DETAILED REMEDIATION ACTION PLAN

INCITEC FERTILIZERS LIMITED

PHASE 4

COCKLE CREEK SITE REDEVELOPMENT

BOOLAROO, NEW SOUTH WALES

25 MARCH 2010

DOC. REF: SG061313 RP07

REV1

FOR

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EXECUTIVE SUMMARY

This Detailed Remediation Action Plan (Detailed RAP) addresses the remediation of the Phase 4 portion of the Incitec Fertilizers Limited (IFL) Cockle Creek manufacturing and distribution site located on Main Road, Boolaroo, New South Wales. Phase 4 of the remediation works comprises the remediation of the Southern Area of the site.

It is noted that this Detailed RAP has been prepared for Phase 4 of the remediation works only and that other Detailed RAPs are to be prepared for Phase 2 (Northern Area and Containment Cell) and Phase 3 (Central Area demolition and remediation works) of the staged remediation works. It is noted that previous documents have referred to each phase of works as stages (i.e Stage 2, Stage 3, etc).

The Phase 4 Detailed RAP has been prepared for the following purposes:

1 To form the basis for the remediation program to be instituted in the Southern Area of the site;

2 To provide a detailed framework for the development of a Construction Environment Management Plan (CEMP) which will retain the detail for the physical on site remediation implementation and the scope and monitoring associated with the health and environment management programs to be implemented throughout the Phase 4 remediation program;

3 To comply with the Director-General's Environmental Assessment Requirements (the Requirements) pursuant to section 75F(3) of the Environmental Planning and Assessment Act 1979;

4 To comply with the Voluntary Management Plan (VMP) entered into with the Department of Environment, Climate Change and Water (DECCW) pursuant to section 26 of the Contaminated Lands Management Act 1997 (CLM Act);

5 To remove the *Declaration of Remediation Site* and the *Significant Risk of Harm* orders for the site; and

6 To satisfy IPL Company Values.

The objective of the Phase 4 Detailed RAP is to remediate the Southern Area of the site from its current industrial use, with historical impacts associated with the former smelting operations which occurred adjacent this area, to a site suitable for residential use.

Subsequent to numerous soil and groundwater investigations undertaken across the site over a number of years, the extent of contamination in both soil and groundwater has been identified and delineated. An assessment of a significant number of remedial options has been undertaken. It is considered the most appropriate management approach at the site would be to consolidate and

contain all the soil and other materials unsuitable for use within a residential setting in isolation within a lined containment cell located on the northern portion of the IFL site (Phase 2). The detail of the cell construction is included in the Phase 2 Detailed RAP and the reader is referred to this document for the cell construction details.

Following removal of the site infrastructure, the contaminated soil materials present across this area of the site, including those in the infilled gully and the contaminated material within the dam wall, will be excavated and placed within the containment cell. Excavation will continue until natural soils are encountered. In general, excavation works will commence in upslope areas and progress to down slope areas to minimise the potential for contaminated stormwater to flow into and re-contaminate excavated and validated areas. In addition, excavation will be coordinated with containment cell construction to allow as much material as possible to be excavated, screened and placed directly in the cell without the need for temporary stockpiling.

A number of environmental management measures were identified as being required during the remediation works and will include the preparation of separate management plans by specialist sub consultants for the following aspects of the project: Occupational Health and Safety Plan, Surface Water Management Plan, Groundwater Management Plan, Traffic Management Plan, Air Quality and Dust Management Plan, Asbestos Management Plan and a Noise and Vibration Management Plan.

The final excavated site surface will be validated in accordance with the validation protocol and to the satisfaction of the site auditor. The final landform of this area of the site will approximate the previous natural site surface prior to the deposition of the waste fill materials from the smelter operations, aside from the areas excavated for building construction. This will reinstate the former gully area across this southern section of the site which may form a natural drainage course as part of the site re-development. It is anticipated that the dam wall occurring within the IFL property will not be required for future water management and this will be removed as part of these works.

No groundwater remediation is proposed as part of the Phase 4 works because the removal of contaminated filling present across the southern portion of the site and in particular within the infilled gully will remove the primary source of groundwater contamination and therefore contaminant concentrations in groundwater should decrease significantly following the completion of remediation works at the site. Groundwater contaminant concentrations will be assessed and monitored as part of a Groundwater Quality Management Plan prepared under separate cover for the site.

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DOCUMENT INFORMATION

Rev.	Status	Date	Company	Name
0	Draft	23 March 2010	Incitec Fertilizers Limited	Mr Mark Shelley
			Soil & Groundwater Consulting	File
1	Final	25 March 2010	Incitec Fertilizers Limited	Mr Mark Shelley
			Soil & Groundwater Consulting	File
Doc. Ref.: SG061313 Cockle Creek Phase 4 D-RAP Rev1 230310				

1. INTRODUCTION

1.1 Background

This Detailed Remediation Action Plan (Detailed RAP) addresses the remediation of the Phase 4 portion of the Incitec Fertilizers Limited (IFL) Cockle Creek manufacturing and distribution site located on Main Road, Boolaroo, New South Wales. Manufacturing works have now ceased at the site.

The site is identified as Lot 1 DP225720 and is shown in Figure 1. Phase 4 works comprises:

- the removal of contaminated fill across the Southern Area of the site and;
- placement of the fill into an engineered containment cell located in the northern portion of the site.

It is noted that this Detailed RAP has been prepared for Phase 4 of the remediation works only. A separate Detailed RAP has been prepared for Phase 2 (Northern Area remediation and construction of an engineered containment cell) and a further Detailed RAP will be prepared for Phase 3 (Central Area demolition and remediation works) of the staged remediation works program for the site.

It is noted that previous documents, in particular the Conceptual RAP, have referred to each phase of works as stages (i.e Stage 2, Stage 3 etc.). The nomenclature has changed although the overall programs remain essentially the same.

1.2 RAP Objectives

The Detailed RAP has been prepared for the following purposes:

1 To form the basis for the remediation program to be instituted in the Southern Area of the site;

2 To provide a detailed framework for the development of a Construction Environment Management Plan (CEMP) which will retain the detail for the physical on site remediation implementation and the scope and monitoring associated with the health and environment management programs to be implemented throughout the Phase 4 remediation program;

3 To comply with the Director-General's Environmental Assessment Requirements (the Requirements) pursuant to section 75F(3) of the Environmental Planning and Assessment Act 1979;

4 To comply with the Voluntary Management Plan (VMP) entered into with the Department of Environment, Climate Change and Water (DECCW) pursuant to section 26 of the *Contaminated Lands Management Act* 1997 (CLM Act);

5 To remove the *Declaration of Remediation Site* and the *Significant Risk of Harm* orders for the site; and

6 To satisfy IPL Company Values (included in Section 1.3).

The objective of the Phase 4 Detailed RAP is to provide the framework for the remediation of the Southern Area of the site from its current industrial use, with historical impacts associated with waste disposal from the former smelting operations which occurred at the adjacent site, to a site suitable for residential purposes.

The remediation of the site will be undertaken in a staged approach and a separate Detailed RAP document will be prepared for each of Phases 2 and 3. It is expected this approach will allow the project to be fast tracked and optimise the time frame over which planning and remediation occur. This will minimise the impact of the remediation program on the community and on the surrounding areas which are concurrently being remediated and managed by others with a similar objective.

The Phase 4 Detailed RAP will ensure that the Southern Area of the site is suitable for residential purposes. The Phase 4 Detailed RAP will ensure that these uses are protected now and into the future and that any environmental impacts arising from the site are limited, are determined to be acceptable in the context of environmental and human health protection and do not preclude use of the site for its intended purposes.

In accordance with the requirements outlined above, IFL has entered into a VMP with DECCW. It is proposed that this Phase 4 Detailed RAP as well as the separate RAPs prepared for the remaining two phases of the remediation project will form part of the VMP conditions. In particular, the Detailed RAPs and associated CEMP will address the following issues in order to satisfy the terms of the VMP:

- The objectives of the proposal specifically referring to the requirements set out under the CLM Act and relevant EPA guidelines;
- The principal features of the proposal including the capital works involved, a detailed description of the remediation works to be completed and details on the proposed monitoring and recording methods to be adopted;
- The proposed reporting requirements including the timeframes in which each report will be submitted to DECC;
- Setting out the key milestones for each major remediation activity undertaken on the site.

It is expected that the Site Auditor and DECCW will provide feedback on the implementation of the remediation approach and that any specific requirements identified by the Site Auditor or DECCW

will be included within the current and subsequent Detailed RAP documents to ensure ongoing compliance with regulatory requirements.

This RAP has been prepared in accordance with the *Guidelines for Consultants Reporting on Contaminated Sites* (NSW EPA, 1997). This reference notes that the RAP should:

- Set remediation goals to ensure the site is suitable for its intended use and will not pose an unacceptable risk to human health or to the environment.
- Detail all procedures and plans to be undertaken to manage the risks such that they are acceptable for the proposed use.
- Establish appropriate environmental safeguards to ensure that the remediation is conducted in an acceptable manner and not to the detriment of the environment and community.
- Identify and obtain approvals and licenses required from the appropriate regulatory authorities.
- Determine ongoing management requirements to ensure that the long term risks to the environment and the community are appropriately managed to ensure that any such risks are acceptable.

Soil and Groundwater Consulting (S&G) was engaged by IFL to undertake the environmental assessment of the site and determine appropriate management methods for the identified contaminated materials to render the remediated site suitable for its intended uses. The adopted management approach for the predominantly heavy metal impacted soil / fill materials at the site is isolation within a fully lined and engineered containment cell located within the Phase 2 remediation area of the site.

The removal of the metal impacted soils, which are the primary source of the identified groundwater contamination, to the engineered containment cell will remove the primary ongoing source of groundwater contamination at the site.

1.3 IPL Project Governance

The remediation of the site is being managed by Incitec Pivot Limited (IPL) on behalf of IFL. The remediation of the site will therefore be conducted in accordance with the IPL corporate philosophy. A summary of the key components of this philosophy is provided below.

Zero Harm for Everyone Everywhere

- Promote safe behaviours > Think Safe > Act Safe > Be Safe
- Train and follow safety systems and procedures
- Identify and control hazards

- Look after ourselves and each other

Care for the Community & Our Environment

- Listen to and work with the community
- Treat water as a precious resource
- Minimise environmental impacts and leave NO legacies

Challenge and Improve the Status Quo

- Be proactive in seeking continuous improvement of ideas
- Embrace change and pursue innovative solutions

Treat the Business as our Own

- Achieve the best financial outcomes through controlling costs, minimising wastes and protecting our assets
- Develop positive customer and supplier relationships that benefit and grow the business
- Be accountable and act with honesty and integrity
- Invest in initiatives that secure our future

Value People - Respect, Recognise and Reward

- Respect each other and work as a team
- Communicate in an open and honest manner
- Invest in the development of people through training and mentoring
- Recognise and reward in line with performance
- Work together to achieve a work-life balance

Think Customer. Everyone. Everyday

- Listen, understand and exceed customer expectations
- Build enduring and mutually beneficial customer relationships at all organisation levels
- Deliver safe, reliable products and services on time and complete
- Be the easiest company to do business with

Deliver on Our Promises

- Do what we say we're going to do
- Take ownership
- Find creative ways to deliver
- Clearly communicate

1.4 Review of RAP by Auditor

In accordance with DECCW requirements, a Site Auditor has been appointed to undertake a statutory environmental audit of the site to ensure that the remediated site is suitable for its intended use. As part of this audit, the auditor will review the components of the remediation program to ensure this objective can be met by the proposed actions and that the resultant risks to the environment are acceptable. This includes the Phase 4 Detailed RAP document and will include the CEMP arising from it for the Phase 4 remediation works.

IFL has appointed Mr Phillip Hitchcock of Environmental Auditors Pty Ltd, an accredited Site Auditor in NSW, to undertake the audit of the site.

We understand that Mr Hitchcock will issue an Interim Advice Letter in relation to the Phase 4 Detailed RAP document and complete a Part A audit at the completion of the remediation work program.

Figure provided by Manidis Roberts, March 2010

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Drawn: DJN	Date: 19 March 2010		Job No.: SG061313	Project: Cockle Creek Assessments	
Checked: AKW	Date: 19 March 2010		Title: SITE PLAN SHOWING PHASES OF REMEDIATION		Sheet 1 of 1
File Name: Fig1.wor	Scale: As Shown	A4			FIGURE 1

2. SITE IDENTIFICATION

2.1 Site Details

The site is located at 13 Main Road, Boolaroo, New South Wales and comprises an area of approximately 16 hectares. The entire site comprises Lot 1 of Deposited Plan DP225720.

The main entrance to the site occurs in the central western boundary. The access road occurs through the Pasminco land and connects the site to Main Road.

The manufacturing facility was closed in January 2009, however the site is currently used for the storage and distribution of fertilisers previously manufactured at the site. The site currently consists of numerous buildings previously used for manufacture and storage of fertiliser, liquids and products as well as administrative, maintenance and despatch buildings. The site is to be progressively decommissioned following rationalisation of IFL's manufacturing facilities, with the site buildings and infrastructure to be removed. The internal roadways are formed of either concrete or bitumen and are in good condition.

The site comprises a former superphosphate manufacturing area in the central western part of the site and a series of large storage sheds, numbered 1 to 4, adjacent the superphosphate manufacturing area. The sheds were used for phosphate rock and superphosphate storage. Other buildings in this area house crushers and other infrastructure. The sheds and buildings are largely constructed with corrugated steel and asbestos fibre containing cement sheets over timber or steel frames. The sheds have concrete floors which are in good condition where the floors can be observed.

The manufacturing area includes a number of above ground storage tanks (ASTs) which were registered for hypochlorite, sodium hydroxide, sulphuric acid and fluorosilicic acid. A diesel AST was also identified which connects via aboveground pipes to a bowser adjacent the roadway near the manufacturing plant. There was no evidence of significant losses or environmental impacts associated with the ASTs. There are no reported underground tanks at the site.

Phase 4 comprises the generally vacant southern area of the site to the south of the buildings and includes the truck turning circle and the adjacent dam wall. A former gully was present in this portion of the site and has been subsequently filled with a range of waste slag materials originating from the adjacent Pasminco smelter.

Areas of open space occur to the south and north of the manufacturing and storage areas. There is no evidence of vegetation stress in areas where vegetation occurs. There are no obvious odours or staining associated with the site soils, however, visible slag materials are present in the surface soils in the northern part of the site and may occur beneath vegetation cover in the southern area.

A fresh water dam is located adjacent the south eastern portion of the site. Whilst the dam itself is located outside of the site boundary, the dam wall is located within the site boundary. Investigations have shown this consists predominantly of clayey fill material. A dam spill way occurs through the IFL site via the '6 foot drain' and subsequently discharges down slope of the IFL site to Cockle Creek.

The nearest surface water body is Cockle Creek, located approximately 580 m to the west of the south west corner of the site and approximately 780 m from the north west site corner. The main axis of the site is located at an angle to Cockle Creek with the site's western boundary approximately falling on a north east - south west alignment. Cockle Creek discharges to Lake Macquarie, which lies approximately 1,600 m to the south of the site.

2.2 Site Boundaries

The site is located east of the former Pasminco zinc and lead smelter and is surrounded by Pasminco lands (which comprise a total area of approximately 191 hectares) on all boundaries, with the exception of a portion of the southern boundary which abuts directly to First Street, Boolaroo.

Residential areas are located to the north at Argenton situated approximately 800 metres from the northern site boundary; Macquarie Hills situated approximately 550 metres from the eastern site boundary and Boolaroo located adjacent to the southern boundary of the site, across First Street.

This RAP only addresses remediation works to be undertaken in the southern area of the site referred to as the Phase 4 remediation works (Figure 1).

2.3 Easements

A number of existing easements occur across the IFL site. The easements currently existing at the site are for several purposes including: railway, drainage, drainage of salt water and freshwater, bulk hoppers, right of carriageway and for electricity purposes. Figure 2 provided in this report indicate the locations of the various easements across the site.

3. SITE HISTORY

The site is located immediately to the east of the former Pasminco zinc and lead smelter. The layout of the site and the adjacent Pasminco facilities (now largely removed) are shown in Figure 2.

The site was originally part of the Pasminco facility (formerly the Sulphide Corporation), with the superphosphate manufacturing process commencing around 1913 and utilising sulphuric acid created as a by-product from the treatment of the smelter off gases. The production of sulphuric acid was and is still commonly undertaken at smelter facilities and limits the discharge of sulphur compounds to the environment, producing a valuable chemical precursor for manufacturing processes. One use is the combination of sulphuric acid with phosphate rock to produce superphosphate.

The site history information has been generally derived from the URS December 2004 summary report, which compiled the site history findings from the previous assessment reports. It is noted that the site has a long history and the capacity to accurately describe the details of the site history beyond the recent past are limited. The site history was developed based on the review of historical information, aerial photographs and interviews with long standing personnel. Whilst this is considered to be a suitable basis for the purpose of the assessment there are likely to be data gaps in the available site history, particularly in relation to specific occurrences of site contamination or details of activities that have occurred in the more distant past.

