REMEDIATION ACTION PLAN

Cronulla Sharks Redevelopment

Stage 1 Commercial and Retail including Carpark

Part Lot 11 in DP526492 461 Captain Cook Drive Woolooware NSW

Prepared for:

Bluestone Capital Ventures No.1 Pty Ltd
Level 6 71 Macquarie Street
Sydney, NSW 2000

Prepared by:

DLA Environmental

DL3007_S000368

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Sydney
Unit 2B 30 Leighton Place
Hornsby NSW 2077
Phone: 9476 1765
Fax: 9476 1557
Email: dlassociates@bigpond.com

Newcastle
PO Box 137
Branxton NSW 2335
Phone: 4938 3800
Fax: 4938 3811
Email: dolane@bigpond.com

ABN 36 926 003 197

Executive Summary

DLA Environmental was engaged by Bluestone Capital Venture No.1 Pty Ltd to prepare a Remedial Action Plan (RAP) for the property bounded by Captain Cook Drive and Woolooware Bay Woolooware NSW formerly identified as Part Lot 11 in DP 526492 (Site). The proposal is for a three Stage development.

- Stage 1 - New Neighborhood Retail Centre, Medical and Commercial/Retail facilities on the eastern car park site and redevelopment of the Leagues Club facilities.
- Stage 2 - Residential Master Planned Estate on the western car park and field area.
- Stage 3 - Extension and improvement of the Cronulla Sharks playing field facilities including grandstand extensions.

A number of Environmental Studies have been undertaken on the Site including a detailed Phase 2 Environmental Assessment conducted in January 2013 by DLA Environmental and historically studies including a Site Contamination Assessment conducted by EIS Pty Ltd in 2002, a Project Environmental Review conducted by EIS Pty Ltd June 2011 including extensive Geotechnical Assessments conducted by EIS Pty Ltd in 2000, 2002, 2006 and a Summary Report 2011. The Phase 2 Environmental Assessment included soil, groundwater and fill material gas generation investigation to delineate contamination and was prepared with reference to aerial photography and previous investigations of the Site (EIS Pty Ltd). The Detailed Site Environmental Assessment conducted by DLA Environmental was undertaken to produce site specific remediation criteria for chemicals of concern and address the data gaps of previous assessments. This RAP has been prepared to address the findings of the assessment.

In order to provide a report that meets the requirements of a Stage 2 Detailed Investigation as specified in *SEPP55* there were a number of issues and data gaps that needed to be resolved. DLA Environmental addressed these data gaps and updated the past data of the Site focusing on Stage 1 of the Development. The need for a NSW EPA Accredited Site Auditor was highlighted. A Sampling Analysis Quality Plan (SAQP) was provided to the Site Auditor before undertaking the assessments

The recent investigations have not encountered any significant widespread chemical soil contamination to be present on the Site. Some isolated elevations of lead have

been encountered. During the 2006 investigation, 30% of the soil samples were found to contain traces of asbestos. The natural soils under the Site were analysed and are considered to be Potential Acid Sulphate Soils.

Additionally the recent investigations have not encountered any significant widespread groundwater contamination. Elevated concentrations of arsenic encountered during one of the investigations were considered to be a regional issue rather than a site specific one.

The site is generating methane gas as a result of organic material buried during the filling process in the late 1950's to 1960's. Methane Gas concentrations of up to 29% v/v have been record by previous assessments. Field measurements conducted during the recent investigations by DLA Environmental found concentrations up to 19% v/v in a low number of boreholes drilled in the car park area.

This RAP is based on the Site Investigation undertaken by DLA Environmental, historical reports and considers the impacts of remediation and the area impacted by the contaminated soils. This Remedial Action Plan (RAP) has been prepared on the basis of the information obtained during the Site inspection and from experience, knowledge and current industry practice in remediation of similar sites.

The Site remediation strategy selected must be the most effective solution, which does not bring about unacceptable long-term liabilities, and which does not impose unreasonable constraints on future site developments or present operations.

Based on the analysis undertaken in this report, considering that time is a constraining factor on the selection of a remediation method; the **On Site Capping and Containment** strategy is the optimal strategy for remediation of the Site. It is recognised that minor amounts of material may need to be removed for service trenches, however, these will be classified in accordance with the *DECCW 2009 Waste Classification Guidelines* where material is considered excess.

Relative benefits of the **On Site Capping and Containment** strategy are as follows:

- The cap and contain strategy has low health risks as it only involves a minimal disturbance of the contaminated soils. Other remediation schemes involve stockpiling the entire contaminated soil mass and may result in the release of hazardous dust or acidic leachate, and thereby create a human health risk to

remediation workers, nearby residents and the environment;

- No increase in road traffic;
- The strategy requires no additional excavation or disposal costs over which would be normally incurred as part of the proposed development;
- The cap can be effectively achieved with the proposed surface and building design therefore requiring no additional works;
- The time frame for implementation of the remediation system is relatively short compared excavate and dispose;

The primary drawback to an On-Site Capping strategy would be as follows:

- The strategy may require a more diligent maintenance schedule than otherwise anticipated;
- The strategy requires the development and implementation of an Environmental Management Plan (EMP);
- Limitations to future development would be expected; and,
- Property values may be negatively affected.

In conclusion the RAP:

- Has been developed in a manner consistent with current industry practice;
- Has selected a preferred remediation strategy based on the site-specific issues and currently available technologies;
- Has presented an outline of the Site Remediation Environmental Management Plan (SREMP) and associated contingency plans to ensure the environment is appropriately protected during the proposed works;
- Has presented an information and consultation program to ensure the stakeholders are informed of the works as they proceed; and,
- Has outlined the means of validation of the completed works and ongoing management.

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1.0 INTRODUCTION

1.1 General

DLA Environmental was engaged by Bluestone Capital Venture No.1 Pty Ltd Pty Ltd to prepare a Remedial Action Plan (RAP) for the property (Site) bounded by Captain Cook Drive and Woolooware Bay, Woolooware NSW formerly identified as Part Lot 11 in DP 526492.

Refer to **Figure 1** – Site Location.

A number of Environmental Studies have been undertaken on the Site including a detailed Phase 2 Environmental Assessment conducted in January 2013 by DLA Environmental and historically studies including a Site Contamination Assessment conducted by EIS Pty Ltd in 2002, a Project Environmental Review conducted by EIS Pty Ltd June 2011 including extensive Geotechnical Assessments conducted by EIS Pty Ltd in 2000, 2002, 2006 and a Summary Report 2011. The Phase 2 Environmental Assessment included soil, groundwater and fill material gas generation investigation to delineate contamination and was prepared with reference to aerial photography and previous investigations of the Site (EIS Pty Ltd). The Detailed Site Environmental Assessment conducted by DLA Environmental was undertaken to produce site specific remediation criteria for chemicals of concern and address the data gaps of previous assessments. This RAP has been prepared to address the findings of the assessment.

The key objective of the RAP is to detail procedures needed in order to address the issues of contaminated areas of the site (both soil and groundwater) in accordance with regulatory guidelines, to a standard suitable for Commercial/Retail land use and provide for uninhibited Commercial development of the Site.

The RAP outlines the remedial strategy, environmental protection measures and occupational health and safety (OH&S) procedures to be followed during works. Although guidance is given on the remediation, environmental management and OH&S procedures, these are not intended to cover all aspects of responsibility. The principal contractor and their individual subcontractors should satisfy themselves that they are complying with OH&S and environmental requirements for the specific tasks undertaken.

It is acknowledged also that the remediation strategies recommended are based on conceptual designs for proposed development and will need to be reviewed to the satisfaction of the appointed NSW EPA Accredited Site Auditor once final design detail is produced.

This RAP has been written with reference to the NSW EPA (1995) *Contaminated sites: Guidelines for Consultants Reporting on Contaminated Sites*. In this RAP professional judgment was used to extrapolate between data points collected by DLA Environmental and EIS Pty Ltd. Even under ideal circumstances actual conditions may vary from those inferred to exist. The actual interface between materials and geological/hydrogeological conditions may be more abrupt or gradual than the report indicates. DLA Environmental Pty Ltd is not responsible for variations due to alterations of site conditions or chemistry since the time of assessments, however are aware that the condition of the Site has remained unchanged or impacted by anthropogenic influences since the last in depth assessments.

This report has been produced for, and is the property of Bluestone Capital Ventures No.1 Pty Ltd. This RAP has been written as per DLA Environmental proposal dated October 2012 and general and special terms and conditions as outlined in the Consulting Agreement dated 20th December 2012

1.2 Objectives of the Remedial Action Plan

The NSW EPA indicates that a Remedial Action Plan should:

- Set remediation goals that ensure the remediated site will be suitable for the proposed use and will pose no unacceptable risk to the human health or the environment;
- Document the procedures and plans to be implemented to reduce the risk of significant harm to acceptable levels;
- Establish the environmental safeguards required in completing the remediation in an environmentally acceptable manner; and,
- Identify necessary approvals and licences required by regulatory authorities.

This report provides:

- A brief summary of the history of the Site;

- A description of the Site, and the surrounding environment;
- A summary of the contamination status;
- A review of the currently available remediation/management options which could achieve the remediation goals, as well as the limitations of each method and comparison of the options;
- Details of the preferred remediation strategy, and an outline of the methodology for the implementation of the selected strategy;
- A brief outline of environmental pollution control, community health and safety, and occupational health and safety measures that should be implemented during remedial works;
- An outline of regulatory approvals and licenses which may be required to adopt the preferred remedial strategy; and
- Conclusions.

The aim of the RAP is to provide advice on the remediation including: addressing of the potential environmental impacts as identified in the Phase 2 Site Environmental Assessment (DLA 2013); on-site/off-site treatment to reduce the concentrations of the contaminants of concern; and options available for treatment and/or management of groundwater, gas generation, asbestos and acid sulphate soil issues.

1.3 Remediation Goals

Based on our understanding of the Department of Infrastructure and Planning, NSW EPA and Sutherland Shire Council requirements by way of SEPP 55, the primary objectives of the remediation program at the Site are:

- To negate any appreciable risk of human exposure to contaminated soils;
- To halt the possible migration of impacted soil; and,
- To provide an end product desirable for the preferred intended land use.

The site acceptance criteria (SAC) for the Site is based on the approach outlined in NSW DECC Contaminated Sites: Guidelines for the NSW Site Auditor Scheme - 2006 2nd Edition (NEHF F) and Schedule B1 Guidelines on the Investigation Levels for Soil and Groundwater from the National Environmental Protection (Assessment of Site Contamination) Measure (NEPM) 1999 – Table 5A - Column F – Commercial/Industrial.

2.0 SITE DETAILS

2.1 Site Identification

The site identification details are summarised below in Table 1.

Table 2a: Site Details.

Item	Detail
Site Owner:	Cronulla-Sutherland Leagues Club Ltd
Site Address:	461 Captain Cook Drive, Woolooware NSW
Lot & Deposited Plan:	Lot 11 in DP 526492 and Lot 20 in DP529644. Future proposed Lot 1 and Lot 2 in Unknown DP.
Local Government Authority:	Sutherland Shire Council
Current Zoning:	Zone 15 - Private Recreation
AHD:	Approximately 2.5m to 7.5m
Geographical Location (MGA):	N:6232100 E: 328300 (approximately)
Site Locality Plan:	Refer to Figure 1
Site Layout Plan:	Refer to Figure 2

The Cronulla Sutherland Leagues Club site is legally described as Lot 11 DP 526492 and Lot 20 DP 529644 and is known as 461 Captain Cook Drive, Woolooware. Three lots owned by Sutherland Shire Council (being Lot 21 DP 529644, Lot 1 DP 711486 and Lot 1 DP 501920) are also included within the proposed future Development. The existing Lots are presently subject to Plan of Subdivision creating Lot 1 and Lot 2 in unknown DP.

The site is located on the northern side of Captain Cook Drive approximately 1.5 kilometres from Caringbah (to the south west) and 2 kilometres from Cronulla (to the south east). The site is bounded by the Solander playing fields to the west, Woolooware Bay to the north, and a Service Station and Gymnasium to the east. The Woolooware Golf Club and the Captain Cook Oval are located to the south of the site across Captain Cook Drive.

The overall site is irregular in shape with an area of approximately 10.0 hectares, of which approximately 6ha is occupied by Toyota Stadium, Leagues Club building and the eastern car park and 4ha is occupied by the western training fields and car park.

Toyota Stadium (also known as Endeavour Field and Shark Park) and the Cronulla Sutherland Leagues Club building occupy the central portion of the site, and represent a major community and entertainment hub within the region. The western playing fields within the site are private open space used as training fields for the Cronulla Sharks and for local games by the Cronulla Caringbah Junior Rugby League Football Club, whilst the remainder of the site is occupied by car parking. Site Location is shown in **Figure 1.**

2.2 Historical and Surrounding Land Use

The Taren Point Employment Area is located approximately 200 meters to the north-west of the site and occupies land located generally between the waterfront, Taren Point Road and the Captain Cook Bridge. Woolooware Railway Station is located one (1) kilometer to the south west of the site, and Caringbah Town Centre is approximately three (3) kilometers by road to the south west.

The site is located to the south of Woolooware Bay which forms part of the northern boundary of the site investigation area. For descriptive purposes the site can be divided into two (2) principal sections.

- The eastern section that is occupied by an on-grade car park; and,
- The western section that is occupied by the Main Club facility.

Refer to **Figure 2** – Site Layout

Neighboring premises and activities are considered unlikely to pose a significant contamination risk to the Site.

A review of aerial photography is summarized in table 2b below.

Table 2b: Historical Aerial Photography Review.

Aerial Photo	Description
1951	The site and surrounding area was a mangrove swamp. Captain Cook Drive had not been constructed. Some minor roads, mainly unpaved, led into this area.
1956	The area remained similar to the 1951 photo, with dense mangroves. Captain Cook Drive had been constructed and surrounding roads had been surfaced.

Table 2b: Historical Aerial Photography Review Cont.

Aerial Photo	Description
1961	The site appeared similar to the 1956 photo apart from an open channel running from south to north at the center of the site. Filling operation were in progress in the area to the south of Captain Cook Drive, and further to the south a golf course was apparent. Residential areas were located further to the south.
1965	The location of the current stadium and Leagues Club was being filled. The east and west sections of the site remained similar to the 1961 photo, with dense mangrove swamp. Land-filling of mangrove swamp to the south of the road and further to the west was also visible.
1970	The east and west sections of the site were being filled. A football field had been constructed on the area occupied by the present day stadium. A small covered spectator stand was visible to the west of the oval. A school had been constructed to the south-east of the site and the golf course had been completed and extended to Captain Cook Drive. Back-filling had also been completed in areas further to the east and west of the site.
1978	Reclamation of the site had been completed. A multi-story club house had been built to the east of the field and landscaped mounds were apparent at the north and south ends of the field. A paved car park was located to the east of the club with two football fields constructed to the west of the main field. A single story building was located at the south of these fields. To the west and east of the site the land was vegetated. The surrounding land use to the south appeared similar to the 1970 photo.
1989	The site appeared similar to the 1978 photo with a car park to the east of the club and a car park and two fields to the west of the stadium. Several more spectator areas had been constructed at the stadium and several more ovals had been constructed to the west of the site.
1998	The south-west portion of the site appeared to have been paved with asphalt and was in use as a car park. The two football fields remained to the north. A larger spectator stand had been constructed to the west of the football stadium. The club had been extended to the east with a driveway and club entrance. A car park remained to the east of the club. To the east of the site the area was vegetated with scrub and trees that graded to mangroves. To the south of the site the land use remains similar to the previous photo. To the west of the site several ovals and a large industrial complex were evident.

Aerial photography prints clearly outlining the past presence of mangrove swamps on the Site and the filling conducted by Sutherland Shire Council. Following filling, the only change to the Site is that of the current land use as Cronulla Sharks.

Refer to **Figure 3** – Aerial Photography

2.2.1 Council Records

A search of building and development application records held by Sutherland Shire Council was undertaken during the DLA Environmental investigation. These records indicate that the site was part of a larger parcel of land bought by the Council from numerous private owners in the late 1950s. The land was purchased with the intention of filling these low-lying areas with 'hard fill' (non-putrescible wastes) to enable the long term development of sports fields. Filling was completed in a number of stages managed by private contractors (from 1964 to 1967) and Council (after 1967).

In 1962 the Electricity Commission of NSW resumed a portion at the north of the site for the Kurnell Transmission Line. In 1965 a drainage culvert was constructed to the west of the main playing field across from Captain Cook Drive to Woolooware Bay at the north.

The Leagues Club and Stadium area of the site were sold by tender to the Cronulla Sutherland Leagues Club in 1968 with an agreement that the Council would fill the remainder of the site and transfer the ownership to the Leagues Club.

Development of the stadium and other club facilities was undertaken in a number of stages with approval for the main Club building obtained in 1973. Approval for spectator seating, change rooms and amenities facilities was obtained in 1979 and extensions to the Club and spectator facilities were undertaken in 1981.

Associated with the construction and upgrade of the spectator areas in 1981 land reclamation resulting in the construction of a fill mound approximately 6m above the field level was undertaken within the transmission line easement. Correspondence records indicate that council approval for this development was not sought prior to the commencement of development works. This mound extended beyond the Leagues Club land into Woolooware Bay. Council subsequently ordered that stabilisation works be undertaken.

Further development of the club facilities and extensions to the club were approved in 1996.

Numerous other development proposals have been lodged with the Council including an industrial development, recreational theme park (water slides, go-kart track, fast food restaurant) and a service station. None of these have eventuated.

2.2.2 Title Search

Title searches of the property were not conducted given the historical knowledge of the Site and the limited ownership and past historical usages. The undeveloped land was passed to Council who sold the land to Cronulla Leagues Club.

2.2.3 WorkCover Dangerous Goods Search

An enquiry as to the presence of UST's on the Site through the WorkCover NSW database revealed no UST's are present currently or have been in the past located on the Site. A Site inspection and anecdotal evidence confirmed the status of the Site.

2.2.4 Contaminated Land Record Search

A search was conducted of all records pertaining to section 58 of the Contaminated Land Management Act 1997 and revealed that the Site (461 Captain Cook Drive Woolooware NSW) is not encumbered by any notices from the NSW EPA with regard to contaminated land. No sites in the vicinity of the site were encumbered by any notices.

2.3 Future Land Use

The proposed mixed use redevelopment of the Cronulla Sutherland Leagues Club site including a new neighborhood retail center, residential development and upgrades to the sports facilities, including the Toyota Stadium, will create a long term sustainable and viable solution for the Club as well as create a new center and destination location that meets the needs of the surrounding community. The Concept Plan prepared for the site is seeking to develop the site in three stages, being:

- Stage 1 — New Neighborhood Retail Centre, Medical and Commercial/Retail facilities on the eastern car park site and redevelopment of the Leagues Club facilities;
- Stage 2 - Residential Master Planned Estate on the western car park and field area; and,
- Stage 3 - Extension and improvement of the Cronulla Sharks playing field facilities including grandstand extensions.

DLA Environmental understands that the proposed re-development is likely to include utilising the capped areas of the east and west sections of the site. It is considered likely that the buildings will be constructed on piles. All car parking will be above ground and there will be no significant excavation of the site.

This RAP is only relevant to Stage 1 Works involving the existing eastern car park area including renovations to the existing Club building being part Lot 11 DP 526492.

Refer to **Figure 2** for Site Layout .

2.4 Environmental Setting

2.4.1 Site Topography

The regional topography falls gently towards Woolooware Bay to the north, apart from the golf course to the south of Captain Cook Drive that was generally at a lower level than the site. Sections of the site appear to have been filled above surrounding levels including the spectator areas. Regional drainage patterns are generally toward Woolooware Bay to the north via a storm water channel located between the east and west sections of the site. Due to previous grading of the site some sections drain locally toward Captain Cook Drive toward the south rather than Woolooware Bay. An easement for transmission lines is located across the north section of the site.

2.4.2 Site Geology and Soils

The 1:100,000 geological map of Wollongong-Port Hacking (Map 9029-91 29, 1:100,000 Department of Mineral Resources —1985) indicates the site to be underlain by manmade fill which typically consists of dredged estuarine sand and mud, coal washing, industrial and household waste. The fill is typically underlain by Quaternary

aged deposits of organic rich, mostly “muddy” marine sand with Hawkesbury Sandstone at greater depths.

2.4.3 Acid Sulfate Soil

The acid sulfate soil (ASS) risk maps indicate areas of high risk, low risk and no known occurrence of acid sulfate soils. The ASS Risk Map for Wollongong Port Hacking (Acid Sulfate Soil Risk Map- 9129 N4 edition 2, December 1997, 1:25000, Department of Land and Soil Conservation) indicates that the site is located at the boundary of two areas as summarised below:

- The majority of the site lies within an area classified as “disturbed terrain” which is indicated to extend to depths of approximately 1 m to 4m. Disturbed terrain may include filled areas, often associated with reclamation of low lying swamps for urban development, mined or dredged areas, or areas of heavy ground disturbance associated with the construction of dams and levees. Soil investigation is commonly necessary to assess acid sulfate soil conditions in these areas; and,
- The area immediately to the north of the site (ie the mangrove area beyond the filled areas) is classified as being of “high probability” of ASS occurrence at or near the ground surface. This classification is typically associated with estuarine swamps, intertidal flats and supratidal flats. There is considered to be a significant environmental risk associated with this classification if ASS materials are disturbed by activities such as shallow drainage, excavation or clearing.

Refer to **Appendix A**: Bore logs and to **Appendix C** for Site Acid Sulphate Soil Management Plan

2.4.4 Site Hydrology

Department of Natural Resources (DNR) records were researched for the previous investigations and indicated that two registered groundwater bores lie within 1 km of the site. The details are summarised below:

Ref No	Approx. distance from site(m)	Approx. direction from site	Depth(m)	Registered Purpose
GWO11287	800m	East	15.30m	Recreational (irrigation)
GWO11287	850	East	19.00m	Industrial

The stratigraphy of the site is expected to consist of relatively high permeability alluvial sandy soil overlying deep bedrock. Based on these conditions, groundwater may be considered to be a significant resource in the area, although use of the resource in the immediate area of the site may be reduced by the moderate salinity levels associated with tidal salt water intrusion from Woolooware Bay.

2.4.5 Site Meteorology

The Bureau of Meteorology NSW presents the average rainfall for the Cronulla area at 1082.1 mm annually, with an average of 96.1 days of greater than 1mm rainfall. The annual average temperature range is from 13.4°- 22.2° C, and an annual average daytime temperature of 21.8°C.

2.4.6 Flora and Fauna

No evidence of stress was observed in any of the stands of vegetation. No threatened or endangered flora or fauna species have been identified within the site. No Endangered Ecological Communities have been identified within the site. The Site is not known to contain dependent populations, or to be representative of unique habitat.

3.0 Contamination Status

3.1 Previous Investigation Reports

EIS have previously prepared the following environmental assessment reports for various sections of wider Leagues Club site. A number of investigations have been undertaken over the years for a variety of different proposed developments. These include:

1. ***"Report to St George Partnership Banking Ltd, Environmental Site Screening (of Site C) at Cronulla Leagues Club, Captain Cook Drive, Woolooware",*** **Ref: El 071** ***5 SC/a,*** **dated 1 November 1994.**

This investigation involved drilling six boreholes in the west section of the site (in the open playing fields). The boreholes encountered fill material ranging from 2m to 3m deep. Eight soil samples were analysed for heavy metals, all of the results were less than the SAC adopted for the purpose of this review. Four soil composite samples were analysed for organics and potentially elevated concentrations of benzo(a)pyrene were detected in one of the samples. However these composite results are not considered to be reliable. Five groundwater samples were analysed. However, as with the composites these results are not considered to be particularly reliable.

