1	266	-	5.95	-	**0.008**	240	6.3	268	11	169	4	14	-	-	-	14	29	4	-	65	4.7	-	1.7	-	45	-	3	-	-
SW001	SW001	22/08/2012	2.46	168	241	5.4	12.8	<0.004	-	-	-	-	129	43	8	8	<1	<1	-	-	-	3	48	-	3	-	1	-	24	<1	1.51	1.47
SW002	SW002	22/08/2012	6.58	177	222	6.9	21.2	<0.004	-	-	-	-	126	9	9	9	<1	<1	-	-	-	3	44	-	3	-	1	-	23	<1	1.42	1.42
SW003	SW003	22/08/2012	6.8	137	207	5.5	19.6	<0.004	-	-	-	-	107	9	4	4	<1	<1	-	-	-	2	33	-	2	-	1	-	18	2	1.05	1.07
SW004	SW004	22/08/2012	6.96	128	198	6	16	<0.004	-	-	-	-	106	<5	4	4	<1	<1	-	-	-	2	32	-	2	-	1	-	18	2	1.02	1.07
SW005	SW005	22/08/2012	-	131	191	5.9	15.4	<0.004	-	-	-	-	104	6	4	4	<1	<1	-	-	-	2	32	-	2	-	1	-	18	2	1.02	1.07
SW006	SW006	22/08/2012	5.27	139	132	6.1	14.8	<0.004	-	-	-	-	105	8	7	7	<1	<1	-	-	-	2	36	-	2	-	1	-	20	2	1.2	1.16
SW007	SW007	22/08/2012	5.87	141	150	6.8	14.5	<0.004	-	-	-	-	112	8	6	6	<1	<1	-	-	-	2	36	-	2	-	1	-	20	1	1.16	1.16
SW008	SW008	22/08/2012	5.65	320	257	4.9	14	<0.004	-	-	-	-	194	15	<1	<1	<1	<1	-	-	-	4	101	-	6	-	1	-	48	5	2.95	2.81
SW009	SW009	22/08/2012	1.54	247	202	5.2	12.9	<0.004	-	-	-	-	157	6	1	1	<1	<1	-	-	-	5	67	-	6	-	2	-	36	20	2.33	2.36

Note: Highlighted cells with a '<' symbol may not necessarily constitute an assessment criteria exceedance

Surface Water Chemistry

			Metals																					
			Aluminium	Aluminium (Filtered)	Antimony	Antimony (Filtered)	Arsenic	Arsenic (Filtered)	Cadmium	Cadmium (Filtered)	Chromium (III+VI)	Chromium (III+VI) (Filtered)	Copper	Copper (Filtered)	Iron	Iron (Filtered)	Lead	Lead (Filtered)	Manganese	Mercury	Mercury (Filtered)	Nickel	Nickel (Filtered)	Zinc	Zinc (Filtered)
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.01	0.01	0.001	0.001	0.001	0.001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.05	0.05	0.001	0.001	0.005	0.001	0.0001	0.001	0.001	0.005	0.005
ANZECC 2000 FW Slightly-moderate disturbed system			0.055	0.055	0.009	0.009	0.013	0.013	0.0002	0.0002	0.001	0.001	0.0014	0.0014			0.0034	0.0034	1.9	0.00006	0.00006	0.011	0.011	0.008	0.008
10 times ANZECC 2000 FW Slightly-moderate disturbed system			0.55	0.55	0.09	0.09	0.13	0.13	0.002	0.002	0.01	0.01	0.014	0.014			0.034	0.034	19	0.0006	0.0006	0.11	0.11	0.08	0.08
30 times ANZECC 2000 FW Slightly-moderate disturbed system			1.65	1.65	0.27	0.27	0.39	0.39	0.006	0.006	0.03	0.03	0.042	0.042			0.102	0.102	57	0.0018	0.0018	0.33	0.33	0.24	0.24
ANZECC 2000 MW Slightly-moderate disturbed system					**0.27**	**0.27**	**0.0045**	**0.0045**	**0.0007**	**0.0007**	**0.0044**	**0.0044**	**0.0013**	**0.0013**			**0.0044**	**0.0044**	**0.08**	**0.0001**	**0.0001**	**0.007**	**0.007**	**0.015**	**0.015**
Field_ID	**LocCode**	**Sample Date**																							
1	DLWC97-SW1	30/04/1997	0.38	-	<0.01	-	**0.005**	-	-	-	-	-	**<0.005**	-	8.4	-	**<0.01**	-	**0.132**	**<0.001**	-	-	-	-	-
2	DLWC97-SW2	30/04/1997	0.85	-	<0.01	-	**0.014**	-	-	-	-	-	**<0.005**	-	15	-	**<0.01**	-	**0.098**	**<0.001**	-	-	-	-	-
3	DLWC97-SW3	30/04/1997	0.16	-	0.15	-	**0.705**	-	-	-	-	-	**0.029**	-	2.7	-	**<0.01**	-	**0.13**	**<0.001**	-	-	-	-	-
4	DLWC97-SW4	30/04/1997	0.25	-	0.26	-	**0.456**	-	-	-	-	-	**0.08**	-	2.9	-	**0.006**	-	0.037	**<0.001**	-	-	-	-	-
5	DLWC97-SW5	30/04/1997	0.25	-	0.21	-	**0.276**	-	-	-	-	-	**0.055**	-	2.6	-	**<0.01**	-	0.037	**<0.001**	-	-	-	-	-
6	DLWC97-SW6	30/04/1997	0.26	-	0.22	-	**0.405**	-	-	-	-	-	**0.101**	-	2.9	-	**0.007**	-	0.041	**<0.001**	-	-	-	-	-
7	DLWC97-SW7	30/04/1997	0.19	-	0.09	-	**0.117**	-	-	-	-	-	**0.009**	-	1.8	-	**<0.01**	-	0.025	**<0.001**	-	-	-	-	-
8	DLWC97-SW8	30/04/1997	0.24	-	0.2	-	**0.294**	-	-	-	-	-	**0.122**	-	2.3	-	**0.008**	-	0.044	**<0.001**	-	-	-	-	-
9	DLWC97-SW9	30/04/1997	0.25	-	0.2	-	**0.394**	-	-	-	-	-	**0.142**	-	3.2	-	**0.009**	-	0.047	**<0.001**	-	-	-	-	-
10	DLWC97-SW10	30/04/1997	0.22	-	0.1	-	**0.236**	-	-	-	-	-	**0.055**	-	2.8	-	**0.009**	-	0.032	**<0.001**	-	-	-	-	-
11	DLWC97-SW11	30/04/1997	0.21	-	0.17	-	**0.194**	-	-	-	-	-	**0.014**	-	2.1	-	**<0.01**	-	0.039	**<0.001**	-	-	-	-	-
12	DLWC97-SW12	30/04/1997	0.14	-	0.11	-	**0.128**	-	-	-	-	-	**0.008**	-	1.9	-	**<0.01**	-	0.042	**<0.001**	-	-	-	-	-
13	DLWC97-SW13	30/04/1997	0.16	-	0.03	-	**0.058**	-	-	-	-	-	**0.005**	-	1.8	-	**<0.01**	-	0.032	**<0.001**	-	-	-	-	-
14	DLWC97-SW14	30/04/1997	0.11	-	0.02	-	**0.048**	-	-	-	-	-	**0.009**	-	1.9	-	**<0.01**	-	0.019	**<0.001**	-	-	-	-	-
15	DLWC97-SW15	30/04/1997	<0.05	-	<0.01	-	**0.021**	-	-	-	-	-	**0.008**	-	3.5	-	**<0.01**	-	0.04	**<0.001**	-	-	-	-	-
16	DLWC97-SW16	30/04/1997	0.09	-	<0.01	-	**0.053**	-	-	-	-	-	**<0.005**	-	4.4	-	**<0.01**	-	**0.092**	**<0.001**	-	-	-	-	-
17	DLWC97-SW17	30/04/1997	<0.05	-	<0.01	-	**0.037**	-	-	-	-	-	**0.005**	-	3.5	-	**<0.01**	-	**0.111**	**<0.001**	-	-	-	-	-
18	DLWC97-SW18	30/04/1997	<0.05	-	<0.01	-	**0.031**	-	-	-	-	-	**<0.005**	-	3.2	-	**<0.01**	-	**0.097**	**<0.001**	-	-	-	-	-
SW001	SW001	22/08/2012	0.36	0.09	0.022	0.01	**0.008**	<0.001	<0.0001	<0.0001	0.001	<0.001	**0.021**	0.001	5.38	0.54	0.001	<0.001	-	-	<0.0001	<0.001	<0.001	**0.016**	**0.018**
SW002	SW002	22/08/2012	0.19	0.11	0.171	0.145	**0.077**	**0.028**	<0.0001	<0.0001	0.001	<0.001	**0.011**	**0.008**	2.94	1.05	0.002	<0.001	-	-	<0.0001	<0.001	<0.001	**0.016**	**0.018**
SW003	SW003	22/08/2012	0.25	0.19	0.139	0.12	**0.171**	**0.118**	<0.0001	<0.0001	<0.001	<0.001	**0.017**	**0.012**	1.72	1.21	**0.005**	0.003	-	-	<0.0001	<0.001	<0.001	**0.026**	**0.032**
SW004	SW004	22/08/2012	0.22	0.19	0.116	0.139	**0.104**	**0.073**	<0.0001	<0.0001	<0.001	<0.001	**0.013**	**0.012**	1.57	1.09	**0.005**	0.003	-	-	<0.0001	<0.001	<0.001	**0.03**	**0.028**
SW005	SW005	22/08/2012	0.22	0.21	0.151	0.133	**0.092**	**0.071**	<0.0001	<0.0001	<0.001	<0.001	**0.014**	**0.012**	1.52	1.15	0.004	0.003	-	-	<0.0001	<0.001	<0.001	**0.032**	**0.031**
SW006	SW006	22/08/2012	0.24	0.18	0.083	0.073	**0.063**	**0.043**	<0.0001	<0.0001	<0.001	<0.001	**0.013**	**0.01**	1.74	1.05	**0.006**	0.003	-	-	<0.0001	<0.001	<0.001	**0.048**	**0.047**
SW007	SW007	22/08/2012	0.2	0.13	0.07	0.061	**0.056**	**0.038**	<0.0001	<0.0001	<0.001	<0.001	**0.012**	**0.008**	1.48	0.97	0.004	0.002	-	-	<0.0001	<0.001	<0.001	**0.041**	**0.025**
SW008	SW008	22/08/2012	0.09	0.06	0.244	0.155	**0.069**	**0.04**	<0.0001	<0.0001	<0.001	<0.001	**0.007**	**0.008**	0.54	0.32	0.002	0.002	-	-	<0.0001	0.003	0.003	**0.114**	**0.124**
SW009	SW009	22/08/2012	0.05	0.03	0.018	0.012	**0.016**	0.002	0.0006	0.0005	0.001	<0.001	**0.016**	**0.01**	0.81	0.13	<0.001	<0.001	-	-	<0.0001	<0.001	<0.001	**0.848**	**0.82**

Note: Highlighted cells with a '<' symbol may not necessarily constitute an assessment criteria exceedance

Groundwater Chemistry

			Field					Inorganics							Alkalinity							Major Ions													
			Dissolved Oxygen (Field)	Electrical Conductivity (Field)	Oxygen Redox Potential (Field)	pH (Field)	Temp (Field)	Cyanide Total	Electrical conductivity *(lab)	pH (Lab)	Redox	TOC	Total Dissolved Solids	Total Suspended Solids	Alkalinity (total) as CaCO3	Alkalinity (Bicarbonate as CaCO3)	Alkalinity (Carbonate as CaCO3)	Alkalinity (Hydroxide) as CaCO3	Bicarbonate	Carbonate	Hardness as CaCO3	Calcium	Calcium (Filtered)	Chloride	Magnesium	Magnesium (Filtered)	Potassium	Potassium (Filtered)	Sodium	Sodium (Filtered)	Sulphate	Anions Total	Cations Total	Ionic Balance
			mg/L	uS/cm	mV	pH_Units	oC	mg/L	uS/cm	pH_Units	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	%
EQL								0.004	1	0.1	1	1	5	2	1	1	1	1	1		0.5	0.1	0.1	0.05	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.01	0.01	0.01
ANZECC 2000 FW Slightly-moderate disturbed system								0.007																										
10 times ANZECC 2000 FW Slightly-moderate disturbed system								0.07																										
30 times ANZECC 2000 FW Slightly-moderate disturbed system								0.21																										
ANZECC 2000 MW Slightly-moderate disturbed system								**0.004**																										
Field_ID	**WellCode**	**Sample Date**																																
4	DLW97-GW4	1/05/1997	-	-	-	-	-	**0.184**	1160	6.4	164	86	858	14,300	267	-	-	-	267	-	130	14	-	213	23	-	8.5	-	222	-	12	-	-	-
6	DLW97-GW6	1/05/1997	-	-	-	-	-	**0.184**	1160	6.4	164	86	858	14,300	267	-	-	-	267	-	130	14	-	213	23	-	8.5	-	222	-	12	-	-	-
7	DLW97-GW7	1/05/1997	-	-	-	-	-	**0.104**	541	6.2	238	59	604	12,900	70	-	-	-	70	-	70	8.6	-	89	12	-	7	-	111	-	28	-	-	-
12	DLW97-GW12	1/05/1997	-	-	-	-	-	**<0.005**	382	6.3	246	65	321	19,400	91	-	-	-	91	-	108	20	-	73	14	-	1	-	57	-	<1	-	-	-
13	DLW97-GW13	1/05/1997	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-	-	-	-	103	15	-	-	16	-	8.2	-	86	-	-	-	-	-
GW004	DLW97-GW4	22/08/2012	1.12	387	163.6	4.46	16.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW006	DLW97-GW6	22/08/2012	0.68	1144	-50.8	6.28	17.8	**0.597**	-	-	-	-	970	1190	285	285	<1	<1	347.7	<1.2	-	-	12	184	-	20	-	8	-	194	<10	10.9	10.9	0.02
GW007	DLW97-GW7	22/08/2012	0.13	784	-37	6.32	15.3	**0.06**	-	-	-	-	560	356	172	172	<1	<1	209.8	<1.2	-	-	9	150	-	14	-	7	-	132	<1	7.67	7.52	0.99
GW013	DLW97-GW12	22/08/2012	0.71	755	-64	6.53	19	<0.004	-	-	-	-	412	408	160	160	<1	<1	195.2	<1.2	-	-	12	78	-	14	-	6	-	71	<1	5.4	5.22	1.6

Note: Highlighted cells with a '<' symbol may not necessarily constitute an assessment criteria exceedance

Groundwater Chemistry

			Metals																						
			Aluminium	Aluminium (Filtered)	Antimony	Antimony (Filtered)	Arsenic	Arsenic (Filtered)	Cadmium	Cadmium (Filtered)	Chromium (III+VI)	Chromium (III+VI) (Filtered)	Copper	Copper (Filtered)	Iron	Iron (Filtered)	Lead	Lead (Filtered)	Manganese	Mercury	Mercury (Filtered)	Nickel	Nickel (Filtered)	Zinc	Zinc (Filtered)
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.005	0.001	0.001	0.001	0.001	0.001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.001	0.005	0.0001	0.0001	0.001	0.001	0.001	0.001
ANZECC 2000 FW Slightly-moderate disturbed system			0.055	0.055	0.009	0.009	0.013	0.013	0.0002	0.0002	0.001	0.001	0.0014	0.0014			0.0034	0.0034	1.9	0.00006	0.00006	0.011	0.011	0.008	0.008
10 times ANZECC 2000 FW Slightly-moderate disturbed system			0.55	0.55	0.09	0.09	0.13	0.13	0.002	0.002	0.01	0.01	0.014	0.014			0.034	0.034	19	0.0006	0.0006	0.11	0.11	0.08	0.08
30 times ANZECC 2000 FW Slightly-moderate disturbed system			1.65	1.65	0.27	0.27	0.39	0.39	0.006	0.006	0.03	0.03	0.042	0.042			0.102	0.102	57	0.0018	0.0018	0.33	0.33	0.24	0.24
ANZECC 2000 MW Slightly-moderate disturbed system					**0.27**	**0.27**	**0.0045**	**0.0045**	**0.0007**	**0.0007**	**0.0044**	**0.0044**	**0.0013**	**0.0013**			**0.0044**	**0.0044**	**0.08**	**0.0001**	**0.0001**	**0.007**	**0.007**	**0.015**	**0.015**
Field_ID	**WellCode**	**Sample Date**																							
4	DLW97-GW4	1/05/1997	9.7	-	**5.6**	-	**19**	-	-	-	-	-	**0.17**	-	27	-	**3**	-	**0.923**	**0.046**	-	-	-	-	-
6	DLW97-GW6	1/05/1997	9.7	-	**5.6**	-	**19**	-	-	-	-	-	**0.17**	-	27	-	**3**	-	**0.923**	**0.046**	-	-	-	-	-
7	DLW97-GW7	1/05/1997	6.5	-	**4.1**	-	**89**	-	-	-	-	-	**0.184**	-	21	-	**1.6**	-	**0.31**	**0.048**	-	-	-	-	-
12	DLW97-GW12	1/05/1997	3.2	-	**1**	-	**0.423**	-	-	-	-	-	**1.3**	-	30	-	**0.245**	-	**1.7**	**<0.001**	-	-	-	-	-
13	DLW97-GW13	1/05/1997	3.2	-	**4.4**	-	**21**	-	-	-	-	-	**0.465**	-	17	-	**0.573**	-	**0.781**	**0.019**	-	-	-	-	-
GW004	DLW97-GW4	22/08/2012	-	1.15	-	**1.17**	-	**5.56**	-	0.0001	-	**0.132**	-	**0.027**	-	9.05	-	**0.017**	-	-	<0.0001	-	**4.07**	-	**0.208**
GW006	DLW97-GW6	22/08/2012	-	2.19	-	**1.39**	-	**72.6**	-	<0.0001	-	**0.014**	-	**0.011**	-	37.4	-	**0.125**	-	-	**0.0026**	-	**0.013**	-	**0.063**
GW007	DLW97-GW7	22/08/2012	-	0.67	-	**1.45**	-	**37**	-	<0.0001	-	**0.006**	-	**0.006**	-	29.3	-	**0.02**	-	-	**0.0005**	-	**0.013**	-	**0.051**
GW013	DLW97-GW12	22/08/2012	-	0.05	-	**1.21**	-	**34.5**	-	<0.0001	-	**0.011**	-	**0.01**	-	90.5	-	0.002	-	-	**0.0002**	-	**0.022**	-	**0.074**

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Brick Analysis

	Antimony	Arsenic	Cadmium	Chromium (III+VI)	Copper	Lead	Mercury	Nickel	Zinc
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL									
NEPM 1999 EIL (bold)		**20**	**3**	**1**	**100**	**600**	**1**	**60**	**200**
NEPM 1999 HIL E		200	40	200	2000	600	30	600	14000
NSW 2008 General Solid Waste (No Leaching)		100	20	100		100	4	40	
NSW 2008 Restricted Solid Waste (No Leaching)		400	80	400		400	16	160	
USEPA RES	310								

Field_ID	LocCode	Sample_Date	Data Source								
Brick001	Brick Stockpile	16/08/2012	XRF	<17.87	<8.74	**<15.23**	**<123.8**	<22.66	<5.76	**<6.34**	<38.12	94.18
Brick001	Brick Stockpile	16/08/2012	XRF	<17.56	<2.65	**<14.85**	**<125.2**	<17.61	<6.55	**<5.84**	<37.29	17.05
Brick001	Brick Stockpile	17/08/2012	XRF	<16.89	12.21	**<14.39**	**<130.8**	<17.43	<6.33	**<5.68**	<36.71	21.79
Brick001	Brick Stockpile	17/08/2012	Lab	<5	<5	<1	**6**	<5	<5	**3**	10	-
Brick002	Brick Stockpile	16/08/2012	XRF	<17.31	18.55	**<14.6**	**<125.3**	<17.51	8.71	**<5.97**	<37.15	35.6
Brick002	Brick Stockpile	17/08/2012	Lab	<5	7	<1	**11**	6	6	**6**	14	-
Brick003	Brick Stockpile	16/08/2012	XRF	<17.3	12.56	**<14.56**	**<114.6**	<17.55	5.87	**<6.15**	<37.42	45.21
Brick004	Brick Stockpile	16/08/2012	XRF	<18.31	10.91	**<15.4**	**<129.9**	<19	<7.06	**<6.45**	<40.03	31.49
Brick005	Brick Stockpile	16/08/2012	XRF	<16.25	4.45	**<13.86**	**<115.3**	<16.2	<4.81	**<5.4**	<34.19	19.1
Brick006	Brick Stockpile	16/08/2012	XRF	<17.8	10.24	**<15.12**	**<136**	<18.15	<6.79	**<6.06**	<38.65	16.28
Brick007	Brick Stockpile	16/08/2012	XRF	<17.69	9.44	**<14.9**	**<145.5**	<18.34	<5.49	**<6.06**	<37.45	24.34
Brick008	Brick Stockpile	16/08/2012	XRF	<16.74	10.46	**<14.31**	**<124.4**	<17.52	<5.08	**<5.89**	<36.18	17.61
Brick009	Brick Stockpile	16/08/2012	XRF	<17.81	<3.81	**<15.16**	**192.9**	15.43	<6.78	**<6.38**	<38.59	35.76
Brick010	Brick Stockpile	16/08/2012	XRF	<16.47	<3.5	**<14.09**	**<122.8**	<16.74	<6.27	**<5.6**	<34.81	24.22
Brick011	Brick Stockpile	16/08/2012	XRF	<17.98	9.18	**<15.27**	**<118.5**	15.95	<7.18	**<6.34**	<38.63	60.31
Brick012	Brick Stockpile	16/08/2012	XRF	<17.7	7.86	**<15.04**	**151.3**	18.29	<5.51	**<6.13**	<38.03	35.3
Brick013	Brick Stockpile	16/08/2012	XRF	<16.53	<2.29	**<14.09**	**<125.4**	<16.33	<5.24	**<5.4**	<35.03	7.82
Brick014	Brick Stockpile	16/08/2012	XRF	<16.92	4.26	**<14.44**	**<124.1**	<16.79	<6.31	**<5.69**	<35.33	27.31
Brick015	Brick Stockpile	16/08/2012	XRF	<17.25	5.9	**<14.63**	**<128.3**	<17.62	<6.04	**<5.82**	<36.8	15.45
Brick016	Brick Stockpile	16/08/2012	XRF	<18.18	7.22	**<15.39**	**<135.9**	23.65	9.38	**<6.45**	<38.79	43.9
Brick017	Brick Stockpile	16/08/2012	XRF	<17.34	6.31	**<14.75**	**<129.7**	<17.58	<5.41	**<6.06**	<36.67	28.39
Brick018	Brick Stockpile	16/08/2012	XRF	<16.78	6.09	**<14.26**	**<128.8**	<17.08	<6.32	**<5.74**	<35.77	18.31
Brick019	Brick Stockpile	16/08/2012	XRF	<17.22	5.58	**<14.68**	**<128.4**	<17.23	<6.52	**<5.84**	<36.71	25.23
Brick020	Brick Stockpile	16/08/2012	XRF	<18.16	9.05	**<15.28**	**<130**	17.7	<5.57	**<6.43**	<39.31	70.24
Brick021	Brick Stockpile	16/08/2012	XRF	<17.68	5.11	**<15.01**	**<130.1**	<18.41	<6.49	**<5.95**	<37.63	28.21
Brick022	Brick Stockpile	16/08/2012	XRF	<16.45	6.46	**<14.1**	**<117**	<16.46	<6.23	**<5.5**	<34.4	50.22
Brick023	Brick Stockpile	16/08/2012	XRF	<17.87	8.74	**<15.23**	**<123.8**	22.66	<5.76	**<6.34**	<38.12	94.18

Note: Highlighted cells with a '<' symbol may not necessarily constitute an assessment criteria exceedance

SOIL QA/QC Data

			SDG	ES1220305	ES1220305		ES1220305	ES1220305		ES1220305	ES1220305		ES1220305	ES1220305		ES1220305	ES1220305		ES1223062	ES1223062		ES1223062	ES1223062		ES1223062	ES1223062	
			Field_ID	SE013_0.0-0.1	SEDUP04	**RPD**	SE050_0.0-0.1	SEDUP03	**RPD**	SE004_0.0-0.1	SEDUP05	**RPD**	BH004_1.0-1.2	BHDUP07	**RPD**	BH002_0.5-0.7	BHDUP06	**RPD**	BH032_0.3-0.5	BHDUP01	**RPD**	BH012_0.0-0.1	BHDUP08	**RPD**	SE032_0.0-0.1	SEDUP01	**RPD**
			Sampled_Date	16/08/2012	16/08/2012		15/08/2012	15/08/2012		16/08/2012	16/08/2012		16/08/2012	16/08/2012		16/08/2012	16/08/2012		14/08/2012	14/08/2012		16/08/2012	16/08/2012		14/08/2012	14/08/2012	
Method_Type	ChemName	Units	EQL																								
1M HCl Extractable Metals	Aluminium	mg/kg	50							**7550.0**	**1400.0**	**137**															
	Antimony	mg/kg	1							**92.4**	**2.7**	**189**															
	Arsenic	mg/kg	1							**11.7**	**3.5**	**108**															
	Cadmium	mg/kg	0.1							**0.3**	**<0.1**	**100**															
	Chromium (III+VI)	mg/kg	1							<1.0	<1.0	0															
	Cobalt	mg/kg	0.5							**1.4**	**<0.5**	**95**															
	Copper	mg/kg	1							**50.4**	**2.2**	**183**															
	Iron	mg/kg	50							**7050.0**	**1120.0**	**145**															
	Lead	mg/kg	1							**28.6**	**2.9**	**163**															
	Manganese	mg/kg	10							**35.0**	**<10.0**	**111**															
	Nickel	mg/kg	1							**3.9**	**<1.0**	**118**															
	Silver	mg/kg	1							<1.0	<1.0	0															
	Vanadium	mg/kg	2							**40.3**	**10.7**	**116**															
	Zinc	mg/kg	1							**70.0**	**3.1**	**183**															
1M HCl Extractable Metals by ICPMS	Selenium	mg/kg	0.5							**1.4**	**0.6**	**80**															
Leachable Mercury by FIMS (leached)	Mercury (Filtered)	mg/l	0.001																0.0011	<0.001	10	<0.001	<0.001	0	**0.0082**	**<0.001**	**157**
Leachable Metals by ICPAES (leached)	Aluminium (Filtered)	mg/l	0.1																2.5	2.0	22	4.7	3.9	19	**1.2**	**8.4**	**150**
	Antimony (Filtered)	mg/l	0.1																3.1	2.5	21	<0.1	<0.1	0	**8.8**	**0.7**	**171**
	Arsenic (Filtered)	mg/l	0.1																14.4	19.2	29	<0.1	<0.1	0	**3.8**	**0.1**	**190**
	Cadmium (Filtered)	mg/l	0.05																<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Chromium (III+VI) (Filtered)	mg/l	0.1																<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Copper (Filtered)	mg/l	0.1																0.2	0.2	0	<0.1	<0.1	0	<0.1	<0.1	0
	Lead (Filtered)	mg/l	0.1																0.1	<0.1	0	<0.1	<0.1	0	**1.6**	**<0.1**	**176**
	Nickel (Filtered)	mg/l	0.1																<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Zinc (Filtered)	mg/l	0.1																0.4	0.4	0	0.9	0.8	12	**0.9**	**5.6**	**145**
Moisture Content	Moisture	%	1 (Primary): 0.5 (Interlab)	66.5	69.2	4	14.5	11.0	27	**80.5**	**32.8**	**84**	28.6	26.3	8	16.8	16.3	3	35.9	33.6	7	41.2	44.1	7	41.6	48.2	15
pH (1:5)	pH (Lab)	pH_Units	0.1	4.5	5.0	11	4.3	4.1	5	5.0	4.8	4															
TCLP for Non & Semivolatile Analytes (leached)	pH (after HCL)	pH_Units	0.1																1.9	1.8	5	1.9	1.9	0			
	pH (Final)	pH Unit	0.1																5.0	5.0	0	4.9	4.9	0	4.9	4.9	0
	pH (Initial)	pH_Units	0.1																6.9	6.6	4	5.8	5.7	2	4.1	6.0	38
	TCLP Fluid	-	1																1.0	1.0	0	1.0	1.0	0	1.0	1.0	0
Total Cyanide by Segmented Flow Analyser	Cyanide Total	mg/kg	1	**82.0**	**28.0**	**98**	<1.0	<1.0	0	**2.0**	**<1.0**	**67**															
Total Mercury by FIMS	Mercury	mg/kg	0.1 (Primary): 0.05 (Interlab)	**48.6**	**19.4**	**86**	1.9	2.3	19	**0.2**	**<0.1**	**67**	**28.9**	**1.3**	**183**	<0.1	<0.1	0	78.8	82.0	4	0.1	<0.1	0	**151.0**	**0.6**	**198**
Total Metals by ICP-AES	Aluminium	mg/kg	50 (Primary): 1 (Interlab)				990.0																				
	Antimony	mg/kg	5 (Primary): 3 (Interlab)	**8900.0**	**3770.0**	**81**	626.0	412.0	41	**242.0**	**<5.0**	**192**	2050.0	3290.0	46	<5.0	<5.0	0									
	Arsenic	mg/kg	5 (Primary): 3 (Interlab)	1660.0	1200.0	32	**1370.0**	**800.0**	**53**	**22.0**	**7.0**	**103**	**1160.0**	**126.0**	**161**	<5.0	5.0	0									
	Cadmium	mg/kg	1 (Primary): 0.3 (Interlab)	<1.0	<1.0	0	<1.0	<1.0	0	<1.0	<1.0	0	<1.0	<1.0	0	<1.0	<1.0	0									
	Chromium (III+VI)	mg/kg	2 (Primary): 0.3 (Interlab)	29.0	23.0	23	4.0	3.0	29	15.0	10.0	40	16.0	10.0	46	11.0	13.0	17									
	Copper	mg/kg	5 (Primary): 0.5 (Interlab)	230.0	377.0	48	**47.0**	**28.0**	**51**	**73.0**	**8.0**	**160**	**166.0**	**34.0**	**132**	7.0	7.0	0									
	Iron	mg/kg	2 (Primary): 0.3 (Interlab)																								
	Lead	mg/kg	5 (Primary): 1 (Interlab)	**1500.0**	**587.0**	**87**	69.0	61.0	12	**37.0**	**6.0**	**144**	**116.0**	**64.0**	**58**	6.0	5.0	18									
	Nickel	mg/kg	2 (Primary): 0.5 (Interlab)	5.0	6.0	18	<2.0	<2.0	0	6.0	4.0	40	**5.0**	**20.0**	**120**	<2.0	<2.0	0									
	Zinc	mg/kg	5 (Primary): 0.5 (Interlab)	73.0	79.0	8	20.0	12.0	50	**74.0**	**6.0**	**170**	95.0	82.0	15	13.0	15.0	14									

*RPDs have only been considered where a concentration is greater than 1 times the EQL.

**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (1-10 x EQL); 50 (10-30 x EQL); 50 (> 30 x EQL))

***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory

Trip Blanks

	Antimony	**Arsenic**
	mg/kg	mg/kg
EQL	5	5
ANZECC (2000) Interim Sediment Quality Guidelines - High	25	70
NEPM 1999 HIL E		200
USEPA RES	310	

Field_ID	**Sampled_Date-Time**	**Matrix_Description**		
TB01	6/08/2012	soil	<5	<5
TB02	6/08/2012	soil	<5	<5

Rinsate Samples

	Antimony	**Arsenic**
	mg/L	mg/L
EQL	0.001	0.001

Field_ID	**Sampled_Date-Time**		
RB01	15/08/2012	1.64	2.35
RB02	15/08/2012	1.24	3.59
RB03	16/08/2012	0.028	0.009
RB04	15/08/2012	0.013	0.005
RB05	16/08/2012	0.01	0.004

SOIL QA/QC Data

			SDG	ES1223935	ES1223935		ES1223935	ES1223935		ES1220305	Interlab_D		ES1220305	Interlab_D		ES1220305	Interlab_D		ES1220305	Interlab_D	
			Field_ID	BH032_0.3-0.5	BHDUP01	**RPD**	BH012_0.0-0.1	BHDUP08	**RPD**	BH075_1.8-2.0	BHLABDUP01	**RPD**	BH004_0.0-0.2	BHLABDUP02	**RPD**	BH031_1.0-1.2	BHLABDUP03	**RPD**	SE050_0.0-0.1	SELABDUP01	**RPD**
			Sampled_Date	14/08/2012	14/08/2012		16/08/2012	16/08/2012		15/08/2012	15/08/2012		16/08/2012	16/08/2012		15/08/2012	15/08/2012		15/08/2012	15/08/2012	
Method_Type	ChemName	Units	EQL																			
1M HCl Extractable Metals	Aluminium	mg/kg	50																			
	Antimony	mg/kg	1																			
	Arsenic	mg/kg	1																			
	Cadmium	mg/kg	0.1																			
	Chromium (III+VI)	mg/kg	1																			
	Cobalt	mg/kg	0.5																			
	Copper	mg/kg	1																			
	Iron	mg/kg	50																			
	Lead	mg/kg	1																			
	Manganese	mg/kg	10																			
	Nickel	mg/kg	1																			
	Silver	mg/kg	1																			
	Vanadium	mg/kg	2																			
	Zinc	mg/kg	1																			
1M HCl Extractable Metals by ICPMS	Selenium	mg/kg	0.5																			
Leachable Mercury by FIMS (leached)	Mercury (Filtered)	mg/l	0.001																			
Leachable Metals by ICPAES (leached)	Aluminium (Filtered)	mg/l	0.1																			
	Antimony (Filtered)	mg/l	0.1																			
	Arsenic (Filtered)	mg/l	0.1																			
	Cadmium (Filtered)	mg/l	0.05																			
	Chromium (III+VI) (Filtered)	mg/l	0.1																			
	Copper (Filtered)	mg/l	0.1																			
	Lead (Filtered)	mg/l	0.1																			
	Nickel (Filtered)	mg/l	0.1																			
	Zinc (Filtered)	mg/l	0.1																			
Moisture Content	Moisture	%	1 (Primary): 0.5 (Interlab)							39.4	40.0	2	9.2	9.7	5	24.2	24.0	1	14.5	12.0	19
pH (1:5)	pH (Lab)	pH_Units	0.1																4.3			
TCLP for Non & Semivolatile Analytes (leached)	pH (after HCL)	pH_Units	0.1																			
	pH (Final)	pH Unit	0.1																			
	pH (Initial)	pH_Units	0.1																			
	TCLP Fluid	-	1																			
Total Cyanide by Segmented Flow Analyser	Cyanide Total	mg/kg	1																<1.0			
Total Mercury by FIMS	Mercury	mg/kg	0.1 (Primary): 0.05 (Interlab)							0.2	0.18	11	61.2	42.0	37	**58.3**	**15.0**	**118**	**1.9**	**0.85**	**76**
Total Metals by ICP-AES	Aluminium	mg/kg	50 (Primary): 1 (Interlab)	3450.0	3120.0	10	13100.0	13400.0	2										990.0	840.0	16
	Antimony	mg/kg	5 (Primary): 3 (Interlab)	6070.0	6070.0	0	**<5.0**	**9.0**	**57**	36.0	55.0	42	4700.0	7800.0	50	9670.0	7100.0	31	**626.0**	**270.0**	**79**
	Arsenic	mg/kg	5 (Primary): 3 (Interlab)	3620.0	4000.0	10	16.0	12.0	29	**129.0**	**51.0**	**87**	1950.0	2200.0	12	5280.0	4700.0	12	**1370.0**	**450.0**	**101**
	Cadmium	mg/kg	1 (Primary): 0.3 (Interlab)	<1.0	<1.0	0	<1.0	<1.0	0	**3.0**	**0.5**	**143**	<1.0	0.4	0	<1.0	<0.3	0	<1.0	<0.3	0
	Chromium (III+VI)	mg/kg	2 (Primary): 0.3 (Interlab)	34.0	44.0	26	15.0	15.0	0	10.0	10.0	0	18.0	27.0	40	9.0	9.8	9	**4.0**	**1.4**	**96**
	Copper	mg/kg	5 (Primary): 0.5 (Interlab)	**231.0**	**111.0**	**70**	12.0	13.0	8	**30.0**	**52.0**	**54**	**136.0**	**250.0**	**59**	21.0	18.0	15	**47.0**	**22.0**	**72**
	Iron	mg/kg	2 (Primary): 0.3 (Interlab)	17600.0	21200.0	19	25400.0	29400.0	15												
	Lead	mg/kg	5 (Primary): 1 (Interlab)	996.0	1450.0	37	12.0	12.0	0	17.0	17.0	0	**150.0**	**73.0**	**69**	133.0	180.0	30	**69.0**	**39.0**	**56**
	Nickel	mg/kg	2 (Primary): 0.5 (Interlab)	<2.0	<2.0	0	5.0	5.0	0	3.0	2.3	26	<2.0	1.6	0	9.0	12.0	29	<2.0	<0.5	0
	Zinc	mg/kg	5 (Primary): 0.5 (Interlab)	39.0	42.0	7	8.0	9.0	12	**76.0**	**22.0**	**110**	47.0	70.0	39	24.0	25.0	4	20.0	18.0	11

*RPDs have only been considered where a concentration is greater than 1 times the EQL.

**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (1-10 x EQL); 50 (10-30 x EQL); 50 (> 30 x I

***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row h

Trip Blanks

	Antimony
	mg/kg
EQL	5
ANZECC (2000) Interim Sediment Quality Guidelines - High	25
NEPM 1999 HIL E	
USEPA RES	310

Field_ID	**Sampled_Date-Time**	**Matrix_Description**	
TB01	6/08/2012	soil	<5
TB02	6/08/2012	soil	<5

WATER QA/QC Duplicate Data

SDG	ES1220550	ES1220550		ES1220550	Interlab_D	
Field_ID	SW003	SWDUP01	RPD	GW006	GWLABDUP01	RPD
Sampled_Date-Time	22/08/2012	22/08/2012		22/08/2012	22/08/2012	

Method_Type	ChemName	Units	EQL						
Alkalinity by PC Titrator	Alkalinity (total) as CaCO3	mg/l	1 (Primary): 50 (Interlab	4.0	4.0	0	285.0	300.0	5
	Alkalinity (Bicarbonate as CaCO3)	mg/l	1	4.0	4.0	0			
	Alkalinity (Carbonate as CaCO3)	mg/l	1	<1.0	<1.0	0			
	Alkalinity (Hydroxide) as CaCO3	mg/l	1	<1.0	<1.0	0			
Chloride by Discrete Analyser	Chloride	mg/l	1 (Primary): 0.05 (Interla	33.0	33.0	0	184.0	170.0	8
Dissolved Mercury by FIMS	Mercury (Filtered)	mg/l	0.0001	<0.0001	<0.0001	0			
Dissolved Metals by ICP-MS - Suite A	Aluminium (Filtered)	mg/l	0.01 (Primary): 0.001 (I	0.19	0.21	10	2.19	2.0	9
	Antimony (Filtered)	mg/l	0.001	0.12	0.112	7	**1.39**	**5.1**	**114**
	Arsenic (Filtered)	mg/l	0.001	0.118	0.116	2	**72.6**	**20.0**	**114**
	Cadmium (Filtered)	mg/l	0.0001	<0.0001	<0.0001	0	<0.0001	<0.0001	0
	Chromium (III+VI) (Filtered)	mg/l	0.001	<0.001	<0.001	0	0.014	0.013	7
	Copper (Filtered)	mg/l	0.001	0.012	0.011	9	0.011	0.01	10
	Iron (Filtered)	mg/l	0.05 (Primary): 0.005 (I	1.21	1.23	2	**37.4**	**6.1**	**144**
	Lead (Filtered)	mg/l	0.001	0.003	0.003	0	0.125	0.16	25
	Nickel (Filtered)	mg/l	0.001	<0.001	<0.001	0	0.013	0.01	26
	Zinc (Filtered)	mg/l	0.005 (Primary): 0.001 (	0.032	0.031	3	**0.063**	**0.036**	**55**
Ionic Balance by PCT DA and Turbi SO4 DA	Anions Total	meq/L	0.01	1.05	1.05	0			
	Cations Total	meq/L	0.01	1.07	1.07	0			
Major Cations - Dissolved	Calcium (Filtered)	mg/l	1 (Primary): 0.1 (Interlal	2.0	2.0	0	12.0	13.0	8
	Magnesium (Filtered)	mg/l	1 (Primary): 0.1 (Interlal	2.0	2.0	0	20.0	21.0	5
	Potassium (Filtered)	mg/l	1 (Primary): 0.2 (Interlal	1.0	1.0	0	8.0	8.5	6
	Sodium (Filtered)	mg/l	1 (Primary): 0.1 (Interlal	18.0	18.0	0	194.0	190.0	2
Sulfate (Turbidimetric) as SO4 2- by Discrete Anal	Sulphate	mg/l	1 (Primary): 0.1 (Interlal	2.0	2.0	0	**<10.0**	**29.0**	**97**
Suspended Solids (High Level)	Total Suspended Solids	mg/l	5	9.0	9.0	0	**1190.0**	**15000.0**	**171**
Total Cyanide By Discrete Analyser	Cyanide Total	mg/l	0.004 (Primary): 0.005 (	<0.004	<0.004	0	**0.597**	**1.3**	**74**
Total Dissolved Solids (High Level)	Total Dissolved Solids	mg/l	10	107.0	106.0	1	970.0	960.0	1
Total Metals by ICP-MS - Suite A	Aluminium	mg/l	0.01	0.25	0.25	0			
	Antimony	mg/l	0.001	0.139	0.154	10			
	Arsenic	mg/l	0.001	0.171	0.171	0			
	Cadmium	mg/l	0.0001	<0.0001	<0.0001	0			
	Chromium (III+VI)	mg/l	0.001	<0.001	<0.001	0			
	Copper	mg/l	0.001	0.017	0.014	19			
	Iron	mg/l	0.05	1.72	1.71	1			
	Lead	mg/l	0.001	0.005	0.006	18			
	Nickel	mg/l	0.001	<0.001	<0.001	0			
	Zinc	mg/l	0.005	0.026	0.03	14			

*RPDs have only been considered where a concentration is greater than 1 times the EQL.

