APPENDIX 6

Draft Remediation Action Plan

Remedial Action Plan

DRAFT

Barangaroo Delivery Authority

Barangaroo Headland Park
Hickson Road, Sydney, NSW

February 2011
JBS41181-16382 (Rev F)
JBS Environmental Pty Ltd

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List of Abbreviations

A list of the common abbreviations used throughout this report is provided below.

- As Arsenic
- Cd Cadmium
- Cr Chromium
- Cu Copper
- BTEX Benzene, Toluene, Ethylbenzene and Xylenes
- B(a)P Benzo (a) pyrene
- DECCW NSW Department of Environment Climate Change and Water
- DoP NSW Department of Planning
- DP Deposited Plan
- DQO Data Quality Objectives
- EPA NSW Environment Protection Authority
- HHERA Human Health and Ecological Risk Assessment
- Hg Mercury
- HIL Health Based Investigation Level
- LOR Limit of Reporting
- LTEMP Long Term Environmental Management Plan
- MAH Monocyclic Aromatic Hydrocarbon
- Ni Nickel
- OCP Organochlorine Pesticide
- OoW NSW Office of Water
- PAH Polycyclic Aromatic Hydrocarbons
- Pb Lead
- PIL Phytotoxicity Based Investigation Level
- PCB Polychlorinated Biphenyls
- PQL Practical Quantitation Limit
- QA/QC Quality Assurance/Quality Control
- REMP Remediation Environmental Management Plan
- ROHSMP Remediation Occupational Health and Safety Management Plan
- SWC Sydney Water Corporation
- TPH Total Petroleum Hydrocarbons (C_6-C_9 and C_{10}-C_{36})
- VOC Volatile Organic Compound
- Zn Zinc

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Definitions

For the purposes of this document, the following definitions apply:

- "Barangaroo Site" – refers to Lots 1, 3, 5 and 6 of Deposited Plan (DP) 876514.
- "Barangaroo Project Site" – refers to the Barangaroo Site, as defined in this RAP, and adjoining parts of Sussex Street, Hickson Road and Towns Place.
- "Declaration Area" - refers to the part of the Barangaroo Project Site which is the subject of the declaration of Significantly Contaminated Land by the NSW DECCW under the *Contaminated Land Management Act 1997* (Declaration Number 21122, Area Number 3221, dated 6 May 2009.
- "Early Works" – refers to those Early Works described in the Preliminary Environmental Assessment report, prepared by MG Planning Pty Ltd.
- "Headland Park and Northern Cove RAP" – refers to this Remedial Action Plan (RAP) for the Early Works and Main Works phases of the creation of Headland Park and Northern Cove, prepared by JBS Environmental Pty Ltd.
- "Headland Park Site" – refers to Lot 1 and Part Lot 5 of DP 876514 located at the northern portion of the Barangaroo Site, including land within the Northern Cove area above 1m AHD.
- "Headland Park HHERA" – refers collectively to the Human Health Risk Assessment and Ecological Risk Assessment for the Headland Park Site, prepared by JBS Environmental Pty Ltd, February 2011.
- "Imported Materials" – refers to fill/soil/rock materials imported onto the Headland Park Site as part of the remediation works, sourced from land other than the Barangaroo Project Site, as defined in this RAP.
- "Main Works" – refers to all other works associated with the creation of Headland Park that are not included in the Early Works, as defined in this RAP.
- "Overarching RAP" – refers to the Overarching RAP for the whole Barangaroo Project Site, prepared by ERM Australia Pty Ltd.
- "Risk-based Criteria" – refers to the criteria established in the Headland Park HHERA, which form part of the Site Acceptance Criteria, as defined in this RAP.
- "Site Acceptance Criteria" – refers to the criteria nominated in this RAP which define the suitability, or otherwise, of materials being accepted onto the Headland Park Site.
- "Site Materials" – refers to fill/soil/rock materials sourced from land within the Barangaroo Project Site, as defined in this RAP.
- "Stage 1 Development" – refers to the southern part of the Barangaroo Project Site, which will be developed for commercial/residential/open space uses.

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- "Tar Containing Material" – refers to material that contains:
  - more than 10% (volume/volume based on visual assessment) of coal tar (where coal tar is a phase separated hydrocarbon by-product from coal gasification); and
  - Contaminant concentrations exceeding the following limits:
  - Polycyclic Aromatic Hydrocarbons (PAHs) – 2000 mg/kg; or
  - Benzo(a)Pyrene (B(a)P) – 150 mg/kg.
- "Treated Tar Containing Material" – refers to material that was Tar Containing Material, but which has been stabilised using a substance or substances in a manner which does not result in any destruction of PAHs.
- "Former Tar Containing Material" – refers to material that was Tar Containing Material, but which has been treated by one or more chemical and/or physical processes which destroy PAHs so that the materials are no longer Tar Contaminated Materials.

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Executive Summary

Introduction

JBS Environmental Pty Ltd (JBS) was commissioned by the Barangaroo Delivery Authority (BDA) to prepare a Remedial Action Plan (RAP) for the Headland Park portion of Barangaroo located at Hickson Road, Sydney, NSW, 2000 (**Figure 1**).

This RAP applies only to the Headland Park portion of the Barangaroo Site. In this RAP, Headland Park - including areas above 1m AHD within the proposed Northern Cove - is referred to as the "Headland Park Site" and the entire Barangaroo Site is referred to as the "Barangaroo Site", whilst the "Barangaroo Project Site" includes the Barangaroo Site and the adjoining parts of Sussex Street, Hickson Road and Towns Place. The southern part of the Barangaroo Project Site, referred to as the "Stage 1 Development", will be developed for a mixture of commercial, residential and open space uses. The locations of the various parts of the Barangaroo Project Site, including the boundary of the Headland Park Site which is the subject of this RAP, are shown on **Figure 2**.

Summary of Contamination Issues

Previous environmental investigations conducted on the Headland Park Site have identified limited soil contamination, being restricted to Total Petroleum Hydrocarbon (TPH), Polycyclic Aromatic Hydrocarbon (PAH) and metal impacted fill materials, primarily around former Warehouse 3. No significant groundwater contamination has been identified on the Headland Park Site.

Whilst this RAP primarily relates to the remediation of contamination within the Headland Park Site, suitable Site Materials from other parts of the Barangaroo Project Site are proposed to be relocated onto the Headland Park Site, in order to recreate the naturalistic Headland Park landform. This RAP therefore gives consideration to the broader contamination issues on the Barangaroo Project Site and outlines the procedures for the acceptance of other Site Materials onto the Headland Park Site.

The contamination issues identified across the broader Barangaroo Project Site are principally associated with fill materials, natural soil and groundwater within the footprint of a former gasworks (located on the Stage 1 Development), namely:

- TPH, Benzene, Toluene, Ethylbenzene & Xylene (BTEX) and PAH impacted fill materials, soils and groundwater;
- Cyanide impacted fill materials, soil and groundwater;
- Phenol and ammonia impacted fill materials, soil and groundwater;
- Minor quantities of asbestos impacted fill materials; and
- Metal impacted fill materials, soil and groundwater (lead, cadmium, copper & zinc).

The footprint of the former gasworks has been declared by the NSW Department of Environment Climate Change and Water (DECCW) as a Remediation Site and is referred to in this RAP as the "Declaration Area". The Declaration Area is not within the Headland Park Site.

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The estimate of required remediation has been detailed in JBS (2011c)[1] to take into account the results of additional environmental assessment completed by Douglas Partners Pty Limited (DP) in December 2010 (DP 2010a and 2010b).

The additional environmental assessment was based on the Sampling, Analysis and Quality Plan (SAQP) (JBS 2010)[2]. This environmental assessment applied only to the Headland Park portion of the Barangaroo Site.

Objectives

The objectives of this RAP are:

- to document the procedures and standards to be followed in order to remove the risks posed by contamination at the Headland Park Site to future site occupants and the surrounding environment (including both human and ecological receptors);
- to document the procedures and standards to be followed in order to ensure the suitability of Site Materials relocated from the broader Barangaroo Project Site onto the Headland Park Site; and
- to enable a Site Audit Report and Site Audit Statement(s) to be prepared by the appointed independent DECCW Accredited Site Auditor, confirming that the Headland Park Site can be made suitable for the proposed uses subject to the successful implementation of the proposed remedial/management measures.

An Overarching RAP (ERM 2010) has been prepared for the Barangaroo Project Site that makes reference to the preparation of individual RAPs and Remedial Work Plans (RWPs) for various elements of the Barangaroo Project Site.

This RAP for the Headland Park Site, including the Northern Cove, is one of the individual RAPs required to be prepared by the Overarching RAP. The RWP for the Headland Park Site will be prepared by the Remediation Consultant (JBS) following endorsement by the Site Auditor of final Headland Park HHERA and RAP.

The Proposed Development/Current Design

The Headland Park Site is proposed to be developed into a naturalistic headland that will simulate the shoreline as it was in 1836. Establishment of the naturalistic headland will involve shaping of the shoreline through the extraction of approximately 150 000 m^3 of fill materials within or behind the existing caissons and seawall that form the western and northern current boundaries of the Headland Park Site. The Headland Park Site is proposed to include the following elements:

- A substantial open area of sloped parkland over the majority of the Headland Park Site provided with a network of pathways and plantings formed by a substantial filling program achieved;
- A submerged area at the south known as Northern Cove;
- A modified shoreline throughout the perimeter of the Headland Park Site;

[1] *Pre-Early Works Additional Environmental Assessment, Headland Park, Barangaroo, Sydney NSW*, JBS Environmental, January 2011 (JBS 2011c).

[2] *Sampling Analysis and Quality Plan, Pre Early Works Additional Environmental Assessment, Barangaroo Delivery Authority, Barangaroo Headland Park and Northern Cove, Hickson Road, Sydney NSW*, JBS Environmental, October 2010 (JBS 2010).

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- A multi-level Car Park as constructed within a space created within the filling used to form the Headland Park Site; and
- A 'Cultural Facility' as constructed above the Car Park and also substantially contained within a space created within the filling used to form the Headland Park Site.

Extent of Remediation Required

The currently anticipated extent of in-situ contamination requiring remediation at the Headland Park Site shown in **Figure 13** by orange shading depicting soils considered inappropriate for use within 0.5 m of the final park surface. This is an approximate quantity of 1000 m^3. The soils as identified on **Figure 13** and shown by blue shading, present over an approximate area of 6 000m^2, are considered inappropriate for use as growing medium.

In addition, a minor, isolated and localised area of tar impact was identified during geotechnical investigations at sampling location shown as JBS312A on **Figure 13**. Based on visual observations recorded on the borehole log, it is anticipated that this comprises an approximate quantity of 100 m^3.

Groundwater sampling and analysis has not indicated that significant groundwater impact is present underlying the Headland Park.

Remediation / Management Approach

With consideration to DECCW's hierarchies for remediation, and to the site-specific contaminants and environmental setting, the following remediation/management approach has been adopted for the Headland Park Site:

Demolition and Earthworks

- On-site reuse/placement of impacted fill materials generated as part of the site excavations, and including any materials from the broader Barangaroo Project Site that meet the Site Acceptance Criteria established in this RAP. No highly impacted gasworks-related fill materials from within the Stage 1 Development will be accepted on the Headland Park Site.

Sewer Upgrade Work

- On-site reuse/placement of excavation materials generated as part of the sewerage upgrade works, but excluding any highly impacted gasworks-related materials from the Barangaroo Project Site. The risk of encountering highly impacted gasworks-related fill materials is considered to be low.
- Characterisation and off-site treatment and/or disposal at licensed waste facilities, of materials generated as part of the sewerage upgrade works which do not meet the Site Acceptance Criteria.
- Characterisation and release to either stormwater, or sewer or off-site disposal of groundwater collected during the excavation of the sewage overflow storage.

Sandstone Extraction Program

- On-site reuse/placement of impacted fill materials generated as part of the sandstone extraction program.
- On-site testing of collected groundwater during the sandstone extraction program, followed by release to stormwater in accordance with regulatory requirements.

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Remediation Works within Headland Park Site

- Excavation of "hotspots" of contaminated soils, followed by on-site management in accordance with the requirements established in the Headland Park HHERA (JBS 2011a and 2011b);
- Excavation of "hotspots" of contaminated soils, followed by classification and off-site disposal of materials which are not able to be managed on-site in accordance with the requirements established in the Headland Park HHERA (ibid); and
- (Likely) ongoing monitoring of groundwater.

Receipt and Placement of Materials from the broader Barangaroo Project Site

- On-site reuse/placement of impacted fill material sourced from the broader Barangaroo Project Site that are demonstrated to meet Site Acceptance Criteria established in this RAP to form part of the naturalistic headland.
- On-site management in accordance with the provisions contained in the Headland Park HHERA (ibid) and the associated engineering controls required to be documented and included in the RWP for the Headland Park Site, which include seepage water prevention, collection and treatment.

Where materials are reused on the Headland Park Site, then this will require ongoing management via the development and implementation of an appropriate Long Term Environmental Management Plan (LTEMP), which will be prepared upon completion of the validation report. A validation program has been developed to verify that the remediation works achieve the intended objectives.

Conclusions

Overall, it is considered that the proposed actions outlined in this RAP conform to the requirements of the *Contaminated Sites Guidelines for the NSW Site Auditor Scheme (2nd Edition)* (DEC 2006) because they are: technically feasible; environmentally justifiable; and consistent with relevant laws policies and guidelines endorsed by NSW DECCW.

Subject to the successful implementation of the measures described in this RAP and the recommendations below, it is concluded that the Headland Park Site can be made suitable for the intended uses and that the risks posed by contamination arising from the creation of Headland Park and Northern Cove can be managed in such a way to as to be adequately protective of human health and the environment.

Recommendations

It is recommended that the processes outlined in this RAP be implemented and that the following documentation be developed and implemented to ensure the risks and impacts are controlled in an appropriate manner:

- A Remediation Environmental Management Plan (REMP), to document the monitoring and management measures required to control the environmental impacts of the works and ensure the validation protocols are being addressed;
- A Remediation Occupational Health and Safety Management Plan (ROHSMP), to document the procedures to be followed to manage the risks posed to the health of the remediation workforce; and
- A Remediation Work Plan (RWP), to detail the precise remediation works to be undertaken following:

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- Review and endorsement by the Site Auditor of final versions of the Headland Park HHERA (JBS 2011a and 2011b) and RAP; and
- finalisation of the design of the Headland Park and Cultural Facility/carpark.

The REMP and the ROHSMP are required to contain a plan addressing plausible contingencies and both Plans are required to be certified by an independent, expert person and submitted for acceptance by the BDA prior to mobilisation onto the Headland Park Site. The RWP shall be prepared by the Remediation Consultant and reviewed/ accepted by the Site Auditor prior to the commencement of remedial works.

Upon completion of the works on the Headland Park Site, a validation report and an on-going LTEMP for impacted materials retained beneath Headland Park are required to be submitted by the Remediation Consultant to the Site Auditor for certification that the Headland Park Site is suitable for the proposed uses, subject to implementation of the LTEMP.

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1 Introduction

1.1 Introduction and Background

JBS Environmental Pty Ltd (JBS) was commissioned by the Barangaroo Delivery Authority (BDA) to prepare a Remedial Action Plan (RAP) for the Headland Park portion of Barangaroo located at Hickson Road, Sydney, NSW, 2000 (**Figure 1**).

This RAP applies only to the Headland Park portion of the Barangaroo Site. In this RAP, Headland Park - including areas above 1m AHD in the proposed Northern Cove - is referred to as the "Headland Park Site" and the entire Barangaroo Site is referred to as the "Barangaroo Site", whilst the "Barangaroo Project Site" includes the Barangaroo Site and the adjoining parts of Sussex Street, Hickson Road and Towns Place. The southern part of the Barangaroo Project Site, referred to as the "Stage 1 Development", will be developed for a mixture of commercial, residential and open space uses. The locations of the various parts of the Barangaroo Project Site, including the boundary of the Headland Park Site which is the subject of this RAP, are shown on **Figure 5**.

Previous environmental investigations conducted on the Headland Park Site have identified limited soil contamination, being restricted to Total Petroleum Hydrocarbon(TPH), Polycyclic Aromatic Hydrocarbon (PAH) and metal impacted fill materials, primarily around former Warehouse 3. No significant groundwater contamination has been identified on the Headland Park Site.

Remediation/management of the identified contamination on the Headland Park Site will be undertaken as part of the development of Headland Park and Northern Cove.

Whilst this RAP primarily relates to the remediation of contamination within the Headland Park Site, suitable Site Materials from other parts of the Barangaroo Project Site are proposed to be relocated onto the Headland Park Site, in order to recreate the naturalistic Headland Park landform. This RAP therefore gives consideration to the broader contamination issues on the Barangaroo Project Site and outlines the procedures for the acceptance of other Site Materials onto the Headland Park Site.

The contamination issues identified across the broader Barangaroo Project Site are principally associated with fill materials, natural soil and groundwater within the footprint of a former gasworks (located on the Stage 1 Development), namely:

- TPH, Benzene, Toluene, Ethylbenzene & Xylene (BTEX) and PAH impacted fill materials, soils and groundwater;
- Cyanide impacted fill materials, soil and groundwater;
- Phenol and ammonia impacted fill materials, soil and groundwater;
- Minor quantities of asbestos impacted fill materials; and
- Metal impacted fill materials, soil and groundwater (lead, cadmium, copper & zinc).

The footprint of the former gasworks has been declared by the NSW Department of Environment Climate Change and Water (DECCW) as a Remediation Site and is referred to in this RAP as the "Declaration Area". The Declaration Area is not within the Headland Park Site.

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1.2 Objectives

The objectives of this RAP are:

- to document the procedures and standards to be followed in order to remove the risks posed by contamination at the Headland Park Site to future site occupants and the surrounding environment (incl. human and ecological receptors);
- to document the procedures and standards to be followed in order to ensure the suitability of Site Materials relocated from the broader Barangaroo Project Site onto the Headland Park Site; and
- to enable a Site Audit Report and Site Audit Statement(s) to be prepared by the appointed independent DECCW Accredited Site Auditor, confirming that the Headland Park Site can be made suitable for the proposed uses subject to the successful implementation of the proposed remedial/management measures.

This RAP has been prepared with consideration to:

- the Director General's Requirements relating to Project Application MP10_0047;
- the requirements of the Overarching RAP prepared for the Barangaroo Project Site (ERM 2010)[3] and the associated Site Audit Statement and Site Audit Report (ENVIRON 2010)[4]; and
- relevant Australian Standards in addition to guidelines made or approved by the NSW DECCW.

1.3 Overarching Remedial Action Plan

An Overarching RAP (ERM 2010) has been prepared for the Barangaroo Project Site that outlines the remediation approach to address the identified contamination across the Barangaroo Project Site as a whole and makes reference to the preparation of individual RAPs and Remedial Work Plans (RWPs) for various elements of the Barangaroo Project Site.

This RAP for the Headland Park Site, including the Northern Cove, is one of the individual RAPs required to be prepared by the Overarching RAP. The RWP for the Headland Park Site will be prepared by JBS following finalisation of the Headland Park HHRA and ERA (**Section 1.4**) and finalisation of the design of Headland Park and the Northern Cove, along with any additional delineation/data gap investigations.

1.4 Headland Park Human Health and Ecological Risk Assessments

Draft Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) have been undertaken by JBS to define risk-based criteria for fill materials, natural soil and groundwater on the Headland Park Site (JBS 2011a[5] and JBS 2011b[6]). The risk assessments are collectively termed the "Headland Park HHERA". The draft risk-based criteria contained within the Headland Park HHERA apply to this RAP for the Headland Park Site.

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[3] *Overarching Remedial Action Plan for The Barangaroo Project Site, Sydney,* ERM, June 2010 (ERM 2010)
[4] *Site Audit Report and Site Audit Statement GN439A, Overarching Remedial Action Plan, Barangaroo,* Graeme Nyland of ENVIRON Australia Pty Ltd, June 2010 (ENVIRON 2010).
[5] *Human Health Risk Assessment, Barangaroo Headland Park,* JBS Environmental Pty Ltd, February 2011 (JBS 2011a)
[6] *Ecological Risk Assessment, Barangaroo Headland Park,* JBS Environmental Pty Ltd, February 2011 (JBS 2011b)

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The draft Headland Park HHERA (JBS 2011a and JBS 2011b) presents soil criteria for the two principal elements of the Headland Park Site, namely:

1. In-situ soils currently present at the Headland Park Site, which are protective of groundwater and the receiving surface water environment of Darling Harbour.
2. Ex-situ (relocated) soils required to create the naturalistic landform of Headland Park, which are protective of future users of the park, vegetation within the park, groundwater and the receiving surface water environment of Darling Harbour.

1.5 Site Auditor Engagement

As part of the assessment and remediation works, a Site Auditor accredited by NSW DECCW has been engaged to provide endorsement of this RAP and to provide a Site Audit Statement at the completion of the works on the Headland Park Site certifying that the Headland Park Site is suitable for the proposed uses, subject to implementation of a Long-term Environmental Management Plan (LTEMP).

1.6 The Proposed Development / Current Design

The Headland Park Site is proposed to be developed into a naturalistic headland that will simulate the shoreline as it was in 1836. Establishment of the naturalistic headland will involve shaping of the shoreline through the extraction of approximately 150 000 m^3 of fill materials within or behind the existing caissons and seawall that form the western and northern current boundaries of the Headland Park Site. Additional material, comprising approximately 10 000 m^3 of fill and natural soils and 60 000 m^3 of sandstone will be excavated from within the area of the Headland Park to facilitate construction of a submerged car park and generation of 'yellow rock' sandstone.

The Headland Park Site is proposed to include the following elements:

- A substantial open area of sloped parkland over the majority of the Headland Park Site provided with a network of pathways and plantings formed by a substantial filling program;
- A modified shoreline throughout the perimeter of the Headland Park Site including the fringe of a submerged area at the south known as Northern Cove, resulting in the excavation of approximately 150 000m^3 of fill based soils;
- A void to a depth of -7.6 mAHD as created by a proposed sandstone extraction program located within the central portion of the site, comprise dimensions of 85 m (east-west) and 70 m (north-south) resulting in the excavation of approximately 60 000 m^3 of sandstone and approximately 5 000 m^3 of overlying fill materials;
- A multi-level Car Park as constructed within the void, partially contained within the area of proposed sandstone extraction and extending within an excavation placed to a depth of -2 mAHD within the central to southern portion of the site. The proposed dimensions of the car park are 40 m (east-west) and 165 m (north-south). In addition to the surplus soils as generated by the sandstone excavation, an additional 5 000 m^3 of fill based and natural soils (alluvium and potential sandstone) will be generated by this proposed excavation outside the designated area of sandstone extraction;

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- A ‘Cultural Facility’ as constructed above the Car Park and also substantially contained within a space created within the filling used to form the Headland Park Site; and
- A system to control seepage water movement, collection and re-use, as constructed with the filling and formation of the headland profile of the Park.

The proposed boundaries of the Headland Park Site are shown on **Figure 2**. Proposed design elements for the Headland Park Site are provided in **Figures 2, 3, 3A to 3G**.

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2 Summary Site Condition / Surrounding Environment

2.1 Site Identification

The Barangaroo Project Site is located at Hickson Road, Sydney, NSW and is legally referred to as Lots 1, 3, 5 and 6 Deposited Plan (DP) 876514 and includes the adjacent parts of Sussex Street, Hickson Road and Towns Place, as shown in **Figure 1**. The Barangaroo Project Site details are summarised in **Table 2.1** and described in more detail in the following sections.

Table 2.1 Summary Details for the Barangaroo Project Site

Lot/DP	Lots 1, 3, 5 and 6 of Deposited Plan 876514, including adjacent parts of Sussex Street, Hickson Road and Towns Place
Address	Hickson Road Millers Point NSW
Local Government Authority	City of Sydney
Site Zoning	Zone B4 Mixed Use and RE1 Pubic Recreation
Current Use	Vacant/Roadway
Geographical Co-ordinates, Elevation	Easting – 333643m E, Northing – 6251851m S, 2-3m AHD
Site Area	Approximately 22 ha

It is noted that two small portions have been excluded from the Barangaroo Project Site for the purposes of remediation planning including:

- Moore's Wharf (in the far north eastern section of the Headland Park Site); and
- The area immediately surrounding the Port Control Tower.