2. ***"Report to St George Partnership Banking Ltd, Environmental Site Screening (of Site B) at Cronulla Leagues Club, Captain Cook Drive, Woolooware",*** **Ref: El 071 5SB/b, dated 1 November 1 994.**

This investigation involved drilling three boreholes in the east section of the site (in the car park). The boreholes encountered fill material 3m to 4m deep. Six soil samples were analysed for heavy metals, all of the results were less than the SAC adopted for the purpose of this review. One soil composite sample was analysed for organics and potentially elevated concentrations of benzo(a)pyrene were detected in the sample. However these composite results are not considered to be reliable. One groundwater sample was analysed. However, as with the composite these results are not considered to be particularly reliable.

3. ***"Report to All Star Real Estate on Further Contamination Investigation (Site C) for Cronulla Sutherland Leagues Club at Captain Cook Drive, Wooloo ware"*** **Ref: El 071 5S/a, dated 1 5 February 1 995.**

This investigation involved the drilling of 34 boreholes in a regular grid across the west section of the site. Most of the boreholes were terminated in the fill at a depth of 1 m. Thirty soil samples were analysed for heavy metals. Two samples contained lead concentrations greater than 1200mg/kg (ie the SAC adopted for the purpose of this review). The maximum lead result was 2295mg/kg. Four groundwater samples were analysed. However, these results are not considered to be particularly reliable. During drilling the methane gas concentration in the boreholes was measured. The methane gas concentrations ranged from 0% v/v to 5% v/v.

4. ***"Report to Cronulla Sharks Rugby Leagues Club on Environmental Site Screening for Shark Park Redevelopment at Cronulla Leagues Club, Captain Cook Drive, Woolooware",*** **Ref: El 5009FRPT/2, dated 29 November 2000.**

This investigation included a desk top site history assessment together with an additional ten boreholes drilled across the site. The limited site history indicated that:

- The site was mangrove swamp in the 1950s and was gradually backfilled in the 1960s and 1970s;
- By 1978 the basic current layout of the site was complete;
- Council records indicated that Council had purchased the land in the 1950s with the intention of filling the low lying areas with non-putrescible waste;
- The Leagues Club and Stadium area of the site were sold by tender to the Cronulla Sutherland Leagues Club in 1968 with an agreement that the Council would fill the remainder of the site and transfer the ownership to the Leagues Club;
- Development of the stadium and other club facilities was undertaken in a number of stages with approval for the main Club building obtained in 1973. Approval for spectator seating, change rooms and amenities facilities was obtained in 1979 and extensions to the club and spectator facilities were undertaken in 1981; and
- A fill mound approximately 6m above the field level was constructed in the north section of the stadium on 1981. Records indicate that approval for this development was not sought from the council. This mound extended beyond the Leagues Club land into Woolooware Bay. Council subsequently ordered that stabilisation works be undertaken.

Of the ten (10) boreholes, four (4) were drilled in the western playing fields, four (4) were drilled in the eastern car park and two (2) were drilled in the area to the north of the stadium. The boreholes in the western playing fields encountered up to 3.2m of fill, the boreholes in the eastern car park encountered 3.4 to 4.5m of fill and the boreholes drilled to the north of the stadium encountered greater than 6m of fill (these two boreholes were drilled in the spectators hill).

Nineteen (19) soil samples were analysed for a range of heavy metals. All of the results were less than the SAC adopted for the purpose of this review. Eight (8) composite samples were analysed for organic compounds. Although no significant elevations of organics were recorded in the composite samples the results are not considered to be reliable. Three (3) of the deeper natural soil samples (estuarine clayey silt/silty clay) were screened for potential ASS conditions using the POCAS analytical technique. The samples were all considered to be potential ASS (PASS).

Significant concentrations of methane gas were encountered in four (4) of the boreholes (up to a maximum concentration of 42% v/v).

5. ***"Report to Cronulla Sutherland Leagues Club on Further Environmental Site Assessment for Proposed Cronulla Leagues Club Rezoning at Captain Cook Drive, Woolooware",*** **Ref:E171 19FK-rpt, dated October 2002.**

This investigation included ten (10) boreholes across the eastern car park for a proposed basement and two (2) boreholes on the west side of the western playing fields for a proposed power easement. The fill depths in the eastern car park ranged from approximately 2.0m in the south west corner of the car park to approximately 4.5m along the north boundary. The depth of fill encountered in the two boreholes drilled on the west boundary of the western playing fields ranged from approximately 1m to 2m.

Twenty four (24) soil samples were analysed for heavy metals, polycyclic aromatic hydrocarbons and organochlorine pesticides. One (1) sample contained an elevated concentration of lead (2,400mg/kg) above the SAC adopted for the purpose of this review. The remaining results were all less than the SAC adopted for the purpose of this review. Twelve (12) samples were analysed for petroleum hydrocarbons. The results were all less than the SAC adopted for the purpose of this review.

Twenty two (22) of the underlying natural samples were analysed for potential acid sulphate soil. The results indicated that the underlying natural soils were considered to be potential acid sulphate.

Groundwater in the boreholes was measured up to 26 hours after completion of drilling at depths that ranged from 2.4m to 3.2m below the existing ground levels.

Methane gas was encountered in the boreholes at concentrations that ranged from 0% to 19% v/v.

6. ***"Report to Cronulla-Sutherland District Rugby League Football Club on Environmental Site Assessment for Proposed Upgrade Works at Toyota Park, 461 Captain Cook Drive, Woolooware",*** **Ref: E20345FJ-RPT, dated August 2006.**

This investigation was confined to the south section of the western playing fields and the accessible open areas adjacent to the north, south and west of the stadium. The depth of fill in the south section of the western playing fields ranged from 1 .6m to 4.3m. The depth of fill in the accessible areas adjacent to the west and south of the stadium ranged from 1.1m to 4.2m. The depth of fill in the area to the north of the stadium ranged from 1 4m to 8.6m (it should be noted that these boreholes were drilled

in the hill located to the north of the stadium). Monitoring wells were installed in eight of the boreholes. Groundwater levels were found to range from 0.41m AHD to 1.2m AHD (this correlates to approximately 1 m to 2m below existing site levels). This investigation was designed to address the requirements *SEPP55-Remediation of Land, Managing Land Contamination: Planning Guidelines.* The investigation was also the subject of a contaminated site audit review by Mr Rod Harwood of Environmental Strategies. However, the audit was never completed due to the cancellation of the proposed development.

A summary of the detailed soil laboratory analysis is provided below:

- Seventy (70) soil samples were analysed for heavy metals and polycyclic aromatic hydrocarbons. One (1) sample contained an elevated concentration of lead (1400mg/kg) above the SAC adopted for the purpose of this review. The remaining results were all less than the SAC adopted for the purpose of this review;
- Sixty one (61) samples were analysed for organochlorine pesticides. The results were all less than the SAC adopted for the purpose of this review;
- Thirteen (13) samples were analysed for organophosphate pesticides and phenoxy acid herbicides. The results were all less than the practical quantification limit of the analytical technique;
- Seventy (70) samples were analysed for petroleum hydrocarbons. The results were all less than SAC adopted for the purpose of this review;
- Fifty eight (58) fill samples were screened for asbestos. Asbestos was detected in eighteen of the samples;
- Thirteen (13) fill samples and thirty four (34) natural samples were screened for ASS characteristics using the SPOCAS method. The fill and natural soil samples were considered to be PASS.

A summary of the groundwater chemistry results encountered in the eight monitoring wells is provided below:

- Groundwater pH was generally neutral and ranged from pH6.7 to 7.4;
- Electrical conductivity ranged from 2,200 uS/cm to 34,000 uS/cm;
- The groundwater samples did not contain organochlorine, organophosphate or herbicide concentrations above the adopted SAC.

- Elevated arsenic concentrations were encountered in seven (7) of the eight (8) monitoring wells. These results were considered to be associated with regional groundwater conditions rather than a site specific source;
- One (1) groundwater sample contained an elevated mercury concentration of 3.7ug/L compared to the site assessment criteria of 0.4pg/L. However this result may have been an anomaly as it was not confirmed by the analysis of a duplicate sample;
- The concentrations of ammonia in the groundwater samples ranged from 2.1 mg/L to 34mg/L and were all above the SAC of 0.9l mg/L.
- The concentrations of volatile organic compounds (VOCs) and petroleum hydrocarbons were less than the practical quantification limits and less than the adopted SAC;
- Two (2) groundwater samples were analysed for herbicides, organophosphate pesticides and organochlorine pesticides. The results were all less than the SAC.

A summary of the Methane Gas monitoring results encountered in the eight (8) monitoring wells is provided below:

Methane gas readings were obtained from the eight monitoring wells. Methane gas reading in six of the eight wells exceeded 1 25% v/v, with a maximum concentration of 29% v/v.

The following letters have also been prepared for the project:

1. *"Assessment of Existing Stockpiled Material for Re-use, Toyota Park, 461 Captain Cook Drive, Woolooware"* Dated 22 August 2007, Ref: E20345FJ2 Let;

2. *"Acid Sulfate Soil Management Plan, Proposed Upgrade of Sports Stadium Facilities, 461 Captain Cook Drive, Woolooware"* Dated 29 August 2007;

3. *"Review of Methane Measures for Proposed Southern Grandstand Works, Toyota Park, 461 Captain Cook Drive, Woolooware"* Dated 30 August 2007, Ref: E20345FJ Let-M; and,

4. *"Review of Methane Measures for Proposed Southern Grandstand Works, Toyota Park, 461 Captain Cook Drive, Woolooware"* Dated 30 August 2007, Ref: E20345FJ Let-M2.

3.1.1 Summary of Previous Investigations

The Cronulla Sharks site consists of three principal sections: the western playing fields (an open grassed area); the centrally located stadium and associated club facility; and the eastern car park (an on-grade asphalt paved car park). The north section of the site is bounded by mangrove swamp and Woolooware Bay. Aerial photographs indicated that the site was initially mangrove swamp that was backfilled sometime in the 1950s to 1960s. The basic layout of the site buildings had been completed by 1978.

Since 1994 EIS have undertaken a number of investigations in various sections of the Site for a variety of proposed developments.

A number of the results in the earlier reports (pre 2001) are not considered to be reliable enough for inclusion in data sets for future reports. The reasons for this are:

- The organics analysis was undertaken on composite samples (ie samples from three or four adjacent boreholes were combined together into one sample to provide a broad screening). Although common at the time this process can result in artefacts;
- QA/QC procedures in the field and in the laboratory in the older reports do not comply with the very stringent procedures that are currently implemented;
- The current procedures for groundwater well installation and subsequent sampling are considered to result in samples that are more representative of actual groundwater conditions; and,
- Due to the above issues old data sets would not be acceptable to a site auditor undertaking a review of older reports.

The old data sets can be discussed in general terms and may be useful if they backup the conclusions of more robust data sets.

Based on the results of investigations a number of general conclusions can be drawn:

- The site sits on approximately 1.0m to 4.5 m of fill and is underlain by natural estuarine soil including silty sand, clayey sand and sandy clay. Bedrock was encountered at depths ranging from 1.2m to 26m. Groundwater was generally encountered at 2 to 4m below the current site levels;

- The investigations have not encountered any significant widespread chemical soil contamination. Some isolated elevations of lead have been encountered. During the 2006 investigation, 30% of the soil samples were found to contain traces of asbestos;
- The investigations have not encountered any significant widespread groundwater contamination.
- Elevated concentrations of arsenic encountered during one of the investigations were considered to be a regional issue rather than a site specific one;
- The natural soils are considered to be PASS; and,
- The site is generating methane gas as a result of organic material buried during the filling process.

3.2 Recent Environmental Investigations

In order to provide a report that meets the requirements of a Stage 2 Detailed Investigation as specified in *SEPP55* there were a number of issues and data gaps that needed to be resolved. DLA Environmental addressed these data gaps and updated the past data of the Site focusing on Stage 1 of the Development. The need for a NSW EPA Accredited Site Auditor was highlighted. A Sampling Analysis Quality Plan (SAQP) was provided to the Site Auditor before undertaking the assessments.

These recent assessments included the following:

- The appointment of an NSW EPA licensed independent contaminated site auditor to undertake a review of former and recent investigations. DLA Environmental understand that Mr. James Davis of Enviroview Pty Ltd has been engaged to provide this function;
- Representative soil sampling over the Stage 1 Development Area so that the final sampling density meets that specified in the *NSW EPA Sampling Design Guidelines (1995),* or are adequate to conclude that the remedial strategies proposed are adequate to resolve all Site potential issues;
- Analysis of soil samples for chemical contaminants;
- Methane monitoring across the site;

- Installation of additional groundwater monitoring wells and groundwater sampling for a more accurate understanding of groundwater conditions;
- Updating of the Acid Sulfate Soil Management Plan presented in the 2006 report to take account of new data and the proposed new development; and,
- Implementation of adequate QA/QC procedures so that a reliable, robust data set can be generated;

3.2.1 Soils and Below Surface Fill Materials

Soil samples were analysed for the following in recognition of the Potential Contaminants of Concern (PCOC).

These included:

Fill Materials and Capping
Heavy Metals
Asbestos
TPH
BTEX
Organochlorine
Pesticides
Natural Materials
Acid Sulphate Soils
PCB's

Below Surface Materials
Methane Gas
Polycyclic aromatic hydrocarbons; (PaH's)
Metals
TPH
BTEX
Asbestos

Results were screened against criteria adapted from the NSW EPA (1998) *Guidelines for the Site Auditor Scheme* and the National Environmental Protection (Assessment of Site Contamination) Measure (NEPM). 1999.

Soil sampling across the Site was conducted utilising a systematic combined with judgmental approach involving setting out gridded areas and targeting specific areas of interest.

For the purpose of this assessment, a total of fourteen (14) soil samples plus duplicates were collected across the Site.

BTEX, PAH and OC/OP/PCB concentrations were not detected above the LOR. TPH and Heavy Metal concentrations on all samples analysed were in compliance with the NSW Service Station Guidelines and the NEPM 1999 table 5a column F – Commercial/Industrial Criteria. Refer to **Tables 2c** and **2d** below for details for soil analysis results.

Table 2c – TPH in Soil (mg/kg)

Sample ID	Total Petroleum Hydrocarbons				
	C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	Total
BH1 - 1	<25	<50	<100	<100	nd
BH1 - 2	<25	<50	<100	<100	nd
BH1 - 3	<25	<50	<100	<100	nd
BH7 - 1	<25	<50	<100	<100	nd
BH7 - 2	<25	<50	<100	<100	nd
BH9 - 1	<25	<50	<100	<100	nd
BH9 - 2	<25	<50	110	110	110
BH12 - 1	<25	<50	140	140	140
BH13 - 1	<25	<50	<100	<100	nd
TP4	<25	<50	<100	<100	nd
TP5	<25	<50	<100	<100	nd
TP10	<25	<50	<100	<100	nd
TP10A	<25	<50	120	320	440
TP14	<25	<50	<100	<100	nd
HIL	**65**	**-**	**-**	**-**	**1000**

Table 2d- Metals in Soil (mg/Kg)

Parameter	Acid Extractable Metals							
	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Average (n=14)	8	1.8	47.9	58.4	111.5	0.18	11.7	281
Standard Deviation	3.4	1.5	104.8	55.3	133	0.1	10.4	310
Min (mg/Kg)	4	0.6	8	3	6	0.1	2	12
Max (mg/Kg)	16	4.7	410	190	510	0.3	37	890
Number Exceeding	0	0	0	0	0	0	0	0
SAC (NEPM F)	**500**	**100**	**500**	**5000**	**1500**	**75**	**3000**	**35000**

3.2.2 Groundwater Sampling

Groundwater monitoring wells were placed in three (3) locations. These locations covered northern, eastern and western aspects of the Site. Groundwater samples were analysed for the following:

- Total recoverable hydrocarbons;
- Polycyclic Aromatic Hydrocarbons;
- Heavy Metals; and
- pH and EC

Groundwater was found to be present at a depth of 3 - 4m. Three (3) groundwater monitoring wells were installed, MW#1, MW#2 and MW#3. Refer to **Figure 2** – *Site Layout with Sample Locations.*

Groundwater analysis indicated an elevated concentration of zinc in MW#2 (300µg/L). MW#1 and MW#3 exhibited much lower concentrations of 3µg/L respectively. It is believed MW#2 concentration levels of zinc are anomalous and not consistent with other on-site recorded concentrations or with groundwater monitoring conducted previously. No other exceedances were recorded for groundwater analytes. Refer to **Tables 2e** – **2g** below for details or groundwater analysis.

Table 2e – Heavy Metals in Water (µg/L) - Dissolved

Parameter	Heavy Metals in Water – Dissolved							
	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Average (n=3)	1.7	nd	nd	nd	2	nd	5.7	**102**
Standard Deviation	0.0	nd	nd	nd	2.6	nd	2.5	**171**
Min (mg/Kg)	1	nd	nd	nd	0.5	nd	3	3
Max (mg/Kg)	2	nd	nd	nd	5	nd	8	**300**
Number Exceeding	0	0	0	0	0	0	0	0
SAC (ANZECC 95%)	**24**	**0.2**	**NA**	**1.4**	**3.4**	**0.6**	**11**	**8**

Nd- Non Detection

Table 2f – Electrical Conductivity and pH

Sample	*Electrical Conductivity*	*pH*
MW1 (BH8)	4,400	6.8
MW2 (BH11)	5,100	6.7
MW3 (BH14)	4,200	6.9

Table 2g – Methane in Water

Sample	*Methane (µg/L)*
MW1 (BH8	8,400
MW2 (BH11)	1,400
MW3 (BH14)	5,600

3.2.3 Methane Gas

Three (3) gas monitoring wells were installed strategically on the Site to provide up to date information on the gas concentrations specifically related to the development, in particular the on-ground structures of the proposed Medical Centre and Club Commercial Facility located to the south and north of the existing Club respectively. Methane concentrations were samples at three (3) locations relative to proposed building locations. A concentration of 0.2% being the highest recorded result. Field observations at the time of test pitting, recorded results of up to 19% v/v within the proposed car park area. This is consistent with previous recorded results. Refer to **Table 2h** and **2i** below for details.

Table 2h – Gas Analysis (Volume %)

Sample Description	Gas Analysis (Volume %)						
	Carbon Dioxide	Oxygen	Carbon Monoxide	Methane	Hydrogen	Nitrogen	Barometric Pressure
MW1(BH8) (c)	5.8%	15.1%	nd	0.2%	low	78.9%	1006mb
MW1(BH8) (o)	5.3%	15.5%	0.001%	0%	nd	79.2%	
MW2(BH11) (c)	6.1%	13.7%	2%	0%	low	80.2%	1004mb
MW2(BH11) (o)	5.9%	14.4%	2%	0%	low	81%	
MW3 (BH14) (o)	0.1%	19.7%	1%	0%	low	80.2%	1003mb

(c) = Closed
(o) = Open

Table 2i – Field Gas Measurements

Field Gas Measurements			
Location	**CH_4 (v/v%)**	**CO_2 (v/v%)**	**O_2 (v/v%)**
BH1	0.4	0.8	19.3
BH2	3.5	1.3	18
BH3	0.1	0.8	18.9
BH7	5.8	4.3	15.2
BH9	1.4	10.9	1.8
BH11	5.8	4.3	15.2
BH12	3	5.8	12.4
BH13	19	15	5

Irrespective of the low results recorded in these important locations elevated concentrations above recent results have been recorded across the Site and most applicable to the car park area. Gas concentrations of up to 29% v/v have been record by previous assessments. Field measurements conducted during the recent investigations by DLA Environmental found concentrations also up to 19% v/v in a low number of boreholes placed in the car park area.

Given the description of materials and the moderate quantities of organic materials it is considered by DLA Environmental the risk from soil gases to be moderate. Recently conducted inspections of fill materials indicated moderate organic content with a higher content of "hard" fill materials. The fill materials were dry with what can be described as a significant lack of moisture present.

It should be noted that the car park and Club facilities are constructed on former Mangrove Swamps, a well-recognised source of methane generation. It is felt that this source is largely contributing to the methane concentrations experienced across the Site.

3.2.4 Leachate

DLA Environmental during their assessments conducted in depth groundwater and visual assessments of the water table associated with the commercial development area. Three (3) groundwater monitoring wells were installed in order to assess the water (leachate) quality of the area. The assessments concluded the water to be of an acceptable quality, clarity and odour. Ammonia concentrations within ground water across the assessment area were low and not indicative of putrescible wastes generally associated with landfills and therefore leachate generation. No further investigations of leachate or control measures are considered necessary.

3.2.5 Asbestos

Asbestos fragments were detected in six (6) of the fourteen (14) test pits and bore holes excavated. Asbestos fibre analysis conducted on all soil samples revealed no respirable fibres detected. The identification of fragments of asbestos is consistent with previous investigation findings. The asbestos fragments were detected within the fill materials.

3.2.6 Acid Sulphate Soils

Acid sulphate soils were noted to be present from the Acid Sulphate Soils Risk Maps and verified by sample collection and analysis. The acid sulphate soils being associated with the mangrove estuarine system below the fill materials present on the Site.

3.3 Past Environmental Assessment Integrity

EIS Pty Ltd conducted both Site Environmental Investigations and Geotechnical Assessments to assess the potential contamination to be present on the property. The Investigations recommended that a Detailed Investigation be undertaken to provide reassurance to the levels of contamination at the Site. This Detailed Investigation was undertaken by DLA Environmental in accordance with the Guidelines outlined in the NSW EPA documents *Guidelines for Consultants Reporting on Contaminated Sites*, *Sampling Design Guidelines* and *Guidelines for the NSW Site Auditor Scheme.*

The Detailed Investigation provided by DLA Environmental in 2013 contains all information generally regarded as necessary to adequately define the contamination status of the Site. The Site has not changed or being *influenced/impacted* in any form since the initial assessment and final assessment. The landform remains unchanged.

The steps generally required within SEPP 55 when addressing contamination are:

- Preliminary Site Environmental Assessment
- Detailed Site Environmental Assessment
- Remediation Action Plan
- Validation Report

The Preliminary Site Environmental Assessment and the Detailed Assessment have been completed by DLA Environmental and EIS Pty Ltd. Discussions and meetings with the NSW EPA Accredited Site Auditor have accepted the need for remediation and the approach to be undertaken. The Remediation Action Plan formalises the next step.

In summary the environmental assessment process undertaken at Cronulla Sharks has been thorough and in accordance with the general directives issued to Consultants

undertaking such work. It is now time to move to the next Stage as required in SEPP 55 the Remediation Action Plan and ultimately Final Site Validation.

3.4 Suitability of the Site for the Proposed Re-development

DLA Environmental understands that the proposed development now includes a commercial/retail development in the eastern section of the site. All Car parking for the development will be above ground and there will be no significant excavation of the area.

DLA Environmental are of the opinion that the site could be made suitable for the proposed re-development provided that:

- The Site remains acceptably capped and the development is constructed on piles (ie there is no significant excavation and no access to the underlying soil) below the cap and that below ground services are adequately protected. DLA Environmental are of the opinion excavation/disturbance of the site should be kept to a minimum in order avoid potential mobilisation of any contaminants present in the landfill and subsequent adverse impacts on the sensitive mangrove zone located to the north;
- Suitable measures are taken to protect the buildings from the ingress of methane gas and that the NSW EPA Site auditor agree with these measures;
- A Remedial Action Plan (RAP) is prepared that addresses all remedial work necessary to make the site suitable for the proposed development including capping requirements;
- No groundwater is extracted for use on the development;
- There are suitable management plans prepared to address any contingencies that may arise during development (eg. an Acid Sulfate Soil Management Plan and Asbestos Management Plan);
- An Environmental Management Plan (EMP), if required, is prepared for the development and that this plan is notated to the land title via the Section 149 certificate or a covenant on the land title under Section 88B of the Conveyancing Act 1919.

In preparing this Remediation Action Plan all of the above considerations and assessments have been taken into account prior to and during the preparation of the RAP. All issues and potential impacts have been and addressed fully in the Plan.

The Design Concept for the Development has resulted in a Concept that:

- Has no deep excavation;
- Minimises the need for significant methane gas control through a naturally ventilated car park structure;
- Recognises that certain of the facility areas (lift wells, plant rooms and Medical Centre) will require methane mitigation measures; and,
- Minimises the need for acid sulphate soil remediation.