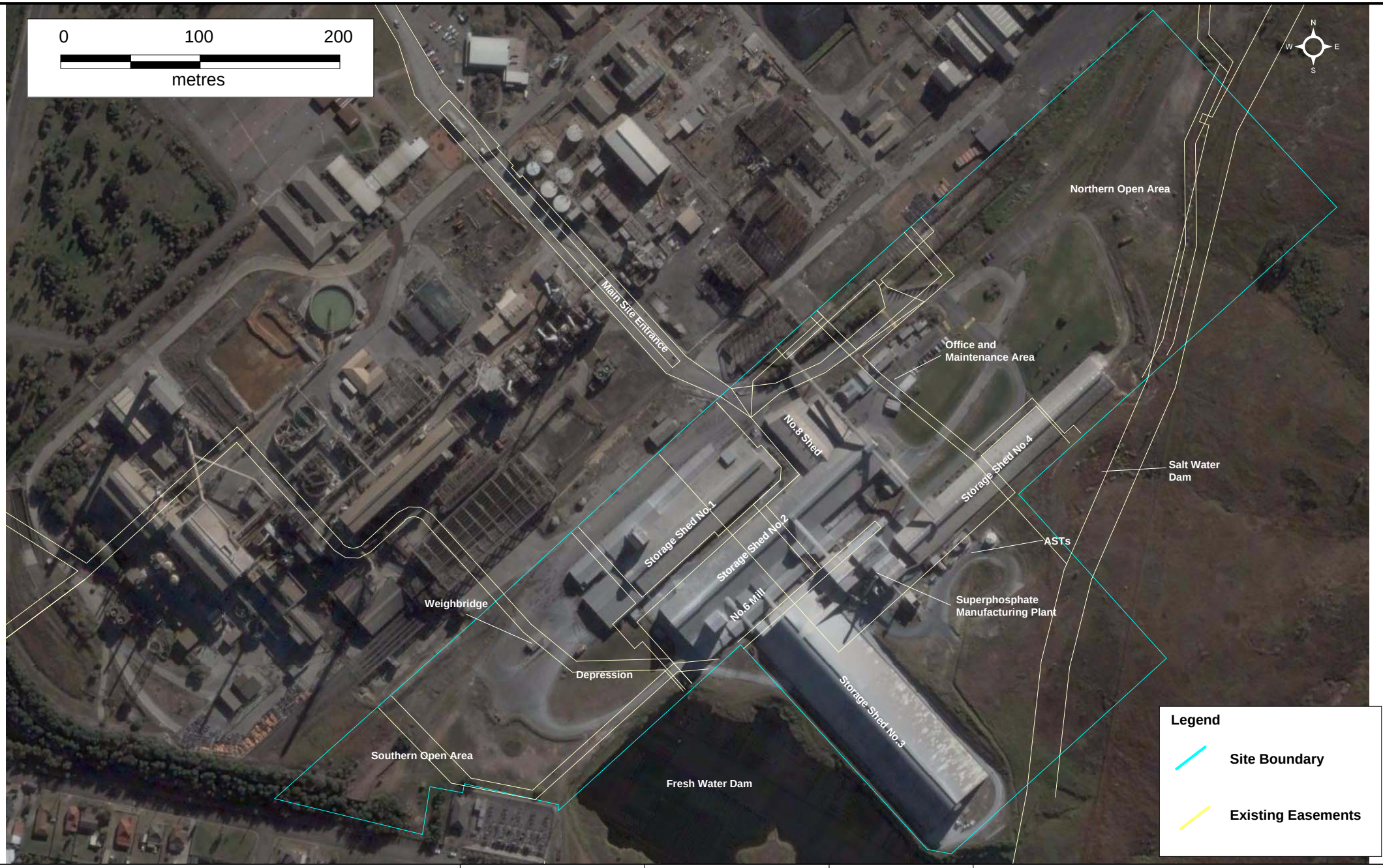
The available title information indicates that the site was sold to a predecessor of IFL (Australian Fertilisers Limited) in 1969. Pasminco continued to provide sulphuric acid to IFL for the manufacturing of superphosphate until 2003 when the smelter operations shutdown. Sulphuric acid is currently sourced from the Incitec Pivot Limited (IPL) Kooragang Island facility via truck and stored on site. The sulphuric acid was formerly piped to the site from the Pasminco smelter via a rising main. Periodic failures of the rising main were reported anecdotally until Teflon lining of the rising main on the IFL site in the early 1990's. The rising main was located above ground or within culverts on the site so the potential for large unnoticed leaks from this source was considered to be relatively low. The more historical use of sulphuric acid within the site is poorly documented and considerable uncertainty exists on its distribution of use at the site.

The natural westerly sloping topography of the site has been altered to allow the construction of the existing site facility and infrastructure. Based on the available information, this required excavation into the hillside on the eastern section of the site in the vicinity of Storage Sheds 3 and 4 and filling of the site slope in a series of steps to the west, providing multiple level surfaces across the site for the establishment of buildings and other infrastructure.

The filling of the site has occurred through the use of natural materials resulting from the excavation works in the west and the use of predominantly slag waste materials from the operation of the early smelter on the adjacent Pasminco site. The slag used as fill is typically fine grained and black, and is visible at the surface in the northern part of the IFL site. Some blocky slag was also apparent at some investigation locations. The slag contains elevated heavy metals concentrations and is the primary source of contamination at the site.

Natural materials and reworked surface materials removed more recently during the construction of the sulphuric acid storage and access road were used as filling in the north western part of the site. The filling of parts of the depression and the low lying ground to the east of the southern drain was reportedly undertaken and incorporated inert wastes such as old plant machinery from the IFL site and from Pasminco.

A freshwater dam occurs immediately to the south east of the southern area of the IFL site and falls predominantly within the Pasminco site. The dam wall and spillway occur within the IFL property. The freshwater dam wall was reportedly constructed of predominantly natural clayey materials that are apparent in the dam face and has been confirmed by the site investigations in the vicinity of the dam wall.



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Drawn: DJN	Date: 10 March 2010	Job No.: SG061313	Project: Cockle Creek Assessments		
Checked: AKW	Date: 12 March 2010	Title: SITE PLAN SHOWING CURRENT SITE LAYOUT FORMER PASMINCO OPERATIONS AND EXISTING EASEMENTS		Sheet 1 of 1	
File Name: Fig2.wor	Scale: As Shown	A4		FIGURE 2	

4. SITE CONDITIONS

4.1 Topography

The site is located in a sloping section of Munibung Hill overlooking the Cockle Creek valley. Whilst the natural topography of the site is therefore consistent with a hill and valley type setting, the cut and fill techniques and the importation of fill material has left the site relatively flat to enable building development. The existing site layout is shown in Figure 2. The site is bounded by a chain mesh fence.

The peak of Munibung Hill occurs to the east of the site, with the topography steepening significantly to the east of the eastern site boundary. This area and the area to the west of the site are included in the adjacent former Pasminco Cockle Creek Smelter (PCCS) site. The PCCS site is currently being remediated and based on the current published Master Plan, will be utilised for a range of land uses including residential use and public open space.

The nearest surface water body is Cockle Creek, located between 580 m and 780 m from the site's oblique western boundary.

4.2 Geology

The 1:250 000 Newcastle Geological map shows the site to be underlain by sediments of the Permian age Newcastle Coal Measures which comprise conglomerate, sandstone, tuff, shale and coal. Quaternary age alluvial sediments were also identified in the lower valley around Cockle Creek. The geological map indicates that the Newcastle Coal measures are underlain by a sequence of Permian age coal measures and siltstone and sandstone formations.

Anecdotal information indicates there is an adit on the eastern side of Munibung Hill, on which the site is located, suggesting an access or investigation point for the Coal Measures. The site lies within the Lake Macquarie Subsidence District, indicating the potential for coal mining to have occurred in the vicinity of the site.

The Newcastle Mine Subsidence Board was contacted regarding the presence of any former underground workings in the vicinity of the site. The closest workings are those associated with the shallow Sulphide Pit mine which occurred to the north west of the site but entirely within the adjacent Pasminco site. There was no historical mine workings identified within the IFL site at Cockle Creek.

Intrusive investigations have been conducted across the site and penetrated to natural materials beneath the fill at most locations. The maximum depth of investigations at the site is 34 m. Investigations indicate the fill materials comprised slag / cinders and general industrial rubbish within a sand, gravel and clay matrix. The near surface fill materials at many locations were generally sandy and gravelly with various waste inclusions. Some asbestos containing material and asbestos fibres were identified at very limited locations within the fill material. These asbestos containing materials are expected to be minor and restricted to the fill materials, and not expected to have impacted the natural materials at the site.

The slag occurs distributed within the fill rather than occurring as discrete layers in most occurrences and suggests the materials were mixed prior to or at the time of placement. The majority of the filling is reported to have occurred prior to the mid 1950s, with additional minor filling occurring prior to 1966 and later around the depression and north-western section of the site. Relatively minor amounts of slag were reported to the east of the main plant and storage areas and this is consistent with the more natural sloping topography of these areas.

Elevated concentrations of heavy metals, particularly lead and zinc, but occasionally arsenic, nickel and cadmium are present in the slag impacted fill materials. The thickness of fill at the site is typically two to three metres, except for the western edges of the site and the former creek bed gully below the dam wall where the fill and reworked colluvial materials is reported to extend to over 10 m in thickness. The inferred thickness of fill materials at the site is shown in Figure 3. The volume of impacted material was estimated to be in the order of 200,000 m^3. A cross section based on the data collected from drill logs is included in Figure 4 to provide a representation of the typical site profile.

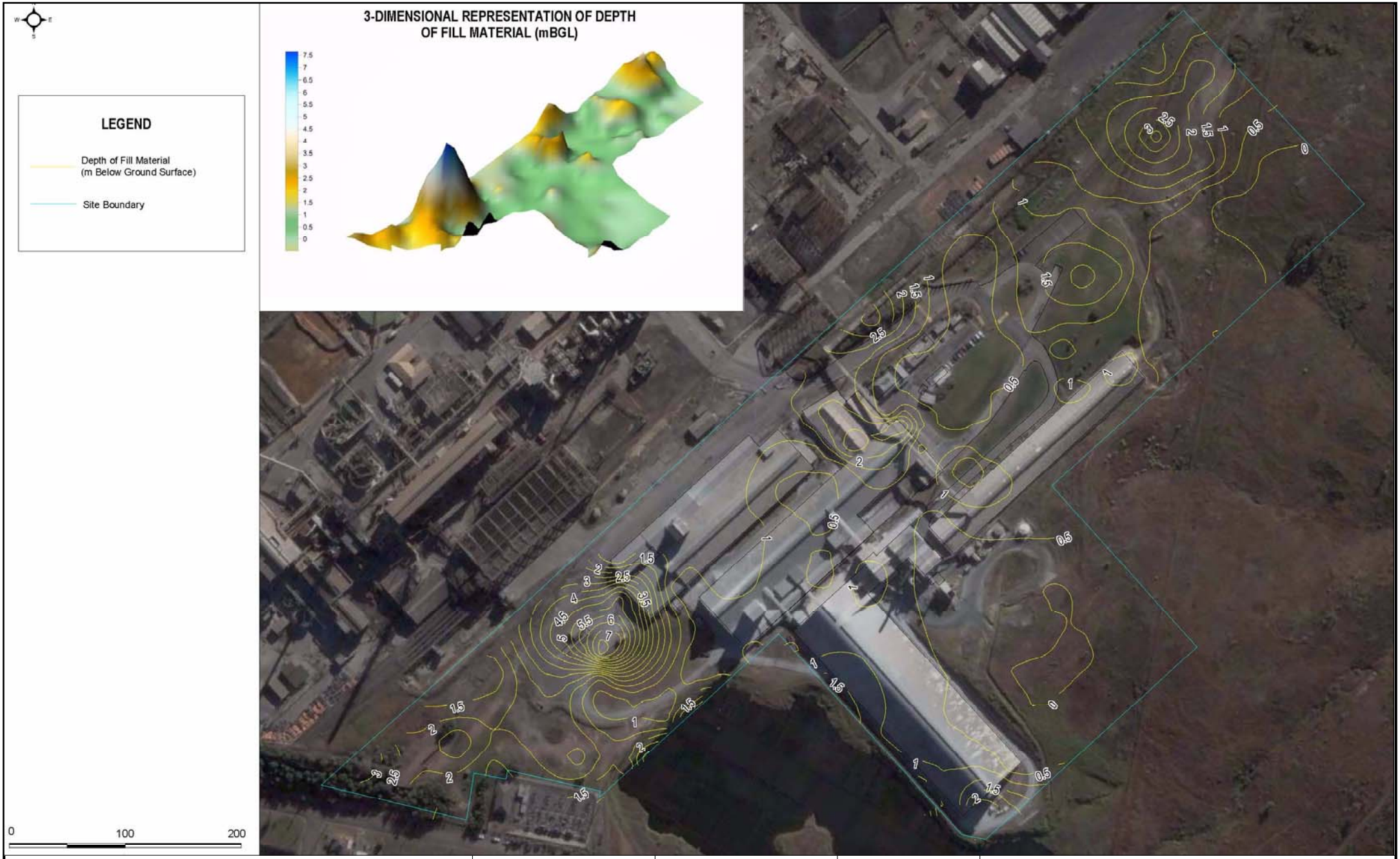
The fill materials are underlain by the weathered siltstone and sandstone associated with the underlying natural formation, the Newcastle Coal Measures. The deeper profile included carbonaceous layers and the weathered materials grade to more consolidated materials with increasing depth, although variably weathered materials have been encountered over the section investigated. The investigations have demonstrated that the natural materials contain low contaminant concentrations and that typically these materials would be suitable for use within a low density residential setting.

4.3 Hydrogeology

A search was undertaken of the NSW Natural Resources Atlas for groundwater bores in the vicinity of the site. The search did not identify any registered bores in close proximity to the site, other than a number of shallow investigation bores.

There are no registered extraction wells between the site and Cockle Creek, which is considered the probable long term discharge point of groundwater emanating from the site. Information included in the Environmental Site Assessment for the adjacent Pasminco site prepared by Fitzwalter Group Pty Limited (2006) suggests that the operations at the Teralba Colliery, located to the west of Cockle Creek, have depressed local groundwater levels and the regional groundwater system does not currently discharge to the creek. The hydrogeological investigations at the adjacent Pasminco site identified a shallow, possibly perched, groundwater aquifer underlain by a deeper groundwater aquifer.

Groundwater at the site was encountered in both the fill and natural materials at the site. A number of nested well installations have been installed as part of the investigations and these show a general downward gradient between the fill, shallow and the deeper natural aquifer sequences.



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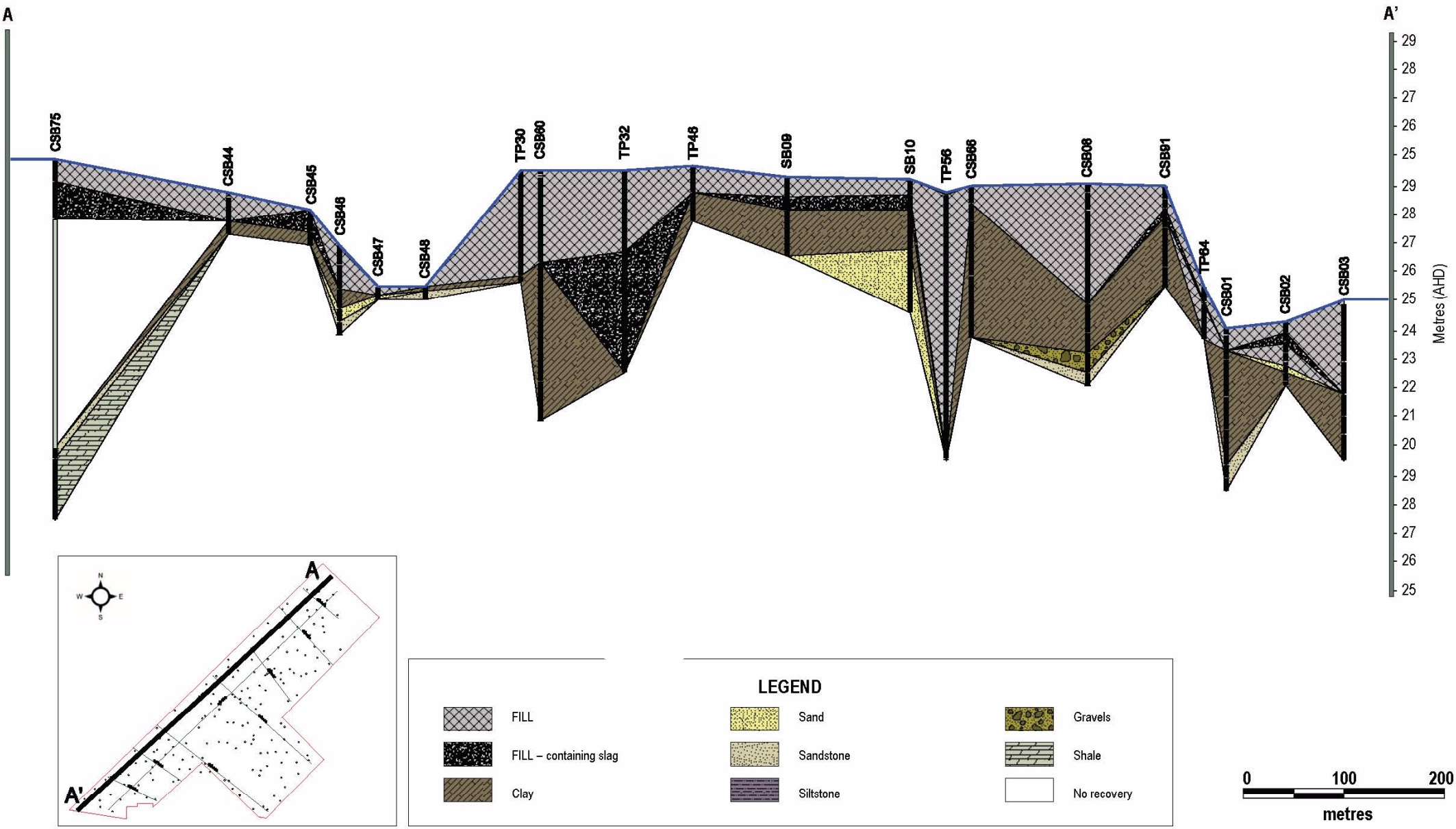
Drawn: DJN	Date: 22 June 2008		Job No.: SG061313	Project: Cockle Creek Assessments	
Checked: APN	Date: 23 June 2008		Title: INFERRED DEPTH OF FILL MATERIALS After S&G 2008		Sheet 1 of 1
File Name: Fig3.wor	Scale: As Shown	A4			FIGURE 3

