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.

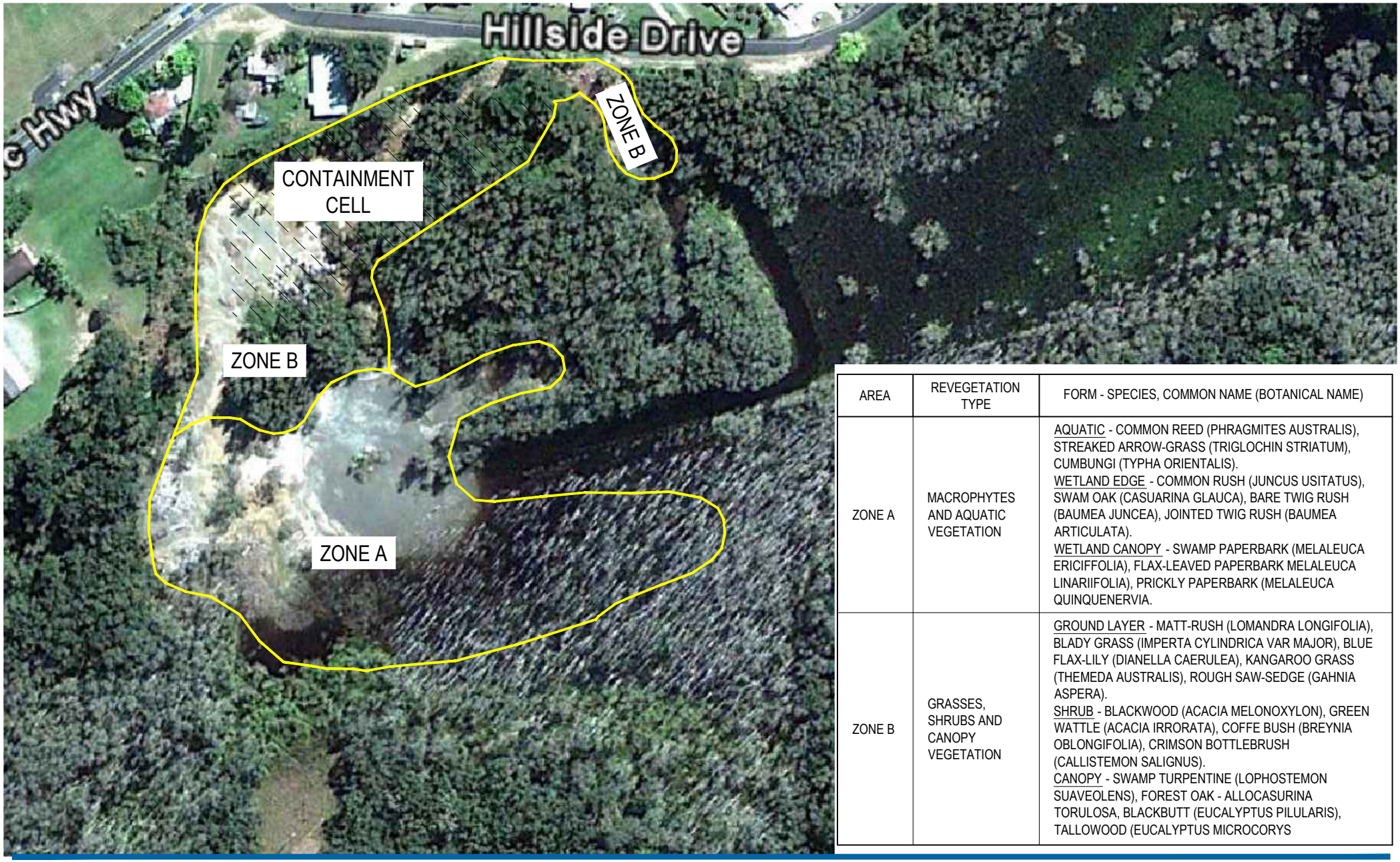
4.9 Backfill and land forming

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

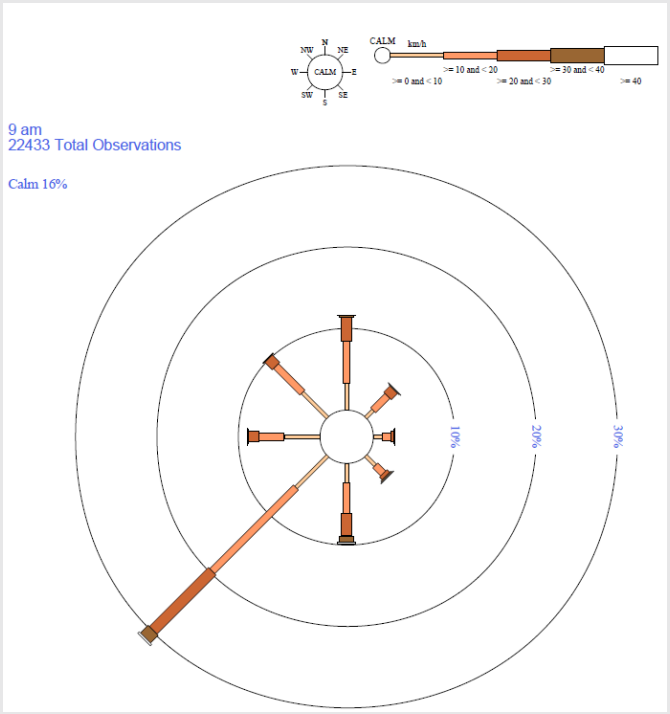
The transport and dispersion of the air emissions from the quarry would be influenced by prevailing synoptic flows and vertical temperature profiles that would alter both diurnally and with wind direction.