4.0 REMEDIATION OPTIONS

4.1 Overview

With regard to site remediation, the NSW EPA (formerly the DECCW) endorses the policy of the 1992 Australian and New Zealand Environment and Conservation Council (ANZECC) and National Health and Medical Research Council (NHMRC) Guidelines for the *Assessment and Management of Contaminated Sites*. Furthermore, the threshold concentrations presented in the *NSW DECC Second Edition 2006 Guidelines for the NSW Site Auditor Scheme* and the *National Environment Protection* (Assessment of Site Contamination) *Measure 1999* (NEPM) are considered as appropriate soil and groundwater assessment criteria.

For groundwater, the *ANZECC 2000 Guidelines for Fresh and Marine Water Quality* have been generally accepted by the NSW DECCW as appropriate investigation levels as well as further criteria outlined in the NEPM 1999. The *NSW EPA Service Station Guidelines* also provide reference guidelines. In addition, the *NSW EPA 2008 Waste Classification Guidelines* have been utilised as the basis of technical review for the waste disposal options most applicable to the site.

The Site preferred order of options for site remediation and management is:

Cap and Contain; or, Excavate and Dispose

The above strategies are in accordance with the Australian and New Zealand *Guidelines for Assessment and Management of Contaminated* Sites (1992) and the hierarchal management of Wastes as outlined in the *NSW DECC Guidelines for the NSW Site Auditor Scheme* (Second Edition, 2006).

The following Sections of the RAP look at the particular circumstances available to the site and compare the feasibility of the remediation hierarchy to the most suitable alternatives available.

4.2 Selecting Remediation Technologies and Methods

A risk management approach has provided the basic principle of the remediation technologies/methods selected for the site. This approach is consistent with the strategy outlined in the *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites* (ANZECC, 1992) and the NEPM1999, which are endorsed by NSW EPA.

A contaminated site, as defined by the NEPM 1999 and the ANZECC 1992, is a site at which hazardous substances occur at concentrations above background levels, and where assessment indicates it poses, or is likely to pose, an immediate or long term hazard to human health or the environment.

Wherever human health is at risk, either on or off-site, or the off-site environment is at risk, a contaminated site should be remediated to the extent necessary in order to minimise such risks in both the short and long terms.

However, in cases where there is no threat to human health and the environment is not at risk, it may be appropriate to accept a strategy of managing contaminants on the site, or use planning controls to manage and minimise risk.

Environmental and Human Health Risk is based on exposure to potential hazards and is defined as:

Risk = Hazard x Exposure

The elimination of the risk can be achieved by the removal of the hazard and/or the exposure pathway. Remediation is defined as any measure that removes the risk to an acceptable level by negating the hazard or exposure pathway.

Therefore, remediation can involve removal of the hazard (i.e. no risk remains) or alternatively, management of the risk by removal of the exposure pathway even if the hazard remains. Exposure pathways to contaminated material can be managed by undertaking a physical action (e.g. erection of a fence, installation of cap etc) and/or a management plan, which prevents exposure to contaminants (e.g. use of planning controls, management of site activities etc.).

Planning controls are a means to control future changes in the land use. These controls can take several forms, from leasing/selling arrangements through to specific

planning legislation controls. For example, if contaminated soil is buried/capped in a particular zone, that zone may be designated to have a particular land use, e.g. public open space or roadways. This enables the material to be placed in less sensitive land use areas (i.e. under roadways) within the residential land.

4.3 Available Remediation Technologies/Methods

There are ranges of different remediation technologies that are available for the remediation of contaminated sites. Some of these technologies are proven while others have not yet been successfully implemented in Australia, and/or there is limited local expertise for implementation.

A review of the available remediation methods and technologies indicates that the following strategies may be applicable to the remediation of the Woolooware site.

On-site Capping and Containment

On-site capping and containment involves the installation of a physical barrier around or above the contaminated area to migration pathways of contaminants. Any groundwater within the capped area may need to be collected and disposed of if infringing on cap performance. Obviously, it is preferable to cap the containment cell with an impermeable material so that the amount of surface water infiltration is minimised.

Thus, when used in combination, capping and containment essentially involves the construction of an on-site landfill, which effectively isolates the contaminated soil from the surrounding area. The inclusion of an effective low permeability capping system and appropriate surface water controls/management results in an effective control system for methane gas and surface water infiltration.

Several material types and mixtures have been developed to act as capping barriers. These include low permeability soil such as clayey soils, soil/bentonite mixes, synthetic material liners and asphalt and concrete layers.

A site management plan would normally need to be implemented for capping to ensure that future excavation work is minimised and where necessary, carried out in strict accordance with appropriate occupational health and safety procedures.

The NSW DECC Contaminated Sites: Guidelines for the NSW Site Auditor Scheme Second Edition, 2006 provides a checklist to ensure the following technical issues associated with cap and containment is identified:

- **That the design maximises the long term engineering security of the works and, where applicable, minimises the potential for leachate formation and/or;**
- **Does not include the erection of structures on the capped or contained area that may result in risk of harm to the public health or the environment, and;**
- **Includes a notification mechanism to ensure that the capped or contained areas are protected from any unintentional or uncontrolled disturbance that could breach the integrity of the physical barrier.**

Excavate and Off-Site Disposal

Landfill disposal is the simplest of all remediation methods, and involves the excavation of the contaminated materials, and disposal off-site to an EPA approved landfill disposal site with appropriate environmental safeguards. The formed excavation is generally then backfilled using clean, validated fill materials.

NSW EPA permits disposal of contaminated material subject to an approval landfill. The DECCW *Waste Classification Guidelines* (2009) document sets out the methodology for assessing and classifying wastes to be disposed to landfill. Essentially, wastes are classified into General Solid (Non-putrescible), General Solid (Putrescible), General Solid – *Special Waste Asbestos*, Restricted Waste and Hazardous Waste.

The principal test used for assessing waste is the Toxicity Characteristic Leaching Procedure (TCLP), which estimates the potential for the waste to release chemical contaminants into a leaching liquid. The DECCW has set two standard pHs for the leaching solution.

With the first standard test the pH of the solution used is dependent upon the pH of the waste. The TCLP simulates the effects of an acidic leaching medium, and involves agitation of soil in a solution of dilute acetic acid for a prescribed period, followed by analysis of the acid solution or “leachate” for the contaminants of concern.

The second standard test used to complete the classification of wastes is the Specific Contaminant Concentration (SCC) test, which is a measure of the total concentration of the contaminants in the waste.

The DECCW provide criteria for TCLP and SCC results for a range of contaminants for the various waste classifications. If the contaminant of concern is not included in the list, then the DECCW advises to discuss the classification with them.

The selection of an appropriate landfill will normally depend largely upon the results of classification of the wastes. It is sometimes necessary for heavily contaminated soils to be pre-treated prior to disposal, to reduce the concentrations or minimise the mobility of the contaminants.

Special criteria are sometimes applicable to certain categories of waste. Contaminants covered by Chemical Control Orders have restrictions placed on their handling and disposal.

5.0 SELECTION OF PREFERRED REMEDIAL STRATEGY

The following section provides a rationale for the selection of the remedial (or management) strategies to be adopted for:

- **461 Captain Cook Drive Woolooware NSW**.

In the following sections an assessment is made (including both a technical and economic appraisal) of the various broad options available for the remediation of the Site. Section 4.3 provides a summary of these appraisals, and hence a rationale for the selection of the preferred remedial strategy.

5.1 Technical Appraisal

Important considerations (from a technical perspective) in selecting and effectively implementing one of the available remediation strategies (as outlined in Section 4) for the site are as follows:

Human Health issues - dust emissions (such as with asbestos) need to be minimised at all times (both during and after remediation). Works that involve the disturbance of contaminated soils can result in significant releases of dust, which can create health risk concerns to both site workers and the general public.

Reliability - this is a measure of the degree of certainty that the remedial system will succeed in meeting the site remediation goals (as outlined in Section 1.3) in both the short and long term.

Regulatory Approvals - any remediation system needs to be endorsed by the relevant regulatory authorities. The difficulty in obtaining regulatory approvals will be largely dependent upon the nature of the remediation system proposed.

Disruptions to Site Structures and Activities - remediation of the site will invariably involve some disturbance, both to the existing site structures, as well as to underground services present in the remediation area. For example, any work involving excavation of the fill materials will involve the removal of any structures located above the excavation zone.

Ongoing Liabilities (Maintenance and Monitoring Requirements) - any remediation system that does not involve the complete removal of all contaminants from the site will necessitate some form of ongoing maintenance and/or monitoring to ensure the longer term integrity of the remediation system adopted.

Contractor Experience - the success and cost effectiveness of any remediation system will be at least partially dependent upon the experience contractors have in undertaking the type of remediation works proposed.

Availability of Appropriate Disposal Sites (for excavation and off-site disposal) - any works involving landfill disposal of contaminated soil will only be feasible if a landfill site is available which is licensed to accept the contaminated soils excavated from the site.

Implementation Time Frame - provides an indication as to the likely time frame involved in implementing each type of remediation strategy.

A summary of these issues, as they relate to each of the possible remedial strategies, is provided in **Table 4a.** Whilst any of the main remediation schemes outlined in Section 4 would be technically feasible, it should be noted that a number of limitations and risks are associated with each system.

Table 5a - Remediation Options Technical Appraisal –Stage 1 461 Captain Cook Drive Woolooware NSW

Technical Characteristics	Option 1 Capping & Containment	Option 2 Excavate and Off-Site Disposal
Human Health Risks	Minimal soil disturbance involved. Limited personal contact.	Relatively low – excavation and direct off-site disposal will minimise personal contact
Reliability	Sound – some potential may exist for contaminant break though if cap breached or not maintained properly. Design will ensure minimal access to cap surface is possible.	Excellent – system ensures the removal of all contaminated materials
Regulatory Approvals	Generally satisfactory – whilst on-site containment is not the EPA's preferred option; it is often accepted as a feasible option.	Satisfactory – Waste will satisfy the 2009 NSW DECCW Waste Classification Guidelines. Compliance with Regulatory Authorities.
Site Suitability	Good – Contaminated area well defined, contamination confined to development area. Location will satisfy all EPA requirements for containment of soils.	Good – Site is accessible by road transport, contaminated soils are shallow and well defined.
Disruption to Site Structures and Activities	Very low – Containment will be incorporated under building works.	Minor – No existing site structures require demolition. Remediation areas can be excavated and treated.
Ongoing Liabilities	Moderate – capping system need to be maintained.	Minimal – all contaminated materials removed
Contractor Experience	Good – Contractors available with experience in the implementation of cap and contain systems	Good – relatively simple strategy involving only basic technologies
Availability of Disposal Sites	Not applicable	Good – landfills available to accept waste
Implementation Time Frame	Short	Short to moderate

Based on the analysis undertaken in Table 5a, the following conclusions are made regarding the technical suitability of the various remedial options available for the Site in order of technical preference:

5.1.1 On-site Capping and Containment

Capping and containment systems for contaminants have been used for remediation of many contaminated sites in and around Sydney and the broader NSW scale. The NSW EPA has approved these strategies within many sites.

The remediation method is a proven technology, which is reliable, has relatively low to moderate capital costs, and can be implemented, in a relatively short time frame.

The method has low health and environmental risks as it does not involve a substantial disturbance of the contaminated soils. There is a range of local Contractors experienced in undertaking works of this nature.

The major disadvantages associated with this remediation method include maintenance requirements and notation that the site is regarded as containing contamination and is noted on title deed information accordingly.

5.1.2 Excavation and Off-Site Disposal

Excavation and off-site disposal to landfill of contaminated soils has been the most common remediation method used in Australia to date. Its advantages are that it is quick, there are no long-term liabilities and there are no constraints on future land use. This method is usually regarded as the most costly option.

The number of truck movements on public roadways would be substantial; considering the large volume of contaminated soil.

5.2 Economic Appraisal

Below are indicative cost estimates for undertaking remediation of the contaminated area in accordance with each of the broad remediation options discussed previously. A breakdown of the estimated costs associated with each of the available remediation strategies is provided in **Table 4b**.

In developing these cost estimates, the following primary assumptions have been made:

- Total volume of contaminated soil, requiring remediation or management is unknown at this stage, but is estimated to be up to 100,000m^3;

- The degree of contamination from Asbestos is considered minor; and
- An acceptable landfill is available to the site.

Table 5b - Remediation Options Economic Appraisal –Stage 1 461 Captain Cook Drive Woolooware NSW

Remediation Option	Element No.	Details of Remediation Element	Indicative Cost Estimate
Excavate, and Dispose	1	Site establishment	$ 3000.00
	2	Excavation of contaminated materials	$ 4,5000.00
	3	Waste Classifications	$ 10,000.00
	4	Landfill Disposal Fees including Transport to Landfill	$ 25M
	5	Validation Reporting	$ 9,500.00
	6	Supply and place clean fill	$ 1.28M
		Indicative total	$ 26.35M
Cap and Contain	1	EMPs	$ 17,500.00
	2	Containment Cell Preparation and integrity	$ 250,000.00
	3	Validation and Reporting	$ 7,500.00
	4	Establish Gas Drainage system	$ 100,000.00
	5	Environmental Supervision	$ 2,200.00
		Indicative total	**$ 377,200.00**

5.2.1 On-site Capping and Containment

The cost projection of *the cap and contain* strategy is significantly lower than the *excavate and dispose* option. Maintenance of the cap has not been forecast as this cost would be normally incurred as part of expected development maintenance programs.

It should be noted that this cost estimate considers only the implementation of the containment and management plan, and does not take into consideration long-term liabilities. The costs also do not reflect the impact on property value.

5.2.2 Excavation and Off-Site Disposal

The cost of this option at approximately $26.35M is significantly more than the other

options, however it has the benefit of being much more time efficient, reliable and has no ongoing liabilities or negative effect on property value. The cost is primarily associated with disposal tipping fees and NSW EPA Levy.

5.3 Preferred Strategy

The site remediation strategy selected must be the most effective solution, which does not bring about unacceptable long-term liabilities, and which does not impose unreasonable constraints on future site developments or present operations.

Based on the analysis undertaken in the previous sections, considering that time is a constraining factor on the selection of a remediation method; the **On Site Capping and Containment** strategy is the optimal strategy for remediation of the Woolooware Site. It is recognised that minor amounts of material may need to be removed for service trenches, however, these will be classified in accordance with the *DECCW 2009 Waste Classification Guidelines* where material is considered excess.

Relative benefits of the **On Site Capping and Containment** strategy are as follows:

- The cap and contain strategy has low health risks as it only involves a minimal disturbance of the contaminated soils. Other remediation schemes involve stockpiling the entire contaminated soil mass and may result in the release of hazardous dust, and thereby create a human health risk to remediation workers and nearby residents;
- No increase in road traffic;
- The strategy requires no additional excavation or disposal costs over that which would be normally incurred as part of the proposed development;
- The cap can be effectively achieved with the proposed surface design therefore requiring no additional works;
- The time frame for implementation of the remediation system is relatively short compared excavate and dispose;

The primary drawback to an **On-Site Capping and Containment** strategy would be as follows:

- The strategy may require a more diligent maintenance schedule than otherwise anticipated;
- The strategy may require the development and implementation of an EMP;
- Limitations to future development would be expected; and,
- Property values may be negatively affected.

Investigations to date have demonstrated that contamination found in the fill materials at the site currently poses a risk to human health with the site in its current condition. There is the potential that disturbance of asbestos and migration of contaminants such as methane gas may pose a risk to the environment through migration to above ground structures. As such remediation of the fill is required in order to remove the risks associated with the contamination.

The preferred remediation strategy for the impacted soil involves cap and contain. Off-site treatment, though feasible, will cost more, result in the excavated material needing to be disposed of to a licensed treatment facility, create substantial on-site and community related impacts.

6.0 IMPLEMENTATION OF SELECTED REMEDIAL STRATEGY

6.1 Introduction

The remediation strategy developed for the Site will be required to achieve three (3) main aims:

- To negate any appreciable risk of human exposure to harmful environments;
- To control the migration of methane gas ; and,
- To provide an end product desirable for the preferred intended land use.

A ranges of technical inputs need to satisfy the functional requirements involved in providing the effective remediation of soils. Increasing the complexity of contamination treatment systems does not necessarily result in a higher level of efficiency. Site-specific constraints may heavily influence the choice of a preferred methodology.

The On-site Remediation strategy proposed incorporates the following elements:

1. Stakeholder consultation;
2. Implementation of an accepted Environmental Management Plan (EMP);
3. Service excavation;
4. Waste Classification and Disposal, if required;
5. Capping Installation;
6. Validation.

A brief outline of each of these elements is outlined in the following sections:

6.2 ELEMENT 1 – Stakeholder Consultation

On approval of the remediation strategy the stakeholders including on-site management will be informed of the intentions and the progress at all stages of the remedial works.

6.3 ELEMENT 2 – Implementation of Environmental Management Plans

Environmental Management Plans (EMP) covering the remedial works will be prepared for the Site. Before work commences it is imperative that all issues relating to potential impacts have been reviewed. The major impacts have been identified as Asbestos, Methane Gas, Acid Sulphate Soils, Air Quality, Erosion Sedimentation Control, Noise and Vibration Monitoring and Traffic Management.

6.4 ELEMENT 3 – Services Excavation and Stockpiling

Excavations will be required for services, which will have to be conducted in accordance with the Environmental Management Plan. Run-off in the event of rainfall will be controlled. In the event that stockpiling of excess material is required, a hay baled and geo-fabric lined area will be constructed in close proximity to the excavation. All stockpiles of contaminated material will remain covered.

6.5 ELEMENT 4 – Waste Classification and Disposal

Since identified soils do not meet the SAC due to the contamination of asbestos, any excess soils will be disposed of in accordance with the 2009 NSW DECCW *Waste Classification Guidelines* and any WorkCover requirements. Arrangements will be made with a facility which is licensed to receive the designated material. Authorisation for disposal will be obtained prior to any material leaving the site. The Contractor will provide tip dockets following disposal.

6.6 ELEMENT 5 – Capping Installation Process

Capping will consist of a concrete slab within the area of the building footprint, landscaping and asphalt outside of this area. These surfaces will be laid in accordance with the Methane Gas Management Plan. Cell design will allow at least 1.0 m of clay/soil cap; in those areas with concrete slabs this will not be required.

6.7 ELEMENT 6 – Validation

Validation will be conducted in accordance with the Australian and New Zealand Conservation Council (ANZECC) *Guidelines for the Assessment of On-Site Containment of Contaminated Soil (1999)*. A range of soil investigation levels have been derived (both locally and worldwide) covering concentrations of contaminants in

soil and water. DLA Environmental has also undertaken a review for the site to derive site specific criteria for various contaminants of concern.

Since all soils are in compliance with the current land use criteria – *Industrial/commercial* the soil criteria will only be applicable to the unexpected find of suspected contaminated soils, or in the need to assess imported fill materials.

For the purpose of this site remediation any materials requiring off-site disposal will need to meet the requirements of the Waste Classification Guidelines (NSW DECCW 2009).

Validation of the site will initially focus on the presence of asbestos and methane gas. The remainder of the site will be dealt with under a Final Validation Report, thus the focus for validation will be on documenting:

- The extent of contamination (if any) remaining outside the confines of the building slabs;
- The adequacy of the final design in handling the methane gas issues,
- Monitoring of methane gas concentrations within surface soils, within building structures and services and on boundaries.
- Requirements for ongoing site monitoring (if any); and
- Risk of remaining material impacting on future site users (if any).

Asbestos will not be visible at the surface or within the surface 100mm soils. This is in accordance with the WA Department of Health *Guidelines for the Assessment, Remediation and Management of Contaminated Sites in Western Australia – May 2009.* Due to the potential for unexpected finds of asbestos contamination within fill soils, the Site will be subject to an Asbestos Management Plan, which will highlight management practices that must be complied with. An asbestos Unexpected Finds Protocol will be implemented for the site, providing a framework for the management of any unexpected finds of asbestos containing material on Site.

Methane gas concentrations will be required to be below 5% LEL during all construction works and non-detect within all building and service conduits at building "lock-up" stage.

Validation will include analysing samples of residual soils to be capped providing information to be included in an EMP.

A Final Validation Report should be prepared by the environmental consultant engaged to validate the remedial works with reference to the NSW EPA (1997) - *Contaminated sites: Guidelines for consultants reporting on contaminated sites.* The report should contain a description of all testing and/or monitoring undertaken as part of the remedial works including but not limited to validation results, waste classification of material disposed offsite/imported onsite (if any), and an appropriate discussion of field and laboratory work undertaken. It will also include a statement regarding the appropriateness of the remediated site for the proposed land use and any limitations or ongoing monitoring/management required

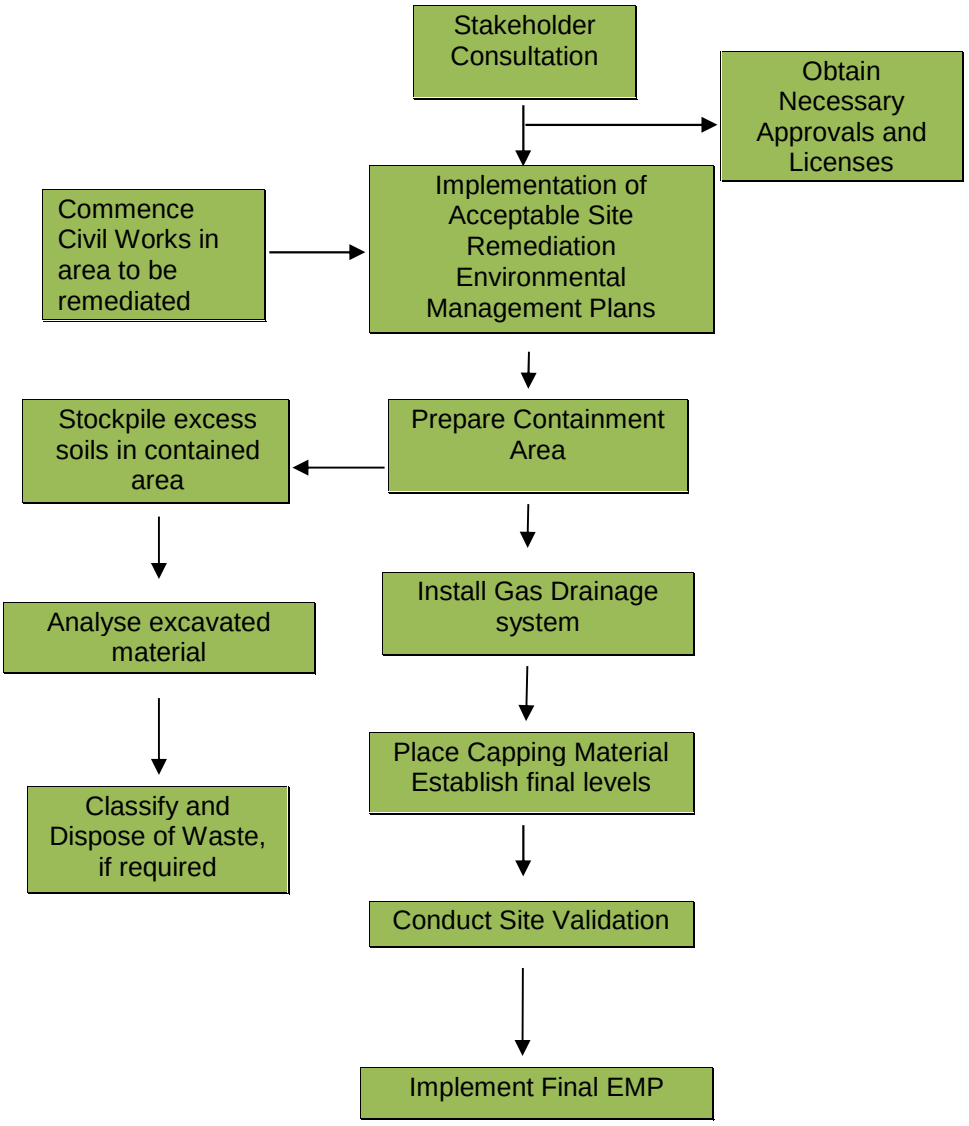
Appropriate Land Use criteria for Industrial/Commercial Developments are identified below in **Table 5:**

Table 6a: Site Acceptance Criteria – Health Based Investigation Levels.