NORTH EAST

SOUTH WEST



LEGEND

- FILL
- FILL – containing slag
- Clay
- Sand
- Sandstone
- Siltstone
- Gravels
- Shale
- No recovery

0 100 200

metres

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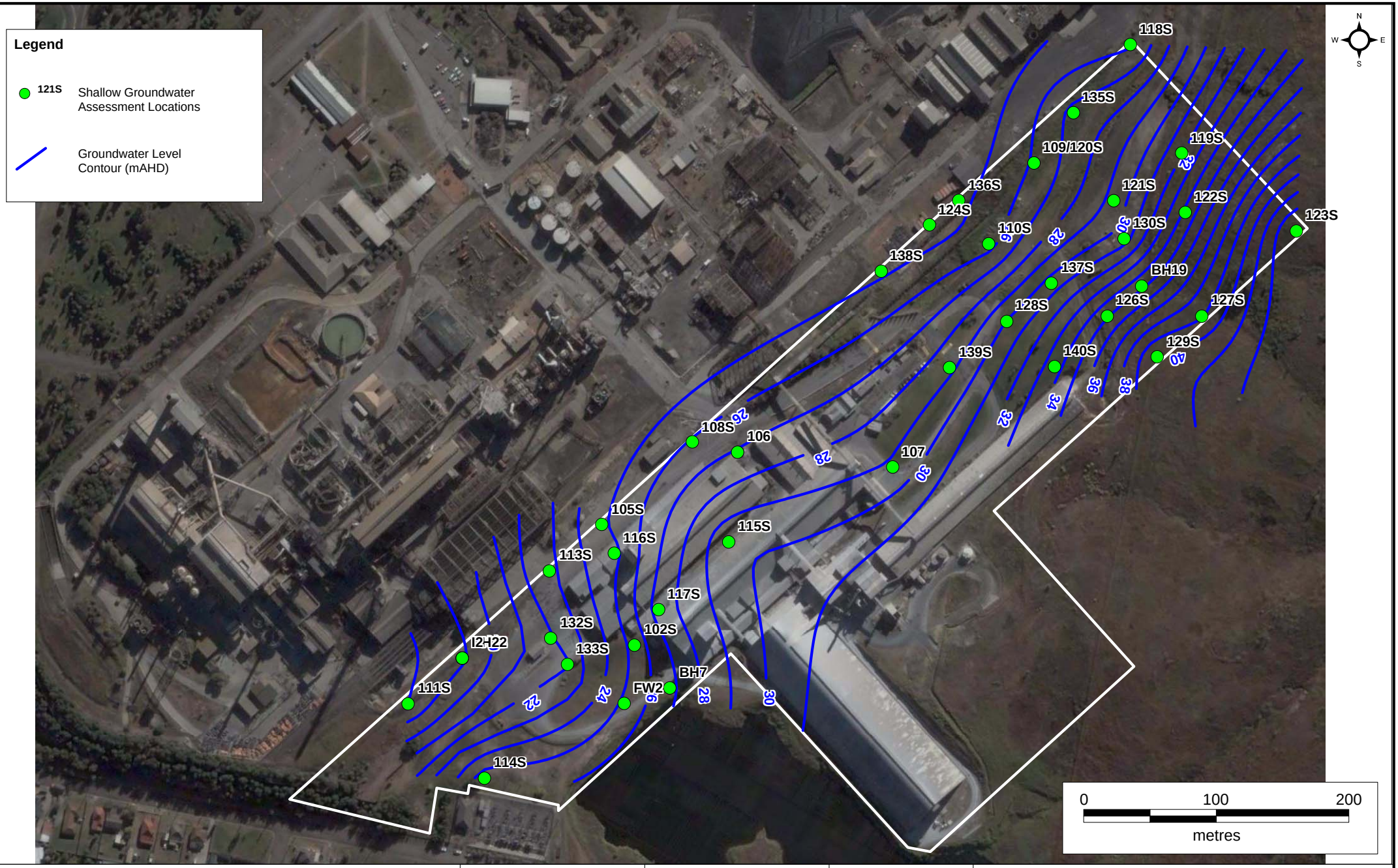
Checked: APN	Date: 23 June 2008		Title: INFERRED PROFILE CROSS SECTION A-A'		Sheet 1 of 1
File Name: Fig4.wor	Scale: As Shown	A4			FIGURE 4

There is generally a substantial downward head difference between the shallow and deep natural aquifer levels at measured locations and this may indicate the deeper aquifer is more regionally influenced by dewatering activities at the Teralba Colliery. Investigations at the adjacent Pasminco site indicated that the deep aquifer has groundwater levels well below the bed level of Cockle Creek. The most likely regional sink was inferred to be the adjacent coal mine operations at the Teralba Colliery. The findings at the IFL site are consistent with the Pasminco conclusions.

The groundwater flow direction in all aquifer sequences was inferred to be in a broadly westerly direction across the majority of the site, with flow in the general direction of Cockle Creek, although as noted above the regional sink may be currently the Teralba Colliery, located further west. In the longer term with the closure of the colliery, the regional groundwater environment would be expected to rebound with natural discharge being to either Cockle Creek or Lake Macquarie.

A more detailed description of the site hydrogeology is included in the S&G *Environmental Site Assessment* and the *Conceptual Hydrogeological Model* reports.

Figure 5 shows the location of the monitoring wells screening the shallow natural aquifer at the site and the inferred groundwater level contours for this aquifer.



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Drawn: DJN	Date: 12 June 2008	Job No.: SG061313	Project: Cockle Creek Assessments
Checked: APN	Date: 12 June 2008	Title: SHALLOW GROUNDWATER LEVELS FEBRUARY 2008	Sheet 1 of 1
File Name: Fig5.wor	Scale: As Shown A4		FIGURE 5

5. SOIL AND WATER ASSESSMENT CRITERIA

5.1 Contaminants of Concern

The following table provides a summary of the principal contaminant sources which have been identified at the site.

Table 1 – Areas and Chemicals of Interest

Areas	Chemicals of Potential Concern	Likelihood	Mobility / Comments
Slag impacted fill material across site	Heavy metals, fluoride	High, known to occur across site and are leachable. Fine grained increases mobilisation potential due to increased surface area for dissolution	Moderate to high leachability, acidic conditions will promote mobilisation
Fertiliser Manufacturing & Distribution	Nitrogen species, phosphorus, sulphate, fluoride, pH, TPH at localised areas	High based on long history of use, historical practices, large volumes of materials	Phosphorus likely to have low mobility in soils, nitrogen species more mobile, acids in liquid forms and likely to be mobile, surface impacts from stack emissions, possibly local impacts from fuel storage / use
Waste materials: brick, wood, metal, plastics, glass, cement sheeting, rock	Nutrients: nitrogen and phosphorus, metals, inert material, asbestos, aesthetics	Moderate, generally inert materials but inclusion of some degradable materials	Possible inclusion of site waste materials in more recently filled areas

5.2 Soil Assessment Criteria

Section 105 of the *Contaminated Land Management Act* 1997 allows DECC to "make or approve" guidelines for any purpose related to the objects of the Act. The *Guidelines for the NSW Site Auditor Scheme (2nd edition)* indicates that the appropriate soil investigation levels (SILs) for the assessment of the suitability of the site are as follows:

5.2.1 Potential Human Health Risks

The human health-based investigation levels (HILs) and the exposure scenarios on which they are based are published in the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPM) and also in the *enHealth Monographs—Soil Series*.

The HILs are based on generally conservative assumptions for the estimated exposure of site occupants in the above land use scenario. The NEPM states that:

> *"An **investigation level** is the concentration of a contaminant above which further appropriate investigation and evaluation will be required (ANZECC/NHMRC Guidelines 1992)".*

An exceedance of an investigation level does not indicate that there is a definite risk to human health, but rather that further site-specific assessment is required to quantify the potential risk to human health.

Where the NEPM investigation levels are silent, other health based guidelines, including the NSW EPA *Guidelines for Assessing Service Station Sites* (EPA, 1994) may be appropriate. It is recognised that the soil criteria provided in the *Guidelines for Assessing Service Station Sites* are provided for sensitive land use and as such, are likely to be conservative criteria for uses other than sensitive uses.

Where appropriate health based criteria are not available in the listed publications then alternative national / international criteria were considered.

5.2.2 Potential Ecological Risks

The NEPM Interim Urban Ecological Intervention Levels (EILs) provide indicative screening level assessment of the ecological impact of contamination based on phytotoxicity.

The EILs aim to protect ecological values (e.g. flora, fauna) in developed areas. The EILs are based on considerations of phytotoxicity (copper, chromium, lead) and soil survey data (barium, phosphorous, sulphur) from four Australian capital cities.

Where no EILs are nominated in the NEPM, reference has been made to the "B" values given in the *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites* (ANZECC/NHMRC 1992).

In the absence of NEPM guidelines, the NSW EPA (1994) *Guidelines for Assessing Service Station Sites*, sensitive land use criteria including terrestrial values where provided, have been adopted as environmental screening criteria for the assessment of TPH and BTEX contamination.

Where appropriate ecological based criteria are not available in the listed publications then alternative national / international criteria were considered (i.e. US EPA Regional Screening Levels (December 2009) and Dutch Soil Remediation Criteria 2006 (as amended October 2008).

5.2.3 Leachability

Residual contaminants may occur in soils that fall below relevant health or ecological based criteria. In most cases these levels are likely to be sufficient to ensure that the contaminants do not pose a significant risk to the quality of the groundwater system. However the leachability of any residual

soil contaminants will be tested to verify that such contaminants are not leachable at concentrations that are likely to result in contamination of groundwater at levels that would preclude relevant uses.

5.2.4 Aesthetics

Soils will be remediated such that they do not present aesthetic contamination. It is noted that the Schedule B(1) of the NEPM (1999) that states that *"there are no numeric Aesthetic Guidelines but the fundamental principle is that the soils should not be discoloured, malodorous (including when dug over or wet) nor of abnormal consistency. The natural state of the soil should be considered".* Additionally, aesthetic considerations are also noted in the DECC Site Auditor Guidelines 2nd Edition. This is considered the relevant guideline for the site on this issue.

The assessment of the soils to date indicates a low probability that they will be odorous and that this will be relevant to the assessment of aesthetics in this case. There is potential for soils to be discoloured (predominantly as a result of slag or other waste) however such materials are likely to result in elevated soil concentrations and thus would require removal in any case to meet the relevant health or ecological based criteria. Nonetheless, the aesthetic criteria or olfactory or visual impact will form part of the assessment of compliance of the remediation program.

5.2.5 Building and Structures

As the Phase 4 portion of the site is intended for low density residential use, and this use if consistent with the Master plan for the area, it is expected that only light structures requiring shallow foundations will be developed at the site. As the soils are expected to be remediated to meet the ecological based criteria, which include sulphate concentrations being protective of concrete structures, it is considered likely that the remediated soils will not pose an unacceptable risk to the durability of concrete structures installed in the site soils.

Nonetheless, the validation program instituted at the site will be sufficiently broad to ensure that the soils do not pose a risk to the durability of structures built at the site. This will include the assessment of soil pH, sulphate, redox potential, salinity and any other potential contaminants of concern which may influence the integrity of buildings or other structures as discussed and agreed with the Site Auditor.

5.2.6 Soil Remediation Assessment Criteria Summary

The following tables summarises the assessment criteria proposed to be adopted for the remediation of Phase 4 of the Cockle Creek site. It is noted that the Phase 4 area is proposed to be developed for low density residential use, therefore on completion of validation works across this site, the soils remaining across the Phase 4 area will be validated to ensure that the soils meet the NEPM 'A' HIL screening values for 'Standard Residential Use' and therefore do not pose a potential risk to future occupiers of the site.

The proposed assessment criteria for the Phase 4 soils have been derived from the NEPM (1999) Ecological Investigation Levels or the NEPM (1999) Health Investigation Levels. Where other

guidelines have been used these are noted on the table below. All adopted soil assessment criteria are summarised in Table 2 below.

Table 2 – Adopted Soil Assessment Criteria Phase 4 Remediation (mg/kg)

Parameter	Ecological Screening Value	Human Health Screening Value - Phase 4
Heavy Metals		
Antimony	0.66[e]	31[d]
Arsenic	20	100
Barium	300[e]	15,000[d]
Beryllium	5.8[e]	20
Cadmium	3	20
Chromium (Total)	400	12,000
Chromium (IV)	1	100
Cobalt	0.49[e]	100
Copper	100	1,000
Lead	600	300
Molybdenum	3.7[e]	390[d]
Mercury	1	15
Nickel	60	600
Silver	1.6[e]	390[d]
Tin	50[a]	47,000[d]
Zinc	200	7,000
Organics		
TPH C_{10}-C_{36}	1,000[b]	
TPH C_{16}-C_{35} Aromatics	-	90
TPH C_{16}-C_{35} Aliphatics	-	5,600
>C_{35} Aliphatics		56,000
Benzene	1[a]	1.1[d]
Toluene	1.4[c]	130[b]
Ethylbenzene	3.1[c]	50[b]
Xylene	14[c]	25[c]
Aldrin + Dieldrin	0.2[a]	10
Chlordane	1.6[e]	50
DDT+DDD+DDE	0.047 to 0.067[e]	200
Heptachlor	0.0012[e]	10
Polycyclic Aromatic Hydrocarbons (Total)		20

Parameter	Ecological Screening Value	Human Health Screening Value - Phase 4
Benzo(a)pyrene		1
Phenol	6.3[e]	8,500
Polychlorinated Biphenyls	1[a]	10
Nutrients		
Fluoride		3,100[d]
Total Phosphorus	2,000	
Reactive Phosphate		1.6[d]
Sulfur	600	
Sulphate	2,000	
Nitrate		130,000[d]

Notes:

a) ANZECC/NHMRC (1992) Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites Environmental Investigation 'B' level
b) NSW EPA (1994) Guidelines for Assessing Service Station Sites, Threshold Concentration for Sensitive Land Use – Soils
c) NSW EPA (1994) Guidelines for Assessing Service Station Sites, Threshold Concentration for Sensitive Land Use – Soils (Protection of terrestrial organisms in soil)
d) USEPA (December 2009) Region 9, Regional Screening Levels for Residential Soil
e) USEPA (August 2003) Region 5, RCRA, Ecological Screening Levels for Soil

5.3 Groundwater Assessment Criteria

Schedule 2 of the *Guidelines for the Assessment and Management of Groundwater Contamination* (DEC, 2007) identifies various environmental values of groundwater which may be required to be protected depending on the location of the site. These environmental values are:

- Aquatic ecosystems - these include surface water ecosystems and groundwater ecosystems;
- Human uses - these include but are not limited to potable water supply, agricultural water supply (irrigation and stock watering), industrial water use, aquaculture and human consumption of aquatic foods, recreational use (primary and secondary contact with surface waters) and visual amenity of surface waters;
- Human health in non-use scenarios - this includes consideration of health risks that may arise without direct contact between humans and the groundwater, for example, exposure to volatile contaminants above groundwater contaminant plumes; and
- Buildings and structures - this includes protection from groundwater contaminants that can degrade building materials through contact, for example, the weakening of building footings resulting from chemically aggressive groundwater.

The above Guideline also notes that Schedule B(6) of the NEPM provides a methodology for using generic or site specific groundwater investigation levels (GILs) to assess contaminated groundwater. The following six environmental values as presented in the NEPM are:

- aquatic ecosystems;
- aquaculture and human consumers of food;
- agricultural water;
- recreation and aesthetics;
- drinking water; and
- industrial water.

Section 2.2 of the Guideline identifies the *Australian Drinking Water Guidelines* (NHMRC & NRMMC, 2004) for assessment of drinking water and the appropriate trigger values (as agreed with the Site Auditor) included in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000), hereafter referred to as ANZECC 2000, for assessment of aquatic ecosystems. Both these documents form part of the National Water Quality Management Strategy. ANZECC 2000 also provides assessment criteria for aquaculture, agricultural waters and recreational water uses.

The following table provides a summary of the environmental values of groundwater and their relevance to this site.

Table 3 – Summary of Relevant Environmental Values

Environmental Value	Comment	Relevance
Aquatic ecosystems	Groundwater may discharge to Cockle Creek, particularly in the long term as dewatering associated with the coal mine ceases	Relevant
Aquaculture and human consumers of food	Low potential of use given site setting, distance from creek and proposed residential / open space development. No aquaculture industries have been identified in the immediate area. It is also considered unlikely that any significant human consumption of aquatic foods sourced from Cockle Creek would be undertaken in this area.	Relevant
Agricultural water	Brackish groundwater unlikely to be suitable for use in residential setting or for open space watering uses without treatment to remove salts.	Not Relevant
Recreation and aesthetics	Site distant from potential surface water receptor. Possible use of shallow groundwater for swimming	Relevant

Environmental Value	Comment	Relevance
	pool makeup water in residential setting	
Drinking water	Salinity unsuitable for potable use and presence of reticulated water supply makes this use improbable	Not Relevant
Industrial water	Residential / open space setting proposed and so use unlikely due to zoning.	Not Relevant
Buildings and Structures	Unlikely to be realised given the light structures with shallow footings likely to be developed in a residential setting. Included due to shallow groundwater and possible risk.	Relevant

Based on the above assessment it is considered that the environmental values of Aquatic Ecosystems, Aquaculture, Buildings and Structures and Recreation and Aesthetics are the only environmental values likely to be relevant at this site.

5.3.1 Groundwater Remediation Assessment Criteria Summary

A summary of the adopted groundwater assessment criteria for each of the relevant environmental values have been largely derived from the ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, with additions from the Dutch (2006) guidelines included in the *Soil Remediation Circular*, the NHMRC (2004) *Australian Drinking Water Guidelines* and the NSW EPA *Guidelines for Assessing Service Station Site* where noted.

The adopted criteria are summarised in Table 4 below.