The location of these areas relative to the Barangaroo Project Site is shown on **Figure 5**, which also shows the location of former structures that were present during the former commercial/industrial site use.

The Headland Park Site is located at the northern part of the Barangaroo Project Site (refer **Figures 2, 3** and **5**) and the details are summarised in **Table 2.2** and described in more detail in the following sections.

Table 2.2 Summary Details for the Headland Park Site

Lot/DP	Lot 1 and Part Lot 5 of Deposited Plan 876514, including adjacent parts of Hickson Road and Towns Place
Address	Hickson Rd Millers Point NSW
Local Government Authority	City of Sydney
Site Zoning	Zone B4 Mixed Use and RE1 Pubic Recreation
Current Use	Vacant
Geographical Co-ordinates, Elevation	Easting – 333547m E, Northing – 6252278m, 2-3m AHD
Site Area	Approximately 8 ha

For the purposes of the RAP and the ensuing Site Audit, the final site as intended to be described in the Site Auditor sign off consists of the site as defined by the high water mark boundary. A plan view of the proposed site is shown as **Figure 2**. Proposed sections are shown as **Figures 3A** to **3G**.

It is noted that a substantial area of the current Lots 1, 3, 5 and 6 are proposed to be inundated with the proposed site development. These inundated areas are understood to be excluded from the area of the final site audit. Approximate dimensions and locations of the future site boundary can be identified as the 1m AHD contour as shown on **Figure 2**.

Soils as contained within the proposed inundated area will be excavated to a maximum likely depth of approximately -4 mAHD. The majority of these soils are proposed to be used as fill material in the creation of the headland landform on the Headland Park Site.

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A survey plan, prepared by a Registered Surveyor, will be included in the RWP to be prepared for the Headland Park Site, defining the boundary of the Headland Park Site.

2.2 Site Condition

The Headland Park Site has an approximate rectangular shape, with the longest boundary in a north-south direction. The far north-eastern portion of the Headland Park Site, known as Moores Wharf (Ports Services), was reported to contain a large heritage listed sandstone building and this section of the Headland Park Site was recently utilised as a base for marine operations by Sydney Ports Marine Services.

The remainder of the Headland Park Site was previously used for wharfage and storage of materials and was last occupied by Patrick Stevedoring. The large warehouse buildings associated with this former use have been demolished. The surface of the Headland Park Site is generally covered with areas of concrete and asphaltic pavement. The pavement surfaces have been reported as being in generally reasonable condition (ERM 2008a). The Sewage Pumping Station at the north of the Headland Park Site is still present.

The main vehicular access to the Headland Park Site is from a number of gates on Hickson Road on the eastern boundary of the Barangaroo Site, in addition to gates off Towns Place.

2.3 Surrounding Landuse

The surrounding uses of land adjacent to the Headland Park Site have been previously reported as follows (ERM 2008b[7]):

- North: Immediately to the north is Sydney Harbour;
- East: Immediately to the east is the residential and commercial area of Millers Point (NE), in addition to Hickson Road (SE);
- South: Immediately to the south is the temporary overseas passenger terminal, beyond which lies the Stage 1 Development; and
- West: Immediately to the west is Darling Harbour.

A former gasworks is known to have operated until the 1920s over part of the Stage 1 Development, as shown on **Figure 5**. The former gasworks location is known to continue to the east beneath Hickson Road, and the contaminated gasworks waste material in this area has been identified to contaminate soils and groundwater on the south-eastern portion of the Barangaroo Project Site. This part of the Stage 1 Development, referred to as the Declaration Area in this RAP, has been declared a Remediation Site by NSW DECCW (Declaration No. 21122, Area No. 3221) under the CLM Act 1997. It is understood that environmental assessment programs are being undertaken on the Stage 1 Development in preparation for remediation.

2.4 Topography

The topography of the Headland Park Site is relatively flat, having been cut and filled for its previous use as a stevedoring facility (ERM 2008b). The Headland Park Site abuts a man-made cliff face on the north-eastern boundary.

The proposed topography will be heavily modified as can be observed from **Figures 2 and 3A** to **3G**. This will be achieved by the importation of fill material to create a mound

[7] *Draft Stage 2 Remedial Action Plan for Barangaroo*, Hickson Road, Sydney, ERM, September 2008 (ERM 2008b)

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over the central portion of the site, and excavation at the north-western and southern areas of the site to form inundated areas. The site elevation will range from the level of surface water in Darling Harbour to a height of 20m in the central eastern portion of the site. Several steep slopes will occur across the site, consistent with a 'headland' topography.

2.5 Hydrology

The closest surface water body to the Headland Park Site is Darling Harbour, located immediately adjacent to the west and north of the Headland Park Site (ERM 2008b). Surface water from the Headland Park Site is collected via a sub-surface drainage network, which generally flows toward the Harbour. The current drainage network is shown on **Figure 5**.

Hydrology on the proposed Headland Park will be substantially modified with the amended topography. Sub-surface drainage will be controlled on the proposed Park. This is shown on a proposed Park section as provided as **Figure 6**. From AgEnviro Solutions (29 September 2010) in 'Barangaroo Water Balance', two drainage systems are proposed over the majority of the proposed Park area with the site redevelopment:

- A shallow drainage system comprising a series of bioswales will be used to collect shallow seepage water in surface soils, used as a growing medium; and
- A deep drainage system with a clay bottom liner will be placed under the majority of the proposed area of filling over the Park. The drain will be located below the depth of the current site surface. The clay liner will rise from the location of the drain at a reported slope of 1°. The most recent advice provided to JBS is that the clay liner will commence at a depth of approximately 2.5m AHD at the boundary of the Headland Park. The indicative lateral extent of the clay liner, consistent with the pathway proposed at the boundary of the Headland Park Site is shown on **Figure 9**.

The hydrological regime of the proposed Park has been described in the 'Barangaroo Water Balance' (AgEnviro Solutions, 2010) as follows:

- 64.46 ML of rainfall falling over the area of the Park annually;
- 9.4 ML of run-on water entering the Headland Park site from surface water flows from adjoining sites;
- 24.46 ML of water lost by evapotranspiration from Plants on the Park;
- 10.8 ML of water lost as surface water run-off and discharged into the Harbour;
- 40.91 ML of water placed on the surface of the Park collected in a near surface drainage system consisting of bioswales;
- 12.05 ML seeping into deeper soils (below the depth of influence of the bioswale drainage system) of which 7.3 ML is captured by a deep drain, 1.6ML seeping through the clay bottom liner provided to the deep drain into underlying groundwater, and 3.15ML seeping into deeper soils at the northern, western and southern extremities of the site outside of the area of the proposed deep drainage system and discharge into Darling Harbour as seepage water / groundwater outflows;
- 19.56 ML of collected water from the near surface drains (bioswales) and deep drain system is re-used as irrigation water on the Park;

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- 3.72 ML of water as placed on the surface in areas concentrated to the northern, western and southern extremities of the site outside of the area of the proposed bioswale system, infiltrating into near surface soils only and discharging into Darling Harbour by shallow seepage water discharge;
- 2.91 ML per year of water re-used as irrigation is lost by evaporation; and
- The remaining 23.64 ML of surplus water (collected water in the sub-surface drainage systems that is in excess of the Parks irrigation / waters re-use requirements) requires to be discharged from the site.

By observation of **Figure 6**, the deep drain system will be present underlying all soils imported onto the Headland Park site, apart from a thin layer of materials to be placed underlying the clay liner to achieve the drain slope (immediately above the current site surface). By correlation to the water balance, the seepage water discharges as reported to occur from the deeper fill materials and near surface soils will occur from soils below the current depth of Headland Park site (2.5-3m AHD) and located at the boundaries of the Park. No drainage controls are known to be proposed for soils to the south of Northern Cove. No significant filling works are proposed in this area of the site.

2.6 Geology

According to the 1:100 000 Geological Survey of NSW (Sydney) Sheet 9130 (Ed 1) 1983, the Headland Park Site is generally underlain by man-made fill that has been placed over marine sands over Hawkesbury Sandstone, which is described as follows (ERM 2008b):

- Man-made fill may consist of "dredged estuarine sand and mud, demolition rubble, industrial and household waste"; and
- Hawkesbury Sandstone is characterised as "medium to coarse-grained quartz sandstone with very minor shale and laminite lenses".

A substantial network of soil sample locations has been previously placed across the Headland Park Site (**Figure 7**). The general geological profile observed at the Headland Park Site, as reported by previous investigations, is summarised in **Table 2.3**.

Table 2.3 Summary of Observed Site Geology

Lithological Unit	Description	Depth (mbgl)
Hardstanding	Asphalt, bitumen or concrete, generally in good condition with no staining.	0 – 0.46
Road base fill	Very dark grey, dry, loose, medium grained sand to fine gravel, poorly sorted, sub angular, no odours or staining noted.	0 – 0.5
Fill	Silty, gravelly sand, olive brown, grey brown, light yellowish brown, dry to wet, fine to coarse sand, sandstone floaters. Fill material including building rubble, bricks, concrete. Black staining and a hydrocarbon odour and significant contamination have been identified in some boreholes, particularly within and around the former gasworks area.	0 – 18.0
Marine Clay/Sand	Interbedded clayey sand and sandy clay, dark greyish brown, saturated, some shell fragments and organic matter. Sandy clay – soft, high plasticity. Clayey Sandy – loose to dense, fine to coarse sand, low to no plasticity. Contamination has been identified within and around the former gasworks area.	3.0 – 18.4
Marine Clay/Sand	Interbedded clayey sand, sandy clay and sand, light yellowish brown, white, reddish brown or dark greyish brown, saturated. Sandy clay – stiff to hard, medium to high plasticity. Clayey Sandy and sand – loose to dense, fine to coarse sand, low to no plasticity.	4.9 – 32.75
Bedrock	Weathered sandstone, white, light yellowish brown, olive brown and reddish brown, wet, fine to coarse grained, some fracturing noted. Contamination has been identified within and around the former gasworks area.	1.3 – 32.75

It was further reported that some areas along the western foreshore and building footprints were covered by concrete with a thickness up to 0.5 m. A layer of fill was

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observed in all boreholes and ranged in thickness from 1.3 m on the east of the Barangaroo Project Site to 18 m on the west of the Barangaroo Project Site.

The current site geology is described in more detail in the site conceptual model provided in the most recent assessment (JBS 2011c). The CSM is discussed further in **Section 4.2**. The most significant changes proposed to the site geology of the final Headland Park site (excluding areas to the north-west and south below the high water mark) include:

- Excavation of soils at the proposed boundaries of the Headland Park to form the proposed grades along the length of the site boundary to the edge of Darling Harbour;
- Placement of substantial quantities of imported fill over the majority of the proposed Park area so as to form the proposed Headland; and
- Excavation of 60,000m^3 of sandstone and overlying fill based soils from the central portion of the eastern site. Backfilling of the subsequent void by imported soils.

Sydney Environmental & Soil Laboratory (SESL, undated) 'Soil Requirements for Barangaroo A Preliminary Scoping Paper' and conceptual plans have been provided to JBS as the basis of the soil design of the Headland Park. Four soil horizons are nominated in this correspondence as listed following:

- A Horizon – topsoil, with the highest fertility, organic matter and biological activity of the layers. It is always sandy and is not anticipated to have a silt / clay content in excess of 5%;
- B Horizon – a subsoil layer that is typically yellow clayey sand containing little if any organic matter. It is of low fertility. In the oldest profile type, the Podsolic, it contains the maximum clay content in the profile (15-30% silt plus clay). Clay content is also reported to increase with depth;
- C Horizon – decomposed rock with little structure, but allows some root penetration as it is not solid rock. Reported as being typically a clayey sand to sandy clay in texture; and
- R Horizon – Described as solid rock, highly compacted engineered material or concrete.

Upper soils on the parkland site, to be used as growing medium, are reported to most likely consist of A and B horizons soils and are proposed to be manufactured with soils available from the development and selected imported materials (i.e. compost). Further advice from SESL as emailed to JBS (9/7/2010), advised that soils to be placed as growing media will vary in depth across the proposed Parkland site as:

- To 350mm deep in areas that are turfed; and
- To 800mm deep in areas used for plantings of large trees.

The surface soils will be drained by the bioswale system as described in the water balance in **Section 2.5**.

It has been further advised that soils below the depths of the growing medium would be compacted to "*prevent root penetration virtually completely*". A further email from SESL to JBS (14/7/2010) advised that surface soils used as growing medium will contain organic content consequent of blending. It was advised that a total organic carbon content of at least 3% should be anticipated for the surface soils / growing medium.

The majority of the in-situ geology, within the boundaries of the Headland Park will remain undisturbed.

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2.7 Hydrogeology

As previously reported (ERM 2008b), information obtained from the Department of Natural Resources (DNR) indicated that 32 registered groundwater bores were situated within a 4 kilometre (km) radius of the Headland Park Site. Review of the groundwater bore information indicated that the bores were used for the following purposes: recreation (8), irrigation (3), and monitoring (22). None of the listed bores were reported to be registered for drinking water purposes. No registered groundwater bores have been reported to be present on or adjacent to the Headland Park Site.

The quality of groundwater on the Headland Park Site has been reported to have been assessed via a network of monitoring wells installed across the Headland Park Site (ERM 2008b). Locations of groundwater monitoring wells are shown on **Figure 8**. Hydrological data indicated that groundwater on the Headland Park Site was strongly influenced by tidal fluctuations, suggesting substantial hydraulic connection with the Harbour potentially due to conduits in the fill material.

The hydrological data suggest that much of the Headland Park Site is likely to be subject to significant seawater flushing. Under typical conditions there is reported to be a likely net groundwater flux towards the Harbour, at a velocity of between 0 and 7.6 m/day (ERM 2008b).

It is not anticipated that the current hydrogeological regime would change substantially with the proposed Park development. The current rate of surface water recharge over the area of the site is unknown as it is controlled by cracks / penetrations in site pavement. Based on the water balance modelling, it has been estimated that 4.75 ML of seepage per year will infiltrate to groundwater from the Headland Park. It is reported that 1.6ML of this vertical seepage recharge will be derived from contained soils as placed above the current site surface forming the Headland profile.

Concentrations of Constituents of Potential Concern (COPCs) in groundwater within the Headland Park Site (which is outside the area of the former gasworks structures on the Stage 1 Development and the adjoining Hickson Road) were generally low and were consistent with what would be expected on an urban site of this nature, as opposed to the elevated concentrations of contaminants observed within the area of the former gasworks.

2.8 Meteorology

The Sydney area has a humid to temperate climate with a seasonal rainfall maximum during the summer and autumn months. Annual mean rainfall recorded at Sydney (Observatory Hill) is 1212 mm[8].

The area has a history of droughts, which are broken by periods of heavy rainfall resulting in significant recharges to groundwater resources. The 1940s and 1980s and the current decade are observed to be dry periods, while the early 1970s and 1990s were wet periods.

Summer winds are predominantly northeasterly with southerly thunderstorms common. Winter winds are predominantly westerly.

[8] http://www.bom.gov.au/climate/averages/tables/cw_066062.shtml visited 7th May 2010

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3 Summary Site History

3.1 Barangaroo Project Site

The Barangaroo Project Site was a large precinct occupied by shipping and related merchants over the 1900s. A gasworks operated by The Australian Gas Light Company (AGL) over the period of approximately 1840 to 1925 was located on part of the Barangaroo Project Site, within the Stage 1 Development, and extended across what is now Hickson Road. During the use of the Barangaroo Project Site for shipping purposes, the original shoreline was altered to enable the constitution of a number of finger wharves and associated activities, with these being reclaimed over the period spanning the 1950s to 1970s. Over the past 20 years, the Barangaroo Project Site was used for principally stevedoring purposes until the majority of buildings were demolished and the land prepared for redevelopment in the past 5 years.

3.2 Headland Park Site

A summary of the Headland Park Site history has been provided in the previous reports (ERM 2008b). A chronological list of activities at the Headland Park Site is summarised below:

- 1840 to 1910: The Headland Park Site was owned by merchants, compositors, manufacturers and various shipping companies and was also used for ship berthing and associated activities. Ownership was largely transferred to Sydney Harbour Trust Commissioners (SHTC) in approximately 1910.
- 1910 to 1936: The majority of the Headland Park Site continued to be owned by the SHTC and was used for ship berthing and associated activities such as workshops and stores.
- 1936 to 1998: Ownership transferred to the Maritime Services Board of NSW and subject to various commercial leases. Part of the Headland Park Site initially consisted of finger wharves, which were removed over time with a significant portion of land reclaimed from the Harbour with unclassified fill between 1951 and 1972.
- 1998: Marine Ministerial Holding Corporation was the proprietor of Lot 1. Sydney Ports Corporation was proprietor of Lots 2, 4 and 5.
- 1996-2007: A number of environmental investigations were conducted on the Headland Park Site; and
- 2007 - 2008: The Headland Park Site was vacated by Patrick Stevedores Operations. The warehouses were demolished and the land predominantly cleared and leveled in preparation for future redevelopment, with the exception of the Temporary Cruise Passenger Terminal.

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4 Contamination Status

4.1 Previous Site Assessments

A number of previous environmental site investigations have been undertaken which provide relevant environmental data for remediation planning associated with the Headland Park Site development. The works and findings of each of these assessments are summarised in the following sections, as relevant to the Headland Park Site.

4.1.1 Environmental Site Assessment (ERM 2007)

This investigation (ERM 2007[9]) comprised a desktop study of existing and previous land uses at the Barangaroo Site. Soil sample locations are shown on **Figure 5**. Groundwater monitoring well locations are shown on **Figure 6**.

The investigations were reported to have encountered a layer of silty/gravelly sand fill in all boreholes, ranging in thickness from 0.5 to 21 m. Boreholes drilled in the Headland Park Site were reported as being generally devoid of a layer of natural sediment, with fill underlain by the sandstone bedrock.

Soils were reported to have been sampled and analysed for a wide range of contaminants commonly associated with former gasworks, other industrial sites and with substances commonly identified in fill materials, including heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn), cyanides, sulphates, TPH, BTEX, PAHs, phenols, polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs) and organophosphorus pesticides (OPPs).

The primary area identified within the Headland Park Site in which levels of contaminants above the adopted investigation criteria was the north-western portion of the Headland Park Site adjacent to former Warehouse 3. The primary constituents of potential concern in this part of the Headland Park Site were TPH, PAHs and sulphates.

Widespread elevated levels of heavy metals were also reported across the Headland Park Site. The potential for asbestos containing materials (ACM) to be present was also identified. However, the sampling methods employed as part of the assessment were not considered appropriate to reliably identify ACM (ERM 2007).

Groundwater underlying the Headland Park Site was found to be subject to tidal influence. No significant groundwater contamination was identified beneath the Headland Park Site.

4.1.2 Additional Investigation Works (ERM 2008a)

The additional investigation at the Barangaroo Project Site (ERM 2008a[10]) consisted of additional soil and groundwater assessment to address perceived data gaps in the initial site assessment (ERM 2007). Sample locations are shown on **Figure 5**.

Soil and groundwater were analysed for the COPCs identified in the initial site assessment (ERM 2007). The following results were reported for the Headland Park Site (ERM 2008a):

- Localised levels of TPH, PAHs and sulphate exceeded the adopted criteria.
- Groundwater was found to be substantially influenced by tidal movements with very high hydraulic conductivities recorded for the fill materials. No significant groundwater contamination was identified beneath the Headland Park Site.

[9] *Environmental Site Assessment, East Darling Harbour, Sydney, NSW*, ERM, June 2007 (ERM 2007)
[10] *Additional Investigation Works at Barangaroo, Hickson Road, Millers Point, NSW,* ERM, July 2008 (ERM 2008a)

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The same limitations with the sampling methodology to identify ACM were present in both ERM 2007 and ERM 2008a investigations.

4.1.3 Preliminary Environmental Investigation Hickson Road (Coffey 2008)

This investigation (Coffey 2008[11]) comprised a review of site history and sampling of soil and groundwater at 15 and 6 locations, respectively (**Figure 7**), in Hickson Road in the vicinity of the former gasworks. These investigations are relevant to the sewerage upgrade component of the Headland Park Site Early Works, which are proposed to occur within parts of Hickson Road, which forms part of the Barangaroo Project Site. Soil and groundwater samples were analysed for the identified COPCs and the following results & observations were reported:

- Elevated levels of TPHs and PAHs (including BaP), BTEX compounds and phenols were reported in soil and groundwater in the proximity of the former gasworks structures, such as the tar pit and the annulus of former gas holders, with the highest concentrations occurring in a number of locations at the soil/bedrock interface.
- Elevated levels of ammonia were reported in groundwater.
- The reported concentrations of metals in soil were generally below the adopted health based criteria, however, a number of elevated levels of metals were reported in groundwater, in particular, arsenic, nickel and zinc.

It is noted that these investigations (Coffey 2008) were undertaken in only a portion of Hickson Road and environmental investigations have not been undertaken been undertaken over most of Hickson Road, Sussex Street and Towns Place.

4.1.4 Remedial Strategy (ERM 2008b)

A remedial strategy for the whole of the Barangaroo Project Site was prepared in ERM (2008b), which has been developed into the Overarching RAP. The preferred remedial approach for the Declaration Area, which comprises the former gasworks, was determined to be source removal via either excavation and off-site treatment and disposal (for the most heavily impacted materials) or excavation and on-site stabilization/reuse (for less heavily impacted materials). However, the Overarching RAP stated that *in situ* remediation methods may be considered if treatability and pilot trials were shown to be successful. Re-use of suitable materials was proposed to occur in any appropriate parts of the Barangaroo Project Site, including on the proposed Headland Park Site.

The parts of the Barangaroo Project Site, including the Headland Park Site on which impacted materials were proposed to be placed were proposed to be made suitable by on-site management, involving capping of impacted materials and removal of “hotspots” of materials exceeding risk based clean-up levels and implementation of a LTEMP.

4.1.5 Douglas Partners (2010)

Limited soil sampling and analysis works were undertaken by Douglas Partners across the area of the Headland Park in May 2010. The works comprised the placement of four sample locations across the area of the Headland Park and analysis for a range of contaminants. Elevated levels of some heavy metals and PAHs were identified in some fill materials. Heavy metals and PAHs were found to be leachable under neutral pH leaching conditions.

[11] *Preliminary Environmental Investigation, 30-38 Hickson Road, Millers Point, NSW, 2000,* Coffey Environments Pty Ltd, 12 May 2000 (Coffey 2008)

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4.2 Summary of Known Contamination

4.2.1 Stage 1 Development

The principal area of impact is located within the footprint of former gasworks (ERM 2008b), which was located on the Stage 1 Development and on the adjacent part of Hickson Road. Contaminants, including PAHs, BTEX, TPH, lead and zinc have been identified in this area of the Stage 1 Development. The highest levels of hydrocarbon contaminants are co-incident with former gasworks infrastructure, with the depth to impact generally increasing to the west with further distance away from the former infrastructure.

Elevated levels of lead have also been identified throughout the area of the former gasworks, generally associated with near-surface fill material generally described as consisting of sand and silty sand soils. These fill materials are present throughout the Stage 1 Development and the lead impact does not appear co-incident with a particular type of fill.

Hydrocarbon impacts have been identified in fill materials, in underlying natural soils and within deeper sandstone occurring within fractures in the area of the former gasworks. There is evidence of the lateral and downward migration of hydrocarbon impact.

Several hot-spots are located over the remainder of the Stage 1 Development, generally consisting of lead or PAH impacted fill materials. These include:

- Lead hot-spots at the south-west of the Stage 1 Development and the centre of the eastern boundary; and
- Several hot-spots of PAH impact generally present in fill materials across the Stage 1 Development including hot-spots at the perimeter of the former gasworks, extensive impact in fill materials at the north-western portion of the Stage 1 Development and localised hot-spots over the central and southern portions of the Stage 1 Development.

Common fill types are identified by the review of borelogs across the Stage 1 Development. It is likely that localised lead and particularly PAH/TPH impacts may be present in other areas of the Stage 1 Development due to the heterogeneous nature of the fill materials. It is also noted with this that the highest levels of hydrocarbon impacts (PAHs, TPH and BTEX) have been coincident with aesthetic impacts, including odours and observations of tar.