Analytes	HIL Thresholds (mg/kg dry wt) Column F Table 5a NEPM 1999	Sources
Benzene	1	NSW Service Station Guidelines
Toluene	130_a	
Ethylbenzene	50_b	
Xylene (total)	25_b	
TPH: C6-C9	65	NEPM 1999, Table 5a, Column F
TPH: C10-C40	1000	
>C16-C35 Aromatics	450	
>C16-C35 Aliphatics	28,000	
>C35 Aliphatics	280,000	
Arsenic	500	
Cadmium	100	
Chromium	500	
Copper	5,000	
Lead	1,500	
Mercury	75	
Nickel	3,000	
Zinc	35,000	
B(a)P	5	
Total PAHs	100	
PCB	50	
Pesticides: (Aldrin/Dieldrin)	50	
Chlordane	250	
DDT+DDE+DDD	1,000	

A schematic of the **Remediation Process** is set out below in the Flow Diagram:

REMEDIATION PROCESS



The preferred remediation strategy will be in general accordance with the requirements as outlined in the **Methane Gas Management Plan** as included as **Appendix B**. It is recognised that during Final Development Design the finer detail of the capping and methane gas drainage systems will be required. (Site Works Remediation Plan).

7.0 IMPLEMENTATION AND STAGING OF REMEDIATION STRATEGY

There are a number of stages which are required to be completed when implementing the remediation strategy. These include some works prior to the commencement of the remedial works. An outline of the stages and the activities required are presented below.

7.1 Stage 1 Securing All Necessary Approvals

The first stage to be undertaken after agreement is reached with relevant stakeholders on the Remedial Action Plan is to secure all necessary approvals. A list of the regulatory licenses/approvals, which may be required prior to the commencement of remedial work, is contained in Section 9 of this Report.

7.2 Stage 2 Tendering and Contractor Selection

Following receipt of all necessary approvals, the next stage will be to prepare tender documents detailing the technical specifications of the remediation system.

These documents should then be used as a basis for calling tenders from specialist contractors to complete the site remediation system.

7.3 Stage 3 Commencements of Site Remedial Works

7.3.1 Stage 3a Establishment

Initial activities at the site shall involve the establishment of all plant and equipment necessary for the remediation works. This shall include:

- Establishment of a Project Manager/Contractor's site office of temporary work sheds and amenities for site workers;
- Establishment of a car parking area for site workers and visitors to the site; and,
- Establish the site environmental monitoring program.

Prior to the commencement of any earthmoving activities, it will also be necessary to install environmental protection safeguards, as well as site security measures. These measures are included as part of the Environmental Management Plan contained within this report.

7.3.2 Stage 3b Site Pre Works

To facilitate the possible excavation of contamination soils the following site preparation is required in the first week.

- Construction of hardstand stockpile area and preparation of a Containment Area.
- Areas designated for any stockpiling are located on a level hardstand.
- Bunding for surface water management will consist of Geo Fabric lined hay bales arranged to constrain all soils and runoff to the civil works area.

7.3.3 Stage 3c Excavation and establishment of Capping layer

The main activities to be undertaken during these works will include:

- Excavation for services
- Provision of Gas control system for all services and building structures;
- Monitoring of systems above;
- Establish the final surface level prior to asphalt and concrete capping;

7.4 Stage 4 Validation and Ongoing Management

At the completion of the remedial works a Remediation Validation Report documenting the works as completed will be prepared.

Sample numbers and analysis will be dependent on area and a review of initial assessment data to conform to EPA NSW Contaminated Sites*: Sampling Design Guidelines (1995)* and Australian and New Zealand Conservation Council (ANZECC) *Guidelines for the Assessment of On-Site Containment of Contaminated Soil (1999)*.
The Quality Assurance (QA) program for the Site will ensure the representativeness and integrity of samples and accuracy and reliability of the analysis results. This includes cleaning of tools before and between sampling, cleaning of containers and delivery of samples to the laboratory within holding times, and in good condition.

The Quality Control (QC) program for site will monitor and measure the effectiveness of the QA procedures. This will involve the use of field duplicates, inter and intra

laboratory checks, trip blanks, rinsate checks, trip spikes, surrogate spikes, and the use of laboratory internal standards.

Duplicate samples will be collected to verify the QA/QC of the soil samples collected at a frequency of 1/10 (10%) intra-laboratory, and 1/20 (5%) inter-laboratory. The samples will be transported in a chilled and security sealed portable cooler to a NATA registered laboratory and analysed for Contaminants of Concern.

The NSW DECCW has issued a number of guidelines relevant to the development of Remediation Action Plans and the clean-up of contaminated sites. The National Environmental Protection Council formulated the National Environment Protection (Assessment of Site Contamination) Measure 1999.

The relevant guidelines most applicable to the remediation are:

- *NSW EPA Guidelines for the NSW Site Auditor Scheme (Second Edition, 2006)*
- *NSW EPA Contaminated Sites - Sampling Design Guidelines (September 1995);*
- *NSW EPA Guidelines for Consultants Reporting on Contaminated Sites (November 1997);*
- *NSW DECCW Waste Classification Guidelines 2009, and;*
- *National Environmental Protection (Assessment of Site Contamination) Measure 1999 – Schedule B.*
- Australian and New Zealand Conservation Council (ANZECC) Guidelines for the Assessment of On-Site Containment of Contaminated Soil, 1999;
- NSW EPA Solid waste Landfill Guidelines.

On completion of the validation process and to be included as part of the Validation Report, it is a requirement to develop and implement an ongoing Environmental Management Plan to ensure the future integrity of the capping system is maintained.

8.0 SITE REMEDIATION WORKS PLAN

8.1 Introduction

A major component of the remedial works shall involve the installation and maintenance of a Site Remediation Works Plan (SRWP). The SWRP will provide the appropriate designed Methane Gas Control Strategy. The SRWP will provide details of the environmental protection and pollution control measures to be implemented during the operational phase of the remedial works. This plan will be formulated once the final design drawings have been approved.

The pollution control measures have the objective of removing/minimising any adverse impact on the surrounding environment. Details of the pollution control measures to be implemented will be documented in the SRWP for the remediation works which is prepared (and approved) prior to commencement of remedial works.

In order to prepare the SRWP for the remedial works a review will be undertaken to identify possible impacts on the surrounding environment. For each potential impact identified the range of pollution control measure(s) available for mitigating the impact will be reviewed and the most practicable, efficient and cost effective were identified for implementation.

It is envisaged that a series of control measures would be common to the various elements of the remedial works. In addition, there are supplementary control measures that would be specific to particular elements of the remedial works.

A Methane Gas Management Plan has been prepared that forms the basis and options available for the formulation of the SRWP upon provision of final construction design drawings. Refer to the Methane Gas Management Plan – **Appendix B.**

In the following sections, outlines have been presented of the various pollution control measures that would be implemented during most elements of the remedial works.

These form the basis of a Construction Environmental Management Plan that should be read in conjunction with this document.

It is appropriate for the Contractor to develop a CEMP control measures for their component of the works based on the broad guidelines of the RAP.

8.2 Erosion Sedimentation Control Plan

Erosion and run-off control measures will be implemented during all elements of remedial works undertaken. Typically, these measures will be designed to prevent the transport of pollutants (including sediments) out of the remediation area via stormwater/surface run-off.

Generally, no surface run-off and/or water from excavations/pits and trenches within the remediation area will be permitted to discharge, without regulatory authority approval, to the surrounding environment. Run-off control measures will be developed giving consideration to the site conditions in each remediation area, and are likely to include (but not necessarily be limited to) the following:

- Diversion drains, berms, sumps and pumping systems to prevent runoff entering or leaving excavation areas. All water in contact with works will be diverted through the treatment system;
- Truck cleaning areas for use in washing down all vehicles potentially coming into contact with contaminated soil leaving a remediation area; and,
- Use of silt fencing, hay bales and/or oil absorbing booms, as required.

8.3 Noise Control Plan

The impact of noise associated with the site remediation works is acknowledged as a potentially important environmental effect. It will be necessary to minimise noise in accordance with EPA Standards. The methods used to control noise will be dependent upon the equipment being used for particular remedial activities, however it would be expected that the methods would include those commonly used during normal construction and demolition works.

Noise control measures will be developed giving consideration to the site conditions in each remediation area, and are likely to include but are not limited to the following:

- Site work will be restricted to the hours specified below in Section 7.8;
- The use of construction vehicles on-site will be kept to a minimum;
- All equipment in operation in open areas on-site shall comply with the requirements of AS 2436-1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites*; and,
- Noise monitoring may be conducted during the site remediation program.

8.4 Dust Control Plan

During the course of remediation works dust control measures shall be undertaken to ensure that dust generated from the site is controlled within acceptable levels. These control measures will be developed giving consideration to the site conditions in each remediation area, and are likely to include but are not limited to the following:

- All vehicles leaving the site will be cleaned on site to remove any potentially contaminated dust;
- Access to water sprays shall be available to water down the excavation/loading if dust generation becomes significant;
- Plastic sheeting shall be available to cover excavation faces and stockpiles; and,
- An ambient air-monitoring program shall monitor dust levels at the site boundary, as necessary.

8.5 Odour Control Plan

Odour controls are not expected to be required for any remedial works. However in the event that odour does become a concern appropriate measure shall be introduced to mitigate the odour. This will include such activities as covering the odour generating materials with HDPE plastic, spraying the materials with Bio-solve, or equivalent, or generally spraying aerosol suppressants utilising a Gerni with applicator.

8.6 Health and Safety

8.6.1 Occupational Health and Safety

An Occupational Health and Safety (OH&S) plan is an essential part of all remediation projects, to ensure the health and safety of all personnel working on or visiting the site. All remediation work would be undertaken in accordance with the provisions set out by the *Workplace Health and Safety Act* (2011) and associated Regulations 2011, and any other regulations or directions set out by regulatory authorities.

Typically the OH&S plan would consider a broad range of issues including but not limited to the following:

- Characterisation of potential hazards including hazardous materials and site

activities (e.g. excavation);

- Air and dust monitoring required within and at the boundary of the remediation area;
- Personnel and equipment movements to and from the remediation area;
- Training, instruction, and induction of site workers/visitors;
- Clear outline of responsibilities for health and safety; and,
- Emergency response plan for injuries or chemical exposure.

Prior to commencing any remediation works, a specific OH&S Plan would be prepared by the Remediation Contractor covering the following aspects:

- Identification of the remediation area and exclusion zones;
- Induction of personnel;
- Hazard identification/locations;
- Identification of contaminants of concern and their physical and toxicological properties;
- Description of exposure pathways and personal protection requirements;
- Location of all underground/aboveground services;
- Details of specific work practice procedures to be followed within the designated contaminated areas;
- Monitoring protocols to identify a potentially hazardous practice;
- Emergency information; and,
- Incident reporting.

Occupational Health and Safety Planning involves the development and implementation of systems and procedures into a Health and Safety Plan included in a Site Work Method Statement. The objectives of these documents are to ensure the health and safety of those undertaking specific tasks on site and the wider community if necessary.

A Health and Safety Plan should be developed for any site work and would typically include the following:

- A clear health and safety policy;
- Requirements for worker health assessments and inductions;
- Identified health and safety training requirements;
- Requirements for occupational health protection and monitoring;
- Site/location specific emergency plan;
- Site/location specific emergency contact details;
- Permit to work/clearance procedures, and
- Task specific safe work method statements.

8.6.2 Personal Hygiene and Decontamination

Appropriate hygiene and decontamination assists with minimising worker exposure and the transportation of potentially contaminated materials from the site to more sensitive home environments.

The following activities are prohibited while working in the hazardous materials area:

- eating;
- drinking;
- chewing gum, and;
- smoking.

Practices that involve contact between the hands and the mouth increase the risk of chemical ingestion. Hands should be thoroughly washed with soap and water after completing work activities and before meal breaks.

Personal decontamination is required to minimise workers' exposure to, and indirect transportation of potential chemicals of concern.

Decontamination involves physically removing material from personnel and equipment. Protective equipment, tools and other equipment are decontaminated by cleaning with

detergent water using a soft-bristle brush followed by rinsing with a sufficient quantity of water.

Decontamination should be conducted before meal breaks, and at the end of a day's work.

8.6.3 Community Health and Safety

The health and safety of the surrounding community is very important for any remediation works. While it is possible to control the activities of personnel within the remediation area (e.g. ensuring appropriate OH&S procedures and equipment are utilised) it is not normally possible to control the activities of the surrounding community. Therefore, to protect the community health and safety it is necessary to control the remedial works so that no fugitive emissions occur during the remedial works that could have an adverse impact on the surrounding community.

These controls are documented in the Environment Management Plan for the remedial works, although monitoring requirements to confirm the effectiveness of the measures may also be documented in the OH&S Plan. The methodology that would normally be used to develop the control measures is described below.

Firstly, the portions of the community that may be impacted by any fugitive emissions will be identified. Secondly an assessment of the hazard posed by the contaminants and the proposed remedial methodology/technology would be undertaken. This assessment would define the hazard posed by the particular contaminants present in the remediation area using risk assessment techniques (i.e. identifying the hazard or contaminants and the exposure pathway that the potentially at risk community could be exposed to the hazard).

Once these have been identified, a review will be undertaken of control measures available to remove or minimise the risk posed to the surrounding community during the remedial works. Typically the control measures would comprise removal/minimisation of the exposure pathway to the community. As indicated above it may be necessary to undertake monitoring to confirm the effectiveness of the control measures, and if the monitoring indicates a possibility for exposure then contingency measures may need to be implemented. By way of example control mechanisms could include (but not necessarily limited to) the following:

- Site security measures to prevent access to the contaminated material by the

public;

- Dust suppression measures to minimise inhalation and ingestion exposure; and,
- Not undertaking certain work if winds are unfavourable etc.

8.6.4 Traffic Control Plan

Movement of excavation equipment, trucks and other vehicles involved in the remediation works, to and from the site will be strictly controlled and restricted to a minimum and only take place during approved working hours. All potentially contaminated vehicles leaving the site will be decontaminated in an appropriate truck wash-down area. All vehicles will be visually free of soil before permission to leave a remediation area is granted.

8.6.5 Hours of Operation

Working hours for any on-site remedial works would be set in consultation with the Council, but it is envisaged the likely hours would be as follows:

• Mondays to Fridays	7:00 am to 5:00 pm
• Saturdays	7:00 am to 3:00 pm
• Sundays and Public Holidays	No Work Permitted.

8.6.6 Emergency and Out of Hours Contact Numbers

Project Manager - Parkview	**(02)95061500**
DLA Environmental	**(02) 94761765**
David Lane	**0410494810**
NSW EPA	**(02) 99955000**
WorkCover NSW	**(02) 43215000**
Sutherland Shire Council	(02) 97100333

9.0 REMEDIATION WORKS MANAGEMENT

9.1 Regulatory Approvals/Licences

Prior to the commencement of remedial work, all relevant regulatory approvals will need to be obtained. Such approvals/licenses will include but may not be limited to the following:

- Appropriate approvals for disposal of wastes to landfill e.g. contaminated soils, concrete demolition waste etc in accordance with the POEO Act 1997;
- Department of Infrastructure and Planning consent; and,
- NSW EPA Accredited Site Auditor sign-off on the concepts of the Remediation Action Plan.

9.2 Environmental Protection and Pollution Control

9.2.1 General

When the remedial works are being planned an assessment of potential mechanism for fugitive emissions from the remediation area will be completed. Contingency plans shall then be developed to deal with any identified emissions. The contingency plans will detail the response procedures to be implemented immediately after detection of a fugitive emission to the surrounding environment. The contingency plan will include details of the potential emissions identified and the appropriate response measures. The following outlines some examples of unexpected situations that may arise and may require response measures:

- Dust, noise, odour levels measured at site boundary may exceed acceptable levels; or,
- Surface water run-off may leave the site.

Typically, in cases where fugitive emissions are identified, the Project Manager will stop work and appropriate situation specific responses will be taken. By way of example these could include:

- reducing dust by further water spraying;
- reducing machinery on-site to minimise noise;
- intercepting run-off with diversion drains and a pumping system; and,
- backfilling an excavation to remove an unpleasant odour etc.

9.2.2 Buffer Zone

Wherever possible, a buffer zone will be established around remedial works. The effect of this buffer zone will to minimise the potential for impacts on the surrounding open space and residential areas as well as the community as a whole. The location and layout of the buffer zone will be determined by consideration of (but not necessarily limited to) the following:

- Hazards associated with, and exposure pathways to the main contaminants in the remediation area;
- Surrounding land uses;
- Prevailing weather conditions; and,
- Existing physical barriers (e.g. fences, buildings etc).

Access to the area within the buffer zone would be restricted to persons directly involved in the remedial works. If it is not possible to establish an adequate buffer zone in some areas where remedial works are to be undertaken, consideration will be given to other means of ensuring that there are no adverse impacts on the surrounding land users. This could include minimising or restricting the extent of any excavations or other activities that would effectively limit exposure to contamination.

9.2.3 Remediation Contingency

If there are events or discoveries made at the site that would prevent the proposed remediation works complying with the validation criteria, or if the selected remedial strategy is not able to precede then the following contingencies are devised:

1. Cap does not effectively cover all contaminated material:

   Option a – Review capping design

   Option b – Reposition contaminated material to beneath the proposed cap

   Option c – Excavate and dispose material outside of cap.

2. Permeability targets cannot be achieved:

   Option a – Review and upgrade capping design.
   Option b - Reassessment of remedial options including Excavate and Dispose Options.

9.3 Community Relations Plan

9.3.1 Communications Plan

Extensive consultation has been conducted on the Project to date. Meetings with stakeholders have kept information on the Project flowing to involved groups. It is envisaged that the remediation program will be developed in consultation with the stakeholders prior to implementation.

It is likely that the plan would intend to:

- Provide the stakeholders with information about the remedial works project;
- Enable the stakeholders to raise questions/concerns and other suggestions regarding the remedial works project; and,
- Co-ordinate matters of concern in relation to the remedial works project with Council and Regulatory Authorities with a stake in the project.

9.3.2 Complaint Response Measures

A complaint response system has been developed for dealing with any complaints received.

The system includes:

- Identification of the individuals (e.g. Project Manager etc) with overall responsibility of ensuring all complaints are dealt with in an appropriate manner;
- A clearly documented procedure for receiving, logging and passing on details of any complaints to the appropriate personnel. Refer to Construction Environmental Management Plan;
- Clearly defined roles for personnel working on the project in relation to complaint reporting and response;
- A complaint register, which will record details of complaints, the party making the complaint, the parties, notified of the complaint, and actions arising from the complaint;
- Mechanisms for advising Council and Regulatory Authorities of complaints in their jurisdiction;
- Mechanisms for disseminating information (as appropriate) to the local community and/or committee regarding complaints and the response to the complaints; and,
- Procedure for following up on the satisfactory resolution of any complaints.

9.3.3 Staged Progress Reporting

It is envisaged that staged progress reporting will be undertaken throughout the remedial works program. It is likely that these will comprise preparation and submission of regular status reports to the appropriate interested parties. The status reports would be expected to include a summary of:

- Results of any monitoring work undertaken during the reporting period;
- Details of the work undertaken during the reporting period;
- Details of any environmental incidents during the reporting period and the actions arising from these incidents;

- Details of any unexpected situations encountered in undertaking the remedial work during the reporting period and the response to these situations;
- Details of any variations required to the RAP for which approval has been sought; and,
- Updates on Project schedule.

Additionally, the occurrence of any event which causes or is likely to cause substantial pollution of the environment or represents a human health risk would be notified to the appropriate Regulatory Authority(s) as soon as practicable after it becomes known to the Project Manager, Remediation Contractor or Council. Should such an event occur a written report shall be supplied to the appropriate Regulatory Authority(s) within 21 days of the event. Such a report would include full details of the incident, including time and duration of the event, the type and volume of any pollutants discharged, any remedial activities undertaken and any measures taken to prevent or mitigate a recurrence of such an event.

Upon completion of the site remediation works a Validation Report shall be prepared and issued. The report will be prepared in accordance with the NSW EPA's *Guideline for Consultants Reporting on Contaminated Sites (1997*) and the *EPA Guidelines for the NSW EPA Site Auditor Scheme* (Second Edition, 2006).

10.0 CONCLUSION

In conclusion the RAP:

- Has been developed in a manner consistent with current industry practices;
- Has selected a preferred remediation strategy based on the site-specific issues and currently available technologies;
- Has presented an outline of the Site Remediation Environmental Management Plan (SREMP) and associated contingency plans to ensure the environment is appropriately protected during the proposed works;
- Has presented an information and consultation program to ensure the stakeholders are informed of the works as they proceed; and,
- Has outlined the means of validation of the completed works and ongoing management.

11.0 REFERENCES

- Australian and New Zealand Guidelines for the Management of Contaminated Sites, 1992, Australian and New Zealand Environment and Conservation Council and National Health and Medical Research Council (ANZECC/NHMRC 1992).

- Australian and New Zealand (ANZECC) Guidelines for Fresh and Marine Water Quality, 2000, Australian and New Zealand Environment and Conservation Council (ANZECC 2000).

- Health - Based Soil Investigation Levels, 1998, Imray, P & Langley, A, National Environmental Health Forum Monographs, Soil Series No. 2 (2nd Ed), South Australian Health Commission (NEHF 1998b).

- Contaminated Sites: Assessing Service Station Sites, 1994, NSW Environment Protection Authority (NSW EPA 1994).

- Contaminated Sites: Sampling Design Guidelines 1995, NSW Environment Protection Authority (NSW EPA 1995).

- Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites, 1998, NSW Environment Protection Authority (NSW EPA 1998).

- Contaminated Sites: Guidelines for the NSW Site Auditor Scheme, 2nd Edition, 2006.

- Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination (NSW DEC 2007).

- National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPM).

- ANZECC (1999) Guidelines for the Assessment of On-site Containment of Contaminated Soil.

- Environment Protection Authority (EPA) (1996) *Environmental Guidelines: Solid Waste Landfills*.

- Contaminated Sites: Guidelines on Significant risk of Harm from Contaminated land and the Duty to Report, 1999, NSW Environment Protection Authority (NSW EPA 1999).

- Managing Land Contamination: Planning Guidelines, SEPP 55 - Remediation of Land (1998), Department of Urban Affairs and Planning/ NSW EPA.

- Contaminated Land Management Act (1997), NSW Government, Sydney, NSW.

- Waste Classification Guidelines, NSW DECCW 2009.