Table 4 – Summary of Groundwater Screening Criteria

Analyte	Marine Aquatic Ecosystems	Aquaculture	Recreation and Aesthetics
	Adopted Criteria (µg/L)		
Metals			
Antimony	270[d]		
Arsenic	2.3[d]	30[f]	50
Barium	-		1,000
Beryllium	-		58[e]
Cadmium	5.5	0.5 to 5[f]	5
Chromium (Total)	27.4	20[f]	50
Chromium (IV)	4.4		50[c]
Cobalt	1		11[e]
Copper	1.3	5[f]	1,000

	Marine Aquatic Ecosystems	Aquaculture	Recreation and Aesthetics
Lead	4.4	1 to 7[f]	50
Mercury	0.4	1[f]	1
Nickel	70	100[f]	100
Selenium	3	10[f]	10
Vanadium	100	100[f]	
Zinc	15	5[f]	5,000
TPH			
TPH C_6-C_9	Based on MAH components		Based on MAH components
TPH C_{10}-C_{36}	650 [a]		650 [a]
Oils and Greases	10,000		10,000
BTEX			
Benzene	700		10 [b]
Toluene	180[d]		800 [b]
Ethylbenzene	5[d]		300 [b]
Xylene (total)	625[b]		600 [b]
Pesticides			
Aldrin	0.003	-	1
Chlordane	0.001	0.004[f]	6
Chlorpyrifos	-	-	2
DDT	0.0004[d]	0.001[f]	3
DDE	0.0005[d]	-	
DDD	-	-	
Dieldrin	0.01[d]	0.003[f]	1
Endosulfan	0.01	0.001[f]	40
Endrin	0.008	0.003[f]	1
Heptachlor	0.0004[d]	-	3
Lindane	0.007[d]	0.004[f]	10
Methoxychlor	0.007[d]	-	
Organics			
Polycyclic Aromatic Hydrocarbons (Total)			3 [b]

	Marine Aquatic Ecosystems	Aquaculture	Recreation and Aesthetics
Benzo(a)pyrene	0.2[d]		0.01
Naphthalene	70		-
Phenol	400	-	
Polychlorinated Biphenyls	0.3[d]	2[f]	0.1
VOCs			
1,1-Dichloroethene	250[d]		0.3
1,2-Dichloroethane	1900		10
Tetrachloroethene	400[d]		10
1,1,1-Trichloroethene	270[d]		30
1,1,2-Trichloroethane	1900[d]		
1,1,2,2-Tetrachloroethane	80[d]		-
Inorganics			
Ammonia	910	100[f]	10
Chloride			400,000
Cyanide	4	5[f]	100
Fluoride	-	-	1.5 [c]
Nitrate (as N)	-		10,000
Nitrate (as NO_{3-})	700[d]	100,000[f]	-
Nitrite (as N)	-	100[f]	1,000
Sulphate			400,000
Sulphide	1		50
Phosphate		50[f]	

Notes:

a) Ministry of Housing Spatial Planning and the Environment, Netherlands (2006) Soil Remediation Circular

b) NSW EPA (1994) Guidelines for Assessing Service Station Sites

c) NHMRC & NRMMC (2004) Australian Drinking Water Guidelines

d) ANZECC (2000) Low Reliability Marine Trigger Value

e) USEPA (December 2009) Region 9, Regional Screening Levels for Tapwater

f) ANZECC (2000) Water Quality Guidelines for the protection of aquaculture species

5.4 Buildings and Structures

In order to assess whether the environmental value Buildings and Structures is likely to be precluded at the site, the groundwater pH together with concentrations of chloride and sulphate,

which have the potential to become corrosive to both concrete and steel structures, will be compared with the values and specific site conditions provided in the document *Australian Standard AS2159-1995 Piling - Design and Installation*.

5.5 Surface Water Assessment Criteria

The quality of surface waters will be assessed in accordance with ANZECC 2000 based on the relevant environmental values of surface waters in the vicinity of the site as follows:

- Aquatic Ecosystems
- Visual Amenity
- Secondary Contact Recreation
- Primary Contact Recreation
- Livestock Water Supply
- Irrigation Water Supply
- Homestead Water Supply
- Drinking Water
- Aquatic Foods (cooked)

Relevant assessment criteria for most of these environmental values are provided in Table 4 above. It is noted that due to the estuarine nature of Cockle Creek that a number of these environmental values are unlikely to be realised including: livestock water supply, irrigation water supply, homestead water supply and drinking water. Therefore assessment criteria have not been provided for these environmental values.

5.6 Rationale for and Appropriateness of the Adopted Criteria

The screening criteria adopted for the remediation of soils has been sourced from the NEPM EILs and HILs, both of which have been approved by the DECC in accordance with Section 105 of the Contaminated Land Management Act 1997.

In the absence of available Australian screening values, the USEPA Region 9 - Regional Screening Levels for Residential Use were adopted as appropriate assessment criteria for the assessment of the health risks posed by residual contamination at the site. It is also noted that the USEPA Regional Screening Levels (formerly referred to as PRGs) have been adopted as Health Investigation Levels for standard residential land use by the Western Australian Department of Environment and Conservation (DEC) in the document *Assessment Levels for Soil, Sediment and*

Water (November 2003), therefore on this basis, it is considered appropriate to adopt these values as initial human health screening values.

In addition the groundwater screening criteria have been derived from the ANZECC/ARMCANZ Australian and New Zealand Guidelines for the Fresh and Marine Water Quality (2000). On this basis, the adopted screening values are considered to be appropriate to validate that remediation has been undertaken successfully at the site and to confirm that reported groundwater concentrations do not impact relevant environmental values identified for the site. In the absence of available ANZECC groundwater screening values, USEPA Regional Screening Levels for Tap Water have been adopted as recreational screening criteria, it is noted that this screening criteria is likely to be conservative because the groundwater is unlikely to be used for potable purposes

6. SITE CHARACTERISATION

6.1 Contamination Status of Soils

The following provides a summary of the key features of the recent extensive soil investigations at the site:

- Elevated concentrations of heavy metals were reported for a large number of fill soil samples with many exceeding the *National Environment Protection (Assessment of Site Contamination) Measure* (NEPM) health based investigation levels for commercial industrial land use (HIL F). Natural soils were found to largely comply with the NEPM 'A' HIL criteria for residential use.

- Concentrations of total phosphorus were generally elevated in surface and fill samples. The maximum concentration detected was 102,000 mg/kg, which significantly exceeds the NEPM ecological investigation level (EIL) of 2,000 mg/kg.

- Concentrations of sulphate were generally elevated with the maximum concentration detected of 14,000 mg/kg. Concentrations of calcium were generally elevated with the maximum concentration detected of 241,000 mg/kg.

- Concentrations of ammonia and nitrate were generally low, with the maximum concentrations detected of 71 mg/kg and 39 mg/kg, respectively.

- Concentrations of total petroleum hydrocarbons (TPH) and benzene, toluene, ethyl benzene and xylenes (BTEX) were below the NSW EPA sensitive use guideline concentrations for all samples analysed.

- All concentrations of polycyclic aromatic hydrocarbons (PAHs), cyanide, organochlorine pesticides (OCP), phenols, polychlorinated biphenyls (PCB) and volatile halogenated compounds (VHC) were below the laboratory detection limits or below NEPM HILs and EILs where available.

- US EPA Toxicity Characteristic Leach Procedure (TCLP) and Australian Standard Leaching Procedure (ASLP) leach testing was undertaken on selected samples and indicates that the metals in fill materials at the site are highly leachable. In particular, lead and zinc leachability shows that all fill materials are potentially moderately to highly leachable and therefore will be required to be managed as part of the remediation design.

The reader is referred to the Environmental Site Assessment report (S&G, 2008) for a detailed discussion of the contamination status of the soils at the site. The following tables provide a summary of the statistics for the fill and natural soil investigations.

Table 5 – Fill Soil Sample Statistics

	pH	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead
Count	196	31	234	20	20	234	234	31	234	234
Average	7	43	385	84	0	79	36	41	666	4441
St Dev	1	154	798	94	0	329	178	77	1185	7268
Min	2.5	<5	<5	<2	<2	<1	<2	< 5	<5	11
Max	11.3	860	6800	300	0	3500	2700	350	8900	46000
No. > EIL		24	181	0	0	193	1	10	144	165
No. > HILA		11	114	0	0	101	0	2	45	190
No. > HILF		6	47	0	0	20	0	0	4	122

	Mercury	Molybdenum	Nickel	Selenium	Solver	Tin	Vanadium	Zinc	Total Phosphorus	Sulphate
Count	234	20	234	31	22	31	31	234	216	216
Average	2.1	2.8	23.2	2.9	0.5	39.5	16.0	18,956	2174	1277
St Dev	5.4	5.7	89.4	9.3	2.6	146.4	12.3	32,362	8980	2247
Min	<0.1	<0.1	<2	<2	<5	<10	<10	0	<5	<10
Max	52.3	15	1300	41	12	813	42	229,000	102,000	14,000
No. > EIL	80	4	13	2	0	0	12	218	36	35
No. > HILA	3	4	1	0	0	2	0	96		
No. > HILF	0	0	0	0	0	0	0	41		

Table 6 – Natural Soil Sample Statistics

	pH	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead
Count	86	16	100	15	15	100	100	16	100	100
Average	5.2	0	19.8	89.7	0	1.9	7.2	1.1	20	112
St Dev	1.7		42.0	160	0	4.4	7.2	3.1	31	162
Min	0	<5	<5	21	<2	<1	<2	<5	<5	<5
Max	8.6	<5	400	520	<2	38	49	10	190	880
No. > EIL			24	2	0	18	0	2	2	3
No. > HILA			1	1	0	1	0	0	0	10
No. > HILF			0	0	0	0	0	0	0	0

	Mercury	Molybdenum	Nickel	Selenium	Silver	Tin	Vanadium	Zinc	Total Phosphorus	Sulphate
Count	100	15	100	16	15	16	16	100	86	86
Average	0.2	0	2.2	0	0	0	16.6	572	565	396
St Dev	0.7	0	5.2	0	0	0	14.1	1455	3696	1010
Min	<0.1	<10	<2	<2	<5	<10	10	<5	<5	<10
Max	6.9	<10	35	<2	<5	<10	40	13000	34000	7970
No. > EIL	2	0	0	0	0	0	7	53		2
No. > HILA	0	0	0	0	0	0	0	1		
No. > HILF	0	0	0	0	0	0	0	0		

Where exceedances of the 'A' HIL criteria occur for the natural materials it is expected that a relatively minor scrape of the area will result in soil concentrations that fall below the criteria. The number of exceedances of the 'A' HIL criteria is low indicating that the natural soils will generally comply with these requirements. We anticipate that localised management of any exceedance will ensure that the residual surface is suitable for its intended use.

The suitability of the natural soils will be verified by the detailed validation procedure prepared under separate cover. Where soils are found to be impacted at concentrations exceeding the adopted validation requirements, then further excavation of these areas will be undertaken until the residual materials meet the relevant acceptance criteria. If this approach leads to significant

localised excavations that distort the final surface then clean fill materials sourced from elsewhere on site, or alternatively imported VENM, may be used to reinstate the required surface profile.

A number of exceedances of the EIL criteria were also identified in the available data set and the 95% Upper Confidence Limit (UCL) of the mean exceeded the NEPM EIL criterion for arsenic, cadmium, zinc and sulphate (as S). The extent to which these contaminants will remain elevated above the EILs following appropriate validation of the site surface is not clear at this time. Should contaminants exceed the EILs following validation then further justification of the retention of these concentrations will be undertaken using specialist soil science advice regarding the mobility and availability of metals in the site environment. Where required to support this assessment, additional analyses will be undertaken to provide an appropriate data set for these additional studies.

It is noted that the 95% UCL for chromium exceeds the EIL criterion for hexavalent chromium but is well below the criterion for trivalent chromium. There is no expectation based on the site history that the identified chromium is in the hexavalent valance state, however this will be verified as part of the validation program and the appropriate assessment criterion for chromium will be used for the assessment based on these findings.

6.2 Contamination Status of Groundwater

The following provides a summary of the key findings of the extensive groundwater investigations conducted at the site and the results of recent intensive investigations targeted to the northern section of the site in preparation for the site remediation program:

- Sixty-seven groundwater wells have been installed across the site targeting the fill, shallow and deep natural aquifer sequences.

- The primary metal contaminant of concern is zinc, with a maximum concentration detected in the 2006 investigation of 28 mg/L compared with the ANZECC 2000 freshwater ecosystem protection criterion 0.015 mg/L. More recent results from the northern investigation have reported zinc concentrations up to 7,000 mg/L in the shallow natural aquifer.

- A range of other heavy metals including cadmium, copper, lead, mercury and nickel occur at concentrations exceeding the ANZECC 2000 ecosystem protection criteria.

- Elevated metal results were typically associated with relatively low pH (acidic) groundwater.

- Whilst the southern area (in the infilled gully area) was the initial concern and the reason for the issue of the *Declaration of Remediation Site,* recent investigations have indicated that the groundwater in the northern area of the site is more heavily impacted. This may be due to the increased potential for recharge and leaching in this area due to the lack of any hardstand surface cover.

- The distribution of groundwater contamination generally indicates that the highest groundwater concentrations are located in areas where relatively large volumes of slag material are located directly hydraulically up gradient. This also tends to correspond with the highest soil concentrations and leachability results.

- The highest groundwater contaminants concentrations generally occur in the fill or shallow natural groundwaters at each location where nested monitoring wells are installed.

- Low pH groundwaters were encountered across the site with results ranging from 2.9 to 7.2. Almost all results were found to be below pH 7. The average groundwater pH was approximately 5.1.

- The highest concentration of ammonia detected was 0.56 mg/L which is considered relatively low and unlikely to give rise to adverse health or environmental impacts.

- Nitrate was detected at concentrations up to 11 mg/L. This is considered to be an elevated level of nitrate although unlikely to require targeted remedial activity given potential for dispersion, dilution or utilisation prior to discharge. The highest nitrate results exceed the ANZECC 2000 trigger value for freshwater ecosystems (95% level of protection) of 0.7 mg/L.

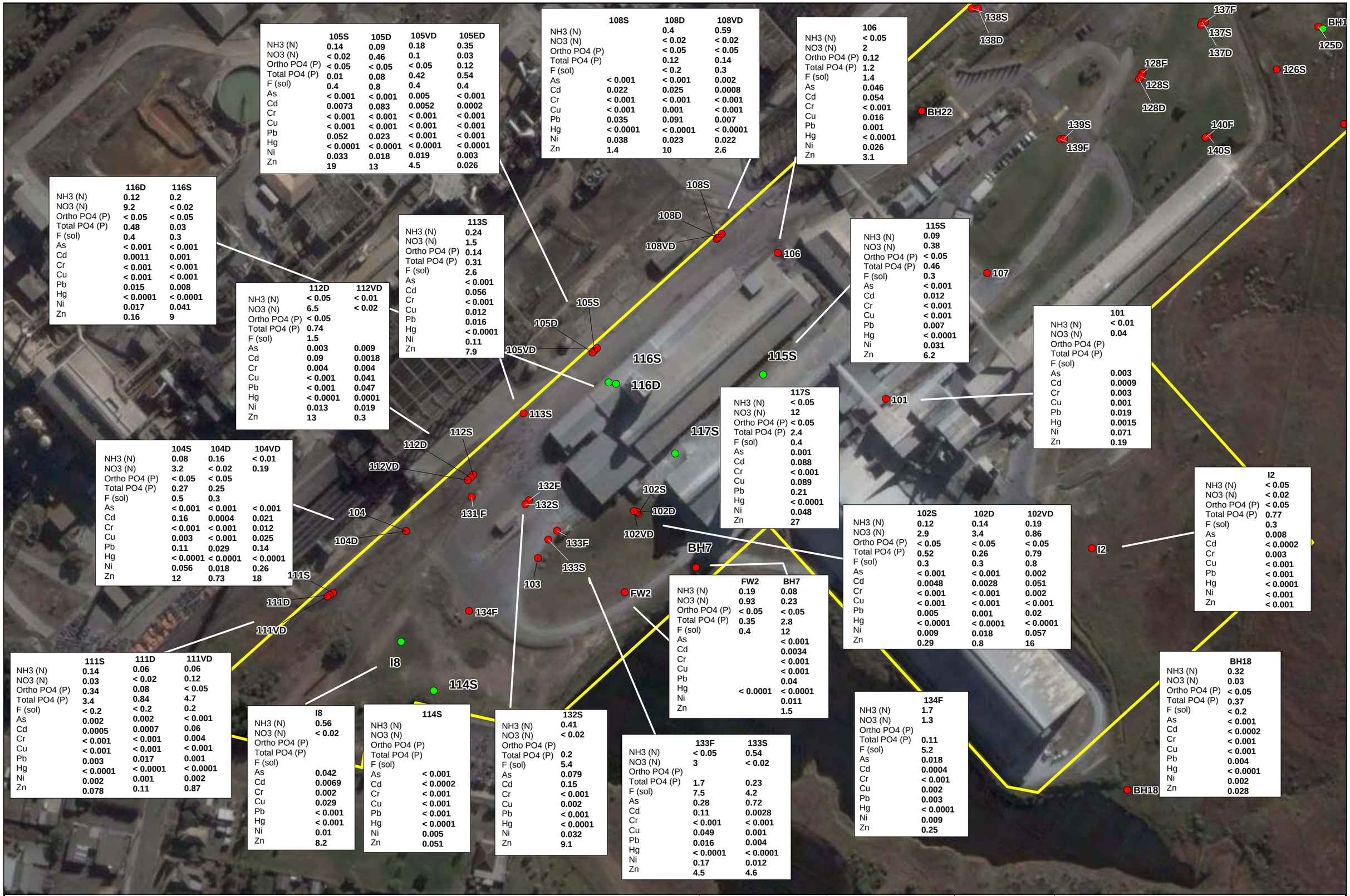
- Other potential contaminants including PAH, cyanide, organochlorine pesticides, phenols, polychlorinated biphenyls and volatile halogenated compounds were below the laboratory detection limits or below adopted guideline values.