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.

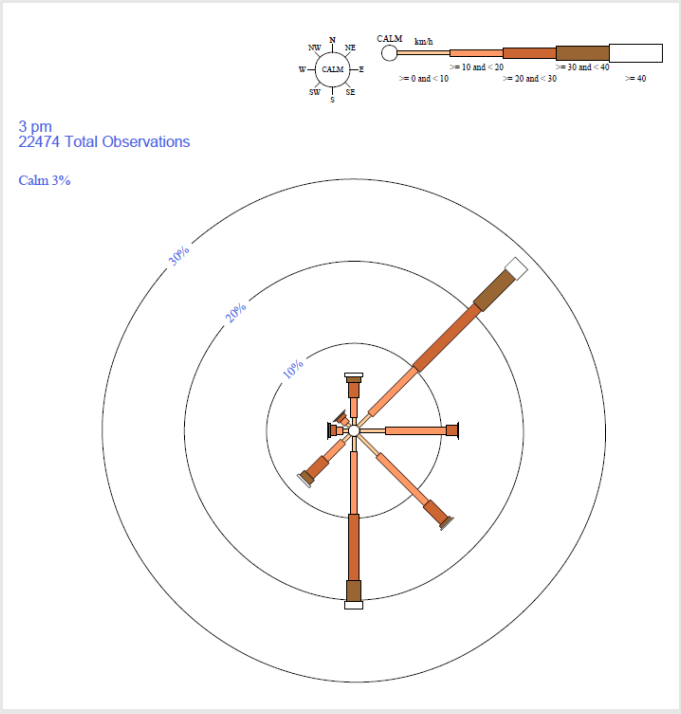
The climate of the Urunga area can be broadly defined as warm temperate. The maximum mean daily temperature is 27˚C in January and the mean minimum temperature is 7.6˚C in July (BOM 2014). The annual maximum mean temperature is 23.3˚C and the annual minimum mean temperature is 14.0˚C (BOM 2014).

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.