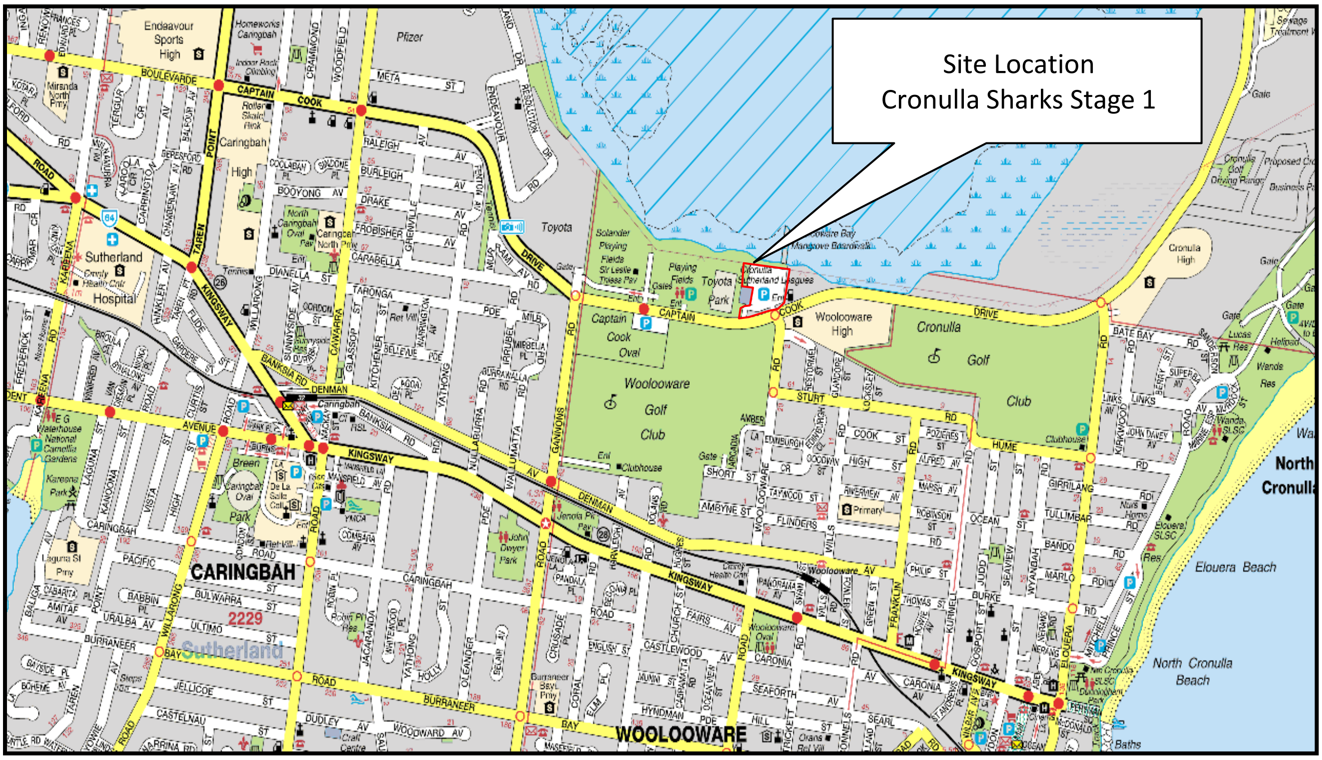
- Sutherland Shire Council LEP 2006.

Checklist Information Required for Completion of Remediation Action Plan

Item	Description	Addressed
	Planning information	
	Development Approval (EP&A Act 1997)	YES
	EPA licence	NA
	SEPP 55 requirements: Council Requirements	YES
	Planning instruments (Council contaminated land policies, DCPs, etc.):	YES
	ANZECC 1992 remediation hierarchy:	YES
	DNR Part 3A permit:	NA
	Work Cover Dangerous Goods Branch (UST removal):	NA
	Chemical Control Orders:	NA
	Others:	NA
	Remedial Action Plan	
	Remediation goals:	YES
	Discussion of the extent of remediation required:	YES
	Discussion of possible remedial options and how risk can be reduced:	YES
	Rationale for the selection of recommended remedial option:	YES
	Proposed testing to validate the site after remediation:	YES
	Contingency plan if the selected remediation strategy fails:	YES
	Interim site management plan (fencing, warning signs, storm water, etc.):	YES
	Site management plan (operation phase): **included**	YES
	Remediation schedule:	YES
	Hours of operation:	YES
	Contingency plans to respond to site incidents or offsite impacts:	YES
	Identification of regulatory compliance requirements:	YES
	Names/phone numbers to contact during remediation:	YES
	Community relations plans, where applicable:	YES
	Staged progress reporting, where appropriate:	YES
	Long-term site management plan:	YES

Figure 1

Site Location



DLA environmental	DESIGNED: DLA	SITE LOCATION		
	COMPILED: SS	CLIENT:	Park View Constructions Pty Ltd	DRAWING: 18/12/2012
Unit 2b/30 Leighton Place Hornsby, NSW 2077	PROJ. No. DL3007	LOCATION:	461 Captain Cook Drive, Woolooware, NSW 2230	FIGURE: 1

Figure 2

Site Layout

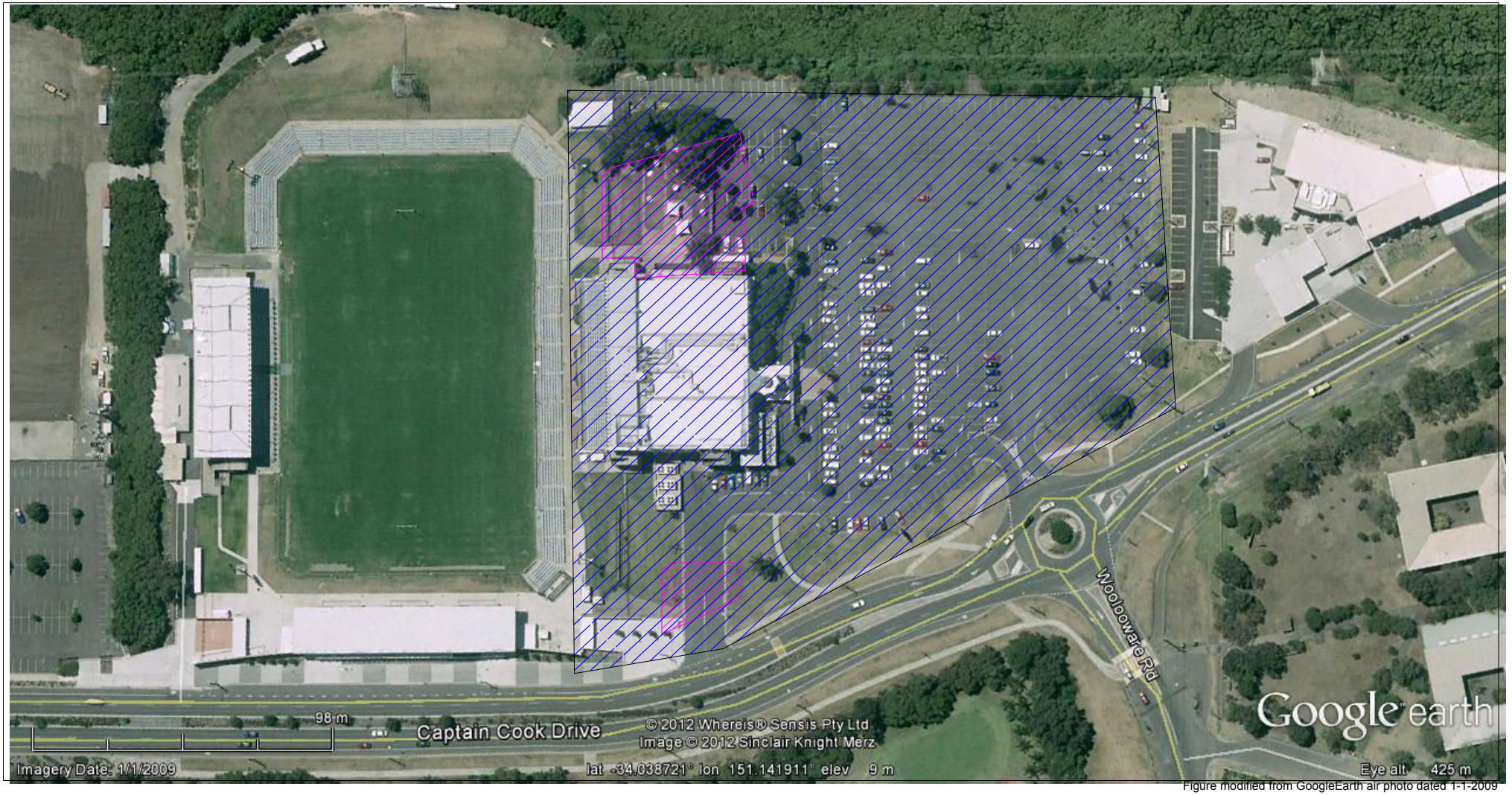


Figure modified from GoogleEarth air photo dated 1-1-2009

Scale (m)

0 25 50

Legend

Commercial/Retail Areas

Stage 1 Area

N

DLA environmental

Unit 2b/30 Leighton Place
Hornsby, NSW 2077

Newcastle Office
Phone (02) 4949 3800
Fax (02) 4949 3811

Sydney Office
Phone (02) 9476 1765
Fax (02) 9476 1557

Title: Stage 1 Site Layout			
Client: Bluestone	Job No: DL3007	Figure No: 2	Date: 29/01/2013
	Scale: As Shown	Sheet: 1 of 1	Revision: R00

Figure 3

Sampling Locations

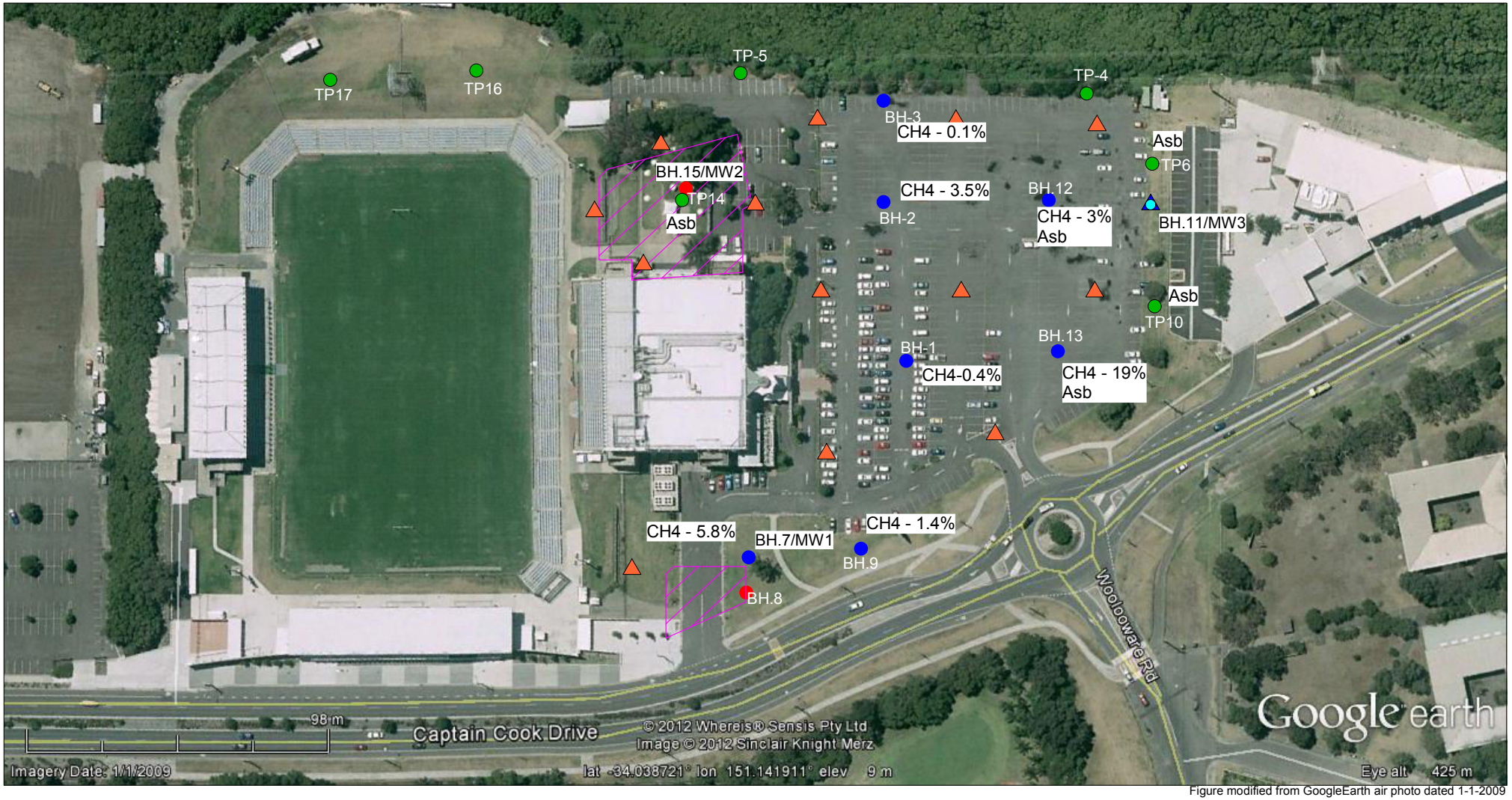


Figure modified from GoogleEarth air photo dated 1-1-2009

Scale (m)

0 25 50

Legend

- Previous Investigation Locations (13)
- Groundwater Well (1)
- Approximate Location of new retail buildings
- Gas & water well location (2)
- Bore hole location (14)
- Test pit location (8)

N

DLA environmental
Unit 2b/30 Leighton Place
Hornsby, NSW 2077

Newcastle Office
Phone (02) 4949 3800
Fax (02) 4949 3811

Sydney Office
Phone (02) 9476 1765
Fax (02) 9476 1557

Title: Site Layout with Sample Locations			
Client: Bluestone	Job No: DL3007	Figure No: 3	Date: 29/01/2013
	Scale: As Shown	Sheet: 1 of 1	Revision: R00

Appendix A

Bore Logs

Soil Profile Log

DLA environmental

BH - 1

Client:	Parkview	Job Type:	St.2 Assessment
Project No:	DL3007	Address:	Captain Cook Drive, Woolooware NSW
Date:	19/12/2012	Logged By:	R Case
Site ID:	Cronulla Sharks	Method:	4wd Mounted Drill Rig
Hole Size	100mm Solid Flight Auger	Co-ordinates:	

Method	Depth (m)	Graphic Log	USCS Classification	Material Description	Moisture	Sampling	Field Records/Comments	Monitoring well Details
			-	Asphalt			30mm thick	
			Fill	Black Silty clay Fill		-1	Landfill Gas on completion of borehole: CH4 - 0.4% CO2 - 0.8% O2 - 19.3%	
	0.5							
	1		Fill	Grey Sandy Fill w/ wire, timber, steel drum.		-2		
	1.5							
	2.0		Fill	Black fine grained sand Fill				
			Fill	Organic woody fill with ash				
	2.5							
	3.0							
			Fill	Brown Gravelly clay fill				
	3.5							
	4.0					-3		
							PID - 55.4	
	4.5		OL	Natural estuarine silt				

Soil Profile Log

BH - 2

Client:	Parkview	Job Type:	St.2 Assessment
Project No:	DL3007	Address:	Captain Cook Drive, Woolooware NSW
Date:	19/12/2012	Logged By:	R Case
Site ID:	Cronulla Sharks	Method:	4wd Mounted Drill Rig
Hole Size	100mm Solid Flight Auger	Co-ordinates:	

Method	Depth (m)	Graphic Log	USCS Classification	Material Description	Moisture	Sampling	Field Records/Comments	Monitoring well Details
			-	Asphalt			30mm thick	
			Fill	Black Silty clay Fill			Landfill Gas on completion of borehole: CH4 - 3.5% CO2 - 1.3% O2 - 18%	
	0.5							
	1							
	1.5						PID - 0.0	
	2.0		Fill	Grey Sandy Fill w/ timber, steel, plastic and glass.				
	2.5							
	3.0							
	3.5			Natural estuarine silt				
	4.0			End of Log				
	4.5							

Soil Profile Log

BH - 3

Client:	Parkview	Job Type:	St.2 Assessment
Project No:	DL3007	Address:	Captain Cook Drive, Woolooware NSW
Date:	19/12/2012	Logged By:	R Case
Site ID:	Cronulla Sharks	Method:	4wd Mounted Drill Rig
Hole Size	100mm Solid Flight Auger	Co-ordinates:	

Method	Depth (m)	Graphic Log	USCS Classification	Material Description	Moisture	Sampling	Field Records/Comments	Monitoring well Details
	0		Fill	Sandy Clay Fill				
	0.5						Landfill Gas on completion of borehole: CH4 - 0.1% CO2 - 0.8% O2 - 18.9%	
	1							
	1.5			Grey Sandy Fill w/ timber, steel, plastic and glass.			PID - 0.0	
	2.0		Fill					
	2.5							
	3.0			Hole Terminated due to drill Jamming				
	3.5							
	4.0							
	4.5							

Soil Profile Log

TP - 4

Client:	Parkview	Job Type:	St.2 Assessment
Project No:	DL3007	Address:	Captain Cook Drive, Woolooware NSW
Date:	19/12/2012	Logged By:	R Case
Site ID:	Cronulla Sharks	Method:	Back Hoe
Hole Size	450mm x 3m	Co-ordinates:	

Method	Depth (m)	Graphic Log	USCS Classification	Material Description	Moisture	Sampling	Field Records/Comments	Monitoring well Details
	0		-					
			Fill	Loamy Topsoil				
	0.5			Orange mottled clay and crushed sandstone		TP4		
	1							
	1.5			Orang/yellow gravelly Clay fill with brick				
	2.0							
	2.5		Fill	Orange Clay Fill				
	3.0		OL	Natural Estuarine Silt				
	3.5							
	4.0							
	4.5							

Soil Profile Log

TP - 5

Client:	Parkview	Job Type:	St.2 Assessment
Project No:	DL3007	Address:	Captain Cook Drive, Woolooware NSW
Date:	19/12/2012	Logged By:	R Case
Site ID:	Cronulla Sharks	Method:	Back Hoe
Hole Size	450mm x 3m	Co-ordinates:	

Method	Depth (m)	Graphic Log	USCS Classification	Material Description	Moisture	Sampling	Field Records/Comments	Monitoring well Details
	0.5 1 1.5 2.0 2.5 3.0 3.5 4.0 4.5		Fill OL	Sandy Fill with brick and tile. Natural Estuarine Silt		TP5		

Soil Profile Log

TP - 6

Client:	Parkview	Job Type:	St.2 Assessment
Project No:	DL3007	Address:	Captain Cook Drive, Woolooware NSW
Date:	19/12/2012	Logged By:	R Case
Site ID:	Cronulla Sharks	Method:	Back Hoe
Hole Size	450mm x 3m	Co-ordinates:	

Method	Depth (m)	Graphic Log	USCS Classification	Material Description	Moisture	Sampling	Field Records/Comments	Monitoring well Details
	0		-	Loamy Topsoil				
			Fill	Mottled orange Clay / sandstone				
	0.5							
	1			Silty sand Fill with waste material including scrap metal, plastic, timber, brick, fibro asbestos and glass.				
	1.5							
	2.0							
	2.5							
	3.0		OL	Natural estuarine silt				
	3.5							
	4.0						PID - 55.4	
	4.5							

Soil Profile Log

BH -7

Client:	Parkview	Job Type:	St.2 Assessment
Project No:	DL3007	Address:	Captain Cook Drive, Woolooware NSW
Date:	19/12/2012	Logged By:	R Case
Site ID:	Cronulla Sharks	Method:	4wd Mounted Drill Rig
Hole Size	100mm Solid Flight Auger	Co-ordinates:	

Method	Depth (m)	Graphic Log	USCS Classification	Material Description	Moisture	Sampling	Field Records/Comments	Monitoring well Details
			Fill	Black Silty loam Fill				
			Fill	Silty Clay Fill		-1	Landfill Gas on completion of borehole: CH4 - 5.8% CO2 - 4.3% O2 - 15.2% CO - 4ppm	
	0.5							
	1					-2		
	1.5						PID - 0.0	
	2.0		Fill	Grey silty Sand and clay Fill w/ timber, carpet, duct tape, steel, plastic and glass..				
	2.5							
	3.0							
	3.5							
			OL	Natural Estuarine Silts				
	4.0							
	4.5							

Soil Profile Log

BH - 8

Client:	Parkview	Job Type:	St.2 Assessment
Project No:	DL3007	Address:	Captain Cook Drive, Woolooware NSW
Date:	19/12/2012	Logged By:	R Case
Site ID:	Cronulla Sharks	Method:	4wd Mounted Drill Rig
Hole Size	100mm Solid Flight Auger	Co-ordinates:	

Method	Depth (m)	Graphic Log	USCS Classification	Material Description	Moisture	Sampling	Field Records/Comments	Monitoring well Details
	0		Fill	Black Silty loam Fill				Bentonite Cement Plug
			Fill	Silty Clay Fill				
	0.5							
	1							2mm sand filter
	1.5			Grey silty Sand and clay Fill w/ timber, steel, plastic and glass.				
	2.0		Fill					
	2.5							
	3.0							
	3.5							
	4.0							
	4.5							

Soil Profile Log

BH - 9

Client:	Parkview	Job Type:	St.2 Assessment
Project No:	DL3007	Address:	Captain Cook Drive, Woolooware NSW
Date:	19/12/2012	Logged By:	R Case
Site ID:	Cronulla Sharks	Method:	4wd Mounted Drill Rig
Hole Size	100mm Solid Flight Auger	Co-ordinates:	

Method	Depth (m)	Graphic Log	USCS Classification	Material Description	Moisture	Sampling	Field Records/Comments	Monitoring well Details
			Fill	Black Silty loam Fill				
			Fill	Silty Clay Fill			Landfill Gas on completion of borehole: CH4 - 1.4% CO2 - 10.9% O2 - 1.8%	
	0.5							
	1					-1		
	1.5						PID - 0.0	
	2.0		Fill	Grey Sandy Fill w/ timber, carpet, steel, plastic and glass.		-2		
	2.5							
	3.0							
	3.5							
			OL	Natural Estuarine Silts				
	4.0							
	4.5							

Soil Profile Log

TP -10

Client:	Parkview	Job Type:	St.2 Assessment
Project No:	DL3007	Address:	Captain Cook Drive, Woolooware NSW
Date:	19/12/2012	Logged By:	R Case
Site ID:	Cronulla Sharks	Method:	Back Hoe
Hole Size	450mm x 3m	Co-ordinates:	

Method	Depth (m)	Graphic Log	USCS Classification	Material Description	Moisture	Sampling	Field Records/Comments	Monitoring well Details
			-	Loamy Topsoil				
			Fill	Mottled orange Clay / sandstone				
	0.5							
					TP10			
	1							
	1.5			Silty sand Fill with waste material including scrap metal, car wheel, plastic, timber, brick, fibro asbestos and glass.				
	2.0							
	2.5							
	3.0		OL	Natural estuarine silt				
	3.5							
	4.0						PID - 55.4	
	4.5							

Soil Profile Log

BH -11

Client:	Parkview	Job Type:	St.2 Assessment
Project No:	DL3007	Address:	Captain Cook Drive, Woolooware NSW
Date:	19/12/2012	Logged By:	R Case
Site ID:	Cronulla Sharks	Method:	4wd Mounted Drill Rig
Hole Size	100mm Solid Flight Auger	Co-ordinates:	

Method	Depth (m)	Graphic Log	USCS Classification	Material Description	Moisture	Sampling	Field Records/Comments	Monitoring well Details
	0		Fill	Black Silty loam Fill				Bentonite Cement Plug
	0.5		Fill	Mottled orange Clay / sandstone				
	1		Fill	Silty sand Fill with waste material including scrap metal, plastic, timber, brick, fibro asbestos and glass..			PID - 0.0	2mm sand filter
	1.5							
	2.0							
	2.5							
	3.0						Water Level	
	3.5							
	4.0		OL	Natural Estuarine Silts				2mm sand filter
	4.5							5.0m

Soil Profile Log

BH -12

Client:	Parkview	Job Type:	St.2 Assessment
Project No:	DL3007	Address:	Captain Cook Drive, Woolooware NSW
Date:	19/12/2012	Logged By:	R Case
Site ID:	Cronulla Sharks	Method:	4wd Mounted Drill Rig
Hole Size	100mm Solid Flight Auger	Co-ordinates:	

Method	Depth (m)	Graphic Log	USCS Classification	Material Description	Moisture	Sampling	Field Records/Comments	Monitoring well Details
			Fill	Asphalt			30mm Thickness	
			Fill	Dark grey / orange Silty Clay Fill			Landfill Gas on completion of borehole:	
	0.5						CH4 - 3%	
							CO2 - 5.8%	
	1						O2 - 12.4%	
						-1	CO - 3ppm	
	1.5						PID - 0.0	
	2.0		Fill	Grey Sandy Fill w/ timber, fibro asbestos, steel, plastic and glass.				
	2.5							
	3.0							
	3.5							
			OL	Natural Estuarine Silts				
	4.0							
	4.5							

Soil Profile Log

BH - 13

Client:	Parkview	Job Type:	St.2 Assessment
Project No:	DL3007	Address:	Captain Cook Drive, Woolooware NSW
Date:	19/12/2012	Logged By:	R Case
Site ID:	Cronulla Sharks	Method:	4wd Mounted Drill Rig
Hole Size	100mm Solid Flight Auger	Co-ordinates:	

Method	Depth (m)	Graphic Log	USCS Classification	Material Description	Moisture	Sampling	Field Records/Comments	Monitoring well Details
			Fill	Asphalt			30mm Thickness	
	0.5		Fill	Dark grey / orange Silty Clay Fill			Landfill Gas on completion of borehole: CH4 - 19% CO2 - 15% O2 - 5%	
	1							
	1.5						PID - 0.0	
	2.0		Fill	Grey Sandy Fill w/ timber, fibro asbestos, steel, plastic and glass.				
	2.5							
	3.0							
	3.5							
	4.0		OL	Natural Estuarine Silts				
	4.5							

Soil Profile Log

TP - 14

Client:	Parkview	Job Type:	St.2 Assessment
Project No:	DL3007	Address:	Captain Cook Drive, Woolooware NSW
Date:	19/12/2012	Logged By:	R Case
Site ID:	Cronulla Sharks	Method:	Back Hoe
Hole Size	450mm x 2m	Co-ordinates:	

BH-15 Adjacent

Method	Depth (m)	Graphic Log	USCS Classification	Material Description	Moisture	Sampling	Field Records/Comments	Monitoring well Details
	0		Fill	Black Silty loam Fill	TP14			Bentonite Cement Plug
			Fill	Silty Clay Fill				
	0.5							
				Grey Sandy Fill w/ steel, plastic, fibro asbestos and glass.			PID - 0.0	
	1							
	1.5			Silty Clay Fill				
				End of Log				2mm sand filter
	2.0		Fill					
	2.5							
	3.0							
	3.5							
	4.0							
	4.5							

Appendix B

Methane Gas Management Plan

GAS MANAGEMENT PLAN

Cronulla Sharks Redevelopment

Stage 1

Commercial and Retail including Carpark

Lot 11 in DP 526492

461 Captain Cook Drive

Woolooware NSW

Prepared for:

Bluestone Capital Ventures No.1 Pty Ltd

Level 6 71 Macquarie Street

Sydney, NSW 2000

Prepared by:

DLA Environmental

DL3007_S0000274

January 2013

Sydney
Unit 2B 30 Leighton Place
Hornsby NSW 2077
Phone: 9476 1765
Fax: 9476 1557
Email: dlassociates@bigpond.com

Newcastle
PO Box 137
Branxton NSW 2335
Phone: 4938 3800
Fax: 4938 3811
Email: dolane@bigpond.com

ABN 36 926 003 197

TABLE OF CONTENTS

Page Number:

FIGURES:

1.0 INTRODUCTION

1.1 GENERAL

David Lane Associates (DLA) was commissioned by Bluestone Capital Ventures No.1 Pty Ltd (Bluestone) to prepare a Gas Management Plan (GMP) for the proposed development site identified as Lot 11 in Deposited Plan 526492 (Site) located at 461 Captain Cook Drive, Woolooware NSW. The GMP is required to manage the risks associated with construction and remediation measures implemented to alleviate Methane Gas soil concentrations as detailed in the following reports:

"Report to All Star Real Estate on Further Contamination Investigation (Site C) for Cronulla Sutherland Leagues Club at Captain Cook Drive, Woolooware" Ref: El 071 5S/a, dated 1 5 February 1 995.