**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (1-10 x EQL); 50 (10-30 x EQL); 50 (> 30 x EQL))

***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory

Supplementary Soil and Stockpile Chemistry

				Inorganics	Metals										
				Moisture	Aluminium	Antimony	Arsenic	Cadmium	Chromium (III+VI)	Copper	Iron	Lead	Mercury	Nickel	Zinc
				%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL				1	50	5	5	1	2	5	50	5	0.1	2	5
NEPM 1999 EIL							**20**	**3**	**1**	**100**		**600**	**1**	**60**	**200**
NEPM 1999 HIL E							200	40	200	2000		600	30	600	14000
USEPA RES						310									
10 times HIL E/USEPA RES						3100	2000	400	2000	20,000		6000	300	6000	140,000
30 times HIL E/USEPA RES						9300	6000	1200	6000	60,000	0	18,000	900	18,000	420,000
Field_ID	**LocCode**	**Sample Depth**	**Sampled Date**												
BH007_0.0-0.1	BH007	0-0.1	11/12/2012	4.9	-	3140	**1370**	-	-	-	-	-	-	-	-
BH007_0.3-0.5	BH007	0.3-0.5	11/12/2012	8.6	-	37	**21**	-	-	-	-	-	-	-	-
BH085_0.0-0.1	BH085	0-0.1	10/12/2012	2.8	-	506	**184**	-	-	-	-	-	-	-	-
BH086_0.0_0.1	BH086	0.1	10/12/2012	3.3	-	767	**171**	-	-	-	-	-	-	-	-
BH087_0.0-0.1	BH087	0-0.1	10/12/2012	2.8	-	156	**44**	-	-	-	-	-	-	-	-
BH087_0.3-0.4	BH087	0.3-0.4	10/12/2012	3.4	-	75	**20**	-	-	-	-	-	-	-	-
BH102_0.0-0.1	BH102	0-0.1	11/12/2012	74.8	-	1830	**30**	-	-	-	-	-	-	-	-
BH102_0.3-0.5	BH102	0.3-0.5	11/12/2012	57.4	-	632	**88**	-	-	-	-	-	-	-	-
BH103_0.0-0.1	BH103	0-0.1	11/12/2012	59.4	3550	4120	**343**	<1	**34**	**272**	4440	40	**4.2**	<2	26
BH103_0.3-0.5	BH103	0.3-0.5	11/12/2012	24.6	6760	17	**442**	<1	**38**	**161**	131,000	31	**8.4**	<2	30
BH104_0.0-0.1	BH104	0-0.1	11/12/2012	14.6	-	169	**24**	-	-	-	-	-	-	-	-
BH104_0.3-0.5	BH104	0.3-0.5	11/12/2012	12.3	-	65	15	-	-	-	-	-	-	-	-
BH105_0.0-0.1	BH105	0-0.1	11/12/2012	40.7	8270	1190	**279**	<1	**78**	**380**	12,700	40	**98.4**	<2	27
BH105_0.3-0.5	BH105	0.3-0.5	11/12/2012	15.2	5970	134	18	<1	**8**	20	6430	11	**22.2**	3	32
BH106_0.0-0.1	BH106	0-0.1	11/12/2012	10.6	-	82	14	-	-	-	-	-	-	-	-
BH107_0.0-0.1	BH107	0-0.1	11/12/2012	13.2	-	60	**23**	-	-	-	-	-	-	-	-
BH107_0.2-0.3	BH107	0.2-0.3	11/12/2012	10.2	-	22	16	-	-	-	-	-	-	-	-
MP001A	Mercury Plug 1		11/12/2012	16.7	<50	39,100	**956**	<1	**<2**	8	970	<5	**3800**	<2	47
MP001B	Mercury Plug 1		11/12/2012	17.6	<50	41,900	**521**	<1	**<2**	<5	650	<5	**5840**	<2	32
MP002A	Mercury Plug 2		11/12/2012	10.4 - 11.2	<50	36,900	**554**	<1	**<2**	<5	590	<5	**2440**	<2	26
MP002B	Mercury Plug 2		11/12/2012	10.4 - 11.2	<50	41,000	**1660**	<1	**<2**	61	24,100	<5	**4680**	<2	99
SP004_0.0-0.1	Stockpile 4	0-0.1	10/12/2012	11.4	5350	565	**241**	<1	**16**	66	33,300	139	**4.6**	3	120
SP004_0.1-0.2	Stockpile 4	0.1-0.2	10/12/2012	7.2	5170	409	**452**	<1	**11**	77	19,200	50	**4.1**	4	143

Supplementary Sediment Chemistry

				Inorganics	Metals	
				Moisture	1M HCl Extractable Antimony	1M HCl Extractable Arsenic
				%	mg/kg	mg/kg
EQL				1	1	1
ANZECC (2000) Interim Sediment Quality Guidelines - High					25	70
ANZECC (2000) Interim Sediment Quality Guidelines - Low					**2**	**20**
10 times ANZECC (2000) Interim Sediment Quality Guidelines - High					250	700
30 times ANZECC (2000) Interim Sediment Quality Guidelines - High					750	2100
Field_ID	**LocCode**	**Sample_Depth**	**Sampled Date**			
SE015_0.0-0.1	SE015	0-0.1	10/12/2012	76.8	**211**	**20**
SE023_0.0-0.1	SE023	0-0.1	10/12/2012	79.7	**1590**	**96**
SE023_0.1-0.25	SE023	0.1-0.25	10/12/2012	74.2	**45.6**	**37.5**
SE024_0.0-0.1	SE024	0-0.1	10/12/2012	76.7	**95.2**	**29.1**
SE034_0.0-0.15	SE034	0-0.15	10/12/2012	76.3	**616**	**62.6**
SE035_0.0-0.1	SE035	0-0.1	10/12/2012	79	**1580**	**55.1**
SE036_0.0-0.2	SE036	0-0.2	10/12/2012	85.8	**413**	**23**
SE044_0.0-0.05	SE044	0-0.05	10/12/2012	63.5	**198**	**56.2**
SE045_0.0-0.2	SE045	0-0.2	10/12/2012	75.7	**240**	17.8
SE069_0.0-0.15	SE069	0-0.15	10/12/2012	84.9	**439**	**348**
SE070_0.0-0.3	SE070	0-0.3	10/12/2012	74.4	**394**	**27.9**
SE071_0.0-0.15	SE071	0-0.15	10/12/2012	51.6	**57.8**	**36.8**
SE072_0.0-0.3	SE072	0-0.3	10/12/2012	85	**682**	**25.8**
SE103_0.05-0.1	SE103	0.05-0.1	10/12/2012	75.9	**467**	**32.5**
SE103_0.1-0.3	SE103	0.1-0.3	10/12/2012	43.1	**87.6**	3.5
SE104_0.0-0.1	SE104	0-0.1	10/12/2012	73.1	**14.2**	6.5

Supplementary QA/QC Results

SDG	ES1229225	ES1229225		ES1229225	ES1229225		ES1229225	ES1229225	
Field_ID	BH007_0.0-0.1	BHDUP 20	**RPD**	SE103_0.05-0.1	SEDUP 21	**RPD**	SE104_0.0-0.1	SEDUP 20	**RPD**
Sampled_Date-Time	11/12/2012	11/12/2012		10/12/2012	10/12/2012		10/12/2012	10/12/2012	
Chem_Group	**ChemName**	**Units**	**EQL**									
Inorganics	Moisture	%	1	4.9	6.2	23	75.9	80.0	5	73.1	70.6	3
Metals	Antimony	mg/kg	5	3140.0	3190.0	2						
	Antimony	mg/kg	1				**467.0**	**1030.0**	**75**	14.2	10.2	33
	Arsenic	mg/kg	5	1370.0	1420.0	4						
	Arsenic	mg/kg	1				32.5	40.6	22	**6.5**	**2.0**	**106**

*RPDs have only been considered where a concentration is greater than 1 times the EQL.

**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (1-10 x EQL); 50 (10-30 x EQL); 50 (> 30 x EQL))

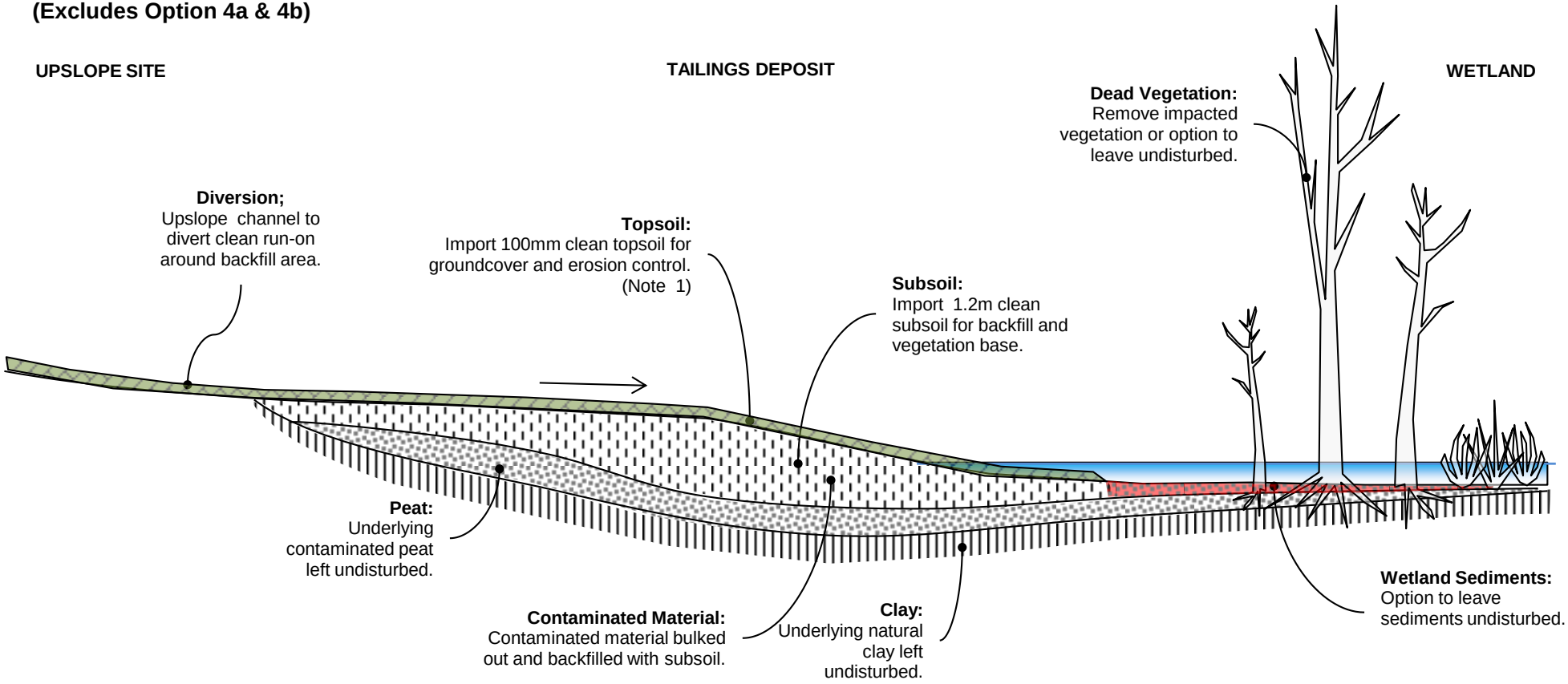
***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory

Filter: SDG in('ES1229225')

Appendix B Remediation Concepts

COMMON OPTION - Bulk Out and Rehabilitate

(Excludes Option 4a & 4b)



NOTES

1. Stabilise topsoil with cover crop and long term landscape planting.
2. All imported material to be classified as ENM and free of debris.

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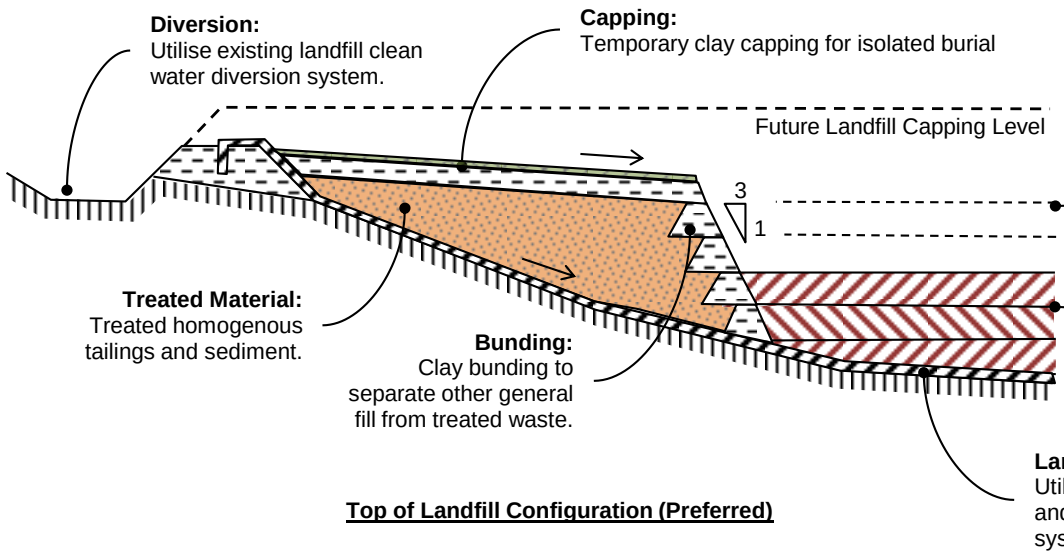
Project	Urunga Antimony Contaminated Site
Client	Crown Lands

Title	Option 1 Bulk Out and Rehabilitate
Drawing	Conceptual Cross-section

Rev.	Date

Proj. No:	5008143		
Scale:	N.T.S.		
Date:	27/11/2013		
Dwg No:	4b	Rev	0

OPTION 2 - LANDFILL ISOLATED BURIAL (Treated)

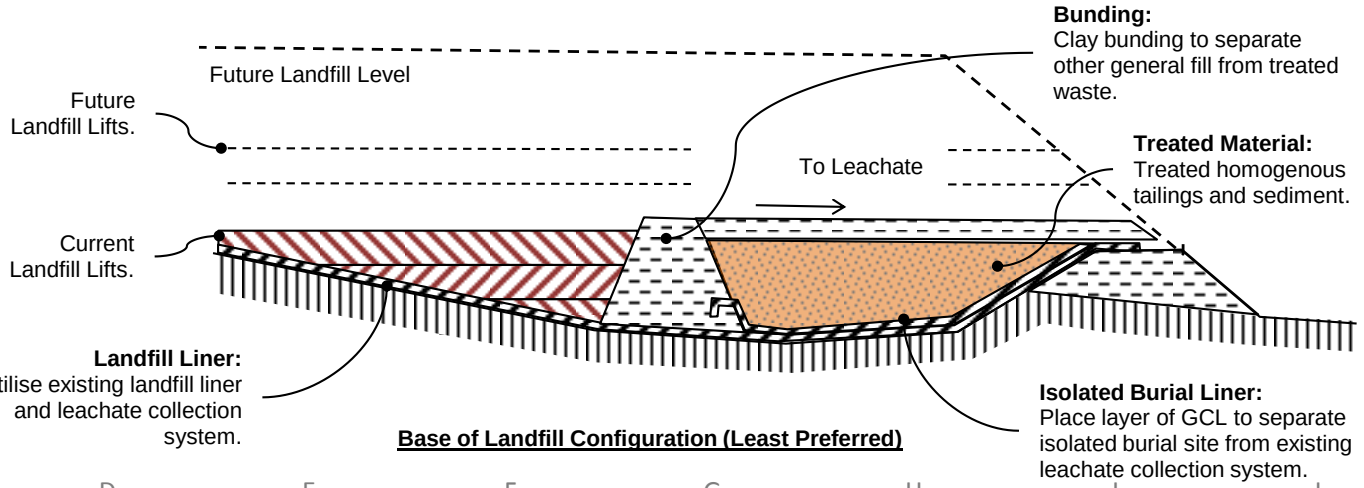


Top of Landfill Configuration (Preferred)

NOTES

1. Landfill to be prepared prior to receiving treated waste including provision of access tracks and bunds.
2. Imported clay to be minimum 75% clay fraction with compacted permeability of maximum $1x10^{-9}$ mm/s
3. Stabilise topsoil with cover crop to prevent erosion while landfill develops to final levels.

Base of Landfill Configuration



Base of Landfill Configuration (Least Preferred)

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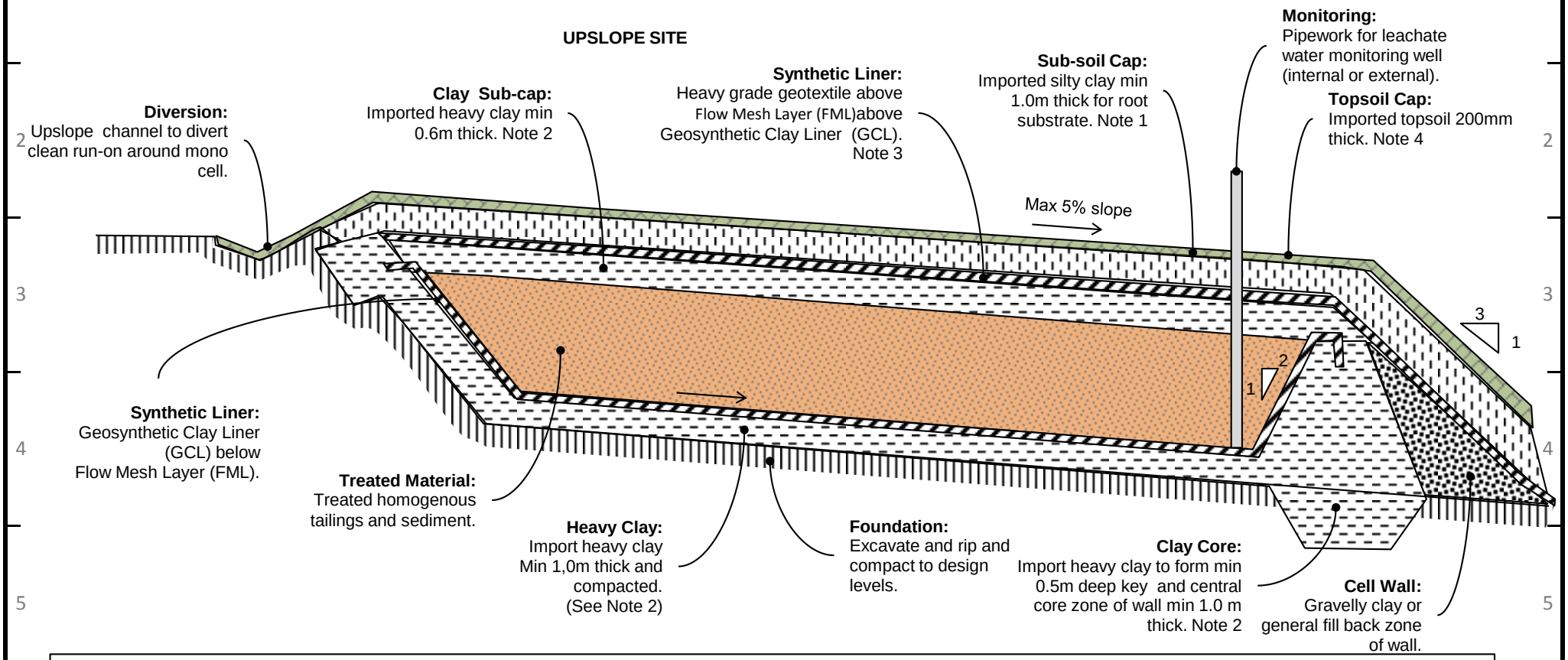
Project	Urunga Antimony Contaminated Site
Client	Crown Lands

Title	Option 2 Landfill Isolated Burial
Drawing	Conceptual Cross-section

Rev.	Date

Proj. No:	5008143		
Scale:	N.T.S.		
Date:	27/11/2013		
Dwg No:	2	Rev	0

OPTION 3a or 3b - ONSITE CONTAINMENT CELL



NOTES

1. Final capping treatment dependent upon subsequent landuse (eg. roadbase and sealed for carpark)
2. Imported clay to be minimum 75% clay fraction with compacted permeability of maximum $1x10^{-9}$ mm/s
3. Optional replacement of FML with clean rock drainage layer
4. Stabilise topsoil with cover crop and long term landscape planting.
5. All imported material to be classified as ENM and free of debris.

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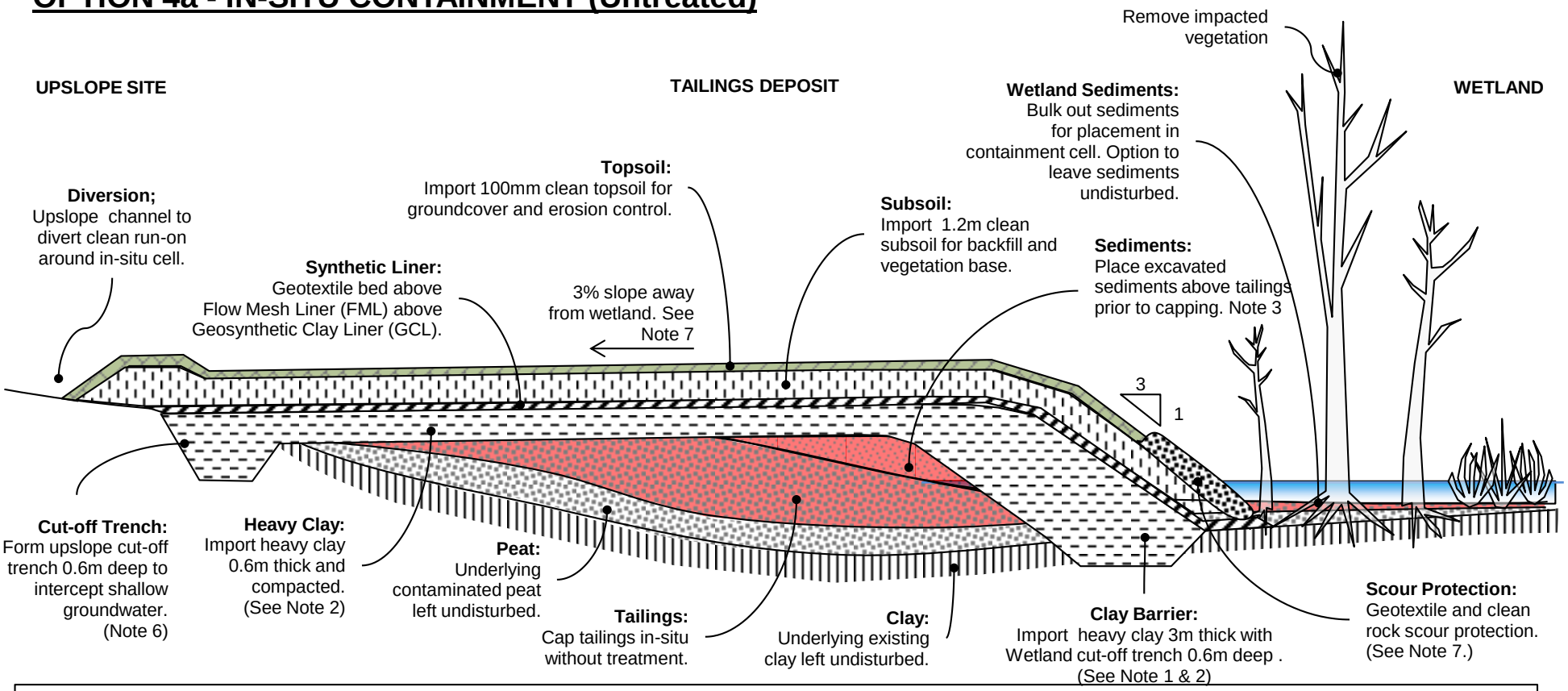
Project	Urunga Antimony Contaminated Site
Client	Crown Lands

Title	Option 3 Mono Cell On-site (treated)
Drawing	Conceptual Cross-section

Rev.	Date

Proj. No:	5008143		
Scale:	N.T.S.		
Date:	27/11/2013		
Dwg No:	3	Rev	0

OPTION 4a - IN-SITU CONTAINMENT (Untreated)



NOTES

1. Cut-off trench to encircle tailings and to key into underlying clay to prevent groundwater inflow and seepage from untreated tailings
2. Imported clay to be minimum 75% clay fraction with compacted permeability of maximum $1x10^{-9}$ mm/s
3. Dewater sediments prior to placement within cell via stockpiling.
4. Stabilise topsoil with cover crop and long term landscape planting.
5. All imported material to be classified as ENM and free of debris.
6. Cut-off trenched to be minimum 0.6 into impervious underlying clay.
7. Direct runoff away from steep barrier wall to minimise scour, else treat barrier wall with rock scour protection to designed flood levels.

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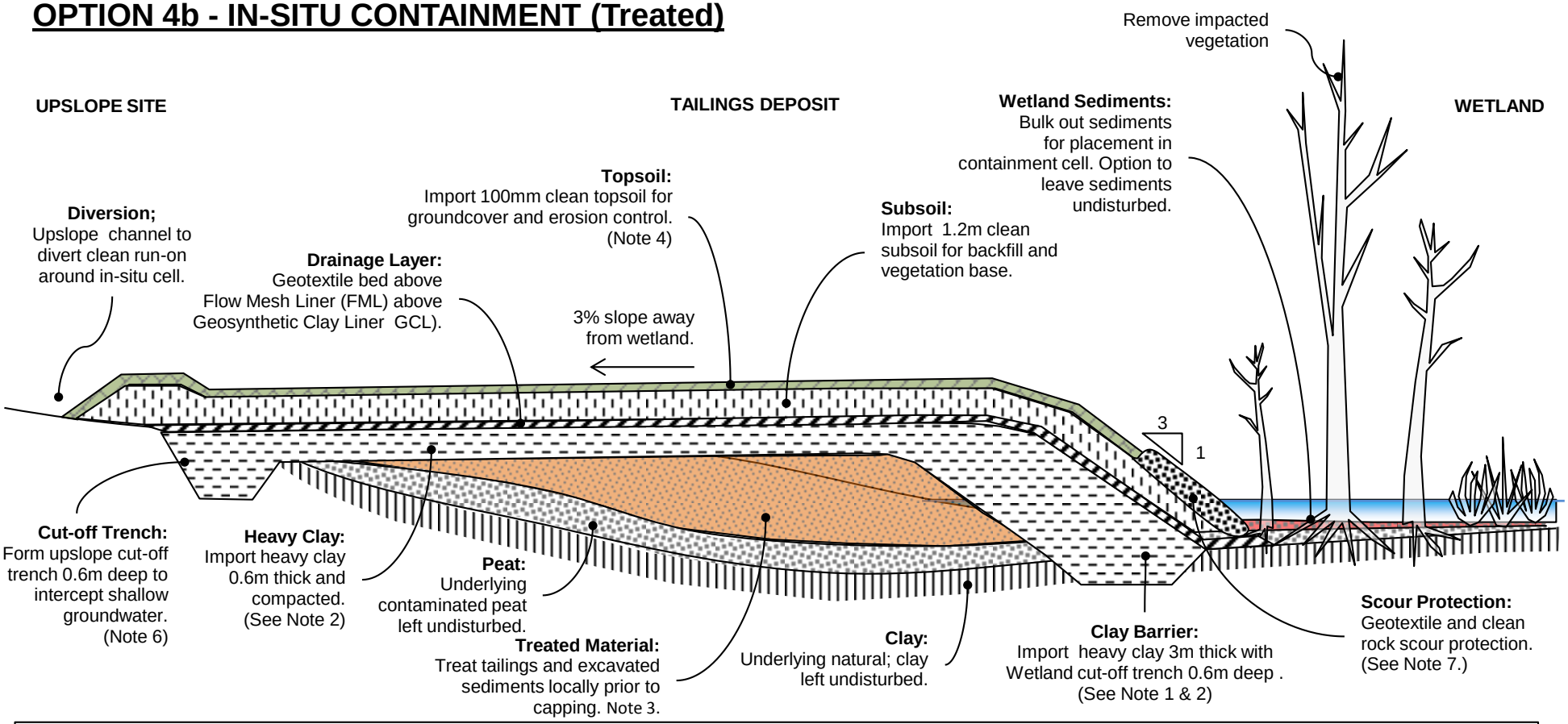
Project	Urunga Antimony Contaminated Site
Client	Crown Lands

Title	Option 4a In-situ Containment (untreated)
Drawing	Conceptual Cross-section

Rev.	Date

Proj. No:	5008143		
Scale:	N.T.S.		
Date:	27/11/2013		
Dwg No:	4a	Rev	0

OPTION 4b - IN-SITU CONTAINMENT (Treated)



NOTES

1. Cut-off trench to encircle tailings and to key into natural underlying clay to prevent seepage from untreated tailings
2. Imported clay to be minimum 75% clay fraction with compacted permeability of maximum $1x10^{-9}$ mm/s
3. Dewater tailings and sediments prior to treatment and placement within cell.
4. Stabilise topsoil with cover crop and long term landscape planting.
5. All imported material to be classified as ENM and free of debris.
6. Cut-off trenched to be minimum 0.6 into impervious underlying clay.

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Project	Urunga Antimony Contaminated Site
Client	Crown Lands

Title	Option 4b In-situ Containment (treated)
Drawing	Conceptual Cross-section

Rev.	Date

Proj. No:	5008143		
Scale:	N.T.S.		
Date:	27/11/2013		
Dwg No:	4b	Rev	0

Appendix C Risk Assessment

Approach to Assessment of Risks

Background

The likelihood and consequence descriptors and risk matrix have been adopted taking into account the risk tolerance of the site owner, the regulator and other stakeholders. This calibration is recommended in AS/NZS ISO 31000:2009 – *Risk Management: Principles and Guidelines*. Indicative probabilities are included in **Table C-1**; these are intended to assist in understanding the descriptor and are not intended to be quantitative measures.

Adopted Likelihood Descriptors

Table C-1 lists the adopted likelihood categories for assessing risks to health and the environment for the site.

The likelihood rankings are limited to "highly unlikely"; where it is considered implausible that an adverse effect would occur, the situation is not considered further.

Table C-1 Likelihood Categories

Rating	Descriptor	Description
A	Certain	The event is occurring or will occur (e.g. probability > 90%), or is expected to occur almost all of the time.
B	Likely	It is likely but not certain that the event will occur (e.g. probability 60 – 90%), or it is expected to occur most of the time.
C	Possible	It is possible that the event may occur, although it is also possible that it will not occur (e.g. probability 40 – 60%).
D	Unlikely	It is unlikely that the event will occur, although it is possible it may occur (e.g. probability 10 – 40%). (It might occur but is not expected to).
E	Highly Unlikely	It is highly unlikely that the event will occur; it would only occur in exceptional or unforeseen circumstances (e.g. probability < 10%).

Adopted Consequence Descriptors

For the purposes of assessing risk for the remediation options, descriptors have been adopted to consider a range of impacts that might occur, with reference to the various receptors and pathways for impact, and various regulatory requirements, policies and guidance documents. The latter include:

- AS/NZS ISO 31000:2009 – *Risk Management: Principles and Guidelines*;
- Vic EPA Publication 1321.2: *Licence Assessment Guidelines*;
- National Environment Protection (Assessment of Site Contamination) Measure (NEPM), 1999;
- Vic EPA Publication 788.1: *Best Practice Environmental Management Siting, Design, Operation and Rehabilitation of Landfills*, 2010.

The adopted descriptors are listed in Table C-2.

Table C-2 Consequence Categories

1	Severe	◗ Death of person(s) either on site or off site. ◗ Substantial long term impacts to an extensive area of the environment off site, offsite clean-up required, breach of environmental legislation, regulatory action. ◗ Severe on-site impacts requiring immediate major rectification works to restore site function. ◗ Broader community outrage or action / adverse media coverage to national level. ◗ Examples: – Off-site: severe extensive impact (e.g. fish kills or surface water contamination impacting on existing recreational users) with the need to undertake immediate large rectification works with major cost (>$1 million) – Off-site and on-site: death or serious long-term health effects to persons arising from ……. – Severe impact with regulatory action likely to result in prosecution.
2	Significant	◗ On-site: hospitalisation of workers. ◗ Offsite: minor immediately observable effects to health of persons; likely longer term significant health effects. ◗ Offsite impacts to a segment of the environment, medium-term environmental damage, offsite clean-up required, breach of environmental legislation. ◗ Significant on-site impacts requiring substantial works to maintain function of site. ◗ Local community outrage / adverse media coverage to state level. ◗ Examples: – Offsite impact (e.g. surface water contamination) resulting in requirement for substantial rectification works (eg $0.5 – 1 million). – EPA enforcement action; issue of order requiring major works – Off-site extensive long term impacts on relevant use of groundwater, surface water or soil (eg extensive area of vegetation affected or where HILs are exceeded by order of magnitude) – On-site impact on beneficial uses of site.
3	Moderate	• On-site: medical attention but no hospitalisation or long term effects • Off-site: no immediately observable effect on human health, but possible longer term health effects • Off-site: temporary or short-term environmental impacts • Moderate long-term on-site impacts requiring ongoing maintenance. • Local community concern and media coverage. • Examples: – Off-site impact requiring moderate rectification costs ($50 000 - $500 000) – EPA enforcement action resulting in fine or moderate rectification costs – Off-site: short-term visually observable impacts on fauna, groundwater,

		surface water or vegetation – Unacceptable aesthetic impacts leading to persistent complaints from neighbours.
4	Minor	◗ On-site: first aid required but no formal medical attention ◗ On-site: On-site: extensive areas of vegetation impact ◗ Off-site: some localised areas where impact is minor but discernible (eg to vegetation, surface water, soil) ◗ Minor on-site impacts immediately contained, or minor maintenance required. ◗ No external complaints received. ◗ Examples: – Off-site impact involving minor rectification costs (<$50,000) – EPA enforcement action unlikely – Off site: contaminant concentrations are measured to exceed beneficial use criteria in localised areas but existing use is not affected (eg use of groundwater, surface water or land) – Off-site: localised area of vegetation effect – Off-site: aesthetic impacts detected beyond the boundary, but few complaints received
5	Negligible	◗ Off-site: long term health impacts unlikely. ◗ Off-site: possible minor (but no clearly discernible) adverse effects on the relevant beneficial uses of groundwater, surface water or land ◗ On-site: some discernible localised areas of vegetation impact but not impeding function of site or requiring maintenance. ◗ Examples: – Off-site: Groundwater, surface water and soil monitoring results in the order of guidelines values with some minor localised exceedence in the immediate vicinity of the site but no existing sensitive use affected – Off-site: no complaints

Adopted Risk Matrix and Risk Ratings

Table D-3 presents the adopted risk matrix and risk rankings that reflect the level of risk expected to result from the various combinations of likelihood and consequence relevant to the remediation options.

In deriving the risk matrix, the following considerations applied:

- Where the likelihood of an event (consequence) occurring is considered to not be plausible, this will not be considered;
- Where consequences are considered to be “negligible”, whatever the likelihood the risk is ranked as “low”; and
- Where consequences are considered to be “catastrophic”, the risk is ranked as “very high” if this is judged to be “possible” (or more likely); “high” if this is judged to be “unlikely” (but possible), and “medium” if it is judged to be “highly unlikely” (but plausible).

Table D-3 Adopted Risk Matrix

		Likelihood				
		A	B	C	D	E
Consequence		Certain	Likely	Possible	Unlikely	Highly Unlikely
1	Severe	V	V	V	H	M
2	Significant	V	H	H	M	M
3	Moderate	H	H	M	M	L
4	Minor	M	M	M	L	L
5	Negligible	L	L	L	L	L

The following definitions of risk ratings are applied:

- V – Very high risk, immediate action required involving emergency response.
- H – High risk, immediate action required by site management.
- M – Medium risk, management action required. Check frequently (eg. monthly).
- L – Low risk, manage with standard operating procedure. Check periodically (eg. annually).

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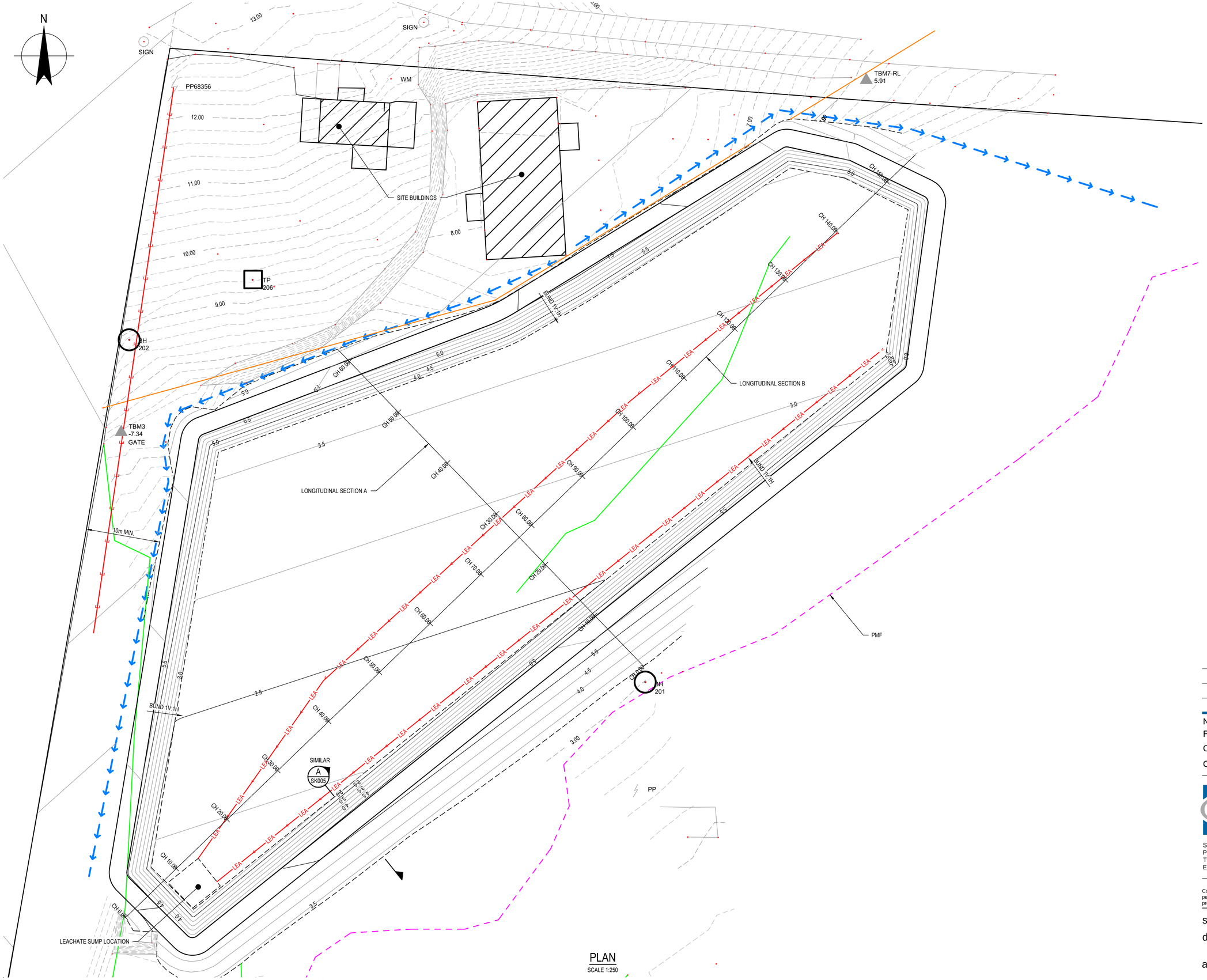
Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	B. Luffman	I. Gregson		I. Gregson		7/4/2014
1	B. Luffman	I. Gregson		I. Gregson		5/9/2014

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Appendix F Containment Cell Design



PLAN
SCALE 1:250

LEGEND:

- MAJOR DESIGN CONTOUR
- MINOR DESIGN CONTOUR
- TOP OF DESIGN BATTER
- TOE OF DESIGN BATTER/GRADE BREAK
- EXTENT OF CUT
- LEACHATE DRAINAGE SYSTEM
- CLEAN WATER DIVERSION DRAINS
- SITE BOUNDARY
- PROBABLE MAXIMUM FLOOD (PMF)
- EXISTING SEWER
- TRIAL PIT LOCATION
- BOREHOLE LOCATION
- EXISTING VEGETATION
- EXISTING ELECTRICAL SERVICE

0 2.5 5 7.5 10 12.5m
SCALE 1:250 AT ORIGINAL SIZE

CONCEPT

rev	description	app'd	date
B	CLIENT ISSUE	DB*	26.06.14
A	INITIAL ISSUE	DB*	29.05.14

NSW CATCHMENT & LANDS - CROWN LANDS
FORMER ANTIMONY PROCESSING PLANT - URUNGA
CONTAINMENT CELL
CELL BASE LAYOUT PLAN

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scale	1:250 for A1	job no.	22-16251
date	MAY 2014	rev no.	B

approved (PD) SK001

Plot Date: 26 June 2014 - 11:47 AM Plotted by: Isaiah Hay Cad File No: G:\22\16251\CADD\Drawings\22-16251-SK001.dwg

N

SIGN

SIGN

WM

PP68356

TBM7-RL
5.91

12.00

11.00

10.00

9.00

8.00

7.00

TP
206

BH
202

TBM3
-7.34
GATE

10m MIN.

CH 160.00

CH 150.00

CH 140.00

CH 130.00

CH 120.00

CH 110.00

CH 100.00

CH 90.00

CH 80.00

CH 70.00

CH 60.00

CH 50.00

CH 40.00

CH 30.00

CH 20.00

CH 10.00

CH 0.00

SLOPE 1V:5H

SLOPE 1V:5H

SLOPE 1V:5H

LONGITUDINAL SECTION A

LONGITUDINAL SECTION B

A
SK005

BH
201

PP

PMF

PLAN
SCALE 1:250

LEGEND:

- MAJOR DESIGN CONTOUR
- MINOR DESIGN CONTOUR
- TOP OF DESIGN BATTER
- TOE OF DESIGN BATTER/GRADE BREAK
- CLEAN WATER DIVERSION DRAINS
- SITE BOUNDARY
- PROBABLE MAXIMUM FLOOD (PMF)
- EXISTING SEWER
- TRIAL PIT LOCATION
- BOREHOLE LOCATION
- EXISTING VEGETATION
- EXISTING ELECTRICAL SERVICE

0 2.5 5 7.5 10 12.5m
SCALE 1:250 AT ORIGINAL SIZE

CONCEPT

rev	description	app'd	date
B	CLIENT ISSUE	DB*	26.06.14
A	INITIAL ISSUE	DB*	29.05.14

NSW CATCHMENT & LANDS - CROWN LANDS
FORMER ANTIMONY PROCESSING PLANT - URUNGA
CONTAINMENT CELL
TOP OF WASTE LAYOUT PLAN

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date JUNE 2014 | rev no. B

approved (PD) SK002

Plot Date: 26 June 2014 - 11:47 AM Plotted by: Isaiah Hay Cad File No: G:\22\16251\CADD\Drawings\22-16251-SK002.dwg

N

SIGN

SIGN

WM

PP68356

TBM7-RL
5.91

SIMILAR

12.00

11.00

10.00

9.00

8.00

7.00

TP
206

BH
202

TBM3
-7.34
GATE

10m MIN.