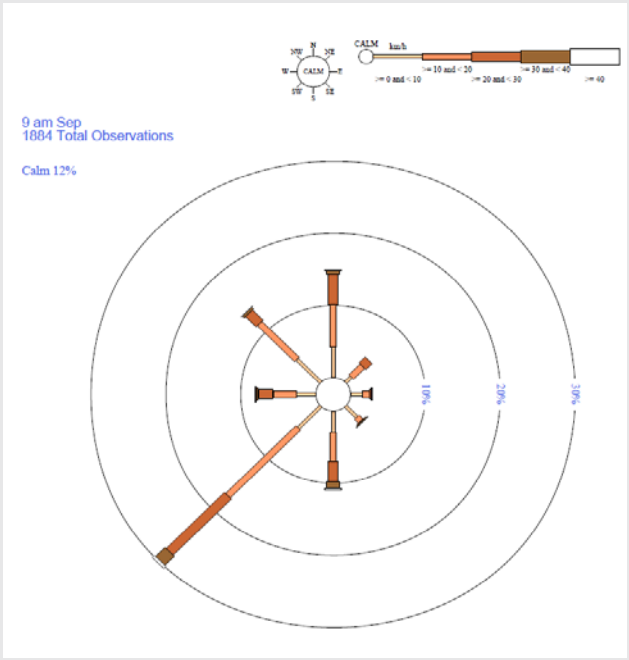


9 am

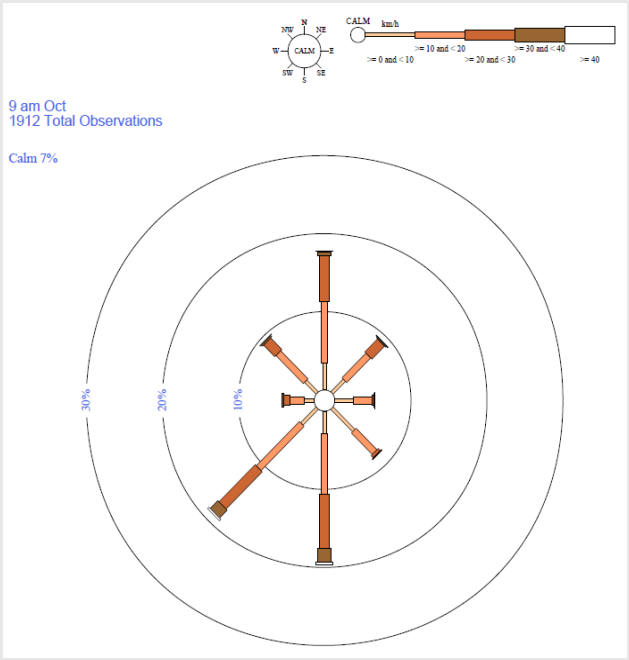


3 pm

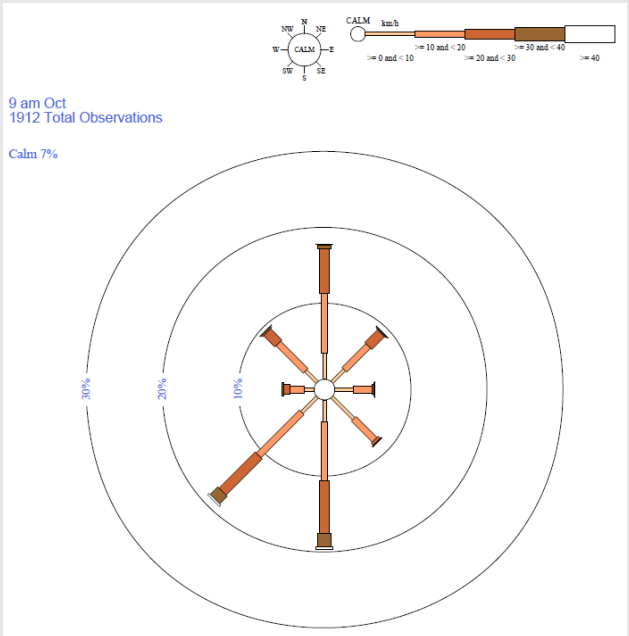
Figure 7-2 Average annual wind direction and speed for Coffs Harbour (BOM 2012)