"Report to Cronulla Sharks Rugby Leagues Club on Environmental Site Screening for Shark Park Redevelopment at Cronulla Leagues Club, Captain Cook Drive, Woolooware", Ref: El 5009FRPT/2, dated 29 November 2000.

Report to Cronulla Sutherland Leagues Club on Further Environmental Site Assessment for Proposed Cronulla Leagues Club Rezoning at Captain Cook Drive, Woolooware", Ref:E171 19FK-rpt, dated October 2002.

"Report to Cronulla-Sutherland District Rugby League Football Club on Environmental Site Assessment for Proposed Upgrade Works at Toyota Park, 461 Captain Cook Drive, Woolooware", Ref: E20345FJ-RPT, dated August 2006

"Review of Methane Measures for Proposed Southern Grandstand Works, Toyota Park, 461 Captain Cook Drive, Woolooware" Dated 30 August 2007, Ref: E20345FJ Let-M; and,

"Review of Methane Measures for Proposed Southern Grandstand Works, Toyota Park, 461 Captain Cook Drive, Woolooware" Dated 30 August 2007, Ref: E20345FJ Let-M2

Stage 2 Environmental Site Assessment, Cronulla Sharks Redevelopment Stage 1 - 461 Captain Cook Drive, Woolooware, DLA 2013.

The SMP is also intended to outline management hierarchy, responsibilities and actions required in the event of ground disturbance, damage to any containment system or for regular maintenance. To ensure proper management, the GMP will be included with the development application and attached to any requests to tender for the Stage 1 works.

1.2 BACKGROUND

Since 1994 EIS have undertaken a number of investigations in various sections of the Site for a variety of proposed developments. Based on the results of gas investigations the general conclusions were that the site is generating methane gas as a result of organic material buried during the filling process. Methane gas readings were obtained from eight monitoring wells, with readings in six of the eight wells exceeding 1.25% v/v, with a maximum concentration of 29% v/v.

Three (3) gas monitoring wells were installed on the Site by DLA in December 2012 to provide up to date information on the gas concentrations. The wells were strategically located to be specifically related to the development, in particular the on-ground structures of the proposed Medical Centre and Club Leisure Facility located to the south and north of the existing Club respectively. Gas concentrations of 0.2% v/v were recorded at each location. MW#3 is located on the eastern boundary of the car park associated with the location of the proposed Woolooware North Road. Low concentrations similar to the other two wells were recorded.

Irrespective of the low results recorded in these important locations elevated concentrations above recent results have been recorded across the Site during soil investigations applicable to the car park area. Gas concentrations of up to 19% v/v were record by previous assessments and field measurements conducted during the recent investigations by DLA Environmental found concentrations also up to 19% v/v in a low number of boreholes placed in the car park area.

Given the description of materials and the moderate quantities of organic materials it is considered by DLA the risk from soil gases to be moderate. Recently conducted inspections of fill materials indicated moderate organic content with a higher content of “hard” fill materials. The fill materials were dry with what can be described as a significant lack of moisture present.

It should be noted that the car park and Club facilities are constructed on former Mangrove Swamps, a recognised source of methane generation. It is felt that this source is largely contributing to the methane concentrations experienced across the Site.

1.3 OBJECTIVES OF THE SITE MANAGEMENT PLAN

This GMP has been prepared for the purpose of managing the potential risk to human health during construction and ongoing management of the environmental controls (Engineered Barrier and Gas Drainage) if implemented on the Stage 1 Cronulla Sharks Development, Woolooware.

The Australian and New Zealand Conservation Council (ANZECC) Guidelines for the Assessment of On-Site Containment of Contaminated Soil, 1999 indicates that any Site Management Plan should clearly identify:

- Environmental objectives;
- Control systems supporting each objective;
- Maintenance requirements for each control system;
- Routine monitoring requirements for each control system;
- Range of acceptable values for monitored parameters
- Action levels which trigger intervention in response to monitoring observations;
- Contingency responses in the event that failure of control systems is identified outside routine monitoring (emergency response);
- A documentation protocol to record maintenance activities, monitoring results, non-conformances, and actions taken to rectify any non-conformance; and
- A reporting procedure to ensure effective communication of information.

This report provides information to address all of the points listed above to ensure the integrity of the remediation strategy for the long term.

2.0 SITE DETAILS

2.1 SITE IDENTIFICATION

The site identification details are summarised below:

Item	Detail
Site Owner:	Cronulla-Sutherland Leagues Club Ltd
Site Address:	461 Captain Cook Drive, Woolooware NSW
Lot & Deposited Plan:	Lot 11 in DP526492 and Lot 20 in DP529644. Future proposed Lot 1 and 2.
Local Government Authority:	Sutherland Shire Council
Current Zoning:	Zone 15 - Private Recreation
Geographical Location (MGA):	N:6232100 E: 328300 (approximately)
Site Locality Plan:	Refer to Figure 1
Site Layout Plan:	Refer to Figure 2

2.2 SITE HISTORY

The Cronulla Sharks site consists of three principal sections: the western playing fields (an open grassed area); the centrally located stadium and associated club house; and the eastern car park (an on-grade asphalt paved car park). The north section of the site is bounded by mangrove swamp and Woolooware Bay. Aerial photographs indicated that the site was initially mangrove swamp that was backfilled sometime in the 1950s to 1960s. The basic layout of the site buildings had been completed by 1978.

The site was part of a larger parcel of land bought by the Council from numerous private owners in the late 1950s. The land was purchased with the intention of filling these low-lying areas with ‘hard fill’ (non-petruscible wastes) to enable the long term development of sports fields. Filling was completed in a number of stages managed by private contractors (from 1964 to 1967) and Council (after 1967).

In 1962 the Electricity Commission of NSW resumed a portion at the north of the site for the Kurnell Transmission Line. In 1965 a drainage culvert was constructed to the west of the main playing field across from Captain Cook Drive to Woolooware Bay at the north. The Leagues Club and Stadium area of the site were sold by tender to the Cronulla Sutherland Leagues Club in 1968 with an agreement that the Council would fill the remainder of the site and transfer the ownership to the Leagues Club.

Development of the stadium and other club facilities was undertaken in a number of stages with approval for the main Club building obtained in 1973. Approval for spectator seating, change rooms and amenities facilities was obtained in 1979 and extensions to the Club and spectator facilities were undertaken in 1981. Associated with the construction and upgrade of the spectator areas in 1981 land reclamation resulting in the construction of a fill mound approximately 6m above the field level was undertaken within the transmission line easement. Correspondence records indicate that council approval for this development was not sought prior to the commencement of development works.

2.3 PROPOSED DEVELOPMENT

Bluestone proposes to construct an on-ground four (4) level car parking facility on the eastern side of the existing leagues club, which will include a medical centre and retail area. The design is anticipated to incorporate an engineered barrier system to exclude gas migration into occupied areas. The final design detail for the structure should be approved by a NSW EPA Accredited Site Auditor prior to construction to confirm that design objectives can be achieved.

3.0 CONSTRUCTION MANAGEMENT

3.1 PILING

Due to geotechnical constraints, the structure is expected to be supported by concrete piling. To install the piling system, it will be necessary to penetrate the ground with augers. The contractor engaged to undertake this process should provide a suitable work method to ensure ignition of methane gas does not occur.

3.2 SLAB CONSTRUCTION

In the car parking area, concrete slabs should either overlying a drainage layer and be graded away from occupied areas or designed as permeable to avoid a build-up of gas beneath the concrete slab. The car parking areas are expected to be open to the atmosphere and will therefore be well ventilated.

Beneath the occupied areas of the development, concrete slabs should be constructed to prevent any intrusion of gas from below ground or from potential pathways originating from below ground, including services and relief joints. The slabs should be constructed on a permeable drainage layer and be graded to avoid accumulation of explosive gasses or migration into established buildings.

3.3 SERVICES

Service conduits, pits and ducts should all be constructed so as to avoid any opportunity for gas build up within. All services entering the occupied areas should be constructed in such a manner as to avoid providing a pathway for gas to enter the building. This may be achieved through venting prior to horizontal entry, or sealing the entry point to exclude gas migration.

3.4 MONITORING

Monitoring of landfill gas should be undertaken during piling operations, any hot works and any other activities that have the potential to be an ignition source of built up explosive gas. The construction manager for the Site should have a work method statement from each contractor that clearly defines action levels in the event of methane gas detection and which also provides steps to be taken should those levels be exceeded.

4.0 REMEDIAL MEASURES

4.1 DESIGN CONCEPT

To allow gas drainage from the Stage 1 area, Ground level slabs will either be sealed and graded or made with permeable gas relief.

The soffit of the sealed slabs will have a nominal 0.5-1.0% grade and there will be a 150mm granular drainage layer between the backfill and slab soffit. It is expected that this system will require some form of semi-regular ongoing inspection once completed and should also incorporate periodic methane gas monitoring.

4.2 MATERIAL AND DESIGN LIFE

Material used in the design and construction of the Engineered Barrier should provide effective barrier for isolation of gas generating soils for the long term, without the need for future active maintenance.

All materials used in the construction of the engineered barrier are expected to have a long design life such that they should be suitable for their intended purpose for the duration of the potential risk. Without a specific degradation mechanism; the selected material is not expected to significantly degrade.

4.3 VALIDATION

Indoor areas of the construction will need to undergo a rigorous gas intrusion assessment in accordance with the following technical documents:

- NSW DECCW, 2010, Vapour Intrusion: Technical Practice Note,.
- CIRIA, 2007, Assessing Risks Posed by Hazardous Ground Gases to Buildings.
- NSW EPA Guidelines for the Assessment and Management of Sites Impacted Hazardous Ground Gases (Draft).

It is expected that landfill gas monitoring should be undertaken monthly internal to the occupied areas of the Stage 1 development, once completed. Concentrations of Methane, Carbon Dioxide, Hydrogen Sulphide and Oxygen should be recorded until no longer relevant as advised by a NSW EPA Accredited Site Auditor.

The commissioning documentation for the structure and all gas monitoring results should be reviewed by a NSW EPA Accredited Site Auditor prior to issuing a Site Audit Statement to confirm that design objectives were achieved. An auditor approved Site Management Plan will need to be implemented also, which will include actions to maintain and monitor the remedial system. The plan should also include contingency measures should the design not achieve the long term objectives.

4.4 MANAGEMENT CONTROLS

In accordance with the Contaminated Land Management Act 1997, the land owner is required to implement, monitor and maintain the remedial systems to maximise the life of the physical barrier and ventilation system. All monitoring and compliance information is to be made available on an ongoing basis to the regulating authorities upon request.

4.4.1 Hierarchy and Responsibilities

During Stage 1 construction works, the principle building contractor will be responsible for the installation and maintenance of all engineered controls including monitoring and inspections to allow the system to be commissioned as suitable for its intended purpose. Once the building is commissioned, the land owner has the primary responsibility for all matters relating to works or maintenance issues associated with engineered barrier area or ventilation systems. All personnel should be made aware of the potential presence of methane gas and should report any activity that may contravene relevant WorkCover guidelines, for example; working in confined spaces.

Prior to commencement of works, appropriate persons should be nominated to document the systems and records required to properly construct and commission the barrier structure. The following Table 4a should be completed prior to the commencement of works.

Table 4a – Management Responsibilities

Area of Responsibility	Company	Name	Contact No.
Barrier Surface Inspections Reporting Maintenance Record Keeping			
Landfill Gas Monitoring Inspections Sampling/Analysis Reporting Record Keeping			
Services Management Building Manager Installation Authority Inspections Compliance			

For any works undertaken in association with the engineered barrier, it is recommended that an appropriate environmental professional is consulted to monitor the works and to advise on management and methodology of works to be undertaken. Personnel employed to undertake any intrusive works must develop a specific Safe Work Method Statement (SWMS) which limits the potential for exposure to any potential gas below the Barrier and ensures system integrity is maintained on completion of works. Works undertaken in soils below the barrier must be undertaken by a suitably licensed contractor and must account for the potential exposure to methane gas.

Any SWMS should be reviewed by the principle contractor, to ensure that associated concerns outlined in this GMP are accounted for. Work methodologies should include appropriate notification regarding the intended level of impact on the potentially contaminated area and the condition of the impacted area at the completion of works. This should also include any integrity QA certification which should be filed in the permanent record to be kept onsite, with file copies being distributed to any regulatory bodies governing the development conditions.

5.0 CONTINGENCIES

5.1 STRUCTURAL INTEGRITY

During the period of management for the barrier at the Site, incidence or changes may occur which need to be considered to properly maintain the objectives of the remediation.

5.2 LANDFILL GAS DETECTIONS

Should gasses be detected internal to the occupied area, or above 5%LEL in the car park area, the following measures must be taken:

a. A risk assessment that considers the likelihood of gas intrusion and the need to install methane sensors as required.

b. A review of the ventilation system.

c. Internal monitoring should be undertaken from locations that consider all potential internal pathways.

d. Consideration of an active ventilation system.

5.2.1 Active Ventilation

Ideally, the proposal should not result in continual monitoring of landfill gas concentrations after completion of construction. As part of the validation, provision has been made for methane concentrations to be monitored within occupied areas of the building. Should concentrations of methane be detected within enclosed areas, it is recommended that an automated active ventilation system be considered.

Two (2) sensors with upper and lower switching thresholds will be installed on the internal ceiling. The sensors will be located at the highest potential collection point. When installed, these sensors should be triggered to activate at 5% LEL and deactivate at no greater than 0.25% LEL.

This system would also be included in a review by a NSW EPA Accredited Site Auditor to confirm that design objectives are achieved.

6.0 MANAGEMENT REVIEW

Circumstances that may lead to any change of information in this management plan must be reflected in an addendum document and filed with this plan. For example:

- Any reported damage and the subsequent repairs undertaken on the barrier should include a review of the Management Plan to ensure up to date information of the engineered barrier is maintained.
- Any works that require intrusive activities into underlying soils also require an appropriate amendment to this Management Plan to maintain the most current information about the barrier system within this document.
- Any changes to the ownership of the land should involve appropriate revision of this Management Plan.

Due to the construction phase of the development incorporating a number of the physical controls required to make the land suitable for the intended use, their ability to do so must be confirmed on completion of construction. At that time, all remedial measures should be reviewed by a NSW EPA Accredited Site auditor, including compliance with the requirements of this Management Plan, to determine if the Stage 1 Development is suitable for its intended use.

7.0 CONCLUSIONS

Adequate control systems have been included to support each objective stating the maintenance requirements and routine monitoring requirements to ensure compliance with the range of acceptable values for monitored parameters.

Contingency responses in the event that failure of control systems is identified outside routine monitoring (emergency response) have been provided for, including a documentation protocol to record maintenance activities, monitoring results, non-conformances, and actions taken to rectify any non-conformance.

This Management Plan has also provided a reporting procedure to ensure effective communication of information.

8.0 LIMITATIONS

DLA Environmental acknowledge that limitations do exist with respect to this management plan. The following comments should be considered in the context of implementation, review, change of ownership or works which may impact the integrity or management of the physical barrier and ventilation system.

The condition of the Site is described as it was during the December 2012 investigations. DLA do not make any representation or warranty that the conclusions in this report will be applicable in the future as there may be changes in the condition of the site, applicable legislation or other factors that would affect the conclusions contained in this report. All recommendations are based on observations during the investigation, with respect to current legislation and guidelines enacted as at the date of this report.

Should Site conditions change significantly from those described in this Management Plan; than this management Plan should be assessed for its suitability in the context of available data at that time.

Appendix C

Acid Sulphate Soil Management Plan

Acid Sulphate Soil Management Plan

Cronulla Sharks Redevelopment

Stage 1 Commercial and Retail including Carpark

Part Lot 11 in DP526492 461 Captain Cook Drive Woolooware NSW 2230

Prepared for:

Bluestone Capital Ventures No.1 Pty Ltd
Level 6 71 Macquarie Street
Sydney, NSW 2000

Prepared by:

DLA Environmental

DL3007_S000284

January 2013

Revision R01

Sydney
Unit 2B 30 Leighton Place
Hornsby NSW 2077
Phone: 9476 1765
Fax: 9476 1557
Email: dlassociates@bigpond.com

Newcastle
PO Box 137
Branxton NSW 2335
Phone: 4938 3800
Fax: 4938 3811
Email: dolane@bigpond.com

ABN 36 926 003 197

Contents

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1.0 INTRODUCTION

1.1 General

DLA Environmental (DLA) was commissioned by Bluestone Capital Venture No.1 Pty Ltd to prepare an Acid Sulphate Soils Management Plan (ASSMP), for the development site identified as the property bounded by Captain Cook Drive and Woolooware Bay Woolooware NSW (Site). The Cronulla Sutherland Leagues Club Site is legally described as Lot 11 DP 526492 and Lot 20 DP 529644 and is known as 461 Captain Cook Drive, Woolooware.

Three (3) lots owned by Sutherland Shire Council (being Lot 21 DP 529644, Lot 1 DP 711486 and Lot 1 DP 501920) are also included within the proposed future Development. The existing Lots are presently subject to Plan of Subdivision creating Lot 1 and Lot 2 in unknown DP. Previous Assessments undertaken at the Site have identified Potential Acid Sulphate Soils (PASS) which will require the preparation of mitigation measures to minimise latent impacts if excavated.

The management plan presented below considers the risk of encountering PASS during the excavation of soils from any part of the development site. The management plan is compliant with the current policies and guidelines of the NSW Office of Environment and Heritage (formerly DECCW) and includes:

- A description of the soil attributes of the site;
- A schedule of the construction activities that involve the potential excavation or movement of acid sulphate soils (ASS);
- A description of the potential impacts caused by the proposed construction activities;
- A description of the measures and procedures to be undertaken in the ASS area, which when implemented will prevent, control or minimise the generation or escape of acid leachate into the surrounding environment;
- A focussed monitoring program covering soils, surface waters and groundwater;
- A description of the contingency procedures to be implemented in the case of failure of management procedures; and,
- A record of consultation with co-ordinating authorities.

1.2 Acid Sulphate Soil

Acid Sulphate Soils (ASS) were formed during the past 10,000 years following the last major sea level rise. They developed on coastal wetlands from deposited layers of marine muds and sands within low-energy environments, including tidal estuaries and coastal lakes. ASS are formed with the assistance of anaerobic bacteria when seawater or sulphate-rich water saturates soil containing iron oxides and organic matter, and with the absence of oxygen.

Whilst soils containing iron sulphides remain in an anaerobic state, they are considered Potential ASS (PASS) and pose no risk to the environment or human health. When exposed to air, due to drainage or disturbance, however; oxidation occurs and these soils produce sulphuric acid, often releasing toxic quantities of iron, aluminium and heavy metals. If the water table is lowered or excavations result in soils becoming exposed to the air, then management is required in accordance with ASSMAC and NSW OEH Guidelines.

1.3 Project Overview

The proposed mixed use redevelopment of the Cronulla Sutherland Leagues Club site including a new neighbourhood retail centre, residential development and upgrades to the sports facilities, including the Toyota Stadium, will create a long term sustainable and viable solution for the Club. Also creating a new centre and destination location that meets the needs of the surrounding community. The Concept Plan prepared for the Site is seeking to develop the Site in three (3) stages, being:

- **Stage 1** — New Neighborhood Retail Centre, Medical and Commercial/Retail facilities on the eastern car park site and redevelopment of the Leagues Club facilities;
- **Stage 2** - Residential Master Planned Estate on the western car park and field area; and,
- **Stage 3** - Extension and improvement of the Cronulla Sharks playing field facilities including grandstand extensions.

DLA Environmental understands that the proposed re-development is likely to include utilising the capped areas of the east and west sections of the Site. It is considered likely that the buildings will be constructed on piles. All car parking will be above ground and there will be no significant excavation of the Site.

Refer to **Figure 2** – Site Stage Layout.

2.0 SITE CONDITIONS PRIOR TO EXCAVATION

2.1 Location

The Site is located on the northern side of Captain Cook Drive approximately 1.5 kilometres from Caringbah (to the south west) and 2 kilometres from Cronulla (to the south east). The site is bounded by the Solander playing fields to the west, Woolooware Bay to the north, and a Service Station and Gymnasium to the east. The Woolooware Golf Club and the Captain Cook Oval are located to the south of the site across Captain Cook Drive.