LONGITUDINAL SECTION A

LONGITUDINAL SECTION B

CH 0.00

CH 10.00

CH 20.00

CH 30.00

CH 40.00

CH 50.00

CH 60.00

CH 70.00

CH 80.00

CH 90.00

CH 100.00

CH 110.00

CH 120.00

CH 130.00

CH 140.00

CH 150.00

SLOPE 1V:5H

SLOPE 1V:4H

A
SK005

BH
201

PMF

PP

PLAN
SCALE 1:250

LEGEND:

- MAJOR DESIGN CONTOUR
- MINOR DESIGN CONTOUR
- TOP OF DESIGN BATTER
- TOE OF DESIGN BATTER/GRADE BREAK
- CLEAN WATER DIVERSION DRAINS
- SITE BOUNDARY
- PROBABLE MAXIMUM FLOOD (PMF)
- EXISTING SEWER
- TRIAL PIT LOCATION
- BOREHOLE LOCATION
- EXISTING VEGETATION
- EXISTING ELECTRICAL SERVICE

0 2.5 5 7.5 10 12.5m
SCALE 1:250 AT ORIGINAL SIZE

CONCEPT

rev	description	app'd	date
B	CLIENT ISSUE	DB*	26.06.14
A	INITIAL ISSUE	DB*	29.05.14

NSW CATCHMENT & LANDS - CROWN LANDS
FORMER ANTIMONY PROCESSING PLANT - URUNGA
CONTAINMENT CELL
FINAL LANDFORM LAYOUT PLAN

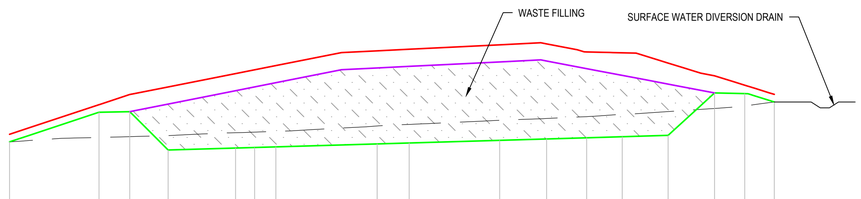
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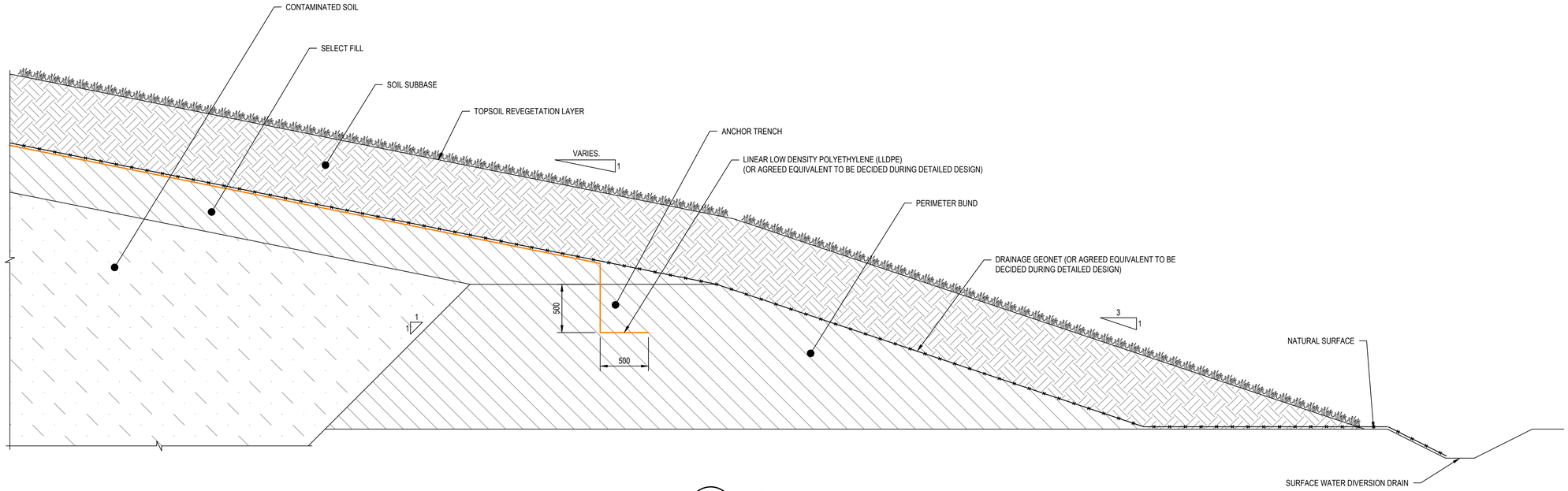
approved (PD) SK003

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DATUM RL. -2.00

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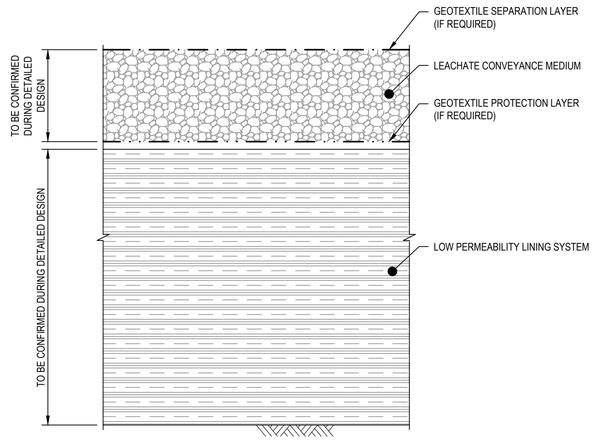


A SECTION
SK002 SCALE 1 : 25

TYPICAL CAP PROFILE AND PERIMETER TIE-INTO NATURAL SURFACE

LEGEND:
DESIGN DETAILS

- SEPARATION GEOTEXTILE
- PROTECTION GEOTEXTILE
- GEOMEMBRANE (LLDPE)
- DRAINAGE GEONET
- PROPOSED DESIGN SURFACE
- COMPACTED CLAY
- DRAINAGE AGGREGATE
- WASTE/CONTAMINATED SOIL
- PREPARED SUBGRADE
- SELECT FILL
- SOIL SUBBASE



1 DETAIL
SK001 SCALE 1 : 10

TYPICAL CELL BASE LINER SYSTEM (DIMENSIONS AND PROFILE TO BE CALCULATED DURING DETAILED DESIGN)

0 0.1 0.2 0.3 0.4 0.5m
SCALE 1:10 AT ORIGINAL SIZE

0 0.25 0.5 0.75 1.0 1.25m
SCALE 1:25 AT ORIGINAL SIZE

Plot Date: 26 June 2014 - 11:47 AM Plotted by: Isaiah Hay Cad File No: G:\22\16251\CADD\Drawings\22-16251-SK005.dwg

CONCEPT

rev	description	app'd	date
A	CLIENT ISSUE	DB*	26.06.14

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CONTAINMENT CELL
TYPICAL CAP & CELL BASE - SECTIONS & DETAILS

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approved (PD) SK005

Appendix G Clause 228 of EP&A Regulations and EPBC Act Considerations

Clause 228(2) Checklist

The following factors, listed in Clause 228(2) of the EP&A Regulation, are required to be considered to assess the likely impacts of the Proposal on the natural and built environment.

Factor	Impact
a. Any environmental impact on a community? As a remediation project, the Proposal would generally have a beneficial impact as it would reduce the potential impacts on soil and water quality, increase visual amenity values, restore ecological values and recreational values and promote socio-economic opportunities in the area. The Proposal would still have potential to result in some short term negative impacts on soil and water quality, traffic, air quality, noise and biodiversity. Mitigation measures as detailed in this EIS would ameliorate or minimise these potential impacts.	Short term minor negative Long term positive
b. Any transformation of a locality? The locality would be transformed through removal of contamination resulting in restored vegetation and modified topography (via construction of the containment cell).	Short term minor negative Long term positive
c. Any environmental impact on the ecosystems of the locality? As a remediation project, the Proposal will mainly impact the ecosystems of the locality in a positive way, through removal of contaminants and restoration of habitat. Some short term, negative impacts may result to the ecosystem through direct injury and mortality of fauna during civil works and disturbance of fauna from noise and vibration during the works. Overall impacts to flora and fauna during the Proposal are considered minimal with the implementation of mitigation measures (see Section 7.10). Mitigation measures outlined in this EIS and proposed for inclusion in the CEMP would reduce the likelihood of any impacts produced during the construction phase of the Proposal. Minimal native vegetation clearing is required.	Short term minor negative Long term positive
d. Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality? As a remediation project, the Proposal will improve the aesthetic, recreational, scientific and other environmental qualities of the locality.	Short and long term positive
e. Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations? No impacts on known Aboriginal, non-Aboriginal heritage items or localities with architectural, cultural, historical, scientific or social significance are anticipated. Aesthetic values will be increased	Short and long term positive

Factor	Impact
through the remediation of the impacted site, including a SEPP 14 wetland.	
f. Any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974)? A positive impact on the habitat of protected fauna would be gained through the remediation of the site including a SEPP 14 wetland.	Short and long term positive
g. Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? The Proposal is considered unlikely to endanger any species of flora or fauna due to the minimal amount of vegetation to be removed, historical levels of disturbance and the presence of large areas of other potential habitat in the locality and immediately adjacent to the study area. Safeguards are outlined in Section 7.10. Conversely, the Proposal will have a potential long term positive impact on flora and fauna through the creation of habitat.	Long term positive
h. Any long-term effects on the environment? The Proposal would generally result in the positive long-term effects on the environment through increased soil and water quality, increased visual amenity values, restored ecological values and recreational values and promote socio-economic opportunities in the area	Short and long term positive
i. Any degradation of the quality of the environment? Any degradation of the quality of the environment would be short-term and localised (e.g. increased traffic, sedimentation, dust and noise). Mitigation measures as outlined in Section 6 would ameliorate these potential impacts.	Minor short term negative Long term positive
j. Any risk to the safety of the environment? There would be some minor short term risks to the safety of the environment during the Proposal. These risks would be managed via the identified mitigation measures and CEMP. In the long term, the risk to the safety of the environment will be improved through removal of contamination.	Minor short term negative Long term positive
k. Any reduction in the range of beneficial uses of the environment? There would be no reduction of the beneficial uses of the environment. Beneficial uses of the environment would be increased through the remediation of the site, increasing recreational and ecological amenity.	Short and long term positive
l. Any pollution of the environment? The Proposal could potentially result in minor short-term water pollution from sediment, contaminants and spilt fuels and chemicals. Management of water quality impacts would be undertaken in	Short term minor negative

Factor	Impact
accordance with the mitigation measures outlined in Section 7.2. The Proposal would also result in minor short-term air pollution from plant and machinery and the generation of dust. Management of air quality impacts would be undertaken in accordance with the mitigation measures outlined in Section 7.3. The mitigation measures outlined in this EIS and the CEMP would limit the potential for generation and impact of any pollution.	
m. Any environmental problems associated with the disposal of waste? The basis of the Proposal relates to the disposal of contaminated waste generated from former antimony processing at the Site. Potential environmental problems associated with the Proposal are assessed in Section 7 of this EIS. Other waste streams generated during construction are common and would pose no difficulty in their disposal. Waste would be recycled wherever possible. The mitigation measures outlined in this REF and the CEMP would manage waste generation and disposal in such a way to reduce any environmental degradation.	Minor short term negative Long term positive
n. Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply? All resources required for the Proposal are readily available and are not in short supply. Refer to Section 7.16.	Nil
o. Any cumulative environmental effect with other existing or likely future activities? The Proposal would not significantly contribute to cumulative environmental impacts of existing or likely future activities in the vicinity of the Site, as discussed in Section 7.18.	Nil
p. Any impact on coastal processes and coastal hazards, including those under projected climate change conditions? The Proposal is located approximately 2 km from the coast. The wetland drains into Station Creek and Urunga Lagoon which forms part of the Bellinger-Kalang estuarine system. Hazards to this coastal environment will be reduced by the Proposal through reducing the potential for surface water contamination. Potential impacts on climate change of the Proposal are deemed insignificant.	Long term positive

Matters of National Environmental Significance

Under the environmental assessment provisions of the *Environment Protection and Biodiversity Conservation Act 1999*, the following matters of national environmental significance (MNES) and impacts on Commonwealth land are required to be considered to assist in determining whether the Proposal should be referred to the Australian Government Department of Sustainability, Environment, Water, Population and Communities.

Factor	Impact
a. Any impact on a World Heritage property? The Proposal would not have any impact on a World Heritage property. There are no World Heritage properties within 10 kilometres of the Proposal.	Nil
b. Any impact on a National Heritage place? The Proposal would not have any impact on a National Heritage place. There are no National Heritage places located within 10 kilometres of the Proposal.	Nil
c. Any impact on a wetland of international importance? The Proposal would not have any impact on a wetland of international importance. There are no wetlands of international importance within 10 kilometres of the Proposal site.	Nil
d. Any impact on a listed threatened species or communities? Threatened species have been recorded in the area. However, it is not considered likely that a significant long term impact would result on a listed threatened species or ecological community. A positive impact on threatened species will be achieved through the remediation of potential habitat.	Positive
e. Any impacts on listed migratory species? The Proposal would not impact on any Commonwealth listed migratory species. Refer Section 7.10.	Nil
f. Any impact on a Commonwealth marine area? The Proposal is located approximately 2 km from the ocean. A Commonwealth Marine Area 'EEZ and Territorial Sea' is located from three to two hundred nautical miles from the coast. The Proposal will not have any impact on this marine area.	Nil
g. Does the Proposal involve a nuclear action (including uranium mining)? The Proposal does not involve a nuclear action.	Nil
h. Additionally, any impact (direct or indirect) on Commonwealth land? No Commonwealth land would be impacted by the Proposal.	Nil

Appendix H Ecological Assessment



NSW Catchment and Lands- Crown Lands

Proposed Remediation of the Former Antimony Processing Plant - Urunga

Ecology Assessment

June 2014

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Appendix A – BioNet Atlas Search Results
Appendix B – Likelihood of Occurrence Tables
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1. Introduction

GHD has been engaged by NSW Catchments and Lands – Crown Lands, to undertake an ecological assessment as part of the Environmental Impact Statement (EIS) assessment for the remediation of the former antimony processing plant at part of Lot 1 and Lot 2 DP 874875 and Lot 253 DP 46013 on Hillside Drive, Urunga, New South Wales ('the site').

1.1 The proposal

The site was previously used for mineral stockpiling and processing. The remediation works will involve clearing of vegetation and removal of soil and surface materials to a depth of up to approximately three metres (refer to Figure 2 in Section 3.5 below).

At the completion of the remediation, it is proposed to revegetate the site with similar species to those in the adjacent vegetated areas.

1.2 Scope and purpose of this report

The purpose of this report is to provide a snapshot of the ecological condition, functions and processes that are associated with the study area in relation to its proposed remediation.

The key tasks in the assessment included:

- A desktop review of available reports, data and maps. Database searches for threatened biota, including *Threatened Species Conservation Act 1995* (TSC Act) and *Fisheries Management Act 1991* (FM Act) species and matters of national environmental significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were completed. An overview of the threatened biota likely to be affected by the proposal has been completed.
- Site inspection to ground-truth the flora and fauna of the site and note the general nature and condition of the habitats present and their relevance to potential threatened biota, including assessment of habitats for threatened species, populations and ecological communities as listed under the TSC Act, and the wetland adjoining a State Environmental Planning Policy 14 (SEPP 14) listed wetland.
- Preparation of a preliminary vegetation map of the site, using available data (e.g. aerial imagery, vegetation data and contours).
- An overview assessment of the significance of potential impacts on threatened biota (as listed under the TSC Act and FM Act), according to the 7-part test under Section 5A of the EP&A Act. We have assumed that individual 7-part tests or detailed assessments for individual threatened biota are not required.
- Identification of suitable measures to mitigate and/or offset potential impacts.

1.3 Limitations

This report: has been prepared by GHD for NSW Catchment and Lands- Crown Lands and *may only be used and relied on by NSW Catchment and Lands- Crown Lands for the purpose agreed between GHD and the NSW Catchment and Lands- Crown Lands as set out in this report.*

GHD otherwise disclaims responsibility to any person other than NSW Catchment and Lands- Crown Lands arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

2. Methods

2.1 Desktop review

2.1.1 Literature and database searches

A desktop review was undertaken which included review of the following:

- A site ecological survey - Redpath, P. and Body, M., 2003. *Flora and Fauna Evaluation for the Urunga Antimony Contaminated Site: An inventory assessment for an EIS.* Although that this work was undertaken 11 years ago, it provides information on the previous condition of the site, and information on species that it may support.
- Atlas of NSW Wildlife (BioNet) database search for a 10 km radius from the centre of the site. An assessment of the likelihood of occurrence of the species identified in this search has been conducted with reference to the broad habitats contained within the study area. This was further refined following field surveys. The likelihood of threatened and migratory biota occurring in the study area was assessed based on presence of records from the locality, species distribution and habitat preferences, and quality of potential habitat present in the study area.
- NSW Department of Primary Industries (Fisheries and Aquaculture), Threatened & protected species – records viewer.
- Protected Matters Search Tool (PMST) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for a one kilometre buffer from the site boundary. This database provides records of EPBC listed threatened species and species that are predicted to occur (based upon modelling), listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as well as species and communities listed as part of International treaties and agreements including the Bonn Convention on Migratory Species, the Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird Agreement (CAMBA) and the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).
- A comparison was made of aerial photography (Google Earth 2010) from 2004, 2010 and 2013.

2.1.2 Likelihood of occurrence

An assessment of the likelihood of occurrence of threatened species returned from database searches was undertaken, based upon the results of the desktop assessment (including database searches and previous surveys) as well as the site survey. The results of this are tabulated in Appendix C.

Table 1 provides a key to the likelihood of occurrence in the study area of threatened biota known or likely to occur in the locality.

Table 1 Key to Likelihood of Occurrence for Threatened Species

Likelihood	Definition
Likely	Species previously recorded within a 10 kilometre radius of the study area and suitable habitat occurs within the study area.
Possible	Species previously recorded within a 10 kilometre radius of the study area but only marginal suitable habitat recorded, OR

Likelihood	Definition
	Species not previously recorded within a 10 kilometre radius of the study area, but the study area is within the species known distribution and suitable habitat occurs within the study area.
Unlikely	Species previously recorded within a 10 kilometre radius of the study area but no suitable habitat recorded.
Nil	Species not previously recorded within a 10 kilometre radius of the study area, suitable habitat not recorded within subject, and/or study area outside species known distribution.

2.2 Site survey

The site was attended on 14 May 2013 by a Senior Ecologist. A random meander across the site was completed, with observations recorded of flora, fauna, habitat and general conditions associated with the vegetation and wetland present (see Figure 1 for a general impression of the site).



Figure 1 View across the Urunga site towards the south east

3. Results

3.1 Desktop review

The results obtained from the desktop review are provided below.

3.1.1 Previous site ecological survey

The *Flora and Fauna Evaluation for the Urunga Antimony Contaminated Site: An inventory assessment for an EIS* (Redpath and Body 2003), involved flora plots and transects, fauna trapping, scat analysis, diurnal bird census, call playback for nocturnal birds and nocturnal searches for herpetofauna in late 2001. The following results were obtained:

- 21 vulnerable fauna species, three endangered fauna species, one threatened species, and four vegetation communities with no threatened flora species, were identified from records and database searches.
- 73 fauna species were recorded on site, including one endangered species and six vulnerable species
    - Black-necked Stork (*Ephippiorhynchus asiaticus*) – endangered
    - Australasian Bittern (*Botaurus poiciloptilus*) - vulnerable
    - Glossy-black Cockatoo (*Calyptorhynchus lathami*) - vulnerable
    - Grey Crowned Babbler (*Pomatostomus temporalis*) - vulnerable
    - Mangrove Honeyeater (*Lichenosstomus fasciogularis*) - vulnerable
    - Northern Long-eared Bat (*Nyctophilus bifax*) - vulnerable
    - Little Bent-wing Bat (*Miniopterus australis*) - vulnerable
- Four vegetation communities were identified:
    - Swamp sclerophyll forest
    - Wet sclerophyll forest
    - Dry sclerophyll forest
    - Weed dominated vegetation

3.1.2 BioNet Wildlife Atlas search

The full results of the BioNet Search are included in Appendix A. The search returned a total of 6,282 records of 802 species. An extract from this list including the results relating to the study area for threatened species, populations and ecological communities under the TSC Act that are likely to occur within the study area or that may occur because there is habitat present within the study area, is provided in tabular format in Appendix C.

3.1.3 Fisheries records viewer

A search of the DPI (Fishing and Aquaculture) Threatened and protected species – records viewer (DPI 2013) returned no species for the Bellingen Local Government Area within which Urunga is located.

3.1.4 Protected Matters Report

The Protected Matters Search Tool (PMST) returned the following matters listed under the EPBC Act:

Matters of National Environmental Significance	
World Heritage Properties	None
National Heritage Properties	None
Wetlands of International Importance	None
Great Barrier Reef Marine Park	None
Commonwealth Marine Areas	1
Listed Threatened Ecological Communities	3
Listed Threatened Species	61
Listed Migratory Species	49

3.2 Likelihood of occurrence

The assessment of likelihood of occurrence (refer Appendix C) indicates that, under both State and Commonwealth legislation, a number of species are considered likely or have the possibility of occurrence.

Under the NSW TSC Act the following species are listed and have been assessed as 'likely' to occur or 'may occur' given the available and suitable habitat within the site:

- three endangered ecological communities
- two vulnerable and one endangered plant species
- one vulnerable frog species
- 10 vulnerable and one endangered bird species
- 8 vulnerable mammal species
- six migratory marine species

An assessment of the likelihood of occurrence within the proposed footprint was completed and those species and communities with an assessment of likely or possible under the EPBC Act include:

- 1 endangered and 2 vulnerable plant species
- 6 migratory marine species
- 2 migratory wetland species

The full results of the PMST Report are provided in Appendix B.

3.3 SEPP 14 Wetland

The State Environmental Planning Policy 14 (SEPP 14) aims to protect coastal wetlands in the environmental and economic interests of the State. SEPP 14 imposes restrictions on development within wetlands mapped and listed under this instrument. Section 7A pertains to restrictions on carrying out of restoration works and outlines the consent requirements.

The wetland along the eastern boundary of the study area flows eventually into Urunga Lagoon (approx. 800 m to the east) and then the Bellinger River before exiting to the sea. This wetland

is a coastal wetland and is mapped under SEPP 14. The proposed remediation may extend into the SEPP14 wetland.

3.4 Aerial photographs

Aerial photography from 2004 and 2010 was compared to the most recent images through Google Earth (2013). There is some indication that between 2004 and 2010 a patch of the paperbark forest to the south east of the bare ground area has died, as shown by the white lines in 2010 that have replaced the green points in 2004 (refer Appendix D), as well as another patch approximately 100 m to the east. In the most recent aerial photographs, it appears that there has been some recovery of these previously impacted areas. It is worth noting that aerial photography represents a snapshot in time and the appearance may be affected by other factors such as seasonal differences, water levels and other disturbances.

3.5 Observations from site

The site was not in use at the time of the survey. The site has historically been substantially cleared and contained disused rusting equipment and infrastructure

The site could broadly be divided into terrestrial and wetland areas. The terrestrial area was comprised of cleared areas and those areas that retain vegetation, while the wetland contained vegetated areas, and areas where vegetation had died but remained standing.

A dilapidated artificial drainage system located within the cleared section still served to direct stormwater across the site and into the adjacent wetland. In some parts the drain was concrete lined or followed an excavated channel. There was some evidence of erosion in association with this drainage system and there were parts of the system where an accumulation of green algae was evident which may indicate some subterranean or up-slope nutrient source.

The wetland was located in the south east of the site, and its extent and depth is likely to vary according to seasonal conditions and rainfall.

3.5.1 Flora and vegetation

A list of species observed during the site visit is provided in Table 2. This is not a comprehensive list but an indication of the dominant species and communities observed within the study area.

Table 2 Observed native flora species

Botanical name	Common name
Acrostichum speciosum	Mangrove Fern
Casuarina glauca	Swamp Oak
Cyperus sp.	Sedge
Eucalyptus robusta	Swamp Mahogany
Gahnia aspera	Rough Saw-sedge
Gleichenia sp.	Coral Fern
Imperata cylindrica	Blady Grass
Juncus usitatus	Common Rush

Botanical name	Common name
Lomandra longifolia	Matt-rush
Melaleuca decora	White Feather Honey Myrtle
Melaleuca quinquenervia	Prickly Paperbark
Parsonsia straminea	Monkey Rope
Phragmites australis	Common Reed
Pteridium esculentum	Soft Bracken
Triglochin striatum	Streaked Arrow-grass
Typha orientalis	Cumbungi

Vegetation communities

Native vegetation has been removed from much of the site as a result of historical clearing followed by excavation of the surface soils and materials to a bedrock base in some parts. Bare soil devoid of vegetation was present in other parts of the site. There is some indication that regeneration of native vegetation has occurred in some parts of the site.

The Redpath and Body (2003) report identified four vegetation communities present on site. The site survey confirmed these findings however two of the communities previously identified now fall within the same vegetation community, resulting in three communities as follows:

- Swamp sclerophyll forest is known as *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions* – endangered ecological community, which now includes the previously identified 'wet sclerophyll forest'.
- Dry sclerophyll forest is known as *Dry Grassy Blackbutt-Tallowwood Open Forest of the central parts of the North Coast of NSW*
- Sedgeland/Rushland is known as *Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* – endangered ecological community

Using the NSW TSC Act identification criteria, the swamp sclerophyll forest is an identified endangered ecological community referred to as *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* (SSF). This community forms the vegetation within and immediately adjacent to the wetland to the west and east.

The *Dry Grassy Blackbutt-Tallowwood Open Forest of the central parts of the North Coast of NSW* (GBT) comprises the remainder of the site that is not in the low lying areas. It is dominated by *Eucalyptus pilularis* (Blackbutt) or *E. microcorys* (Tallowwood) depending on the local soil and other conditions such as past fires.

The sedgeland/rushland identified by Redpath and Body (2003) conforms to the identification criteria for *Freshwater Wetlands on the Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* (FW). This community forms the vegetation community dominated by sedges approximately one metre tall such as *Baumea articulata, Eleocharis equisetina* and *Lepironia articulata* as well as floating species in more open water spaces such as *Ludwigia peploides* subsp *montevidensis*. The vegetation community is located in the

transitional zone between the SSF and the GBT as well as dominating the wetland to the east of the site (refer Figure 2).

Further to these communities, there are areas of previously cleared land which support exotic vegetation and a component of the site is comprised of previously cleared land with regenerating natural vegetation and exotic species combined (refer Figure 2).



1:1,500 (at A3)

0 10 20 40 60 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Lot
- Contour
- SEPP14
- Approx. Extent of Clearing
- Dry Grassy Blackbutt - Tallowwood (GBT)
- Sedgeland / Rushland - Freshwater Wetland (FW)
- Paperbark - Swamp Sclerophyll Forest (SSF)
- Paperbark - Swamp Sclerophyll Forest (SSF) (dead)
- Cleared / exotic
- Regrowth

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NSW Catchment and Lands- Crown Lands
Former Antimony Processing Plant, Urunga NSW

Vegetation Communities on Site

Job Number	22-16251
Revision	A
Date	25 Jun 2014

Figure 2

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© 2012. Whilst every care has been taken to prepare this map. GHD, LPI, DoPI and OEH make no representations or warranties about its accuracy, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred as a result of the product being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: LPI, Aerials 2012, DTDB, 2012; OEH, vegetation mapping, 2014; DoPI, SEPP14, 2013. Created by: gmcdiarmid, fmackay, tmorton

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3.5.2 Weeds

Areas of high weed density were observed within the study area. Species observed are listed in Table 3. This is not an exhaustive list of weed species but provides an indication of the species present within the study area with their declaration status including NSW Department of Primary Industries (Agriculture) Noxious Weed Listing under the *Noxious Weeds Act 1993*, and inclusion on the list of Weeds of National Significance (WONS).

Table 3 Weed species observed within the study area

Botanical name	Common name	Declaration status*
Ageratina adenophora	Crofton Weed	Class 4
Ageratum houstonianum	Blue Billy Goat Weed	
Andropogon virginicus	Whisky Grass	
Asparagus sp.	Asparagus Fern	
Chrysanthemoides monilifera	Boneseed	Class 4
Bidens pilosa	Farmers' Friends	
Colocasia esculenta	Elephants Ear (Taro)	
Cortaderia sp.	Pampas Grass	Class 4
Cotoneaster glaucophyllus	Cotoneaster	
Desmodium uncinatum	Silver-leaved Desmodium	
Erythrina crista-galli	Coral Tree	
Gymnocoronis spilanthoides	Senegal Tea (unconfirmed)	Class 1
Ipomoea cairica	Morning Glory Vine	
Lantana camara	Lantana	Class 4 & WONS
Monstera deliciosa	Fruit Salad Plant	
Musa sp.	Banana Palms	
Paspalum dilatatum	Paspalum	
Rubus fruticosus sp.	Blackberry	Class 4
Schefflera actinophylla	Umbrella Tree	
Senna pendula var. glabrata	Easter Cassia	
Solanum mauritianum	Wild Tobacco Plant	

*NSW *Noxious Weeds Act 1993* declaration status includes:

Class 1 The plant must be eradicated from the land and the land must be kept free of the plant;

Class 2 The plant must be eradicated from the land and the land must be kept free of the plant;

Class 3 The plant must be fully and continuously suppressed and destroyed; and

Class 4 The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction and the plant must not be sold propagated or knowingly distributed.

3.5.3 Fauna and habitat

Fauna species

Observations of fauna on site included possible bandicoot diggings towards the north, wallaby tracks, and frogs (Eastern Sedge Frog, *Litoria fallax*) were heard calling to the east of the site in a smaller wetland area adjacent to the main water body. Woodland bird species were observed and one snake skeleton was recorded in the cleared part of the study area (indeterminable species). Oyster shells in a pile were observed, however the origin of these is unknown,

Habitats

Fauna habitat within the study area included areas of dense vegetation, wetland, cleared and transitional areas. Habitat types are described in Table 4:

Table 4 Habitat types observed on site

Habitat types	Description and potential fauna type present
Closed forest	Forest with a canopy and dense shrub layer with some emergent trees, reduced light availability, higher humidity than more open areas providing habitat especially for birds, arboreal and ground-dwelling mammals, reptiles, invertebrates.
Paperbark forest	Inundated, partially inundated or periodically inundated, providing habitat for semi-aquatic species or those dependent on aquatic species as a food source such as invertebrates, frogs, reptiles, bats and microbats.
Open forest edges / clearings	Forest edges and cleared areas provide thoroughfares for many species. Partially forest habitat and adjacent open spaces provide an increased diversity in available habitat types allowing larger mammals access, and flight paths for many birds and bats.
Casuarina forest	May be dense or sparse and provides particular habitat for black cockatoos of many species.
Mudflats	Provides forage habitat for many waterbirds, marine and aquatic, at this location.
Sedgelands	Provides aquatic habitat with emergent vegetation particularly beneficial to breeding aquatic species such as dragonflies.
Aquatic	Provides habitat for fish and other aquatic species requiring permanent or semi-permanent fresh to slightly brackish water. Provides forage for bats and microbats above the water's surface.

The transitional zones between each of these habitat types often provide characteristics of each in a combination that supports a greater diversity of organisms.

It is likely that bat, microbat and flying fox activity would be prevalent in association with the wetland because of the likelihood of flying insects as a food source and in association with the surrounding vegetation where flowering plants provide food for nectivorous species. No grey-headed flying fox camp site was observed.

Given the proximity to the coast, to the estuary, to other wetlands and to dense vegetation, there are extensive and diverse habitat types present within and immediately adjacent to the site. Many species of wetland birds, including listed migratory species would be likely occur at least on an occasional basis at the site.

4. Potential impacts

It is proposed that vegetation, soil and surface materials will be removed from the area of the site shown in Figure 2 (as “Extent of clearing”) to a depth of approximately 3 m in the dry areas and approximately 0.5 m of soil and sediment from the wetland area. The extent of clearing and excavation would be limited to the boundary formed by healthy vegetation. The likelihood of an overall positive impact following completion of the remediation works does not form part of this study.

The potential clearing that would result from the proposal would include the following estimates of clearing (refer to Figure 2):

- Already cleared and exotic dominated 1.60 ha
- Dry grassy blackbutt – Tallowwood GBT 0.29 ha
- Paperbark – Swamp Sclerophyll Forest SSF 0.64 ha
- Regrowth vegetation 0.33 ha
- Freshwater Wetland (FW) 0.03 ha

4.1 Summary

Potential impacts from remediation works may include, but not be limited to the following:

- Clearing of terrestrial vegetation - impact on total native vegetation and habitat in the area
- Clearing of aquatic vegetation – impact on adjacent wetland
- Removal of soils – impact on local geomorphology, drainage and soil ecology
- Disturbance of site - potential for runoff, sedimentation and water quality into adjacent wetland
- Impacts from machinery and equipment on local fauna – collision, noise, air, vibration
- Spread of weeds
- Increased edge effects on remnant adjacent vegetation
- Importation of soils from off-site

4.2 Clearing of terrestrial vegetation - impact on total native vegetation and habitat in the area

Clearing of vegetation to enable remediation works is likely to include the native vegetation that has re-established since operations ceased, as well as some native vegetation along the boundaries of the disturbed area. Both the regenerating and boundary vegetation communities are heavily weed infested.



Figure 3 A boundary zone of the Urunga site

4.3 Clearing of aquatic vegetation – impact on adjacent wetland

It is likely that the wetland vegetation including the dead trees will be removed as part of the remediation works. This will result in removal of habitat and potential impacts on water quality associated with erosion and sedimentation.



Figure 4 The wetland within the impact zone of the Urunga site

4.4 Removal of soils – impact on local geomorphology, drainage and soil ecology

Removal of the contaminated soil profile is likely to result in alterations to the local geomorphology and ground structure which will impact on stormwater flows and local conditions including temperature and humidity within the area of disturbance and into adjacent areas. These factors in turn may influence the local flora and fauna by altering the water quality in the adjacent wetland and the associated vegetation communities.

4.5 Disturbance of site - potential for runoff, sedimentation and water quality into adjacent wetland

During the remediation works, there is potential for runoff from the site during heavy rainfall events. Runoff may result in sedimentation in the wetland. Runoff from the site will impact on water quality in the wetland and in the downstream estuary and wetland. These impacts will impact on aquatic fauna and flora.

4.6 Impacts from machinery and equipment on local fauna – collision, noise, air, vibration

The potential impacts from construction machinery on fauna include direct mortality or injury from collision, as well as the impacts of noise, exhaust fumes on air quality and the vibration created by earthmoving equipment.

4.7 Spread of weeds

There are many weed species present within the site. The remediation works have potential spread weed propagules within the site or off-site.



Figure 5 Weeds established at the Urunga site entrance

4.8 Increased edge effects on remnant adjacent vegetation

The current edges of the site are well vegetated and form an informal barrier to weed incursions further into the adjacent vegetation communities. Disturbance to this 'barrier' vegetation is likely to result in the re-establishment of a new 'edge' which may result in a reduction in the condition of the adjacent vegetation patch and a greater weed incursion.

4.9 Importation of soil from off-site

It will be necessary to import soils from off-site in order to restore vegetation onto some parts of the site. While attempts will be made to match the subject site conditions at the site from which the soil will be taken, there is some likelihood that the soil will differ from those in and adjacent to the subject site. A difference in the species present in the imported soil may also occur.

5. Mitigation measures

The following measures may be used to mitigate the potential impacts identified in Section 4 above.

5.1 Clearing of terrestrial vegetation - impact on total native vegetation and habitat in the area

- Carefully and clearly mark the extent of clearing at every boundary of the site prior to clearing works commencing
- Erect high visibility mesh fencing protection barriers along the western / south-western boundary to prevent impacts on existing vegetation
- Adhere to standard construction environmental management plan (CEMP) recommendations for vegetation clearing including avoidance of unnecessary clearing, pre-clearance checking for threatened flora species, progressive clearing approach.

5.2 Clearing of aquatic vegetation – impact on adjacent wetland

- Undertake the clearing during the dry season
- Establish sediment barriers to avoid contamination flowing into the downstream wetland areas, monitor and maintain
- Remove only the wetland vegetation (dead and alive) that is necessary to achieve the remediation outcomes agreed
- Utilise the weed-seed-free vegetation waste on site to assist with the generation of alternative habitat particularly in cleared and re-soiled areas.

5.3 Removal of soils - impact on local geomorphology

- Establish soil and sediment control barriers prior to commencement of the remediation earthworks, monitor and maintain
- Re-create the ‘natural’ ground structure upon completion of the remediation works by importing certified clean and appropriate soils from a similar location
- Revegetate to reduce the amount of exposed/bare ground in order to restore similar-to-local conditions.

5.4 Disturbance of site - potential for runoff, sedimentation and water quality into adjacent wetland

- Implement a water quality monitoring program prior to the commencement of remediation works (parameters will be determined following initial water quality data collection and analysis). Undertake water quality testing weekly during remediation, and for six months after completion (or as directed by the approval authority). Include water monitoring at two other downstream locations, including the estuary and the downstream wetland
- Visual inspection will be undertaken daily by the site manager during the construction phase in order to quickly remedy any breaches or leaks in sediment and erosion control measures.

5.5 Impacts from machinery and equipment on local fauna – collision, noise, air, vibration

- Time the remediation works so as to avoid the common fauna breeding season (e.g. Black-necked Stork in Spring) in order to reduce the impact on local fauna
- Adhere to standard construction environmental management plan recommendations for construction including regularly serviced machinery/equipment, restricted working hours, reduction in amount of machinery/equipment used, pre-commencement fauna checks of vegetation to be cleared, and pre-start fauna checks of machinery.

5.6 Spread of weeds

- Treat weeds present on site two weeks prior to commencement of the remediation works
- Complete weed hygiene procedures including machinery washdown prior to plant and machinery entering the site to reduce the risk of new weed species being introduced
- Raise awareness with machinery/equipment operators of weeds that are likely to spread within the site.

5.7 Increased edge effects on remnant adjacent vegetation

- Clearly and definitively mark the 'no-go' zone with high visibility mesh temporary fencing such that the adjacent vegetation community is impacted as little as possible by the remediation works.

6. Assessment of significance of the potential impacts

An overview assessment of the significance of the potential impacts identified on threatened biota according to the 7-part test under Section 5A of the EP&A Act is provided below.

Species considered, based upon the likelihood of occurrence are summarised in Section 3.2 and listed in Appendix C. Consideration of the significance of potential impacts has been given in groups of species/communities with similar habitat requirements and includes the following.

6.1 Endangered ecological communities and plant species

The assessment of significance of potential impacts for the following species and communities has been considered together:

- Leafless Tongue-orchid (*Cryptostylis hunteriana*)
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South Easter Corner Bioregions
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions
- Swamp Sclerophyll Forest on Coast Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

a. **In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

Due to the degraded nature of the habitats present within the site, it is unlikely that Leafless Tongue-orchid would be solely dependent on the subject site for its lifecycle. Given the availability of adjacent and nearby habitats, it is not considered likely that the proposed action would have an adverse effect on the life cycle of the species considered likely to occur on the site.

b. **In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

No endangered population is known to occur within the site.

c. **In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

It is not considered likely that the proposed action will adversely affect the extent of the EEC or the plant such that the local occurrence is likely to be placed at risk of extinction. The site and the proposed disturbance footprint represent a small portion of the adjoining Swamp Sclerophyll Forest. The vegetation within or in close proximity to the site has been impacted by the antimony plant in the past and impacts are continuing to spread from the site. The proposed remediation is expected to halt the spread of these impacts and to reinstate, as far as practicable, the site to its pre-disturbed condition.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Given the degraded and weed infested nature of the subject site, it is not considered likely that the proposed action will modify the composition of the ecological community or the potential habitat for the plant such that its local occurrence would be placed at risk of extinction. At the completion of remediation works, it is expected that there will be an overall improvement in the conditions of the site.

d. **In relation to the habitat of a threatened species, population or ecological community:**

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The extent of habitat that may be removed as part of the proposed action is limited to highly modified and weed infested vegetation at the edge of communities in better condition, and/or vegetation in poor condition due to the local site conditions within the cleared and regenerating areas, and/or highly disturbed paperbark forest consisting of dead trees and scattered reeds. It is not considered likely that these areas would provide core habitat for any listed threatened species given the poor condition of the areas. It is considered that the extent of habitat to be removed is not significant given the area of adjacent similar ecological community in better condition.

The estimates for area of removal are as follows:

- Dry grassy blackbutt – Tallowwood GBT 0.29 ha
- Paperbark – Swamp Sclerophyll Forest SSF 0.64 ha
- Regrowth vegetation 0.33 ha
- Freshwater Wetland (FW) 0.03 ha

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Habitats on site have predominantly been historically cleared, and it is not considered likely that the proposed action will significantly further fragment or isolate habitats.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

It is not considered that the habitat that will be removed for the remediation works is of importance to threatened species, as it is not likely to be core habitat for listed threatened species, and the wetland has previously been degraded. Given the extent of similar ecological communities in adjacent areas and in the greater region it is not considered that the proposal will impact on the long-term survival of species or ecological communities.

e. **whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),**

No critical habitat is considered likely to occur within the area of the proposed action.

f. **whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,**

Species Action Statements have been prepared under the *Saving our Species* program for all listed threatened species under the TSC Act. Those that have potential to occur on

the site are included under Management Streams. Management actions include control of vegetation clearing and management of national parks and reserves.

The initial action involving clearing of vegetation is not supportive of the recovery, however the final action of remediation is considered to be supportive of recovery and abatement of threat for the site and its associated flora and fauna.

g. **whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

Whilst vegetation clearing constitutes a key threatening process, the aim of the remediation works is to remove a threat and reduce the level of ongoing impact resulting from past land use practices. Vegetation clearing is necessary to complete the remediation works, however it will only result in a short term impact, with longer term improvement in the site and local/regional ecological conditions expected.

6.2 Endangered and Vulnerable fauna

- Wallum Froglet (*Crinia tinnula*) - vulnerable
- Australasian Bittern (*Botaurus poiciloptilus*) - vulnerable
- Black Bittern (*Ixobrychus flavicollis*) - vulnerable
- Black-necked Stork (*Ephippiorhynchus asiaticus*) – endangered
- Brolga (*Grus rubicunda*) – vulnerable
- Comb-crested Jacana (*Irediparra gallinacea*) – vulnerable
- Eastern Grass Owl (*Tyto longimembris*) – vulnerable
- Eastern Osprey (*Pandion cristatus*) - vulnerable
- Glossy-black Cockatoo (*Calyptorhynchus lathami*) - vulnerable
- Little Eagle (*Hieraaetus morphnoides*) - vulnerable
- Mangrove Honeyeater (*Lichenostomus fasciogularis*) – vulnerable
- Rose-crowned Fruit-dove (*Ptilinopus regina*) – vulnerable
- Square-tailed Kite (*Lophoictinia isura*) - vulnerable

h. **In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

Due to the degraded nature of the habitats present within the site, it is unlikely that the above frog and bird species would be solely dependent on the subject site for their lifecycle. Given the availability of adjacent and nearby habitats, it is not considered likely that the proposed action would have an adverse effect on the life cycle of the species considered likely to occur on the site.

i. **In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

No endangered population is known to occur within the site.

j. **In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

EECs have been considered separately above.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

EECs have been considered separately above.

k. **In relation to the habitat of a threatened species, population or ecological community:**

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The extent of habitat that may be removed as part of the proposed action is limited to highly modified and weed infested vegetation at the edge of communities in better condition, and/or vegetation in poor condition due to the local site conditions within the cleared and regenerating areas, and/or highly disturbed paperbark forest consisting of dead trees and scattered reeds.