The remnant gasworks infrastructure beneath Hickson Rd, which lies on the hydraulically up-gradient boundary of the central and southern portion of the Barangaroo Project Site, has been identified as a potential source of COPCs. No potential off-site sources of COPCs have been identified at the north of the Barangaroo Project Site.

4.2.2 Headland Park Site

A conceptual site model (CSM) was prepared by JBS (2011c) following additional assessment to document the constituents of potential concern (COPCs), sources of COPCs, pathways, and potential receptors on the Headland Park site. The CSM has been included in **Section 4.3** to assist in remedial planning. Sample locations from the additional assessment (JBS 2011c) are shown in **Figures 11 and 12**.

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It is noted that the CSM has not focussed extensively on existing pathways or contaminant distribution. Substantial earthworks are proposed for the site which will result in the movement of soils about the site. The CSM has instead focussed on potential interactions with soils with the future development of the Headland Park.

Based on previous investigation reports, the principal area of impact on the Headland Park Site is located around the former Warehouse 3, in the northern portion of the Headland Park (**Figure 5**). Contaminants include TPH and PAHs from a human health and environmental perspective, in addition to heavy metals from a potential phytotoxicity perspective and sulphate from a built structures perspective.

The contamination has been identified in fill materials and the COPCs do not appear co-incident with a particular type of fill. Underlying natural soils in the Headland Park Site do not appear to have been substantially impacted by the overlying impacted fill materials. Groundwater at the northern portion of the Barangaroo Project Site in the proximity of the Headland Park Site was identified to be free of significant environmental impact.

A summary of the investigation data for the Headland Park Site is presented in tables included in **Appendix B**.

All data gaps identified following the Overarching RAP were addressed in the recent JBS (2011c) additional assessment.

The Headland Park HHERA (JBS 2011a) identified that current maximum levels of groundwater impact do not pose a potential unacceptable risk or hazard to Park users. The HHRA did not consider beneficial use of groundwater for irrigation on the basis existing groundwater is typically saline and thus unsuitable for such use.

4.3 Conceptual Site Model (CSM)

4.3.1 Constituents of Potential Concern

COPCs identified as adversely impacting soils and/or groundwater within the Headland Park Site have been found to include:

- Heavy metals including arsenic, cadmium, copper, lead, nickel and zinc;
- Total petroleum hydrocarbons (TPH); and
- Polycyclic aromatic hydrocarbons.

4.3.2 Exposure Pathways

The exposure pathways considered to be potentially complete for the redeveloped Headland Park, taking into consideration materials that are proposed to be present within the Headland Park Site, include:

- Inhalation of COPC vapours migrating upwards from current in-situ impacted soils and/or groundwater and/or groundwater caused to be impacted by the imported fill materials used to form the park; and/or
- Potential dermal and oral contact to impacted soils as present at shallow depths and/or accessible by future service excavations with the proposed Park design; and/or
- Potential oral and dermal contact to shallow groundwater as accessible by potential future service excavations; and/or
- Potential contaminant uptake by vegetation proposed to be established in the Headland Park more than likely including substantial fig plantings.

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Oral and dermal contact to current 'in-situ' soils and groundwater on the Headland Park Site would only be anticipated at the proposed site boundaries. The proposed filling works over the remainder of the site would cause underlying soils to be inaccessible.

Oral and dermal contact to soils and potential shallow seepage water will occur with fill materials placed at near surface depths over the filled portion of the Headland. These fill materials will potentially be sourced from materials to be excavated with the proposed Northern Cove and shoreline adjustment works, or excavation works within the proposed Headland Park Site boundary required for the sandstone extraction and Car Park.

It is not anticipated that any groundwater extraction will occur over the area of the site. Levels of total dissolved solids, consistent with marine water, cause the groundwater underlying the site to be unsuitable for beneficial use. This has not been considered as a complete exposure pathway.

4.3.3 Receptors

Potential receptors of COPCs include:

- Future recreational users of the Park; and/or
- Excavation / construction / maintenance workers conducting activities at or in the vicinity of the site, who may potentially be exposed to COPCs through inhalation of vapours or via direct dermal contact with impacted soils present within excavations; and/or
- Flora species to be established on the Headland Park including large fig plantings; and/or
- The marine water ecosystem of Darling Harbour and Port Jackson.

4.3.4 Occurrence of Existing Sample Locations within the Headland Park Site

Soil and groundwater data was available for the site as previously collected by ERM (2007 and 2008) and DP (2010). The soil sample locations within the proposed site boundaries, and within the current site dimensions, are shown on **Figure 7** and the groundwater monitoring locations are shown on **Figure 8**. It can be observed that several sample locations are situated outside of the proposed future site boundaries. Soil and groundwater as sampled at these locations will not be representative of 'in-situ' soil and groundwater conditions on the site subsequent to the proposed development and alteration of the site boundaries. However, noting that excavation works are required in these areas, soil and groundwater conditions will be indicative of soil conditions and potential seepage water conditions within the filled area used to create the headland landform.

4.3.4.1 *Extent of Current Fill Based Soils Occurring Within the Proposed Park Boundaries*

The extent of in-situ soils to remain on the Headland Park Site has been further analysed in **Figure 9**. The site is currently underlain by fill material. The inferred depth to the base of the fill material across the proposed site is shown on the contour plot in **Figure 9**. Fill materials occur from the current site surface, which is generally at 2.5-3 mAHD. Groundwater underlying the site has been previously reported by ERM (2007 and 2008) to be significantly influenced by tidal variations. Soils, including fill materials as present below a depth of 1.9 mAHD, are considered to be potentially in contact with infiltrating groundwater in the future, based on the assumption of continuing significant tidal influence.

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Fill materials have been specifically assessed as these are commonly associated with environmental impact when present in industrial settings. The environmental status of fill materials is discussed in more detail in **Section 5.5**.

It can be observed by **Figure 9** that the profile of historical site filling correlates with the 1836 shoreline as predicted by the proposed Park dimensions. However, a significant quantity of fill material has been historically placed within the extent of the historical shoreline. It has been estimated that approximately 150,000m^3 of fill based soils are present within the proposed Headland Park site boundaries below a depth of 1.9m AHD. Approximately 50,000 m^3 of fill material occurs in the area to the south and south-east of Northern Cove. The majority of the remaining fill materials are concentrated near the boundaries of the proposed Headland Park. As can be seen from **Figure 9**, the greatest depths of fill materials are present near the boundaries.

4.3.4.2 *Characterisation of Fill Material received on Headland Park Site*

Soils present outside the boundaries of the Headland Park Site will be excavated to a maximum depth of approximately -4m AHD. The majority of these soils are proposed to be used as filling materials in the creation of the Headland. BDA have previously advised that up to 150 000m^3 of these soils will be received on the Headland Park Site as part of the Early Works.

Surplus soils present at the area of the sandstone excavation and the proposed area of the car park to the north and south of the area of the sandstone extraction will also be potentially re-used within the Headland Park. This consists of approximately 60 000 m^3 of 'yellowrock' sandstone from the sandstone excavation area, and approximately 10 000m^3 of fill based and natural soils (including sand based soils and sandstone) from shallow depths.

4.3.5 Known Occurrences of COPCs in Soils

Soil data was available for the site as previously collected by ERM (2007 and 2008) and DP (2010). Soil data has been summarised in Summary Tables in **Appendix A** on the basis of fill based soils and naturally occurring soils. Additional data collected in this assessment by Douglas Partners have also been included in the Summary Tables in **Appendix B**. Data for fill based soils has been further sorted into the following classifications as based on the contouring completed in **Figure 9**:

- Soils located within the central eastern portion of the proposed Headland Park which are above the predicted 2100 high water mark have been identified as 'Above GW'. It is considered that these soils will not potentially contact infiltrating groundwater in the future. Potential human exposure to these soils will be limited by the extent of fill materials proposed to be placed above with the formation of the Headland;
- Soils over the remainder of the site which have been collected above a depth of 1.9m AHD have been identified as 'Unsaturated'. It is considered that these soils will not potentially contact infiltrating groundwater in the future. Limited potential human exposure to these soils may occur, dependent on their proximity to the finished site levels on the Headland Park. Assessment of these soils will need to identify potential human exposure pathways by consideration of the location of the soils within the overall Headland Park development;
- Soils in sample locations within the proposed boundaries of the Park, as defined by the 2010 high water mark of 1m AHD which are present below a depth of 1.9m AHD have been identified as '<2100 High Water'. These soils will potentially

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contact infiltrating groundwater in the future, and will be required to be protective of groundwater quality. Limited potential human exposure to these soils may occur dependent on their proximity to the finished site levels on the Headland Park, similarly to that described for 'unsaturated soils';

- Soils in sample locations outside of the proposed Park boundaries, as defined by the 2010 high water mark of 1m AHD, have been identified as 'off-site'. It is understood that these soils will be excavated to a depth of -4m AHD and more than likely re-used as filling material in constructing the Headland Park, or disposed off-site. Potential human exposure to these soils may occur within the filled portion of the Headland Park dependent on the depth at which they are placed. Dependent on the depth of soil placement, ecological impacts to potential Park flora may occur. Ecological impacts by leaching to groundwater does not require consideration for these soils as the filled area of the Park will be provided with leachate controls; and
- Soils in sample locations in close proximity of the proposed Park boundaries which are present above the proposed finished level of the Park have been identified as 'excavated'. Soils within the areas of the proposed car park and sandstone excavations have also been identified as excavated. As with soils outside of the site boundaries, these soils will be excavated and either transferred to the fill emplacement area or disposed off-site.

Available environmental data and levels of site constituents in each soil type are described in more detail in the following sections.

4.3.5.1 *Fill Based Soils above Maximum Future Depth of Groundwater*

A total of six samples have been analysed from the in-situ soils within the central portion of the site that will be present above the depth of groundwater within the site boundaries. Apart from a single elevated detection of PAHs, levels of constituents are consistent with background levels of impact. Some of these samples are noted to be within the proposed excavated soils at the central portion of the site, and are identified as 'excavated' in **Appendix B** and are also discussed in **Section 4.3.5.2**.

A total of 15 samples have been analysed from the upper level soils in proximity of the site boundary. Several samples have reported elevated levels of PAHs. Levels of heavy metals are consistent with background levels as would be anticipated in proximity of the site.

PAHs detected at significant concentrations are generally heavier PAH constituents. These are generally found to be immobile in the environment.

4.3.5.2 *Fill Based Soils outside Park Area to be Excavated*

A total of 52 samples have been analysed from fill based soils outside the site and at shallow depths near to proposed site boundaries, where excavation works are proposed. A total of five samples have been analysed of fill based soils from within the proposed excavation areas for the sandstone extraction and car park. Levels of heavy metals are found to be generally consistent with anticipated background levels. Several samples are impacted with PAHs, with some levels of total PAHs and benzo(a)pyrene marginally exceeding the published assessment criteria for recreational uses.

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4.3.5.3 *Fill Based Soils within Park Area below Maximum Future Depth of Groundwater*

A total of 63 samples of in-situ soils which will be present within the saturated zone of the proposed Park have been analysed for heavy metals, 49 for TPH and 46 samples for PAHs and MAHs.

The majority of samples are impacted with PAHs with some levels substantially above the published assessment criteria for recreational uses. Some isolated elevated levels of copper, lead and zinc have also been identified in these soils. These constituents have also been identified in groundwater.

Notwithstanding this, the majority of soils have low levels of PAHs (generally consisting of relatively immobile heavier PAHs) and levels of heavy metals consistent with background levels of impact.

4.3.5.4 *Natural Soils Underlying Fill Materials*

A total of 26 samples of natural soils (underlying fill material) have been analysed for heavy metals, 25 samples for TPH, 23 samples for PAHs and 22 samples for MAHs. This has included six sandstone samples submitted for analysis. Samples of sandstone submitted for analysis has been found to be free of impact, with levels of analytes at or only marginally exceeding detection limits.

In general the natural soils have been found to contain substantially lower levels of heavy metals and PAHs than the fill based soils. Though some elevated levels of PAHs, lead and copper are present in some samples, these have generally been collected from alluvium based soils within the natural soil / fill interface. The extent of natural alluvium soils, consisting of sands, clayey sands and sandy clays has been shown on **Figure 10**.

Based on **Figure 10**, it can be observed that alluvium type soils are generally absent from the central portion of the site. Minor thicknesses, generally not exceeding 1.0m are present in the proximity of the northern and western portions of the proposed site boundary. Greater thicknesses are observed to be present in the proximity of the Northern Cove, with potentially significant thickness of alluvium occurring at the south of Northern Cove. It is noted that little data was available east and south of Northern Cove. However, from a review of **Figure 9**, the depth of fill materials is observed to be significant in these areas.

The natural soils with elevated levels of heavy metals and PAH impact have been identified at sample locations BH034, BH083, BH164, BH169 and BH215. These locations are located at the northern and southern extent of the site and sample location BH215 is located within the proposed Northern Cove. Few samples have been analysed from the western portion of the site.

Based on the limited data set available, impacted natural soils are generally restricted to shallow depths, typically occurring within 2 m of the fill / natural soil interface. Based on the history of the site development reported in ERM (2007), and the assumption that site filling was generally required to make the site usable for industrial activity, it is considered unlikely that significant impact would be present in the natural soils, below a fill / natural soil interface depth not considered to exceed a thickness of 2 m. The highest levels of impact, where present, would be anticipated to occur in soils closer to the fill interface.

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4.3.6 Known On-Site Occurrences of COPCs in Groundwater

Groundwater monitoring well locations MW01 to MW07, MW19, MW25 and MW215 are located within the northern portion of the Barangaroo development. However, by reference to **Figure 8** and the proposed Headland Park site dimensions:

- MW02 and MW04 are present within the proposed Headland Park;
- MW01, MW03, MW06 and MW07 are present on the proposed site boundary; and
- MW05, MW19, MW25 and MW215 are located substantially outside of the proposed site.

Each of these wells has been screened in fill materials. It is considered that the extent of monitoring wells available on the site is generally adequate to broadly characterise groundwater discharged from the site, apart from groundwater discharged at the northern boundary. By reference to **Figure 8**, monitoring well MW01 and MW25 are presently located at the north-eastern and north-western corners of the site respectively. No other monitoring wells are present in the approximate 150m length of the site boundary between these wells. Wells on the western boundary are spaced at approximately 50-70m apart. Groundwater potentially discharging from the site along the northern boundary may not be adequately characterised by the existing extent of monitoring wells.

There are no monitoring wells within the area of the proposed Headland Park to characterise groundwater moving onto the site. However monitoring well MW179 located to the south of the Headland Park site, at the north-eastern portion of the proposed Barangaroo Central development area (as shown on **Figure 2**), can be considered to be indicative of likely background groundwater quality which may be migrating onto the Headland Park site. All available groundwater data for these monitoring wells is summarised in **Appendix A**. The following is observed with regards to measured levels of groundwater impact and the proposed site boundaries:

4.3.6.1 *PAHs*

- Levels of PAH constituents exceeding the adopted ecological criteria have been identified at monitoring wells MW04 and MW07 located at the proposed site boundaries in a single monitoring round only (August 2007). No sampling notes are available for the August 2007 groundwater monitoring event. Levels of PAHs in two other monitoring events at these wells (July 2006 and June 2008) have been below detection limits;
- PAH constituents have been identified in off-site monitoring well MW25, located within the proposed Northern Cove excavation at levels exceeding ecological criteria in the August 2007 monitoring round. Levels in the more recent monitoring event (June 2008) where sampling notes and laboratory certificates are available are all below detection limits;
- Low levels of naphthalene have been identified in monitoring wells MW05 and MW19 to be located outside of the proposed site, however at levels below the adopted assessment criteria; and
- Low levels of PAHs have been identified in the background well MW179.

On the basis of PAHs being detected above detection limits in the monitoring wells located on the proposed Headland Park site in one groundwater monitoring event only, (noting that no field notes or reporting was available) it is considered likely that levels of PAHs in groundwater do not pose a potential human health or ecological risk. PAHs are more than

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likely not present at significant concentrations in groundwater within the proposed boundaries of the Headland Park site.

4.3.6.2 *Heavy Metals*

Table 4.1 summarises heavy metal levels in groundwater for boundary monitoring wells only, as based on the proposed Headland Park site boundary. Averages have been calculated using half detection limits.

Table 4.1: Summary of Levels of Heavy Metals in Groundwater at Boundary Wells MW01, MW02, MW03, MW04, MW06 and MW07 (µg/l)

Constituent		Arsenic	Cadmium	Copper	Lead	Nickel	Zinc
July 2006	Maximum	<10	<1	3	5	10	17
	Minimum	<10	<1	<1	0.2	<10	95
	Average	-	-	*1.6*	*1.9*	*6.7*	*39.5*
August 2007	Maximum	13	18.8	153	65	241	392
	Minimum	<10	1.1	25	<10	29	86
	Average	*10.3*	*6.4*	*105*	*24*	*136*	*190*
June 2008	Maximum	2.2	5.5	11	1.3	186	31
	Minimum	<0.5	<0.2	<1	<0.2	<0.5	7
	Average	*1.3*	*1.4*	*2.5*	*0.4*	*111*	*16.3*

The highest levels of heavy metals were recorded in the August 2007 monitoring round. As noted in **Section 4.3.4.2**, no field notes or other reporting was available for this monitoring round. Apart from the level of nickel at monitoring well MW04 in the June 2008 monitoring round, levels of heavy metals are within an order of magnitude of the adopted ecological criteria. Averaged levels over the area of the Headland Park site are generally below or close to adopted ecological investigation levels. Considering the size of the Headland Park and the groundwater discharge over a long boundary into a single water body, it is considered appropriate to characterise constituent levels in groundwater near to the site boundary on the basis of average levels.

It was considered most likely that levels of heavy metals discharging from groundwater from the Headland Park site will not cause ecological criteria to be exceeded in Darling Harbour.

4.3.6.3 *Total Petroleum and Monocyclic Aromatic Hydrocarbons*

Levels of TPH and MAHs are generally below detection limits. Some TPH and MAH concentrations, generally at or slightly above detection limits below the adopted ecological criteria, have been recorded in some boundary wells. However these levels are not considered to pose an ecological risk.

4.3.6.4 *Ammonia (as N)*

Levels of ammonia (as N) in wells on the Headland Park site are generally below or at the adopted ecological criteria. An elevated level of ammonia (as N) had been recorded in monitoring well MW25 located to the north-east of the proposed Headland Park within an area proposed to be excavated with the shoreline adjustment at the north-eastern portion of the site. Limited data is available for ammonia (as N) concentrations in soil to allow an assessment of whether a potential ammonia source is present.

It is considered that levels of ammonia (as N) that will discharge from groundwater on the Headland Park site will not pose a potential risk to ecological receptors, considering the levels of ammonia (as N) present in groundwater monitoring wells across the site, and the extent of excavation proposed with shoreline relocation (and boundary adjustment) at the north-eastern portion of the site. Notwithstanding this, a potential source of ammonia (as N) may be present within soils present at the north-eastern portion of the site.

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4.3.7 Potential Off-Site Sources of COPCs

The remnant gasworks infrastructure beneath Hickson Road has been identified as a potential off-site source of COPCs. This is hydrogeologically upgradient of the central and southern portion of the Barangaroo site, and cross-gradient of the Headland Park. No potential off-site sources of COPCs have been identified north of the Headland Park site.

4.3.8 Preferential Pathways

For the purpose of this assessment, preferential pathways have been identified as natural and/or manmade pathways that result in the preferential migration of COPCs as either liquids or gasses.

Man-made preferential pathways are present throughout the site, generally associated with extensive sand and gravel based fill materials. As indicated by estimates of hydraulic conductivity and extent of tidal influence observed in groundwater monitoring wells on the site, these fill materials are found to have a high permeability.

Fill materials sourced from on-site and comprising sand based soils potentially with crushed sandstone, will form the basis of the geology of the Headland Park. As such, the geology of the Headland Park formed by the filling and raising of the site profile, is also likely to be very permeable.

4.3.9 Potential Leaching of Environmental Impact

Potential leaching of environmental impacts requires consideration for the current in-situ soils and the proposed soils to be used as filling materials on the Headland Park site.

Current in-situ soils will be substantially exposed to groundwater which currently occurs underlying the site. Impact present in sub-surface soils below a current level of 1.0 m AHD and a future level of 1.9 m AHD will potentially contact and leach to groundwater.

Known impacted and leachable soils will more than likely be used as filling material to form the Headland portion of the Park in the area as contained by the drainage provisions. Seepage water as generated by these soils will be controlled by drainage provisions as provided to the Park. However it has been estimated that 1.6ML/year (4.4 kL/day) will seep vertically out of the contained area and into underlying groundwater over the area of the Park. In comparison, it has been further estimated by Douglas Partners (per comm. 28/7/2010) that 100 – 150 ML of groundwater will move in and out of the underlying site sub-surface (current in-situ soils) per tidal movement. It is considered that the predicted extent of leaching is insignificant compared to the extent of tidal flushing that is present in the site sub-surface and will not cause an impact on levels of constituents in groundwater.

Vertical migration of seepage water is also predicted to occur through in-situ soils as present at the site boundaries in the area of the Headland Park, and within the area of the site adjoining the east and south of Northern Cove. Surface water will occur in these areas by rainfall and irrigation of grassed areas. The extent of infiltration in these areas is anticipated to substantially increase above existing levels consequent of the removal of the existing pavement. Where leachable materials are present, this will lead to an increase in leaching of impact to groundwater. This potential may not be represented by the previous groundwater monitoring results.

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5 Remedial Action Plan

5.1 Remediation/Management Goals

The remediation/management goals for the Headland Park Site are:

- To reduce the risks to future site users posed by the identified in-situ contamination within the Headland Park Site to enable the proposed redevelopment of the site to proceed in accordance with the intended parks/open space landuse, including an associated Cultural Facility and carpark;
- To reduce the risks to groundwater and the receiving waters of Darling Harbour posed by the identified in-situ contamination within the Headland Park Site; and
- To reduce the risks to future site users or the surrounding environment posed by Site Materials relocated from other parts of the Barangaroo Project Site onto the Headland Park Site.

5.2 Extent of Remediation/Management Required

5.2.1 In-Situ Soils within the Headland Park Site

All available environmental data for the Headland Park site has been analysed and compared to risk based criteria generated for the proposed site, as part of additional assessment (JBS 2011c). Based on that assessment, it has been found:

- The soils as identified in **Figure 13** by orange shading are considered inappropriate for use within 0.5 m of the final park surface. This is an approximate quantity of 1000 m^3; and
- The soils as identified on **Figure 13** and shown by blue shading, present over an approximate area of 6 000m^2, are considered inappropriate for use as growing medium.

In addition, a minor, isolated and localised area of tar impact was identified during geotechnical investigations at sampling location shown as JBS312A on **Figure 13**. Based on visual observations recorded on the borehole log, it is anticipated that this comprises an approximate quantity of 100 m^3.

Groundwater sampling and analysis has not indicated that significant groundwater impact is present underlying the Headland Park.

Prior to commencement of remedial works, the final anticipated extent of in-situ soils requiring remediation on the Headland Park Site will be documented in the RWP, following:

1. Review and endorsement of the final Headland Park Cove HHERA (JBS 2011a and 2011b) and RAP; and
2. Finalisation of the design of the Headland Park and the Cultural Facility/carpark;

5.2.2 Ex-Situ Soils to be Relocated on the Headland Park Site

The following ex-situ soils relocated on the Headland Park Site require management in accordance with the provisions outlined in this RAP:

- All soils excavated on the Headland Park Site which are to be reused to create the naturalistic Headland Park; and

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- All Site Materials relocated onto the Headland Park Site which are not Virgin Excavated Natural Materials (VENM), as defined in relevant regulations;
- All Imported Materials brought onto the Headland Park Site which are not VENM or Excavated Natural Materials (ENM), as defined in relevant regulations.

The extent of remediation required in other parts of the Barangaroo Project Site outside the Headland Park Site will be addressed in other RAPs and RWPs and is outside the scope of this RAP.