The overall site is irregular in shape with an area of approximately 10.0 hectares, of which approximately 6ha is occupied by Toyota Stadium, Leagues Club building and the eastern car park and 4ha is occupied by the western training fields and car park. Toyota Stadium (also known as Endeavour Field and Shark Park) and the Cronulla Sutherland Leagues Club building occupy the central portion of the site, and represent a major community and entertainment hub within the region. The western playing fields within the site are private open space used as training fields for the Cronulla Sharks and for local games by the Cronulla Caringbah Junior Rugby League Football Club, whilst the remainder of the site is occupied by car parking.

Refer to **Figure 1** – Site Location.

2.2 Geology, topography and soil

The 1:100,000 geological map of Wollongong-Port Hacking (Map 9029-91 29, 1:100,000 Department of Mineral Resources —1985) indicates the site to be underlain by manmade fill which typically consists of dredged estuarine sand and mud, coal washing, industrial and household waste. The fill is typically underlain by Quaternary aged deposits of organic rich, mostly “muddy” marine sand with Hawkesbury Sandstone at greater depths.

The regional topography falls gently towards Woolooware Bay to the north, apart from the golf course to the south of Captain Cook Drive that was generally at a lower level than the site. Sections of the site appear to have been filled above surrounding levels including the spectator areas. Regional drainage patterns are generally toward Woolooware Bay to the north via a storm water channel located between the east and west sections of the Site. Due to previous grading of the Site some sections drain locally toward Captain Cook Drive toward the south rather than Woolooware Bay. An easement for transmission lines is located across the north section of the Site.

3.0 PREVIOUS ASS ASSESSMENTS

Previous soil contamination assessments have been carried out, from 1994 to present, on the Site. Investigations were undertaken to develop an understanding of the soil profile and potential contamination present on Site. Due to the proximity of the Site to the coast, it was likely that Acid Sulphate Soils would be present, with laboratory analysis of soil samples for Acid Sulphate Soils undertaken. This management Plan has considered results and findings from the previous investigations in developing an appropriate strategy. For detailed presentation of ASS results across the Site, the following documents should be referred to in conjunction with this management Plan:

- Environmental Investigation Services (EIS) (2000) – *Report to Cronulla Sharks Rugby League Club on Environmental Site Screening for Shark Park Redevelopment at Cronulla Leagues Club, Captain Cook Drive, Woolooware*. Report ID E15009FRPT/2, dated 29th November 2000;
- Environmental Investigation Services (2002) – *Report to Cronulla Sutherland Leagues Club Limited on Further Environmental Site Assessment for Proposed Cronulla Leagues Club Rezoning at Captain Cook Drive, Woolooware.* Report ID E17119FKRPT, dated October 2002;
- Environmental Investigation Services (2006) – *Report to Cronulla-Sutherland District Rugby Leagues Football Club on Environmental Site Assessment for Proposed Upgrade works at Toyota Park, 461 Captain Cook Drive, Woolooware.* Report ID E20345FJ-RPT; dated August 2006,
- Environmental Investigation Services (2012) – Conceptual Acid Sulphate Soil Management Plan, C*ronulla Sharks Redevelopment, 461 Captain Cook Drive, Woolooware.* Report ID E20345Klrt3 rev 1, dated 17 May 2012.

All reports identify the presence of Potential Acid Sulphate Soil (PASS) to be present on Site within natural estuarine silty clays.

4.0 ASS RISKS AND IMPACTS

4.1 Construction Activity

The following activities may have an impact on ASS soils during construction of the project infrastructure:

- Excavations by surface trenching for services.
- Piling Excavations for Building support; and,
- Groundwater dewatering.

4.2 Potential Environmental Impacts

The following consequences need to be considered during construction in an acid sulphate soil environment:

- Exposure and oxidation of excavated material and the consequent discharge of acidic groundwater and continued acid leachate.
- Release of acidic subsurface water during the excavation.
- The ongoing oxidation of excess ASS generated by the piering excavations and the consequent generation of acidic groundwater.

Effective control of these potential impacts including adequate identification and appropriate management and monitoring programs will ensure such impacts will not occur. An effective monitoring program combined with a planned maintenance program with appropriate contingencies will ensure there is no incremental contribution of acid leachates during construction.

Inadequate identification, management and monitoring will result in detectable incremental impacts. Many aquatic and marine organisms are extremely sensitive to acid drainage; as a result, the acid leachates released may have serious environmental impacts including:

- Dissolved aluminium and iron in acid leachates can be poisonous to fish and aquatic plants and to both aquatic and terrestrial life forms;
- Sulphate salts released can increase the salinity of freshwater; and,
- Acidic sediment may fix phosphates and other nutrients which prevents their uptake by plants.

5.0 MANAGEMENT OF ACID SULPHATE SOIL

5.1 General

The general strategy for the Site is to avoid, where possible, any disturbance of ASS. Excavations at the Site each include an individual risk assessment, which considers the deepest excavation RL levels (services and piling) and relating them to the occurrence of ASS sediments, as determined by investigations referenced in **Section 3.0**. Excavations will also be supervised by a contaminated land manager and, where field testing determines the risk to be significant, analysis will be undertaken to confirm the treatment rate.

It is intended to utilise treated soils as subsurface fill on the Site wherever possible in preference to generating unnecessary waste. Excess material is likely to be generated however; therefore some waste disposal will be required. Where possible PASS soils will be excavated and immediately transported for placement at suitable landfills equipped to receive PASS. Otherwise soils will be treated prior to disposal as General Solid Waste. Field assessment and any subsequent analysis and treatment required, will be in accordance with methods outlined in this Management Plan.

Management strategies, including assessment and recommendation for each Stage, have been provided below. Options include consideration of the potential for environmental effects in the context of treatment, onsite reuse and waste disposal, due to the required disturbance of ASS.

5.2 Risk Assessment

Bulk Excavations – it is not intended that bulk excavation of the Site will be undertaken, due to building design on the Site. Natural soils analysed to be PASS are located in excess of 2 meters below ground level and will not be disturbed.

Piling works will be extended to bed rock through imported fill material and natural clays. Laboratory results indicate that PASS is present and any piling spoil must be placed in a controlled storage area prior to determination of any treatment requirements.

5.3 Monitoring and Assessment

Following the collection of any generated piling spoil in a designated storage area, as described in **Section 5.4**, additional testing will be required to be carried out to determine specific liming rates for the volume of material collected.

Analysis of the soil following treatment of lime will also be undertaken to ensure neutral pH conditions have been achieved. Results obtained will be compared with background levels to establish the success of control procedures implemented during the construction activities. The leachate generated by the acid sulphate storage area shall be sampled and discharged subject to compliance with water discharge requirements.

5.3.1 Laboratory Analysis

Standard approved methods have been developed for routine laboratory analysis of soil samples. The approved methods include:

SPOCAS – Suspension Peroxide Oxidation Combined Acidity and Sulphate

The SPOCAS Method is in accordance with the *Acid Sulphate Soils Laboratory Methods Guidelines, ASSMAC, Wollongbar NSW.*

For assessment purposes, and for the development of effective management strategies, Total Oxidisable Sulphur (TOS) results will need to be complemented with the POCAS method for a fuller understanding of the oxidisable sulphur content of the soil.

The criteria (based on oxidisable sulphur) which should trigger management action are grouped into three (3) broad texture categories in Table 1. For this study, the action criteria for the Fine texture action category were selected on the basis that the soil type most closely resembles the medium clays found in the study area. In order to assess the potential for acid generation the action levels applicable to a disturbance of less than 1000 tonnes has been used.

Table 2 - Action Criteria 1-1000 tonnes disturbed

Texture	Approximate Clay Content	Sulphur Trail S_{pos}%	Acid Trail TPA Mol H^+/tonne
Coarse Texture Sands to Loamy Sands	<5.0%	0.03	18
Medium Texture Sandy Loams to Light Clays	5-40%	0.06	36
Fine Texture Medium to Heavy Clays and Silty Clays	>40%	0.1	62

Texture Range as describe by McDonald et al (1990)

5.4 Treatment Plan

The construction activities associated with the development detailed above may generate specific acid sulphate soil related issues, which will need to be addressed. For environmental purposes, **the highest result by either the sulphur or the acid trail** is generally used as the action criteria unless mitigating factors are established eg: The quantity, fineness and reactivity of neutralising material such as shell etc.

The control procedures set out below are to be implemented in the event that natural materials are excavated and exposed to oxidation. The stated procedures to be implemented for the Project are *conservative* and should ensure that any incremental increase in groundwater and soil acidity should be negligible.

The steps to ensure minimal acid generation and run-off are set out below:

1. Establish an area close to the excavation to store the excavated material. The designated area needs to be plastic lined (two layers) with no leakage at overlaps. Hay bales will provide the surrounds over which the plastic will be covered. This will effectively provide a bunded area;

2. The bunded area should be slightly sloped to encourage water to drain to a lower point and away from the sand and loam;

3. All excavated material where either PASS or AASS are present will be immediately placed in the confined bunded area;

4. The ASS will be spread and immediately treated with natural lime material by way of mechanical mixing. Initial rates calculated by EIS, 2006 indicated that up to 120Kg/tonne of lime will be required to neutralize the PASS soils. Additional testing of bunded stockpiled PASS will be required to determine specific liming rates for the generated materials;

5. The excavated soil will be built up as the excavation proceeds and undergo regular sampling to validate the treatment rates;

6. Water generated from drainage of the sand will be treated with the lime to achieve neutral pH; and,

7. Following treatment and validation, material can be utilized as fill or disposed of as General Solid Waste. Excess material will be disposed of as soon as practical, in accordance with regulatory criteria.

5.5 Contingency Procedures

Contingency procedures that may occur during the project could include:

- Extended rainfall generating excessive water to be analysed, treated (if required) and disposed of prior to installation activities recommencing.

  The control procedures detailed in the plan will accommodate this contingency. The timeframe needed to recover the excessive water may extend the period during which the piling is open increasing the potential for acid generation and therefore requiring more careful consideration.

- Extended Delays due to equipment failure, leaving trenches or excavations and material extracted open to oxidation.

  The control procedure requires the addition of lime sufficient to neutralise the total potential acidity of the excavated waste. A safety factor of 1.5 is included in the calculation of lime required which should ensure sufficient neutralising capacity

should the excavation be open for greater than the planned period.

- Spillage of Acid Sulphate Soil.

Spillage of Acid Sulphate Soils should be collected and transferred to the acid soil storage facility as soon as practicable to ensure surface soil or groundwater is not adversely impacted.

6.0 CONSULTATION

During the development of the Acid Sulphate Soil Management Plan, regard was given to the needs of the following organisations:

- Office of Environment and Heritage (formerly DECCW) concerning their requirements with respect to the various pollution control issues/associated with the project and the detail required in the Acid Sulphate Soil Management Plan;
- Department of Planning (DNR) concerning the extent of ASS in the local region; and,
- Local Government regarding DA Compliance and the handling requirement for ASS situations.

7.0 RECORDS

A file has been established to store all hard copy records associated with Acid Sulphate Soil Management for the project. All analysis and monitoring information will be stored in computer to permit ease of access and manipulation.

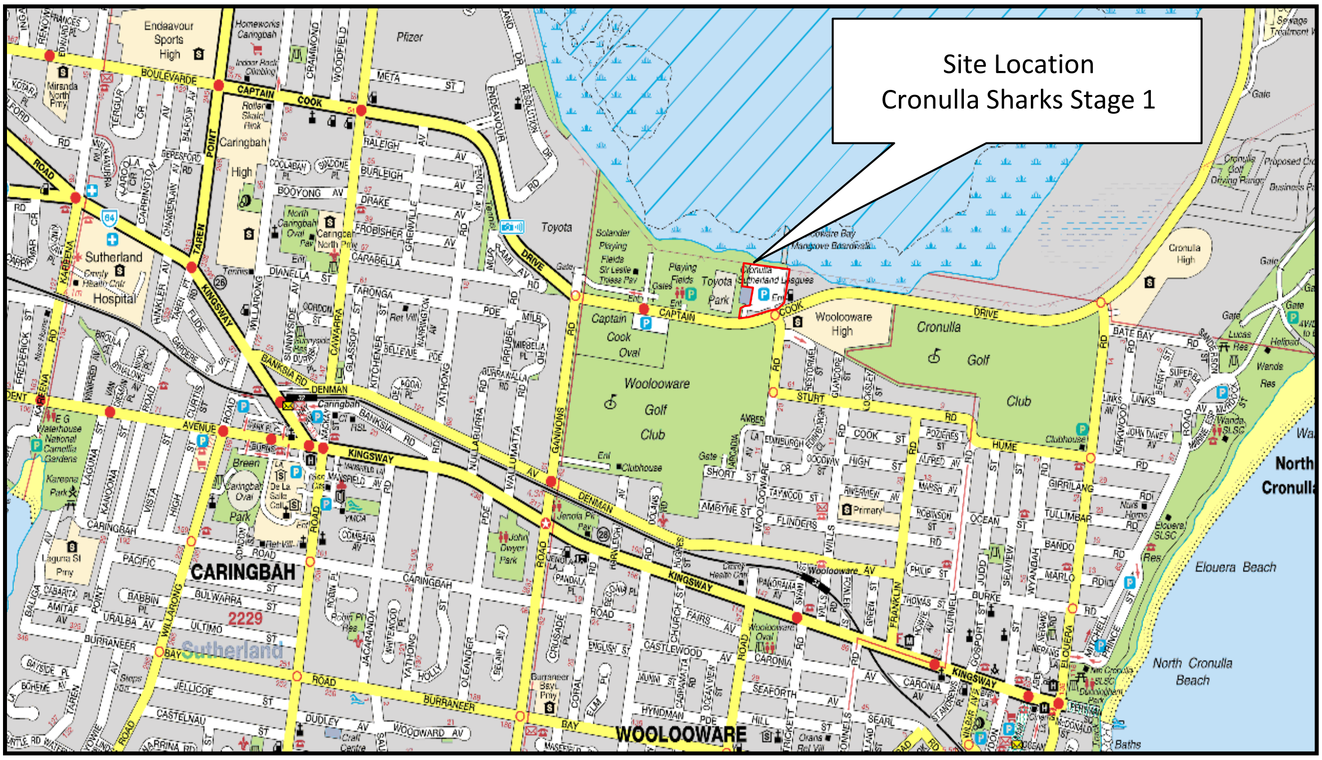
8.0 REFERENCES

Acid Sulphate Soil Manual – ASSMAC August 1998

Acid Sulphate Soils Assessment and Management - Environment Protection Authority, December 1995.

Figure 1

Site Location



DLA environmental Unit 2b/30 Leighton Place Hornsby, NSW 2077	**DESIGNED:** DLA	SITE LOCATION	
	COMPILED: SS	**CLIENT:** Park View Constructions Pty Ltd	**DRAWING:** 18/12/2012
	PROJ. No. DL3007	**LOCATION:** 461 Captain Cook Drive, Woolooware, NSW 2230	**FIGURE:** 1

Figure 2

Planned Development Stage Layout

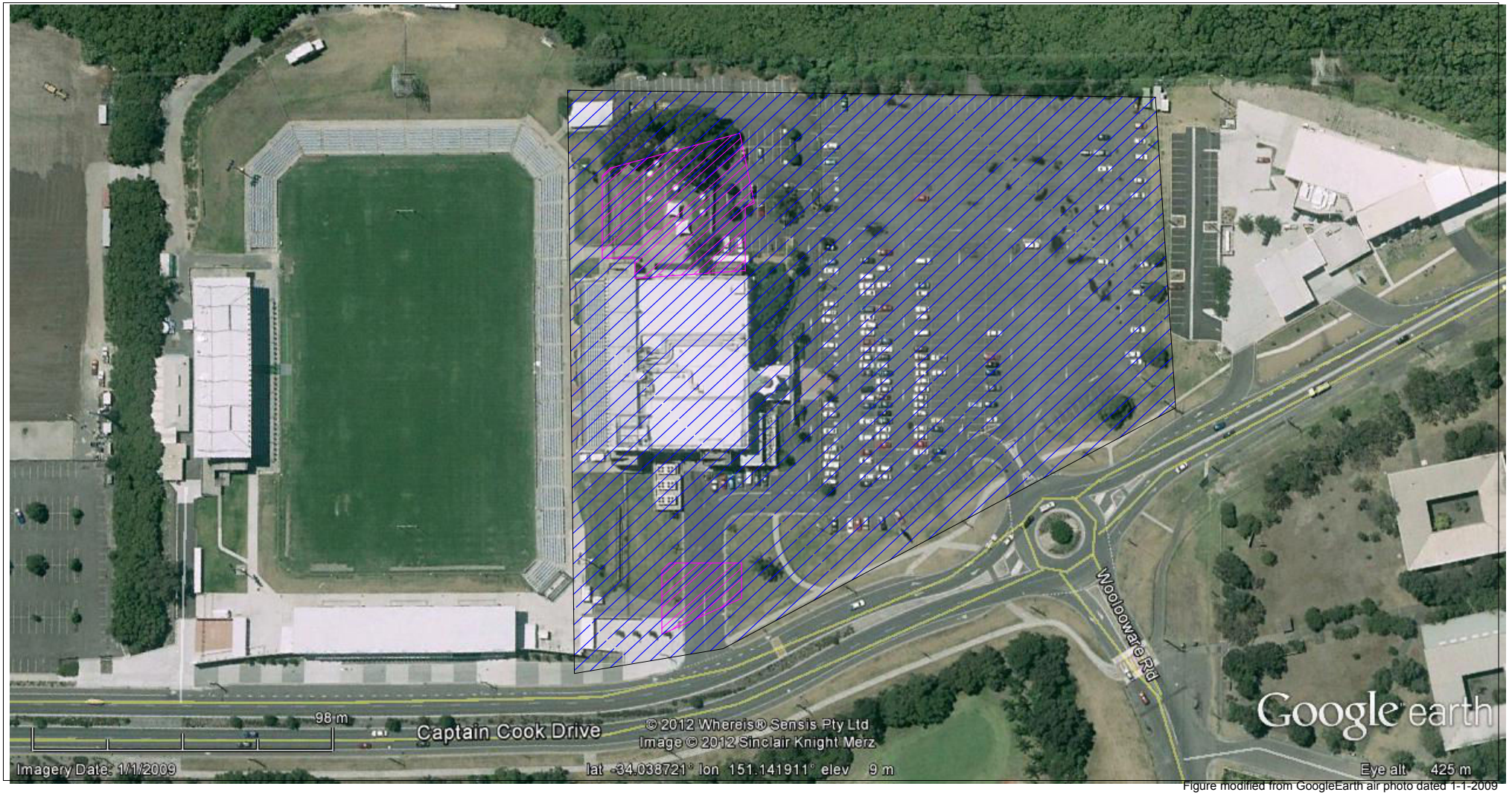


Figure modified from GoogleEarth air photo dated 1-1-2009

Scale (m)

0 25 50

Legend

Commercial/Retail Areas

Stage 1 Area

N

DLA environmental

Unit 2b/30 Leighton Place
Hornsby, NSW 2077

Newcastle Office
Phone (02) 4949 3800
Fax (02) 4949 3811

Sydney Office
Phone (02) 9476 1765
Fax (02) 9476 1557

Title: Stage 1 Site Layout			
Client: Bluestone	Job No: DL3007	Figure No: 2	Date: 29/01/2013
	Scale: As Shown	Sheet: 1 of 1	Revision: R00

Appendix D

Asbestos Management Plan

SITE ASBESTOS MANAGEMENT PLAN

Cronulla Sharks Redevelopment Stage 1 Commercial and Retail Including Car Parking

Lot 11 in DP 526492 461 Captain Cook Drive Woolooware NSW 2230

Rev 0.0

Prepared for:
Bluestone Capital Ventures No.1 Pty Ltd
Level 6, 71 Macquarie Street
Sydney
NSW 2000

Prepared by:
DLA Environmental
DL3007

January 2013

Sydney
Unit 2B 30 Leighton Place
Hornsby NSW 2077
Phone: 9476 1765
Fax: 9476 1557
Email: dlassociates@bigpond.com

Newcastle
PO Box 137
Branxton NSW 2335
Phone: 4938 3800
Fax: 4938 3811
Email: dolane@bigpond.com

ABN 36 926 003 197

1.0 INTRODUCTION

DLA Environmental (DLA) was commissioned by Bluestone Capital Venture No.1 Pty Ltd to prepare a Site Asbestos Management Plan (SAMP) for the re-development works associated with Cronulla Sharks property, part Lot 11 DP526492 461 Captain Cook Drive Woolooware NSW.. Previous Assessments undertaken at the Site have identified asbestos containing materials within the fill materials associated primarily with what is known as the Eastern Car Park Area. A Site Asbestos Management Plan (SAMP) has been prepared which considers the risks to workers from identified asbestos contamination/waste.

Previous assessments of the Site were undertaken by Environmental Investigation Services (EIS) from 1994 through to 2006 of the entire Cronulla Sharks Site. This included Stage 2 which is located to the west of the main stadium. This Stage has been designated for seven hundred (700) residential units, ranging from 8-16 storeys. Asbestos was detected within eighteen (18) of fifty eight (58) samples collected as part of the 2006 Site Assessment within Stage 2.

DLA undertook further investigation in December 2012. DLA noted asbestos fragments associated with the fill layer of the landfill materials. The fragments were located within eight (8) of the fourteen (14) test pits excavated on the Stage 1 area.

All soil samples collected (20) were analysed for the presence of asbestos fibres. One sample, TP14 (0.5 – 1.0) contained the presence of synthetic mineral fibres, however no asbestos was detected at the reporting limit of 0.1g/kg. All other soil samples returned negative results for the presence of asbestos fibres or other fibres. Asbestos fragments were detected in the fill materials of boreholes TP6, TP10, BH11, BH12, BH13 and TP14. Previous environmental assessments conducted indicated that 30% of the Boreholes excavated contained minor asbestos content. Limited numbers of these Boreholes were within the Stage 1 area.

Refer to **Figure 1** – Site Layout with Sample Locations for details.

Although asbestos was present in fibre form, it appears to have originated from a bonded source and no fibres of respirable dimensions were identified.

The SAMP is required to satisfy the *NSW DEC Site Auditor Scheme Guidelines 2nd Edition. 2006* to negate the risk of potential exposure to, or release of, contamination from on-site fill soils. The SAMP is also intended to outline management hierarchy, responsibilities and actions required in the event asbestos contamination is located during development of the Site.

This SAMP has been prepared by DLA for the purpose of ongoing management of the environmental controls that are outlined within this report, to address on site potential asbestos contamination and health risk concerns.. The SAMP is to be submitted to all contractors involved with the development that will impact sub-surface fill soils within the Site boundaries.

The Australian and New Zealand Conservation Council (ANZECC) Guidelines for the Assessment of On-Site Containment of Contaminated Soil, 1999 indicates that any Site Management Plan should clearly identify:

- Environmental objectives;
- Control systems supporting each objective;
- Maintenance requirements for each control system;
- Routine monitoring requirements for each control system;
- Range of acceptable values for monitored parameters
- Action levels which trigger intervention in response to monitoring observations;
- Contingency responses in the event that failure of control systems is identified outside routine monitoring (emergency response);
- A documentation protocol to record maintenance activities, monitoring results, non-conformances, and actions taken to rectify any non-conformance; and
- A reporting procedure to ensure effective communication of information.

This report provides information to address all of the points listed above to ensure the integrity of the remediation strategy for the long term.

2.0 STATUTORY REQUIREMENTS

Guidelines covering asbestos contaminated environments are issued by the WorkCover Authority of New South Wales, and by the Australian Safety and Compensation Commission (ASCC). The latter guidelines are the most relevant to this Project and are recognised as such by all workers in the asbestos field.