It is not considered likely that these areas would provide core habitat for any listed threatened species given the poor condition of the areas. It is considered that the extent of habitat to be removed is not significant given the area of adjacent similar ecological community in better condition.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Habitats on site have predominantly been historically cleared, and it is not considered likely that the proposed action will significantly further fragment or isolate habitats.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

It is not considered that the habitat that will be removed to facilitate the remediation works is of importance to threatened species, as it is not likely to be core habitat for listed threatened species, and the wetland has previously been degraded. Given the extent of similar ecological communities in adjacent areas and in the greater region it is not considered that the proposal will impact on the long-term survival of species or ecological communities.

l. **whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),**

No critical habitat is considered likely to occur within the area of the proposed action.

m. **whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,**

Species Action Statements have been prepared under the *Saving our Species* program for all listed threatened species under the TSC Act. Those that have potential to occur on the site are included under Management Streams. Management actions include control of vegetation clearing and management of national parks and reserves.

The initial action involving clearing of vegetation is not supportive of the recovery, however the final action of remediation is considered to be supportive of recovery and abatement of threat for the site and its associated flora and fauna.

n. **whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

Whilst vegetation clearing constitutes a key threatening process, the aim of the remediation works is to remove a threat and reduce the level of ongoing impact resulting from past land use practices. Vegetation clearing is necessary to complete the remediation works, however, it will only result in a short term impact, with longer term improvement in the site and local/regional ecological conditions expected.

6.3 Vulnerable Mammals

- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) – vulnerable
- Eastern Freetail-bat (*Mormopterus norfolkensis*) – vulnerable
- Eastern Long-eared Bat (*Nyctophilus bifax*) – vulnerable
- Greater Broad-nosed Bat (*Scoteanax rueppellii*) – vulnerable
- Grey-headed Flying-fox (*Pteropus poliocephalus*) - vulnerable
- Little Bent-wing Bat (*Miniopterus australis*) – vulnerable
- Southern Myotis (*Myotis macropus*) - vulnerable

o. **In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

It is unlikely that these bats and flying-fox species would be solely dependent on the subject site for their lifecycle. Given the availability of adjacent and nearby habitats, it is not considered likely that the proposed action would have an adverse effect on the life cycle of any of the species considered likely to occur or that may occur on the site.

p. **In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

No endangered population is known to occur within the site.

q. **In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

EECs are considered separately above.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

EECs are considered separately above.

r. **In relation to the habitat of a threatened species, population or ecological community:**

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The extent of habitat that may be removed as part of the proposed action is limited to highly modified and weed infested vegetation at the edge of communities in better

condition, and/or vegetation in poor condition due to the local site conditions within the cleared and regenerating areas, and/or highly disturbed paperbark forest consisting of dead trees and scattered reeds. It is not considered likely that these areas would provide core habitat for any listed threatened species given the poor condition of the areas. It is considered that the extent of habitat to be removed is not significant given the area of adjacent similar ecological community in better condition.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Habitats on site have predominantly been historically cleared, and it is not considered likely that the proposed action will significantly further fragment or isolate habitats.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

It is not considered that the habitat that will be removed for the remediation works is of importance to threatened species, as it is not likely to constitute core habitat for listed threatened species. Similar ecological communities are present in the region and will persist to support threatened species if they occur.

s. **whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),**

No critical habitat is considered likely to occur within the area of the proposed action.

t. **whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,**

Species Action Statements have been prepared under the *Saving our Species* program for all listed threatened species under the TSC Act. Those that have potential to occur on the site are included under the Landscape Species Management Stream. Management actions include control of vegetation clearing and management of national parks and reserves.

The action of remediation is considered to be supportive of recovery and abatement of threat for the site and its associated flora and fauna.

u. **whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

Vegetation clearing constitutes a key threatening process. Mitigation measures will be taken during the works phase and revegetation comprises the major component of the final project. The impact is considered to be short term, with a longer term improvement in the site and local/regional ecological conditions expected.

The likely significance of impacts of the proposal on the above threatened species and communities has been assessed in accordance with DECC's *Threatened species assessment guidelines* (DECC 2007). The assessments of likelihood of occurrence are presented in Appendix B.

It considered that no significant impact on threatened species or endangered ecological communities would result from the proposal at the site, given the condition of the vegetation and habitat to be removed and the availability of adjacent communities.

7. Conclusion

Based on this assessment and the overview 7-part test and given the intent of the proposed works to remediate the site, in conjunction with the implementation of an environmental management plan during the works phase, it is considered that the proposed remediation works would be unlikely to significantly impact on threatened species, populations or ecological communities. A more detailed survey is not expected to be required.

References

Atlas of NSW Wildlife (BioNet) database search

Australian Government, Department of the Environment, Protected Matters Search Tool Report

Google Earth, historic aerial imagery

NSW Department of Primary Industries (Agriculture) Noxious Weed Listing under the *Noxious Weeds Act 1993*

NSW Department of Primary Industries (Fisheries and Aquaculture), Threatened & protected species – records viewer

NSW Office of Environment and Heritage, threatened species database

Protected Matters Search Tool (PMST) under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

Redpath, P. and Body, M., 2003. *Flora and Fauna Evaluation for the Urunga Antimony Contaminated Site: An inventory assessment for an EIS.*

Appendices

Appendix A – BioNet Atlas Search Results

Data from the BioNet Atlas of NSW Wildlife website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions.

Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1°; ^^ rounded to 0.01°).

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Search criteria : Public Report of all Valid Records of Entities in selected area [North: -30.45 West: 152.95 East: 153.06 South: -30.55] returned a total of 6,282 records of 802 species.

Report generated on 23/06/2014 3:09 PM

Scientific Name	Common Name	NSW status	Comm. status
FROGS			
Crinia tinnula	Wallum Froglet	V,P	
Mixophyes iteratus	Giant Barred Frog	E1,P,2	E
BIRDS			
Oxyura australis	Blue-billed Duck	V,P	
Anthochaera phrygia	Regent Honeyeater	E4A,P	E
Botaurus poiciloptilus	Australasian Bittern	E1,P	E
Calyptorhynchus lathami	Glossy Black-Cockatoo	V,P,2	
Charadrius leschenaultii	Greater Sand-plover	V,P	C,J,K
Coracina lineata	Barred Cuckoo-shrike	V,P	
Daphoenositta chrysoptera	Varied Sittella	V,P	
Ephippiorhynchus asiaticus	Black-necked Stork	E1,P	
Glossopsitta pusilla	Little Lorikeet	V,P	
Grus rubicunda	Brolga	V,P	
Hieraaetus morphnoides	Little Eagle	V,P	
Irediparra gallinacea	Comb-crested Jacana	V,P	
Ixobrychus flavicollis	Black Bittern	V,P	
Lichenostomus fasciogularis	Mangrove Honeyeater	V,P	
Lophoictinia isura	Square-tailed Kite	V,P,3	
Ninox strenua	Powerful Owl	V,P,3	
Pandion cristatus	Eastern Osprey	V,P,3	
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V,P	
Ptilinopus magnificus	Wompoo Fruit-Dove	V,P	
Ptilinopus regina	Rose-crowned Fruit-Dove	V,P	
Stagonopleura guttata	Diamond Firetail	V,P	
Tyto longimembris	Eastern Grass Owl	V,P,3	
Tyto novaehollandiae	Masked Owl	V,P,3	
Tyto tenebricosa	Sooty Owl	V,P,3	
MAMMALS			
Dasyurus maculatus	Spotted-tailed Quoll	V,P	E
Phascogale tapoatafa	Brush-tailed Phascogale	V,P	
Phascolarctos cinereus	Koala	V,P	V

Petaurus australis	Yellow-bellied Glider	V,P	
Petaurus norfolcensis	Squirrel Glider	V,P	
Pteropus poliocephalus	Grey-headed Flying-fox	V,P	V
Mormopterus norfolkensis	Eastern Freetail-bat	V,P	
Miniopterus australis	Little Bentwing-bat	V,P	
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V,P	
Myotis macropus	Southern Myotis	V,P	
Nyctophilus bifax	Eastern Long-eared Bat	V,P	
Scoteanax rueppellii	Greater Broad-nosed Bat	V,P	
PLANTS			
Marsdenia longiloba	Slender Marsdenia	E1,P	V
Parsonsia dorrigoensis	Milky Silkpod	V,P	E
Acacia chrysotricha	Newry Golden Wattle	E1,P	
Dendrobium melaleucaphilum	Spider orchid	E1,P,2	
Hicksbeachia pinnatifolia	Red Boppel Nut	V,P	V
Acronychia littoralis	Scented Acronychia	E1,P	E
Niemeyera whitei	Rusty Plum, Plum Boxwood	V,P	
ECOLOGICAL COMMUNITIES			
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E3	V
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E3	
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E3	CE
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	E3	CE
Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion	Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion	E3	CE
Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions	Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions	E3	E
Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	E3	

Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E3	
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E3	
Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions	E3	
White Box Yellow Box Blakely's Red Gum Woodland	White Box Yellow Box Blakely's Red Gum Woodland	E3	CE
White Gum Moist Forest in the NSW North Coast Bioregion	White Gum Moist Forest in the NSW North Coast Bioregion	E3	

Appendix B – Likelihood of Occurrence Tables

Assessment of the Likelihood of Occurrence of Threatened Ecological Communities and Flora Species

The likelihood of occurrence assessment conducted by GHD ecologists determines the likelihood of conservation significant species, or species' habitat, occurring within the Study Area. The assessment involved a review of the desktop survey results (i.e. EPBC Act Protected Matters Report, BioNet extracts); relevant literature (e.g. Commonwealth Species Profile and Threats Database (SPRAT), and field guides).

A likelihood of occurrence ranking was attributed to each conservation significant species/community, based on the following framework:

- **Unlikely to occur**: species has not been recorded in the area (no records from desktop search extent **AND/OR** current known distribution does not encompass Study Area **AND/OR** suitable habitat is generally lacking from Study Area;
- **May occur**: species has not been recorded in the desktop search extent although species' distribution incorporates Study Area **AND** potentially suitable habitat occurs at the Study Area;
- **Likely to occur**: species has been recorded in the desktop search extent **AND** potentially suitable habitat is present at the Study Area; and
- **Confirmed present**: species recorded during field surveys.

Common Name Scientific Name	EPBC Act Status	TSC Act Status	Species Distribution and Habitat	Likelihood of Occurrence Within Study Area
Ecological communities				
Lowland Rainforest of Subtropical Australia	CE	EEC	This community is known as the Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions. Undisturbed, this community has a closed canopy, with a high diversity of trees and includes palms, vines and vascular epiphytes. This community is known to occur on the Clarence lowlands within the Northern Rivers Catchment Management Authority area.	Unlikely based on the species observed within the study area. No rainforest was noted.
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South Easter Corner Bioregions		EEC	This community is recorded within the project area. It is associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. This community is dominated by herbaceous plants and has very few woody species.	Likely in certain parts of the site.
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions		EEC	This community is recorded within the project area. It is typified by a dense to sparse tree layer of swamp oak (*Casuarina glauca*) with other trees including lilly pilly (*Acmena smithii*), cheese trees (*Glochidion spp.*) and paperbarks (*Melaleuca spp.*) present as subordinate species.	Likely in certain parts of the site.
Swamp Sclerophyll Forest on Coast Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions		EEC	This community is recorded within the project area. It typically consists of an open to dense layer of *Eucalypt*s and paperbarks. The most widespread and abundant dominant trees include swamp mahogany (*Eucalyptus robusta*) and paperbark (*Melaleuca quinquenervia*) in the subject region. Shrubs include *Leptospermum polygalifolium* subsp. Polygalifolium and *Melaleuca* spp., while groundcover is composed of abundant sedges, ferns, forbs and grasses including G*ahnia clarkei, Pteridium esculentum, Dianella caerulea, Viola hederacea and*	Confirmed Present.

Common Name Scientific Name	EPBC Act Status	TSC Act Status	Species Distribution and Habitat	Likelihood of Occurrence Within Study Area
			Lomandra longifolia.	
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregion	En	EEC	Coastal Saltmarsh occurs in the intertidal zone on the shores of estuaries and lagoons that are permanently or intermittently open to the sea. It is frequently found as a zone on the landward side of mangrove stands. Characteristic plants include *Baumea juncea*, Sea Rush (*Juncus krausii* subsp. *australiensis*), Samphire (*Sarcocornia quinqueflora* subsp. *quinqueflora*), Marine Couch (*Sporobolus virginicus*), Streaked Arrowgrass (*Triglochin striata*), Knobby Club-rush (*Ficinia nodosa*), Creeping Brookweed (*Samolus repens*), Swamp Weed (*Selliera radicans*), Seablite (*Suaeda* australis) and Prickly Couch (*Zoysia macrantha*). Occasionally mangroves are scattered through the saltmarsh. Tall reeds may also occur, as well as salt pans (OEH 2014).	Unlikely.
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	CE	EEC	Littoral Rainforest is generally a closed forest, the structure and composition of which is strongly influenced by its proximity to the ocean. The plant species of this community are predominantly rainforest species. Several species have compound leaves, and vines may be a major component of the canopy. These features differentiate littoral rainforest from forest or scrub, but while the canopy is dominated by rainforest species, scattered emergent individuals of sclerophyll species, such as *Angophora costata*, *Banksia integrifolia*, *Eucalyptus botryoides* and *Eucalyptus tereticornis* occur in many stands. It occurs on sand dunes and on soil derived from underlying rocks. Stands occur on headlands within 2 km of the sea (OEH 2014).	Unlikely.
Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion	CE	EEC	Lowland Rainforest on Floodplain is a rainforest community which now occurs only as small remnants in scattered localities on the NSW north coast, with less than 1000 ha in total thought to remain. Larger stands of the community typically have a dense canopy, which blocks most light from reaching the ground, creating cool, moist conditions within. Lowland Rainforest on Floodplain supports a rich diversity of plants and animals. Typical tree species in the community include figs *(Ficus macrophylla, F. obliqua* and *F. watkinsiana),* palms *(Archontophoenix cunninghamiana* and *Livistona australis),* Silky Oak *(Grevillea robusta)*, Black Bean *(Castanospermum australe)* and Brush Cherry *(Syzygium australe).* Animals present include fruit-eating rainforest pigeons, Noisy Pitta, Brush-turkey, pademelons, flying foxes, the Land Mullet skink and rainforest snails (OEH 2014).	Unlikely.
Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion		EEC	This subtropical forest occurs on the coastal floodplains of the North Coast of NSW. It has a tall open tree layer of eucalypts, angophoras, melaleucas and bloodwoods, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality.	Unlikely.

Common Name Scientific Name	EPBC Act Status	TSC Act Status	Species Distribution and Habitat	Likelihood of Occurrence Within Study Area
			It occupies central or marginal parts of floodplains and sandy flats, including Pleistocene back-barrier flats; habitats where flooding is periodic and soils are rich in silt and sand, sometimes humic, and show little influence of saline ground water (OEH 2014).	
Listed threatened flora species				
Austral Toadflax (*Thesium australe*)	Vu		Austral Toadflax is a herb to 40 cm tall that occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. It is often found in association with Kangaroo Grass (*Themeda australis*). This species is predicted to occur within the locality (OEH 2013).	Unlikely as no grasslands occur within the proposed footprint.
Clear Milkvine (*Marsdenia longiloba*)	Vu	En	Slender Marsdenia is a slender climber of the milk vine group, with pairs of very finely pointed leaves and 5-6 tiny glands at the base of the leaves. The stems of Slender Marsdenia exude clear, watery sap when cut, unlike most of the milk vines which have milky sap. Clusters of small white star-shaped flowers are produced in summer and are followed by long, narrow seed-capsules that split to release many seeds with tufts of long silky hair (OEH 2014).	Unlikely as no rainforest is present within the footprint.
Cryptic Forest Twiner *(Tylophora woollsii)*	En	En	This species grows in moist eucalypt forest, moist sites in dry eucalypt forest and rainforest margins. It flowers in summer and autumn. It is found from the New England Tablelands to southern Queensland but is not common (AoA 2014).	Unlikely. Moist sites do not contain eucalypt or rainforest species.
Dwarf Heath Casuarina (*Allocasuarina defungens*)	En		Dwarf Heath Casuarina is found only in NSW from Nabiac to Byron Bay. This species grows mainly in tall heath on sand, but can also occur on clay soils and sandstone. It is predicted to occur within the study area. No records within study area (OEH 2013).	Unlikely. No tall heath within the proposed footprint.
Hairy-joint Grass (*Arthraxon hispidus*)	Vu		Hairy-joint Grass is moisture and shade-loving, found in or on the edges of rainforest and in wet *Eucalypt* forest, often near creeks or swamps. It has been recorded within the locality (OEH 2013).	Possible.
Leafless Tongue-orchid (*Cryptostylis hunteriana*)	Vu	Vu	Habitat preferences are not clearly defined for this species. It is known from a range of communities including swamp-heath and woodland. It has not been recorded in the locality (OEH 2014).	Possible.
Lesser Swamp-orchid (*Phaius australis*)	En		The Lesser Swamp-orchid is commonly associated with coastal wet heath/sedgeland wetlands, swampy grassland or swampy forest and often where Broad-leaved Paperbark or Swamp Mahogany are found. Typically, the Lesser Swamp-orchid is restricted to the swamp-forest margins, where it occurs in swamp sclerophyll forest (Broad-leaved Paperbark/Swamp	Likely.

Common Name Scientific Name	EPBC Act Status	TSC Act Status	Species Distribution and Habitat	Likelihood of Occurrence Within Study Area
			Mahogany/Swamp Box (*Lophostemon suaveolens*)), swampy rainforest (often with sclerophyll emergents), or fringing open forest. It is often associated with rainforest elements such as Bangalow Palm (*Archontophoenix cunninghamiana*) or Cabbage Tree Palm (*Livistona australis*) (OEH 2014).	
Milky Silkpod (*Parsonsia dorrigoensis*)	En	Vu	Milky Silkpod is a slender climber found in subtropical and warm-temperate rainforest, on rainforest margins, and in moist *Eucalypt* forest up to 800 m on brown clay soils. This species is known to occur within the locality (OEH 2013).	Unlikely as moist *Eucalypt* forest and rainforest not present within the site.
Newry Golden Wattle (*Acacia chrysotricha*)		En	This tree grows up to 15 m. It is restricted to an area south of Bellingen on NSW north coast. It occurs as an understorey species on rainforest edges, in steep narrow gullies on quartzite soils. It is recorded within the locality (OEH 2013).	Unlikely as no rainforest or steep narrow gully occurs on site.
Red Boppel Nut (*Hicksbeachia pinnatifolia*)	Vu	Vu	This small tree grows to 10 m in subtropical rainforest, moist *Eucalypt* forest and brush box forest. It is recorded within the locality (OEH 2013).	Unlikely as suitable habitat does not occur within the site.
Rusty Plum (*Niemeyera whitei*)		Vu	The Rusty Plum is a tree to 20 m high that occurs in rainforest and adjacent understorey of moist *Eucalypt* forest. It is location north from Macleay and around Coffs Harbour in NSW. This species is known to occur within the locality (OEH 2013).	Unlikely as no rainforest occurs within the proposed footprint.
Scented Acronychia (*Acronychia littoralis*)	En	En	Scented Acronychia is a small tree to 6 m high found between Fraser Island in Queensland and Port Macquarie in NSW. It grows in littoral rainforest on sand. This species is known to occur within the locality (OEH 2013).	Unlikely as no littoral rainforest occurs within the proposed footprint.
Siah's Backbone (*Streblus pendulinus*)	En		Siah's Backbone is found in warmer rainforests, mainly along watercourses, growing in well-developed rainforest and gallery forest and drier seasonal rainforest (OEH 2014).	Unlikely.
Slender Marsdenia (*Marsdenia longiloba*)	Vu	En	Slender Marsdenia is a climber found in subtropical and warm temperate rainforest, lowland moist *Eucalypt* forest adjoining rainforest and sometimes in areas with rock outcrops. This species is predicted to occur within the locality (OEH 2013).	Unlikely as no rainforest forms part of the proposed footprint.
Spider Orchid (*Dendrobium melaleucaphilum*)		En	This Orchid grows on other plants and sometimes on rocks occurring in coastal districts and nearby ranges. It frequently grows on *Melaleuca styphelioides* and less commonly on rainforest trees or on rocks in coastal districts. This species is known to occur within the locality (OEH 2013).	Unlikely as *Melaleuca styphelioides* not present on site.

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White-flowered Wax Plant (*Cynanchum elegans*)	En	En	The White-flowered Wax Plant is a climber or twiner with a highly variable form. Mature stems have fissured corky bark and can grow to 10 m long. It usually occurs on the edge of dry rainforest vegetation including littoral rainforest, Coastal Tea-tree, Coastal Banksia, coastal scrub, Forest Red Gum open forest and woodland, Spotted Gum open forest and woodland and Bracelet Honeymyrtle scrub to open scrub. This species is predicted to occur in the locality (OEH 2013).	Unlikely as appropriate vegetation types not present within the site.

Assessment of the Likelihood of Occurrence of Threatened and / or Migratory Fauna

The likelihood of occurrence assessment conducted by GHD ecologists determines the likelihood of conservation significant species, or species' habitat, occurring within the Study Area. The assessment involved a review of the desktop survey results (i.e. EPBC Act Protected Matters Report, BioNet extracts); relevant literature (e.g. Commonwealth Species Profile and Threats Database (SPRAT), and field guides).

A likelihood of occurrence ranking was attributed to each conservation significant species/community, based on the following framework:

- **Unlikely to occur**: species has not been recorded in the area (no records from desktop search extent **AND/OR** current known distribution does not encompass Study Area **AND/OR** suitable habitat is generally lacking from Study Area;
- **May occur**: species has not been recorded in the desktop search extent although species' distribution incorporates Study Area **AND** potentially suitable habitat occurs at the Study Area;
- **Likely to occur**: species has been recorded in the desktop search extent **AND** potentially suitable habitat is present at the Study Area; and
- **Confirmed present**: species recorded during field surveys.

Common Name Scientific Name	EPBC Act Status	TSC Act Status	Species Distribution and Habitat	Likelihood of occurrence
Frogs				
Wallum Froglet (*Crinia tinnula*)		Vu	Wallum Froglets are found in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They typically occur in sedgelands and wet heathlands. They can also be found along drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests (OEH 2014).	Possible.
Giant Barred Frog (*Mixophyes iteratus*)	En	En	Giant Barred Frogs are found along freshwater streams with permanent or semi-permanent water, generally (but not always) at lower elevation. Moist riparian habitats such as rainforest or wet sclerophyll forest are favoured for the deep leaf litter that they provide for shelter and foraging, as well as open perching sites on the forest floor. However, Giant Barred Frogs will also sometimes occur in other riparian habitats, such as those in drier forest or degraded riparian remnants, and even occasionally around dams (OEH 2014).	Unlikely.
Birds				
Australasian Bittern (*Botaurus poiciloptilus*)	En	En	This species favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.). Known to occur within the locality (OEH 2014).	Possible.
Barred Cuckoo-shrike (*Coracina lineata*)		Vu	Rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses. They are usually seen in pairs or small flocks foraging among foliage of	Unlikely.

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			trees for insects and fruit. They are active birds, frequently moving from tree to tree (OEH 2014).	
Black Bittern (*Ixobrychus flavicollis*)		Vu	This species inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves (OEH 2014).	Possible.
Black-necked Stork (*Ephippiorhynchus asiaticus*)		En	Black-necked Storks are mainly found in shallow, permanent, freshwater terrestrial wetlands and surrounding marginal vegetation including swamps, floodplains, watercourses and billabongs. They are also known to forage around estuaries and along intertidal shorelines. They prefer open wetlands with shallow still water. This species is recorded within the locality (OEH 2013; Redpath & Body 2003).	Possible.
Blue-billed Duck (*Oxyura australis*)		Vu	The Blue-billed Duck is a stiff-tailed diving duck that is endemic to south-eastern and south-western Australia. It prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. It is completely aquatic. This species has been recorded within the locality (OEH 2013).	Unlikely.
Brolga (*Grus rubicunda*)		Vu	Though Brolgas often feed in dry grassland or ploughed paddocks or even desert claypans, they are dependent on wetlands too, especially shallow swamps, where they will forage with their head entirely submerged. The Brolga was formerly found across Australia, except for the south-east corner, Tasmania and the south-western third of the country. It is still abundant in the northern tropics, but very sparse across the southern part of its range (OEH 2014).	Possible.
Comb-crested Jacana (*Irediparra gallinacea*)		Vu	This species inhabits permanent freshwater wetlands, either still or slow-flowing, with a good surface cover of floating vegetation, especially water-lilies, or fringing and aquatic vegetation (OEH 2014).	Possible.
Diamond Firetail (*Stagonopleura guttata*)		Vu	Diamond Firetails are found in grassy *Eucalypt* woodlands as well as open forest and grasslands, often in riparian areas. Feed exclusively on the ground. This species is known to occur within the locality (OEH 2013).	Unlikely
Eastern Grass Owl (*Tyto longimembris*)		Vu	Eastern Grass Owls are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains (OEH 2014).	Possible.
Eastern Osprey (*Pandion cristatus*)		Vu	The Eastern Osprey favours coastal areas, especially the mouths of rivers lagoons and lakes. They feed on fish over clear open water. This species is known to occur within the locality (OEH 2013).	Possible.

Common Name Scientific Name	EPBC Act Status	TSC Act Status	Species Distribution and Habitat	Likelihood of occurrence
Glossy Black-Cockatoo (*Calyptorhynchus lathami*)		Vu	The Glossy Black-Cockatoo inhabits open forest and woodlands on the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*A. torulosa*) or Drooping She-oak (*A. verticillata*) occur. They feed almost exclusively on the seeds on *Casuarina* and *Allocasuarina* species. This species is known to occur within the locality (OEH 2013).	Possible.
Greater Sand-plover (*Charadrius leschenaultii*)	CJK	Vu	The Greater Sand-plover is almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks (OEH 2014).	Unlikely.
Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)		Vu	The Grey-crowned Babbler inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains (OEH 2014).	Unlikely.
Little Eagle (*Hieraaetus morphnoides*)		Vu	The Little Eagle occupies open *Eucalypt* forest, woodland or open woodland. It nests in tall living trees within a remnant patch. This species is known to occur within the locality (OEH 2013).	Possible.
Little Lorikeet (*Glossopsitta pusilla*)		Vu	The Little Lorikeet forages mainly in the canopy of open *Eucalypt* forest and woodland on nectar and pollen. This species is known to occur within the locality (OEH 2013).	Unlikely.
Mangrove Honeyeater (*Lichenostomus fasciogularis*)		Vu	The primary habitat of the species is mangrove woodlands and shrublands but Mangrove Honeyeaters also range into adjacent forests, woodlands and shrublands, including casuarina and paperbark swamp forests and associations dominated by eucalypts or banksias (OEH 2014).	Possible.
Masked Owl (*Tyto novaehollandiae*)		Vu	Masked Owls live in dry *Eucalypt* forest and woodland often hunting along the edges of forests including roadsides. Diet consists of tree-dwelling and ground mammals, especially rats. This species is known to occur within the locality (OEH 2013).	Unlikely.
Powerful Owl (*Ninox strenua*)		Vu	The Powerful Owl inhabits a range of vegetation types from woodland to rainforest. It requires large tracts of vegetation. Preferred roost trees include Turpentine, Black She-Oak, Cherry Ballart and a number of *Eucalypt* species. They mainly prey on medium sized arboreal marsupials. This species is known to occur within the locality (OEH 2013).	Unlikely.

Common Name Scientific Name	EPBC Act Status	TSC Act Status	Species Distribution and Habitat	Likelihood of occurrence
Regent Honeyeater (*Anthochaera phrygia*)	En/Mi	CE	Patchy distribution, mainly confined to two main breeding areas in NSW (Capertee Valley and Bundarra-Barraba the locality) and surrounding fragmented woodlands. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-Oak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. This species is known to occur within the locality (OEH 2013).	Unlikely.
Rose-crowned Fruit-Dove (*Ptilinopus regina*)		Vu	Rose-crowned Fruit-doves occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. They feed entirely on fruit from vines, shrubs, large trees and palms, and are thought to be locally nomadic as they follow the ripening of fruits (OEH 2014).	Possible.
Sooty Owl (*Tyto tenebricosa*)		Vu	Sooty Owls occur in rainforest and temperate rainforest as well as moist *Eucalypt* forest. Require large tree hollows for roosting and nesting. This species is known to occur within the locality (OEH 2013).	Unlikely.
Square-tailed Kite (*Lophoictinia isura*)		Vu	The Square-tailed Kite is found in a variety of timbered habitats including dry woodlands and open forests. It prefers timbered watercourses. It is a specialist hunter of honeyeaters. This species is known to occur within the locality (OEH 2013).	Possible.
Varied Sittella (*Daphoenositta chrysoptera*)		Vu	Varied Sittellas inhabit *Eucalypt* forests and woodlands, especially with rough-barked species and smooth barked species with dead branches. This species is known to occur within the locality (OEH 2013).	Unlikely.
Wompoo Fruit-Dove (*Ptilinopus magnificus*)		Vu	This species occurs in or near rainforest. Most often seen in mature rainforest. This species is known to occur within the study area (OEH 2013).	Unlikely.
Mammals				
Brush-tailed Phascogale (*Phascogale tapoatafa*)		Vu	Brush-tailed Phascogales prefer dry sclerophyll open forest with sparse groundcover of herbs grasses shrubs or leaf litter. They also inhabit swamps, heath, rainforest and wet sclerophyll forest. This species is known to occur within the locality (OEH 2013).	Unlikely.
Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)		Vu	The Eastern Bentwing-bat roost primarily in caves, although they do use old mines, stormwater tunnels, buildings and other man-made structures. They hunt in forested areas, catching moths and other flying insects above tree tops. This species has been recorded within the locality (OEH 2013).	Possible.

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Eastern Freetail-bat (*Mormopterus norfolkensis*)		Vu	This species occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range (OEH 2014).	Likely.
Eastern Long-eared Bat (*Nyctophilus bifax*)		Vu	This species is known to occupy lowland subtropical rainforest and wet and swamp eucalypt forest, extending into adjacent moist eucalypt forest. Coastal rainforest and patches of coastal scrub are particularly favoured. They roost in tree hollows, hanging foliage of palms, dense clumps of foliage of rainforest trees under bark and in shallow depressions on trunks and branches, among epiphytes, in the roots of strangler figs, among dead fronds of tree ferns and less often in buildings (OEH 2014).	Possible for foraging.
Greater Broad-nosed Bat (*Scoteanax rueppellii*)		Vu	This species utilises a variety of habitats from woodland to rainforest, but most common in tall wet forest. It is found mainly on the New England Tablelands in NSW, but not above 500 m altitude. This species is known to occur within the locality (OEH 2013).	Possible for foraging.
Grey-headed Flying-fox (*Pteropus poliocephalus*)	Vu	Vu	This species is found within 200 km of the eastern coast of Australia. It occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps generally located within 20 km of a regular food source and are commonly found in gullies, close to water and in vegetation with a dense canopy. Travel up to 50 km to forage and feed on the nectar and pollen of *Eucalypt*us, Melaleuca and Banksia, and fruits of rainforest trees and vines (OEH 2014).	Possible.
Koala (*Phascolarctos cinereus*) (combined populations of Qld, NSW & the ACT)	Vu	Vu	Has a fragmented distribution throughout eastern Australia. Limited to areas of preferred feed trees in *Eucalypt* woodlands and forests. Home range varies depending on the quality of habitat, ranging from less than 2 ha to several hundred hectares in size. This species is known to occur within the locality (OEH 2013).	Unlikely.
Little Bentwing-bat (*Miniopterus schreibersii oceanensis*)		Vu	This species prefers moist *Eucalypt* forest, rainforest, vine thicket, wet and dry sclerophyll forest, *Melaleuca* swamp, dense coastal forest and banksia scrub. Generally found in well-timbered areas. This species is known to occur within the locality (OEH 2013).	Likely.
Southern Myotis (*Myotis macropus*)		Vu	This species generally roosts in groups of 10-15 close to water in caves, mine shafts, hollow bearing trees and buildings as well as in dense foliage. They forage over streams and pools. This species is known to occur within the locality (OEH 2013).	Likely.
Squirrel Glider (*Petaurus norfolcensis*)		Vu	This species inhabits Blackbutt-Bloodwood forest with heath understorey in coastal areas. It prefers a mix of canopy species with a shrub or acacia midstorey.	Unlikely.

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			This species is known to occur within the locality (OEH 2013).	
Yellow-bellied Glider (*Petaurus australis*)		Vu	Yellow-bellied Gliders occur in tall mature *Eucalypt* forest generally in areas with high rainfall and nutrient rich soil. Mixed coastal forests are one preferred habitat type. This species is known to occur within the locality (OEH 2013).	Unlikely.
Insects				
Pink Underwing Moth (*Phyllodes imperialis smithersi*)	En	En	The Southern Pink Underwing Moth is found in subtropical rainforest below about 600 m elevation. Potential breeding habitat is restricted to areas where the caterpillar's food plant, a native rainforest vine, *Carronia multisepalea*, occurs in subtropical rainforest (OEH 2014).	Unlikely.
Listed Migratory Marine Species *(excluding marine-dependent species eg albatross and whale)*				
Black-faced Monarch (*Monarcha melanopsis*)	Mi/Ma	-	The Black-faced Monarch is found in rainforests, *Eucalypt* woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	Possible.
Fork-tailed Swift (*Apus pacificus*)	Mi/Ma		The Fork-tailed Swift is almost exclusively aerial, flying from less then 1 m to at least 300 m above ground and probably much higher (OEH 2014).	Possible.
Rainbow Bee-eater (*Merops ornatus*)	Mi/Ma	-	The Rainbow Bee-eater occurs in mainly open forests and woodlands, shrublands and in various cleared and semi-cleared habitats, including farmland. It usually occurs in open cleared or lightly timbered areas, often close to permanent water. It is often associated with mangroves.	Possible.
Rufous Fantail (*Rhipidura rufifrons*)	Mi/Ma	-	The Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by *Eucalypt*s such as Tallowwood (*Eucalypt*us *microcorys*) and Blackbutt (*E. pilularis*) and other species, usually with a dense shrubby understorey often including ferns.	Possible.
Satin Flycatcher (*Myiagra cyanoleuca*)	Mi/Ma	-	Satin Flycatchers inhabit heavily vegetated gullies in *Eucalypt*-dominated forests and taller woodlands, and on migration occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. They often prefer to be near wetlands or watercourses.	Unlikely.

Common Name Scientific Name	EPBC Act Status	TSC Act Status	Species Distribution and Habitat	Likelihood of occurrence
Spectacled Monarch (*Monarcha trivirgatus*)	Mi/Ma/ MiW	-	The Spectacled Monarch prefers dense rainforest and moist *Eucalypt* forest, sometimes utilising mangroves and other densely vegetated habitats.	Unlikely.
White-bellied Sea-Eagle (*Haliaeetus leucogaster*)	Mi/Ma	-	The White-bellied Sea-Eagle is found in coastal habitats especially close to the sea shore and around terrestrial wetlands in tropical and temperate regions. Their habitat is characterised by large areas of open water as a food source.	Possible.
White-throated Needletail (*Hirundapus caudacutus*)	Mi/Ma	-	This species is almost exclusively aerial. Although they occur over most types of habitat, they are most often recorded above wooded areas including open forest and rainforest, less commonly above woodland.	Possible.
Listed Migratory Wetland Species				
Cattle Egret (*Ardea ibis*)	MiW/ Ma	-	The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. Commonly associated with the habitats of farm animals. Recorded in earthen dam walls and ploughed fields. Prefers high grasses (OEH 2014).	Possible.
Great Egret (*Ardea alba*)	MiW/ Ma	-	The Great Egret occurs in a wide range of wetland habitats, usually in shallow waters (OEH 2014).	Possible.
Latham's Snipe (*Gallinago hardwickii*)	MiW/ Ma	-	Latham's Snipe occurs in wetlands usually in open freshwater wetlands with low dense vegetation. It usually occurs in temperate and tropical regions (OEH 2014).	Unlikely.
Little Curlew (*Numenius minutus*)	MiW/ Ma	-	The Little Curlew congregates around pools, river beds and water-filled tidal channels, and shallow water at edges of billabongs when resting during the day. The species prefers pools with bare dry mud (including mudbanks in shallow water) and they do not use pools if they are totally dry, flooded or heavily vegetated (Higgins & Davies 1996).	Unlikely.
Painted Snipe (*Rostratula benghalensis (sensu lato)*)	MiW/ Ma En	-	The Painted Snipe generally inhabits shallow terrestrial freshwater wetlands, inundated or waterlogged grasslands (OEH 2014).	Unlikely.

Note: All species distribution and habitat information was adapted from the Department of Environment and Climate Change webpage - Threatened Species, Species Populations and Ecological Communities of NSW, URL: **http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/home_species.aspx**, and from the Commonwealth Department of Sustainability, Environment, Water, Population and Communities, unless referenced otherwise.

Key – Vu = Vulnerable, En = Endangered, CE = Critically Endangered, Mi = Migratory, Ma = Marine, MiW = Migratory Wetland.

Appendix C – Protected Matters Search Tool results

Australian Government

Department of the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 23/06/14 15:52:54

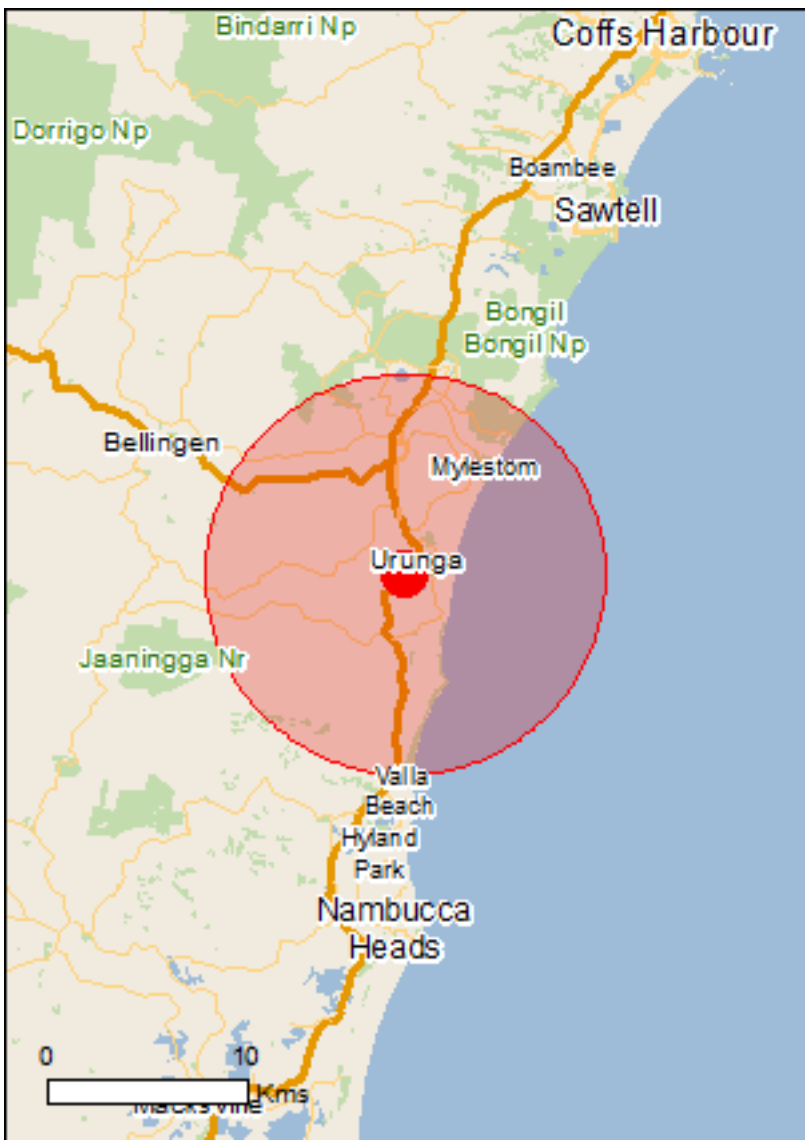
Summary

Details

- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat

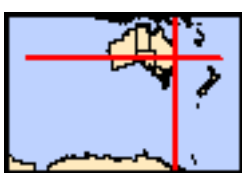
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	1
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	61
Listed Migratory Species:	49

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	63
Whales and Other Cetaceans:	14
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	3
State and Territory Reserves:	6
Regional Forest Agreements:	1
Invasive Species:	41
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Commonwealth Marine Areas [Resource Information]

Approval may be required for a proposed activity that is likely to have a significant impact on the environment in a Commonwealth Marine Area, when the action is outside the Commonwealth Marine Area, or the environment anywhere when the action is taken within the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name

EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to a Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name

Temperate East

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Critically Endangered	Community likely to occur within area
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia		
Regent Honeyeater [82338]	Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus		
Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Dasyornis brachypterus		
Eastern Bristlebird [533]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Diomedea epomophora epomophora Southern Royal Albatross [25996]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora sanfordi Northern Royal Albatross [82331]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans exulans Tristan Albatross [82337]	Endangered	Species or species habitat may occur within area
Diomedea exulans gibsoni Gibson's Albatross [82271]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Pterodroma leucoptera leucoptera Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma neglecta neglecta Kermadec Petrel (western) [64450]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta salvini Salvin's Albatross [82343]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Status	Type of Presence
Thalassarche eremita		
Chatham Albatross [64457]	Endangered	Species or species habitat may occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris impavida		
Campbell Albatross [82449]	Vulnerable	Species or species habitat may occur within area
Fish		
Epinephelus daemelii		
Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Frogs		
Litoria aurea		
Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat likely to occur within area
Litoria booroolongensis		
Booroolong Frog [1844]	Endangered	Species or species habitat may occur within area
Mixophyes balbus		
Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
Mixophyes iteratus		
Giant Barred Frog, Southern Barred Frog [1944]	Endangered	Species or species habitat likely to occur within area
Insects		
Phyllodes imperialis smithersi		
Pink Underwing Moth [86084]	Endangered	Species or species habitat likely to occur within area
Mammals		
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat may occur within area
Chalinolobus dwyeri		
Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Dasyurus maculatus maculatus (SE mainland population)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata		
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus		
Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
[Pseudomys novaehollandiae](#) New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
[Pteropus poliocephalus](#) Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
[Acronychia littoralis](#) Scented Acronychia [8582]	Endangered	Species or species habitat likely to occur within area
[Allocasuarina defungens](#) Dwarf Heath Casuarina [21924]	Endangered	Species or species habitat likely to occur within area
[Arthraxon hispidus](#) Hairy-joint Grass [9338]	Vulnerable	Species or species habitat may occur within area
[Cryptostylis hunteriana](#) Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat may occur within area
[Cynanchum elegans](#) White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area
[Hicksbeachia pinnatifolia](#) Monkey Nut, Bopple Nut, Red Bopple, Red Bopple Nut, Red Nut, Beef Nut, Red Apple Nut, Red Boppel Nut, Ivory Silky Oak [21189]	Vulnerable	Species or species habitat likely to occur within area
[Marsdenia longiloba](#) Clear Milkvine [2794]	Vulnerable	Species or species habitat likely to occur within area
[Parsonsia dorrigoensis](#) Milky Silkpod [64684]	Endangered	Species or species habitat likely to occur within area
[Phaius australis](#) Lesser Swamp-orchid [5872]	Endangered	Species or species habitat likely to occur within area
[Streblus pendulinus](#) Siah's Backbone, Sia's Backbone, Isaac Wood [21618]	Endangered	Species or species habitat likely to occur within area
[Thesium australe](#) Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
[Tylophora woollsii](#) [20503]	Endangered	Species or species habitat likely to occur within area
Reptiles		
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
[Eretmochelys imbricata](#) Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Name	Status	Type of Presence
[Natator depressus](#)		
Flatback Turtle [59257]	Vulnerable	Breeding likely to occur within area
Sharks		
[Carcharias taurus (east coast population)](#)		
Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Species or species habitat likely to occur within area
[Carcharodon carcharias](#)		
Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
[Pristis zijsron](#)		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat may occur within area
[Rhincodon typus](#)		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
[Apus pacificus](#)		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
[Calonectris leucomelas](#)		
Streaked Shearwater [1077]		Species or species habitat may occur within area
[Diomedea antipodensis](#)		
Antipodean Albatross [64458]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
[Diomedea dabbenena](#)		
Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
[Diomedea epomophora (sensu stricto)](#)		
Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
[Diomedea exulans (sensu lato)](#)		
Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Diomedea gibsoni](#)		
Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
[Diomedea sanfordi](#)		
Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
[Macronectes giganteus](#)		
Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
[Macronectes halli](#)		
Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
[Puffinus carneipes](#)		
Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
[Puffinus leucomelas](#)		
Streaked Shearwater [66541]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Breeding likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Foraging, feeding or related behaviour may occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species

Name	Threatened	Type of Presence
		habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Telecommunications Corporation

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Breeding likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Foraging, feeding or related behaviour may occur within area
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Fish		
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippichthys heptagonus Madura Pipefish, Reticulated Freshwater Pipefish [66229]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]		Species or species habitat may occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Solegnathus dunckeri Duncker's Pipehorse [66271]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paegnius Rough-snout Ghost Pipefish [68425]		Species or species habitat may occur within area
Solenostomus paradoxus Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding likely to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area
Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Wenonah Ornithological Area	NSW	Indicative Place
Bongil Bongil Area	NSW	Registered
Historic		
Bellingen River (North Arm) Valley	NSW	Indicative Place

State and Territory Reserves [Resource Information]

Name	State
Bongil Bongil	NSW
Jaaningga	NSW
Jagun	NSW
Nunguu Mirral	NSW
Unnamed FMZ2	NSW
Valla	NSW

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
North East NSW RFA	New South Wales

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Bufo marinus Cane Toad [1772]		Species or species habitat likely to occur within area
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Coordinates

-30.50515 153.00878

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix D – Aerial Photography Comparison



25 June 2004



15 August 2010



15 January 2013

GHD

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	T Chadwick	E Cornelius		I Gregson		25/6/14

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Appendix I Stakeholder Consultation

NSW EPA

Our reference: DOC12/25136
Contact: Matthew James, (02) 9995 5707
or John Coffey , (02) 9995 5621

Ms Deana Burn
Mining and Industry Projects
Department of Planning
GPO Box 39
Sydney NSW 2001

Dear Ms Burn

Re: Urunga Antimony Plant Remediation (SSD 5357)

I refer to your letter of 21st June 2012 requesting the Environmental Protection Authority (EPA) review the project application and provide our requirements for the preparation of the Environmental Impact Statement (EIS) for potential inclusion in the Department of Planning's Director General's Requirements (DGRs) for the proposed remediation of the above site.