- There was no odours apparent or visually impacted groundwater indicative of gross organic contamination during any sampling event.

- The most significant contaminants in groundwater at the site are considered to be heavy metals and of these, zinc occurs at the highest concentrations.

Figure 6 provides a summary of the selected groundwater results for the southern area of the site. The reader is referred to the *Environmental Site Assessment* report (S&G, 2006) and the *Further Environmental Investigations* report (S&G, 2008) for a detailed discussion of the contamination status of the groundwater at the site.

The following tables provide a summary of the key groundwater contaminants in the northern area and the central and southern areas of the site for each of the designated aquifer sequences intersected by the monitoring network. A separate fill aquifer has been defined in the northern section, although this is not as persistent in the southern area and most shallow wells in the central and southern area are inferred to be screened in the shallow natural aquifer, with the exception of a number of wells installed within the infilled gully materials.



	105S	105D	105VD	105ED
NH3 (N)	0.14	0.09	0.18	0.35
NO3 (N)	< 0.02	0.46	0.1	0.03
Ortho PO4 (P)	< 0.05	< 0.05	< 0.05	0.12
Total PO4 (P)	0.01	0.08	0.42	0.54
F (sol)	0.4	0.8	0.4	0.4
As	< 0.001	< 0.001	0.005	< 0.001
Cd	0.0073	0.083	0.0052	0.0002
Cr	< 0.001	< 0.001	< 0.001	< 0.001
Cu	< 0.001	< 0.001	< 0.001	< 0.001
Pb	0.052	0.023	< 0.001	< 0.001
Hg	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Ni	0.033	0.018	0.019	0.003
Zn	19	13	4.5	0.026

	108S	108D	108VD
NH3 (N)		0.4	0.59
NO3 (N)		< 0.02	< 0.02
Ortho PO4 (P)		< 0.05	< 0.05
Total PO4 (P)		0.12	0.14
F (sol)		< 0.2	0.3
As	< 0.001	< 0.001	0.002
Cd	0.022	0.025	0.0008
Cr	< 0.001	< 0.001	< 0.001
Cu	< 0.001	0.001	< 0.001
Pb	0.035	0.091	0.007
Hg	< 0.0001	< 0.0001	< 0.0001
Ni	0.038	0.023	0.022
Zn	1.4	10	2.6

	106
NH3 (N)	< 0.05
NO3 (N)	2
Ortho PO4 (P)	0.12
Total PO4 (P)	1.2
F (sol)	1.4
As	0.046
Cd	0.054
Cr	< 0.001
Cu	0.016
Pb	0.001
Hg	< 0.0001
Ni	0.026
Zn	3.1

	116D	116S
NH3 (N)	0.12	0.2
NO3 (N)	9.2	< 0.02
Ortho PO4 (P)	< 0.05	< 0.05
Total PO4 (P)	0.48	0.03
F (sol)	0.4	0.3
As	< 0.001	< 0.001
Cd	0.0011	0.001
Cr	< 0.001	< 0.001
Cu	< 0.001	< 0.001
Pb	0.015	0.008
Hg	< 0.0001	< 0.0001
Ni	0.017	0.041
Zn	0.16	9

	113S
NH3 (N)	0.24
NO3 (N)	1.5
Ortho PO4 (P)	0.14
Total PO4 (P)	0.31
F (sol)	2.6
As	< 0.001
Cd	0.056
Cr	< 0.001
Cu	0.012
Pb	0.016
Hg	< 0.0001
Ni	0.11
Zn	7.9

	115S
NH3 (N)	0.09
NO3 (N)	0.38
Ortho PO4 (P)	< 0.05
Total PO4 (P)	0.46
F (sol)	0.3
As	< 0.001
Cd	0.012
Cr	< 0.001
Cu	< 0.001
Pb	0.007
Hg	< 0.0001
Ni	0.031
Zn	6.2

	112D	112VD
NH3 (N)	< 0.05	< 0.01
NO3 (N)	6.5	< 0.02
Ortho PO4 (P)	< 0.05	
Total PO4 (P)	0.74	
F (sol)	1.5	
As	0.003	0.009
Cd	0.09	0.0018
Cr	0.004	0.004
Cu	< 0.001	0.041
Pb	< 0.001	0.047
Hg	< 0.0001	0.0001
Ni	0.013	0.019
Zn	13	0.3

	101
NH3 (N)	< 0.01
NO3 (N)	0.04
Ortho PO4 (P)	
Total PO4 (P)	
F (sol)	
As	0.003
Cd	0.0009
Cr	0.003
Cu	0.001
Pb	0.019
Hg	0.0015
Ni	0.071
Zn	0.19

	104S	104D	104VD
NH3 (N)	0.08	0.16	< 0.01
NO3 (N)	3.2	< 0.02	0.19
Ortho PO4 (P)	< 0.05	< 0.05	
Total PO4 (P)	0.27	0.25	
F (sol)	0.5	0.3	
As	< 0.001	< 0.001	< 0.001
Cd	0.16	0.0004	0.021
Cr	< 0.001	< 0.001	0.012
Cu	0.003	< 0.001	0.025
Pb	0.11	0.029	0.14
Hg	< 0.0001	< 0.0001	< 0.0001
Ni	0.056	0.018	0.26
Zn	12	0.73	18

	117S
NH3 (N)	< 0.05
NO3 (N)	12
Ortho PO4 (P)	< 0.05
Total PO4 (P)	2.4
F (sol)	0.4
As	0.001
Cd	0.088
Cr	< 0.001
Cu	0.089
Pb	0.21
Hg	< 0.0001
Ni	0.048
Zn	27

	102S	102D	102VD
NH3 (N)	0.12	0.14	0.19
NO3 (N)	2.9	3.4	0.86
Ortho PO4 (P)	< 0.05	< 0.05	< 0.05
Total PO4 (P)	0.52	0.26	0.79
F (sol)	0.3	0.3	0.8
As	< 0.001	< 0.001	0.002
Cd	0.0048	0.0028	0.051
Cr	< 0.001	< 0.001	0.002
Cu	< 0.001	< 0.001	< 0.001
Pb	0.005	0.001	0.02
Hg	< 0.0001	< 0.0001	< 0.0001
Ni	0.009	0.018	0.057
Zn	0.29	0.8	16

	I2
NH3 (N)	< 0.05
NO3 (N)	< 0.02
Ortho PO4 (P)	< 0.05
Total PO4 (P)	0.77
F (sol)	0.3
As	0.008
Cd	< 0.0002
Cr	0.003
Cu	< 0.001
Pb	< 0.001
Hg	< 0.0001
Ni	< 0.001
Zn	< 0.001

	FW2	BH7
NH3 (N)	0.19	0.08
NO3 (N)	0.93	0.23
Ortho PO4 (P)	< 0.05	< 0.05
Total PO4 (P)	0.35	2.8
F (sol)	0.4	12
As		< 0.001
Cd		0.0034
Cr		< 0.001
Cu		< 0.001
Pb		0.04
Hg	< 0.0001	< 0.0001
Ni		0.011
Zn		1.5

	111S	111D	111VD
NH3 (N)	0.14	0.06	0.06
NO3 (N)	0.03	< 0.02	0.12
Ortho PO4 (P)	0.34	0.08	< 0.05
Total PO4 (P)	3.4	0.84	4.7
F (sol)	< 0.2	< 0.2	0.2
As	0.002	0.002	< 0.001
Cd	0.0005	0.0007	0.06
Cr	< 0.001	< 0.001	0.004
Cu	< 0.001	< 0.001	< 0.001
Pb	0.003	0.017	0.001
Hg	< 0.0001	< 0.0001	< 0.0001
Ni	0.002	0.001	0.002
Zn	0.078	0.11	0.87

	I8
NH3 (N)	0.56
NO3 (N)	< 0.02
Ortho PO4 (P)	
Total PO4 (P)	
F (sol)	
As	0.042
Cd	0.0069
Cr	0.002
Cu	0.029
Pb	< 0.001
Hg	< 0.001
Ni	0.01
Zn	8.2

	114S
NH3 (N)	
NO3 (N)	
Ortho PO4 (P)	
Total PO4 (P)	
F (sol)	
As	< 0.001
Cd	< 0.0002
Cr	< 0.001
Cu	< 0.001
Pb	< 0.001
Hg	< 0.0001
Ni	0.005
Zn	0.051

	132S
NH3 (N)	0.41
NO3 (N)	< 0.02
Ortho PO4 (P)	
Total PO4 (P)	0.2
F (sol)	5.4
As	0.079
Cd	0.15
Cr	< 0.001
Cu	0.002
Pb	< 0.001
Hg	< 0.0001
Ni	0.032
Zn	9.1

	133F	133S
NH3 (N)	< 0.05	0.54
NO3 (N)	3	< 0.02
Ortho PO4 (P)		
Total PO4 (P)	1.7	0.23
F (sol)	7.5	4.2
As	0.28	0.72
Cd	0.11	0.0028
Cr	< 0.001	< 0.001
Cu	0.049	0.001
Pb	0.016	0.004
Hg	< 0.0001	< 0.0001
Ni	0.17	0.012
Zn	4.5	4.6

	134F
NH3 (N)	1.7
NO3 (N)	1.3
Ortho PO4 (P)	
Total PO4 (P)	0.11
F (sol)	5.2
As	0.018
Cd	0.0004
Cr	< 0.001
Cu	0.002
Pb	0.003
Hg	< 0.0001
Ni	0.009
Zn	0.25

	BH18
NH3 (N)	0.32
NO3 (N)	0.03
Ortho PO4 (P)	< 0.05
Total PO4 (P)	0.37
F (sol)	< 0.2
As	< 0.001
Cd	< 0.0002
Cr	< 0.001
Cu	< 0.001
Pb	0.004
Hg	< 0.0001
Ni	0.002
Zn	0.028

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Drawn: DJN	Date: 22 June 2008	Job No.: SG061313	Project: Cockle Creek Assessments		
Checked: APN	Date: 23 June 2008	Title: LATEST SELECTED GROUNDWATER RESULTS SOUTHERN AREA (mg/L)		Sheet 1 of 1	
File Name: GW S.wor	Scale: NTS	A3		FIGURE 6	

Table 7 – Groundwater Statistics – Fill Aquifer

Analyte	Northern Area					Central and Southern Area				
	count	Min (mg/L)	Max (mg/L)	No. > ANZECC	No. > NHMRC	count	Min (mg/L)	Max (mg/L)	No. > ANZECC	No. > NHMRC
Ammonia (N)	10	< 0.05	5.8	3	4	2	< 0.05	1.7	1	1
Nitrate (N)	10	< 0.02	1.5		0	2	1.3	3		0
TKN (N)	10	< 0.1	7.2			2	4.9	13		
Total Nitrogen (N)	6	< 0.2	7.4	5		2	6.5	16	2	
Nitrate + Nitrite (N)	6	< 0.02	0.55	3	0	2	1.6	3.2	2	0
Phosphate ortho (P)	4	< 0.05	< 0.05							
Total Phosphate (P)	10	< 0.01	6.5	7		2	0.11	1.7	2	
Sulphate (S)	10	85	880		3	2	450	480		0
Fluoride (sol)	10	0.5	41		5	2	5.2	7.5		2
Arsenic	12	< 0.001	0.22	4	5	2	0.018	0.28	2	2
Cadmium	12	0.0063	0.53	12	12	2	0.0004	0.11	2	1
Chromium	12	< 0.001	< 0.001	0	0	2	< 0.001	< 0.001	0	0
Copper	12	0.002	0.18	12	0	2	0.002	0.049	2	0
Lead	12	< 0.001	0.22	7	7	2	0.003	0.016	1	1
Mercury	12	< 0.0001	0.0084	1	1	2	< 0.0001	< 0.0001	0	0
Nickel	12	0.016	0.62	12	9	2	0.009	0.17	1	1
Zinc	12	2	210	12	11	2	0.25	4.5	2	1
Benzene	2	< 0.001	< 0.001	0	0					
Ethylbenzene	2	< 0.001	< 0.001	0	0					
Toluene	2	< 0.001	< 0.001	0	0					
Xylenes	2	< 0.001	< 0.001	0	0					
Total PAH	2	< 0.001	< 0.001							
TRH C29-C36	2	< 0.05	< 0.05							
TRH C10-C14	2	< 0.1	< 0.1							
TRH C15-C28	2	< 0.1	< 0.1							
TRH C6-C9	2	< 0.02	< 0.02							

Table 8 – Groundwater Statistics – Shallow Aquifer

Analyte	Northern Area					Central and Southern Area				
	count	Min (mg/L)	Max (mg/L)	No. > ANZECC	No. > NHMRC	count	Min (mg/L)	Max (mg/L)	No. > ANZECC	No. > NHMRC
Ammonia (N)	43	< 0.01	6.6	7	10	33	< 0.05	0.56	0	2
Nitrate (N)	43	< 0.02	11		0	33	< 0.02	12		0
TKN (N)	39	< 0.1	14			15	< 0.1	8.2		
Total Nitrogen (N)	25	< 0.2	7.4	19		2	0.8	8.2	2	
Nitrate + Nitrite (N)	25	< 0.02	0.35	1	0	2	0	0	0	0
Phosphate ortho (P)	14	< 0.05	< 0.05			13	< 0.05	< 0.05		
Total Phosphate (P)	39	< 0.01	1.4	18		15	0.01	3.4	13	
Sulphate (S)	39	31	4100		8	15	33	790		2
Fluoride (sol)	39	< 0.2	46		3	15	< 0.2	12		4
Arsenic	73	< 0.001	0.43	19	17	34	< 0.001	0.72	6	10
Cadmium	73	< 0.0002	17	63	43	34	< 0.0002	0.16	25	21
Chromium	73	< 0.001	0.019	5	0	34	< 0.001	0.004	1	0
Copper	73	< 0.001	2.5	29	2	34	< 0.001	0.089	19	0
Lead	73	< 0.001	0.64	34	23	34	< 0.001	0.21	23	14
Mercury	73	< 0.0001	0.0094	3	3	35	< 0.0001	0.049	5	5
Nickel	73	< 0.5	1.8	47	17	36	< 0.001	0.11	21	17
Zinc	73	0.008	6600	47	34	34	< 0.001	28	33	15

Analyte	Northern Area					Central and Southern Area				
	count	Min (mg/L)	Max (mg/L)	No. > ANZECC	No. > NHMRC	count	Min (mg/L)	Max (mg/L)	No. > ANZECC	No. > NHMRC
Benzene	3	< 0.001	< 0.001	0	0	2	< 0.001	< 0.001	0	0
Ethylbenzene	3	< 0.001	< 0.001	0	0	2	< 0.001	< 0.001	0	0
Toluene	3	< 0.001	< 0.001	0	0	2	< 0.001	< 0.001	0	0
Xylenes	3	< 0.001	< 0.001	0	0	2	< 0.001	< 0.001	0	0
Total PAH	3	< 0.001	< 0.001			2	< 0.001	< 0.001		
TRH C29-C36	3	< 0.001	< 0.001			2	< 0.001	< 0.001		
TRH C10-C14	3	< 0.001	< 0.001			2	< 0.001	< 0.001		
TRH C15-C2	3	< 0.001	< 0.001			2	< 0.001	< 0.001		
TRH C6-C9	3	< 0.001	< 0.001			2	< 0.001	< 0.001		

Table 9 – Groundwater Statistics – Deep Aquifer

Analyte	Northern Area					Central and Southern Area				
	count	Min (mg/L)	Max (mg/L)	No. > ANZECC	No. > NHMRC	count	Min (mg/L)	Max (mg/L)	No. > ANZECC	No. > NHMRC
Ammonia (N)	11	0.06	0.95	1	4	28	< 0.01	0.59	0	1
Nitrate (N)	11	< 0.02	0.08		0	28	< 0.02	9.2		0
TKN (N)	11	0.1	18			12	< 0.1	6.4		
Total Nitrogen (N)	8	< 0.2	8.8	5		0	0	0	0	
Nitrate + Nitrite (N)	8	< 0.02	0.08	0	0	0	0	0	0	0
Phosphate ortho (P)	3	< 0.05	0.21			12	< 0.05	0.12		
Total Phosphate (P)	11	< 0.01	1.9	10		12	0.08	4.7	12	
Sulphate (S)	11	44	820		2	12	68	640		1
Fluoride (sol)	11	< 0.2	1.4		0	12	< 0.2	1.5		0
Arsenic	16	< 0.001	1.1	6	7	28	< 0.001	0.018	1	2
Cadmium	16	< 0.0002	0.0055	7	4	28	< 0.0002	0.09	24	13
Chromium	16	< 0.001	0.017	6	0	28	< 0.001	0.012	9	0
Copper	16	< 0.001	0.005	5	0	28	< 0.001	0.041	11	0
Lead	16	< 0.001	0.054	2	1	28	< 0.001	0.28	17	14
Mercury	16	< 0.0001	< 0.0001	0	0	28	< 0.0001	0.012	3	3
Nickel	16	0.003	0.24	8	5	28	< 0.001	0.26	19	10
Zinc	16	< 0.001	52	14	4	28	0.026	23	28	10

The removal of the primary source of groundwater contamination through the isolation of the contaminated fill materials within a fully lined and engineered containment cell will greatly diminish the ongoing risks to groundwater quality from the site.

Management of the residual groundwater contamination is expected to result in an improvement in groundwater quality with time due to the marked reduction in mass inputs to the groundwater system with the removal of the fill materials which will prevent the further leaching of contaminants to the groundwater from the site fill materials.

6.3 Assessment of Possible Exposure Pathways and Receptors

The following table provides a qualitative summary of the potential exposure pathways, possible receptors and the significance of the risks posed by the identified site contamination.