5.3 Consideration of Possible Remediation Options

5.3.1 Regulatory Guidance

Soil Remediation

The *Contaminated Sites Guidelines for the NSW Auditor Scheme* (DEC 2006) lists the following order of preference for soil remediation and management:

1. On-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;
2. Off-site treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site;
3. Removal of contaminated soil to an approved site or facility, followed where necessary by replacement with clean fill; and
4. Consolidation and isolation of the soil on-site by containment within a properly designed barrier.

In addition, it is also a requirement that remediation should not proceed in the event that it is likely to cause a greater adverse effect than leaving the site undisturbed. And, where there are large quantities of soil with low levels of contamination, alternative strategies are required to be considered or developed (DEC 2006).

Consideration of each of the available options is presented in **Table 5.1**, taking into account both the remediation works required for in-situ soils on the Headland Park Site and the ex-situ soils to be relocated on the Headland Park Site from other parts of the Barangaroo Project Site.

Groundwater Remediation

Whilst groundwater has not been found to be significantly impacted at the Headland Park Site, the foreshore alignment is proposed to be altered which may disturb existing in-situ soil contamination and/or result in parts of the site being located closer to the harbour and subject to increased tidal flushing. Since the receipt and placement of Site Materials on the Headland Park Site will provide a significant impairment to groundwater remediation or further soil (source) removal, the extent of soil remediation required to address existing in-situ contamination has been based on the potential risks posed by such soils leaching contaminants into groundwater and the receiving environment.

The proposed soil remediation works at the Headland Park Site therefore address the potential future migration of contamination in in-situ soils via groundwater, which may result from the re-alignment of the foreshore and resulting changes to the groundwater flow regime beneath the Headland Park Site.

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The proposed management measures associated with the creation of the naturalistic Headland Park landform include seepage water controls which prevent and capture/treat seepage waters which come into contact with the relocated/placed materials. As such, additional consideration of groundwater remediation/management associated with contamination in ex-situ soils which may migrate via groundwater is not required, since the potential migration pathway will be incomplete.

5.3.2 Site-Specific Guidance

The Overarching RAP for the Barangaroo Site (ERM 2010) outlines a range of remediation options and identifies the following preferred remediation option for "Area 4", in which the Headland Park Site lies:

- Excavation of "hotspots" of contaminated soils, followed by on-site management in accordance with the requirements established in the Headland Park HHERA (JBS 2011a and 2011b);
- Excavation of "hotspots" of contaminated soils, followed by classification and off-site disposal of materials which are not able to be managed on-site in accordance with the requirements established in the Headland Park HHERA (JBS 2011a and 2011b); and
- (Likely) ongoing monitoring of groundwater.

The Site Audit Statement and accompanying Site Audit Report (ENVIRON 2010) confirmed the appropriateness of the Overarching RAP for the Barangaroo Site (ERM 2010). The Site Auditor noted that:

"Specific remediation action plans and more detailed remediation work plans will be prepared for each individual portion of the site. The principles incorporated into the overarching RAP which should be incorporated into each individual RAP include:

- *Establishment of appropriate remediation end points applicable to both human health and the environment by a risk assessment that considers future landuse and potential long term impacts to Darling Harbour*
- *Establishment of a lateral and vertical extent of remediation that will address remediation end points*
- *Development of technical details for the remediation methods proposed that support that the selected method(s) are technically feasible with a low chance of failure*
- *Sustainable remediation, by reuse of material within the Barangaroo project area where possible*
- Documentation of a methodical and rigorous process for validation of the results of remediation."

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Table 5.1 Remediation Options Assessment Matrix – Headland Park Site

Option	Discussion	Conclusion
Option 1 On-site treatment so that the contaminants are either destroyed or the associated hazards are reduced to an acceptable level.	Impacted fill materials Due to the relatively intractable nature of metals within the fill material, there are no proven, cost-effective or reliable treatment processes which are able to destroy these contaminant. However, there are a number of microencapsulation treatment technologies which can reduce the mobility of the identified contaminants of concern (e.g., cement stabilisation). In addition, for low level hydrocarbon impacted soils landfarming is potentially suitable.	Not a suitable option for metals impacted fills. Potentially suitable for low level hydrocarbon impacted soils.
	Gasworks impacted soil/groundwater The gasworks related impacted soil can be treated with thermal methods to reduce/destroy the contamination, however, the close proximity of the Barangaroo Project Site to high density human receptors and sensitive environments (i.e., the Harbour), can present land-use conflicts during the operation of such equipment. An on-site water treatment plant can be incorporated into the proposed works to deal with any contaminated groundwater encountered as part of the sewage overflow storage excavation proposed to be undertaken as part of the creation of Headland Park. The water treatment plant can also be used to treat other waters which may be collected as part of the remediation works.	Not expected to be widespread on the Headland Park Site. Not a suitable option for soil. Contaminated groundwater has not been identified on the Headland Park Site. However, this is a preferred option if contaminated groundwater is encountered.
Option 2 Off-site treatment so that the contaminants are either destroyed or the associated hazards are reduced to an acceptable level, after which the soil is returned to the site.	Impacted fill materials As above (Option 1).	Not a suitable option.
	Gasworks impacted soil/groundwater As above (Option 1), however, additional time, energy and costs are incurred to take soils off site and return them to the site, in addition to there being no currently licensed facilities to undertake thermal treatment. Off-site immobilisation or bioremediation can also be used, however there are no suitably licensed treatment facilities in close proximity of the site (requiring considerable transportation and associated impacts) and heavily impacted materials may take significant timeframes to achieve the validation endpoints.	Not a suitable option.
Option 3 Excavation and off-site removal of the impacted material.	Impacted fill materials There are currently suitably licensed waste facilities in the Sydney Metropolitan region capable of accepting the identified contaminants within fill materials which have not been impacted by the former gasworks activities at the site.	A potentially applicable option but inferior to on-site placement (option 4) due to additional costs and environmental impacts.
	Gasworks impacted soil/groundwater The gasworks related soil can be stabilised (micro-encapsulation) in order to facilitate disposal to landfill under an immobilisation permit issued by DECCW and, in certain cases, may be reused on site within appropriately engineered structures. It is noted that highly impacted materials require treatment prior to landfilling, due to the waste classification of such materials. Off-site tankering/treatment/disposal of contaminated groundwater encountered during the works is an available, albeit expensive, option and has increased environmental impacts than on site treatment due to truck movements.	Significant volumes of gasworks waste are not expected to be encountered on the Headland Park Site. The preferred option for highly impacted soils, but inferior to on-site placement for low impacted soils, due to additional environmental impacts. Contaminated groundwater has not been identified on the Headland Park Site. Off-site water treatment is a suitable option but considered inferior in terms of overall cost and environmental impact to on-site water treatment.

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Table 5.1 Remediation Options Assessment Matrix – Headland Park Site

Option	Discussion	Conclusion
Option 4 Consolidation and isolation of the soil by on-site containment within a properly designed barrier and ongoing management.	Impacted fill materials Subject to compliance with the requirements outlined in the Headland Park HHERA (JBS 2011a and 2011b), the impacted materials appear suitable for retention within the Headland Park Site.	The preferred option for impacted fill materials, subject to finalisation of the Headland Park HHERA and review/acceptance by the Site Auditor.
	Gasworks impacted soil/groundwater Subject to compliance with the requirements outlined in the Headland Park HHERA (JBS 2011a and 2011b), the impacted materials appear suitable for retention within the Headland Park Site. Tar Containing Materials or Treated Tar Containing Materials (i.e., heavily impacted) are not suitable for reuse/placement in the Headland Park Site without additional capping/containment and ongoing management requirements. In addition, on-site treatment of certain materials may be required prior to reuse in a number of the identified reuse "zones", as defined in the Headland Park HHERA.	Significant volumes of gasworks waste are not expected to be encountered on the Headland Park Site. No significant contaminated groundwater has been identified on the Headland Park Site. The preferred option for soils with low levels of gasworks related impact. Not suitable for highly impacted soils and moderately impacted soils may require on-site treatment prior to reuse in a number of the identified reuse "zones", as defined in the Headland Park HHERA.

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5.4 Preferred Remediation Option

With consideration to DECCW's hierarchies for remediation, and to the site-specific contaminants and environmental setting, the following remediation/management approach has been adopted for the Headland Park Site:

Demolition and Earthworks

- On-site reuse/placement of impacted fill materials generated as part of the site excavations, and including any materials from the broader Barangaroo Project Site that meet the Site Acceptance Criteria established in this RAP. No highly impacted gasworks-related fill materials from within the Stage 1 Development will be accepted on the Headland Park Site.

Sewer Upgrade Work

- On-site reuse/placement of excavation materials generated as part of the sewerage upgrade works, but excluding any highly impacted gasworks-related materials from the Barangaroo Project Site. The risk of encountering highly impacted gasworks-related fill materials is considered to be low.
- Characterisation and off-site treatment and/or disposal at licensed waste facilities, of materials generated as part of the sewerage upgrade works which do not meet the Site Acceptance Criteria.
- Characterisation and release to either stormwater, or sewer or off-site disposal of groundwater collected during the excavation of the sewage overflow storage.

Sandstone Extraction Program

- On-site reuse/placement of impacted fill materials generated as part of the sandstone extraction program.
- On-site testing of collected groundwater during the sandstone extraction program, followed by release to stormwater in accordance with regulatory requirements.

Remediation Works within Headland Park Site

- Excavation of "hotspots" of contaminated soils, followed by on-site management in accordance with the requirements established in the Headland Park HHERA (JBS 2011a and 2011b);
- Excavation of "hotspots" of contaminated soils, followed by classification and off-site disposal of materials which are not able to be managed on-site in accordance with the requirements established in the Headland Park HHERA (JBS 2011a and 2011b); and
- (Likely) ongoing monitoring of groundwater.

Receipt and Placement of Materials from the broader Barangaroo Project Site

- On-site reuse/placement of impacted fill material sourced from the broader Barangaroo Project Site that are demonstrated to meet Site Acceptance Criteria established in this RAP to form part of the naturalistic headland.
- On-site management in accordance with the provisions contained in the Headland Park HHERA (JBS 2011a and 2011b) and the associated engineering controls required to be documented and included in the RWP for the Headland Park Site, which include seepage water prevention, collection and treatment.

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Where materials are reused on the Headland Park Site, then this will require ongoing management via the development and implementation of an appropriate LTEMP, which will be prepared upon completion of the validation report.

5.5 Scope of Remediation Works

5.5.1 Introduction

This section of the RAP provides principles and guidance for measures that are required to be implemented by the Remediation Contractor prior to and during works. The Remediation Contractor will be required to:

- Develop and implement a comprehensive Remediation Works Environmental Management Plan (REMP) to manage, monitor, maintain and report environmental control measures.
- Develop and implement a comprehensive Remediation Occupational Health and Safety Management Plan (ROHSMP) to manage, monitor, maintain and report health, safety and rehabilitation measures.

In addition to the above plans, the Remediation Consultant (JBS) shall prepare a detailed RWP on the specific remediation works for the Headland Park Site.

5.5.2 Site Establishment

The Headland Park Site boundary and any other relevant boundaries such as the Barangaroo Site boundary or the Barangaroo Project Site boundary will be defined by survey and contained as appropriate to ensure that all safety and environmental controls are implemented, including necessary contractor briefings and inductions for the remediation workforce. The details of the controls are provided in **Section 8**.

5.5.3 Demolition of Pavements and Structures

A number of structures and areas of pavement are to be demolished on the Headland Park Site. All materials generated as part of this shall be managed in accordance with the protocols described in **Section 8**. No structures and areas of pavement are to be demolished on the other parts of the Barangaroo Project Site as part of the requirements of this RAP.

5.5.4 Buildings and Services Protection

There are a number of buildings and existing services which require appropriate protection prior to the commencement of intrusive subsurface works. The protection measures include:

- Termination and relocation of in-ground services infrastructure by licensed contractors, as required; and
- Temporary or permanent retaining, shoring and stabilisation works necessary to perform the remediation works.

5.5.5 Dewatering/Treatment Plant Installation – Hickson Road

An appropriately designed network of dewatering spears shall be installed on the Barangaroo Project Site to allow the target depth of the sewage overflow storage excavation in the Hickson Road verge to be achieved. Dewater may be impacted with high levels of TPH, PAHs, BTEX and some metals and shall be transferred to a Water Treatment Plant (WTP) designed and installed within the Barangaroo Project Site to enable these works to proceed.

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Water treatment trials have not been undertaken to assess necessary contact times on Granular Activate Carbon (GAC) and appropriateness of GAC to remove identified groundwater contaminants, however, it is anticipated that the WTP would comprise the following elements:

- A triple interceptor trap to allow retention of phase separated hydrocarbons that may be encountered during dewatering works. The triple interceptor trap will further facilitate the removal of gross levels of suspended solids in influent; and
- GAC filters are included in the water treatment system. Sizing of GAC filters should be sufficient to achieve an appropriate contact time.

In addition, it is likely that suspended solids present in dewater will cause clogging of the GAC filters. Consideration should also be given to: the provision of sand or bag filters prior to the GAC; and/or backflushing; in addition to appropriate pressure ratings on all components, given the anticipated additional pressures associated with the solids present in the inflow waters.

Treated water shall be discharged to stormwater/sewer, depending on volumes, water quality and discharge requirements from City of Sydney Council (CoS) or Sydney Water Corporation (SWC) (**Section 10**).

5.5.6 Dewatering – Sandstone Excavation on the Headland Park Site

The groundwater or seawater that migrates into the excavation of sandstone on the Headland Park Site is required to be tested for all relevant COPC to determine if it can be discharged to storm water. If this is not possible, the water from excavations will be required to be either discharged to sewer under license to SWC or be treated in the WTP so that it is suitable.

5.5.7 Contaminated Soil Excavation

In accordance with the principles established for the Headland Park Site, it is proposed that, where possible, materials will be retained on the Headland Park Site.

Contaminated Soils within the Headland Park Site

Contaminated fill materials requiring remediation shall be excavated and stockpiled for characterisation and on-site reuse/placement, subject to compliance with the Site Acceptance Criteria (**Section 6.2**).

Site Materials from other Parts of the Barangaroo Project Site

Soils excavated from other parts of the Barangaroo Project Site associated with the creation of Headland Park (e.g., soils associated with the sewer upgrade works) shall be transferred to the Headland Park Site for stockpiling and/or placement.

If any highly contaminated materials are encountered, they may be required to be treated so that the contaminants are stabilised prior to placement on the Headland Park Site (excluding treated tar impacted materials) or disposed off-site to a landfill licensed to receive the appropriate class of waste.

Fill materials from the excavation of basements across the broader Barangaroo Site will be accepted for placement in the naturalistic landform, subject to compliance with the Site Acceptance Criteria (**Section 6.2**).

Highly Impacted Soils from within Declaration Area

Any highly impacted materials excavated from within the Declaration Area associated with the construction of the sewer line (refer **Figure 4**) and sewage overflow storage in

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Hickson Road shall be characterised to enable an assessment against the Site Acceptance Criteria established in this RAP for possible on-site reuse/placement. Any materials which do not meet the Site Acceptance Criteria established in this RAP will be removed offsite for treatment and/or disposal at appropriately licensed waste facilities.

No materials, excavated as part of the relocation of the sewer line, will be permitted on the Headland Park Site unless they meet the Site Acceptance Criteria established in this RAP.

5.5.8 Material Characterisation and Storage

A program of materials characterisation shall be undertaken for the following purposes:

- To verify that the composition of materials excavated from the Headland Park Site and retained on the Headland Park Site meet the Site Acceptance Criteria;
- To verify that the composition of materials received for placement within the Headland Park Site from the broader Barangaroo Project Site are consistent with that indicated by existing in-situ data and meet the Site Acceptance Criteria; and
- To assess the suitability of any materials excavated around an unexpected find of contaminated materials, such as drums or gasworks waste, for placement within the Headland Park Site.

Details of the characterisation program are provided in **Section 6**.

The storage of materials is envisaged, to allow a programming interface between material receipt and placement.

A Materials Compliance Management System (MCMS) shall be developed prior to receipt of Site Materials for reuse on the Headland Park Site, as described in **Section 6.1.5**.

5.5.9 Material Placement / Containment of Site Materials

A program of material placement shall be undertaken, following the completion of appropriate further investigations and development and implementation of the following supporting documentation/plans:

- Water Balance Assessment (WBA) to be completed by an appropriately qualified and experienced person;
- Subsurface Drainage Assessment and Design Plan (SDADP), incorporating the required details on the seepage water controls, to be completed by an appropriately qualified and experienced engineer; and
- Engineered Materials Placement Plan (EMPP) to be completed by an appropriately qualified and experienced engineer, including demonstrating that the design and integrity of the placed materials and associated structures are consistent with best practice standards.

The RWP should also demonstrate and document:

- How any incompatibilities between the placement locations and materials proposed to be placed are identified, including procedures as to how incompatibility issues are to be addressed; and
- How the placed materials and associated structures/controls (e.g., seepage water prevention/collection/treatment) will be retained on the Headland Park Site in a manner which does not impact on the surrounding environment.

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5.5.10 Validation

Validation of the remedial works will be undertaken to demonstrate that the works were undertaken in accordance with the requirements outlined in this RAP. Details of the validation program are provided in **Section 6**. An independent Site Audit, completed by a Site Auditor accredited by the NSW DECCW, will be conducted to review:

- The validation report(s) prepared when the validation criteria are achieved; and
- The LTEMP prepared to document the ongoing monitoring/management requirements to ensure the suitability of the Headland Park Site for the intended uses.

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6 Validation Plan

6.1 Soil Characterisation / Validation Sampling and Analyses

6.1.1 Validation Plan

The Validation Plan addresses materials sourced from:

- Excavations on the Headland Park Site;
- The Stage 1 Development Area; and
- The works associated with relocation of the sewer line and installation of the sewage overflow storage in Hickson Road within the Barangaroo Project Site.

The minimum requirements for the proposed soil sampling and analytical program, which is required to be derived as part of the Data Quality Objectives (DQOs) program (**Section 6.1.4**), is outlined in **Table 6.1**.

Table 6.1 Validation Sampling Program

Item	Sampling Frequency			Analytes
	Excavation floors	Excavation Walls (from each distinct horizon / material type)	Materials	
Contaminated soils identified as requiring remediation excavated from within the Headland Park Site	1/400 m^2	1/20 m	1/400 m^3	pH Metals TPH/BTEX PAHs Asbestos
Soils not identified as requiring remediation excavated from within the Headland Park Site and intended for reuse/placement within the Headland Park Site	N/A	N/A	1/400 m^3	pH Metals TPH/BTEX PAHs Asbestos
Excavated fill materials provided for placement in the Headland Park Site (Non Declaration Area Source)	1/400 m^2	1/20 m	1/400 m^3 for each material type*	pH Metals TPH/BTEX PAHs Total Cyanide ASLP (Metals) ASLP (TPH) ASLP (PAHs) Asbestos
Non aesthetically impacted excavated fill materials provided for placement in the Headland Park Site (Declaration Area Source)	1/400 m^2	1/20 m	1/250 m^3 for each material type*	pH Metals TPH/BTEX PAHs Phenols Total Cyanide ASLP (Metals) ASLP (TPH) ASLP (PAHs) Asbestos
Aesthetically impacted materials provided for placement in the Headland Park Site	N/A	N/A	1/25 m^3	pH Metals TPH/BTEX PAHs Phenols Total Cyanide ASLP (Metals) ASLP (TPH) ASLP (PAHs) Asbestos
Unexpected finds	1/25 m^2	1/5 m	1/25 m^3	As appropriate, depending on the location and characteristics of the find
Imported Soils (if required), either “VENM” or other waste	N/A	N/A	Minimum 10 samples per	pH

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Item	Sampling Frequency			Analytes
	Excavation floors	Excavation Walls (from each distinct horizon / material type)	Materials	
regulatory framework exempt materials (e.g., "ENM")			source site to enable calculation of 95%UCL_{avg} concentrations**	8 metals TPH/BTEX PAHs OCPs/PCBs Asbestos

Notes:

* This frequency may be relaxed for homogeneous materials and as agreed with the Site Auditor

** Validation of VENM materials shall be undertaken in accordance with the requirements of EPA 1995 and incorporate a review of the (source) site history and inspection of materials prior to/during/after importation onto the site.

6.1.2 Sampling Rationale

The sampling and analytical regime presented in **Table 6.1** is based on the following rationale:

- Inspection of the excavated surface is required to be made and sampling is to commence only if no evidence of contamination is identified by visual or olfactory means.
- The sampling frequency for the excavated materials (non Declaration Area source) received for placement in the Headland Park Site is intended to supplement, not replace, the existing in-situ data presented in ERM (2007 and 2008a). The adopted frequency is consistent with the frequency presented in the RAP prepared for the Blocks 1 – 3 within the Stage 1 Development (AECOM 2010)[12].
- The sampling frequency for the excavated materials sourced from the Declaration Area and received for placement in the Headland Park Site is intended to supplement, not replace, the existing in-situ data. The adopted frequency is more than that for materials from the non-Declaration Area parts of the Barangaroo Project Site, due to the higher likelihood of contamination and higher levels of the identified COPCs reported in this part of the Barangaroo Project Site. The frequency is broadly consistent with NSW DECCW guidance for sampling excavated natural materials, that being 10 samples per 4 000 tonnes, on a pro-rated basis.
- The sampling frequency may be decreased, with agreement of the Site Auditor, for materials that are judged to be homogeneous.
- The minimum validation grid size for unexpected finds is 25 m, which is capable of detecting circular hotspots of 29.5 m diameter or greater with 95% confidence, using Procedure A from *Contaminated Sites Sampling Design Guidelines* (EPA 1995), which is considered adequately conservative given the proposed development layout of the Headland Park Site.
- Analytical requirements are consistent with the COPCs identified at the Barangaroo Project Site and also meet the requirements for imported fill materials outlined in *Contaminated Sites Guidelines for Assessing Service Station Sites* (EPA 1994).

[12] *Barangaroo Remedial Action Plan – Other Remediation Works (South),* AECOM Australia Pty Ltd, June 2010 (AECOM 2010)

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- Imported material sampling frequencies exceed the minimum one composite sample requirement outlined in EPA 1995, and are based on having sufficient data to generate reliable 95%UCL_{avg} concentrations.

6.1.3 Sampling Methodology

Samples shall be collected by appropriately trained and experienced personnel from across the full depths of excavation walls and bases by the use of a hand trowel, or in excavations deeper than approximately 1 m from the central part of the bucket of an excavator or back-hoe.

Where samples are obtained from stockpiles, they will be collected from at least 200 mm beneath the surface of the stockpile. The hand trowel will be thoroughly decontaminated using a solution of a phosphate-free detergent and potable water between each sampling location. Where samples are required within large stockpiles or embankments, samples shall be collected by testpits placed using an excavator. Samples shall be collected from the centre of the excavator bucket ensuring that no part of the sample has contacted the sides of the excavator bucket. During the collection of soil samples, features such as seepage, discolouration, staining, odours and other indications of contamination will be noted on the field documentation.

Collected soil samples will be immediately transferred to laboratory-supplied glass jars and sealed using Teflon-lined screw enclosures. Sample labels will record: job number; sample identification number; sampler's initials; and date and time of sampling. Sample containers will be transferred to a chilled ice box for sample preservation prior to and during shipment to the testing laboratory. A chain-of-custody form will be completed and forwarded with the samples to the testing laboratory.

Soil validation samples shall be analysed by a primary laboratory which shall be NATA accredited for the required analyses. The secondary (check) laboratory responsible for analysing a certain proportion and type of QA/QC samples shall also be NATA accredited for the required analyses. Both laboratories will also be required to meet the environmental consultant's internal quality assurance requirements.

6.1.4 Data Quality Objectives and Data Quality Indicators

Prior to commencing the validation program, the Remediation Consultant is required to establish the DQOs that are required to be achieved. The DQO program is required to meet the requirements of DEC 2006.

The achievement of the DQOs established for the validation program are required to be assessed by reference to pre-determined Data Quality Indicators (DQIs) established for the validation program which are discussed below in relation to precision, accuracy, representativeness, comparability and completeness (PARCC parameters), and are shown in **Table 6.2**.

- **Precision** - measures the reproducibility of measurements under a given set of conditions. The precision of laboratory data and sampling techniques is assessed by calculating the Relative Percent Difference (RPD)[13] of duplicate samples.