The EPA considers that the key environmental issues that Crown Lands need to address in the Environmental Impact Statement (EIS) for the Urunga Remediation Project are:

- Contaminated Sites Assessment and Remediation
- Air quality (dust management)
- Noise impacts
- Waste (including soil treatment by immobilisation of contaminants in waste)
- Soil and Sediment (including the assessment and management of Acid Sulfate Soil)
- Water Quality (groundwater and surface water)
- Threatened Species (Flora and Fauna including SEPP 14 wetland)

Other issues which should be considered are:

- Cultural heritage (Aboriginal and non-Aboriginal)
- Occupational Health and Safety (including traffic management)

Further detail on these issues is detailed in attachment 1a and 1b.

Currently the site is regulated under the *Contaminated Land Management Act, 1997* and is subject to a Management Order (20111405) for the remediation of the site. Given the contamination present at the site (associated with the former minerals processing) and the proposed use of the site as public open space, the Management Order obligates Crown Lands to the following:

- The proponent will engage a suitably qualified, experienced and reputable environmental consultant to undertake a contaminated land assessment at the site, including further investigation of the contamination of soil, sediment and groundwater due to the use of part of the site as a mineral processing plant. The investigation must be conducted and reported in

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accordance with all relevant guidance, including the EPA publication titled *Guidelines for Consultants Reporting on Contaminated Sites*, September 2000.

- The proponent will prepare a remedial action plan (RAP) and submit the RAP to the EPA. Upon approval of the RAP by the EPA the proponent must implement the RAP. Following the remedial action the proponent will submit a validation report to the EPA for review.

We recommend that the DGRs are concurrent with the obligations of the Management Order.

Further, we have provided two documents:

- The **Key Environmental Issues,** Attachment 1a, provides a summary of potential environmental impacts. We recommend these issues be considered as potential DGRs.
- The **Environmental Impact Statement (EIS) requirements,** Attachment 1b, have been provided as additional guidance for the proponent for matters that the EIS should address.

Additionally, we recommend that a Construction Environmental Management Plan be provided to address the Key Environmental Issues. The plan must provide mitigation and management options describing measures to prevent, control, abate or minimise the identified environmental impacts of the project and to reduce and/or manage the risks to the environment and human health.

In our review of the Project Application we identified five major points which need clarification and/or revision by Soil Conservation on behalf of Crown Lands. Our review is provided in Attachment 2.

If you have any queries regarding the matters discussed in this letter please contact John Coffey on (02) 9995 5621 or Matthew James on (02) 9995 5707.

Yours sincerely

3/7/2012

NIALL JOHNSTON
Manager Contaminated Sites
Environment Protection Authority

Attachment 1a:

KEY ENVIRONMENTAL ISSUES

- **Contaminated Sites Assessment and Remediation**

Compliance with the existing Management Order (20111405) on the site under the Contaminated Land Management Act, 1997

- **Air Quality** (dust management)

Assess the risk of dust emissions and monitor dust levels during project works. Report on the measures to prevent dust emissions from the project site.

- **Noise impacts**

Identify the source, nature and scope of possible noise impacts and detail feasible and reasonable noise mitigation measures.

- **Waste**

Provide classification of all potential sources of liquid and non-liquid wastes that will be taken off site for disposal. Describe quantities, storage, treatment (including immobilisation of contaminants) and disposal or re-use of all waste generated.

- **Soil and Sediments**

Provide an assessment and details of the management of Acid Sulfate Soil. Detail the erosion and sediment controls during excavation, stockpiling, treatment and backfilling.

- **Water Quality** (groundwater and surface water)

Detail the existing background and pre-remediation water quality. Provide an impact assessment and details of monitoring over time.

- **Threatened Species (**Flora and Fauna including SEPP 14 wetland)

Detail the existing environment including discussion on flora and fauna characteristics. Provide a description of the measures proposed to mitigate and / or ameliorate the impact of the development on the flora and fauna species identified. As the project encroaches across a State Environmental Planning Policy No 14 (SEPP 14) Coastal Wetland, a specific assessment of the potential impacts on the wetland and the measures proposed to minimise those impacts must be presented.

Other Issues Summary

- **Cultural heritage** (Aboriginal and non-Aboriginal)

Assess the potential impacts of the remediation and operational phase of the project on sites and places of aboriginal and non-aboriginal cultural heritage, including areas of archaeological potential.

- **Occupational Health and Safety** (including traffic management)

Identify the risks associated with the remediation works and prepare an OH&S Plan which describes what mitigation and management measures are proposed to be used to eliminate, prevent, control, abate or minimize the identified OH&S risks. Include a Traffic Management Plan in the OH&S plan.

Impacts should be assessed in accordance with relevant guidelines.

Attachment 1b:

ENVIRONMENT IMPACT STATEMENT REQUIRMENTS

Contaminated Sites Assessment and Remediation

The EIS should:

1. Include an assessment of the contaminated site that is conducted in accordance with the guidelines made or approved under section 105 of the Contaminated Land Management Act 1997.
2. Provide the details on how the site contamination will be remediated and/or managed to the site is, or can be, made suitable for the proposed use.

All reports should be prepared in accordance with the Guidelines for Consultants Reporting on Contaminated Sites (2000).

Air Quality (dust management)

The EIS should assess and report on the risk of dust emissions during project construction / remediation works and the measures to prevent dust emissions from the project site, including how real time monitoring of local meteorological conditions might be used as:

1. An indicator of the risk of dust emissions from the project site; and

2. The trigger for implementing dust control measures, including the cessation of certain work during unfavourable meteorological conditions.

Noise impacts

The EIS should:

1. Identify the source, nature and scope of possible noise impacts.
2. Identify the project duration and normal operational hours.
3. Identify feasible and reasonable noise mitigation measures.

Waste

The EIS should include:

1. Details of the quantity and type of liquid and/or non-liquid waste(s) generated, handled, treated or disposed of at the site. Waste to be removed from the site must be classified according to the EPA's *Waste Classification Guidelines 2008*.

2. Details of liquid waste and non-liquid waste management at the site, including:
    a. The assessment, handling, treatment and transportation of waste generated at the site;
    b. Any stockpiling of wastes or recovered materials and procedures to prevent cross-contamination at the site;
    c. And waste processing related to the project, including reuse, recycling, reprocessing or treatment (including immobilisation) both on and off site;
    d. The method for disposing of all wastes or recovered materials generated by the project; and
    e. The proposed controls for managing the environmental impacts of these activities.

3. Details of procedures for the assessment, handling, storage, transport and disposal of all hazardous materials used, stored, processed or disposed of at the site, in addition to the requirements for liquid and non-liquid wastes.

4. Details of the type and quantity of any chemical substances to be used or stored and a describe arrangements for their safe use and storage.

Soil and Sediment (including the assessment and management of Acid Sulfate Soil)

The EIS should include:

1. Erosion and sediment controls during excavation, stockpiling, treatment and backfilling. Particular attention should be given to soil erosion and sediment transport – in accordance with *Managing urban stormwater: soils and construction*, vol. 1 (Landcom 2004) and vol. 2 (DECCW 2008)

Acid Sulfate Soil

If the proposed development (or part thereof) is located on land marked Class 1, 2, 3 or 4 on the relevant Acid Sulfate Soil Planning Map, or within 500 metres of adjacent Class 2, 3 or 4 land that is below 5 metres Australian Height Datum (AHD), The EIS should:

2. Assess the potential impacts of the development on acid sulfate soils in accordance with the relevant guidelines in the Acid Sulfate Soils Manual (Stone et al. 1998) and the Acid Sulfate Soils Laboratory Methods Guidelines (Ahern et al. 2004).
3. Describe mitigation and management options that will be used to prevent, control, abate or minimise potential impacts from the disturbance of acid sulfate soils associated with the project and to reduce risks to human health and prevent the degradation of the environment. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.

Water Quality (groundwater and surface water)

Background Conditions

The EIS should include:

1. Describe existing surface and groundwater quality prior to remediation works. An assessment needs to be undertaken for any water resource likely to be affected by the proposal.
2. Provide an outline of baseline surface and groundwater information, including, for example, depth to water table, flow direction and gradient, groundwater quality, reliance on groundwater by surrounding users and by the environment, tidal levels, flood levels, connectivity of local creeks, stormwater systems, wetlands and receiving waters.
3. State the Water Quality Objectives for the receiving waters relevant to the proposal. These refer to the community's agreed environmental values and human uses endorsed by the NSW Government as goals for ambient waters (http://www.environment.nsw.gov.au/ieo/index.htm). Where groundwater may be impacted the assessment should identify appropriate groundwater environmental values.
4. State the indicators and associated trigger values or criteria for the identified environmental values. This information should be sourced from the ANZECC (2000) Guidelines for Fresh and Marine Water Quality (http://www.daff.gov.au/oldmincos/publications/australian_and_new_zealand_guidelines_for_fresh_and_marine_water_quality).
5. State any locally specific objectives, criteria or targets which have been endorsed but the NSW Government.

Impact Assessment

6. Describe the nature and degree of impact that any proposed discharges will have on the receiving environment.
7. Assess impacts against the relevant ambient water quality outcomes. Demonstrating how the proposal will be designed and operated to:
    a. Protect the Water Quality Objectives for receiving waters where they are currently being achieved; and
    b. Contribute towards achievement of the Water Quality Objectives over time where they are not currently being achieved.
8. Assess impacts on groundwater and groundwater dependant ecosystems.
9. Describe how stormwater will be managed both during and after the project.
10. Provide an assessment of flooding frequency, levels and what impact a major flooding event may have on the site. Include details of contingency measures that will be adopted if a major flooding event occurs during and following the remediation works.

Monitoring

11. Describe how the predicted impacts will be monitored and assessed over time.

Threatened Species (Flora, Fauna and SEPP 14 wetlands)

Detail the existing environment including discussion on flora and fauna characteristics. Make use of previous investigations and complete further desktop evaluations. Provide a description of the measures proposed to mitigate and / or ameliorate the impact of the development on the flora and fauna species identified. As the project encroaches across a State Environmental Planning Policy No 14 (SEPP 14) Coastal Wetland, a specific assessment of the potential impacts on the wetland and the measures proposed to minimise those impacts must be presented.

OTHER ISSUES

Cultural heritage (Aboriginal and non-Aboriginal)

The EIS should:

1. Identify the nature and extent of impacts on cultural heritage values across the project area.
2. Describe the actions that will be taken to avoid or mitigate impacts or compensate to prevent unavoidable impacts of the project on cultural heritage values. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.
3. If items of Aboriginal cultural heritage are identified, clearly demonstrate and document that effective community consultation with Aboriginal communities has been undertaken in determining and assessing impacts, developing options and making final recommendations.

Occupational Health and Safety (including traffic management)

The EIS should:

1. Identify the risks associated with the remediation works such as; exposure to contaminated media and increase in heavy vehicles; to:
    a. Workers onsite;
    b. Off site residents;
    c. Local community members; and
    d. Pacific Highway users.

2. Prepare an Occupational Health and Safety Management Plan which describes what mitigation and management measures are proposed to be used to eliminate, prevent, control, abate or minimize the identified OH&S risks.
3. Include a Traffic Management Plan in the OH&S plan.

Attachment 2:

EPA Review of the Project Application

The EPA is generally satisfied with the Project Application (PA) document;

Urunga Antimony Processing Plant Contaminated Site – Project Application & Preliminary Environmental Assessment, prepared by Department of Primary Industries, Soil Conservation Service, June 2012.

We have 5 major points which need clarification and/or revision:

- **Section 2.1 Location and Land Titles** & **Section 4.5 Post Remediation Landuse**

  Figure 4 includes the north-west corner of the site as part of the remediation site. We note that this part of the site is not currently regulated as a declared area of significant contamination under the existing Management Order. The PA should note that this part of the site is not regulated and describe the area as potentially being utilised as part of the remediation process. The north-west corner of the site may be proposed as the location of a containment cell. This should be clearly presented in the PA so that the Planning Approval allows for utilisation of this area as part of the remediation of the site.

- **Section 4.6 Validation**

  The EPA will not be requiring a NSW EPA accredited Site Auditor to review the remediation works nor to provide a Site Audit Statement/Report for the site.

  The proponent will submit a Validation report to the EPA following the remediation works.

  Note: The EPA understands that the Post Remediation land use of the entire site, including the former residential areas in the north-west corner of the site will become Public Open Space.

- **Section 5.2 State Legislation, Protection of the Environment Operations Act 1997**

  It is our understanding that the remediation works will **not** require an Environment Protection Licence as the PA suggests. The PA quotes Clause 15 (2) (a) which refers to treatment of contaminated soil received from 'off site'. As the site will not be receiving or treating any soil from 'off site' this section of the Act is not applicable.

  With regard to Section (2) (b); contaminated soil originating exclusively from on site sources may potentially be treated however the treatment will **not** involve:
  - Incineration (i);
  - Treatment or storage of over 30,000m3 of contaminated soil (ii); or
  - Disturbing more than an aggregate area of 3 hectares of contaminated soil (iii).

- **Section 6.1 Environmental Factors**

  The PA mentions in section 3.3 'Contamination', that acid sulphate soil has the potential when disturbed and exposed to oxygen to generate acid. The acid could potentially exacerbate the mobilisation of metal contaminants from the tailings or contaminated soil.

  Thus, we request that Acid Sulfate Soil / Potential Acid Sulfate Soil (ASS/PASS) is addressed as an individual key environmental factor and removal from the Waste section. Mitigation strategies are to be employed to ensure that the ASS/PASS are handled and treated appropriately during excavation works.

- **Section 6.6 Air Quality & Section 6.11 OH&S**

  In Section 6.6 Air Quality, the **Risk** section part (ii) needs clarification and further information. Specifically what “inorganic toxic gases” are being referred to as a potential exposure risk upon “exposure to oxygen”?

  In Section 6.11 OH&S, the **Risk** section part (i) needs clarification and further information. Specifically what risk of infection is posed from tailings contaminated with heavy metals and what gases are being referred to.

  Note: the word “plume” refers to water and air bodies only. Hence, we would consider replacing ‘tailings plume’ with ‘tailings’ or ‘tailing material’ throughout the document.

Additionally, we have these **minor comments regarding the Application**.
Page 2: The report has not been signed by the report reviewer.
Page 13: Source Zone, paragraph 3: typographical error for mercury.

Transport
Roads & Maritime
Services

NTH12/00063, CR2012/006515
Your ref: SSD 5357

The Director
Mining & Infrastructure Projects
NSW Planning & Infrastructure
GPO Box 39
SYDNEY NSW 2001

Attn: Deana Burn

Dear Sir/Madam,

Urunga Antimony Plant Remediation (SSD 5357), Lot 1 DP 874874, Hillside Drive, Urunga

I refer to your letter of 21 June 2012 seeking comment on the abovementioned state significant development proposal.

The key concern for Roads and Maritime Services (RMS) is the safety and efficiency of the state classified road network, in particular the Pacific Highway (HW10), which connects with Hillside Drive.

RMS requests that the DGRs include the following issues to be addressed by any Environmental Impact Statement (EIS).

A detailed traffic study should be undertaken that takes into account the key issues relevant to the scale of this proposal as set out in Table 2.1 of the Roads and Traffic Authority's current 'Guide to Traffic Generating Developments" (copy attached). The traffic study should include information relating to:

- An assessment of the potential traffic impacts on the capacity, efficiency and safety of the state classified road network, particularly the impacts of heavy vehicles.
- The number and type of vehicle trips to be generated by the proposed development.
- Existing and proposed access conditions.
- Intersection sight distances of connections with the Pacific Highway including;
    - Safe Intersection Sight Distance (SISD),
    - Approach Sight Distance (ASD),
    - Truck Safe Sight Distance (TSSD).
- Improvements for roads, junctions / intersections.
- Proposed Haulage routes for removed materials
- Detail of servicing and parking arrangements
- Connectivity to existing developments
- Impact on Transport (Public and School Bus Routes)
- Provisions for pedestrians, alternative transport modes such as bicycles
- Road Traffic Noise

To ensure that haulage routes do not adversely impact on the safety of the road network adjoining these proposals, RMS recommends that the traffic study be supported by a Road Safety Audit, undertaken by a suitably qualified person.

Current AUSTROADS standards should be adopted for any necessary upgrading of the surrounding road infrastructure.

To fulfil legislative, construction and environmental requirements, RMS will require the developer to enter into a Works Authorisation Deed (WAD) to carry out any works on the Pacific Highway. Prior to any construction activities on a state road, a number of prescribed requirements and conditions will need to be undertaken, including the process for geometric and pavement design approval, project management arrangements, insurances, WHS and environmental management during construction, construction specifications and the process for approval of road occupancies. All works will need to be undertaken by an RMS approved Contractor and be at no cost to RMS. Additionally, RMS will require payment of costs for the administration of the WAD.

Should you have any further questions please contact Matt Adams of RMS Development Northern on (02) 6640 1300 or via email at: development.northern@rms.nsw.gov.au

Yours faithfully,

10 JUL 2012

for David Bell
Regional Manager, Northern

BELLINGEN SHIRE COUNCIL

33-39 Hyde Street, Bellingen NSW

All communications to be addressed to the General Manager
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EMAIL: council@bellingen.nsw.gov.au
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L10011
my
Anthony Brandie
Direct Line: (02) 66 557 326

3 July 2012

Deana Burn
NSW Planning and Infrastructure
GPO Box 39
SYDNEY NSW 2001

Dear Madam

URUNGA ANTIMONY PLANT REMEDIATION (SSD 5357)

I refer to your correspondence dated 21 June 2012 requesting Council's requirements for the preparation of the Environmental Impact Statement (EIS) for the referenced project. The Project Application and Preliminary Environmental Assessment documents prepared by Clayton Colmer of the Soil Conservation Service have been reviewed and Council hereby requests that the following matters be given consideration in the preparation of the EIS for the subject project;

- *Local traffic impacts and potential conflict with the existing vehicular access to the site being adjacent to the Pacific Highway.*
- *Potential conflicts with downstream users of the watercourse during the remediation phase ie. fishing and other recreational activities.*
- *Management of public perception and community expectations during the remediation phase (pollution management) and post remediation (future land use).*
- *The potential for remediation works to adversely impact on Aboriginal objects and/or Aboriginal places of heritage significance and the limitation to desktop investigations to identify this potential.*
- *Contemporary legislative provisions, noting that the preliminary report references repealed material.*

Thank you for the opportunity to comment on this project.

Should you have any further enquiries contact the undersigned between 8.30am –10.30 am. **NB:** The Division of Environmental Health and Planning Office hours are Monday to Friday 8.30am to 4.30pm.

Yours faithfully

Anthony Brandie
Environmental Health and Building Surveyor

From: Chris Ritchie
To: Deana Burn
Date: 7/5/2012 12:29 pm
Subject: Fwd: 6/22 Urunga Antimony Processing Plan - DGRs

>>> "Lawrence, Kerryn" <Kerryn.Lawrence@ncahs.health.nsw.gov.au> 7/5/2012 12:28 pm >>>
Hi Chris,

Please find below two recommendations from NSW Ministry of Health for inclusions in the DGRs for application 6/22, remediation of the contaminated site at the old Antimony processing plant in Urunga.

Thank you for this opportunity.

Regards,
Kerryn

1. A comprehensive Communication and Community Consultation Strategy should be undertaken in Stage 1 of the project. This should include but not be limited to the residents in the neighbourhood, the nearby Child Care Centre management and the parents of children attending the Centre, concerned citizens of the area and the Coffs Harbour Local Aboriginal Land Council.

2. An assessment of public health risk should be undertaken. This should include but not be limited to fugitive dust emmissions from the site and public access to the site.

Kerryn Lawrence
Senior Environmental Health Officer (Tue-Fri) |**Public Health**
PO Box 126 Port Macquarie NSW 2444
Tel. 02 6588 2792 | Fax. 02 6588 2837 | Mob. 0418 112 248 |
Kerryn.Lawrence@ncahs.health.nsw.gov.au
www.ncahs.nsw.gov.au/public-health

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NSW GOVERNMENT | Department of Primary Industries

OUT12/15878

16 JUL 2012

Ms Deana Burn
Mining & Industry Projects
NSW Department of Planning and Infrastructure
GPO Box 39
SYDNEY NSW 2001

Email: Deana.Burn@planning.nsw.gov.au

Dear Ms Burn

Re: Urunga antimony plant remediation (SSD 5357) - input into Director-General's requirements for the environmental assessment.

Reference is made to your letter to the NSW Office of Water, which is now an agency within the Department of Primary Industries (DPI), in respect to this matter.

The Office of Water advises that the environmental assessment should demonstrate consideration of the following points, and address the expanded list of assessment requirements detailed in Attachment A.

1. An adequate and secure water supply for the proposal.
2. Existing and proposed water licensing requirements in accordance with the *Water Act 1912* and the *Water Management Act 2000*.
3. All proposed groundwater works, including bores for the purpose of investigation, extraction, dewatering, incidental pit water, testing or monitoring must be identified in the proposal.
4. An assessment of impact of the remediation works on adjacent licensed water users, basic landholder rights or groundwater-dependent ecosystems (GDEs).
5. Requirements to intercept groundwater and predicted dewatering volumes, water quality and disposal/retention methods of contaminated water.
6. An assessment of the associated impacts on the local and regional groundwater system due to the proposed remediation works.
7. An assessment of the potential impact on groundwater and surface water due to the potential on-site disposal/ containment of contaminated material.
8. A detailed monitoring program and mitigation plan to address surface and groundwater impacts on and off-site.
9. Identification and assessment of any impacts on watercourses and drainage lines on site and adjacent to the site and the future management of these areas, in particular the adjacent SEPP 14 wetland, Station Creek and Urunga Lagoon.

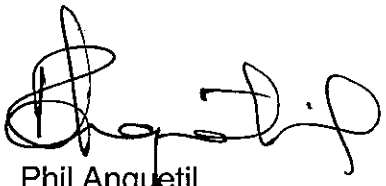
NSW Department of Primary Industries
Level 6, 201 Elizabeth Street, Sydney NSW 2000
PO Box K220, Haymarket NSW 1240
Tel: 02 8289 3999 Fax: 02 9286 3208 www.dpi.nsw.gov.au ABN: 72 189 919 072

10. An assessment of the occurrence of Acid Sulfate Soils on the site and the management of these soils during the remediation of the site, including the development of an Acid Sulfate Management Plan.

For further information please contact Christie Jackson, Planning and Assessment Coordinator (Tamworth office) on 6701 9652 or at: christie.jackson@water.nsw.gov.au.

Discussion with your office on 11 July 2012 advised that there was no other referral to DPI generally. A perusal of the application suggests that the matter may be of interest to Fisheries NSW, also an agency within DPI. An internal referral to Fisheries NSW has now been made. However, in the meantime it is suggested that direct consultation with Fisheries NSW by the proponent be a further requirement by the Director-General. For further information please contact Greg Paine, Senior Policy Officer (Planning), Business Services Department of Primary Industries on 8289 3951 or by email at: greg.paine@industry.nsw.gov.au.

Yours sincerely



Phil Anquetil
Executive Director Business Services

ATTACHMENT A

NSW Office of Water Environmental Assessment Requirements Urunga Antimony Plant Remediation (SSD 5357) [Our Ref: ER21925]

1. Legislation

The assessment is required to take into account the objects and water management principles of the *Water Management Act 2000* (WMA 2000) and statutory requirements of the *Water Act 1912*, as applicable.

2. Water Sharing Plans

Gazetted Water Sharing Plans (WSPs) prepared under the provisions of the WMA 2000 establish rules for access to, and the sharing of water between the environmental needs of the surface or groundwater source and water users. As such the assessment is required to demonstrate consistency with the rules of the WSP. The remediation site is located within the *Water Sharing Plan for the Bellinger River Area Unregulated and Alluvial Water Sources 2008.*

Refer to: *http://www.water.nsw.gov.au/Water-Management/Water-sharing/default.aspx*

3. State Government technical and policy documents

The assessment is required to take into account the following NSW Government policies, as applicable:

- *NSW Groundwater Policy Framework Document - General*
- *NSW Groundwater Quality Protection Policy*
- *NSW State Groundwater Dependent Ecosystem Policy*
- *NSW State Rivers and Estuaries Policy*
- *NSW Wetlands Policy*
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*
- *Australian and New Zealand Guidelines for Water Quality Monitoring and Reporting*
- *Guidelines for the Assessment and Management of Groundwater Contamination*
- *Guidelines for Groundwater Protection in Australia*

4. Controlled Activity Guidelines

The assessment is required to take into account the NSW Office of Water Guidelines for Controlled Activities, as applicable, for all activities to occur on *waterfront land,* as defined in the WMA 2000. Refer to:
http://www.water.nsw.gov.au/Water-Licensing/Approvals/Controlled-activities/default.aspx

5. Groundwater

a) Licensing

All proposed groundwater works, including bores for the purpose of investigation, extraction, dewatering, testing or monitoring must be identified in the proposal and an approval obtained from the NSW Office of Water prior to their installation.

b) Groundwater source

The assessment is required to identify groundwater issues and potential degradation to the groundwater source and provide the following:

- Details of any works likely to intercept, connect with or infiltrate the groundwater sources.
- Details of any proposed groundwater extraction, including purpose, location and construction details of all proposed bores and expected annual extraction volumes.

- Describe the flow directions and rates and the physical and chemical characteristics of the groundwater source.
- Details of the predicted impacts of any final landform on the groundwater regime.
- Details of the existing groundwater users within the area (including the environment) and include details of any potential impacts on these users.
- Assessment of the quality of the groundwater for the local groundwater catchment.
- Details of how the proposed development will not potentially diminish the current quality of groundwater, both in the short and long term.
- Details on preventing groundwater pollution.
- Details on protective measures for any groundwater dependent ecosystems (GDEs).
- Details of proposed methods of the disposal of waste water and approval from the relevant authority.
- Assessment of the need for an Acid Sulfate Management Plan (prepared in accordance with ASSMAC guidelines).
- Assessment of the potential for saline intrusion of the groundwater and measures to prevent such intrusion into the groundwater aquifer.
- Details of the results of any models or predictive tools used.

c) Groundwater dependent ecosystems (GDEs)

The assessment is required to identify any impacts on GDEs and address the following:

- Identification of potential GDEs within the development site and adjacent area.
- Current GDEs condition, water quantity and quality required by the ecosystems (minimum 2 year fortnightly baseline data).
- Flora and fauna assessment for all ecosystems which includes macro invertebrate and macrophyte diversity and abundance assessments within all watercourses within and adjacent to the development site.
- Determine critical thresholds for negligible impacts.
- Manage groundwater extraction within defined limits thereby providing flow sufficient to sustain ecological processes and maintain biodiversity.
- Ensure sufficient groundwater of suitable quality is available to ecosystems when needed.
- Ensure the precautionary principle is applied to protect GDEs, particularly the dynamics of flow and availability and the species reliant on these attributes.
- Details on protective measures to minimise any impacts on GDEs and any potential offset areas which will be monitored and protected.

d) Contingency measures

Where potential impacts are identified the assessment will need to identify limits to the level of impact and contingency measures that would remediate, reduce or manage potential impacts to the existing groundwater resource and any dependent groundwater environment or water users, including information on:

- Details of proposed monitoring programs, including water levels and quality data.
- Reporting procedures monitoring programs including mechanism for transfer of information to the Office of Water.
- An assessment of any groundwater source that may be sterilised as a consequence of the proposal.
- Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (this may entail water level triggers or a beneficial use category).
- Description of the remedial measures or contingency plans proposed.
- Any funding assurances covering the anticipated post development maintenance cost, for example on-going groundwater monitoring for the nominated period.

6. Surface water and riparian protection

The assessment is required to consider the impact of the proposal on watercourses and associated riparian vegetation within the site and provide the following (where applicable):

- Identify the sources of surface water.
- Details of stream order (using the Strahler System).
- Details of any proposed surface water extraction, including purpose, location of existing pumps, dams, diversions, cuttings and levees.
- Detailed description of any proposed development or diversion works including all construction, clearing, draining, excavation and filling.
- An evaluation of the proposed methods of excavation, construction and material placement.
- A detailed description of all potential environmental impacts of any proposed development in terms of vegetation, sediment movement, water quality and hydraulic regime.
- A description of the design features and measures to be incorporated into any proposed development to guard against long term actual and potential environmental disturbances, particularly in respect of maintaining the natural hydrological regime and sediment movement patterns and the identification of riparian buffers.
- Details of the impact on water quality and remedial measures proposed to address any possible adverse effects.

7. Rehabilitation, final landform and final void management

The assessment must include:

- Justification of the proposed final landform with regards to its impact on local and regional groundwater systems and surface water systems.
- A detailed description of how the site will be progressively rehabilitated and integrated into the surrounding landscape.
- Detailed modelling of potential groundwater volume, flow and quality impacts of the presence of an inundated final void on identified receptors, specifically considering those environmental systems likely to be groundwater dependent.
- A detailed description of the measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation.
- The measures that would be established for the long-term protection of local and regional aquifer and surface water systems and for the ongoing management of the site following the cessation of the project.

End Attachment A

*****

From: Matthew James [mailto:Matthew.James@epa.nsw.gov.au]
Sent: Tuesday, 10 June 2014 12:47 PM
To: Brian Cork
Cc: Ben Luffman; Arminda Ryan; Clayton Colmer
Subject: RE: Urunga antimony site remediation EIS

Hi Brian,

As discussed, the EPA Contaminated Sites section provides the following comments based on internal discussions with the EPA North Branch. We recommend that a qualitative approach to the assessment of likely impacts is appropriate, however a quantitative approach for monitoring of dust is required. Further:

- A noise assessment should be done in accordance with the *Interim Construction Noise Guidelines,* and adopt the 'Qualitative Assessment Method'. The CEMP should then detail a response plan to excessive noise levels and/or noise complaints.

- Dust management and controls on site will be critical as will ongoing air quality monitoring (dust) for the duration of the project. Please detail an appropriate plan which includes conservative criteria for dust levels based on the contaminants of concern identified previously.

Regards,

Matthew James
Senior Operations Officer | Contaminated Sites | **NSW Environment Protection Authority** |
☎: (02) 9995 5707 | 🖷: (02) 9995 5930|🖱:Matthew.James@epa.nsw.gov.au |P.O. Box A290 Sydney South NSW 1232 |

Brian Cork

From: Denique Littler (InTouch)
Sent: Friday, 13 June 2014 10:20 AM
To: Brian Cork
Subject: RE: Urunga antimony site remediation

Hi Brian, as discussed unless anything has changed significantly since Anthony's input I am not sure what value there would be in providing comment at this stage. If however there has been a significant change and you consider it beneficial for Council to again provide input please let me know and provide relevant documentation and I will allocated it accordingly noting that we are in the middle of a recruitment process to replace staff vacancies.

Thanks, Denique

Bellingen Shire COUNCIL

Denique Littler
Manager Land Use Services
Administrative Centre | Hyde Street | PO Box 117 | Bellingen NSW 2454
Ph: +61 2 6655 7335 | Fax +61 2 66552310

www.bellingen.nsw.gov.au

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From: Brian Cork [mailto:Brian.Cork@ghd.com]
Sent: Wednesday, 4 June 2014 10:02 AM
To: Denique Littler
Cc: Ben Luffman
Subject: Urunga antimony site remediation

Hi Denique,

I understand you are the new BSC contact for the Urunga antimony site remediation project. As part of the EIS for the project we have included feedback from Anthony Brandie (former BSC) but I thought I would give you the opportunity to provide any additional feedback on the project prior to finalisation of the draft EIS.

Would you mind giving me a call to discuss it when you get back? I am on leave from Friday 13 June so there is a small window where we overlap. If you could call in that window that would be great.

Regards

Brian Cork
Senior Environmental Engineer

GHD
T: +61 2 6650 5666 | V: 225666 | M: +61 43903 7488| E: brian.cork@ghd.com
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Trade & Investment, Regional Infrastructure & Services



DRAFT

Risk Identification & Assessment Workshop

Urunga Remediation Project

Risk Assessment Study

20th December 2011

Draft Report

Prepared by NSW Public Works

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Summary Report

Executive Summary

The remediation of the former Antimony processing plant in Urunga contains a number of risks associated with the site location, remediation area, quantity of contaminated material, planning pathway, and budget.

Scope creep is a significant risk, as the extent of remediation boundary is yet to be defined. A GAP analysis will assist in defining project scope and boundary.

The scope and complexity of the project planning phase, will be determined by the Director General Requirements, community interest and expectations. Department of Lands will need to develop a communication strategy to engage with adjoining residents and local community.

Risks associated with the current funding shortfall will require close management to target funds for the remediation of high risk areas. Department of Lands will need to liaise closely with regulatory authorities to confirm draft Director General Requirements (DGR's), and scope of works for budget estimating.

The contractor will determine remediation work methods for excavations, location of dust suppression equipment, sediment and erosion control, water treatment etc. A high level Remediation Action Plan completed by a consultant may not provide sufficient work method details to meet the DGR's, increasing risk for delays in planning approval.

The final remediation contract value will reflect the level of project risk and uncertainty. The contractor will need to design work methods that manage risks including a high watertable, dewatering, water treatment, acid sulphate soils, treatment of contaminated soil, site access restricted by the Pacific Highway. Generally lower tender prices are gained when sufficient details are provided to contractors to reduce uncertainty and risks .

Early Tenderer Involvement (ETI) has been successful in managing the contractors understanding of project risks and define the tender document prior to tender.

As the site contains building debris and rubbish, an early works site clean up would reduce risk associated with unidentified contaminates such as asbestos containing material.

The workshop did not identify any risks that cannot be managed or mitigated. The careful management of risks will be required to ensure funds are not exhausted in the early site investigation and planning phase.

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1. Introduction & Risk Study Context

The site is located on vacant undeveloped land adjacent to a SEPP 14 wetland, located on both private and crown land. The private land is currently being acquired by the government. Broken Hill Antimony Pty Ltd operated on the site between 1969 to 1974, the operations included processing stibnite ore for the removal of the mineral Antimony. The waste produced was discharged as a slurry into the wetland area.

EPA-Ordered Site Remediation triggered the site works being classified as State Significant Development planning assessment pathway which includes an Environmental Impact Assessment and community consultation.

Previous investigations undertaken by the Department of Lands have indicated that tailings and sediments containing significant levels of heavy metal and metalloid are present as an exposed surface layer across the processing site and adjoining Crown Land. The Environmental Protection Authority (EPA) has determined that the contamination is considered significant contamination under the Contaminated Land Management Act 1997, and consequently the site has been declared a remediation site due to the presence of metals (antimony, arsenic, copper, lead and mercury) in soil and sediments. The issues of concern were: the potential for human exposure through dusts; the degradation of groundwater and the nearby Station Creek, and; observed dieback of Melaleuca trees and other vegetation.

The current estimate of contaminated soil onsite is 15,000 tonnes, the remediation area is yet to be defined, and may extend into the Melaleuca tree wetland area. A significant area of the excavation will below the high tide mark, in an area known to have acid sulphate soils.

A site inspection followed by Risk Management Workshop was held on 20th December 2011 at the Urunga Golf Club, attended by Bellingen Council, NSW Health, NSW EPA, Department of Lands, and Public Works as representatives of the community.

NSW Public Works facilitated the workshop and this report summarises the findings of the workshop. The participants for the on-site inspection and the workshop are listed in **Appendix 1**.

2. Purpose

The purpose of the Risk Management Workshop was:

- To seek a range of perspectives on potential risks and possible risk mitigation strategies for the proposed remediation of the Urunga Processing Site.

- Document the results of the workshop, using the documentation as a planning and monitoring instrument for the documentation and construction phases of the remediation works.

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3. Key Outcomes

The key outcomes expected from the workshop were to:

- Identify significant risks related to Planning, State Significant Development and Director General's Requirements (DGR's)
- Discuss strategy to engage with the local community prior to planning exhibition.
- Define risks with project scope, Gap analysis, remediation boundaries;
- Adequacy of budget, including a contingency for risks;
- Risks associated with Remediation Action Plan and work methods.
- Identify the risks and suitable mitigation strategies for the construction phase.

As a result of the inspection and risk assessment workshop the participants were able to:-

- Confirm that the risks to the project are seen as manageable provided a competent project manager and contractor is engaged to ensure reliable performance; and
- Agree on a range of actions and risk management measures that enable Department of Lands to structure and procure the works, develop contract documentation, as well as provide a reliable budget.

These outcomes were reached through:-

- Sharing of specialist knowledge and understanding about the site, its current condition and hazard features and its remediation requirements;
- Considering the community and environmental significance in achieving prompt and safe successful remediation;
- Clarifying the issues that must be addressed in successful procurement and completion of the works;
- Appreciating the significance to Lands in complying with EPA order in a timely, effective and cost efficient manner; and

4. Key Risks

The Workshop identified a range of hazards/risks for the project. These risks are tabulated in Risk Register format and are included in Appendix 2. The Risk Register details the various risks and their categories, and the proposed risk mitigation measures.

The risks that have been identified can be broadly into the following categories: -

- Community perception/concerns of the proposal;
- Planning and Approval processes;
- Management of excavations below water, and acid sulphate soils;
- Remediation adjacent to sensitive wetland;
- Dusts;
- Management and disposal of contaminated sediments; and
- Project budget.

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4.1 Occupational Health & Safety Issues

These risks relate to the safety of both workers and the public associated with remediation works. The risk mitigation strategies would include (but not necessarily limited to) the following: -

- During the planning phase the onus will be on the Department of Lands to provide security to the site to prevent illegal entry to the site.
- Early contractor involvement will be sought to formulate the methodologies and processes for remediation with due consideration given to safety and environmental issues. These methodologies/processes will be incorporated in the tender documents to yield desirable outcomes.
- Specific requirements of EPA with respect to safety and environment will be included in the tender documents (dust suppression, stoppage of site activities during high wind conditions etc).
- Management of Dusts;

4.2 Community concerns/perception

This risk largely relates to the perception that the Community is affected by the contaminants on site (transported through air or other means) and its lack of understanding or the acceptance of the project.

An appropriate mitigation strategy is for Department of Lands to undertake consultation to inform the community of the project, for example media release, information sessions, news letters/letterbox drops/web site updates (e.g. FAQ) and meeting the residents directly adjacent to the site. The NSW State Property Authority website shows a similar example for the remediation of Nelson Parade Hunters Hill see;

http://www.lpma.nsw.gov.au/spa/our_business/current_projects

NSW Health are to provide Lands a list of residents that have previously contacted Health regarding site matters.