Table 10 – Risk Exposure Summary

Receptor Type	Medium	Potential Receptors	Pathways	Risks
Human	Soil	Site Workers & Contractors involved in soil disturbances. Dust generation leading to offsite migration / deposition.	Dermal contact, inhalation of dust and accidental ingestion.	High: for workers in unpaved areas or contractors involved with shallow soil disturbances.
	Groundwater	Site Workers & Contractors involved in excavations >1m.	Dermal contact, inhalation of vapours / aerosols, and accidental ingestion.	High: for workers or contractors involved with excavations >1m deep.
		Users of groundwater on site.	Dermal contact, inhalation of vapours / aerosols, and accidental ingestion	Low: due to no groundwater extraction or use on site.
		Users of groundwater off site.	Dermal contact, inhalation of vapours / aerosols, and accidental ingestion	Low: due to development on adjacent site and lack groundwater extraction for subsequent utilisation.
	Vapour	Site Workers & Contractors involved in soil disturbances, excavations and utilising groundwater.	Vapours emanating from contaminated soil and groundwater migrating through the vadose zone into buildings and enclosed spaces on site.	Very low: No volatile components identified in soil or groundwater so exposure form vapours is remote risk.
Environmental	Soil	Soil ecosystems, flora and fauna.	Direct contact with contaminated soils	High due to shallow soil and groundwater contamination but not relevant due to the industrial nature of the site. Possible dust generation and deposition off site.
	Groundwater	On and Off site aquatic ecosystems, flora and fauna.	Discharge of groundwater to offsite aquatic ecosystems.	Low on site: due to absence of aquatic ecosystems receiving site groundwater.
				Moderate off site: limited impacts due to low seepage / transport rates, distance to possible receptors particularly under current hydrogeological regime, retardation/ adsorption potential within clayey aquifer matrix.
		Groundwater dependant ecosystems, flora and fauna.	Uptake and use of groundwater by groundwater dependent flora and fauna.	Low and irrelevant: due to absence of a significant groundwater dependent ecosystem on site
	Vapour	On site flora and fauna.	Vapours emanating from contaminated soil and groundwater migrating through the vadose zone into buildings and enclosed spaces on site.	Low and irrelevant due to absence of significant flora and fauna on site due to the industrial nature of the site and the low potential for vapours associated with known contaminants.

7. REGULATORY COMPLIANCE REQUIREMENTS

The following section provides a summary of the prevailing hierarchy of legislation relevant to the Phase 4 remediation program.

7.1 State Planning

7.1.1 Contaminated Land Management Act 1997

The CLM Act 1997 aims to establish a process for investigating and remediating land where contamination presents significant risk of harm to human health and other aspects of the environment.

On 22 July 2005 the IFL site was issued with a Declaration of Remediation Site under Part 3, Division 3 of the Act. Under s21 of the CLM Act 1997:

> "*The EPA may declare land to be a remediation site if the land has…been found to be contaminated in such a way as to present a significant risk of harm*."

As discussed previously, following the EPA's declaration of the IFL site as a remediation site, IFL has committed to preparing and entering into a Voluntary Management Plan (VMP) with DECCW in order to remediate the site in accordance with the terms of the CLM Act 1997. This Detailed RAP is intended to form part of that VMP.

7.1.2 State Environmental Planning Policy Major Projects 2005 (Major Projects SEPP)

The Major Projects SEPP aims to identify developments of economic, environmental and social significance either at a regional or state scale within NSW. Major Projects SEPP provides consistency in the assessment and approvals process for developments identified as being of state or regional significance. As outlined in clause 28 of Schedule 1 of Major Projects SEPP (as at July 2005), developments for which the Major Projects SEPP applies for remediation projects include:

> *"(a) premises subject to a notice requiring prescribed remedial action to be taken under section 35 or section 36 of the Environmentally Hazardous Chemicals Act 1985 (as continued in force by the Contaminated Land Management Act 1997), or*
>
> *(b) land declared as a remediation site under Division 3 of Part 3 of the Contaminated Land Management Act 1997*."

In light of the site being declared a remediation site in 2005, any proposed remedial activity will be subject to assessment and approval under Part 3A of the Environmental Planning and Assessment Act 1979.

7.1.3 Environmental Planning and Assessment Act 1979 (EPAA 1979)

Part 3A of the EPAA 1979 consolidates the assessment and approvals process for all major projects that require Ministerial approval. Part 3A applies to projects deemed to be critical infrastructure, major projects and other projects declared by the Minister.

In light of the IFL site's inclusion under the Major Projects SEPP, the site is subject to assessment under Part 3A of the EPAA 1979. As outlined under section 75B of the Act, Part 3A Major Infrastructure and other projects applies to developments that are either declared:

"(a) by a State environmental planning policy, or

(b) by order of the Minister published in the Gazette."

This means that IFL must seek approval from the Minister to carry out remediation action at the IFL site.

In response to this IFL, prepared and submitted a preferred project application with the NSW Department of Planning (DoP) in February 2007. This was accepted by the DoP and the Director General's Requirements were issued in March 2007. IFL is currently preparing an environmental assessment with all relevant specialist studies to meet these requirements.

7.1.4 State Environmental Planning Policy 55 Remediation of Land (SEPP 55)

The proposed remediation works on the IFL land are in alignment with the aims of SEPP 55. The objective of this policy is to provide a statewide planning approach for the remediation of contaminated land.

The aims of the SEPP include remediation of contaminated land for the purpose of reducing risk of harm to human health and the environment. Remediation of the IFL site is consistent with the provisions of this policy.

As the remediation of the IFL site has potentially significant environmental impacts, the proposed remediation would be defined as Category 1 work under clause 9 of the SEPP. Under SEPP 55, Category 1 work requires consent.

7.1.5 Protection of the Environment (Operations) Act 1997 and (General) Regulations 2009

The *Protection of the Operations Act 1997* (POEO Act) is the key piece of environment protection legislation administered by DECCW. Clean-up notices, prevention notices and prohibition notices are the provided for under the legislation.

The POEO Act provides a single licensing arrangement to replace the different licences and approvals under existing separate Acts relating to air pollution, water pollution, noise pollution and waste management.

Licences usually are issued with conditions. Examples of conditions that can be attached to a licence are included in the POEO Act. These include requirements to monitor, to provide certification of compliance with a licence, to undertake and comply with a mandatory environmental audit program and pollution studies, reduction programs and financial assurances. A *Protection of the Operations Act* license will be required for any proposed groundwater remediation activities involving dewatering and injection.

There is provision for a public register to be kept by all regulatory authorities, which must include a range of specified information on licences, review of licences, prosecutions, notices and the conclusions of any mandatory audit report. The register must be available for public inspection and copies provided on request.

An amendment Act was introduced in 2005 which addressed licensing administration, waste regulatory framework, the issuing of notices and related cost recovery, noise, smoke abatement notices, offences and penalties, classified waters, green offset schemes or works, powers of authorised officers, regulation-making powers, evidentiary matters and a number of other miscellaneous matters.

The *Protection of the Environment Operations (General) Regulation 2009* made under the POEO Act forms the basis for the licensing of activities which may impact the environment, give effect to the *National Environment Protection (National Pollutant Inventory) Measure* including green offset schemes, defines land and water pollution and the management of noise amongst other actions. The most recent *Protection of the Environment Operations Amendment (Waste) Regulation 2005* came into affect in April 2008.

The *Protection of the Environment Operations (Waste) Regulations 2005* set out the requirements to track any hazardous, industrial, Group A or controlled waste, including asbestos waste that are generated by activities on site and are proposed to be disposed of off site. Licences issued under the POEO Act also usually contain conditions relating to tracking requirements if such activities are being carried out or proposed to be carried out on the site.

7.2 Regional Planning

7.2.1 Lower Hunter Regional Strategy 2006–31

The NSW Government's Lower Hunter Regional Strategy 2006-31 (LEHRS) is a land use planning document that outlines provisions for ensuring sustainable development over the next 25 years throughout the Lower Hunter region. The strategy makes provisions for ensuring sufficient housing and employment land, the protection of high quality agricultural land and natural resources, as well as the delivery of services and infrastructure.

The strategy is based upon population projections, which estimate that by 2031 an additional 160,000 people will live in the Lower Hunter region. The LEHRS applies to five local government areas (Lags) across the Lower Hunter region. The Lags to which the strategy applies includes Newcastle, Lake Macquarie, Port Stephens, Maitland and Cessnock.

The LEHRS is relevant to IFL as it provides a framework for the future use of the Cockle Creek site and surrounding lands.

7.3 Local Planning

7.3.1 Lake Macquarie Local Environmental Plan 2004

The IFL site is currently zoned 4(1) Industrial (core) zone. The proposed structure demolition and remediation of the IFL lands is consistent with the objectives of the current site zoning. These objectives include:

- Ensuring that industries are designed and located so as not to cause unacceptable environmental harm or adversely affect the amenity of the environment, including residential neighbourhoods.

- Providing for sustainable water cycle management.

The remediation of the IFL site will ensure improvements to amenity and groundwater quality. This would contribute to the establishment of sustainable water cycle management practices.

7.4 Site Heritage Status

Preliminary background investigation undertaken by heritage consultants included searches of a range of heritage registers (*Incitec Pivot Cockle Creek Demolition and Remediation – Heritage Assessment,* ERM Consulting, 2008).

These investigations found that no previously recorded historic heritage sites existed within the study area, although some were located in close proximity. Similarly, there were no previously recorded Aboriginal heritage sites within the study area, although some were located in the vicinity. The results of the heritage assessment are provided in the CEMP prepared under separate cover for the proposed site remediation works.

8. REMEDIAL ACTION PLAN

8.1 Remediation Goal

The primary objective of the Phase 4 works is to remediate contaminated soils from the southern portion of the site including the infilled gully, to ensure the site is suitable for its proposed future residential land use and ensuring protection of human health, the environment and property during the works. The removal of any remaining site infrastructure (roadways and weighbridge) will also be undertaken as part of this phase of works.

Following removal of the site infrastructure, the contaminated soil materials from this area of the site, including those located within the infilled gully and the contaminated material within the dam wall, will be excavated and placed within the containment cell to be constructed as part of Phase 2 remedial works. The detail of the cell construction is included in the Phase 2 Detailed RAP and the reader is referred to this document for the cell construction details.

The steep grade near the site boundary and the extension of fill materials across the site boundary onto the Pasminco site will require liaison with the adjacent site operators to facilitate the effective removal of the contaminated soils from this area. The dam wall is located largely within the Phase 4 site and the dam is located on Pasminco land. Control measures for water entering the dam will be coordinated between IFL and Pasminco.

8.2 Extent of Remediation Required

Phase 4 will involve the excavation of all contaminated soil located within the southern area of the site and placement of the contaminated material into an engineered containment cell to be constructed in the northern portion of the site as part of Phase 2 remediation works.

The final excavated site surface will be validated in accordance with the validation protocol and to the satisfaction of the Site Auditor. The compliance requirement for the southern area will be the NEPM 'A' HIL and EIL screening values with additional TCLP assessment if required, applied in accordance with the agreed and approved validation protocol.

Excavated contaminated materials will be held in temporary stockpiles, located within Shed 4 or placed directly within the cell. The soils will be screened to remove inert oversize material, which will be stockpiled and removed from site to an appropriate landfill following testing and approval of the disposal procedure by the Site Auditor. All stockpiles will be managed to prevent environmental impacts through surface sealing and covering.

It is expected that the removal of the contaminated material will result in the site surface resembling the previous natural site surface prior to the deposition of the waste fill materials from the smelter operations. Hence the remediation program will generally restore the natural shape of the landform across the site including the former natural gully area.

8.3 Recommended Remedial Options

An evaluation of various remedial options for both soil and groundwater contamination was undertaken and reported in the *Conceptual Remediation Action Plan (October 2008)* prepared by S&G and Golder Associates.

It was concluded that the most viable option for soil remediation at this site was the on-site containment of contaminated fill materials within a fully lined, engineered containment cell to be constructed in the northern portion of the site. Therefore soils excavated from Phase 4 area will be encapsulated within an engineered containment cell. This approach was considered to provide the best environmental outcome.

8.4 Selected Remediation Strategy

Prior to the commencement of remedial works demolition of all remaining site infrastructure will be undertaken in the southern area of the site. Uncontaminated waste materials will be disposed off site to appropriate handling or disposal facilities. It is expected that the asbestos containing materials will be buried within the containment cell, pending appropriate approvals. If these approvals cannot be obtained for on site disposal within the cell, the asbestos containing materials will be disposed offsite to an appropriately licensed landfill.

Following removal of the site infrastructure, the contaminated soil materials present across this area of the site, including those in the infilled gully and the contaminated material within the dam wall, will be excavated and placed within the containment cell. Excavation will continue until natural soils are encountered. In general, excavation works will commence in upslope areas and progress to down slope areas to minimise the potential for contaminated stormwater to flow into and re-contaminate excavated and validated areas.

In addition, excavation will be coordinated with containment cell construction to allow as much material as possible to be excavated, screened and placed directly in the cell without the need for temporary stockpiling. Due to the steep grade near the site boundary and the extension of fill materials across the site boundary onto the Pasminco site, liaison with the adjacent site operators will be required to facilitate the effective removal of the contaminated soils from this area.

Environmental management measures required during the remediation works are summarised as follows:

1. Establishment of environmental controls:

    - stormwater management: diversions, storage, clean and impacted water separation, discharge points.

    - groundwater management: down gradient interception, seepage collection, excavation dewatering.

    - water treatment plant (if required).

- stockpile areas, including base preparation, seepage collection, and dust management.
- internal haul roads.

2. Ensure that Pasminco easements across the IFL property are appropriately addressed (either maintained or relocated if required, or negotiate surrender of redundant easements).
3. Soil excavation and placement:
    - excavation of contaminated soil, screen to remove oversize and inert materials (e.g. boulders, scrap metal).
    - validation of excavated surface
    - placement and compact contaminated soil within cell.
    - establishment of storm water management and erosion/sediment control measures for the newly excavated area.

The final excavated site surface will be validated in accordance with the validation protocol and to the satisfaction of the Site Auditor. The final landform of this area of the site will approximate the previous natural site surface prior to the deposition of the waste fill materials from the smelter operations, aside from the areas excavated for building construction. This will reinstate the former gully area across this southern section of the site which may form a natural drainage course as part of the site re-development. It is anticipated that the dam wall occurring within the IFL property will not be required for future water management and this will be removed as part of these works.

No groundwater remediation is proposed as part of the Phase 4 works because the removal of contaminated filling present across the southern portion of the site and in particular within the infilled gully will remove the primary source of groundwater contamination and therefore contaminant concentrations in groundwater should decrease significantly following the completion of remediation works at the site.

A baseline groundwater monitoring program will be conducted in the area of interest. Periodic groundwater monitoring of selected wells will be conducted throughout the remediation program to characterise the influence of the remediation program on groundwater contaminant concentrations and to provide a temporal record of the variation in groundwater concentrations. Groundwater monitoring will continue routinely across the remainder of the site. The groundwater monitoring program has been included in the CEMP.

8.5 Key Stakeholder Responsibilities and Contact Details

To facilitate the completion of the proposed remediation works in accordance with this Detailed RAP document, the stakeholders and their roles and responsibilities are identified in Table 11.

Table 11 – Project Stakeholders

Role	Company	Representative	Contact Details	Roles and Responsibility
Principal	IFL	Mr Mark Shelley	(03) 5279 4104	To provide financial support for the project and to manage publicity and other aspects of the project which may impact on corporate profile. Provision of OH&S requirements. To develop and manage community liaison and ensure neighbours and the wider community are informed about the works being undertaken. Provide liaison and interface with adjacent Pasminco remediation and management team. To liaise with Council and regulatory authorities.
Regulatory	Department of Environment, Climate Change and Water	Mr John Coffey	(02) 9995 5000	Provision of guidance regarding legislative controls and local guideline levels where available. Provide support for the comment on the design of the remediation system including re-injection of treated water to the aquifer.
	Department of Water and Energy	Mr Peter Johns / Mr Mark Mignanelli	(02) 4904 2500	Licensing of groundwater extraction for the groundwater remediation / management systems.
	Department of Planning	Ms Ann-Maree Carruthers	(02) 9228 6550	To ensure the project meets all planning requirements and that all appropriate licences and approvals are obtained.
	City of Lake Macquarie	Mr David Pavitt	(02) 4921 0333	To ensure the project meets the requirements and objectives of community and that the master plan for the area is consistent with Council's objectives.
Auditor	Environmental -Auditors Pty Ltd	Mr Phillip Hitchcock	(02) 4040 8150 or 0418 761 814 (mobile)	The Auditor's role is to provide Interim Advice Letters, Site Audit Statements (SAS) and Site Audit Reports (SAR) as required throughout the process. This approach will ensure that: the objectives of the RAPs as stated are met to the extent practicable; ensure that adequate data is collected through the process to ensure outcomes can be independently verified; and the quality of the data is sufficient to allow conclusions to be drawn.
Community Liaison	IFL	Mr Scott Nairn	(08) 8440 2343 or 0428 112 599	To provide information to the community regarding the proposed works and the objective for remediation at the site. To provide a central path for communication with the project between the community and the project team.
Legal Counsel	Mallesons Stephen Jaques	Mr Stephen Davis	(03) 9643 4107 or 0408 168 218	To provide legal advice to the project to ensure compliance with legislative requirements.
Planning Consultant	Manidis Roberts	Ms Janine Stablum Mr Nick Johnson	(02) 9248 9800 or 0421 197 154	To manage the interface of the project with the regulatory planning function. To manage a series of sub-consultants

Role	Company	Representative	Contact Details	Roles and Responsibility
				engaged to address key aspects of the planning process and in support of the site management plans.
Environmental Consultant	S&G	Mr Andrew Nunn / Mr David Nunn	(08) 8431 7113 or 0428 154 976 (03) 5367 1255 or 0407 526 074	Management of environmental aspects of the project to ensure completion in accordance with client expectations. Management of contractors to ensure compliance with design requirements, quality of services and verification of environmental outcomes. Completion and supervision of groundwater remediation system commissioning, operation and monitoring.
Remediation / Soil Containment Consultant	Golder Associates	Dr Gary Schmertmann / Dr Lange Jorstad	(02 9478 3900 or 0447 249 250	To undertake the design of the soil remediation containment cell, develop remediation earthwork and surface water management staging plans, assist with the tendering process and provide verification monitoring of the contractor performance against specified objectives. To liaise with other consultants and ensure the cell design meets technical and amenity objectives.