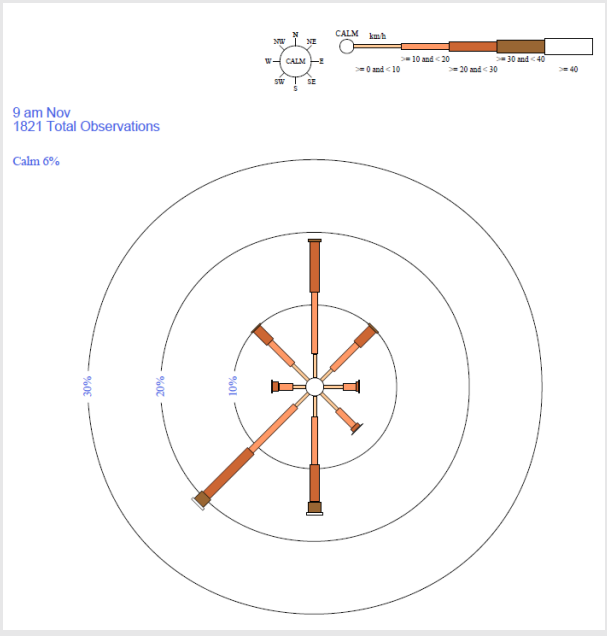
September



November

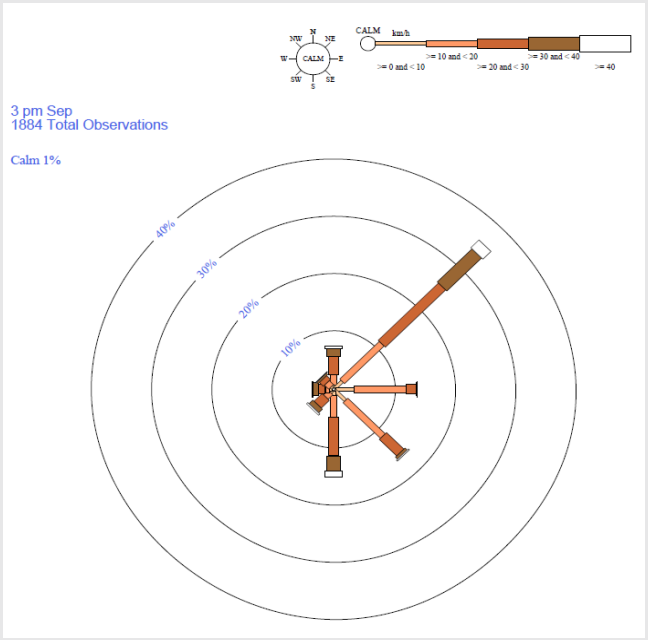


October

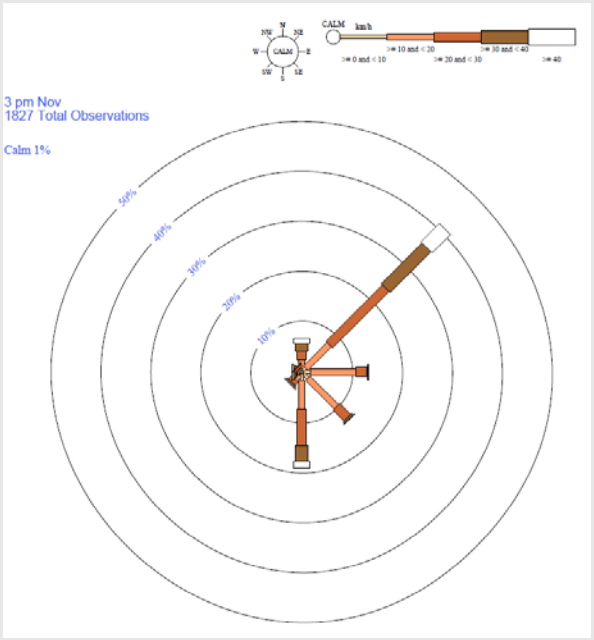


December

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



September



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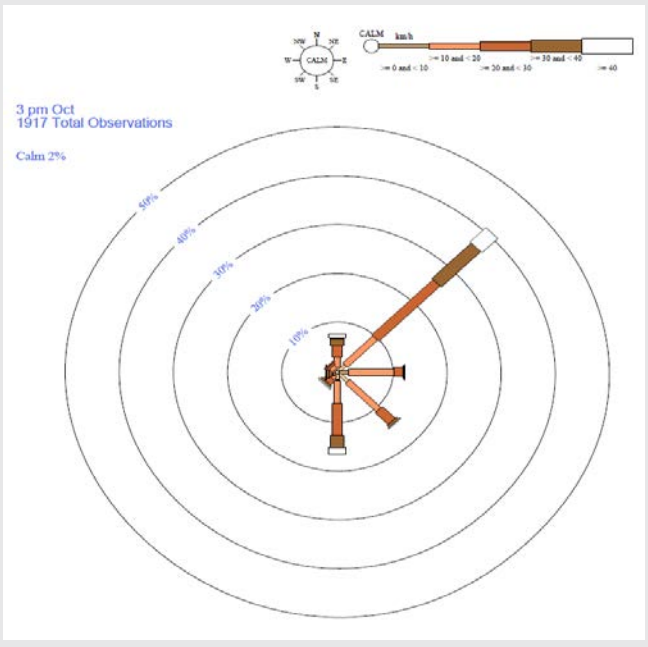

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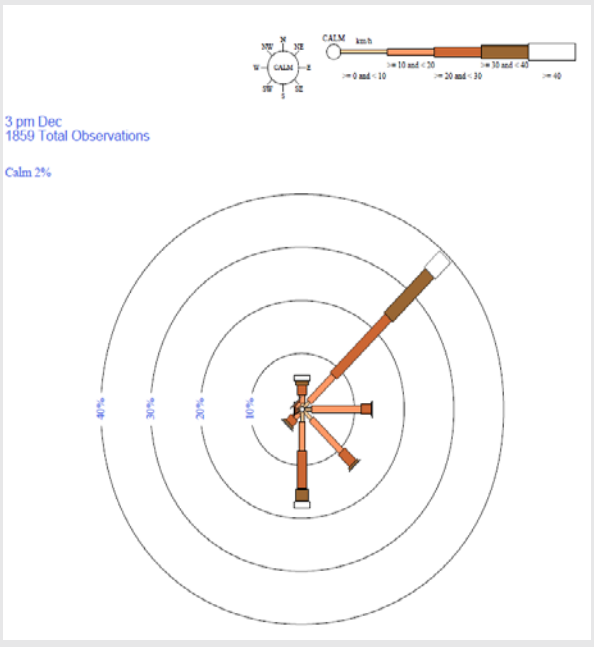

December

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

Vegetation Communities on Site

Job Number	22-16251
Revision	A
Date	25 Jun 2014

Figure 7-5

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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.