[13] $$RPD(\%) = \frac{|C_o - C_d|}{C_o + C_d} \times 200$$

Where C_0 is the analyte concentration of the original sample
C_d is the analyte concentration of the duplicate sample

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- **Accuracy** - measures the bias in a measurement system. The accuracy of the laboratory data that are generated during this study is a measure of the closeness of the analytical results obtained by a method to the 'true' value. Accuracy is assessed by reference to the analytical results of laboratory control samples, laboratory spikes and analyses against reference standards.
- **Representativeness** –expresses the degree which sample data accurately and precisely represent a characteristic of a population or an environmental condition. Representativeness is achieved by collecting samples on a representative basis across the site, and by using an adequate number of sample locations to characterise the site to the required accuracy.
- **Comparability** - expresses the confidence with which one data set can be compared with another. This is achieved through maintaining a level of consistency in techniques used to collect samples; ensuring analysing laboratories use consistent analysis techniques and reporting methods.
- **Completeness** – is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being sufficient valid data generated during the study.

Table 6.2: Summary of Data Quality Indicators for Validation Program

	PARCC Components	Frequency	Data Quality Indicator Limits
Precision	*Field*		
	Appropriate standard operating procedures for sample collection & handling	All Samples	All samples
	Collection of blind and split duplicate samples	1/20 samples	-
	Possession of lab-prepared trip spike during fieldworks	1/day	-
	Laboratory		
	Blind duplicate analyses (intra laboratory)	1/20 samples	<50% RPD[1]
	Split duplicate analyses (inter laboratory)	1/20 samples	<50% RPD[1]
	Laboratory duplicate analyses	1/batch	<50% RPD[1]
	Trip spike analyses	1/20 samples[2]	>70%
Accuracy	*Field*		
	Appropriate standard operating procedures for sample collection & handling	All Samples	All samples
	Preparation and collection of rinsate blanks for each type of sampling equipment	1/day	-
	Possession of field blanks during fieldworks	1/day	-
	Laboratory		
	Trip blank analyses	1/20 samples	<LOR
	Rinsate blank analyses	1/20 samples	<LOR
	Surrogate spikes	All organics	70-130%
	Matrix spikes	1/batch	70-130%
	Matrix spike duplicates	1/batch	<50% RPD[1]
	Laboratory blanks	1/batch	<LOR
Represent-ativeness	*Field*		
	Sampling appropriate for media and analytes	All media / analytes	All media / analytes
	Laboratory		
	Samples analysed for correct (pre-defined) constituents	As per plan	-
	Samples extracted and analysed within holding times	All samples	As per NEPC 1999
Comparability	*Field*		
	Standard operating procedures for sample collection & handling	All Samples	All samples
	Consistent field conditions and sampling personnel	All Samples	All samples
	Appropriately trained and experienced sampling personnel	All Samples	All samples
	Laboratory		
	Standard & consistent analytical methods used for all analyses	All Samples	All samples
	Limits of reporting appropriate and consistent	All Samples	All samples
Completeness	*Field*		
	Critical locations sampled	As per plan	-
	Proposed locations sampled and samples retrieved from	As per plan	-

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	PARCC Components	Frequency	Data Quality Indicator Limits
	target depths		
	Sample description and COCs completed and appropriate	All Samples	All samples
	Appropriate documentation	All Samples	-
	Standard operating procedures for sample collection & handling	All Samples	All samples
	Appropriately trained and experienced sampling personnel	All Samples	All samples
	Laboratory		
	Satisfactory frequency and result for QC samples	All QA/QC samples	100%
	Data from critical samples is considered valid	All samples	Critical samples valid

(1) If the RPD between duplicates is greater than the pre-determined data quality indicator, a judgement will be made as to whether the excess is critical in relation to the validation of the data set or unacceptable sampling error is occurring in the field.
(2) Only required where volatile substances (TPH C_6-C_9 and BTEX) analysed.

6.1.5 Site Materials Compliance Management

A Materials Compliance Management System (MCMS) shall be developed prior to receipt of Site Materials for reuse on the Headland Park Site and include two primary elements:

1. Materials Management Guideline (material qualities); and
2. Materials Tracking Plan (quantity / movement / location).

The MCMS will contain the following specific details:

- Definition of responsibilities, including the Remediation Contractor(s), other contractor(s) e.g., sewerage upgrade works, Lend Lease Remediation Consultant (AECOM), BDA Remediation Consultant (JBS) and the Site Auditor.
- Material Quality, summarising existing analytical (in-situ) data, additional analytical (ex-situ) data, additional observations to satisfy other acceptance criteria (e.g., % tar) and alignment of all data to enable classification as per "zones established in the Headland Park HHERA (JBS 2011a and 2011b).
- Where the materials have originated & what classification have they been given, noting that source depths are not critical if tied to material type, while placement depths are critical since tied to Headland Park HHERA criteria.
- Where the materials have been placed (lateral & vertical).
- The quantity of placed materials.
- Site grid squares / Site survey data (GPS / GIS), noting size of grid and elevations.
- Frequency of data collection, with consideration to both program (time) and area/material type.
- Material Tracking Records.
- Standard forms / documentation.
- Non-conformances / Unexpected Finds.
- QA/QC.

6.1.6 Imported Soils Compliance with Validation Plan

As stated in the Validation Plan (**Section 6.1.1**), only materials which meet the definition of VENM or ENM as defined under relevant regulations will be accepted onto the Headland Park Site.

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Prior to VENM or ENM materials being accepted onto the site, the following compliance procedure will be implemented:

- The source site(s) and material type(s) shall each be inspected by the Remediation Consultant and confirm that the site history indicates the site is uncontaminated and that the soil proposed to be excavated is visually clean and undisturbed;
- The documentation relating to the materials shall be reviewed by the Remediation Consultant and assessed against the requirements outlined in **Sections 6.1.1 – 6.1.4** of this RAP and any additional requirements such as specific sampling/analytical requirements for ENM, as prescribed by relevant regulations. If the data is incomplete / insufficient, the materials will not be accepted onto the Headland Park Site until additional data has been collected in accordance with the requirements of this RAP and relevant regulatory requirements, as relevant, to the satisfaction of the Remediation Consultant;
- Regular inspections of imported materials accepted for importation on the Headland Park Site shall be undertaken by the Remediation Consultant. In the event that imported materials are observed by the Remediation Consultant to be inconsistent with that described in the imported material classification documentation and/or that observed by the Remediation Consultant at the source site and/or if suspected signs of contamination are identified, the importation of soils from the specific source site(s) shall be suspended until such time as confirmatory sampling/analyses is undertaken by the Remediation Consultant to confirm the suitability of the materials for acceptance onto the Headland Park Site.

6.2 Soil Characterisation / Validation Criteria

6.2.1 Background

Draft site-specific risk-based criteria have been developed in the Headland Park HHERA in accordance with relevant guidelines and in consultation with the NSW DECCW. The draft risk-based criteria shall be reviewed and accepted for use by the appointed NSW DECCW accredited Site Auditor prior to being applied during the remediation works to be undertaken at the Headland Park Site.

The following definition of Tar Containing Materials will apply, since Tar Containing Materials shall not be accepted onto the Headland Park Site from other parts of the Barangaroo Project Site (source: BDA):

Tar Containing Material has been defined for the purpose of the Barangaroo Project Site as being material that contains:

- *more than 10% (volume/volume based on visual assessment) of coal tar (where coal tar is a phase separated hydrocarbon by-product from coal gasification); and*
- *Contaminant concentrations exceeding the following limits:*
  - *Polycyclic Aromatic Hydrocarbons (PAHs) – 2000 mg/kg; or*
  - *Benzo(a)Pyrene (B(a)P) – 150 mg/kg.*

Although Tar Containing Materials and Treated Tar Containing Materials shall not be accepted onto the Headland Park Site from other parts of the Barangaroo Project Site, Former Tar Containing Materials that have been treated by one or more chemical and/or

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physical processes which destroy PAHs so that the materials are no longer Tar Contaminated Materials, are able to be accepted onto the Headland Park Site from other parts of the Barangaroo Project Site.

In addition to the quantitative criteria referred to in this Section of the RAP, the following qualitative observations/detections will also supplement the characterisation/validation process:

- Observations made regarding the condition of visible asbestos containing materials in addition to laboratory analyses for the presence of asbestos fibres; and
- The presence of odorous or discoloured soils (caused by contamination).

Material tracking details shall be prepared as part of the MCMS (**Section 6.1.5**) prior to commencement of the remediation works, detailing the material inspection/tracking/testing protocols, consistent with the validation sampling program outlined in **Section 6.1** and the validation of placement areas outlined in **Section 6.3**.

6.2.2 Site Acceptance Criteria

Materials will only be retained or accepted on the Headland Park Site if they meet the Site Acceptance Criteria, defined below for the following categories of materials:

1. Site Materials – fill/soil/rock materials sourced from land within the Barangaroo Project Site; and
2. Imported Materials – fill/soil/rock materials imported onto the Barangaroo Project Site as part of the creation of Headland Park which have been sourced from land other than the Barangaroo Project Site.

Site Acceptance Criteria for Site Materials

Site Materials will only be retained or accepted on the Headland Park Site if:

1. The concentrations of contaminants within the materials meet the risk-based criteria in the Headland Park HHERA (JBS 2011a and 2011b); and
2. Are not Tar Containing Materials as defined in **Section 6.2.1**, or Treated Tar Containing Materials.

The following statistical criteria shall be applied to the soil data when assessing against the Site Acceptance Criteria:

- The upper 95% confidence limit on the mean concentration for each analyte (calculated for samples collected from consistent soil horizons, stratigraphy or material types) must be below the adopted criterion for each COPC;
- No single analyte concentration shall exceed 250% of the adopted criterion for each COPC; and
- The standard deviation of the results must be less than 50% of the criterion for each COPC.

The draft risk-based soil criteria for the Headland Park Site for ex-situ soils to be placed within the Headland Park naturalistic landform and in-situ soils beneath the existing site surface are presented in the **Table 6.3** . The final risk-based soil criteria for the Headland Park Site will be documented in the RWP once the Headland Park HHERA has been reviewed/accepted by the Site Auditor.

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Table 6.3: Summary of Risk Based Criteria (Site Specific Human Health Based Risk Criteria Unless Otherwise Specified) – Refer to Figure 14 for location of Zones

Constituent	Zone 1 Risk Based Criteria (mg/kg)			Zone 2 Risk Based Criteria (mg/kg)		Zone 3 Risk Based Criteria (mg/kg)	Zone 4 Risk Based Criteria (mg/kg)	Zone 5 Risk Based Criteria (mg/kg)	Zone 6 Risk Based Criteria (mg/kg)					Irrigation Water Risk Based Criteria (mg/L)
		Outside Drainage Control Area		Saturated Zone Soils					Saturated Zone Soils		Unsaturated Soil Zones			
	Soils within Drainage Control Area	Sourced from Headland Park	Sourced from Barangaroo Central and South	Sourced from Headland Park	Sourced from Barangaroo Central and South				Sourced from Headland Park	Sourced from Barangaroo Central and South	Sourced from Headland Park	Sourced from Barangaroo Central and South	Soil In Clay Liner[6]	
Ammonia	5100			>MAX		580	750	2500	>MAX		>MAX			72
Arsenic	27[4]	92[5]	102[5]	23[5]	26[5]	>MAX	>MAX	>MAX	23[5]	26[5]	92[5]	102[5]	>MAX	0.93[7]
Cadmium	7.7			>MAX		>MAX	>MAX	>MAX	>MAX					0.077
Chromium	450			>MAX		>MAX	>MAX	>MAX	>MAX					0.29
Copper	152[4]	124[5]	87[5]	31[5]	22[5]	-	-	-	31[5]	22[5]	124[5]	87[5]	>MAX	4.3[7]
Lead	130			157[5]	129[5]	>MAX	>MAX	>MAX	157[5]	129[5]	129[5]	629[5]	>MAX	1.1[7]
Mercury	2.9[4]	0.8[5]	2.9[4]	0.2[5]	7[5]	-	-	-	0.2[5]	7[5]	0.8[5]	27[5]	>MAX	0.056[7]
Nickel	67[4]			1061[5]	700[5]	>MAX	>MAX	>MAX	1061[5]	700[5]	4242[5]	2800[5]	>MAX	1.0[7]
Zinc	430[4]	395[5]	180[5]	99[5]	45[5]	-	-	-	99[5]	45[5]	395[5]	180[5]	>MAX	6.9[7]
Cyanide	0.5[4]	<LOR[5]	<LOR[5]	<LOR[5]		950	>MAX	2500	<LOR[5]		<LOR[5]		3400	0.051
Benzene	1.0[4]			1.3		0.1	0.1[1]	0.3[1]	1.3[5]		5.4[5]		2.3	0.023
Toluene	1.4[4]			0.7[5]		180	260[1]	690[8]	0.7[5]		2.9[5]		690	0.02[7]
Ethylbenzene	3.1[4]	<LOR[5]	<LOR[5]	<LOR[5]		25	36[1]	80[8]	<LOR[5]		<LOR[5]		80	0.023[7]
Xylenes	14[4]	1.9[5]	1.9[5]	<LOR[5]		64	86[1]	180[8]	<LOR[5]		1.9[5]		180	0.12[7]
1,2,4-trimethylbenzene	21			44		0.8	1.2[1]	46[8]	46		46		46	0.51
TPH C_6-C_9	65[4]			65[9]		100	130[1]	430[1]	65[5]		261[5]		3500	150[7]
TPH C_{10}-C_{14}	1000[4]			1165.5[9]		107.5	1391	3800[8]	1165.5[10]		4661.5[10]		3800	5.6[11]
TPH C_{15}-C_{28}				714.5[2]		<MAX	<MAX	<MAX	764.5[5]		2857[5]		<MAX	1.15[11]
TPH C_{29}-C_{36}														
Acenapthene	-	279[5]	888[5]	70[5]	222[5]	-	-	-	70[5]	222[5]	279[5]	888[5]	-	0.00066[7]
Acenaphthylene	-	20[5]	12[5]	5[5]	2.9[5]	-	-	-	5[5]	2.9[5]	20[5]	12[5]	-	-
Anthracene	-	167[5]	233[5]	42[5]	58[5]	-	-	-	42[5]	58[5]	167[5]	233[5]	-	-
Benz(a)anthracene	31			95		39	73	>MAX	>MAX					0.0043
Benzo(a)pyrene	3.1			810		810	810	810	>MAX					0.0015
Benzo(b)fluoranthene	31			>MAX		>MAX	>MAX	>MAX	>MAX					0.26[7]
Benzo(k)fluoranthene	31			>MAX		>MAX	>MAX	>MAX	>MAX					0.15[7]
Chrysene	310			>MAX		>MAX	>MAX	>MAX	>MAX					0.18[7]
Dibenz(a,h)anthracene	3.1			>MAX		>MAX	>MAX	>MAX	>MAX					0.0011[7]
Dibenzofuran	>MAX			>MAX		>MAX	>MAX	>MAX	>MAX					21[7]
Fluoranthene	670			35[5]	23[5]	>MAX	>MAX	>MAX	35[5]	23[5]	140[5]	90[5]	>MAX	0.91
Fluorene	30[4]			2.4[5]	3.2[5]	>MAX	>MAX	>MAX	2.4[5]	3.2[5]	10[5]	13[5]	>MAX	8.0[11]
Indeno(1,2,3-c,d)pyrene	31			>MAX		>MAX	>MAX	>MAX	<MAX		>MAX		>MAX	0.0083
2-methylnaphthalene	2600			1100		610	940	2500[8]	2500		2500		2500	9.6
Naphthalene	880	833[5]	104[5]	208[5]	26[5]	12	17[1]	73[1]	208[5]	26[5]	833[5]	104[5]	>MAX	3.3
Phenanthrene	-			17[5]	6[5]	-	-	-	17[5]	6[5]	67[5]	24[5]	-	-
Pyrene	14[4]			12[5]	4.8[5]	>MAX	>MAX	>MAX	12[5]	4.8[5]	48[5]	19[5]	>MAX	3.3[11]
Phenol	>MAX			1.2[5]		>MAX	>MAX	>MAX	1.2[5]		4.9[5]		>MAX	0.25[11]
2,4-dimethylphenol	>MAX	4.9[5]	4.9[5]	<LOR[5]		>MAX	>MAX	>MAX	<LOR[5]		<LOR[5]		>MAX	42
Cresols	3100	3.9[5]	3.9[5]	1.0[5]		>MAX	>MAX	>MAX	1.0[5]		3.9[5]		>MAX	150

Note:
1. Zone 6 criteria may be applied for these constituents where soils are >10m from Cultural Space.
2. Concentration based on risk based criteria from TPH $C_{>16}$ aromatic concentration only, risk based criterion TPH $C_{>16}$ aliphatic concentration >MAX for Ecological Protection of Surface Water
3. Concentration based on risk based criteria from TPH $C_{>16}$ aromatic concentration only, risk based criterion TPH $C_{>16}$ aliphatic concentration >MAX for Ecological Protection of Surface Water
4. Risk based criteria derived for Ecological Protection of Potential Phytotoxicity Effects in 'Growing Zone' soils
5 Risk based criteria derived for Ecological Protection of Surface Water
6 Soil within drainage control area
7 Risk based criteria for Ecological Protection of Potential Phytotoxicity Effects from Irrigation Water
8 Zone 6 criteria applied for constituent
9 Concentration based on risk based criteria from TPH $C_{>6-9}$ aliphatic concentration only, for Ecological Protection of Surface Water
10 Concentration based on risk based criteria from TPH C_{10-14} aromatic and aromatic concentrations
11 Risk based criteria for Human Health Protection from Irrigation Water
Zone 1 – 0-0.5m below open area of Park
Zone 2 – Below Car Park
Zone 3 – 0-1m away from 'Cultural Space'
Zone 4 – >1-10m below / away from 'Cultural Space' and 0-10m away from Car Park
Zone 5 – >10-30m below / away from 'Cultural Space' and away from Car Park
Zone 6 – >30m lateral distance from western portion of 'Cultural Space' and >0.5m below Park surface
<SOL - Above solubility limit
<MAX – risk based criteria exceeds maximum detected concentration on site

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Site Acceptance Criteria for Imported Materials

Imported materials will only be accepted on the Headland Park Site if they:

- meet the definition of Virgin Excavated Natural Material (VENM) as defined in relevant legislation, noting that all reported concentrations of organic constituents should be below the laboratory limits of reporting and the reported concentrations of inorganic constituents consistent with published background levels (NEPC 1999); or
- meet the definition of Excavated Natural Material (ENM) as defined in relevant regulations.

6.3 Water Characterisation / Validation

6.3.1 Water Sampling and Analyses

Water samples shall be collected by the Remediation Consultant from the outlet of the groundwater treatment system. These shall be collected at a frequency of two samples per day at the commencement of treatment (prior to demonstration of treatment efficiency to required standards). Once the treatment capabilities of the plant have been demonstrated by way of 6 consecutive monitoring results below the nominated treatment criteria (**Section 6.3.2**), the monitoring frequency shall be reduced to a weekly basis.

Laboratory supplied sample bottles of appropriate size, composition and preservation shall be labelled as described for soil sample containers. Bottles shall be filled directly and transferred to a chilled ice box for transport to the testing laboratories under chain of custody conditions.

Groundwater validation samples shall be analysed by a primary laboratory which shall be NATA accredited for the required analyses. The secondary (check) laboratory responsible for analysing a certain proportion and type of QA/QC samples shall also be NATA accredited for the required analyses. Both laboratories will also be required to meet the environmental consultant's own internal quality assurance requirements.

6.3.2 Water Validation Criteria

Water quality data shall be compared against the criteria presented in **Table 6.4** prior to release of water to Darling Harbour. The final irrigation water criteria will be included in LTEMP following review/acceptance by the Site Auditor.

Table 6.4 Discharge Criteria for Waters Released to Darling Harbour (µg/l)

	Limit of Reporting	Laboratory Method	Aquatic Ecosystem Criteria[1]	Recreational Criteria – primary and secondary contact[2]
METALS				
Cadmium	0.1	ICP-AES (USEPA 200.8)	0.7[3]	5
Copper	1.0	ICP-AES (USEPA 200.8)	1.3	1000
Nickel	1.0	ICP-AES (USEPA 200.8)	7	100
Lead	1.0	ICP-AES (USEPA 200.8)	4.4	50
Zinc	1.0	ICP-AES (USEPA 200.8)	15	5000
Mercury	0.5	ICP-AES (USEPA 200.8)	0.1[3]	1
PETROLEUM HYDROCARBONS				
C10 – C36 Fraction	250	P&T GC/MS (USEPA 8020A, 8000)	600[4]	No odour or sheen
BTEX				
Benzene	1.0	P&T GC/MS (USEPA 8020A)	500	10
Toluene	1.0	P&T GC/MS (USEPA 8020A)	180	-
Ethylbenzene	1.0	P&T GC/MS (USEPA 8020A)	5	-

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	Limit of Reporting	Laboratory Method	Aquatic Ecosystem Criteria[1]	Recreational Criteria – primary and secondary contact[2]
o-Xylene	1.0	P&T GC/MS (USEPA 8020A)	350[5]	-
m-Xylene	1.0	P&T GC/MS (USEPA 8020A)	75[5]	-
p-Xylene	1.0	P&T GC/MS (USEPA 8020A)	200[5]	-
POLYCYCLIC AROMATIC HYDROCARBONS				
Naphthalene	0.1	GCMS (USEPA8270)	50[3]	-
Anthracene	0.1	GCMS (USEPA8270)	0.1[6,7]	-
Phenanthrene	0.1	GCMS (USEPA8270)	0.6[6,7]	-
Fluoranthene	0.1	GCMS (USEPA8270)	1[3,5]	-
Benzo(a)pyrene	0.1	GCMS (USEPA8270)	0.1[3,5]	0.1[8]

Notes
(1) 95% Protection Trigger Values for Marine Water (ANZECC/ARMCANZ 2000)
(2) Recreational Trigger Values for Primary and Secondary Contact Recreation (ANZECC/ARMCANZ 2000)
(3) 99% Protection Level used, as recommended by ANZECC/ARMCANZ 2000
(4) No reliable Trigger Value provided in ANZECC/ARMCANZ 2000. Dutch Criterion for mineral oil used for screening level purposes
(5) Low Reliability Trigger Value (ANZECC/ARMCANZ 2000)
(6) Indicative Interim Working Level (ANZECC/ARMCANZ 2000)
(7) Laboratory limit of reporting is less than the available criterion, hence the laboratory LOR is adopted as the criterion.
(8) Total PCBs

6.4 Validation of Soil Placement Areas

Areas where soils are reused by placement to form Headland Park will be subject to the following data recording process for future reference purposes, and detailed in the REMP:

- A dilapidation survey of the retained pavements prior to material placement;
- A location plan of the placed materials with co-ordinates relative to the lot boundaries;
- The levels in mAHD of the base of the placement location(s) prior to the material placement;
- Confirmation of appropriate modifications to any existing drainage infrastructure beneath the material placement areas so that there are no direct migration pathways for infiltration to enter the receiving waterbody.
- The levels in mAHD of the placement locations once all materials have been placed;
- The levels in mAHD of any defining layers, such as marker layers; and
- Subsequently the total placed volume of materials.

At the completion of the Main Works program on the Headland Park Site, a LTEMP will be prepared documenting the presence of the placed materials and the ongoing monitoring/management measures that are expected to be implemented to ensure environmental compliance over the life of the Headland Park Site.

6.5 Validation Reporting

6.5.1 Validation Reports

The overall Headland Park Site validation report, prepared after completion of the Main Works associated with Headland Park, will be required to be in general accordance with the *Contaminated Sites Guidelines for Consultants Reporting on Contaminated Sites* (EPA 1997).