8.6 Interim Site Management Plan (Prior to Remediation)

Given the current limited use of the site, no unacceptable risks to site users and the environment associated with the identified contamination have been identified. Therefore, required interim site management measures have not been identified. The contaminants are not expected to result in acute risks from short term exposure.

The site is currently secured with a chain link fence, therefore further fencing / security measures are not considered necessary.

8.7 Validation Testing

A key outcome of the soil remediation program will be to provide a final surface that is suitable from both a contaminant status and aesthetic perspective that is suitable for low density residential use for the entire Phase 4 southern portion of the site.

The objective for remediation of this portion of the site is to meet the NEPM 'A' HIL criteria for unrestricted low density residential use and the EIL criteria or other nominated criteria for protection of ecological values. The leaching potential of the residual soils will also need to be satisfied such that the residual soils do not pose an ongoing risk to the groundwater environment. It is anticipated that if the adopted screening criteria are met then it is likely that the risk of contamination posed to the groundwater environment will be low.

It is noted that that the fill materials which are the focus of the remediation works are visually distinctive from the underlying natural soils and so this provides a convenient distinction between the materials to be excavated and contained and those that can remain, subject to validation

testing. It is anticipated that the process of validation will progressively refine the material identification and excavation program.

The protocol for surface validation has been agreed with the Site Auditor and forms part of the CEMP. An overview of the validation protocol is included in the following section.

8.7.1 Validation Overview

The surface validation will occur using a combination of NATA certified laboratory based analytical program and real-time guidance validation of heavy metal concentrations using a field portable X-ray fluorescence (XRF) meter. This use of an XRF meter as part of the validation protocol is considered appropriate in this case since the primary contaminants of concern are heavy metals and principally, these contaminants are lead and zinc. These contaminants are likely to represent markers of fill contamination and as such, their removal to acceptable levels is expected to result in a surface where the slag impacted fill materials have been suitably removed and in doing so, the excavation will have removed any other potentially contaminated fill materials.

The XRF will be used to provide a screening level assessment of the excavation surface to assist in determining excavation extents. Following successful excavation, the XRF meter will be used to provide a rapid, high-density validation program to ensure compliance of each allotment or sub parcel with the adopted remediation criteria and provide adequate data for statistically based assessments.

The XRF and analytical validation sampling will be conducted in combination with a GPS unit to allow for accurate location of the sampling locations within the site and verify a suitable density of sampling across each portion of the site.

8.7.2 Validation Density

The validation density will be based on the proposed land use.

8.7.2.1 Residential Southern Zone - XRF

In the residential area to the south, small residential block sizes are considered likely and as a result it is proposed to conduct sampling at the higher density, consistent with a small residential block assessment.

It is expected that slag materials will represent an aesthetic issue in this zone and any evidence of residual slag material should have been removed through the remediation program. Any zones of slag material or other aesthetically unacceptable material identified during the validation program should be removed from this area and placed within the cell. The final surface should represent only natural soil materials.

In the residential area, the validation density using XRF will be 100 points per hectare on a square grid basis.

The proposed density would identify an approximately 12 m diameter hot spot with a 95% level of confidence. This is consistent with the density recommended in AS4482.1 for site characterisation of a site comprising 0.05 ha (500 m^2).

8.7.2.2 Laboratory Based Density

The XRF validation data will be verified and extended by the laboratory analytical program. Duplicate soil samples analysed by the XRF will be analysed routinely by the laboratory at the rate of 10% of the XRF sampling locations. This is greater than the minimum 5% recommended in US EPA Method 6200.

The locations for analytical assessment will be appropriately dispersed to provide a wide coverage of the site. These analytical assessment locations will also be assessed for a wider range of chemical and physical parameters and will provide a more detailed verification of the surface validation for low likelihood contaminants (ie those contaminates which are not expected to occur based on available data).

The laboratory analytical program will also include analyses of other broader organic and inorganic contaminants (including fluoride and asbestos) to verify the suitability of the site soils for residential use. The frequency of primary samples tested by this method and the extent of the analyses conducted is stipulated in the validation protocol and will occur at no less than five samples per hectare.

Should the analytical program identify low likelihood contaminants at elevated concentrations, then further analytical testing would be undertaken. The analyte suite and density of this further sampling would be discussed and agreed with the Site Auditor.

The residual soils must also meet the criteria for aesthetic considerations regarding the use of the site for residential purposes. Aesthetic issues include the generation of odours from the site and any discolouration of the soil as a result of contamination. The discoloration criterion would also include the presence of slag materials. As noted previously, the generation of odours is considered to be a low risk at this site due to the absence of any significant concentrations of volatile or other organic contaminants.

A detailed site validation protocol is included within the CEMP. The validation plan will include:

- A statement of the validation objectives;
- A summary of the validation methods to be used;
- A discussion of the Data Quality Objectives and how these will be achieved;
- A description of the validation criteria and the statistically based decision methodology for determining compliance;

- A protocol for the field XRF operation and the laboratory analytical program including frequency of laboratory sampling, the laboratory analytical program, comparison of laboratory and field results and the methods for resolving discrepancies including re-validation of areas where discrepancies cast doubt on the validity of the field based data;

- A proposed grid spacing and density of sampling locations across the site;

- A protocol for addressing areas of the site that do not meet the validation criteria, including delineation, excavation and re-validation; and

- A method for reporting the validation results for review and approval by the Site Auditor.

The final site validation report will form part of the overall remediation report prepared for the site and will demonstrate that the residual surfaces are suitable for their intended uses.

8.8 Construction Environmental Management Plan

The remediation works will be conducted under a site-specific Construction Environmental Management Plan (CEMP). This plan will be prepared in accordance with relevant guidelines to ensure the appropriate environmental management measures and contingencies are implemented during the remediation works to protect human health and the environment. The CEMP must be reviewed and approved by the Site Auditor prior to the commencement of remediation works at the site.

Due to the complexity and scale of the remediation project, the CEMP will contain a variety of management plans developed for each component of the environmental management process with input provided by the respective specialist sub consultants to ensure that each area of potential environmental impact is managed appropriately. The detailed management plans to address all identified issues, which will form the CEMP, are summarised in the following sections.

8.8.1 Occupational Health and Safety

A comprehensive, site-specific safety management system will be developed prior to the commencement of remediation activities to ensure that safe work conduct is front of mind throughout the remediation process. The safety management system will be consistent with the requirements of the *NSW OHS Act* (2000) and the *NSW OHS Regulation* (2001). The minimum components of the safety management system will include:

- A site induction process that addresses both the IFL safety requirements and the general safety requirements of the remediation program.

- Clear definition of a management structure for OHS-related roles and responsibilities for the Principal Contractor, subcontractors, site supervisors and employees undertaking the various remediation tasks.

- Preparation of a Health, Safety and Environmental Plan by the Principal Contractor that specifies the safety management processes and requirements for the site, which will be provided to all major or long-term contractors and personnel associated with the remediation program for review, feedback and endorsement prior to commencement of works on site.

- All contractors and subcontractors on the project will be required to prepare and submit for review site-specific Job Safety Analyses (JSA) or Safe Work Method Statements (SWMS) for their specific work tasks prior to commencement of works on site. Safety management, performance and experience and training of personnel to conduct their tasks in a safe and professional manner will comprise a key evaluation criterion during tendering of the works.

- Specification of a risk-based assessment system for all work activities associated with the remediation program, including adoption of a 'TAB' approach to evaluating risks on-the-spot associated with unexpected or changed conditions on site, or revised work tasks that are not adequately addressed in an existing JSA or SWMS (lessons learned from 'take five' assessments will be shared at the next daily toolbox talk, and incorporated into the relevant JSA / SWMS if warranted).

- Daily 'toolbox' talks prior to commencement of works, involving the site supervisor and all remediation personnel, to discuss the safety issues associated with the days planned activities, and update or revise SWMS and JSA to reflect new site safety guidelines and new or modified work activities.

- Clear lines of communication for hazard / near miss / incident reporting, and work processes for addressing these reports.

- A safety documentation management system to provide evidence of the implementation and proper conduct of the safety management system throughout the project.

- Emergency procedures to respond to incidents requiring urgent medical attention, or potential hazards that require isolation and/or evacuation of parts or all of the site (and potentially notification of the local authorities and surrounding community).

- A "no-fault" audit / inspection process to encourage open communication between all site personnel regarding the effectiveness of the safety system, and group contribution to continual improvement of the safety management system throughout the project.

8.8.2 Surface Water Management Plan

Management of surface water will be a critical component of the remediation program for the IFL facility. The IFL facility is situated on the foot slopes of Munibung Hill, and primarily comprises an industrial plant constructed on infilled drainage gullies. Surface water management issues will generally include the following components:

- Diversion of stormwater run on from Pasminco property up slope from the IFL property, which may include the use of drainage easements that Pasminco holds across IFL land (this will primarily be the responsibility of Pasminco, with IFL providing maintenance of Pasminco drainage easements across its property). IFL will allow run on to flow over the IFL site at the southern gully through armoured channel so that further contamination does not occur.

- The southern catchment area and parts of the central area will be diverted into the existing depression at the south of the buildings and then pumped into a large dam in the northern catchment. The remainder of the central catchment will be diverted to the northern dam at the current acid dosing location.

- The northern dam will receive these diverted streams plus runoff from the cell footprint and northern catchment. The pollutant concentrations and pH of water collected in the dam will be managed with aeration through cycling, dosing to encourage precipitation, dispersion across the site for dust suppression and biofiltration through engineered swales. The combined storage volume of the dams allows for the gradual treatment of water, minimising the overall treatment system capacity.

- Treatment of water stored in the northern dam through a combination of precipitation and ion exchange depending on the volume and concentrations of the water during. The treated water will then be discharged through the central easement according to the Department of Environment, Climate Change and Water (DECCW) licence conditions.

- Armouring of batter slopes on the property edges and direction of clean runoff to approved easements over Pasminco land.

- Separate management of leachate water derived from stockpiled material, drainage of saturated material emplaced within the containment cell, and potential ingress of groundwater seepage from excavation faces during remediation.

An outline of the proposed surface water management strategy to be adopted at the site is provided as Figure 7.

A Surface Water Management Plan will be prepared prior to the commencement of remediation works and included in the CEMP. The plan will provide details of the strategies and civil works required to manage the various surface water types throughout the course of the remediation program. A primary objective of the program will be to manage all surface water on the site through storage and treatment prior to discharge to the drainage easements. The plan will be structured to adapt to changes in the land forms as remediation progresses. In addition, careful site management will assist in minimising the load on the treatment systems.

Examples of measures that will be considered to minimise the potential for water quality impacts to surface run off include:

- Minimising the area of disturbed ground that has yet to be validated.

- Diversion of water around disturbed areas, stockpiles, and the containment cell.

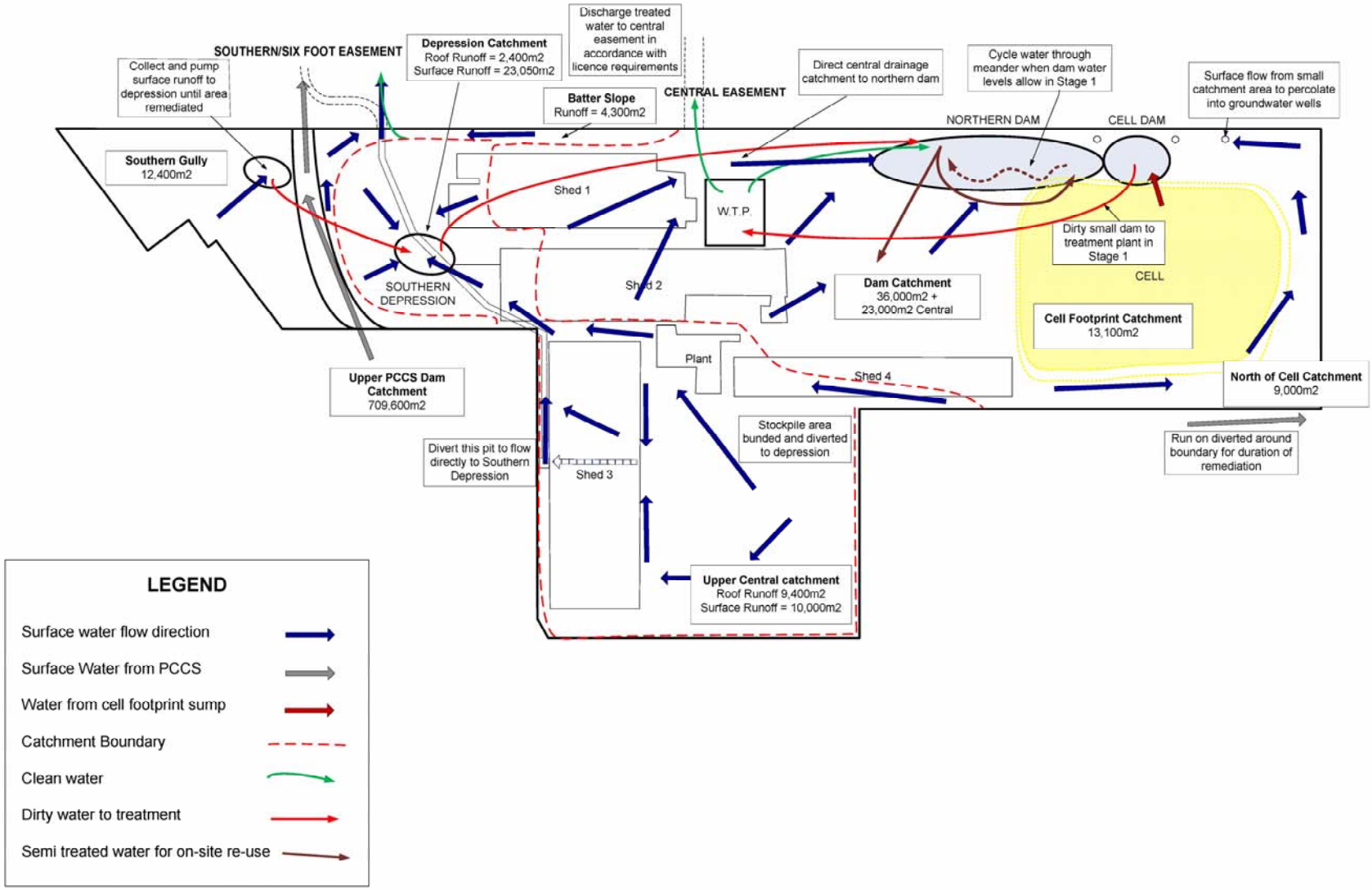

Figure provided by BMT WBM, March 2010

BASE DRAWING – GOLDER AND ASSOCIATES FILE NUMBER 077623082_5300 01 Rev3 FIGURE 1 – NOVEMBER 19 2009

Issue	Date	Amendments
1	15/12/2009	Draft
2	12/01/2010	Direct whole site to Northern dam

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Project: Incitec Pivot Surface Water Management – S 863

Drawing Title: Surface Water Management Plan Stage 1

NTS
Designed: RB
Drawing Number: ST - 01
Issue: 1

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Drawn: DJN	Date: 19 March 2010		Job No.: SG061313	Project: Cockle Creek Assessments	
Checked: AKW	Date: 19 March 2010		Title: SURFACE WATER MANAGEMENT STRATEGY		Sheet 1 of 1
File Name: Fig8.wor	Scale: As Shown	A4			FIGURE 7

- Use of barrier strategies for stockpiles, excavation faces or other disturbed areas that could potentially generate contaminated run off, including:
    - Shotcreting batter slopes,
    - Sealing stockpiles with semi-permanent membrane materials, and
    - Interim and daily cover within cell areas; and
- Capturing base seepage from contaminated soil stockpiles and pore water drainage from saturated fill material emplaced in the cell.

8.8.3 Traffic Management Plan

Traffic movements will be carefully managed during remediation with regards to safety issues on site and upon entering and exiting the former Pasminco smelter complex onto Boolaroo surface roads. Coordination of on site traffic flow will be especially important during the overlap period between the commencement of the remediation program and ongoing IFL commercial activities, which involve a significant number of truck movements to and from the site. Finally, coordination with the former Pasminco remediation program will be required, as heavy plant commonly crosses the primary access road through the Pasminco property to the IFL facility.

For each stage of remediation, primary haul roads will be established to provide access to the active development areas of the site, and speed limits, right-of-way protocols and safe work methods for working around moving plant will be developed as part of the remediation safety management system. As remediation progresses, traffic flow through remediated and validated portions of the site will be restricted to permit a staged audit process of the remediation works, and minimise the potential for re-contamination of remediated portions of the site.

In addition, the movement of trucks along external roads will be assessed and appropriately managed to avoid congestion issues to local traffic areas.

8.8.4 Air Quality, Dust Management and Odour Plan

The activities associated with decommissioning and remediation of the IFL facility has the potential for significant dust generation, which is both a nuisance and health risk to the surrounding community. Features of primary concern with regards to dust generation include soil stockpiles, open excavation faces and areas of stripped vegetation, particularly following periods of limited rainfall.

As such, an Air Quality Management Plan will be developed that will provide details of a dust monitoring program (locations, frequency, type of monitoring), regulatory compliance criteria based on NEPM standards, reporting requirements for monitoring results and site management practices to minimise dust generation.

The Plan will be based on the *National Environment Protection (Ambient Air Quality) Measure* (as amended) (NEPC, 2003) and *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DECC, 2005).