Relevant source documents include those detailed below:

- Code of Practice for the Safe Removal of Asbestos [NOHSC:2002 (2005)]
- Code of Practice for the Management and Control; of Asbestos in Work places [NOHSC:2018] (2005)
- Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres [NOHSC:3003 (2005)];

Above all the requirements of the Workplace Health and Safety Act 2011 and the associated regulations under the Act the Workplace Health and Safety Regulations 2011 *Asbestos – Particular Provisions.*

The debate over the friable or bonded nature of asbestos fragment contamination of soils has been ongoing for some time. NSW WorkCover Authority have clarified the situation recently in their documentation *Your Guide to Working with Asbestos 2008.*

The Working with Asbestos Guide concludes the following:

Asbestos in Soils (Contaminated Sites)

- *Asbestos cement fragments on or in the surface layer should be removed as bonded asbestos material.*
- *Where there has been damage to the bonded material so that it has been crushed and become friable this material should be treated as friable asbestos and removed by a friable asbestos removal contractor.*
- *Where the condition of the asbestos material or the extent of contamination has*

not been established, competent Occupational Hygienists should assess the site and determine safe work procedures for the remediation of the site. The assessment and safe work procedure should reflect the level of hazard and the proposed use of the land. Environmental and Planning legislative requirements will also need compliance

- *Buried limpet, lagging or other friable asbestos material is to be treated as friable and removed by a friable asbestos removal contractor.*

3.0 ASBESTOS MONITORING PROGRAM

Project Management in association with the Environmental Hygienist will establish monitoring programs to ensure that all activities undertaken in relation to asbestos comply with relevant exposure limits, standards and guidelines.

Areas of the Stage 1 Re-development area have been identified as containing asbestos in the previous environmental reports and the additional pre-construction assessments completed by DLA Environmental in accordance with the requirements These areas will have specific Safe Work Method Statements (SWMS's) and monitoring programs implemented.

Monitoring requirements will include

- Background Air Borne Asbestos Monitoring prior to the commencement of work within the identified areas;
- Daily Airborne Asbestos Monitoring during all works undertaken within identified areas; and,
- Meteorological monitoring - wind speed and direction during works within identified areas.

The Project Manager will ensure that workers entering the site meet the standards of this Management Plan.

3.1 Airborne Asbestos Criteria

The risk associated with asbestos relates to the inhalation of air borne asbestos fibres. These fibres may be liberated by disturbance of the asbestos containing material.

NOHSC has set air quality criteria. This criterion has been incorporated into the appropriate OH and S Regulations. The exposure standard sets out the time-weighted average (TWA) fibre concentration of the air breathed by the worker throughout a working shift, as calculated from one or more measurements taken over

a sampling period of not less than four hours using the Membrane Filter Method.

The TWA airborne concentrations shall not exceed:

- Chrysotile - 0.1 fibres per millilitre
- Crocidolite - 0.1 fibres per millilitre
- Amosite - 0.1 fibres per millilitre
- other forms of asbestos - 0.1 fibres per millilitre
- any mixture of these, or where the composition is unknown - 0.1 fibres per millilitre.

These values may be reviewed from time to time, therefore the most recent publication of the NOHSC Exposure Standards document [NOHSC: 1003] should be consulted for any variations and in consultation with the latest legislative requirements.

Air sampling is used to determine exposure to airborne asbestos fibres, using a modified version of the Membrane Filter Method (NOHSC, 2005).

Once the below stated air sampling methodology has determined asbestos exposure levels, a level of action is to be taken in response to the recorded levels. These actions are listed below in **Table 1**.

Table 1
Recommended Action Levels for Asbestos Exposures

Measured Fibre Concentration (% of Exposure Standard)	Recommended Action
<0.01 fibres/ml	No action necessary; maintain a low-level baseline air sampling program and Continue with Control Measures
≥ 0.01 fibres per ml	Review Control Measures. Ensure all PPE requirements and Decontamination practices are being complied with in the area. Increase monitoring frequency, focussing on personal exposure monitoring and worker category assessment. Ensure personal exposures are maintained as low as practicable. Investigate workplace/work practices and control measures. Invoke agreed work and management procedures. Implement routine personal monitoring and auditing procedures.
Result ≥ 0.02 fibres/ml	Stop work in the affected area and investigate the cause of elevated results Designate area and take remedial action. Implement formal asbestos management procedures including cease work until such time as asbestos concentrations are acceptable.

It is important that interpretation of these results are undertaken by an experienced person conversant with the Membrane filter method and its limitations, particularly given that the asbestos matrix is soils and dust that may inadvertently positively bias results.

All results of air sampling must be recorded and filed. The results will be reported and made available to all employees.

Auditing procedures should be used as the primary technique to ensure that agreed work and management procedures and control measures are operating effectively.

Airborne Asbestos monitoring will be carried out using the only internationally recognised sampling and analytical methodology - the Membrane Filter Method for Estimating Airborne Asbestos Dust [NOHSC:3003 (2005)].

3.2 Air Sampling Strategy

A preliminary background air sampling investigation is to be conducted areas which have been identified as containing asbestos. The background monitoring will provide baseline concentrations prior to the work commencing and form the basis for more extensive sampling if required.

A colour coding strategy depending on potential for asbestos exposure or the identified presence of asbestos has been formalised for all areas of the Project easement.

White Areas

White Areas are areas not affected by asbestos and have no known potential for asbestos exposures. Airborne asbestos monitoring is not required within these areas.

Grey Areas

The potential for asbestos exposure within grey areas is minor. Areas are classified as grey if a minor unexpected find of asbestos containing material is identified during construction, in accordance with the attached Unexpected Finds Protocol. It is the responsibility of the Site Foreman in consultation with the Project Manager to determine whether airborne asbestos monitoring is required.

As required, during works within these areas, exposure control monitoring will be conducted daily until the area is designated White.

Black Areas

Black areas are areas of known asbestos containing materials where disturbance of asbestos materials is likely. Monitoring will be conducted daily during works within

these areas and will continue until the area is designated White. The monitoring strategy for this area will then apply.

3.2.1 Number of Monitors

The number of monitors used will be as required but as a minimum two (2) samplers within a designated area.

3.2.2 Duration and Location of Monitors

Environmental air monitoring will be undertaken continuously and reported in four (4) hour intervals. These monitoring periods may be varied depending on filter dust loadings but always in accordance with the requirements of the membrane filter method.

The location of monitors will be as follows:

1. On the boundaries of designated asbestos work areas.

2. Within the cabins of representative plant and equipment.

3. Within lunch and amenity facilities.

3.2.3 Sample Result Feedback

Monitoring results will be reported to the Project Manager as soon as possible after the conclusion of the monitoring interval. Results will be readily available and accessible to both management and employees and will be displayed in a prominent position. Every week, the Project Manager will provide a summary of current monitoring results detailing dates of sampling, fibre concentration levels and the date of notification of results to the Project Manager. These results will be communicated to all site personnel.

4.0 RECOMMENDED IDENTIFICATION, CHARACTERISATION AND REMEDIAL PROCEDURES

4.1 Asbestos Management Strategy Overview

Previous Environmental Investigations have identified asbestos containing materials along sections of the Cronulla Sharks Redevelopment. These areas have been categorised into one of three categories depending upon known asbestos content. The soils will be designated **black, grey or white** as outlined below.

- **BLACK:** Asbestos containing materials present, requiring off-site disposal;

- **WHITE:** Soils not impacted, which can be beneficially reused on site;

- **GREY:** Materials that may contain bonded asbestos, but at a very minor concentration and manageable by remediation by an Asbestos Licensed Contractor through hen picking (under DLA supervision). The ultimate aim is to create material suitable for beneficial re-use on site. All remediated grey materials are subject to asbestos clearance certification and, when opportunity exists, are to be placed at a depth of >1.0 metres below final surface levels;

4.2 Excavation Strategy

In the event that asbestos related materials are identified, the procedures below will be implemented.

Prior to any commencement of excavation within areas known to contain asbestos contamination, the surface should be inspected and hen-picked to remove any rogue surface bonded asbestos fragments, therefore minimising cross contamination of the Site (this will not include materials within areas designated as Black). In sealed areas, such as those beneath car parks, this is to be done immediately following the removal of asphalt and sub grade.

4.2.1 Unexpected Finds

Due to the nature of material it is never possible to guarantee every fragment of asbestos containing material has been identified. In the event that soil disturbance uncovers a fragment of an asbestos containing material within areas identified as White, given its bonded matrix and isolated nature; this event would not pose an unacceptable health risk to the property. However all asbestos events should be addressed and for this reason an Unexpected Finds Protocol has been included for future construction activities in this documentation. The Unexpected Finds Protocol should be implemented to address any minor discoveries during the construction activities and planned civil works.

The **Unexpected Finds Protocol** is attached in **Attachment 1**.

4.2.2 White Material

These materials are suitable for re-use on-site without any remediation of treatment. All white material however will be subject to a visual inspection and an Unexpected Finds Protocol. In the event of an unexpected find of asbestos containing material within a White area, the Protocol will allow for assessment to determine whether the materials will be reclassified as either Black or Grey depending upon the nature and volume of asbestos containing materials discovered.

4.2.3 Grey Material

All works within these areas are to be undertaken under the supervision of an Environmental Hygienist.

Unexpected finds of bonded asbestos containing materials classed as ‘minor’ by the unexpected finds protocol will be identified if deemed suitable for remediation as Grey Material. The material will be hen picked in-situ to remove all visible fragments. All works within these areas are to be undertaken under the supervision of an AS2 licensed asbestos removal contractor. Visual clearance will be undertaken by DLA Environmental prior to compaction/placement.

Grey material that fails validation following remedial works (black material), will be classified for off-site disposal at a NSW EPA licensed landfill, utilising the NSW DECC 2009, Waste Classification Guidelines.

The **detailed remedial approach** for *Grey Materials* is outlined below:

4.2.3.1 Essential Requirements

1. Supervision by an Environmental Hygienist and Project Manager;
2. The presence of an AS2 Asbestos Removal Contractor;
3. Notification to WorkCover and a Permit obtained;
4. Licensed transporters for removed materials;
5. Licensed landfill to receive material;
6. Personal protective equipment including disposable overalls and respiratory protection;
7. Inspection of excavation and transport machinery prior to exiting contaminated area;
8. Dumping certification from landfill; and,
9. Airborne asbestos monitoring.

4.2.3.2 Responsibilities

1. The Project Manager is to ensure the transporters of the asbestos contaminated material carries an appropriate environment protection license;
2. The Project Manager is to ensure the disposal landfill facility is appropriately licensed to receive the waste;

3. Appropriate personal protective equipment is readily available;

4. The Project Manager to ensure all infrastructure to conduct the works are in place;

5. Ensure dumping certificates are received from the transporter indicating correct tonnages;

6. The work area is identified and secured to prevent unauthorised access;

7. The Environmental Hygienist is to provide Supervision of works to ensure correct procedures are implemented;

8. The Environmental Hygienist is to provide airborne asbestos fibre monitoring throughout the process;

9. The Environmental Hygienist to provide Clearance Certification prior to allowing unrestricted access and works to re-commence in the area.

4.2.3.3 Procedure

1. All operators are to be suitably protected during all sorting, inspection and removal practices.

   Personal protection must include:

   - disposable overalls
   - respiratory protection
   - safety boots
   - hard hat
   - enclosed cabin equipment;

2. The identified areas of minor contamination (grey material) are to be investigated in accordance with the Unexpected Finds Protocol and any asbestos contaminated materials are to be removed and disposed of at an appropriately licensed landfill. All visible asbestos fragments are to be identified and removed

by a Class 2 Asbestos Removalist. The procedure involves extensively hen-picking the material, obtaining visual clearance, re-turning the materials, repeat hen-picking and obtaining final clearance by way of visual inspection and airborne asbestos monitoring. Works undertaken under supervision and consultation with Environmental Hygienist.

3. Plant operators are to remain inside vehicle during the operation. The excavator air-conditioning is to be on recycle only or switched off;

4. Unauthorised access is to be prevented to this area;

5. On completion of the treatment and asbestos detailing process the materials are ready for asbestos clearance assessments prior to chemical classification and ultimately re-use on-site;

If to be beneficially re-used on-site the *grey materials* should be placed at the lower depths with *white materials* at surface levels. This is seen only as a precautionary measure and is not necessary if material handling procedures does not allow this practice in certain areas.

If the materials are to be removed from site this will be undertaken in accordance with the DECCW Waste Classification Guidelines 2009.

Remediation works are planned for commencement following appointment of an appropriate Contractor with Class AS2 capabilities, notification and the obtaining of the relevant work permits from WorkCover Authority.

4.2.4 Black Material

All works within these areas are to be undertaken under the supervision of an AS2 licensed asbestos removal contractor and Environmental Hygienist. These are materials deemed unsuitable for remediation, suitable only for waste classification according to the NSW DECC 2009, Waste Classification Guidelines, for off-site disposal at an NSW EPA licensed landfill.

If an area is designated as Black, the materials will be chemically assessed and loaded directly into trucks for off-site disposal at a suitably licensed facility. Dockets issued by the land fill facility will be collected.

If existing data obtained from previous reports is insufficient, it is proposed the stockpiled waste will be sampled with a frequency of approximately 1 per 100m^3 or 1 per 180 tonnes, with 1/10 samples having intra-laboratory duplicates, and 1/20 samples having inter laboratory duplicate samples collected for sampling QA/QC in accordance with the NSW DECC 2008, *Waste Classification Guidelines*.

It is feasible to contain detected contaminants (Black Materials) on-site provided all conditions relating to storage, placement and final land-use can be addressed.

Outlined below are the responsibilities and procedures to be employed during **the direct off-site disposal** of the contamination *(black)* materials, if required.

4.2.4.1 Essential Requirements

1. Licensed transporters for material;
2. Supervision by a Class 2 Licensed Asbestos Removalist;
3. Notification to WorkCover and a Permit obtained;
4. Licensed landfill to receive material;
5. Personal protective equipment including disposable overalls and respiratory protection;
6. Inspection of excavation and transport machinery prior to exiting contaminated area;
7. Dumping certification from landfill; and,
8. Airborne asbestos monitoring.

4.2.4.2 Responsibilities

1. The Project Manager is to ensure the transporter of the asbestos contaminated material carries appropriate environment protection license;

2. The Project Manager is to ensure the disposal landfill facility is appropriately licensed to receive the waste;

3. Appropriate personal protective equipment is readily available;

4. The Project Manager to ensure all infrastructure to conduct the works are in place;

5. Ensure dumping certificates are received from the transporter indicating correct tonnages;

6. The work area is identified and secured to prevent unauthorised access;

7. The Environmental Hygienist is to provide Supervision of excavation to ensure correct quantities are removed;

8. The Environmental Hygienist is to provide airborne asbestos fibre monitoring throughout the process;

9. The Environmental Hygienist to provide Clearance Certification prior to allowing unrestricted access and works to re-commence in the area;

10. The Environmental Hygienist is to ensure the trucks are appropriately lined and the operation is kept wet at all times.

4.2.4.3 Procedure

1. All operators are to be suitably protected during excavation and truck loading practices.

Personal protection must include:

- disposable overalls
- respiratory protection
- safety boots
- hard hat;
- enclosed cabin equipment;

2. The identified areas present on the site are to be excavated and the asbestos contaminated materials are to be removed from the site and disposed of at an appropriately licensed landfill. Excavation is to continue until such time as DLA Environmental is satisfied the contamination has been removed;

3. Trucks arriving in the loading area are to use the designated roadways only and park in designated areas;

4. Drivers are to prepare the truck for receival of material before entering the loading area ie. tarps pulled back, plastic lined etc;

5. The truck driver is to remain inside his vehicle during the loading operation. The truck air-conditioning is to be on recycle only or switched off;

6. The truck after loading may transport the material to a suitable area for the load to be secured and any spillage removed from the truck body;

7. The operation is to be kept wet at all times;

8. Unauthorised access is to be prevented;

9. At least two operators should be involved in the truck loading operation. One operator to drive the loading equipment whilst the other operator remain adjacent continuously wetting the material by hose;

10. On completion of the truck loading operation the load is to be wetted thoroughly;

11. The removalist operator should cover the load with plastic;

12. Material inadvertently spilt on the ledges of the truck or truck sides are to be washed off prior to the truck leaving the area. This material is to be included in the last load of the disposal process;

13. On completion of the work the operators should hose down the loading equipment and place this material in the last load at the same time washing the bucket into the truck;

14. The truck may then move to a queuing area to cover the load prior to leaving the site;

15. On completion of the work the operators should move to the decontamination facility, remove their disposable overalls and bag them for disposal in the last truckload. Respirators can then be removed.

16. Airborne asbestos monitoring at the boundary and facilities ie lunchrooms etc is to be conducted during all operations, and;

17. A clearance inspection is conducted following the disposal exercise to ensure all contaminated material has been removed.

4.2.4.4 Off-Site Disposal of Asbestos Contaminated Materials

Landfill disposal is the simplest of all remediation methods, and involves the loading out of the contaminated materials, and disposal off-site to a NSW EPA approved landfill disposal site with appropriate environmental safeguards.

EPA permits disposal of contaminated material subject to an approval process. The EPA document “Classifying Waste” sets out the methodology for assessing and classifying wastes to be disposed to landfill. Essentially, wastes are classified into four (4) groups:

General Solid (putrescible/non-putrescible), Restricted, Hazardous and Special Waste

Any material classified as *black* is contaminated with bonded asbestos fragments and therefore in accordance with Schedule 1 Part 3 of the Operations Act is classified as Special Waste. In accordance with Table 7: Disposal of Special Waste is suitable for disposal at landfill licensed to accept bonded Asbestos materials.

Figure 1

Site Layout with Sample Locations

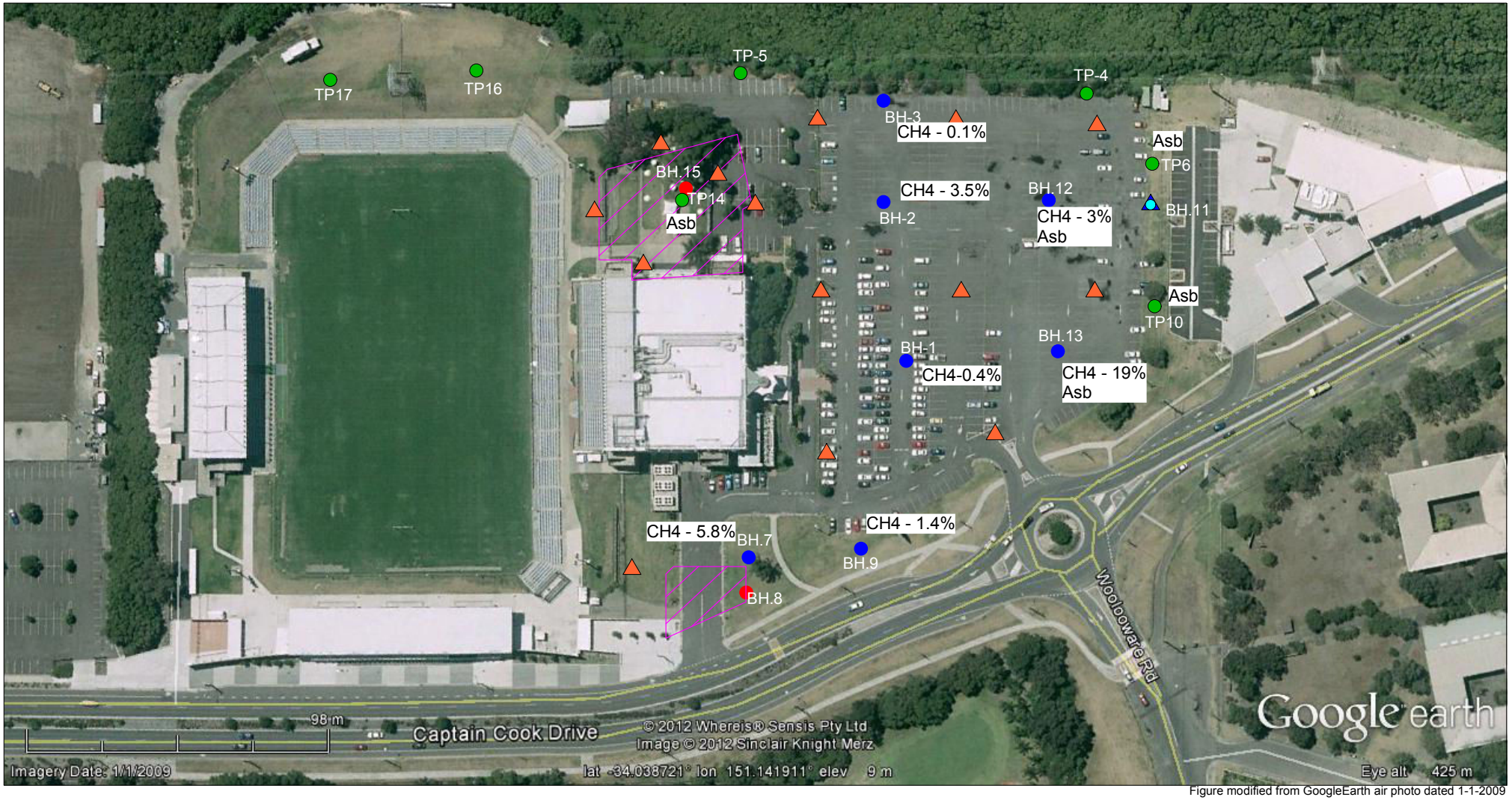


Figure modified from GoogleEarth air photo dated 1-1-2009

Scale (m)

0 25 50

Legend

- Previous Investigation Locations (13)
- Groundwater Well (1)
- Approximate Location of new retail buildings
- Gas & water well location (2)
- Bore hole location (14)
- Test pit location (8)

N

DLA environmental
Unit 2b/30 Leighton Place
Hornsby, NSW 2077

Newcastle Office
Phone (02) 4949 3800
Fax (02) 4949 3811

Sydney Office
Phone (02) 9476 1765
Fax (02) 9476 1557

Title: Site Layout with Sample Locations

Client:	Job No:	Figure No:	Date:
Bluestone	DL3007	1	29/01/2013
	Scale: As Shown	Sheet: 1 of 1	Revision: R00

Attachment 1

Unexpected Finds Protocol

Bluestone Capital Ventures No.1 Pty Ltd

Cronulla Sharks Re-development

Unexpected Find of Asbestos Containing Material

PROTOCOL

Listed below are the steps that need to be followed in the event of an unexpected discovery of suspected asbestos containing materials during the Construction Works associated with Stage 1 Cronulla Sharks Re-development

This protocol is to be kept on-site in an accessible location for all operators to read with its contents included in the on-site or pre-works “tool box” meeting.

➢ SUSPECTED ASBESTOS MATERIAL UNCOVERED

1. Cease disturbance of the material and leave the immediate area.

2. Contact the Site Foreman or appropriate Manager.

3. Foreman to conduct an assessment of the location of the suspected asbestos containing material taking into consideration possible asbestos matrix and quantity of material.

   ie. if the quantity is small the Foreman initiates a cleanup using appropriate personal protective equipment and procedures.

4. If Foreman decides the material and quantities warrants further investigation the area is to be barricaded off to provide a ten (10) metre exclusion zone. Work can recommence in adjacent areas outside the exclusion zone.

5. The Foreman arranges with his Manager to organise a further qualified assessment of the suspected materials by the Environmental Hygienist.

6. Visual assessments and samples collected by a suitably qualified Environmental Hygienist. Samples sent to a NATA registered laboratory for analysis.

➢ CONFIRM PRESENCE OF ASBESTOS BY VISUAL OR ANALYSIS?

YES – Conduct asbestos clean-up utilising accepted practices in accordance with the NOHSC Code of Practice and Particular Provisions of the OHS Regulation 2011.

- Conduct visual Clearance Inspections and Airborne Asbestos Monitoring.
- If both inspections and monitoring are acceptable the barricades can be removed and resume work notification instructed.
- Complete the Asbestos Incident Report form and forward to appropriate Management.

NO - Remove the barricades and resume work.

Bluestone Capital Ventures No.1 Pty Ltd

Cronulla Sharks Re-development

Asbestos Incident Report

Report Number_____

Date of Incident_____

Time of Incident_____

Location of Incident_____

Details of Incident:

_____
_____
_____
_____
_____
_____
_____
_____
_____

Classification of Incident (Circle) Minor asbestos Incident

Major Asbestos Incident

Breach of Regulations

Regulatory Involvement

Immediate Action Taken:

_____
_____
_____
_____
_____
_____

Signed:_____ Date:_____