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The overall Headland Park Site validation report will contain information including:

- Details of the remediation works conducted;
- Information demonstrating that the objectives of this RAP have been achieved, in particular the validation sample results and assessment of the data against both the pre-defined data quality objectives and the Site Acceptance Criteria;
- Information demonstrating compliance with relevant regulatory requirements;
- Any variations to the strategy undertaken during the implementation of the remedial works;
- Results of all environmental monitoring undertaken during the course of the remedial works;
- Details of any environmental incidents occurring during the course of the remedial works and the actions undertaken in response to these incidents;
- Details on waste classification, tracking and off-site disposal;
- Clear statement of the suitability of the site (or part of the site) that is the subject of the validation report, for the proposed use(s);
- Other information as appropriate, including details of LTEMP that will apply to the site that is the subject of the validation report.

The report will serve to document the remediation works for future reference.

6.5.2 Ongoing Monitoring / Management

The proposed remediation strategy for the Headland Park Site will require ongoing monitoring and management. A LTEMP will be prepared to detail the ongoing management and monitoring requirements for the Headland Park Site, however, the precise nature and extent of the management/monitoring requirements will not be known until intrusive remediation works are conducted and the validation data obtained. The LTEMP will be prepared following the completion of the validation report for the Headland Park Site.

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7 Contingency Plan

A review of the proposed contamination-related aspects of the works associated with the development of the Headland Park has been undertaken and has identified a number of potential risks, which are outlined in the following sections, and has led to the development of contingencies that will be implemented to ensure that the objectives of this RAP are met.

The Contingency Plan is required to be part of the REMP, as described in **Section 8**, below, and part of the ROHSMP, as described in **Section 9**.

7.1 Unexpected Finds

The possibility exists for hazards that have not been identified to date to be present at the Headland Park Site. The nature of hazards which may be present and which may be discovered at the Barangaroo Project Site are generally detectable through visual or olfactory means, for example:

- Fragments of asbestos-containing materials (visible) or aggregates of friable asbestos materials (visible);
- Construction/Demolition Waste (visible);
- Hydrocarbon impacted materials (visible/odorous);
- Drums or underground storage tanks (USTs) (visible); and
- Ash and/or slag contaminated soils/fill materials (visible).

As a precautionary measure to ensure the protection of the workforce and surrounding community, should any of the abovementioned substances (or any other unexpected potentially hazardous substance) be identified, the procedure summarised in **Figure 7.1** is to be followed.

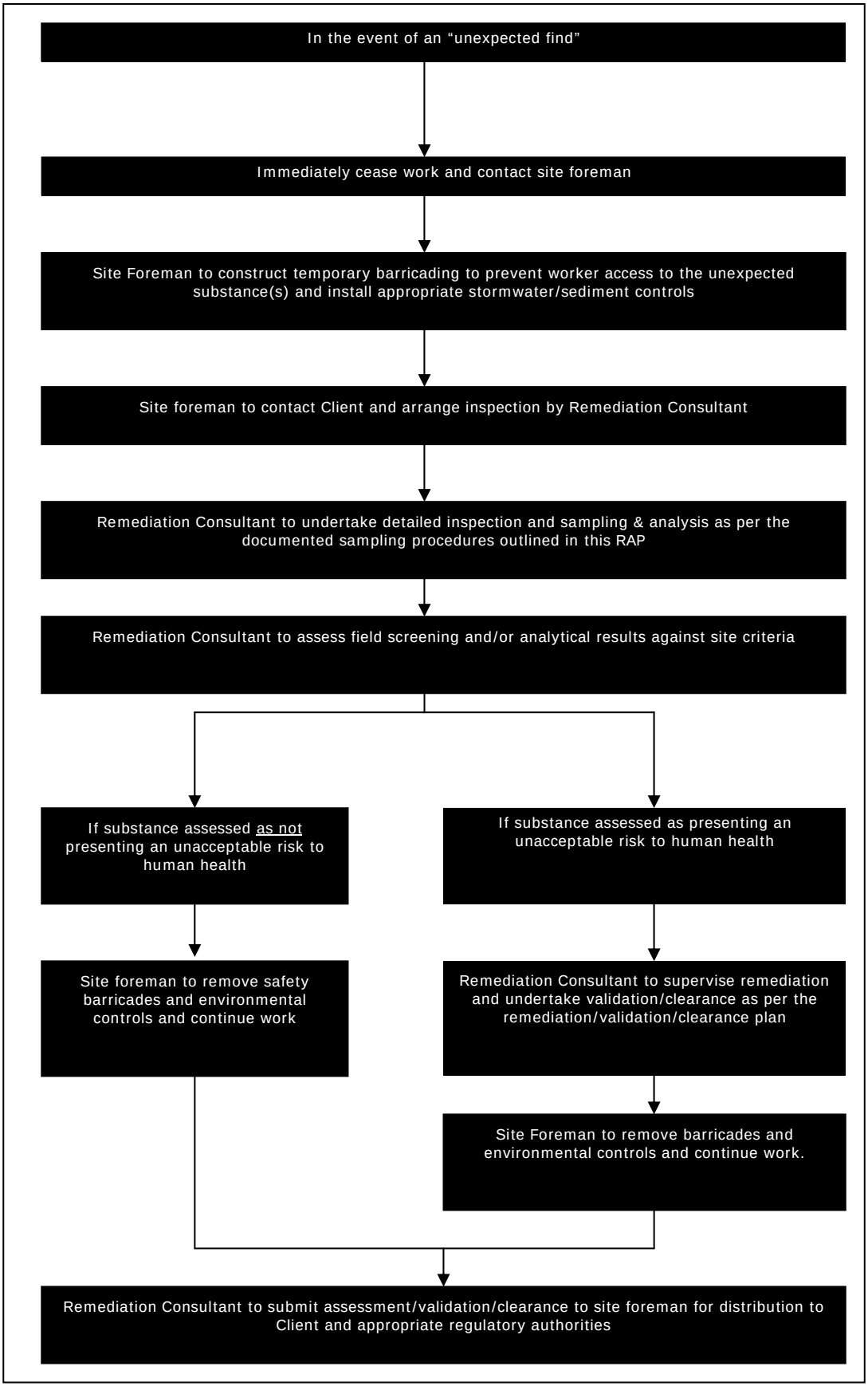
An enlarged version of the unexpected finds protocol, suitable for use on site, should be posted in the Site Office and referred to during the Site Specific Induction by the Remediation Contractor.

The sampling strategy for each “unexpected find” shall be designed by a suitably qualified environmental consultant. The strategy will, however, be aimed at determining the nature of the substance – that is, is it hazardous and, if so, is it at concentrations which pose an unacceptable risk to human health or the environment.

The sampling frequency of the identified substance/materials shall meet the minimum requirements outlined in EPA 1995 in addition to those outlined in **Section 6.1**.

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Figure 7.1 - Unexpected Finds Protocol



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7.2 Contingency Scenarios

7.2.1 Identification of Coal Tar Impacted Materials

In the event that coal tar impacted materials are encountered, the provisions outlined in the unexpected finds protocol will be implemented, comprising inspection, testing and appropriate action as advised by the Remediation Consultant (**Section 7.1**).

Any suspected coal tar impacted materials must be segregated from other excavated materials and placed in a designated area with appropriate odour controls until such time as an appropriate assessment and methodology is confirmed for their appropriate management. In the event that the coal tar impacted materials do not meet the Site Acceptance Criteria, then they shall be stored in a secure area for later treatment or classified and removed from the Barangaroo Project Site for treatment and/or disposal at an appropriately licensed facility, in accordance with the requirements in **Section 8**.

7.2.2 Identification of Asbestos Containing Materials

In the event that asbestos containing materials are encountered, the materials will be characterised in accordance with the *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia* (WA DoH 2009) to:

- Assess the concentration of fragments of bonded asbestos in the soil matrix; and
- Assess the presence of asbestos fibres within the soil matrix.

The data obtained shall be assessed against the Site Acceptance Criteria (**Section 6.2.2**), to assess the suitability of the materials for placement on the Headland Park Site.

7.2.3 Material Storage Breach

In the event that any materials storage containment controls are breached and stockpiled materials have escaped (or have the potential to escape), then the management controls shall be rectified and investigations undertaken to review the adequacy of the controls and any improvements implemented. The REMP (**Section 8**) shall include a documented process for identifying and responding to such incidents.

7.2.4 Emissions Complaints

Due to the nature of the activities and type of contaminants identified at the Barangaroo Project Site, there is a potential for complaints to be received from members of the public relating to environmental emissions including:

- Odour emissions arising from handling of malodorous soil/groundwater;
- Noise and vibration arising from excavation, tunnelling and other works;
- Dust emissions arising from excavation, material handling and placement; and
- Visibly impacted water quality in Darling Harbour.

Monitoring of all environmental emissions shall be undertaken during the works as detailed in the REMP (**Section 8**) and appropriate actions taken to further control emissions following receipt of a complaint. Such additional controls may include the following actions, required to be detailed in the REMP (**Section 8**):

- Increased application of odour masking chemicals on odorous materials;
- Disturbance of soils during meteorologically favourable periods only; and/or
- Covering highly impacted soils which are generating excessive odours.

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8 Remediation Environmental Management Plan

8.1 Preparation of Remediation Environmental Management Plan

Prior to mobilising on the Headland Park Site, a Remediation Environmental Management Plan (REMP) shall be prepared by the Remediation Contractor, which documents the environmental monitoring and management measures required to be implemented during the remediation-related activities associated with the Headland Park Development.

The REMP shall address each of the nominated items in **Section 8.2** and shall include the Contingency Plan, referred to in **Section 7**, above.

8.2 Required Elements/Procedures

An assessment of the proposed activities and the associated elements required to be incorporated into the REMP is provided in **Table 8.1**. The REMP is required to address each of the required elements and procedures in full detail and to include detailed monitoring processes and procedures, corrective actions and reporting requirements.

Table 8.1 Required Elements of the REMP

Element	Specific Minimum Requirements to be included in REMP
1. Dust and Airborne Hazard Control	Real time airborne dust analyser monitoring. Asbestos air monitoring if/as required. Provisions for dust control based on monitoring results.
2. Flora and Fauna	As appropriate.
3. Heritage/Archaeological	In accordance with relevant heritage/archaeological studies.
4. Visual Impacts	Visual monitoring at site boundary Specific colour requirements for various controls/measures, including PPE (e.g., navy coveralls)
5. Emergency Response	As appropriate. Procedures required for spill incident response including material storage breach.
6. Noise Control	Hours of operation, consistent with the consent conditions. Boundary monitoring at commencement of work site activities with potential for environmental noise emissions. Potential noise monitoring at nearest receptors. Procedures for control and management of noise emissions, as appropriate (e.g., restricted hours).
7. Traffic	Controls on vehicle movements on public roads. Controls on transport of tar impacted materials.
8. Protection of Adjoining Structures	As appropriate.
9. Odour Control	Enclosure of all potential tar odour generating activities (i.e., excavation of sewage overflow storage) with appropriate ventilation controls, including provisions of a negative-pressure enclosure from which air is passed through an odour filtration system (for enclosure) design requirements, incorporating safeguards and monitoring. Daily monitoring of odour levels at boundary during handling of malodorous materials. Procedures for addressing elevated odour monitoring results, including, but not limited to: reduction in earthworks activities within odorous material areas during adverse meteorological conditions; application of odour masking solutions at the odour source or between identified source(s) and receptor(s); and covering identified odour sources by hydromulching or with less odourous materials.
10. Handling of Contaminated Soil	Soil and water management (stockpiling, site access, excavation pump out, reinstatement).
11. Soil Storage/Placement Areas	Soil and water management (stockpiling, site access, excavation pump out, reinstatement). Bunding. Heavy vehicle/personnel decontamination. Interim storage requirements for materials requiring later treatment. Site drainage requirements, incorporating clean/dirty areas and modifications to existing surface water and drainage controls beneath retained pavements. Monitoring as required.
12. Sediment Control	Bunding. Collection/treatment/handling impacted sediments.

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Element	Specific Minimum Requirements to be included in REMP
13. Operation of Site Office	As appropriate.
14. Decontamination of Heavy Equipment	As appropriate.
15. Environmental Monitoring	Monitoring of dusts, noise, odour. Monitoring as required for vibration and water releases. Monitoring as required for asbestos. Inspection checklists and field forms.
16. Water Treatment	Excavation pump out. Water treatment. Water sampling and testing.
17. Environmental Criteria	Soil criteria sourced from Headland Park HHERA (JBS 2011a and 2011b).
18. Material Classification	As detailed in this RAP (Section 6). Materials tracking, including QA/QC inspection and sampling.
19. Community Relations Plan	Refer to BDA project specific communication protocols, incorporating nomination of specific contact persons & details and requirements for communications/response register.
20. Incident Reporting	As appropriate, including standard form/checklist.
21. Security and Signage	Secure site perimeter. Site boundary signage.
22. EMP Review	As appropriate.
23. Training	As appropriate.
24. Contact Details	Company/personnel details, including names/phone numbers for: - Principal - Site Auditor - Remediation Consultant - Remediation Contractor - OH&S Compliance - Environmental Compliance

8.3 Certification

Prior to establishment on the Headland Park Site, the Remediation Contractor is required to have the REMP certified as acceptable by a person independent of the Remediation Contractor who is experienced with protection of the environment during remediation and management of contaminated sites.

A copy of the REMP and the certification to the satisfaction of BDA are required to be provided to the BDA prior to establishment on the Headland Park Site.

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9 Health and Safety

9.1 Remediation Occupational Health and Safety Management Plan

A Remediation Occupational Health and Safety Management Plan (ROHSMP) shall be prepared by the Remediation Contractor prior to mobilisation onto the Headland Park Site. The Plan shall contain procedures and requirements that are to be implemented as a minimum during the works, in addition to the Contingency Plan, referred to in **Section 7**.

The objectives of the ROHSMP are:

- to apply standard procedures that minimises risks resulting from the works;
- to ensure all employees are provided with appropriate training, equipment and support to consistently perform their duties in a safe manner; and
- to have procedures to protect other site workers and the general public.

These objectives will be achieved by:

- assignment of responsibilities;
- an evaluation of hazards;
- establishment of personal protection standards, mandatory safety practices and procedures;
- monitoring of potential hazards and implementation of corrective measures; and
- provision for contingencies that may arise while operations are being conducted at the site.

9.2 Additional Site-Specific Elements/Procedures

In addition to the normal construction-related matters, the ROHSMP shall address the following site-specific specific hazards associated with the works relating to the management of contaminated soil and groundwater:

- Under/aboveground services, specifically former gasworks infrastructure;
- Use of plant and machinery within confined spaces (i.e., enclosure required for sewage overflow storage excavation;
- Contact with contaminated soil (incl. dust), groundwater and vapours, including requirements for specific Personal Protective Equipment (PPE);
- Operation of water treatment plant; and
- Heat/Cold stress.

9.3 Certification

Prior to establishment on the Headland Park Site, the Remediation Contractor is required to have the ROHSMP certified as acceptable by a Certified Occupational Hygienist who has experience in the protection of the health and safety of workers, visitors and of neighbours with respect to remediation and management of contaminated sites.

A copy of the ROHSMP and the certification to the satisfaction of the BDA is required to be provided to the BDA prior to establishment on the Headland Park Site.

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10 Regulatory Approvals / Licensing

As noted previously, the RAP has been prepared in accordance with the Director General's Requirements relating to the Project Application MP10_0047, confirming BDA's commitment to completing remedial works to meet appropriate regulatory requirements.

10.1 Environment Planning and Assessment Act 1979

The site is listed as a State Significant Site within Schedule 3 of the Major Projects State Environmental Planning Policy. As such development approval for the project falls under the provisions of Part 3A of the *Environmental Planning and Assessment Act 1979.*

The specific State Environmental Planning Policy (SEPP) which is relevant to remediation of the site is SEPP 55 (Remediation of Land), which requires that development consent is not granted unless contamination has been considered and, if required, remediated.

Since the works have assessed under Part 3A of the EP&A Act, the remediation works are ancillary to other development, and the consent authority is the Director General of the NSW Department of Planning, who has approved the proposed Early Works.

Specifically in relation to the remediation works, SEPP 55 also requires that:

- remediation works are carried out in accordance with the Planning Guidelines (DUAP 1998) and any guidelines in force under the *Contaminated Land Management Act 1997*;
- remediation works are carried out in accordance with any development consent conditions; and
- notice of completion is provided to the local council and the consent authority (Department of Planning) within 30 days of completion of the works, with the details required under Regulation 18 of SEPP.

10.2 Protection of the Environment Operations Act 1997

In relation to the *Protection of the Environment Operation Act 1997*, specific advice will be sought in relation to licensing requirements, since elements of the remediation works:

- may fall within the licensing requirements for Contaminated Soil Treatment Works;
- may fall within the licensing requirements for Extractive Industries;
- may fall within the licensing requirements for Crushing, Grinding or Separating Works.

No waste materials, other than VENM/ENM, are to be imported onto the Barangaroo Project Site, as defined in this RAP. As such, it is not expected that there are any licensing requirements in relation to waste/resource recovery. In the event that any materials are required to be removed from the Barangaroo Project Site, all activities will be undertaken in accordance with the requirements of the Act, including:

- Ensuring waste is classified in accordance with relevant guidelines;
- Waste materials are transported by an appropriately licensed transporter;
- Waste materials are disposed to appropriately licensed facilities;
- Other materials are removed to facilities lawfully able to accept such materials.

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Any waters released from the Barangaroo Project Site shall not result in pollution of waters, as defined under this Act, with consideration given to discharge to sewer under a Trade Waste permit issued by SWC in the event that the required water quality is not achieved for discharge to storm water.

10.3 Protection Of The Environment Operations (Waste) Regulation 2005

The regulations make requirements relating to non-licensed waste activities and waste transporting. The proposed works on the Barangaroo Project Site will not require to be licensed. Section 48 of the Regulation requires that wastes are stored in an environmentally safe manner. It also stipulates that vehicles used to transport waste must be covered when loaded.

10.4 Water Management Act 2000 / Water Act 1912

Temporary dewatering of groundwater will be required during various elements of the proposed remediation works. Whilst approval is not required under the Water Management Act 2000 due to certain provisions under the EP&A Act, bores (spears) required for dewatering purposes may require to be licensed under the requirements of the Water Act 1912.

10.5 Waste Classification Guidelines (DECC 2008)

All wastes generated and proposed to be disposed off-site shall be assessed, classified and managed in accordance with the *Waste Classification Guidelines: Part 1: Classifying Waste* (DECC 2008).

10.6 Asbestos Regulations

In the event that asbestos impacted fill materials are encountered, all related works and the disposal of asbestos waste shall be undertaken in accordance with the requirements of the:

- *Occupational Health and Safety Act 2000*;
- *Occupational Health and Safety Regulation 2001*;
- *Code of Practice for the Safe Removal of Asbestos, 2nd Edition* (NOHSC 2005);
- *Guideline: Your Guide to Working With Asbestos* (WorkCover 2008); and
- *Waste Classification Guidelines: Part 1: Classifying Waste* (DECC 2008).

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11 Conclusions and Recommendations

11.1 Conclusions

Overview

Previous environmental investigations conducted on the Headland Park Site have identified limited soil contamination, being restricted to Total Petroleum Hydrocarbon(TPH), Polycyclic Aromatic Hydrocarbon (PAH) and metal impacted fill materials, primarily around former Warehouse 3. No significant groundwater contamination has been identified on the Headland Park Site.

Remediation/management of the identified contamination on the Headland Park Site will be undertaken as part of the development of Headland Park and Northern Cove. This RAP documents the processes and procedures required to address the identified contamination issues in order to make the Headland Park Site suitable for the proposed landuses.

Whilst this RAP primarily relates to the remediation of contamination within the Headland Park Site, suitable materials from other parts of the Barangaroo Project Site are proposed to be relocated onto the Headland Park Site, in order to recreate the naturalistic Headland Park landform. This RAP therefore gives consideration to the broader contamination issues on the Barangaroo Project Site and outlines the procedures for the acceptance of other Site Materials onto the Headland Park Site.

The contamination issues identified across the broader Barangaroo Project Site are principally associated with fill materials, natural soil and groundwater within the footprint of a former gasworks (located on the Stage 1 Development), namely:

- Petroleum hydrocarbon (assessed as Total Petroleum Hydrocarbons(TPH)), Benzene, Toluene, Ethylbenzene & Xylene (BTEX) and Polycyclic Aromatic Hydrocarbon (PAH) impacted fill materials, soils and groundwater;
- Cyanide impacted fill materials, soil and groundwater;
- Phenol and ammonia impacted fill materials, soil and groundwater;
- Minor quantities of asbestos impacted fill materials; and
- Metal impacted fill materials, soil and groundwater (lead, cadmium, copper & zinc).

This RAP for the Headland Park Site is a requirement of the Overarching RAP (ERM 2010), which has been prepared for the whole Barangaroo Project Site. The Overarching RAP requires that a Human Health and Environmental Risk Assessment (HHERA) be undertaken to define the risk-based criteria for fill materials, natural soil and groundwater on the Headland Park Site. The risk assessment comprised both HHRA and ERA that are herein collectively termed the “Headland Park HHERA” (JBS 2011a and 2011b). The risk-based criteria will apply to the Headland Park Site, including any Site Materials relocated onto the Headland Park Site for reuse/placement.

Extent of Remediation Required

The currently anticipated extent of in-situ contamination requiring remediation at the Headland Park Site shown in **Figure 13** by orange shading depicting soils considered inappropriate for use within 0.5 m of the final park surface. This is an approximate quantity of 1000 m^3. The soils as identified on **Figure 13** and shown by blue shading, present over an approximate area of 6 000m^2, are considered inappropriate for use as growing medium.

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In addition, a minor, isolated and localised area of tar impact was identified during geotechnical investigations at sampling location shown as JBS312A on **Figure 13**. Based on visual observations recorded on the borehole log, it is anticipated that this comprises an approximate quantity of 100 m^3. Groundwater sampling and analysis has not indicated that significant groundwater impact is present underlying the Headland Park.

Remediation/Management Approach

With consideration to DECCW's hierarchies for remediation, and to the site-specific contaminants and environmental setting, the following remediation/management approach has been adopted for the Headland Park Site:

Demolition and Earthworks

- On-site reuse/placement of impacted fill materials generated as part of the site excavations, and including any materials from the broader Barangaroo Project Site that meet the Site Acceptance Criteria established in this RAP. No highly impacted gasworks-related fill materials from within the Stage 1 Development will be accepted on the Headland Park Site.

Sewer Upgrade Work

- On-site reuse/placement of excavation materials generated as part of the sewerage upgrade works, but excluding any highly impacted gasworks-related materials from the Barangaroo Project Site. The risk of encountering highly impacted gasworks-related fill materials is considered to be low.
- Characterisation and off-site treatment and/or disposal at licensed waste facilities, of materials generated as part of the sewerage upgrade works which do not meet the Site Acceptance Criteria.
- Characterisation and release to either stormwater, or sewer or off-site disposal of groundwater collected during the excavation of the sewage overflow storage.

Sandstone Extraction Program

- On-site reuse/placement of impacted fill materials generated as part of the sandstone extraction program.
- On-site testing of collected groundwater during the sandstone extraction program, followed by release to stormwater in accordance with regulatory requirements.

Remediation Works within Headland Park Site

- Excavation of "hotspots" of contaminated soils, followed by on-site management in accordance with the requirements established in the Headland Park HHERA (JBS 2011a and 2011b);
- Excavation of "hotspots" of contaminated soils, followed by classification and off-site disposal of materials which are not able to be managed on-site in accordance with the requirements established in the Headland Park HHERA (ibid); and
- (Likely) ongoing monitoring of groundwater.

Receipt and Placement of Materials from the broader Barangaroo Project Site

- On-site reuse/placement of impacted fill material sourced from the broader Barangaroo Project Site that are demonstrated to meet Site Acceptance Criteria established in this RAP to form part of the naturalistic headland.

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- On-site management in accordance with the provisions contained in the Headland Park HHERA (ibid) and the associated engineering controls required to be documented and included in the RWP for the Headland Park Site, which include seepage water prevention, collection and treatment.

Where materials are reused on the Headland Park Site, then this will require ongoing management via the development and implementation of an appropriate LTEMP, which will be prepared upon completion of the validation report.

A validation program has been developed to verify that the remediation works achieve the intended objectives.

Site Suitability

Overall, it is considered that the proposed actions outlined in this RAP conform to the requirements of DEC 2006 because they are: technically feasible; environmentally justifiable; and consistent with relevant laws policies and guidelines endorsed by NSW DECCW.