Water Tanks may also contains heavy metal contamination from past mining in the area.

Residents may be interested in final visual aesthetics of the site.

The DGR's may require a Human Health Risk Assessment including dust modelling to assess quantitative risk to residents, and fugitive dust monitoring during site works.

An interagency task force has previously been used to manage communications within government.

4.3 Planning and Approval Process

The complexity of the project planning phase will be determined by the Director Generals Requirements, community interest and community expectations. A high level Remediation Action Plan may not meet the specific requirements for a State Significant Environmental Assessment.

This risk largely relates to potential project delays arising from: -

- the required approval processes not being clear, and
- Remediation Action Plan not describing work methods for remediation, or sufficient details for Environmental Impact Statement.

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- A Remediation Action Plan completed by a consultant will not describe the work methods utilised by the successful contractor. The contractors work methods need to be outlined in the Remediation Action Plan. A high level RAP that does not include work methods may fail to provide sufficient information.
- RTA are likely to require significant conditions regarding access to the pacific highway. A detailed traffic management plan, and truck movements are likely requirements in DGR's.
- The appropriate mitigation strategy is to seek clarification and formal confirmation of planning requirements in Draft Director General Requirements via consultation with the Department of Planning. This will enable formulation of the approvals processes for the works.

The Department of Planning require fees (based on project value) for the assessment of the Environmental Impact Assessments.

4.4 Remediation and Management

The value of antimony metals on site should be assessed prior to defining a remediation option. The processing of ore and tailings on site may be included in the Planning Approval process. The extractive metallurgical processing of antimony may be classified as waste treatment and provide needed capital for remediation works.

The project budget may not be sufficient to remediate entire site, Lands may consider remediation of only high risk areas, with some un-remediated areas managed in the Site Management Plan.

An early works package to remove building waste would reduce the risk of asbestos or other unidentified materials onsite.

The extractive metallurgy option is largely driven by commercial requirements– the feasibility of such re-use will need to be assessed as part of the GAP analysis and early contractor involvement process. There are at least four options and a number of combinations for the disposal of the heavy metal tailings and sediments. They are: -

- Immobilisation and onsite encapsulation;
- Onsite processing treatment (soil washing) with partial disposal off-site and partial onsite encapsulation (Council Tip,);
- Immobilisation and onsite encapsulation;
- Capping Site, and
- On site treatment including immobilisation and off site disposal to Council Tip (Insitu Waste Classification).

After defining the project scope these options have to be investigated further to determine the most suitable option. The option will need to be cost effective and the most appropriate option for the following reasons:

- High water level and dewatering of the excavations will be very costly and certain heavy machinery may not be effective.
- Unknown geotechnical conditions required for construction of containment cell.
- Management of Acid Sulphate soils, and risks of discharge into wetland;
- Risks associated with the transportation on and offsite (instability of the soft sediments onsite and Pacific Highway access);
- The proposed construction of access pathway from the pacific highway to wetland area will require ground stabilisation works;

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- Council Tip will not accept restricted industrial waste.
- Burial of the waste onsite would require hydro-geological investigations to confirm the buried material will not contaminate ground water in the longer term;
- Design of onsite encapsulation including, geotechnical information prior to excavation;
- Water management including diversion of water from entering site, and treatment of water before discharge to wetlands.

4.5 Project Budget

The project budget clearly relates to the final scope of the remediation works. The additional investigations as outlined above (Gap analysis, Geotechnical, Planning/Approval process, hydrogeological investigation etc) would assist in defining the scope of works and also address any latent conditions on the site. Satisfactorily addressing these issues would greatly contribute to the development of the budget estimate.

Early involvement of the remediation contractor would assist in defining a reliable pre-tender estimate for the remediation works. Should the tender prices exceed the budget allocation there should be a mechanism in place for early submission to seek extra funding or a prioritized list of works developed so that the scope of works could be amended to suit the budget.

The project scope may need to be adjusted to meet the project budget, with only high risk contamination being remediated.

5. Conclusions

The workshop did not identify any risks that cannot be managed or mitigated. The scope and commencement of the work is depended on the availability of funds.

The current lack of funds will require the project scope to be carefully managed, and include close liaison with the EPA to agree on a targeted remediation scope that removes the high risk areas. After the GAP analysis and site investigations the scope of works will need to be refined to meet budget.

The planning requirements for State Significant Development require Director Generals Requirements and an Environmental Impact Statement. Preparing a high level Remediation Action Plan that does not outline the work methods may not provide sufficient details to meet the DGR's and delay gain planning approval.

The following actions may be initiated:

- Liaise with Planning regarding Draft Director General Comments
- Commission a suitably qualified and experienced consultant to undertake a "GAP Analysis" for additional investigations.
- Soil analysis to confirm feasibility of treatment of soil including removal of minerals, soil washing, and onsite immobilisation.
- Commencement of community consultation to make local residents aware of the project.
- Early Tenderer involvement process to assist with the formulation of methodologies and processes for remediation and preparation of a pre-tender estimate for the works.
- Once the scope of works is finalised. Prepare an Environmental Impact Statement based on approved remediation method.

DRAFT

DRAFT

Appendix 1. List of Participants

NSW Department of Industry & Investment

Mr Richard Chewings	Richard.Chewings@lands.nsw.gov.au
Mr Adrian Harte	Adrian.Harte@lands.nsw.gov.au
Mr David Howley	david.howley@scs.nsw.gov.au

NSW Health

Ms Kerryn Lawrence	Kerryn.Lawrence@ncahs.health.nsw.gov.au
Mr David Basso	david.basso@ncahs.health.nsw.gov.au

NSW Environment Protection Agency

John Coffey	John.coffey@environment.nsw.gov.au
Ernst Kemmerer	Ernst.Kemmerer@environment.nsw.gov.au

Bellingin Shire Council

Liz Jeremy	ljames@bellingen.nsw.gov.au

NSW Public Works

John Formosa	John.formosa@services.nsw.gov.au
Willie Li	Willie.li@services.nsw.gov.au

DRAFT

Appendix 2. Hazard Identification & Risk Assessment

Step 1 – Identify the Hazards

The site inspection commenced at 10:30 am and it covered Urunga Crown Land and private land area. Following the site visit the participants gathered at Urunga Golf Club for the Risk Management Workshop.

Then, working as a whole group they stated their potential hazards, which were recorded by the facilitator.

.

Step 2 – Assess the Risk

The NSW Public Works rated the consequences, using a qualitative framework (See overleaf) and the likelihood of its occurrence for this project. Again some further hazards emerged during this process.

Step 3 – Risk Ranking

Those with the higher risk rating (colour highlighted in the risk register) were then confirmed. The opportunity was taken to add further hazards as they came to mind.

Step 4 – Risk Management

Only the higher ranked risks were looked at as to how these should be managed – to either reduce the likelihood of its occurrence or to mitigate if not eliminate the consequences if it was to occur.

The outputs of this process are included in the following schedules.

DRAFT

NSW GOVERNMENT | Soil Conservation Service

Experienced people protecting your resources

14 May 2012

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URUNGA ANTIMONY CONTAMINATED SITE
INCEPTION MEETING MINUTES

Attendees: Regulator: NSW EPA (Sydney) - Matthew James
Specialist Consultant: GHD - Ben Luffman/Brian Cork/Ian Gregson
Local Authority: Bellingen Shire Council (BSC) - Anthony Brandy/Garry Hankinson
Land Owner: Crown Lands - Richard Chewings
Project Manager: Soil Conservation Service (SCS) - Clayton Colmer

Apologies: Regulator: NSW EPA (Sydney) - John Coffey
Project Manager: Soil Conservation Service - David Howley
Local Authority: Bellingen Shire Council - Liz Jeremy/Charlie Hannavy
Land Owner: Crown Lands - David McPherson

Time: 10:00 am Meet at Hillside Drive, Urunga. Walk the site from 10:45am. Left site at 12:45pm to return to GHD Office at 230 Harbour Drive, Coffs Harbour for lunch and to discuss meeting agenda items. Finished 3:30 pm.

Facilitator Clayton Colmer, Senior Environmental Officer, SCS
Mobile 0437 013 126

MINUTES

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1 Project Objectives

a. Achieve compliance with the EPA Management Order 20111405.
b. Outcome of remediation to be commensurate with possible future uses which may include passive recreation.
c. Council to consider appropriate zoning post remediation works.
d. Improve the visual amenity of the site, however inert elements will be retained for education purposes with interpretative signage (eg dead trees).

Note that the revised management order includes all of Lot 1 of Tickners property and hence nullifies the End of Remediation Declaration. Seek to have this declaration referenced in the Management Order and hence lessening the contaminated area. This will allow GHD to lessen the sampling area and focus on more meaningful areas.

Action: CROWN

2 Scope of Work

2.1 Project Brief:

The following broad tasks will be completed as part of Stage 1 of the project.

1. Desktop Investigation: Background data, Contaminants of Concern, data gaps, CSM, SAQP, Preliminary Report.
2. Detailed Investigation: Fieldwork sampling, broadscale rapid and detailed at boundary using pushcore, XRF and lab testing, update CSM, provide min, 2 viable remediation options. Consider ASS and resource recovery in options. Groundwater, sediment and surface water sampling requirements. Prepare Investigation Report.
3. Remedial Action Plan (RAP): Consider EPA recommendations, select preferred and prepare RAP, provide sufficient detail to allow remediation work to be procured.

2.2 Consultant Submission

The detailed methodology and strategy has been provided initially in the successful proposal and refined following discussions on-site and at the table.

- Essentially divides site into 3 zones: (i) Source Zone, (ii) Impact Zone and (iii) Receptor Zone.
    - *Source Zone* - Detailed investigation of tailings material but focus at the perimeter of tailings body rather than the central obvious area. Perimeter will involve sampling into the wetland from waterborne craft or waders. Investigations across main central tailings body to be limited to the minimum required to complete any gaps from the 1997 report and to better estimate the volume of source material (nominal +/- 10% accuracy).

      EPA would encourage re-sampling some of the DLWC 1997 locations which had very high metals concentrations in the tailings, to see whether these are isolated anomalies in the material (eg. a small particle of ore), or larger hot spot. GHD propose to accommodate this in the methodology by doing a few

replicates of samples (eg. by multiple XRF and possibly lab analysis of subsamples) where very high concentrations are found.
Groundwater monitoring in existing bores not critical for certain remediation options but may be useful for In-situ Containment option.

- *Impact Zone*.- Detailed investigation of sediments beyond the tailings derived source zone. Essentially sediment sampling from benthic layer of wetland, prioritising the 'L shaped' trench and if required, beyond into the wetland further. Where contaminant thresholds in the Impact Zone (including the 'L shaped' trench) exceed thresholds, additional studies may be required to determine if this material is to remain or be removed. This includes ecotoxicology tests (test impact on simple aquatic organisms) and geochemical testing (measure changes to the chemistry of the sediment with disturbance/exposure). The need for these additional studies would be deferred until results of sediment sampling have been assessed. These detailed studies will enable a decision to be made on whether to remove and treat this material, or manage the site to lessen human risk (eg no fishing, but boating OK).

- *Receptor Zone* - No detailed investigation of the receptor zone is commissioned at this stage, however EPA has requested to undertake surface water quality sampling for background data purposes.

2.3 Sampling Methodology

- Develop a relationship between the XRF and lab testing to allow extrapolation of quick XRF analysis and avoid large number of lab tests but still covering a large area of the site.
- GHD recommend drawing in specialist remediation company Entec, to conduct specific trials on various grades of tailings from the site to determine best formula for stabilisation. Best to engage Entec during preparation of the RAP once it has been determined that on-site treatment is preferred option (ie once off-site reprocessing is ruled out). The decision to bring in Entech would be made once it is clear that reprocessing is not an option. If so, then GHD recommend engaing Entech to conduct trials as part of Milestone 2.
- Initial proposal is 80 sampling locations, collect 320 samples using 4WD mounted rig or hand push tubes. The number of sampling locations will be refined during preparation of the SAQP, based on the inspection and discussions. The type and quantity of sampling (surface water, sediment, groundwater) will be quantified on completion of the SAQP. GHD will shift samples from the tailings area where possible to minimise costs.
- Push tubes to be used in soft tailings and underlying sediments, jaret auger for compacted firm soils. SCS to assist in arranging access through or to vegetated areas;
- Undertake field XRF, and laboratory testing (Al, As, S, Hg, Pb, CN, Metals, TCLP, pH, ASS(field), ASS (lab-SPOCAS);
- No sampling of bricks on-site which were suggested as being manufactured on-site but appear to be proprietry products. Since the Inception Meeting, documents show

that Tickner had brick making machinery and intended to process material from site into bricks. Need to determine whether this material is written off as contaminated and include in bulk disposal option or run tests on brick fragments for leachable metals and if clear dispose as lesser waste. Seek EPA advice.

Action: EPA

- Not discussed during meeting but there is no allowance for testing of other potential contaminants such as asbestos or petroleum based products. This may be appropriate as they are relatively minor compared to the greater contamination risk of the tailings plume. They will also be incorporated into the larger remediation option of containment (be in on-site or off-site) regardless of their character. Seek comment from other stakeholders.

Action: ALL:CROWN/GHD/EPA/BSC

3 Remediation

3.1 Remediation Options

The preferred general remediation options are in order of preference/priority:

1. Off-site Reprocessing: Removal of source material, long haul transport, and off-site reprocessing at an appropriate ore processing facility;
2. Off-site Disposal: Removal of source material, treatment on-site, long haul transport, and disposal to a licensed facility with possible containment cell;
3. On-site Disposal: Removal of source material, treatment on-site, short haul transport for disposal to a containment cell on-site;
4. In-situ Containment: Leave source material in place, and construct containment system in-situ.

The remediation options are to be selected based on the budgeted remediation cost (~$1M) and reducing the environmental risk to an acceptable level by EPA.

Options 1,2 & 3 will leave a void requiring suitable Virgin Excavated Natural Material (VENM) to backfill and shape. With the Urunga bypass commencing early in 2013, there may be an opportunity to be supplied with such material free of charge. Preference would be for non-ASS swamp clays capped with clay loam which may be deemed ‘unsuitable’ by engineers for Pac Hwy construction.

Option 1 requires liaison with local mining facilities such as Hillgrove. Reprocessing will be based on mineralogy of the tailings/ore and the total quantities. GHD has a relationship established with Emu Resources and an office near their headquarters in Perth. GHD will make initial contact with Emu Resources and brief investigation of other possibilities for reprocessing. GHD requests that SCS assist with ongoing negotiations with such companies if required.

Action: GHD then SCS

Option 2 requires consideration by regional or local landfill facilities. Coffs Harbour is the closest regional facility which can accept certain classifications of contaminated waste. Bellingen Shire Council has a facility at Raleigh which is in a sunset state which may provide an opportunity or a hindrance to possible disposal. The Raleigh site is also subject

to environmental constraints which is presumably why it is being progressed towards shut down.

EPA regional office in Grafton has Landfill specialist. SCS has relationship with officer and will contact.

Action: SCS

Any disposal at a licensed facility will attract a landfill levy and will represent an uneconomic cost to the remediation (stage 2) works. Hence an application for exemption should be investigated on the basis of 'Public Interest'.

Action: EPA

Option 3 will require preliminary investigation of the upper portion of the Tickner land to assess suitability for a containment cell. It needs to make allowance for climate change predictions on sea level rise in regards to positioning. Detailed investigations (eg. geotech, groundwater) would be deferred until it is apparent whether this option of on-site containment is preferred.

Action: GHD

Serious consideration of Option 4 is likely to require a detailed hydrogeological investigation to determine the groundwater flux and connectivity with the lagoon and surface waters. This study could be avoided if certain assumptions are made (eg underlying grey clays are impermeable, groundwater is highly connected to wetland surface levels). If in-situ containment looks like being a preferred option, the detailed hydrogeological investigations would be required to verify these assumptions as valid. The decision to undertake further groundwater investigations would be deferred until Milestone 2.

Option 4 may also be able to take advantage of the Pac Hwy upgrade and import of suitable clay capping material.

3.2 General Remediation Considerations

Regardless of the selected option, the RAP and remediation needs to allow for the removal of the solid waste material scattered around the site presumably by a licensed contractor.

GHD recommend that all relevant stakeholders should be involved in agreeing on preferred remediation options at completion of Milestone 2, prior to preparation of the RAP.

4 Program

Timeframe for delivery of Milestones and opportunities for creating more space to delivery better quality outcome.

Milestone 1 - CSM & SAQP	17th May 2012 extended to 24th May 2012
Milestone 2 – Investigation Report	14 August 2012 need review.
Milestone 3 – Submit RAP	10th December 2012

Need to request EPA to extend the Milestone 2 deadliine.

Action: CROWN

5 Existing Data

Need to find the survey data for the sampling points in the 1997 DLWC report.SCS to review file or speak with authors.

Action: SCS

NSW Health has conducted WQ testing in Urunga Lagoon which is to be provided by EPA. Note that this information/reference is from the Urunga Lagoon area, remote from the site, and would not be directly incorporated in GHD's assessment under the current scope.

Action: EPA

Andrew Mitchell has conducted XRF sampling. Data to be provided to GHD.

Action: EPA

A university of NSW PhD student monitored water quality below the Urunga STP in the lagoon. May be useful. BSC to investigate.

Action: BSC

An EIS was prepared and submitted to BSC for Wild Cattle Creek antimony mine which may have some useful data relating to the source material and history of both sites.

Action: BSC

Old B&W Ortho photos held by BSC.

Action: BSC

GHD has already received the ended a remediation declaration for a parcel of land in Lot 1, DP 874874 (north east corner).

NSW State Government - SCS currently sourcing govt spatial data on the site:

- LiDAR 1m DEM
- ADS40 50 cm res aerial photo
- Flood photo (10cm – 20 cm res)
- Spot 5 spectral
- All historic aerial and flood photo's

Local consultants Coffey Geotechnics have undertaken studies in the area previously to clear a site of contamination for a proposed development project. Report is in the public domain.

Straits Hillgrove has conducted investigations previously with a view to reprocess the tailings. Matt O'Neil (caretaker) has a copy which is to be sought during interview and site visit week commencing 14 May 2012.

Action: SCS

Individuals with knowledge of the site to be interviewed by GHD and arranged by SCS so far are:

1. Colin George (worked at the site as a young fella)
2. Matthew O'Neil (caretaker for Tickner property in recent times)

Action: GHD/SCS

The SEPP 14 Wetland boundary needs to be defined. BSC can provide the plan although it may also exist on the NSW Lands tool SIX viewer.

Action: BSC

6 Planning & Approvals

The SCS is currently preparing the PEA and Project Application to NSW Planning. NSW Planning to issue DGR's which will include requirement for an EIS.

Will need approvals to conduct work in a SEPP 14 wetland. Needs to be investigated.

Action: SCS

Drilling holes into groundwater for the investigation is deemed to not require approval as it is in response to an EPA Order.

Changing access to the Tickner property requires council road opening permit. Need ASAP to enable regular unimpeded access.

Action: BSC

7 OH&S & Access

Risks related to accessing the site, drilling for sampling, machinery entering and exiting, etc. eg gas release, dust, contaminants on soil, etc.

The investigation works needs to be supported with a Safe Work Method Statement (SWMS) which addresses the safety risks and documents required controls to mitigate risk to an acceptable level. Eg carrying contaminated soil off-site ----washdown procedures on-site, contact with contaminated material – use of protective clothing. The SWMS needs to be approved by NSW Crown Lands who are effectively engaging the consultant.

The tenants are being evicted to allow 'vacant possession' of the site as part of the land transfer. This is reducing their co-operation in accessing the site. They have validly expressed concerned about use of machinery and request that all machinery that contacts the tailings be washed before passing through the house yard. The tenants have also stated that due to the inconvenience of locking up their dog, they can no longer cooperate before 1:00pm weekdays to assist with access through their yard.

Hence it is decided to install a second two leaf gate lower down Hillside Drive, away from the junction with the Pac Hwy. It is recommended to get the tenant to provide a quote to make the gate and install it. A small track will then need to be slashed from the gate to the old mill site.

Action: SCS

Access from the road to the gate may be provided by BSC but isn't required at this stage for the small number of 4WD required to enter the site.

Action: BSC

8 Contract

The SCS will be engaging GHD through their IMS system and hence be contractually bound to SCS. SCS will finalise the contract ASAP for execution.

Action: SCS

The contract needs to include milestone payments once provided by GHD.

Action: GHD

Investigation of the impact zone to fine the most appropriate 'boundary' requires a variation to the conforming tender. Seek approval from Crown Lands.

Action: SCS

EPA's requirement to take snap shot of surface waters requires a variation to the conforming tender.

Action: SCS

Sampling of groundwater bores requires a variation to the conforming tender. Seek approval from Crown Lands.

Action: SCS

9 Public Relations/Community Management

Crown Lands have a draft community relations plan for the project which needs to be finalised. The plan should include media releases to demonstrate to the public the positive benefits of the project and hence lessen any negative public action.

A steering committee consisting of EPA, SCS, Crown Lands and BSC has been suggested to deal with Community Management and media interaction/releases. NSW Health may also be an important organisation for public relations issues. The steering committee is to conference in every 4 weeks or so. Facilitated by Crown Lands preferably or SCS.

Action: CROWN or SCS

Bellingen Shire Council is the usual target for enquiries or complaints and hence Anthony Brandy has volunteered to be the single point of contact to accept public calls and provide direction in accordance with steering committee outcomes.

GHD will refer any enquiries that may be encountered during investigation works, to Anthony Brandy.

It may be useful to provide a media release prior to drilling activities (4 weeks) informing the public that a reputable and local environmental consultant has been engaged to undertake a detailed investigation and to prepare a practical and effective remediation plan, etc.

END OF MINUTES

NSW GOVERNMENT Soil Conservation Service

Experienced people protecting your resources

23 November 2012

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Re: Urunga Antimony Processing Site
Agenda (Draft)

Hey guys,

Rough format for next Tuesday is as follows:

Location: Urunga Golf Club (Morgo Street)

5:30pm
I'll be there from 5:30pm to setup and chat with other attendees. There is a chinese restaurant there which may be convenient.

I'll have a projector for my presentation. I am thinking we'll arrange the chairs at the front so official staff can address the public at question time.

6:30pm
Liz Jeremy (Bello Council) can welcome/thank the community to the public meeting and introduce either myself or all the stakeholders. We'll need name tags.

Attendance

Name	Organisation	Title	S
Symone Williams	Bellingen Shire Council	Personal Assistant	A
Anthony Brandie	Bellingen Shire Council	Planning Officer	A
Richard Chewings	Crown Lands	Landowner & Funding Body	A
John Coffey	EPA	Contamin. Sites Manager	A
Matthew James	EPA	Regional Operations Officer	A
Catherine Karpiel	Mineral Resources	Derelict Mines Coordinator	A
Clayton Colmer	Soil Conservation Service	Project Manager	A
Lorraine Gordon	Urunga Chamber of Commerce	Representative	A
Lawrence Orel	EPA		A
Lawrence, Kerryn	Public Health	Sen. Env. Health Officer	A
Liz Jeremy	Bellingen Shire Council	BSC General Manager	T
Ben Luffman	GHD Pty Ltd	Contamination Specialist	T
Brian Cork	GHD Pty Ltd	Contamination Specialist	T
Corben, Paul	Public Health		T
David McPherson	Crown Lands	Regional Manager	D
Marcus Riches	NSW Fisheries	Habitat Officer	D
David Howley	Soil Conservation Service	SCS General Manager	D
Colin Matthews	Bellingen Landcare	Manager	D

S= Status, A=Accepted, T = Tentative, D = Declined

We need someone to walk around and handout a proforma for input. I am also thinking of providing 1 double sided handout with the contamination summary map and executive summary on back.

6:40pm
I'll run through the presentation which should be about 30 mins and may put them to sleep...still finalising the slides but it is looking like containing the following points:

- Introduction
  - Project Team
  - Location
  - Land Ownership
- Community
  - Media
  - Public Inclusion
- Site History
  - Source Ore
  - Processing
  - Antimony
  - Abandonment
  - Site Aerials
- Health
  - Contaminants of Concern
  - Health risks
- Previous Investigations
  - Summary of Scope/Results
- Current Investigation
  - Sampling Locations
  - Methodology
  - Laboratory Testing
  - XRF
- Investigation Results
  - Tailings Deposit
  - Sediment Deposits
  - Surface Water (Wetland)
  - Groundwater
  - Unknown areas
- Contamination
  - Summary of Assessment
- Remediation
  - Budget
  - Broad (4) Options
  - Remediation Issues/Risks
  - Environmental Impact Assessment
- Community Input
  - Questions
  - Feedback Form including:
    - Any Anecdotal/Scientific Information
    - Remediation Preference
    - Specific Issues

7:10 pm
Take questions from community. We'll need someone to take notes.

Likely questions from discussions with locals and Urunga Chamber of commerce:

1. Is it safe to swim in Urunga Lagoon?
2. Is it safe to eat seafood caught in Urunga Lagoon?
3. Is it safe to dredge or reconstruct the sea-lido at mouth of Urunga Lagoon?
4. Are children at risk who are known to have played in the site?
5. Are children/adults at risk who currently neighbour the property or live in Hillside Drive?
6. Will the remediation itself cause new human health/environmental risks?
7. How do we know the thresholds are safe?
8. Is the investigation comprehensive enough to identify the true extent of contamination?
9. Feedback suggests the community don't want any on-site disposal options (even if moved up hill) adopted.
10. May be general concern regarding the impact of flooding and sea level rise at the site.
11. How much will it cost?
12. Is there enough funding to cover the cost?

We may need to discuss these questions before hand to get consensus, or perhaps put together an answer 'cheat sheet' as our investigation has addressed a lot of the above.

7:50 pm
Direct community to the handouts to be filled in and posted or emailed to a project specific temporary email address: antimony@scs.nsw.gov.au

8:00 pm
Meeting closed (hopefully).

Urunga Contamination - Community Meeting

The second Community meeting date has been set in regards to the Antimony Processing Plant contamination remediation. It is at:

Location: Urunga Golf Club (Morgo Street)
Date: Thursday 29th May 2014
Time: 6.00pm – 7:30pm

An advert in the local papers will go out next week to invite the larger community.

This second community meeting aims to inform the Urunga residents of the recommended option and to invite comment/input regarding any possible concerns or local requirements.

The meeting is again being facilitated by Bellingen Shire Council and presented by the Soil Conservation Service (myself). I will do a 30 min presentation covering:

* Background
* Recommended Option
* Remediation Methodology (broad terms)
* Environmental Mitigation Measures (broad terms)
* Community Input

Do not hesitate to call myself or Richard Chewings (Crown Lands) to discuss.

Regards,

CLAYTON COLMER| Senior Environmental Officer
SOIL CONSERVATION

SERVICE
Suite 5 Level 1 City Square 76 Harbour Drive | PO Box 530 |

Coffs Harbour NSW 2450
M: 0437 013 126 | F: 02 6650 3143 | E: clayton.colmer@scs.nsw.gov.au
W: www.scs.nsw.gov.au

When Thu 29 May 2014 18:00 – 19:30 Eastern Time - Melbourne, Sydney

Where Urunga Golf Club (map)

Who
- Clayton Colmer - creator
- 'lorraine@moffatfalls.com.au'
- Matthew James
- David Howley
- John Coffey
- belland
- Ben Luffman
- 'catherine.karpiel@industry.nsw.gov.au'
- 'Brian Cork'
- 'marcus.riches@dpi.nsw.gov.au'
- 'Liz Jeremy'
- 'Symone Williams'
- 'Lawrence, Kerryn'
- Richard Chewings
- Nick Stahayeff
- mayor@bellingen.nsw.gov.au
- property@coffsharbourlalc.com.au
- Peter Menzies
- gfarrell@bellingen.nsw.gov.au
- 'Lawrence Orel' - optional

NSW GOVERNMENT | Department of Primary Industries

Media Release

19 June 2012

Clean up process begins on Contaminated Urunga Site

The NSW Government has begun planning the remediation work on the Urunga antimony contaminated site on the mid-north coast of NSW.

General Manager of Crown Lands, Graham Harding, said the site, adjacent to the Pacific Highway 1.5km from the centre of Urunga, was significantly contaminated by historical activities including antimony ore crushing and processing.

“While the processing activities occurred on private land many years ago, the waste material spread over time and has impacted on an adjoining wetland, which is Crown land,” Mr Harding said.

“Detailed investigations into the extent and nature of contamination were undertaken by the then Department of Land and Water Conservation.

“These investigations showed the estimated 9000m^3 of tailings, which cover over a hectare of the site, contained high levels of contaminants including antimony, arsenic, copper, lead, zinc, chromium and mercury,” he said.

Mr Harding said officers from the Soil Conservation Service have been engaged to manage Stage 1 of the project, which is developing the remediation action plan.

They will be on site over the coming weeks carrying out investigation work.

In 2011, the Environment Protection Authority (EPA) sought to place a remediation order upon the private owner of the site, which resulted in an agreement to transfer the ownership of the land to the State to enable remediation to occur.

The Department of Primary Industries Catchments and Lands Division is responsible for the remediation, in collaboration with the EPA, Bellingen Shire Council and other government agencies, and will identify the most cost effective and efficient remediation program for the site.

A process is also being developed to assist in keeping the community informed of the progress of the project.

The Environmental Trust and the NSW Trade and Investment Derelict Mines Program have each given conditional agreement to fund up to $700,000 towards the remediation project, with investigation and planning activities now underway and on-site remediation works are expected to start in 2013.

Media contact: **Craig Vaughan 9527 8597 or 0488 196 594**

twitter Follow us: http://twitter.com/#!/nswdpi

NSW GOVERNMENT Soil Conservation Service

Experienced people protecting your resources

21 May 2014

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To the Resident,

Re: Antimony Processing Plant – Remediation
Hillside Drive Residents Information Leaflet

The Soil Conservation Service (SCS) on behalf of NSW Trade & Investment (Crown Lands) is project managing the remediation of the disused Antimony Processing Plant at the top of Hillside Drive.

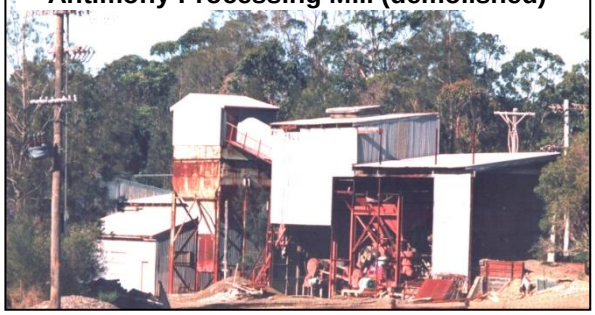
This leaflet is intended to provide a summary of the project to date and to invite all residents from the western end of Hillside Drive to a public meeting to be held:

Venue: Urunga Gold Club
Date: Thursday 29th May 2014
Time: 6:00pm – 7:30pm

Site History

Antimony ore (stibnite) was mined from Wild Cattle Creek, Dorrigo (1969-1974), and around 10,500 tonnes was transported to the Hillside Drive address for processing. In late 1970, a private developer purchased the land and made application to recommence operations but was refused by Bellingen Shire Council. Later the applicant intended to redevelop the property for residential uses but was thwarted by the increasing awareness of the contamination.

Antimony Processing Mill (demolished)



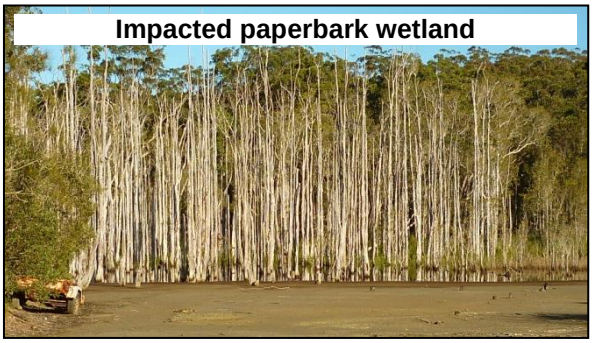
Contamination

The source of the contamination was through the crushing of the antimony ore which contains not only antimony, but impurities such as arsenic (as arsenopyrite) and mercury (as cinnabar). The crushings were destabilised using Soda ash to make the metals leachable (soluble) which allowed extraction. Once the target metals were removed, the waste tailings were then pumped to the adjoining SEPP14 wetland, and subject to periodic flooding, run-on and groundwater flushing. It is this combination of factors that has lead to the widespread contamination of the wetland over the last 40 years.

Investigations

A series of investigations were conducted by government departments, mainly during the 1990's however funding for remediation at that time was not forthcoming. In 2011, the EPA placed a Remediation Management Order (No. 20111405) across the site, forcing the landowner to handover to the Crown. Funding was secured through the Environmental Trust and the DPI Derelict Mines Committee each contributing $700,000 ($1.4M total) for the remediation.

This funding enabled a detailed investigation of the site to be completed by GHD Pty Ltd (2012) and more recently, preparation of a Remediation Action Plan (RAP) which sets out the remediation strategy and preferred option. The results of the investigation are shown graphically as Appendix A (attached).


Impacted paperbark wetland

Remediation Options
The RAP identified four major strategies to isolate the contamination from the sensitive wetland:

Option 1 Off-site reprocessing and disposal
Involves removal of contaminated material, long haul transport off-site for reprocessing, or disposal at a mining (Hillgrove) or hazardous waste management facility (Ipswich, Qld).

Option 2 Off-site disposal
Involves removal of contaminated material, treatment on-site or off-site, long haul transport, and disposal to a licensed general waste facility (Grafton Landfill) within a containment cell or isolated (segregated) portion of the landfill.

Option 3 - On-site disposal
Involves the removal of contaminated material, optional treatment, and placement within a specially constructed containment cell (Monocell) upslope of wetland.

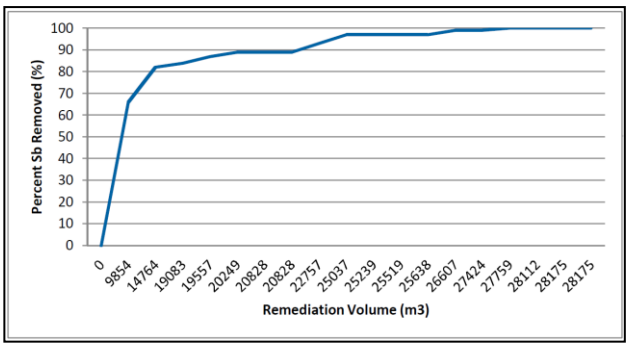
Option 4 - In-situ containment
Involves leaving the contaminated material within the wetland, optional treatment, and construction of a barrier containment system in-situ and capped.

Recommended Option
The recommended option was determined by considering the following criteria:

- Recovery of Wetland
- Health & Safety of local communities
- Long term durability of option
- Cost
- Technical feasibility
- Legislative requirements

It was determined that Option 3 – On-site Disposal best met the criteria. This involves excavation of the contaminated soils and sediments, treatment to buffer acidity and reduce leachability of the material, construct an engineered containment cell ('monocell') above the flood level, and cap the surface. The monocell would then be revegetated to blend with the native vegetation for use as passive recreation – public open space.

Remediation Area
Around 6 ha of land is contaminated, the condition of which varies according to metals concentration, depth, vegetation cover and inundation by the wetland. Hence a rationalisation of what areas (and hence volume) of contamination to remove was conducted based on these conditions. The site was divided into 'zones' from A to O, each with an estimated volume of contaminated soil or sediment (Appendix A). The chart opposite shows graphically the asymptotic relationship between volume of material to excavate verses Antimony removed from the environment.



It was determined that areas A, B, C, D, E, G, H, I, & M were the only practical zones to remediate which equates to 97% removal. Removing 97% of contaminants equates to around 190 – 280 tonnes[1] of antimony and requires excavation of up to 26,000m^3 of soils and sediments.

Remediation Cost Estimate
The cost of the recommended option is larger than the initial budget, however additional funding is being made available through NSW Crown Lands to meet the shortfall.

Environmental Impact Assessment
An assessment of the environmental impacts associated with the preferred option will be prepared and approved by all relevant agencies before remediation commences. The assessment will consider all expected impacts including:

- Soil, sediment and water
- Air quality (including dust)
- Noise and vibration
- Biodiversity
- Heritage (Aboriginal & Non-Aboriginal)
- Traffic
- Visual amenity & Socio-economic
- Waste management

The EIS will also address mitigation measures for reducing the impact on local residents and the wetland which must be incorporated into the remediation works under what is called the Construction Environmental Management Plan (CEMP).

Commencement
Works will commence after determination of the DA and supporting EIS by NSW Planning as a State Significant Development (SSD). The determination is expected to occur after August 2014 to coincide with the seasonally dry period. An "Early Works' package will also be submitted to Bellingen Shire Council for approval to undertake low risk tasks such as demolition of structures and removal of general waste from the site.

Residents Feedback
If you wish to know more about this project, please fill in the attached Feedback Form or contact me as below.

Urunga Antimony Contamination
Post: Soil Conservation Service
PO Box 530 Coffs Harbour NSW 2450
Email: scs.antimony@scs.nsw.gov.au
Landline: 02 6650 3143

Thankyou for your time.

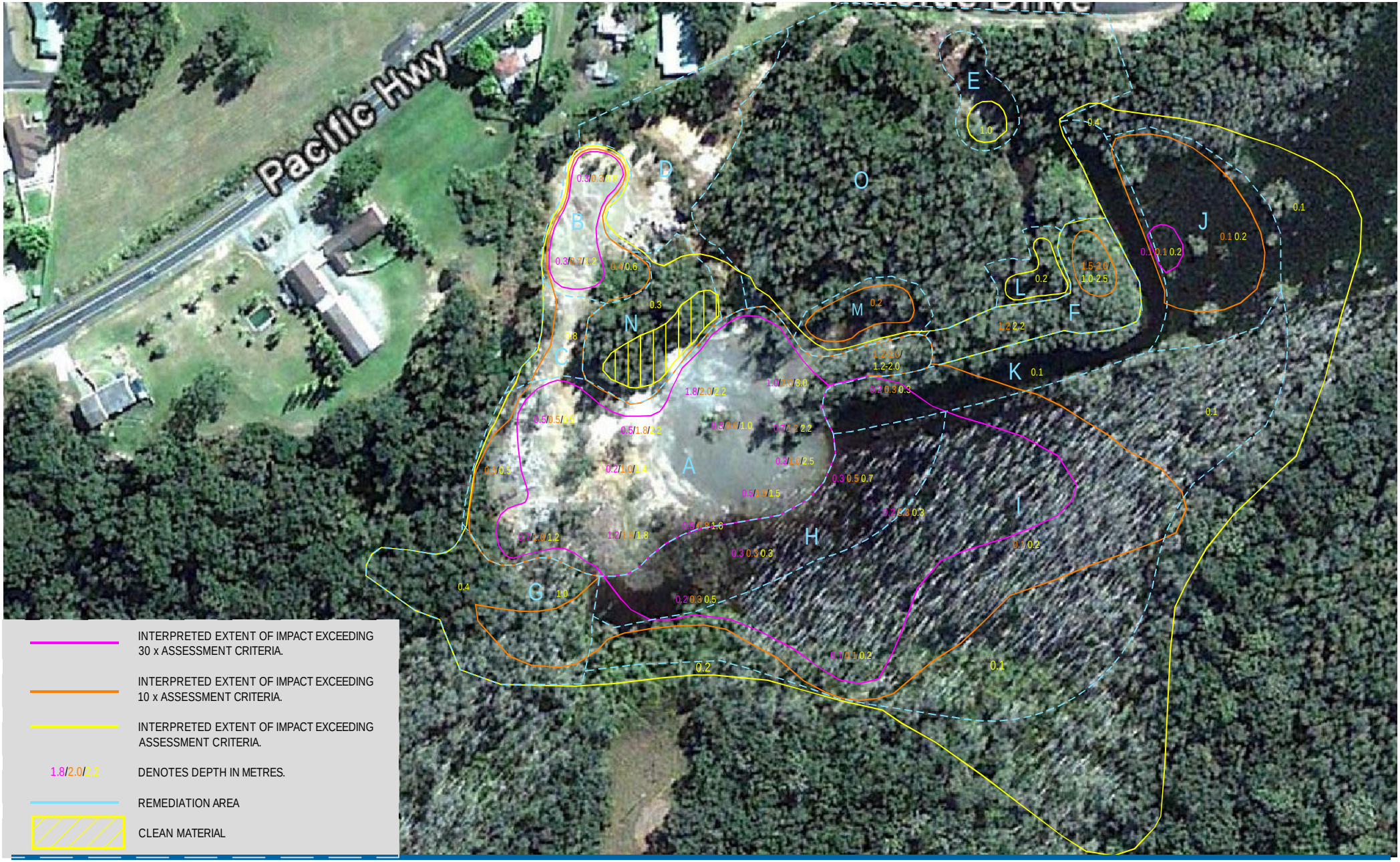
Yours sincerely



Clayton Colmer
Senior Environmental Officer

[1] Can only estimate range based on nature of soil sampling techniques.

APPENDIX A



N

GHD

NSW Catchment & Lands - Crown Lands
Former Antimony Processing Plant - Urunga
Detailed Investigation Report
REMEDIATION AREAS

Job Number 22-16251
Revision A
Date Oct 2012

Figure 7

230 Harbour Drive Coffs Harbour NSW 2450 Australia T 61 2 6650 5600 F 61 2 6650 5601 E cfsmail@ghd.com W www.ghd.com

Plot Date: 4 July 2013 - 10:25 AM Plotted by: Mika Kama Cad File No: G:\22\16251\CADD\Drawings\22-16251-FIG 1 & 2.dwg

NSW GOVERNMENT Soil Conservation Service

Experienced people protecting your resources

URUNGA ANTIMONY CONTAMINATED SITE
COMMUNITY CONSULTATION – FEEDBACK FORM

Use this form if you wish to submit your information relating to the site in writing.