Considering the nature of the primary contamination issue at the site (i.e. smelter slag), the potential for generation of offensive odours during remediation is considered to be low. However, the following odour mitigation measures will be adopted if odour emission issues are encountered:

- Physical barriers over material stockpiles or excavation faces, which may include plastic sheeting, sacrificial clean fill covers, or other barrier methods.
- Use of spray or mist odour mitigation chemicals, applied either along the site boundary or directly onto stockpiled material or excavation faces.
- Maintenance of equipment and plant to minimise vehicle exhaust emissions.

Odour control methods will be employed at any stage that site personnel become aware of offensive odours arising from remediation activities, or an odour complaint is registered from the surrounding local community.

8.8.5 Asbestos Management Plan

The initial stage of the demolition program (Phase 3) will include the removal of a large quantity of asbestos-cement sheeting from most of the buildings and structures planned for demolition. A survey of the IFL property and facilities for the presence of asbestos materials was conducted by Indec Consulting Pty Ltd in December 2007, and their report estimated that over 56,000 m^2 of asbestos-cement materials are present on the Site.

The removal of these materials will be a major activity, undertaken by an appropriately licensed contractor, and in accordance with specific regulatory requirements, work practices, personal protective equipment and handling procedures (as dictated by NSW WorkCover Authority).

At any time, areas or buildings which are actively undergoing asbestos removal work will be identified and segregated from other work activities by physical barriers and warning signs, and all personnel other than those involved in asbestos removal will be excluded from entry.

Handling and removal of asbestos-containing materials will also be carried out in accordance with legislative and regulatory requirements for the removal and disposal of asbestos containing materials. An Asbestos Management Plan to be implemented at the site has been provided in the CEMP. Pertinent information provided in the CEMP has been summarised as follows.

Any asbestos removal will be undertaken by a licensed asbestos removal contractor in accordance with the following key legislation:

- Occupational Health and Safety Act 2000;
- Occupational Health and Safety Regulations 2001

- Dangerous Goods Act 1975; and
- Waste Avoidance and Resource Recovery Act 2001.

The asbestos materials will be removed and contained in accordance with relevant Australian Standards and guidelines. In addition, exposure monitoring will also be undertaken during removal activities in accordance with Australian Standard requirements. A third party will be engaged to undertake auditing of the asbestos removal procedures.

The site surface will be visually inspected following the completion of asbestos removal works to ascertain whether asbestos cement fragments or fibres remain within the soils and verification of the surface and validation samples will be undertaken to confirm that asbestos fibres do not occur in soils.

8.8.6 Noise and Vibration Management Plan

Demolition and remediation works at the Site will naturally cause the generation of noise and, to a lesser degree, vibration effects. Noise will be produced by the movement of machinery (mostly mobile plant, trucks and other vehicles), the cutting of steel, breaking and removal of concrete etc, the impact noise associated with loading, dumping and dropping of materials and general earthworks noise. The main sensitive noise receivers include the residential areas to the south-west and east of the IFL site.

It is proposed that a noise assessment will be carried out and, based on that assessment, a Noise & Vibration Management Plan will be prepared covering the following issues:

- Fitting of residential standard silencers on stationary and mobile equipment, where possible.
- Restrictions on working hours, as dictated by the Director-General's requirements.
- Notifying local residents of scheduled works and providing Site contact names and telephone numbers.
- Undertaking noise monitoring where required.
- Erecting temporary noise barriers if required.

8.9 Remediation Schedule

The remediation schedule and staging (allowing for the timing variation permitted in that document) are included in the Voluntary Management Plan included in the Submissions Report.

8.10 Hours of Operation

Works will be undertaken during standard working hours only in order to minimise disruptions to local residences. Working hours will be 6:00 am to 6:00 pm Monday to Friday and Saturday 7:00 am to 3:00 pm. No work is to occur on Sundays or Public Holidays.

The remediation project is expected to take a number of years to complete.

8.11 Contingency Plans

8.11.1 Soil

The remediation approach for contaminated soil is to place it within a secure, lined containment cell. The approach relies of the excavation of the contaminated fill, preparation and validation of the base, construction of a cell and placement of contaminated materials within the cell.

No alternative management strategy is possible within the scope of the remediation program. The only potentially viable alternative is the offsite disposal of contaminated soils to landfill. This approach has substantial costs and community impact considerations and was not considered viable or desirable under the remedial options review.

The appropriate design and construction of the cell with appropriate management, quality control and environmental control measures would be expected to provide the best solution for the long term management of soil contamination at this site.

8.11.2 Groundwater

Hot spot groundwater remediation is occurring in the northern area of the site via a series of extraction trenches with treatment of contaminated groundwater using a precipitation treatment plant. The treated water is being returned to the aquifer via an infiltration trench.

Although the southern area was initially the reason for the *Declaration of Remediation Site*, the northern area was subsequently found to have more highly contaminated groundwater and remediation efforts have been focused on this area, particularly given the cell was to be constructed here and access timeframe was limited.

Other than the hot spot remediation works, no specific groundwater remediation activities are proposed at this time. It is anticipated that the removal of the soil source via containment of the contaminated fill materials within the cell will substantially reduce the leaching of contaminants to groundwater and the quality of the groundwater will gradually improve as a result over time. The groundwater monitoring program will establish if this is the case.

The western boundary trenches will remain during and after the cell construction and these could be used for boundary hydraulic control of the northern groundwater plume if needed. These trenches provide a relatively rapidly deployed contingency measure if groundwater concentrations require further management and containment of groundwater contamination within the site. The

extracted groundwater will require either onsite treatment or offsite disposal to an appropriate treatment facility.

A series of extraction wells are located along portions of the western boundary in the central and southern area and these could be operated longer term if required as a contingency if groundwater concentrations persist at elevated levels and these levels are determined to pose an unacceptable risk.

It is anticipated that the site metal adsorption data together with ongoing monitoring data and a detailed numerical fate and transport modelling program will indicate that residual contamination arising from the site will be substantially retarded within the aquifer and the potential for any significant impacts on the potential off site receptors will be acceptably low.

8.11.3 Surface Water

The primary objective of the surface water management plan is to manage all water flow generated on the IFL site in storage dams, from which water will be treated to an acceptable standard for discharge. The storages have been sized to accommodate the average expected flows from the site, based on the previous 25 years rainfall records. Water flowing from upstream PCCS land through the IFL site will be allowed to flow over clean armoured surfaces so that no degradation of water quality occurs. It is unfeasible for IFL to attempt to manage the large volumes of water which could flow from the upper PCCS catchment (Munibung Hill).

It is likely that the entire IFL site will be exposed to erosion and mobilisation of contaminants at some time during the project, as well as leachate drainage from the stockpiled excavated materials. Therefore majority of site runoff is to be managed in some way prior to discharge. Some batter slopes along the property boundaries will be sealed with shotcrete so that only clean water runs off across PCCS through agreed easements.

Phosphates will be a major concern during the early stages of the project and metals are expected to be the main contaminant requiring treatment during remediation. These surface water contaminants can be removed by various treatment methods depending on concentration and flow rates. The current precipitation treatment plant is best suited to relatively high concentrations of metals and phosphates at low volumes. To accommodate the expected volumes of runoff during high rainfall events, an additional treatment plant could be installed to treat lower concentration, higher volume waters to meet disposal requirements. An ion exchange treatment plant would satisfy this requirement.

It will be simpler and more effective to manage the surface water flows to avoid contamination rather than to treat large volumes of surface water. Therefore, the first priority of any contingency measure will be to minimise the mobilisation of contaminated soils and exposure to water flow to optimise the management program. Although this has already been considered within the surface water management plan, there may be opportunities to further reduce this during the remediation phase through careful site management. The installation of water treatment infrastructure should be considered part of the holistic site management strategy.

The staging of the project means that different volumes and concentrations of runoff can be expected at different time from different locations. The surface water management strategy responds to this with an adaptive management plan, anticipating and addressing the issues as they arise. This will be driven ultimately by the monitoring of runoff at the licenced monitoring points.

8.12 Stakeholder / Community Relations Plan

IFL is committed to communicating and consulting with stakeholders throughout the life of the remediation project. Feedback received from stakeholders will continue to inform the remediation project and will continue to be used to assist in managing potential adverse impacts.

Over the life of the project, IFL will continue to communicate and consult with stakeholders and the community via the following methods:

- Meetings will be held with key stakeholders and community groups as appropriate.
- Periodic issue of IFL's community newsletter will be prepared and distributed to publicise actions and progress at the site.
- Website information will be updated on an ongoing basis.
- Contact details will provide in various forums to allow project feedback from the community and other stakeholders.

The details of the stakeholder liaison and community consultation process, including complaints notification and resolution will be included in the CEMP.

8.13 Staged Progress Reporting

A progress report will be prepared at the end of each calendar month following the commencement of Phase 4 remedial activities. This will follow a set format and provide a brief synopsis of the works completed for the month, any significant results obtained, and a summary of works intended for the following month. The report will be circulated to the Principal and the Auditor. Any comments received will be addressed in the first week of the following month.

Formal reports will be prepared at milestone events and on an annual basis. Milestone reports will include completion of various major phases of the soil remediation program. These reports will provide a comprehensive documentation of the works conducted, the results obtained and the outcomes of the remediation program. The report will include the results of all relevant monitoring conducted during the period relevant to the report.

A validation report will be completed at the conclusion of the construction of the containment cell in order to facilitate final Audit sign off.

A detailed reporting program will be developed following the final staging of the remediation work programs.

8.14 Long Term Management Plan

Following completion of the remediation works in accordance with the Detailed Phase 4 RAP, an investigation and assessment of the residual (if any) soil and groundwater contamination will be completed. These investigations will facilitate the assessment of risks posed by this residual contamination (if any) and if required, recommend appropriate management measures to manage the associated risks. These investigations may include targeted soil investigations to provide inputs to a site specific risk assessment which would identify the risks posed to receptors from the residual contaminant concentrations and produce inputs for a Site Management Plan. The Site Management Plan may document measures to manage:

- Below ground excavations and maintenance works to prevent human exposure to residual contaminated soils;
- The requirement for an impermeable barrier or clean fill capping layer to prevent exposure to underlying contaminated soils;
- Groundwater use restrictions due to elevated contaminant concentrations; and,
- Groundwater quality management plan (GQMP) to ensure adequate groundwater quality information is obtained.

The GQMP will ensure adequate site groundwater quality information is collected to facilitate the monitoring of groundwater contaminant concentration trends, confirm reducing contaminant trends and ensure no unacceptable risks to receptors remain following completion of the remediation program.

8.14.1 Groundwater Quality Management Plan

Once the materials are contained within the cell, the greatest risk for off site migration of contamination is expected to be via the groundwater system as a result of seepage from the containment cell. Although the lined cell will be designed to minimise seepage losses, a small volume may be lost from the cell. This seepage is expected to be diluted and dispersed within the natural groundwater system and the design will verify that this seepage rate acceptable and does not restrict applicable environment values of the groundwater.

For the Phase 4 area, the removal of the contaminated fill material is expected to remove the ongoing source of groundwater contamination for this area. Consequently there is expected to be an improvement in groundwater quality with time as the residual groundwater contamination is diluted and dispersed within the natural groundwater system.

To verify that this is the case, a GQMP will be developed for the site. During the remediation this will form part of the CEMP, but following remediation this will likely fall under the Site Management Plan document. The detail of the long term GQMP will be developed following the completion of the remediation. This document will detail the monitoring well network required, the frequency of sampling and extent of the analytical program, QA/ QC measures to be adopted, revision and assessment of the data, and reporting of results to stakeholders.

A series of level responses will be developed for each element monitored, with successive levels resulting in a greater degree of investigation and / or remedial action to mitigate any risk posed by the identified contamination. The initial response level(s) will ensure that appropriate data is collected to support and define any required intervention actions.

The data collected through the GQMP is expected in due course to provide suitable information for the extinguishment of the *Declaration of Remediation Site* and the *Significant Risk of Harm* orders currently imposed on the site.

9. CONCLUSIONS

This Detailed Remediation Action Plan (Detailed RAP) addresses the remediation of the Phase 4 portion of the Incitec Fertilizers Limited (IFL) Cockle Creek manufacturing and distribution site located on Main Road, Boolaroo, New South Wales. Phase 4 of the remediation works comprises the remediation of the Southern Area of the site.

It is noted that this Detailed RAP has been prepared for Phase 4 of the remediation works only and that separate Detailed RAPs are proposed to be prepared for Phase 2 (Northern area remediation and construction of engineered containment cell) and Phase 3 (Central area demolition and remediation works) of the staged remediation works.

This Detailed RAP provides a framework for the implementation of the Phase 4 remediation program at the IFL Cockle Creek site, identifies the key environmental issues associated with the proposed remediation program and nominates methodologies for managing those issues so that the risk to the community and the environment are both minimised and are acceptable.

The Detailed RAP has been prepared for the following purposes:

1. To form the basis for the remediation program to be instituted in the Southern Area of the site;

2. To provide a detailed framework for the development of a Construction Environment Management Plan (CEMP) which will retain the detail for the physical on site remediation implementation and the scope and monitoring associated with the health and environment management programs to be implemented throughout the Phase 4 remediation program;

3. To comply with the Director-General's Environmental Assessment Requirements (the Requirements) pursuant to section 75F(3) of the Environmental Planning and Assessment Act 1979;

4. To comply with the Voluntary Management Plan (VMP) entered into with the Department of Environment, Climate Change and Water (DECCW) pursuant to section 26 of the Contaminated Lands Management Act 1997 (CLM Act);

5. To remove the *Declaration of Remediation Site* and the *Significant Risk of Harm* orders for the site; and

6. To satisfy IPL Company Values.

The objective of the Phase 4 Detailed RAP is to remediate the site from its current industrial use, with historical impacts associated with the former smelting operations which occurred in this area, to a site suitable for residential use.

Subsequent to numerous soil and groundwater investigations undertaken across the site over a number of years, the extent of contamination in both soil and groundwater has been identified and delineated. An assessment of a significant number of remedial options has been undertaken. It is considered the most appropriate management approach at the site would be to consolidate and contain all the soil and other materials unsuitable for use within a residential setting in isolation within a lined containment cell located on the northern portion of the IFL site (Phase 2). The detail of the cell construction is included in the Phase 2 Detailed RAP and the reader is referred to this document for the cell construction details.

Following removal of the site infrastructure, the contaminated soil materials present across this area of the site, including those in the infilled gully and the contaminated material within the dam wall, will be excavated and placed within the containment cell. Excavation will continue until natural soils are encountered. In general, excavation works will commence in upslope areas and progress to down slope areas to minimise the potential for contaminated stormwater to flow into and re-contaminate excavated and validated areas. In addition, excavation will be coordinated with containment cell construction to allow as much material as possible to be excavated, screened and placed directly in the cell without the need for temporary stockpiling.

A number of environmental management measures were identified as being required during the remediation works and will include the preparation of separate management plans by specialist sub consultants for the following aspects of the project: Occupational Health and Safety Plan, Surface Water Management Plan, Groundwater Management Plan, Traffic Management Plan, Air Quality and Dust Management Plan, Asbestos Management Plan and a Noise and Vibration Management Plan.

The final excavated site surface will be validated in accordance with the validation protocol and to the satisfaction of the site auditor. The final landform of this area of the site will approximate the previous natural site surface prior to the deposition of the waste fill materials from the smelter operations, aside from the areas excavated for building construction. This will reinstate the former gully area across this southern section of the site which may form a natural drainage course as part of the site re-development. It is anticipated that the dam wall occurring within the IFL property will not be required for future water management and this will be removed as part of these works.

No groundwater remediation is proposed as part of the Phase 4 works because the removal of contaminated filling present across the southern portion of the site and in particular within the infilled gully will remove the primary source of groundwater contamination and therefore contaminant concentrations in groundwater should decrease significantly following the completion of remediation works at the site. Groundwater contaminant concentrations will be assessed and monitored as part of a Groundwater Quality Management Plan prepared under separate cover for the site.

10. LIMITATIONS

Purpose

1. This report was prepared by Soil & Groundwater Consulting ('**S&G**') for the sole use of the client identified in the body of the report (**'Client'**), in relation to the property identified in the body of the report ('**Site**') and in accordance with the scope of work agreed between S&G and the Client.

Standard

2. This report was prepared by S&G generally in accordance with the usual and accepted practices and standards for consultants at the time it was prepared. The data referred to in this report was obtained between the dates as set out in the body of the report ('Data Collection Period').

3. S&G is not responsible for any inaccuracies or omissions in this report outside the scope of work and purpose set out in the report. There was no indication to S&G during the data collection period that any information contained in this report was false.

4. Opinions and recommendations contained in this report are based on data provided by representatives of the Client, information gained during site inspection and fieldwork, employee interviews and information provided from government authorities' records and other third parties, to the extent to which such information has been sought and obtained.

Variation in Conditions

5. This report presents the results of an investigation and assessment program to determine the presence of a range of potential contaminants in soil or groundwater at the Site.

6. This report is based on the conditions encountered and information available during the Data Collection Period.

7. Subsurface conditions may vary significantly between sampling locations and depth intervals and at locations other than where data collection was performed. Contaminant concentrations may vary from day to day.

8. S&G does not accept any responsibility for any changes to the Site conditions that may have occurred after the Data Collection Period described in Clause 2 above, or for the impact of any such changes on this report.

Use of Report

9. This report must be read in its entirety.

10. This report may not be relied upon by any third party without the express written permission of S&G, which permission may be granted or withheld in S&G's absolute discretion.

11. No responsibility is accepted by S&G for use of this report, or any part of this report, in any context or for any purpose or for any party, other than the Client, and for the purpose identified in the body of the report.

12. The information in this report is considered to be accurate at the date of issue and is in accordance with conditions at the Site during the data collection period.

13. This report and the information contained in it should only be regarded as validly representing the Site conditions at the time of the data collection period unless otherwise explicitly stated in this report.

No third party warranties

14. No warranties, express or implied, are made to any third party in relation to the subject matter of this report, or the recommendations or conclusions expressed within it.