Subject to the successful implementation of the measures described in this RAP and the recommendations made in **Section 11.2**, it is concluded that the Headland Park Site can be made suitable for the intended uses and that the risks posed by contamination arising from the creation of Headland Park and Northern Cove can be managed in such a way to as to be adequately protective of human health and the environment.

11.2 Recommendations

It is recommended that the processes outlined in this RAP be implemented and that the following documentation be developed and implemented to ensure the risks and impacts are controlled in an appropriate manner:

- A Remediation Environmental Management Plan (REMP), to document the monitoring and management measures required to control the environmental impacts of the works and ensure the validation protocols are being addressed;
- A Remediation Occupational Health and Safety Management Plan (ROHSMP), to document the procedures to be followed to manage the risks posed to the health of the remediation workforce; and
- A Remediation Work Plan (RWP), to detail the precise remediation works to be undertaken following:
  - Review and endorsement by the Site Auditor of final versions of the Headland Park HHERA (JBS 2011a and 2011b) and RAP; and
  - finalisation of the design of the Headland Park and Cultural Facility/carpark.

The REMP and the ROHSMP are required to contain a plan addressing plausible contingencies and both Plans are required to be certified by an independent, expert person and submitted for acceptance by the BDA prior to mobilisation onto the Headland Park Site. The RWP shall be prepared by the Remediation Consultant and reviewed/ accepted by the Site Auditor prior to the commencement of remedial works.

Upon completion of the works on the Headland Park Site, a validation report and an on-going LTEMP for impacted materials retained beneath Headland Park are required to be submitted by the Remediation Consultant to the Site Auditor for certification that the Headland Park Site is suitable for the proposed uses, subject to implementation of the LTEMP.

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12 Limitations

This report has been prepared for use by the client who commissioned the works in accordance with the project brief only and has been based in part on information obtained from other parties. The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose. Additionally, this report has been based on investigation results documented by others in previous reports. The reader is referred to these reports for the limitations of the investigations.

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Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements and site history, not on sampling and analysis of all media at all locations for all potential contaminants.

Changes to the subsurface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this report are based on the information obtained at the time of the investigations.

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, JBS Environmental Pty Ltd reserves the right to review the report in the context of the additional information.

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13 References

Additional Investigation Works at Barangaroo, Hickson Road, Millers Point, NSW, ERM, July 2008 (ERM 2008a)

Barangaroo Headland Park and Northern Cove, Preliminary Assessment and Request for Director-General's Requirements for Early Works and Main Works Project Applications, MG Planning Pty Ltd, March 2010 (MG 2010)

Code of Practice for the Safe Removal of Asbestos, 2nd Edition, National Occupational Health and Safety Commission, 2005 (NOHSC 2005)

Contaminated Sites: Guidelines for Assessing Service Station Sites, NSW EPA, 1994 (EPA 1994)

Contaminated Sites: Sampling Design Guidelines, NSW EPA, 1995 (EPA 1995)

Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites, NSW EPA, 1997 (EPA 1997)

Contaminated Sites: Guidelines for the NSW Site Auditor Scheme (2nd Edition), NSW DEC, 2006 (DEC 2006)

Draft Stage 2 Remedial Action Plan for Barangaroo, Hickson Road, Sydney, ERM, September 2008 (ERM 2008b)

Environmental Site Assessment, East Darling Harbour, Sydney, NSW, ERM, June 2007 (ERM 2007)

Guideline: Your Guide to Working With Asbestos, NSW WorkCover, 2008 (WorkCover 2008)

Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia, Western Australia Department of Health, May 2009 (WA DoH 2009)

Managing Land Contamination, Planning Guidelines, NSW Department of Urban Affairs and Planning, August 1998 (DUAP 1998)

National Environment Protection (Assessment of Site Contamination) Measure, National Environment Protection Council, 1999 (NEPC 1999)

Overarching Remedial Action Plan for The Barangaroo Project Site, Sydney, ERM, June 2010 (ERM 2010)

Preliminary Environmental Investigation, 30-38 Hickson Road, Millers Point, NSW, 2000, Coffey Environments Pty Ltd, 12 May 2000 (Coffey 2008)

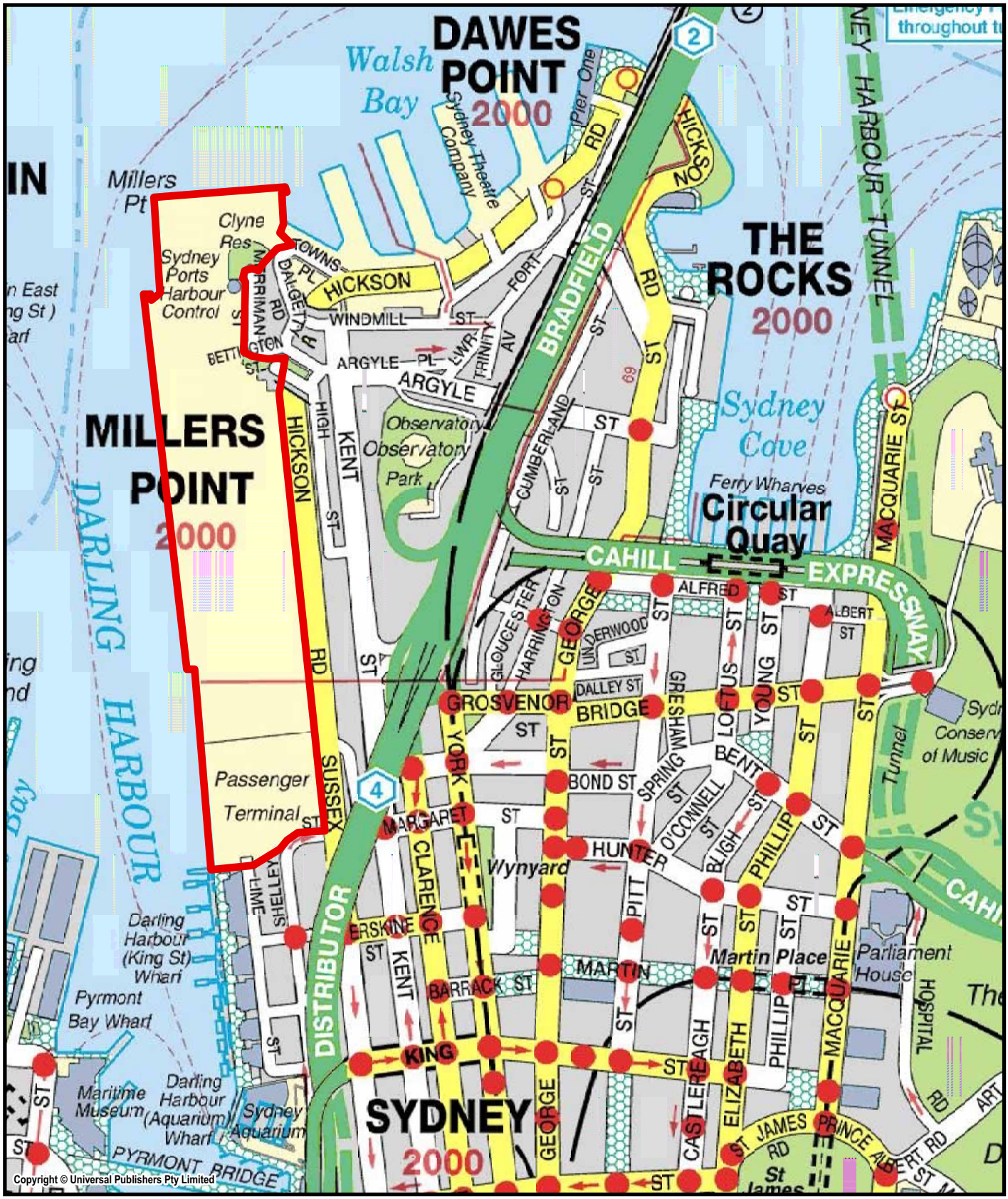
Site Audit Report and Site Audit Statement, Overarching Remedial Action Plan, Barangaroo, ENVIRON, June 2010 (ENVIRON 2010)

Waste Classification Guidelines: Part 1: Classifying Waste, NSW Department of Environment and Climate Change, July 2008, (DECC 2008)

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Figures

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0 250m

Approximate scale

Figure 1 **Location of Barangaroo Site**

ERM (2008)
Note- All locations shown are approximate only



Figure 2

1:500 @ A0 0 10 20 30 50m

BARANGAROO HEADLAND

PWP Landscape Architecture
739 Allston Way, Berkeley, California 94710

Johnson Pilton Walker
Level 10, Plaza Building Australia Square, 95 Pitt Street, Sydney NSW 2000

DESIGN DEVELOPMENT
HEADLAND PARK DD-PWP-L-S3-1003
PLAN

REV. 00 28th SEPTEMBER 2010





Figure 3

1:800 @ A3 0 5 10 20 40m

BARANGAROO HEADLAND

PWP Landscape Architecture
739 Allston Way, Berkeley, California 94710
Johnson Pilton Walker
Level 10, Plaza Building Australia Square, 95 Pitt Street, Sydney NSW 2000

MAIN WORKS APPLICATION
BARANGAROO HEADLAND PARK
HEADLAND SECTION 1

MW-PWP-L-S3-2001 REV. 00 16th September 2010

MOORES WHARF

TOWNS PLACE

ARGYLE PLACE

KENT STREET

HIGH LANE

HIGH STREET

HUNGRY MILE

MUNN RESERVE

Car Park Entrance

RHODENS LANE

MERRIMAN STREET

CLYNE RESERVE

Low Tide

Toilet Block

Cultural Facility Entrance

Oyster Bar

Elevators

Spray Fountain

Amphitheatre

2005

2001

TIDAL POOLS

U P P E R B L U F F

Bush Walk

NORTHERN COVE

Public Wharf

HEADLAND FORESHORE

STONE BEACH

ROCKY SHORE

2003

2002

2004

Stage 3

Stage 2

Figure 3A

1:1500 @ A3

0 10 20 30 50

BARANGAROO HEADLAND

PWP Landscape Architecture
739 Allston Way, Berkeley, California 94710

Johnson Pilton Walker
Level 10, Plaza Building Australia Square, 95 Pitt Street, Sydney NSW 2000

MAIN WORKS APPLICATION
BARANGAROO HEADLAND PARK
HEADLAND PARK PLAN

MW-PWP-L-S3-1002 REV. 00 22nd September 2010





1:800 @ A3 0 5 10 20 40m

BARANGAROO HEADLAND

PWP Landscape Architecture
739 Allston Way, Berkeley, California 94710
Johnson Pilton Walker
Level 10, Plaza Building Australia Square, 95 Pitt Street, Sydney NSW 2000

MAIN WORKS APPLICATION
BARANGAROO HEADLAND PARK
HEADLAND SECTION 1

MW-PWP-L-S3-2001 REV. 00 22nd September 2010

Figure 3B



Figure 3C

1:500 @ A3

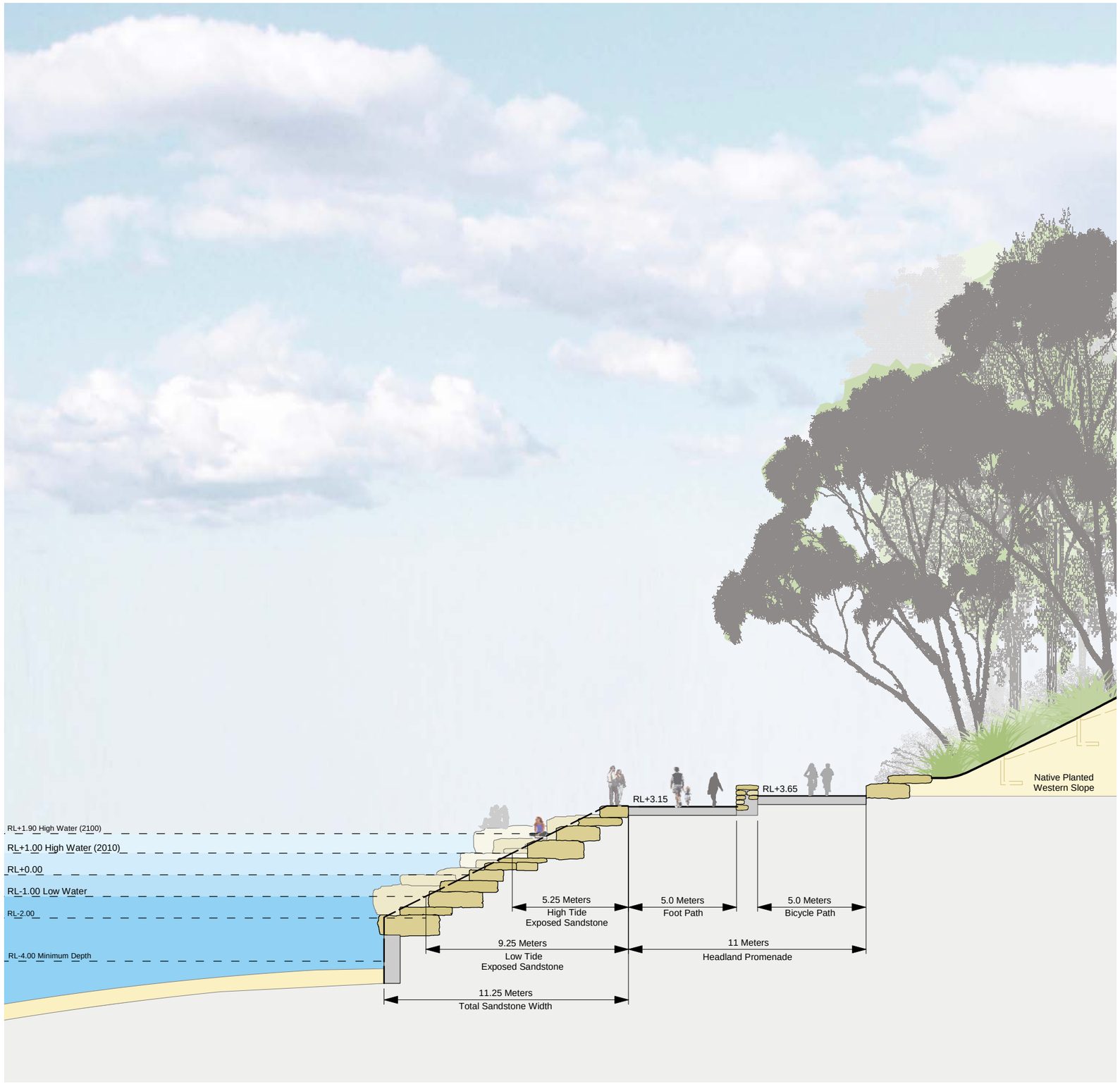
0 5 10 20m

BARANGAROO HEADLAND

PWP Landscape Architecture
739 Allston Way, Berkeley, California 94710
Johnson Pilton Walker
Level 10, Plaza Building Australia Square, 95 Pitt Street, Sydney NSW 2000

MAIN WORKS APPLICATION
BARANGAROO HEADLAND PARK
HEADLAND SECTION 2

MW-PWP-L-S3-2002 REV. 00 22nd September 2010



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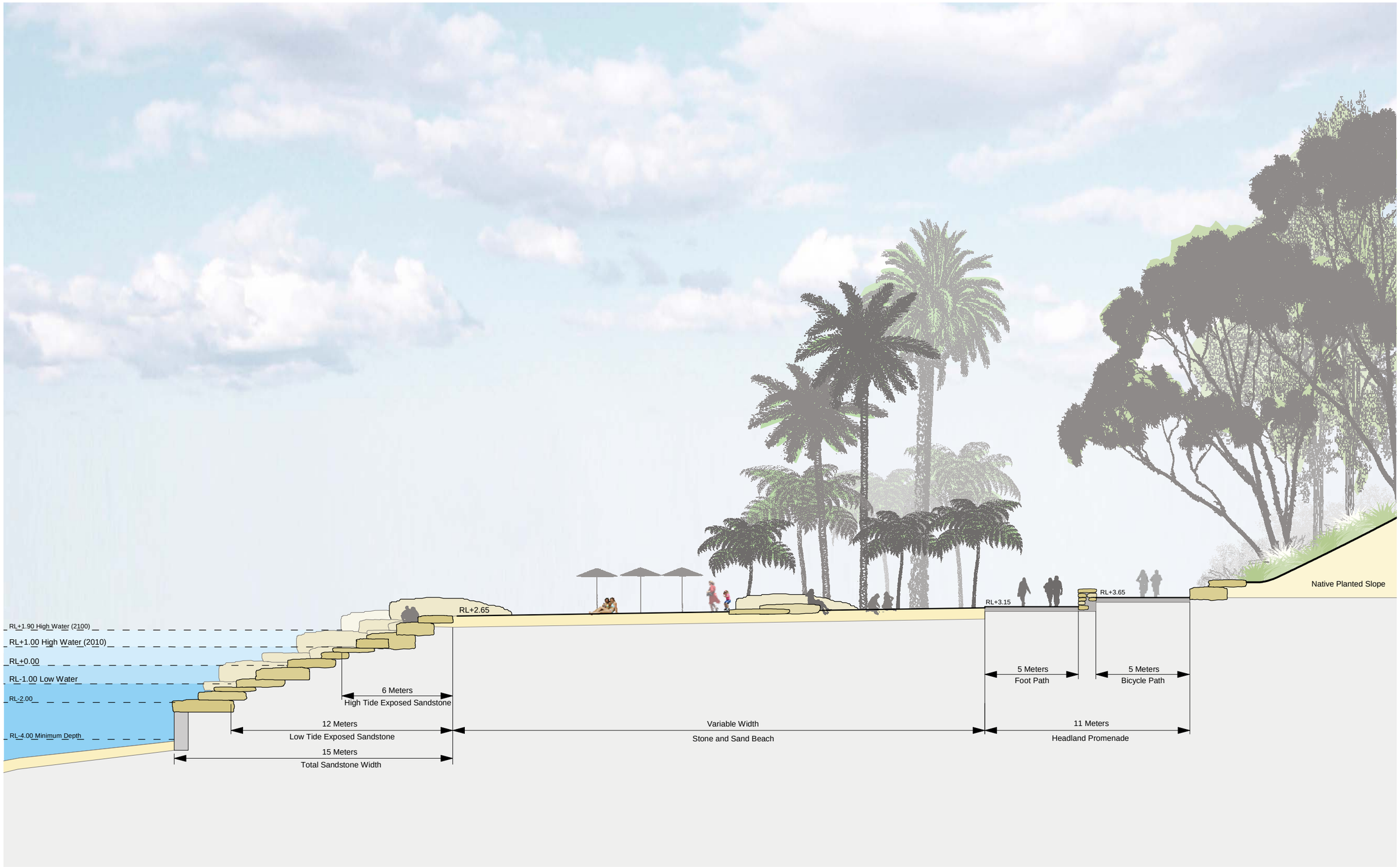
BARANGAROO HEADLAND

PWP Landscape Architecture
739 Allston Way, Berkeley, California 94710
Johnson Pilton Walker
Level 10, Plaza Building Australia Square, 95 Pitt Street, Sydney NSW 2000

MAIN WORKS APPLICATION
BARANGAROO HEADLAND PARK
HEADLAND SECTION 3

MW-PWP-L-S3-2003 REV. 00 22nd September 2010

Figure 3D



1:200 @ A3 0 1 2 3 5 10m

BARANGAROO HEADLAND

PWP Landscape Architecture
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Johnson Pilton Walker
Level 10, Plaza Building Australia Square, 95 Pitt Street, Sydney NSW 2000

MAIN WORKS APPLICATION
BARANGAROO HEADLAND PARK
HEADLAND SECTION 4

MW-PWP-L-S3-2004 REV. 00 22nd September 2010

Figure 3E

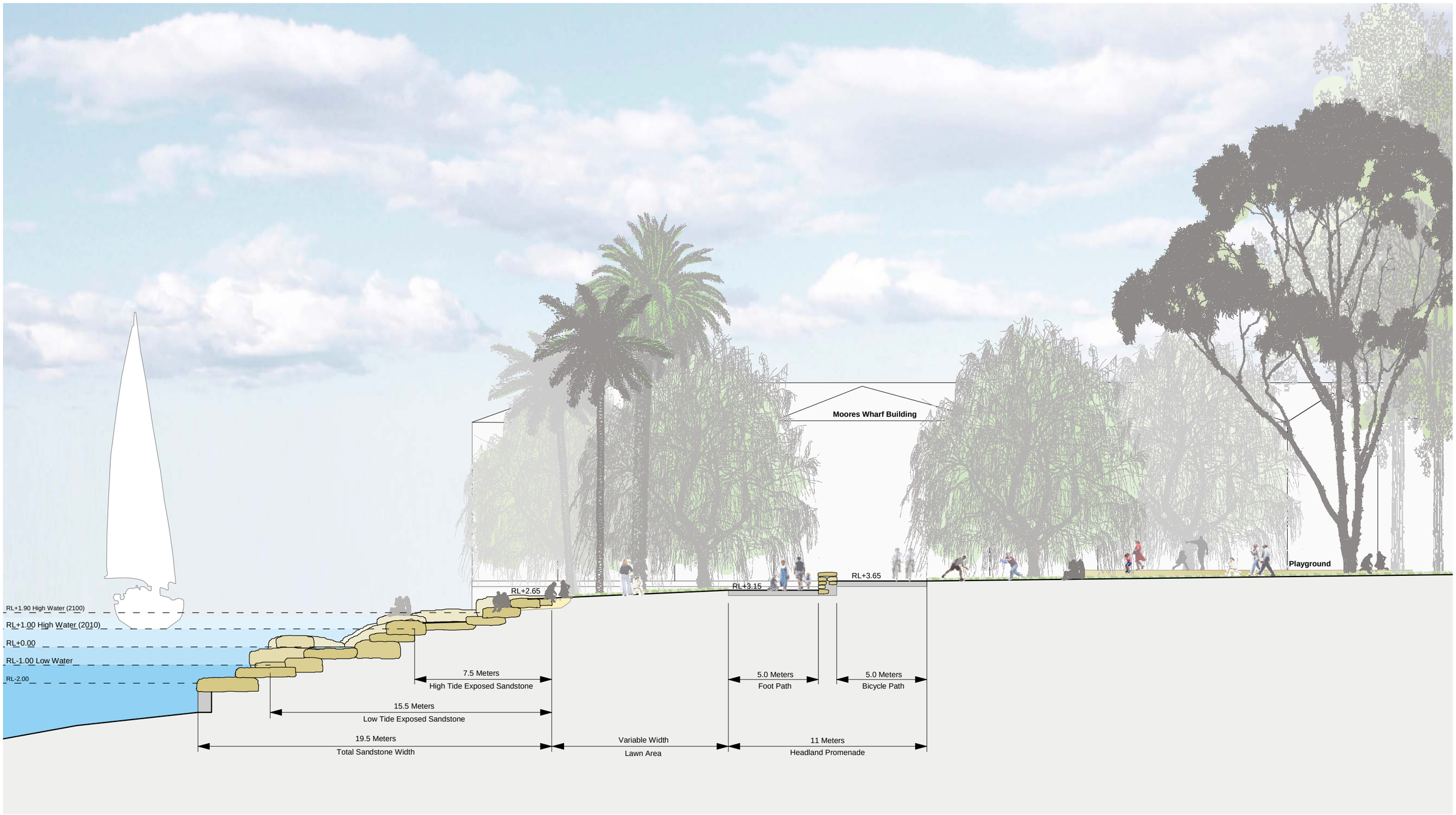


Figure 3F

1:200 @ A3 0 1 2 3 5 10m

BARANGAROO HEADLAND

PWP Landscape Architecture
739 Allston Way, Berkeley, California 94710
Johnson Pilton Walker
Level 10, Plaza Building Australia Square, 95 Pitt Street, Sydney NSW 2000