Post to: PO Box 530 Coffs Harbour NSW 2454
Email to: scs.antimony@scs.nsw.gov.au

Site	Antimony Processing Plant – Contaminated Site in Hillside Drive Urunga

Name (Optional)	
Address (Optional)	
Phone (Optional)	
Questions *(If you want a particular question answered list it here)*	
Local Knowledge *(List here anything you think may be relevant to the site in terms of, contamination, remediation, access along Hillside Drive. Can be anecdotal or scientific data/reports etc)*	

Remediation Option

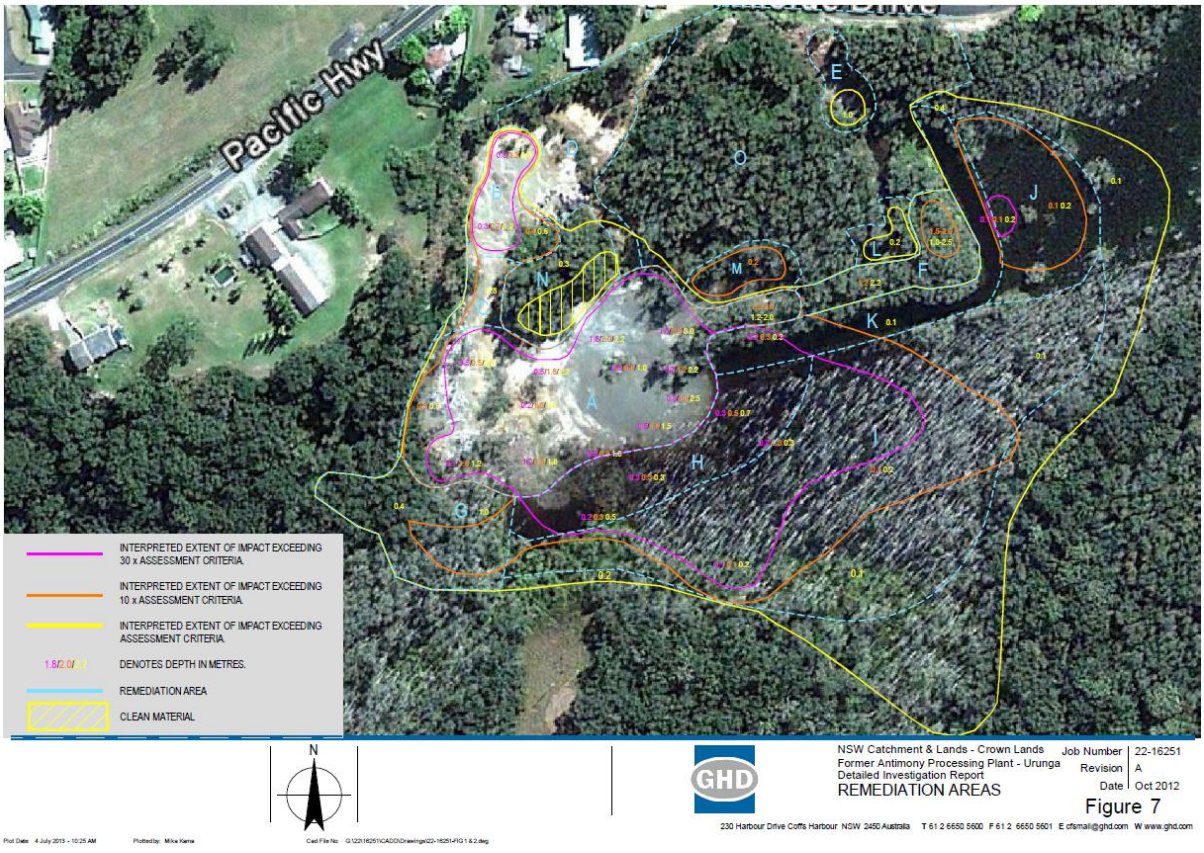
Are you satisfied with the recommended option? Yes ☐ No ☐

If not, what Option do you prefer?

- Option 1a: Off-site Disposal in Mine Facility (Hillgrove) ☐
- Option 1b: Off-site Disposal in Hazardous Waste Facility (Ipswich Qld) ☐
- Option 2: Off-site Disposal in General Waste Facility ☐
- Option 3a: On-site Disposal in Monocell (Treated) ☐
- Option 3b: On-site Disposal in Monocell (No Treatment) ☐
- Option 4a: In-situ Containment in Wetland (No Treatment) ☐
- Option 4b: In-situ Containment in Wetland (Treatment) ☐
- Other (You to provide details below) ☐

Details:

Environmental Risks *(List here any issues/concerns/or comments you have in relation to the environmental impact of the remediation – Note that an opportunity to review the EIS will be made during the planning process)*	
Mitigation Measures *(List any mitigation measures or environmental protection measures you would like to see implemented during the remediation works)*	
Other *(List anything else you think is relevant to tonight's meeting or the remediation in general)*	



Please use the above map as reference if you need it.

NSW GOVERNMENT Soil Conservation Service

Experienced people protecting your resources

URUNGA ANTIMONY CONTAMINATED SITE
COMMUNITY CONSULTATION – FEEDBACK FORM

Use this form if you wish to submit your information relating to the site in writing.

Post to: PO Box 530 Coffs Harbour NSW 2454
Email to: scs.antimony@scs.nsw.gov.au

Site	Antimony Processing Plant – Contaminated Site in Hillside Drive Urunga

Name (Optional)	
Address (Optional)	
Phone (Optional)	
Questions *(If you want a particular question answered list it here)*	
Local Knowledge *(List here anything you think may be relevant to the site in terms of, contamination, remediation, access along Hillside Drive. Can be anecdotal or scientific data/reports etc)*	
Remediation Option *(List here any issues/concerns/or comments you have in relation to the recommended remediation option)*	
Environmental Assessment *(List here any issues/concerns/or comments you have in relation to the environmental impact of the remediation – Note that an opportunity to review the EIS will be made during the planning process)*	

Date	Stakeholders	Forum	Notes	Attachment
			1.	
19 June 2012	BSC Shire Community	Newspaper	2. Article in paper informing community that investigations are commencing - "Clean up process begins on contaminated Urunga site"	
31 Oct 2012	Urunga Chamber of Commerce	Private Presentation	1. SCS presented to the Chamber with a view of getting preferred option from Chamber 2. Chamber responded by email stating preferred option is 2 – offsite burial.	
15 Nov 2012	Community Groups	Private Letter	1. Inviting community groups to attend Investigation results meeting	
19 Nov 2012	Local Community	Media release	1. Discussing project and inviting community to meeting - "Antimony clean-up underway"	
27 Nov 2012	Local Community Fisheries EPA NSW Health Office of Water Derelict Mines	Public Meeting	1. See GHD Minutes	
27 Nov 2012	Meeting Attendees	Feedback Form	1. Provided forms for community feedback – nil received. No submissions detailing preferred option. 2. However extensive email feedback all regarding protest to using Hillgrove mine for disposal (approx 50 emails) 3. Extensive media coverage against the use of Hillgrove in Jan 2013	
30 Nov 2012	BSC Shire Community	Media release – Local Paper	1. Documented results of public meeting – no feedback – "Remediation plan for contaminated site"	
5 March 2014	Bronwyn Shipp (Westrella Motel	Email & Phone Correspondence	1. SCS requested permission to enter property for further investigations	

	Owner)		2. Requesting investigation results from her land. 3. Supplimentary report provided 4. No discussion on preferred option as yet	
26 Feb 2014	Bellingen Shire Council Senior Staff & Councillors	Private Meeting	1. SCS & Crown Lands & EPA presented option selection presentation. 2. Some councillors expressed concern that the waste would be kept on-site 3. No motions were passed (not determining authority) to accept the option but generally it was accepted	
26 Feb 2014	Terry Wall Coffs Harbour Land Council	Private Meeting	4. SCS & Crown Lands & EPA presented option selection presentation. 5. SCS provided follow-up email summarising the option for CHALC formal review. 6. SCS explained that CHALC have 2 options for land tiltle transfer in regards to contamination: a. Excise the SEPP 14 wetland boundary in contamination zone plus 20m buffer from title b. Retain SEPP 14 wetland boundary in contamination zone but accept receiving contaminated sediments. 7. CHALC had no issue with a monocell at Hillside Drive	
6 Mar 2014	Chris Phillips (neighbour)	Private Meeting	1. No problem with a monocell downslope of the current security fence 2. Requested a grassed finish to monocell to macth existing 3. Enjoys the vegetated outlook and will be disappointed if cleared. SCS confirmed it will be cleared. Insisted on a landscape plan to revegetate for the purposed of screening the site	
6 Mar 2014	Urunga Chamber of	Private Presentation	1. SCS gave option presentation.	

	Commerce		2. Chamber recommended notifying residents along Hillside Drive ahead of public meeting 3. Recommended to focus on detail of preferred option rather than other redundant options 4. Need to cover issues regarding environmental impacts	
26 Mar 2014	Bellingen Environment Centre	Members AGM Meeting	1. SCS asked to update the group on the project 2. SCS presented the options report presentation 3. Concern raised over design life of monocell 4. Concern raised over earthquake robustness of monocell 5. Concern raised on whether it will be safe for children to swim in the Lagoon afterwards	Presentation
21 May 2014	Hillside Drive Residents & Neighbours (Stepping Stones to Highway)	Mail Drop & Face to Face Discussion	1. Only half residents home so leaflet left in letterbox (See attached) 2. SCS explained the project and potential impacts 3. No. 12 - Stepping Stones was unaware of the site when the business commenced in 2005. 4. Concerned about truck movements in front of the long day care centre 5. Concerned about dust generation, with many kids having asthma 6. SCS informed Stepping Stones that mitigation measures will be implemented to address such concerns. 7. No. 10 – expressed concern over losing fence. 8. SCS explained that discussions on fence retention can be decided during project. 9. No. 97 Pac Hwy asked if the contaminated site could be responsible for developing heart conditions. 10. SCS stated that the contaminants are known to affect soft tissues but it is impossible for SCS to	Community Feedback Form 2

			know if that would cause disease in any one individual. 11. Westella Motel – no comment. 12. No. 131 Pac Hwy do not consider themselves affected by the site.	
20th May 2014		Media Release	13. Media release discussing RAP and public meeting - “Plan to fix poisoned land”	
20th May 2014	Mid North Coast Com munity	Radio coverage	14. News article based on Media Release	
27 May 2014	Community Groups	Email Mail Out	15. Invited community groups in Bellingen Shire to attend proposed 29th May 2014 meeting	Community Group – Meeting 2 - Email advert
29th May 2014	Local Community EPA NSW Health	Public Meeting	16. Presentation of recommended option to approximately 20 community members and representatives of environmental groups. 17. Provided question & answer time 18. Provided forms for submitting a written response if preferred. 19. Concern over effect of sea level rise on monocell 20. Concern over durability & design life of monocell 21. Show of hands demonstrated most attendees are satisfied that on-site option the best way forward	Community Feedback Form 2b & Presentation
30 May 2014	Mid North Coast Com munity	Radio Interview	22. Summary of presentation in news grab for radio.	

NSW GOVERNMENT Soil Conservation Service

Experienced people protecting your resources

27 May 2014

Suite 5 Level 1 City Square
76 Harbour Drive
PO Box 530
Coffs Harbour NSW 2450
P: 02 6650 3143
M: 0437 013 126

NOTICE: URUNGA ANTIMONY CONTAMINATED SITE RECOMMENDED OPION

The Soil Conservation Service (SCS) has been engaged by NSW Trade & Investment (Crown Lands) to project manage the remediation of the Antimony Processing Plant Contaminated Site at Hillside Drive, Urunga.

As part of the project, local relevant community groups are being invited to a public meeting to discuss the recommended option as developed in the Remediation Action Plan (RAP). The meeting will include a presentation explaining who the project stakeholders are, a quick history snap shot, the final investigation results, the remediation options, the environmental impact assessment, the remediation methodology, and to seek community feedback community on issues relating to the remediation.

The information gathered at the meeting in relation to the recommended option will be considered by the agencies, and issues regarding environmental impact will be included in the preparation of the Environmental Impact Statement.

The meeting is being facilitated by Bellingen Shire Council and presented by Clayton Colmer from the Soil Conservation Service.

Date: Thursday 29th May 2014
Time: 6.00pm – 7:30pm
Location: Urunga Golf Club (Morgo Street)

If you wish to attend please RSVP to swilliams@bellingen.nsw.gov.au or phone 6655 7315.

Yours sincerely

Clayton Colmer
Senior Environmental Officer

		
View of old processing plant area (demolished)	Undertaking geotechnical investigations	Installation of groundwater monitoring wells

Wasteland to Wetland - Urunga Antimony Contaminated Site Rehabilitation Project

Background:

The subject site is located adjacent to the Pacific Highway, approximately 1.5km from the town of Urunga on the mid-north coast of NSW. The site was significantly contaminated by historical activities including antimony ore crushing and processing. Whilst the processing activities occurred on freehold land, the associated tailings spread over time to impact on an adjoining SEPP14 wetland, which is Crown land.

Crown Lands became aware of the site in 1995 when a subsequent freehold owner reported the issue following Council refusing a development application for a retirement village due to the contamination. Crown Lands immediately took action to protect the public by erecting fencing and warning signs.

Detailed investigations into the extent and nature of contamination of the site were undertaken by the then Department of Land and Water Conservation (DLWC) in 1995 and 1997. These investigations showed the estimated 9000m^3 of tailings, which cover over a hectare of the site, were actively eroding and high levels of contaminants including antimony, arsenic, copper, lead, zinc, chromium and mercury had been detected. Wastewater and tailings had spread downstream contaminating the freshwater and brackish wetland.

Insert health issues discussion.

The DLWC considered several options for the remediation of the site, including: doing nothing; on-site burial of the tailings beneath the watertable or water surfaces; excavating, relocating and burying the tailings off-site; further processing of the tailings to remove contaminants; vertical mixing. The option recommended by DLWC however, was to contain the tailings to prevent further erosion and oxidation.

The site has a very high public profile and there has been growing community pressure to see the site rehabilitated. Crown Lands has been seeking funding to remediate the site from numerous sources since 1997. In 2011, the Environment Protection Authority (EPA) sought to place a remediation order upon the freehold owner of the site. This resulted in an agreement to transfer the ownership of the freehold land to Crown Lands to enable remediation to

occur. The EPA is revising the order to cover the whole site and is collaborating with Crown Lands which is now responsible for the remediation.

In late 2011, it was announced that the Environmental Trust had allocated $700,000 towards the project. Also, despite not being a mine site, the DPI Derelict Mines Committee has indicated an allocation of a further $700,000 towards the project in the public interest. Project planning is now underway with on-ground remediation works expected to occur in 2013.

The Soil Conservation Service (SCS) has been engaged to manage Stage 1 of the project, namely developing the remedial action plan. SCS will be utilising the services of GHD Pty Ltd to provide specialist expertise in the development of the plan.

Key messages:

The following messages are designed to be delivered through briefings, public awareness campaigns, publications, media and/or public enquiries as required:

- The Urunga site was significantly contaminated by historical activities including antimony ore crushing and processing.
- Whilst the processing activities occurred on freehold land, the associated tailings spread over time to impact on an adjoining SEPP14 wetland, which is Crown land.
- Upon becoming aware of the site in 1995, Crown Lands immediately took action to protect the public by erecting fencing and warning signs.
- Detailed investigations into the extent and nature of contamination of the site were undertaken by the then Department of Land and Water Conservation (DLWC) in 1995 and 1997.
- The DLWC investigations showed the estimated 9000m^3 of tailings, which cover over a hectare of the site, were actively eroding and high levels of contaminants including antimony, arsenic, copper, lead, zinc, chromium and mercury had been detected.
- Wastewater and tailings had spread downstream contaminating the freshwater and brackish wetland.
- The DLWC considered several options for the remediation of the site, including:
    - doing nothing;
    - on-site burial of the tailings beneath the watertable or water surfaces;
    - excavating, relocating and burying the tailings off-site;
    - further processing of the tailings to remove contaminants;
    - vertical mixing.
- The option recommended by DLWC however, was to contain the tailings to prevent further erosion and oxidation.
- Crown Lands has been seeking funding to remediate the site from numerous sources since 1997.
- In 2011, the Environment Protection Authority (EPA) sought to place a remediation order upon the freehold owner of the site.

- The proposed order resulted in an agreement to transfer the ownership of the freehold land to Crown Lands to enable remediation to occur.
- The EPA is revising the order to cover the whole site and is collaborating with Crown Lands which is now responsible for the remediation.
- The Environmental Trust has allocated $700,000 towards the project, with the DPI Derelict Mines Committee also allocating of a further $700,000 towards the project in the public interest.
- Crown Lands is liaising with the EPA to identify any data deficiencies in the 1997 DLWC study and to determine the most cost-effective remediation plan.
- It is anticipated that remediation works will be undertaken in 2013.
- Health issues
- The Soil Conservation Service (SCS) has been engaged to manage Stage 1 of the project, namely developing the remedial action plan.
- SCS will be utilising the services of GHD Pty Ltd to provide specialist expertise in the development of the plan.

Project Co-operators

DPI Catchment and Lands
DPI Derelict Mines
EPA
Environmental Trust
Bellingen Shire Council
Department of Health

Project Steering Committee (suggested nominees/alternates)

DPI Catchment and Lands – Richard Chewings/Adrian Harte/David McPherson
EPA – John Coffey/Matthew James
Bellingen Shire Council – Liz Jeremy/Anthony Brandy
Department of Health – Kerryn Lawrence/David Basso
SCS – Clayton Colmer/David Howley

Target Stakeholders

Local residents
Community groups (environmental, fishing etc.)
Day care centre
Agency staff
Relevant executive and ministers

Communication Pathways

Press release
One on one
Targeted stakeholder consultation

Communication Product Needs

Media releases
Project reports
Q&As
Pamphlets/brochures
Communication strategy

News Business

Guardian News (/)

Public warned of troubled waters

By UTE SCHULENBERG
July 18, 2013, 8 a.m.



TROUBLED WATERS: Signs warning of the public health risk will be posted by Bellingen Council.

BELLINGEN Shire Council will erect health warning signs downstream from the derelict antimony processing plant at Urunga following worrying early results of a water testing program.

Results received so far have been consistent with those from a NSW Beachwatch program conducted in the area a decade ago, which indicated elevated levels of antimony and arsenic at Station Creek, which flows from the plant into the Urunga Lagoon.

Council's deputy general manager for Environment and Planning, Stephen Taylor, said a review of the current test results indicated it was unsafe to swim or fish in the vicinity, and so health warning signs would be posted.

"Obviously this has been an ongoing problem and I am not sure why these signs were not installed 10 years ago," Mr Taylor said.

"Plans are now well underway for the remediation of the Urunga site and hopefully

Is your business mobile ready?

we will see an improvement in the future.”

A spokesman for NSW Lands, Catchments and Water, said soil testing was continuing on the site and the community would be advised of the chosen remediation strategy before any work commences later this year. There are four options under consideration.

The water test results will provide an important benchmark against which the effectiveness of the remediation efforts can be measured.

Samples from the Sea Lido public swimming area show it is safe for recreational use.

Contaminated land at Urunga the focus of a Crown Land clean-up

Posted Fri 30 May 2014, 10:45am AEST

The department of Crown Lands took its plan to clean up a contaminated site in Urunga to the local community last night.

A hectare of land on Hillside Drive adjoins a wetland that feeds into the Urunga lagoon, and it was used for mineral processing in the early 1970s.

Over the past 40 years waste tailings including antimony, arsenic, mercury and lead have leached into the wetland.

Crown Lands spokesman Richard Chewings says there is now a remediation plan.

"We considered a number of options for the site and had to work through each of those options in terms of which was the most feasible," he said.

"But the option that's preferred is to basically remove the contaminated material from the wetland and store it in a specially constructed containment cell elsewhere on the site, but well away from the wetland."

Mr Chewings said it is hoped the remediation work can start in the next few months.



PHOTO: Contaminated wetland, Urunga NSW
(Steven Leahy, UTS)

MAP: Urunga 2455

> It's been a long time coming for the project to get underway and I think there's a fair bit of relief in the community to see it happening

"Fingers crossed if we can get the final approvals through the Department of Planning we'd like to get into the remediation proper in August and have it done by Christmas," he said.

"So that's the program we're working to unless something unforeseen happens.

"It's been a long time coming for the project to get underway and I think there's a fair bit of relief in the community to see it happening.

"We're budgeting on about $4 million to do the work."

Appendix J Aboriginal Heritage Information

AHIMS Web Services (AWS)
Search Result

Your Ref Number : 2216251

Client Service ID : 127170

GHD-Management Engineering Environment (Coffs Harbour)

Date: 04 March 2014

unknown P O Box 1340
Coffs Harbour New South Wales 2450
Attention: Ben Luffman

Email: ben.luffman@ghd.com

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lat, Long From : -30.5063, 153.0078 - Lat, Long To : -30.5044, 153.0109 with a Buffer of 200 meters, conducted by Ben Luffman on 04 March 2014.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

PO BOX 1967 Hurstville NSW 2220
43 Bridge Street HURSTVILLE NSW 2220
Tel: (02)9585 6345 (02)9585 6471 Fax: (02)9585 6094

ABN 30 841 387 271
Email: ahims@environment.nsw.gov.au
Web: www.environment.nsw.gov.au



OFFICE OF THE REGISTRAR
Aboriginal Land Rights Act 1983

Level 5 – 83 Clarence Street SYDNEY NSW 2000 Ph (02) 9290 8700 Fax (02) 9290 8704

Our Ref: 98R/0029Cof2128Amens:CK

Mr Jeff Weiley
The Manager
Aboriginal Land Claims Investigation Unit
Department of Land and Water Conservation
GPO Box 39
SYDNEY NSW 2001

Dear Mr Weiley

Re: Coffs Harbour LALC Land Claim 2128

I refer to your letter of 15 April 2002 regarding Coffs Harbour LALC's intention to amend Land Claim 2128. This Office's records have been appropriately noted.

Yours sincerely

Cheryl Kistan
Policy Officer
17 April 2002

G:\DAA\Registra\Cheryl\Correspondence\LALCS\Land Claims\Letters\CORRESP\DLWC\Coffs Habrour 2128 Amendment 15April2002.doc

Our Ref: **HO85H1113**
Contact: **Ian Ritchie**
Phone: **(02) 9228 6369**

LAND & WATER CONSERVATION

Mr S Wright
Aboriginal Land Rights Registrar
Department of Aboriginal Affairs
Level 5
83 Clarence Street
SYDNEY NSW 2000

Dear Mr Wright

Aboriginal Land Claim 2128
Parish Newry, County Raleigh

The Subject claim was lodged by the Coffs Harbour and District Local Aboriginal Land Council on 30 May, 1985 in respect of Lot 253, DP46013 (formerly portion 209) of about 65.52 hectares at Urunga, shown by red edge on the attached diagram.

By letter dated 13 March 2002 addressed to this Office, the Land Council has notified the withdrawal from the claim of the parts shown by orange and yellow colours. The Land Council's letter which was received by facsimile transmission is enclosed.

In anticipation of your formal acceptance of the withdrawal this Department's records have been appropriately noted.

I might mention that the part shown by blue colour was previously withdrawn from the claim in April 1997.

Yours sincerely

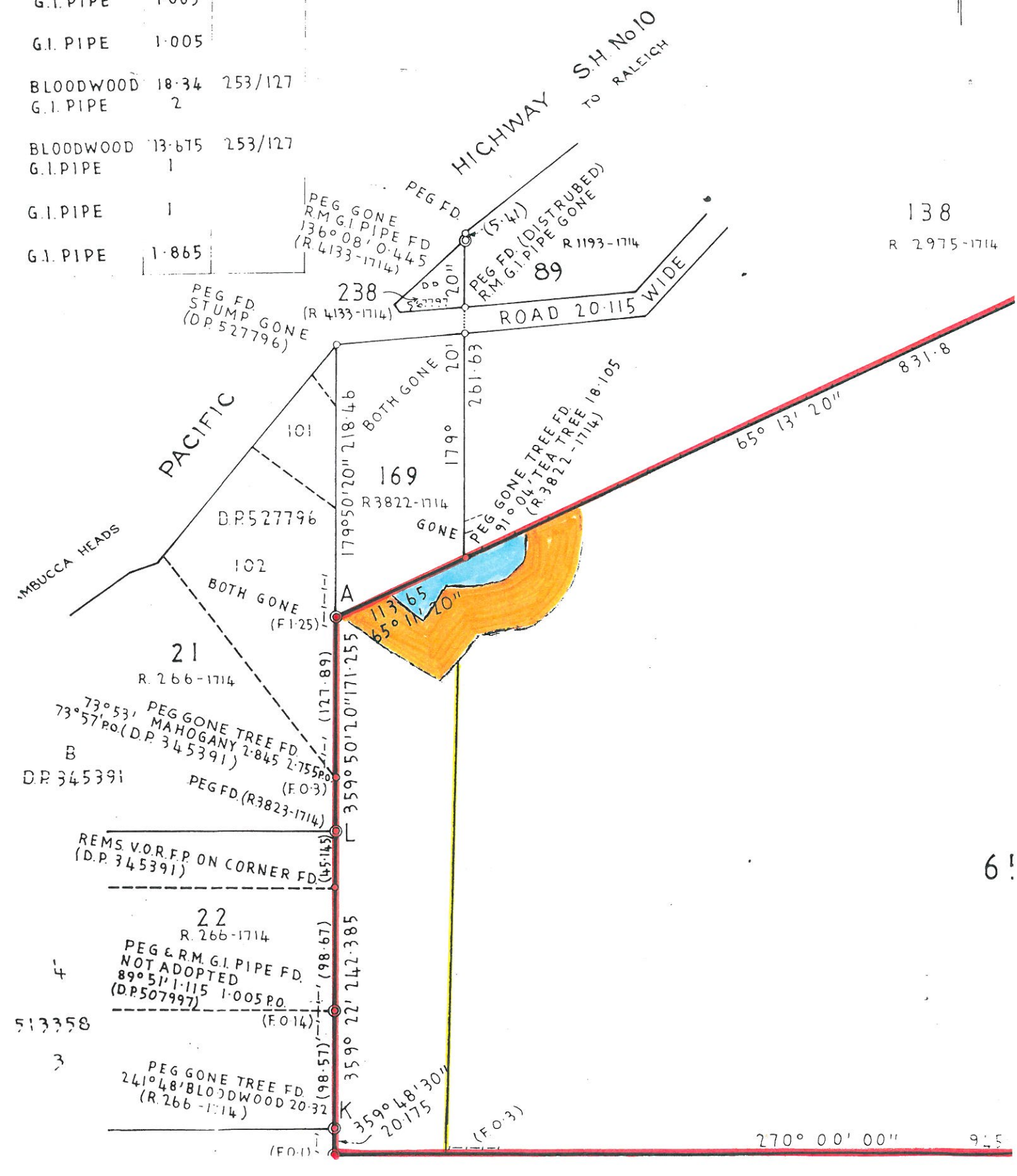
J.M. Weiley
Manager
Aboriginal Land Claim Investigations
15-4-2002

DATABASE NOTED
15.4.2002

23-33 Bridge Street Sydney NSW 2000 GPO Box 39 Sydney 2001 DX 22 Sydney
Telephone: (02) 9228 6111 International: (61 2) 9228 6111 Facsimile: (02) 9228 6140

FROM	DIST.	NO ON PEG/TREE
		169/253
G.I.PIPE	1	
G.I.PIPE	1	
G.I.PIPE	1·31	253
G.I.PIPE	0·38	
G.I.PIPE	0·995	
G.I.PIPE	1·005	
G.I. PIPE	1·005	
BLOODWOOD	18·34	253/127
G.I. PIPE	2	
BLOODWOOD	13·675	253/127
G.I.PIPE	1	
G.I.PIPE	1	
G.I. PIPE	1·865	

LINE	BEARING	DISTANCE
1	173° 15' 40"	41·71
2	174° 31' 40"	31·53
3	176° 37' 40"	44·125
4	178° 38' 40"	41·33
5	180° 44' 40"	69·84
6	178° 56' 40"	54·53
7	228° 55' 40"	56·72
8	170° 04'	23·61





Coffs Harbour & District Local Aboriginal Land Council

PO Box 6150, Coffs Harbour Plaza NSW 2450

Phone (066) 52 8740 Fax (066) 52 5923

Mr J Weiley
Manger
Aboriginal Land Claim Investigations
GPO Box 39
Sydney 2001

13 March 2002

RE: ABORIGINAL LAND CLAIM 2128

Dear Mr Weiley,

I write to advise that at its meeting of 6 March 2002 Land Council resolved to satisfy DLWC requirements with regard to the above claim.

In satisfaction of this claim please find below an extract of the minutes of the meeting dealing with ALC 2128.

EXTRACT OF MEETING 6/3/02

"Summary:

The Coordinator explained that DLWC was ready to grant ALC 2128 of 65 HA and that the LALC needed to pass the following three motions to finalise the claim.

MOTION: 12/02:

TO WITHDRAW FROM ALC CLAIM 2128 (LOT 253 DP 46013) PARISH NEWRY COUNTY RALEIGH AN AREA OF APPROX 2 HA FOR THE PURPOSE OF PROVIDING A BUFFER ZONE AROUND CONTAMINATED LAND. SAID LAND BEING DESCRIBED IN DLWC DOCUMENTS AS TABLED.

MOVED: Ken Craig Snr
SECONDED: Bert Ballangarry
RESOLUTION: CARRIED

MOTION: 13/02

TO WITHDRAW FROM CLAIM 2128 (LOT 253 DP 46013) PARISH NEWRY COUNTY RALEIGH THE SITE OF PROPOSED EASEMENT 20 M WIDE FOR THE PURPOSES OF ELECTRICITY TRANSMISSION.

MOVED: Fay French
SECONDED: Leigh Gittins
RESOLUTION: CARRIED

MOTION: 14/02

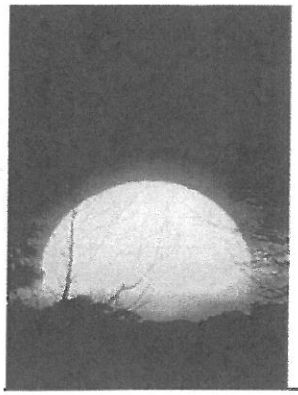
TO LODGE CLAIM ON SITE OF PROPOSED EASEMENT FOR TRANSMISSION LINE 20 M WIDE WITHIN LOT 253 DP 46013 PARISH NEWRY COUNTY RALEIGH. AND GRANT SAID EASEMENT IN FAVOUR OF NORTHPOWER – COUNTRY ENERGY.

MOVED: Ken Craig Snr
SECONDED: Bert Ballangarry
RESOLUTION: CARRIED"

I trust that this information meets DLWC requirements for the granting of the claim. Should you require further information please contact me on the above number.

Yours sincerely

David Kennedy
Coordinator



OFFICE OF THE REGISTRAR
Aboriginal Land Rights Act 1983

Level 5 – 83 Clarence Street SYDNEY NSW 2000 Ph(02) 9290 8700 – Fax(02) 9290 8704

Mr Jeff Weiley
State Manager
Aboriginal Land Claims Investigation Unit
Department of Land and Water Conservation
Room 226
23-33 Bridge Street
SYDNEY NSW 2000

Dear Mr Weiley

The Coffs Harbour and District LALC has amended Land Claim 2128 and I attach a copy of the letter from the Land Council confirming this.

Yours sincerely

R. Merrick
REGISTRAR
B 1/12/97



Coffs Harbour & District Local Aboriginal Land Council

PO Box 6150, Coffs Harbour Plaza NSW 2450
Phone (066) 52 8740 Fax (066) 52 5923

Chairperson Sue Hoskins Secretary Judy Ferguson Treasurer Ken Craig

COPY

The Registrar
NSW Aboriginal Land Rights
DAA
83 Clarence Street
Sydney 2000

Dear Tony

re Aboriginal Land Claim 2128, Parish Newry County Raleigh

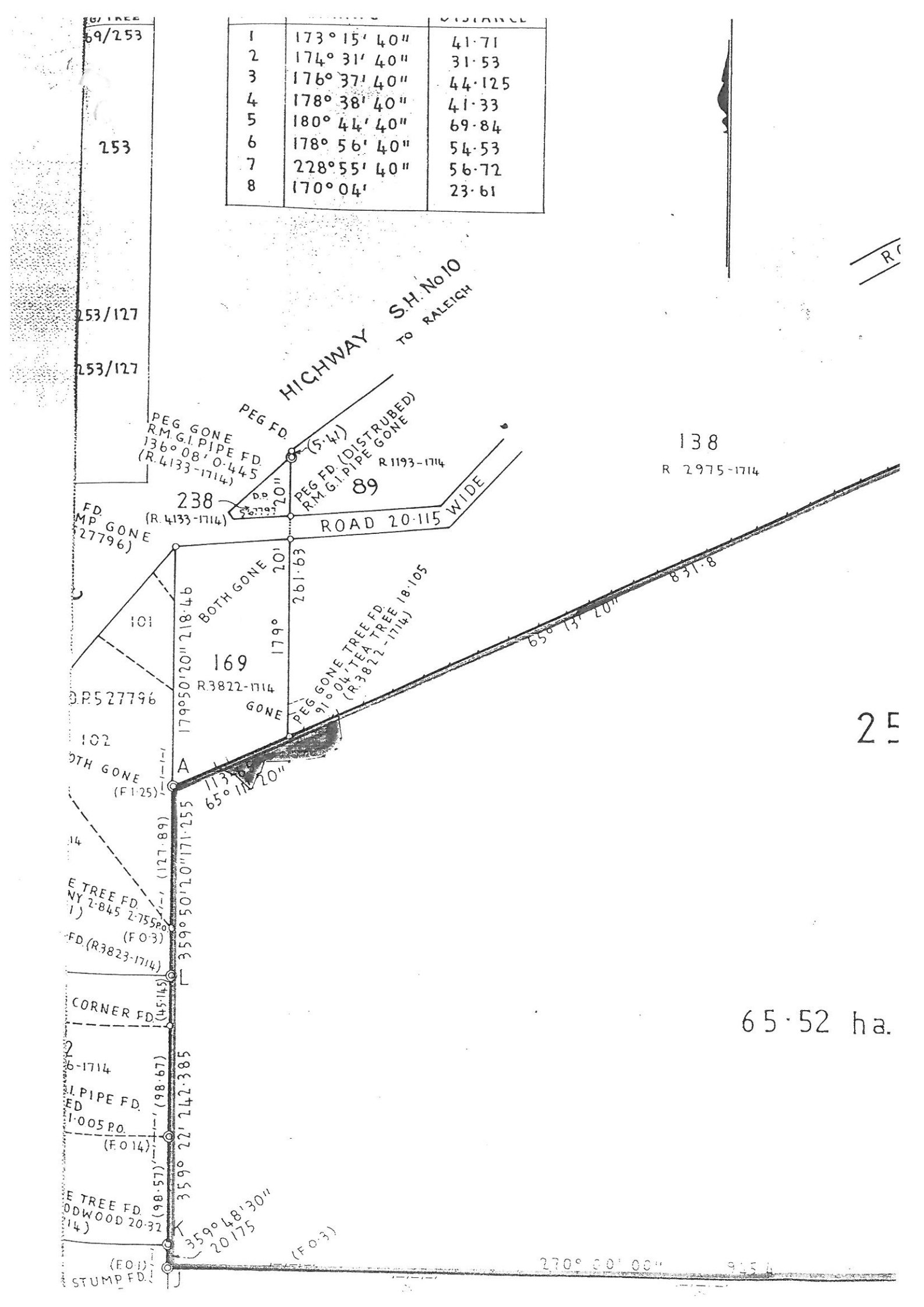
On 7 February, the Land Council received the attached letter from the Department of Land & Water in which it has advised that there is a contaminated area within the land under claim.

I have indicated to the Aboriginal Land Claims Investigations Branch that this land council does not wish to include the contaminated area within the land claim. The purpose of this letter is to confirm that the contaminated area only should be withdrawn from Claim 2128. I understand that the protocol requires this formal advice to the Registrar who will forward it on to Aboriginal Land Claims Investigations Branch. I have sent a copy of this letter to the Branch but would appreciate your confirmation that the requirements have been satisfied.

Yours sincerely

Janet Layton
Coordinator
21 April 1997





1	173° 15' 40"	41.71
2	174° 31' 40"	31.53
3	176° 37' 40"	44.125
4	178° 38' 40"	41.33
5	180° 44' 40"	69.84
6	178° 56' 40"	54.53
7	228° 55' 40"	56.72
8	170° 04'	23.61

Coffs Harbour & District Local Aboriginal Land Council

Cnr Pacific Highway & Arthur Street, Coffs Harbour 2450
PO Box 6150, Coffs Harbour Plaza NSW 2450
Phone (02) 6652 8740 Fax (02) 6652 5923

20th May 2014

Attention: Mr Clayton Colmer

Senior Environmental Officer
NSW Soil Conservation Service
76 Harbour Drive
Coffs Harbour NSW 2450

RE: Remediation of Contamination of Former Antimony Mining Activities Lot 1 DP 874874, Urunga, NSW.

Aboriginal Cultural Heritage Assessment

Dear Mr Colmer,

Thank you for your enquiry and the opportunity to comment in relation to Aboriginal Culture and Heritage for the proposed remediation of contaminated lands formerly used for Antimony mining activities on Lot 1 DP 874874 Urunga, NSW.

Coffs Harbour and District Local Aboriginal Land Council's (CHDLALC) Cultural Heritage Officers, Mr Mark Flanders and Mr Ian Brown performed o walk over inspection of the property on 3rd April 2014 to ascertain if any Aboriginal cultural heritage constraints exist within the property that require considerations prior to the works program being undertaken.

During the assessment it was noted that there is heavy previous land use and modification disturbance activities that took place over the entire property.

No objects of Aboriginal origin were located or identified during the assessment.

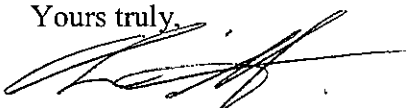
Please note that the CHDLALC provides the following recommendations for the property pertaining to Aboriginal cultural heritage;

1. That the property's northern boundary (where current dwelling and entry point to the property are located) holds strong potential to contain Potential Archaeological Deposits (PAD) and this area should be void of any earth disturbance activities. Should earth disturbance activities be required in this area further consultation with CHDLALC should be sought prior to the activities.

2. All other areas of the property are deemed to be culturally sterile due to the previous land use activities; however an unexpected find procedure should be developed to give directions to staff should any unexpected find occur.
3. Should any objects be suspected to be of Aboriginal origin be uncovered during works all works must cease immediately in vicinity of the find and CHDLALC notified immediately to allow inspection of object/s and clearance granted for works to recommence in that area.

If you have any questions in relation to this matter, please do not hesitate to call me on the above number.

Yours truly,



Chris Spencer
Chief Executive Officer

Appendix K Non Aboriginal Heritage Information

Search Results

1 result found.

Wenonah Ornithological Area Pacific Hwy		Urunga, NSW, Australia	(Indicative Place) Register of the National Estate (Non-statutory archive)

Report Produced: Wed Mar 19 11:40:19 2014

Accessibility | Disclaimer | Privacy | © Commonwealth of Australia

Search for NSW heritage

Return to search page where you can refine/broaden your search. ItemName
0

Statutory listed items

Information and items listed in the State Heritage Inventory come from a number of sources. This means that there may be several entries for the same heritage item in the database. For clarity, the search results have been divided into two sections.

- **Section 1**. contains items listed by the **heritage council** under the NSW Heritage Act. This includes listing on the state heritage register, an interim heritage order or protected under section 136 of the NSW Heritage Act. This information is provided by the Heritage Branch.
- **Section 2**. contains items listed by **local councils & shires and state government agencies**. This section may also contain additional information on some of the items listed in the first section.

Section 1. Items listed under the NSW Heritage Act.

Your search did not return any matching results.

ItemName 0

Section 2. Items listed by Local Government and State Agencies.

Your search returned 29 records.

Item name	Address	Suburb	LGA	Information source
Bicentennial Exhibit - Urunga Library	34 Bonville Street	Urunga	Bellingen	LGOV
Carmel Convent Group - buildings and grounds	34, 36 and 40 High Street & 37 Pilot Street	Urunga	Bellingen	LGOV
Cultural Planting	1 Bellingen Street	Urunga	Bellingen	LGOV
Cultural planting - Bonnie Doon	8564 Pacific Highway	Urunga	Bellingen	LGOV
Cultural Planting - Christian Park	Atherton Drive	Urunga	Bellingen	LGOV
Cultural planting - Morgo Street Reserve	Morgo Street	Urunga	Bellingen	LGOV
Ellis Timber Mill	Banks of Kalang River, Allison Place	Urunga	Bellingen	LGOV
Former Pilot House	4 Morgo Street	Urunga	Bellingen	LGOV
Former Pilot House fence	4-4A Morgo Street	Urunga	Bellingen	LGOV
Former Urunga Bridge	Banks of Kalang River below Dolphin Court and the Pacific Highway corridor	Urunga	Bellingen	LGOV
House	64 Yellow Rock Road	Urunga	Bellingen	LGOV
House	56 Yellow Rock Road	Urunga	Bellingen	LGOV

O'Briens Timber Mill	804 Valery Road	Valery	Bellingen	LGOV
Ocean View Hotel	15, 17 and 19 Morgo Street	Urunga	Bellingen	LGOV
Pedestrian footbridge - east of Morgo Street Reserve	Morgo Street	Urunga	Bellingen	LGOV
Remnant forest - also bounded by Bellingen and Crescent Streets	Valla Street	Urunga	Bellingen	LGOV
Remnant native swamp forest	Clybucca & Dudley Streets	Urunga	Bellingen	LGOV
Ruined Drougher	Banks of Kalang River, Allison Place	Urunga	Bellingen	LGOV
School ground - Urunga Public School	1 and 3 Bonville Street	Urunga	Bellingen	LGOV
Street trees	Bonville Street road reserve adjacent to 1 and 3 Bonville Street	Urunga	Bellingen	LGOV
Traffic Bridge	Orara Street, bridge over rail corridor at junction of Pilot, Fitzroy and Railway Streets	Urunga	Bellingen	LGOV
Two Graves, Early Urunga Cemetery	Hungry Head Road - Sports Ground	Urunga	Bellingen	LGOV
Urunga Breakwater and Training Walls	Morgo Street, Bellinger and Kalang Rivers west of the river mouth	Urunga	Bellingen	LGOV
Urunga General Cemetery	110 Hungry Head Road	Urunga	Bellingen	LGOV
Urunga Golf Course	Bellingen and Morgo Streets	Urunga	Bellingen	LGOV
Urunga Museum - former Literary Institute	Morgo Street	Urunga	Bellingen	LGOV
Urunga Recreational Reserve	Morgo Street	Urunga	Bellingen	LGOV
Urunga War Memorial	5 Bonville Street	Urunga	Bellingen	LGOV
Urunga, Bellinger River South Underbridge	581.890km North Coast Railway	Urunga	Bellingen	SGOV

There was a total of 29 records matching your search criteria.

Key:
LGA = Local Government Area
GAZ= NSW Government Gazette (statutory listings prior to 1997), HGA = Heritage Grant Application, HS = Heritage Study, LGOV = Local Government, SGOV = State Government Agency.
Note: The Heritage Branch seeks to keep the State Heritage Inventory (SHI) up to date, however the latest listings in Local and Regional Evironmental Plans (LEPs and REPs) may not yet be included. Always check with the relevant local council or shire for the most recent listings.