11. References and further reading

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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

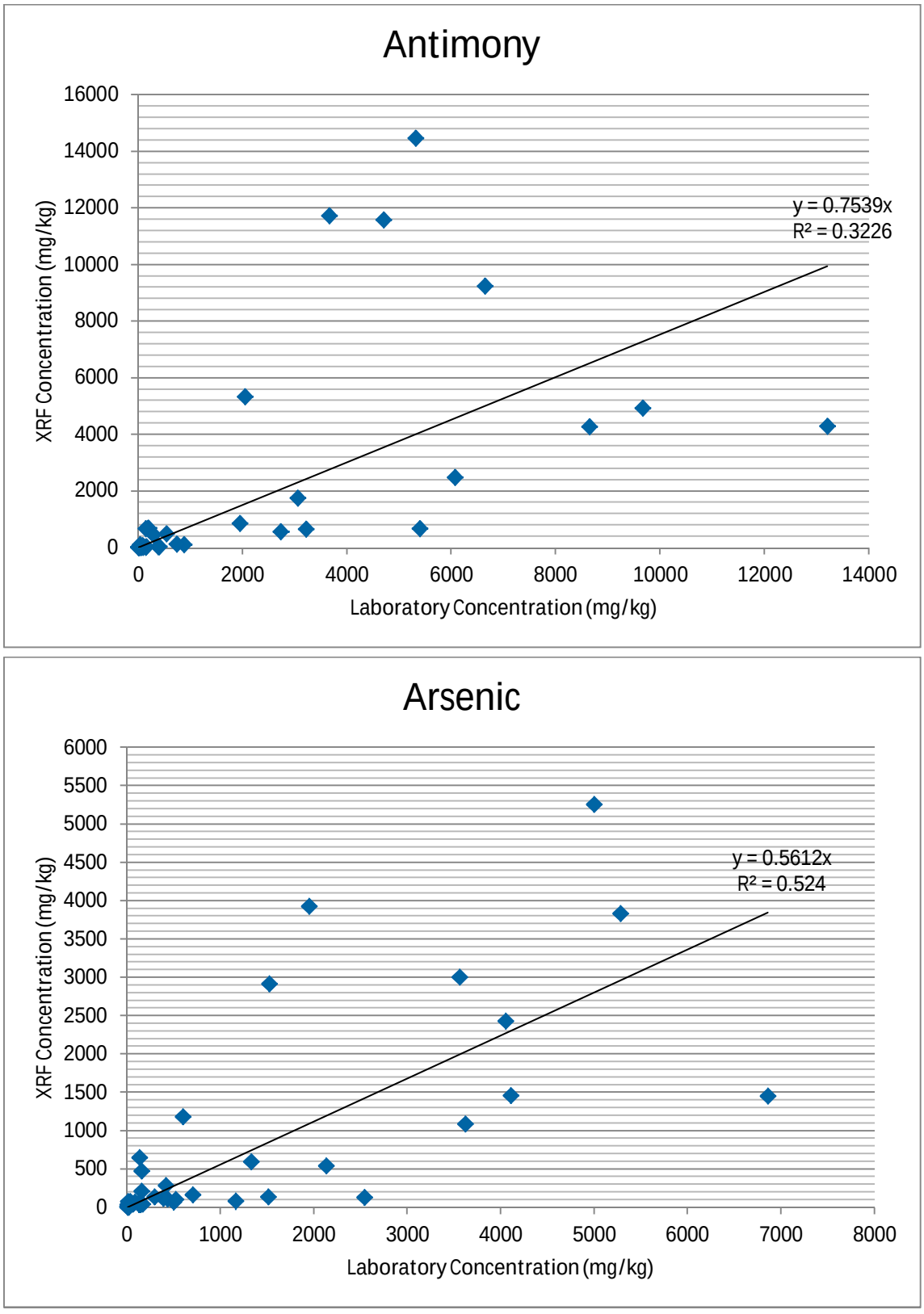
5.1.2 Field Analysis

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).