Appendix L Traffic Impact Assessment











NSW Soil Conservation Service

Urunga Antimony Processing Plant

Traffic Impact Assessment

Rev 0

June 2014

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   - 1.3 Scope 1
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Appendices

Appendix A – Agency Responses to DGR's

Appendix B – Crash Data

1. Introduction

Soil Conservation Service (SCS) has been engaged by NSW Catchment and Lands - Crown Lands (Crown Lands) to manage the rehabilitation of a former antimony processing facility located at Hillside Drive, Urunga, NSW (the Site). GHD has been engaged to undertake an Environmental Impact Statement (EIS). This has been prepared to assess the potential impacts of the proposed remediation of a former antimony processing facility located at Hillside Drive, Urunga, NSW (the Site), hereafter referred to as the 'Proposal'.

1.1 Purpose

The purpose of this investigation was to undertake a traffic and access assessment of the Proposal.

1.2 Scope and limitations

This report has been prepared by GHD for NSW Soil Conservation Service and may only be used and relied on by NSW Soil Conservation Service for the purpose agreed between GHD and the NSW Soil Conservation Service as set out Section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than NSW Soil Conservation Service arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

Site conditions may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

1.3 Scope

The study area for this traffic and access assessment encompasses the local road network around Hillside Drive, Urunga NSW.

This assessment has been prepared to address specific requirements, including the Director General's Requirements from the Department of Planning and Infrastructure (DP&I) (now Department of Planning and Environment), and key issues raised by statutory agencies through formal correspondence. This correspondence is included in Appendix A.

The requirements relevant to this assessment, along with a reference to the relevant sections of this report, are provided below

Table 1-1 Assessment requirements

Source	Requirement	Section of this report
Director General's Requirements (Traffic and Transport)	The EIS must address the following specific matters including:	
	a description of site accesses, haulage routes, internal roads and parking required as a result of the development;	3.2, 3.5 and 4.2
	an assessment of the potential impacts on the capacity, efficiency and safety of the road network, including an analysis of intersection sight distances; and	2.5 and 4.1
	details of any upgrades to road infrastructure that would be required.	5
Roads and Maritime Services	A detailed traffic study should include:	
	Impact of existing and proposed development on the road network	4
	Existing and proposed access conditions	2 and 3.2
	Intersection sight distances	2.5
	Proposed improvements for road intersections	n/a
	Cumulative traffic impact	4.1
	Detail of servicing and parking arrangements	3.4, 4.4
	Impact on School zone	4.3
	Impact on transport	4.3
	Consideration for pedestrians and cyclists	4.3
	Impact of road traffic noise and dust	Refer to separate air and noise assessments
	Clauses 104 of the SEPP (Infrastructure)	4.5

2. Existing conditions

A plan of the study area is shown in **Error! Reference source not found.**. Key roads in the surrounding area are the Pacific Highway, Hillside Drive and Pilot Street.

2.1 Pacific Highway

The Pacific Highway is a national road transport route along Australia's east coast. In Urunga, the Pacific Highway is the primary road route from Nambucca Heads through Urunga to Coffs Harbour. Construction is currently underway of an upgrade of the Pacific Highway. The Nambucca to Urunga section is scheduled for completion in 2016.

In the township of Urunga, the Pacific Highway has a sign posted speed limit of 50km/hr. A fixed speed camera is located on the road 100 metres south-west of the intersection of Pacific Highway and Hillside Drive.

There is one lane in each direction with lanes line-marked 3.5 metres wide with sealed shoulders varying from 0.5 to 1.0 metres wide.

2.2 Hillside Drive

The intersection of Pacific Highway and Hillside Drive is a rural basic left turn in the minor road (BAL). There is no pavement widening allowing traffic to pass around right tuning vehicles on the Pacific Highway and there are no auxiliary lanes provided for accelerating or decelerating vehicles.

Hillside Drive is approximately 7 metres wide with no line marking. The road provides direct access for residential properties, generally located on the northern side of Hillside Drive. SO-type kerb is located in front of properties. There is no formal drainage on the southern side of Hillside Drive.



Paper Size A4

0 65 130 260 390 520 650

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND

- Site boundary
- PrimaryRoad
- Railway
- Waterbody
- Suburb

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga NSW

Job Number 22-16251-03
Revision A
Date 13 Jun 2014

Site Locality

Figure 2.1

N:\AU\Newcastle\Projects\22\16251\GIS\Maps\Deliverables\TrafficReport\2216251_T001_Locality_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

© 2014. Whilst every care has been taken to prepare this map, GHD (and LPI) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: LPI; DTDB, 2012. Commonwealth of Australia (Geoscience Australia); 250K Topographic Data Series 3, 2006. Created by: tmorton



Figure 2.2 Pacific Highway Looking South form Hillside Drive



Figure 2.3 Hillside Drive Looking East



Figure 2.4Pacific Highway Looking North from Hillside Drive

2.3 Daily traffic volumes

2.3.1 Pacific Highway

RMS Count Station 09.247 is located at the boundary of Bellingen Shire and Nambucca Shire. This station provides an indication of the traffic on the Pacific Highway south of Urunga.

In 2007, the Average Annual Daily Traffic (AADT) reported was 10,550.

2.3.2 Hillside Drive

Bellingen Shire Council provided traffic data for a Hillside Drive undertaken in 1995. The Average Daily Traffic on Hillside Drive was 401.

2.4 Crash history

Crash history of the roads within the study area was provided by Roads and Maritime Services (RMS) for the period between January 2009 and December 2013. This data is included in Appendix B.

During the 5 year reporting period, there were 26 crashes recorded, one crash causing fatalities, 10 injury crashes and 15 non-casualty crashes. 22 of these crashes occurred on the Pacific Highway. On the Pacific Highway, 8 crashes were attributed to rear-end type.

There was one crash on The Pacific Highway reported at the intersection of Hillside Drive, a rear-end type crash. There were no crashes reported on Hillside Drive.

There were two crashes recorded on High Street, both off bend into object type. There were also two crashes reported on Pilot Street, both off road into object types.

2.5 Sight distance

Austroads Guide to Road Design Part 4A Unsignalised and Signalised Intersections Section 3.2 recommends a safe intersection sight distance of 97 metres and a minimum gap sight distance of 69 metres for a 50 km/hr speed zone. Site measurements indicated that visibility for vehicles turning from Hillside Drive onto the Pacific Highway have approximately 250 metres line of sight available in each direction. The sight distance at Hillside Drive is also within the recommendations of Austroads.

2.6 Other transport modes

2.6.1 Buses

Busways operates public bus services between Macksville and Bellingen incorporating Urunga. The bus routes are shown in Figure 2.5

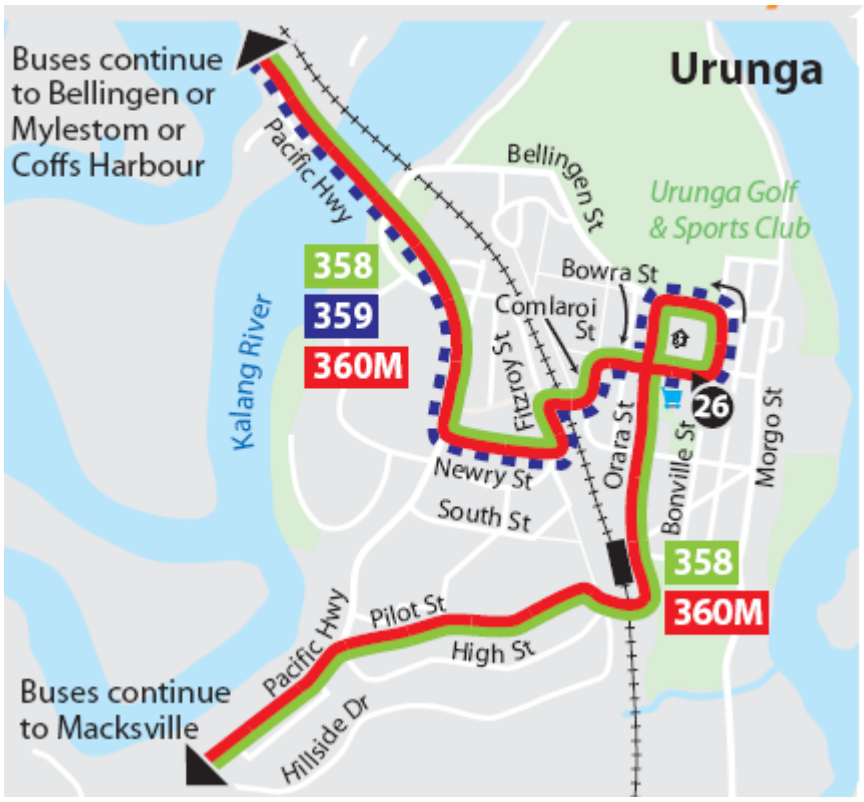


Figure 2.5 Urunga Public Bus Services – Source Busways

The number of daily services is shown in Table 2-1.

Table 2-1 Bus services

Route	Destination	Week Day Services	Weekend Services
358	Bellingen	8	3
358	Macksville	13	4
359	Bonneville	2	0
360M	Coffs Harbour	6	2
360M	Macksville	7	2

2.6.2 Coaches

Premier and Greyhound provide coach services on the Pacific Highway. These services are summarised in Table 2-2. The passenger pickup and drop off point in Urunga is the Tourist Information Centre, approximately 3.6 kilometres north of Hillside Drive.

Table 2-2 Coach services

Operator	Route	Service Frequency
Greyhound	Sydney - Brisbane	3 daily each direction
Premier	Sydney - Brisbane	1 daily each direction

2.6.3 Cyclists

There is no provision for cyclists on the Pacific Highway, Hillside Drive or Pilot Street.

2.6.4 Pedestrians

There is no provision for pedestrians on the Pacific Highway or Hillside Drive. A concrete footpath is provided on the northern side of Pilot Street for approximately 90 metres to the intersection with Orara Street.

3. Proposed development

3.1 General Description

The Proposal is to undertake remediation works at a former Antimony Plant.

3.1.1 Proposal Tasks

The remediation project will require the following tasks to be undertaken:-

1. Site Establishment
2. Water Management
3. Excavation works
4. Excavation validation
5. Soil treatment
6. Containment cell construction
7. Backfilling and land forming
8. Management on ongoing management

3.2 Access

Machinery would access the site from Hillside Drive. Two access roads would be constructed as part of the Proposal. These locations have previously been used for site access but will require clearing, widening and pavement work in order to function appropriately. The proposed access locations are provided on Figure 3.1.



Paper Size A4

0 15 30 60 90 120 150

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Site boundary
- Cadastre
- Site access

NSW Catchment and Lands - Crown Lands
Former Antimony Processing Plant, Urunga NSW

Job Number	22-16251-03
Revision	A
Date	25 Jun 2014

Locality Plan

Figure 3.1

N:\AU\Newcastle\Projects\22\16251\GIS\Maps\Deliverables\TrafficReport\2216251_T002_SitePlan_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

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Data source: LPI; DTDB, 2012. Commonwealth of Australia (Geoscience Australia); 250K Topographic Data Series 3, 2006. Created by: tmorton

3.3 Site layout and traffic circulation

The proposed site layout is shown in Figure 3.1. There is required safe manoeuvring space for vehicles available within the site.

3.4 Parking

On-street parking is permissible on Hillside Drive, however, this may obstruct safe ingress and egress of site vehicles. All site personnel will be required to park at a suitable location within the site.

3.5 Traffic generation

3.5.1 Haulage vehicles

During the remediation, an average of 10-20 vehicles per day would be required to access the site. This equates to 20-40 total daily movements. It is expected that on occasion, heavy vehicle movements would peak at 60 movements per day. This increased volume of heavy vehicle movements would occur during:-

- Construction of containment cell base
- Construction of containment cell cap
- Backfilling of the excavation

The likely source of imported material would be from the Pacific Highway construction works. Depending on the location of the source material, the heavy vehicle routes would be either to the north or the south. Haulage vehicles would access the site via Hillside Drive.

3.5.2 Construction workforce

During remediation, it is anticipated that there would be a maximum of 20 employees on the site at any one time. This would yield a daily workforce traffic generation in the order of 60 vehicle trips per day (vtpd). It is assumed the majority of the workforce would arrive between 6:30 am and 7:30 am and depart generally between 4:00 pm and 6:30 pm.

3.5.3 Operational traffic generation

At the completion of the remediation work, access to the site would be required for monitoring purposes. This would occur infrequently and would not impact on the local traffic and access.

3.6 Construction hours

The site remediation is expected to be undertaken over a period of 4-6 months, commencing in mid-late 2014.

The hours of operation would depend on site requirements. The proposed hours of operation are:

- Weekdays - 7.00am - 6.00pm
- Saturdays - 8.00am - 1.00pm
- Saturday afternoons and Sundays - No work
- Public holidays - No work

3.7 Site equipment

Table 3-1 lists the plant and equipment that would operate on site.

Table 3-1 Site equipment

Item	Number on site
Excavator (35 tonne)	2
Skid Steer Loader	1
Bob cat	2
Compactors/rollers	2
Haul Trucks	2
Water Pump	2
Hand tools (motorised and pneumatic)	Various

4. Impact assessment

4.1 Cumulative traffic impacts

At its peak, the site would be expected to generate 60 truck movements and 20 staff movements per day. The likely traffic volumes at the Hillside Drive intersection were be estimated, and compared with design warrants in the Austroads Guide to Road Design Part 4A. Projecting the supplied traffic data to 2015 assuming a 0.5% p.a. growth rate, and a 50/50 directional split is shown in Table 4-1.

Table 4-1 Projected traffic volumes

Road	AADT	Year	Growth Rate	2015 volumes	Peak Hour volumes
Pacific Highway	10550	2007	0.5	10980	549
Hillside Drive	401	1995	0.5	444	23

Assuming 50% traffic turns south from Hillside Drive and 50% turns north, these volumes were compared to the Austroads design warrants as shown in Figure 4.1.

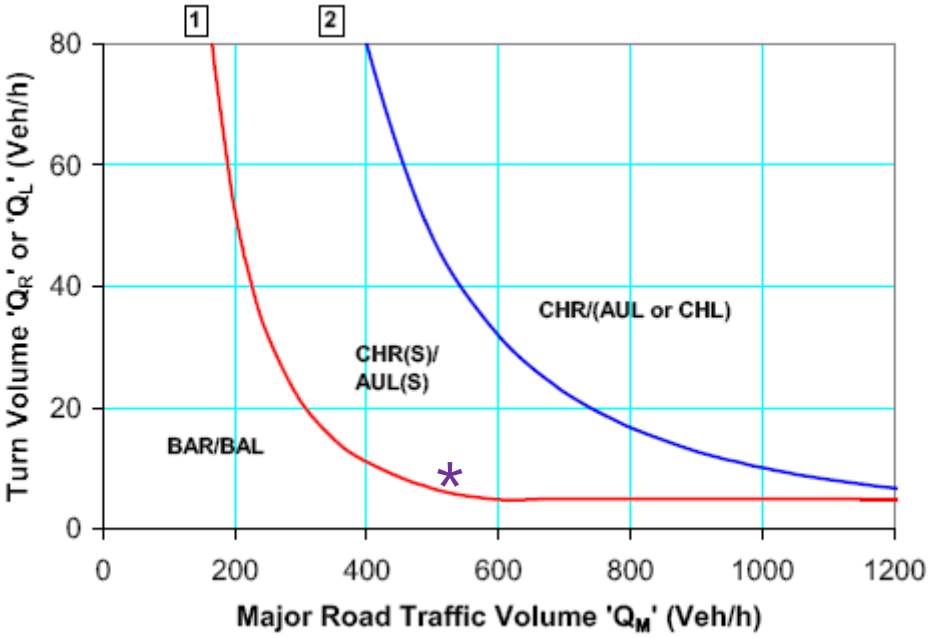


Figure 4.1 Austroads warrants for turn treatments on the major road at unsignalised intersections

Based on this warrant, the need for a channelized treatment is marginal. Given the relaytively short duration of traffic-generating activity, the relatively low volume of traffic that would be turning into and out of Hillside Drive, the good sight distance available in all directions, and the low traffic speed on the Pacific Highway, no intersection upgrade is considered necessary.

4.2 Haulage route

Haulage of materials would primarily be between the site and the Pacific Highway via Hillside Drive, for distribution onto the wider network. Routes will depend on the source of materials.

4.3 Impact on vulnerable road users

As noted in Section 2.6, there are no dedicated facilities for pedestrians or cyclists on Hillside Drive. Given the relatively low traffic volumes on the road and the scale of traffic increase expected, there is not expected to be any deterioration in safety for pedestrians or cyclists. Similarly, there will be no direct impact on any existing bus stops, or bus services.

There are no school zones with the study area. As such, there will be no impact to the safety of school zones.

4.4 On-site traffic management

The site will be accessed via Hillside Drive. A site office and amenities block will be located within the site. At this location, there is expected to be sufficient space for the manoeuvring and parking of staff vehicles, and other site vehicles as required.

Traffic movement within the site will depend on the task being undertaken at the time. Vehicle access paths will be established to suit the specific activities being undertaken.

Details of the long term use of the Site have not yet been finalised however a passive public space/recreational use is likely. This may result in a minor increase in vehicles parking along Hillside Drive and increased on-site pedestrian access. This development would be subject to a separate application.

4.5 State Environment Planning Policy (Infrastructure) 2007

Clause 104 of the SEPP for Infrastructure requires that, amongst other things, the consent authority (in this case, Bellingen Shire Council) advise the RTA (now RMS) of the application, and take into account any response received from RMS on the proposal when determining the application. The items the consent authority is also required to take into consideration are described in Table 4-2.

Table 4-2 State Environment Planning Policy – Items for consideration

Item to be addressed	How addressed
The efficiency of movement of people and freight to and from the site and the extent of multi-purpose trips	The most efficient route to the site is via Hillside Drive. Refer Section 3.5.1
The potential to minimise the need for travel by car and to maximise movement of freight in containers or bulk freight by rail	Access by rail is not available for this development
Any potential traffic safety, road congestion or parking implications of the development.	Refer Sections 4.1, 4.2, 4.3 and 4.4

5. Recommendations

To minimise potential impacts to traffic and access due to the proposal, the following measures are recommended:

A detailed Traffic Management Plan would be prepared prior to construction which would include such measures to provide safe access points to work areas from the adjacent road network, temporary speed restrictions when necessary, adequate sight distances and prominent warning signage.

Contractor Preconstruction

- Residents in the vicinity of the access tracks must be consulted in regard to site access
- No machinery or vehicles are to park along Hillside Drive

Contractor Construction

- Vehicle access is to be maintained to all driveways along Hillside Drive
- Access tracks are to be stabilised or rehabilitated following completion of the works

Subject to these recommendations, the proposed development is supported on traffic grounds.

Appendices

Appendix A – Agency Responses to DGR's

Transport
Roads & Maritime
Services

NTH12/00063, CR2012/006515
Your ref: SSD 5357

The Director
Mining & Infrastructure Projects
NSW Planning & Infrastructure
GPO Box 39
SYDNEY NSW 2001

Attn: Deana Burn

Dear Sir/Madam,

Urunga Antimony Plant Remediation (SSD 5357), Lot 1 DP 874874, Hillside Drive, Urunga

I refer to your letter of 21 June 2012 seeking comment on the abovementioned state significant development proposal.

The key concern for Roads and Maritime Services (RMS) is the safety and efficiency of the state classified road network, in particular the Pacific Highway (HW10), which connects with Hillside Drive.

RMS requests that the DGRs include the following issues to be addressed by any Environmental Impact Statement (EIS).

A detailed traffic study should be undertaken that takes into account the key issues relevant to the scale of this proposal as set out in Table 2.1 of the Roads and Traffic Authority's current 'Guide to Traffic Generating Developments" (copy attached). The traffic study should include information relating to:

- An assessment of the potential traffic impacts on the capacity, efficiency and safety of the state classified road network, particularly the impacts of heavy vehicles.
- The number and type of vehicle trips to be generated by the proposed development.
- Existing and proposed access conditions.
- Intersection sight distances of connections with the Pacific Highway including;
    - Safe Intersection Sight Distance (SISD),
    - Approach Sight Distance (ASD),
    - Truck Safe Sight Distance (TSSD).
- Improvements for roads, junctions / intersections.
- Proposed Haulage routes for removed materials
- Detail of servicing and parking arrangements
- Connectivity to existing developments
- Impact on Transport (Public and School Bus Routes)
- Provisions for pedestrians, alternative transport modes such as bicycles
- Road Traffic Noise

To ensure that haulage routes do not adversely impact on the safety of the road network adjoining these proposals, RMS recommends that the traffic study be supported by a Road Safety Audit, undertaken by a suitably qualified person.

Current AUSTROADS standards should be adopted for any necessary upgrading of the surrounding road infrastructure.

To fulfil legislative, construction and environmental requirements, RMS will require the developer to enter into a Works Authorisation Deed (WAD) to carry out any works on the Pacific Highway. Prior to any construction activities on a state road, a number of prescribed requirements and conditions will need to be undertaken, including the process for geometric and pavement design approval, project management arrangements, insurances, WHS and environmental management during construction, construction specifications and the process for approval of road occupancies. All works will need to be undertaken by an RMS approved Contractor and be at no cost to RMS. Additionally, RMS will require payment of costs for the administration of the WAD.

Should you have any further questions please contact Matt Adams of RMS Development Northern on (02) 6640 1300 or via email at: development.northern@rms.nsw.gov.au

Yours faithfully,

10 JUL 2012

for David Bell
Regional Manager, Northern

BELLINGEN SHIRE COUNCIL

33-39 Hyde Street, Bellingen NSW

All communications to be addressed to the General Manager
P.O. BOX 117 BELLINGEN NSW 2454

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FAX.: (02) 6655 2310
EMAIL: council@bellingen.nsw.gov.au
WEBSITE: www.bellingen.nsw.gov.au

L10011
my
Anthony Brandie
Direct Line: (02) 66 557 326

3 July 2012

Deana Burn
NSW Planning and Infrastructure
GPO Box 39
SYDNEY NSW 2001

Dear Madam

URUNGA ANTIMONY PLANT REMEDIATION (SSD 5357)

I refer to your correspondence dated 21 June 2012 requesting Council's requirements for the preparation of the Environmental Impact Statement (EIS) for the referenced project. The Project Application and Preliminary Environmental Assessment documents prepared by Clayton Colmer of the Soil Conservation Service have been reviewed and Council hereby requests that the following matters be given consideration in the preparation of the EIS for the subject project;

- *Local traffic impacts and potential conflict with the existing vehicular access to the site being adjacent to the Pacific Highway.*
- *Potential conflicts with downstream users of the watercourse during the remediation phase ie. fishing and other recreational activities.*
- *Management of public perception and community expectations during the remediation phase (pollution management) and post remediation (future land use).*
- *The potential for remediation works to adversely impact on Aboriginal objects and/or Aboriginal places of heritage significance and the limitation to desktop investigations to identify this potential.*
- *Contemporary legislative provisions, noting that the preliminary report references repealed material.*

Thank you for the opportunity to comment on this project.

Should you have any further enquiries contact the undersigned between 8.30am –10.30 am. **NB:** The Division of Environmental Health and Planning Office hours are Monday to Friday 8.30am to 4.30pm.

Yours faithfully

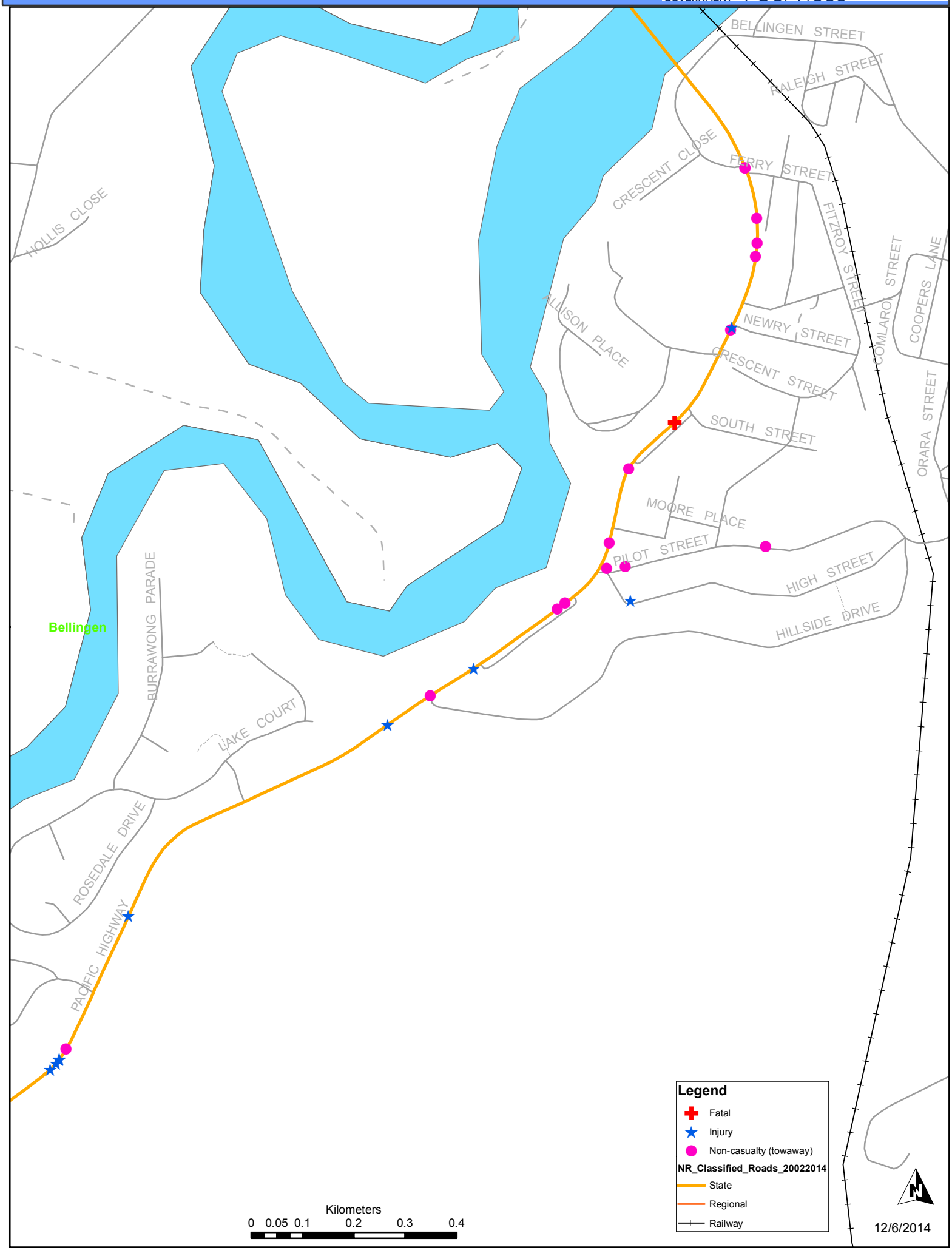
Anthony Brandie
Environmental Health and Building Surveyor

Appendix B – Crash Data

Pacific Highway, Pilot St, High St and Hillside Dr, Urunga

Crash Data 1/1/2009 to 31/12/2013

NSW GOVERNMENT Transport Roads & Maritime Services



Summary Crash Report

# Crash Type		
Car Crash	24	92.3%
Light Truck Crash	4	15.4%
Rigid Truck Crash	0	0.0%
Articulated Truck Crash	4	15.4%
'Heavy Truck Crash	(4)	(15.4%)
Bus Crash	0	0.0%
"Heavy Vehicle Crash	(4)	(15.4%)
Emergency Vehicle Crash	0	0.0%
Motorcycle Crash	1	3.8%
Pedal Cycle Crash	0	0.0%
Pedestrian Crash	1	3.8%

' Rigid or Artic. Truck " Heavy Truck or Heavy Bus
These categories are NOT mutually exclusive

Location Type		
*Intersection	6	23.1%
Non intersection	20	76.9%

* Up to 10 metres from an intersection
~ 07:30-09:30 or 14:30-17:00 on school days

Collision Type		
Single Vehicle	7	26.9%
Multi Vehicle	19	73.1%

Road Classification		
Freeway/Motorway	0	0.0%
State Highway	22	84.6%
Other Classified Road	0	0.0%
Unclassified Road	4	15.4%

Contributing Factors		
Speeding	9	34.6%
Fatigue	5	19.2%
Alcohol	3	11.5%

Weather		
Fine	14	53.8%
Rain	7	26.9%
Overcast	5	19.2%
Fog or mist	0	0.0%
Other	0	0.0%

Road Surface Condition		
Wet	10	38.5%
Dry	16	61.5%
Snow or ice	0	0.0%

Natural Lighting		
Dawn	1	3.8%
Daylight	16	61.5%
Dusk	0	0.0%
Darkness	9	34.6%

Crash Movement		
Intersection, adjacent approaches	0	0.0%
Head-on (not overtaking)	3	11.5%
Opposing vehicles; turning	1	3.8%
U-turn	1	3.8%
Rear-end	8	30.8%
Lane change	0	0.0%
Parallel lanes; turning	0	0.0%
Vehicle leaving driveway	2	7.7%
Overtaking; same direction	0	0.0%
Hit parked vehicle	0	0.0%
Hit railway train	0	0.0%
Hit pedestrian	0	0.0%
Permanent obstruction on road	0	0.0%
Hit animal	0	0.0%
Off road, on straight	0	0.0%
Off road on straight, hit object	2	7.7%
Out of control on straight	1	3.8%
Off road, on curve	0	0.0%
Off road on curve, hit object	6	23.1%
Out of control on curve	1	3.8%
Other crash type	1	3.8%

CRASHES	26	
Fatal crash	1	3.8%
Injury crash	10	38.5%
Non-casualty crash	15	57.7%

CASUALTIES	24	
Killed	2	8.3%
Injured	22	91.7%
^ Unrestrained	1	4.2%

^ Belt fitted but not worn, No restraint fitted to position OR No helmet worn

Time Group		% of Day	
00:01 - 02:59	1	3.8%	12.5%
03:00 - 04:59	0	0.0%	8.3%
05:00 - 05:59	1	3.8%	4.2%
06:00 - 06:59	0	0.0%	4.2%
07:00 - 07:59	0	0.0%	4.2%
08:00 - 08:59	0	0.0%	4.2%
09:00 - 09:59	0	0.0%	4.2%
10:00 - 10:59	4	15.4%	4.2%
11:00 - 11:59	3	11.5%	4.2%
12:00 - 12:59	2	7.7%	4.2%
13:00 - 13:59	1	3.8%	4.2%
14:00 - 14:59	0	0.0%	4.2%
15:00 - 15:59	1	3.8%	4.2%
16:00 - 16:59	3	11.5%	4.2%
17:00 - 17:59	1	3.8%	4.2%
18:00 - 18:59	1	3.8%	4.2%
19:00 - 19:59	0	0.0%	4.2%
20:00 - 21:59	5	19.2%	8.3%
22:00 - 24:00	3	11.5%	8.3%

Crashes		Casualties
4	2013	4
5	2012	13
2	2011	2
10	2010	3
5	2009	2

~ School Travel Time		
Involvement	1	3.8%

Speed Limit				
40 km/h or less	0	0.0%	80 km/h zone	4	15.4%
50 km/h zone	7	26.9%	90 km/h zone	0	0.0%
60 km/h zone	12	46.2%	100 km/h zone	0	0.0%
70 km/h zone	3	11.5%	110 km/h zone	0	0.0%
~ 40km/h or less	0	0.0%			

Street Lighting Off/Nil			% of Dark
6	of	9 in Dark	66.7%

McLean Periods			% Week
A	0	0.0%	17.9%
B	1	3.8%	7.1%
C	8	30.8%	17.9%
D	2	7.7%	3.5%
E	0	0.0%	3.6%
F	3	11.5%	10.7%
G	4	15.4%	7.1%
H	2	7.7%	7.1%
I	3	11.5%	12.5%
J	3	11.5%	10.7%

Day of the Week						# Holiday Periods		
Monday	5	19.2%	Thursday	4	15.4%	Sunday	3	11.5%
Tuesday	3	11.5%	Friday	6	23.1%	WEEKDAY	20	76.9%
Wednesday	2	7.7%	Saturday	3	11.5%	WEEKEND	6	23.1%

New Year	0	0.0%	Queen's BD	0	0.0%	Easter SH	0	0.0%
Aust. Day	0	0.0%	Labour Day	0	0.0%	June/July SH	4	15.4%
Easter	0	0.0%	Christmas	3	11.5%	Sept./Oct. SH	0	0.0%
Anzac Day	0	0.0%	January SH	5	19.2%	December SH	3	11.5%

Crashid dataset Urunga, Pacific Highway, Pilot St, High St, Hillside Dr Crash Data ~~1/10/2008 to 30/9/2013~~

Note: Crash Data 1/1/2009 to 31/12/2013 Data for the 9 month period prior to the generated date of this report are incomplete and are subject to change.

Percentages are percentages of all crashes. Unknown values for each category are not shown on this report.

Detailed Crash Report

Transport for NSW — Centre for Road Safety

Crash No.	Date	Day of Week	Time	Distance		ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
																					S F
Northern Region																					
Bellingen LGA																					
Urunga																					
High St																					
845151	31/05/2013	Fri	20:20		at	NUMBER 4 HN	2WY	CRV	Fine	Dry	50	2	CAR	F65	W in HIGH ST	Unk	Proceeding in lane	I	0	1	S F
E52273063							RUM:	81	Off left/rt bnd=>obj				STR		N in HIGH ST		Parked				
																	Tree/bush				
777687	12/11/2011	Sat	21:15		at	PILOT ST	TJN	STR	Fine	Dry	50	2	CAR	F28	N in HIGH ST	50	Turning right	N	0	0	S
E148339898							RUM:	81	Off left/rt bnd=>obj				CAR		E in PILOT ST	0	Parked				
Pacific Hwy																					
718638	17/07/2010	Sat	12:45		at	BELLINGEN ST	XJN	CRV	Fine	Dry	60	2	4WD	M50	N in PACIFIC HWY	40	Proceeding in lane	N	0	0	
E41500176							RUM:	30	Rear end				CAR	M19	N in PACIFIC HWY	60	Proceeding in lane				
723872	27/08/2010	Fri	10:30		at	BELLINGEN ST	XJN	CRV	Fine	Dry	60	2	CAR	M53	N in BELLINGEN ST	5	Turning right	N	0	0	
E41634435							RUM:	24	Right/right				CAR	F44	S in BELLINGEN ST	5	Turning right				
684869	06/09/2009	Sun	20:55	100 m	S	BELLINGEN ST	2WY	CRV	Fine	Wet	60	2	CAR	M44	N in PACIFIC HWY	50	Proceeding in lane	N	0	0	
E38793477							RUM:	30	Rear end				CAR	M45	N in PACIFIC HWY	0	Stationary				
720254	02/08/2010	Mon	12:00	150 m	S	FITZROY ST	2WY	CRV	Fine	Dry	60	2	TRK	M50	S in PACIFIC HWY	50	Proceeding in lane	N	0	0	
E43561980							RUM:	32	Right rear				CAR	F21	S in PACIFIC HWY	0	Wait turn right				
695655	07/01/2010	Thu	16:30		at	HILLSIDE DR	TJN	STR	Fine	Dry	60	2	CAR	M26	N in PACIFIC HWY	40	Proceeding in lane	N	0	0	
E39374817							RUM:	30	Rear end				TRK	M18	N in PACIFIC HWY	40	Proceeding in lane				
684489	29/09/2009	Tue	17:00	100 m	N	HILLSIDE DR	2WY	STR	Fine	Dry	60	1	M/C	M55	S in PACIFIC HWY	60	Proceeding in lane	I	0	1	
E38948140							RUM:	74	On road-out of cont.												
803559	10/07/2012	Tue	10:10	300 m	N	HILLSIDE DR	2WY	STR	Overcast	Dry	50	1	CAR	M26	N in PACIFIC HWY	50	Proceeding in lane	N	0	0	F
E50655284							RUM:	73	Off rd rght => obj				Fence (prior to 2014)								
780544	07/01/2012	Sat	11:45	100 m	S	HILLSIDE DR	2WY	STR	Fine	Dry	60	2	CAR	F25	S in PACIFIC HWY	60	Proceeding in lane	I	0	1	
E46172509							RUM:	30	Rear end				CAR	F61	S in PACIFIC HWY	60	Proceeding in lane				
697650	28/12/2009	Mon	18:10	1.085 km	S	HILLSOIDE DR	2WY	CRV	Raining	Wet	80	1	CAR	M38	S in PACIFIC HWY	80	Proceeding in lane	I	0	1	S F
E39568461							RUM:	81	Off left/rt bnd=>obj				Tree/bush								
801880	02/07/2012	Mon	11:30		at	LIBERTY SERVIC SN	2WY	CRV	Fine	Dry	50	2	CAR	M68	E in PACIFIC HWY	10	Forward from drive	N	0	0	
E47916115							RUM:	47	Emerging from drive				CAR	F72	N in PACIFIC HWY	45	Proceeding in lane				
719273	15/06/2010	Tue	22:45	835 m	N	MARTELLS RD	2WY	CRV	Overcast	Wet	80	2	CAR	M22	N in PACIFIC HWY	Unk	Incorrect side	I	0	2	S
E41703663							RUM:	20	Head on				BDBL	M58	S in PACIFIC HWY	70	Proceeding in lane				

Detailed Crash Report

Crash No.	Date	Day of Week	Time	Distance		ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
																					S F
714238	02/06/2010	Wed	23:35	870 m	N	MARTELLS RD	2WY	CRV	Raining	Wet	80	1	BDBL	M39	S in PACIFIC HWY	70	Proceeding in lane	N	0	0	S
E41372507							RUM:	88	Out of cont on bend												
719994	09/07/2010	Fri	10:25	5 m	S	NEWRY ST	TJN	STR	Fine	Dry	60	2	4WD	M19	N in PACIFIC HWY	55	Proceeding in lane	I	0	1	
E41327311							RUM:	32	Right rear				CAR	F34	N in PACIFIC HWY	0	Wait turn right				
836844	04/01/2013	Fri	15:10	10 m	S	NEWRY ST	TJN	STR	Fine	Dry	50	2	CAR	M57	S in PACIFIC HWY	50	Incorrect side	N	0	0	
E52024387							RUM:	20	Head on				4WD	F43	N in PACIFIC HWY	50	Proceeding in lane				
671954	18/06/2009	Thu	11:15	50 m	N	PILOT ST	2WY	CRV	Overcast	Dry	60	2	TRK	M39	S in PACIFIC HWY	45	Proceeding in lane	N	0	0	
E37588727							RUM:	32	Right rear				4WD	F52	S in PACIFIC HWY	0	Wait turn right				
682385	16/09/2009	Wed	13:00	100 m	S	PILOT ST	2WY	STR	Fine	Dry	60	2	4WD	M24	N in PACIFIC HWY	15	Forward from drive	N	0	0	
E40915888							RUM:	47	Emerging from drive				CAR	F81	N in PACIFIC HWY	15	Proceeding in lane				
846320	29/07/2013	Mon	00:50	650 m	S	RANGE RD	2WY	CRV	Raining	Wet	70	1	CAR	M32	N in PACIFIC HWY	70	Proceeding in lane	I	0	1	S
E249342593							RUM:	85	Off rt/lft bnd=>obj				Tree/bush								
739866	06/01/2011	Thu	16:40	650 m	S	RANGER ST	2WY	CRV	Raining	Wet	80	1	4WD	F36	S in PACIFIC HWY	70	Proceeding in lane	I	0	2	S
E43171705							RUM:	81	Off left/rt bnd=>obj				Tree/bush								
794130	23/04/2012	Mon	20:30	650 m	S	RANGER ST	2WY	CRV	Raining	Wet	70	1	CAR	F18	N in PACIFIC HWY	70	Proceeding in lane	I	0	1	S
E47819203							RUM:	87	Off lft/lft bnd=>obj				Signpost								
772631	08/01/2012	Sun	05:00	25 m	S	SOUTH ST	2WY	STR	Fine	Dry	60	12	UTE	M38	N in PACIFIC HWY	60	Incorrect side	F	2	9	F
E46805257							RUM:	20	Head on				BDBL	M51	S in PACIFIC HWY	Unk	Proceeding in lane				
													PED	F U	PACIFIC HWY		Ped not on carriageway				
													PED	M U	PACIFIC HWY		Ped not on carriageway				
													PED	M U	PACIFIC HWY		Ped not on carriageway				
													PED	M U	PACIFIC HWY		Ped not on carriageway				
													PED	M11	PACIFIC HWY		Ped not on carriageway				
													PED	F46	PACIFIC HWY		Ped not on carriageway				
													PED	M U	PACIFIC HWY		Ped not on carriageway				
													PED	M46	PACIFIC HWY		Ped not on carriageway				
													CAR		N in PACIFIC HWY	0	Parked				
													CAR		W in PACIFIC HWY	0	Parked				
738064	03/09/2010	Fri	23:45	150 m	S	SOUTH ST	2WY	CRV	Overcast	Wet	60	2	CAR	M38	S in PACIFIC HWY	5	Perform U-turn	N	0	0	
E42112026							RUM:	40	U turn				BDBL	M52	S in PACIFIC HWY	20	Proceeding in lane				
1008051	26/12/2013	Thu	10:45	15 m	E	THE HONEY PLACE OT	2WY	STR	Raining	Wet	70	4	TRK	M53	N in PACIFIC HWY	40	Proceeding in lane	I	0	2	
E52890609							RUM:	30	Rear end				TRK	M31	N in PACIFIC HWY	0	Stationary				
													4WD	M49	N in PACIFIC HWY	60	Proceeding in lane				
													4WD	F31	N in PACIFIC HWY	0	Stationary				

Detailed Crash Report

Crash No.	Date	Day of Week	Time	Distance		ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
																					S F
Pilot St																					
730999	05/11/2010	Fri	21:15	50 m	E	PACIFIC HWY	2WY	STR	Raining	Wet	50	3	CAR	M27	W in PILOT ST	45	Proceeding in lane	N	0	0	F
E42834062							RUM:	71	Off rd left => obj				CAR		W in PILOT ST	0	Parked				
													CAR		W in PILOT ST	0	Parked				
737055	26/12/2010	Sun	16:00	330 m	E	PACIFIC HWY	2WY	CRV	Overcast	Dry	50	3	CAR	M24	W in PILOT ST	60	Proceeding in lane	N	0	0	S
E623141590							RUM:	81	Off left/rt bnd=>obj				CAR		W in PILOT ST	0	Parked				
													CAR		W in PILOT ST	0	Parked				

Report Totals: Total Crashes: 26 Fatal Crashes: 1 Injury Crashes: 10 Killed: 2 Injured: 22

Crashid dataset Urunga, Pacific Highway, Pilot St, High St, Hillside Dr Crash Data ~~1/10/2008 to 30/9/2013~~

Note: Crash Data 1/1/2009 to 31/12/2013 Data for the 9 month period prior to the generated date of this report are incomplete and are subject to change.

GHD

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	K Burns	T Bickerstaff		I Gregson		25/06/2014

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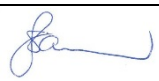
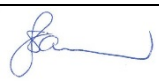
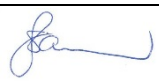
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