MAIN WORKS APPLICATION
BARANGAROO HEADLAND
HEADLAND SECTION 5

MW-PWP-L-S3-2005 REV. 00 22nd September 2010

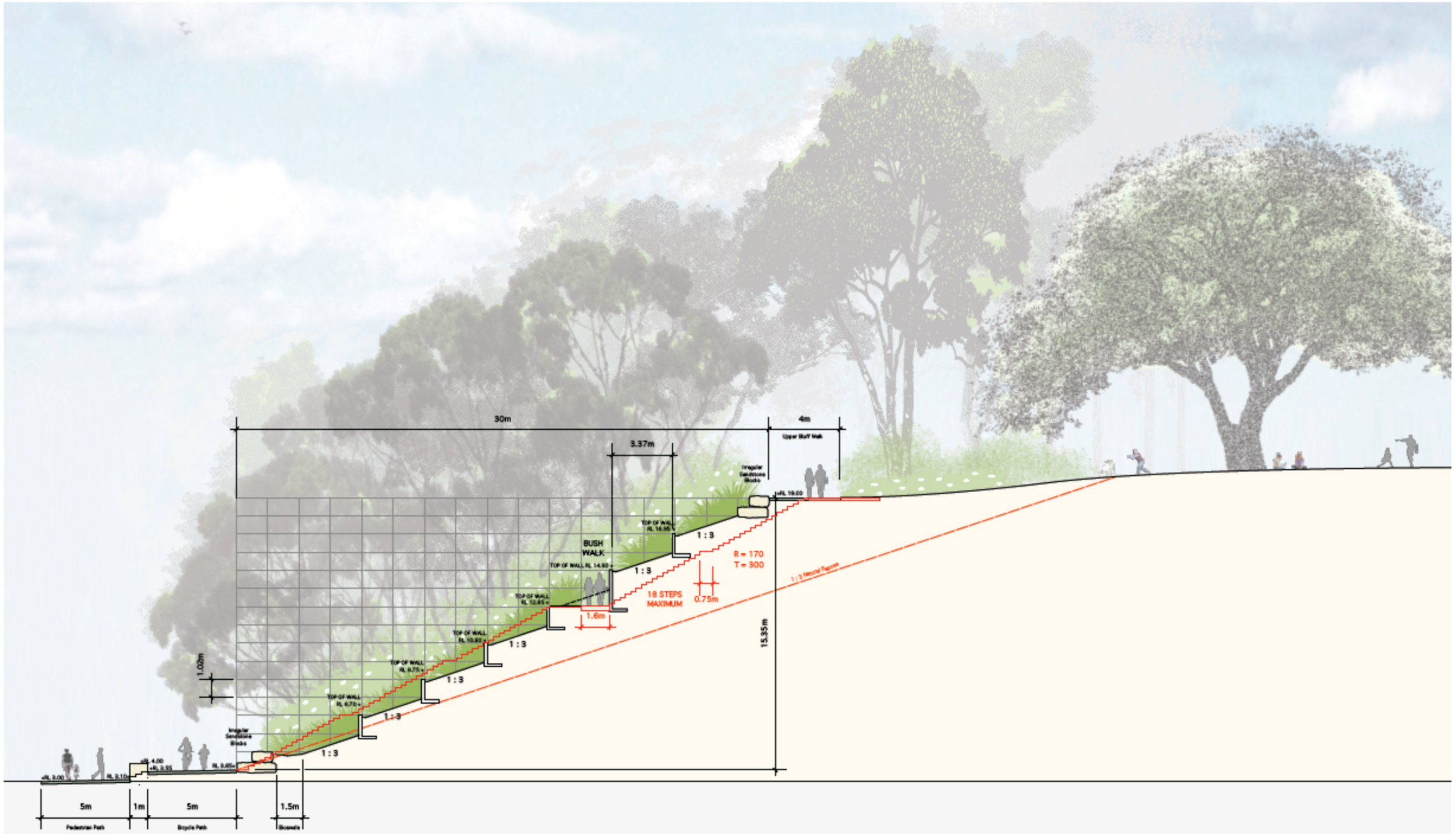
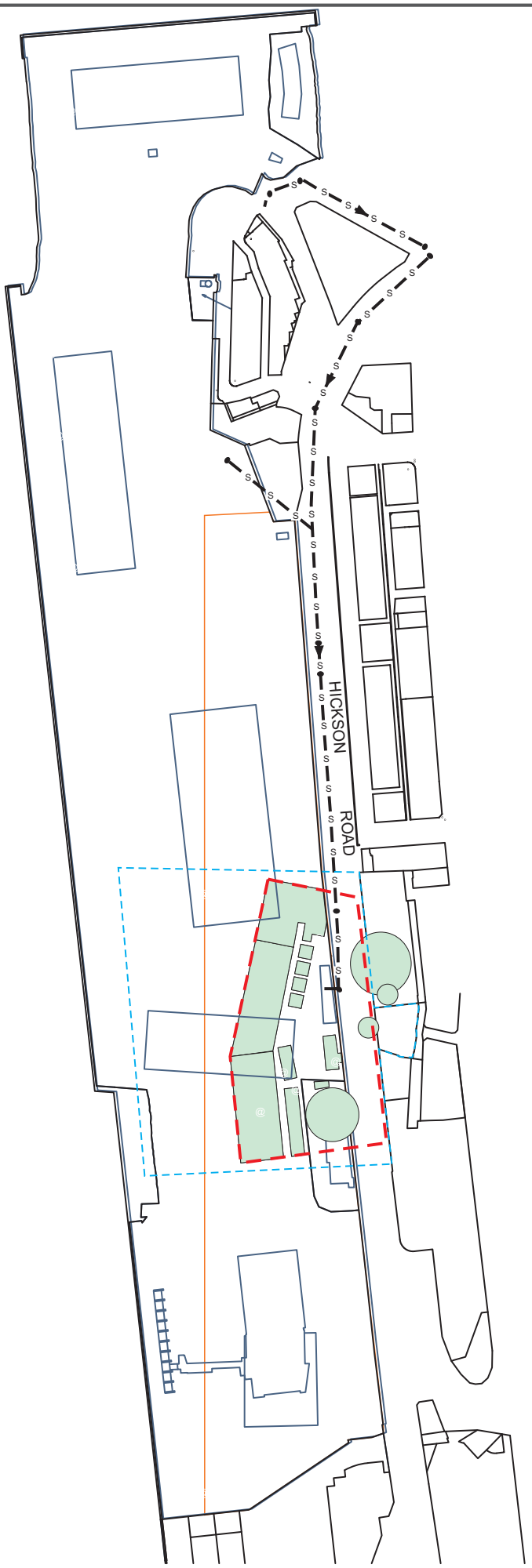


Figure 3G

1:100 @ A1 0 2 4 8 10m	BARANGAROO HEADLAND PWP Landscape Architecture 739 Alston Way, Berkeley, California 94710 Johnson Pilton Walker Level 10, Plaza Building Australia Square, 95 Pitt Street, Sydney NSW 2000	DESIGN DEVELOPMENT HEADLAND PARK SLOPE STABILIZATION SECTION A DD-PWP-L-03-2006 REV. 01 21th September 2010



LEGEND

- IndicativeFormer boundary of Declaration Area
- Indicative current boundary of Remediation Site Declaration Area
- Proposed Chamber
- Flow Direction
- Sydney Water Corporation Sewer
- Lot Boundaries
- Existing or Former Site Features
- Approximate Boundary of Landuse Zones
- Approximate Location of Former Gasworks Structures
- Approximate Location of Former Gasworks Infrastructure

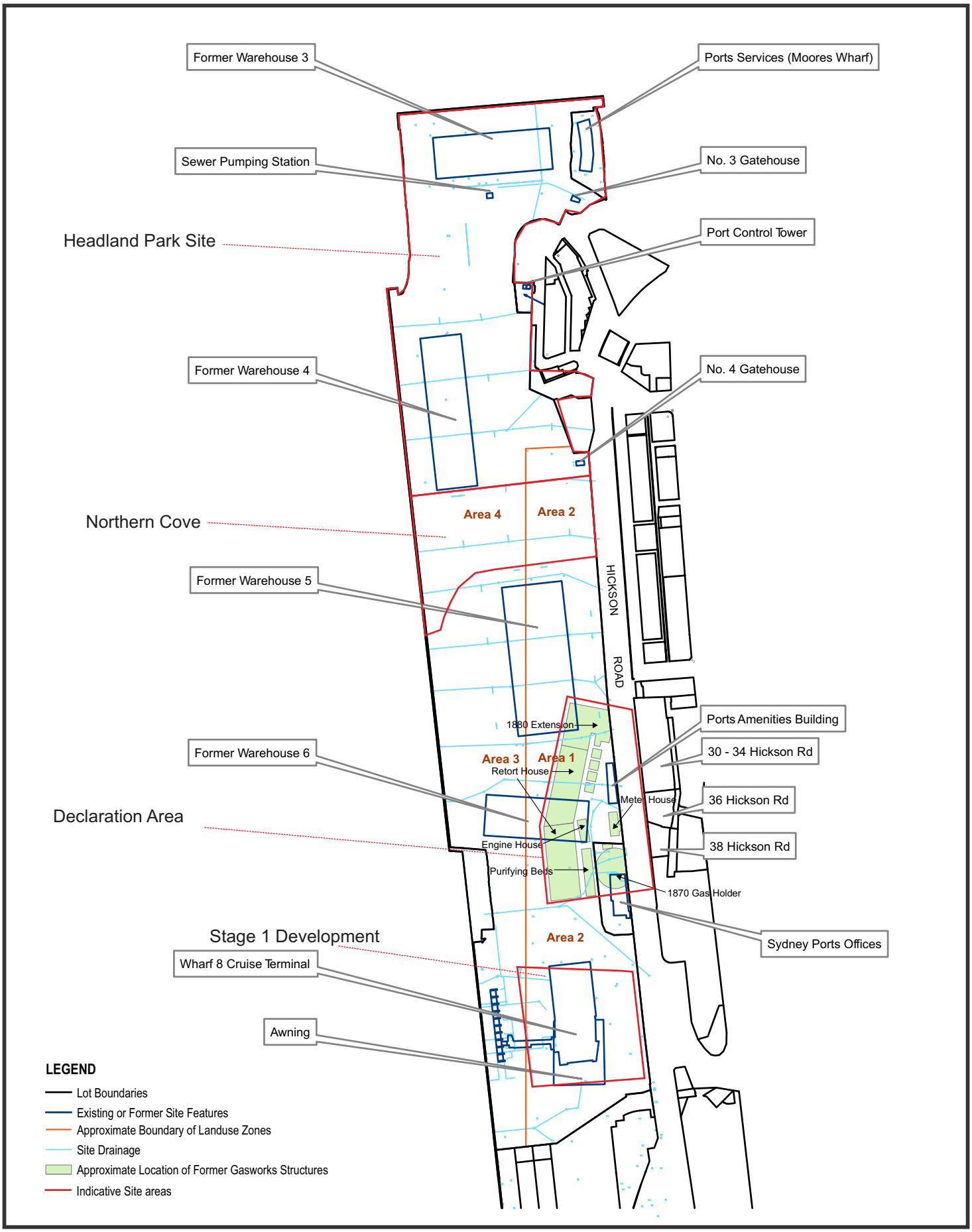
JBS ENVIRONMENTAL

0 100m

Approximate scale

Figure 4 **Location of proposed sewer line along Hickson Road**

ERM (2008)
Note- All locations shown are approximate only

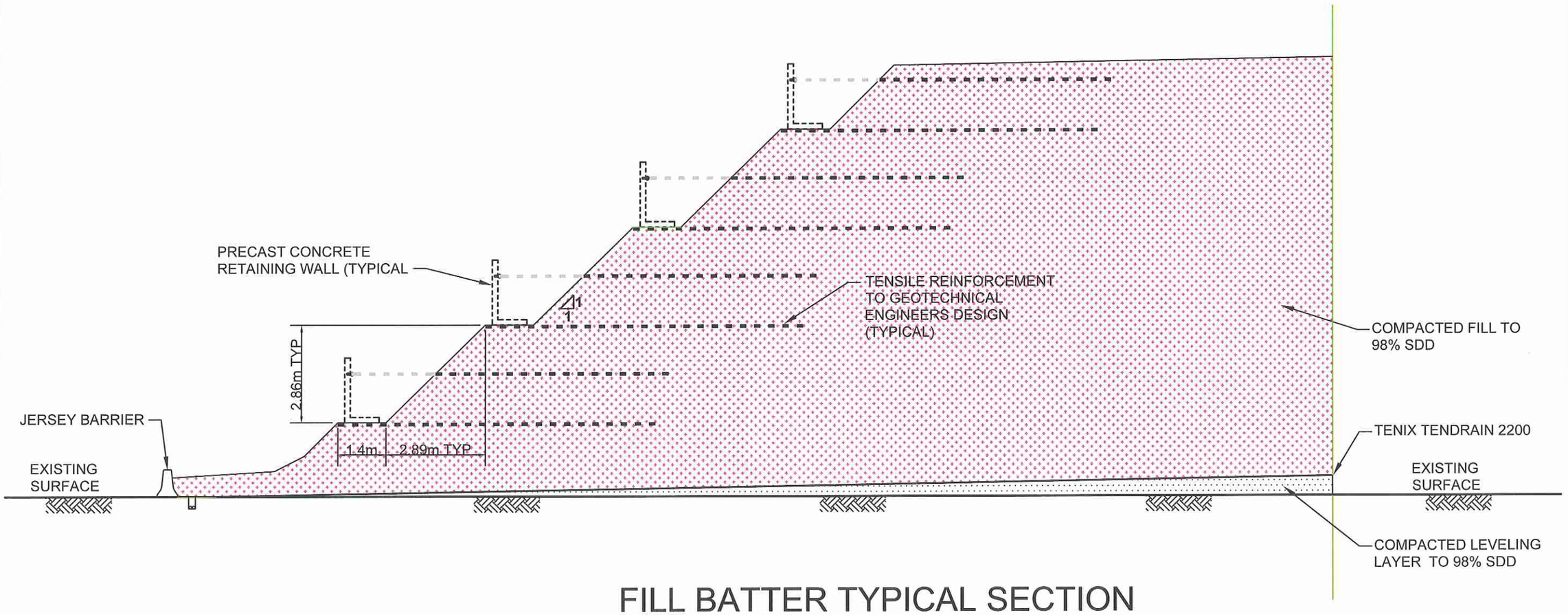


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Figure 5 **Current Site Layout showing Current Site Features**

ERM (2008)
Note- All locations shown are approximate only

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FILL BATTER TYPICAL SECTION

N.T.S.

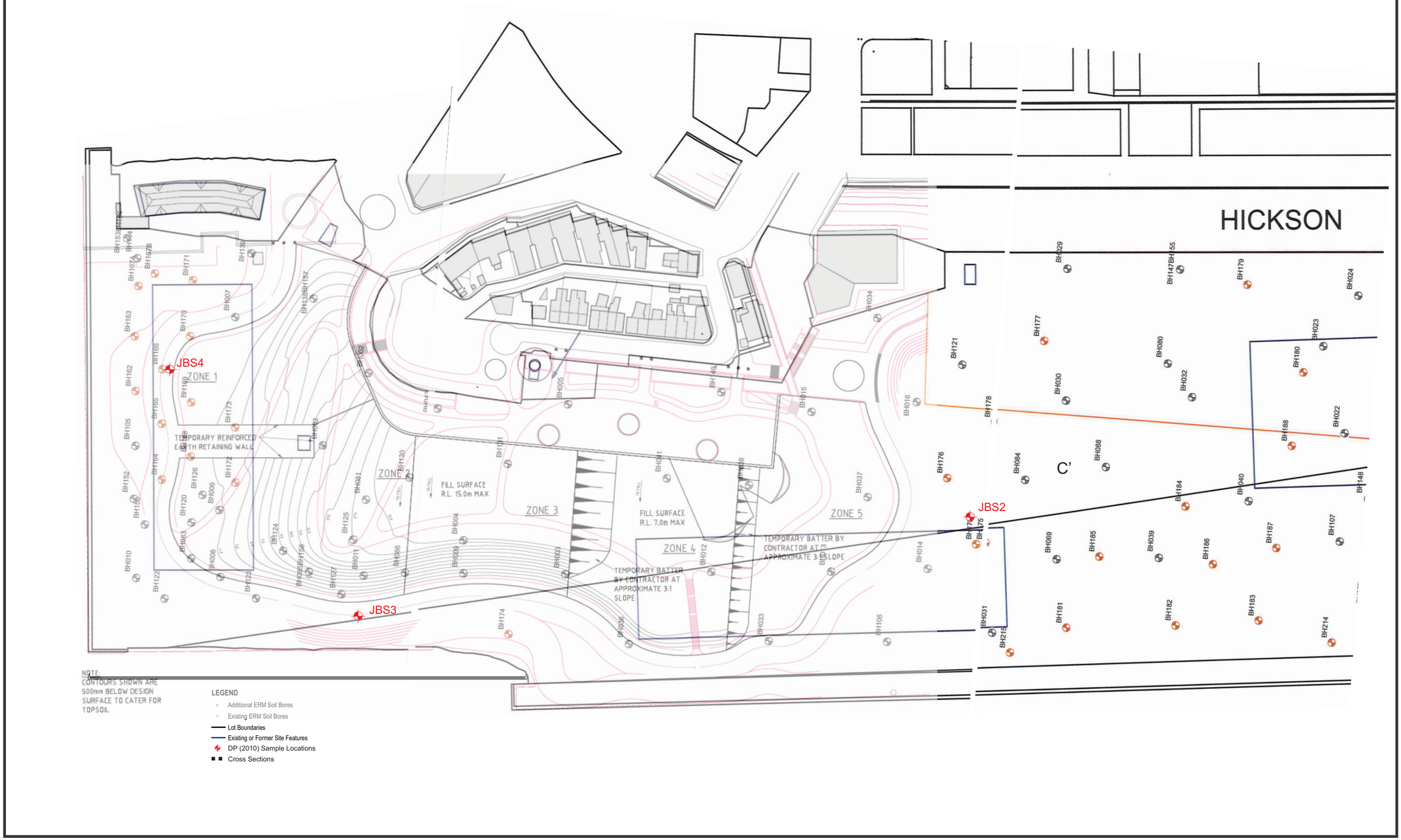
Figure 6

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Rev.	Revision Description	Date
P1	FOR INFORMATION	01.10.10

Client:	BARANGAROO SYDNEY AUSTRALIA	Designed: PD	Date: OCT 2010
Project/Job:	BARANGAROO PUBLIC DOMAIN HEADLAND PARK	Drafted: PD	Scale: AS NOTED
Subject:	FILL BATTER TYPICAL SECTION	Job No: 10400	Dwg No: SK3 Rev: P1



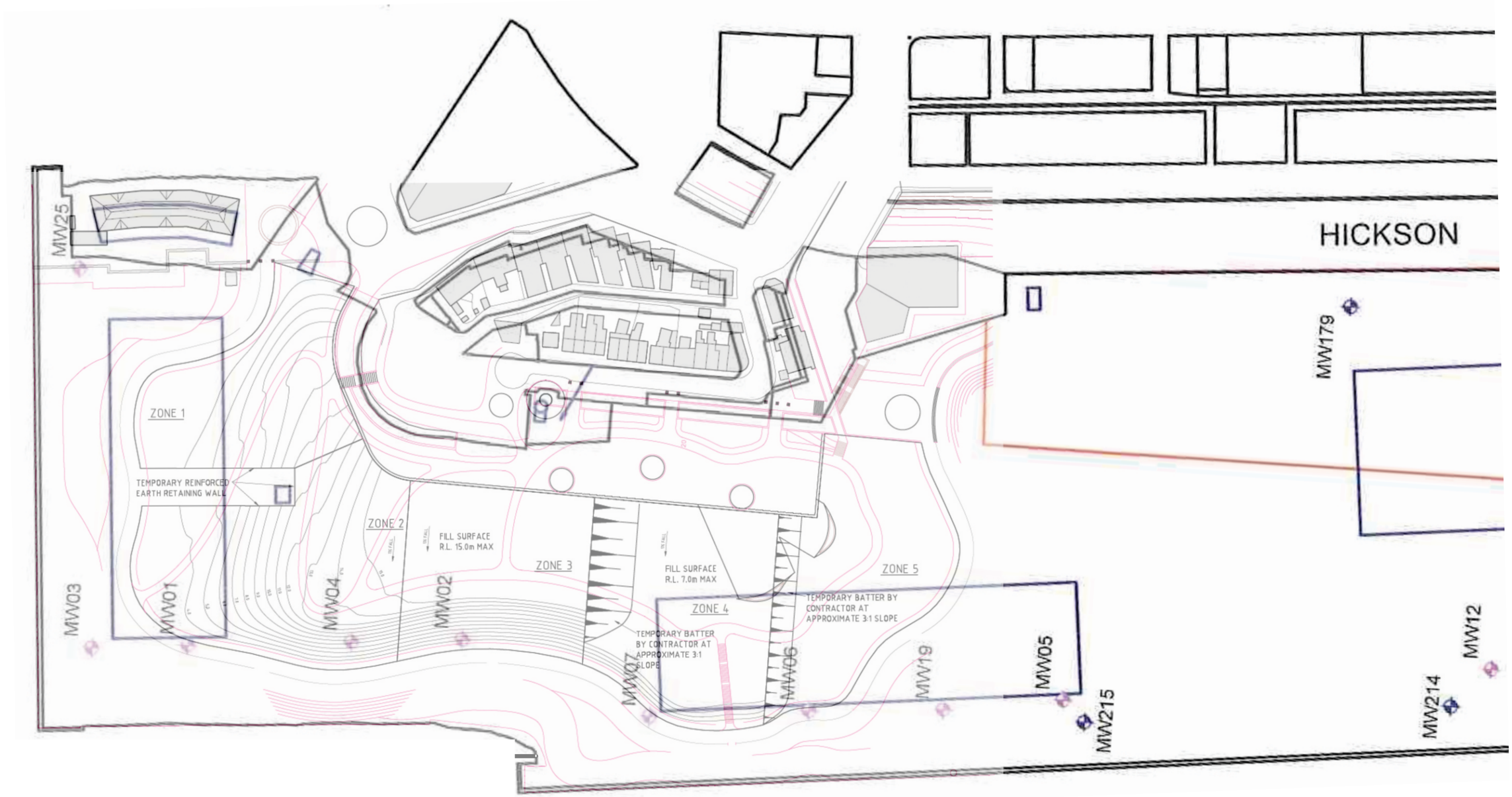
JBS ENVIRONMENTAL

0 200m

Approximate scale

Figure 7 **Historical Soil Sample Locations as Overlaid on Approximate Proposed Park Dimensions**

ERM (2008) & Robert Bird Group (2010)
Note- All locations shown are approximate only



JBS ENVIRONMENTAL

0 200m

Approximate scale

Figure 8 **Historical Groundwater Monitoring Well Locations as Overlaid on Approximate Proposed Park Dimensions**

ERM (2008) & Robert Bird Group (2010)
Note- All locations shown are approximate only

LEGEND

- Depth to Base of Fill Contour (m AHD)
- Proposed Site Boundary as Based on 2010 High Water Mark (1m AHD)
- Site Boundary as Defined as Limit of Works
- Proposed Excavation -7.6m AHD
- Proposed Excavation -2m AHD
- Likely extent of clay liner
- Shading to Indicate Depth to Natural Soils (Alluvium / Sandstone) / Fill Thickness

HICKSON

JBS4
JBS3
JBS2

-1.9m
-2m
0m
1m
-8m
-10m
-12m

333700
333650
333600
333550

6252400
6252350
6252300
6252250
6252200
6252150
6252100
6252050
6252000
6251950
6251900

0 100m
Approximate scale

JBS ENVIRONMENTAL

Figure 9 **Depth to Base of Fill Contours Overlaid on Proposed Site Dimensions and Soil Sample Locations**

Johnson Pilton Walker (2010) and ERM (2008)
Note- All locations shown are approximate only

LEGEND

- Depth to Base of Fill Contour (m AHD)
- Proposed Site Boundary as Based on 2010 High Water Mark (1m AHD)
- Site Boundary as Defined as Limit of Works
- Proposed Excavation -7.6m AHD
- Proposed Excavation -2m AHD
- Shading to Indicate Alluvium/ Natural Soil Thickness

HICKSON

JBS4

JBS3

JBS2

0m

1m

3m

5m

10m

333650 333700

333550 333600

6252400 6252350 6252300 6252250 6252200 6252150 6252100 6252050 6252000 6251950 6251900

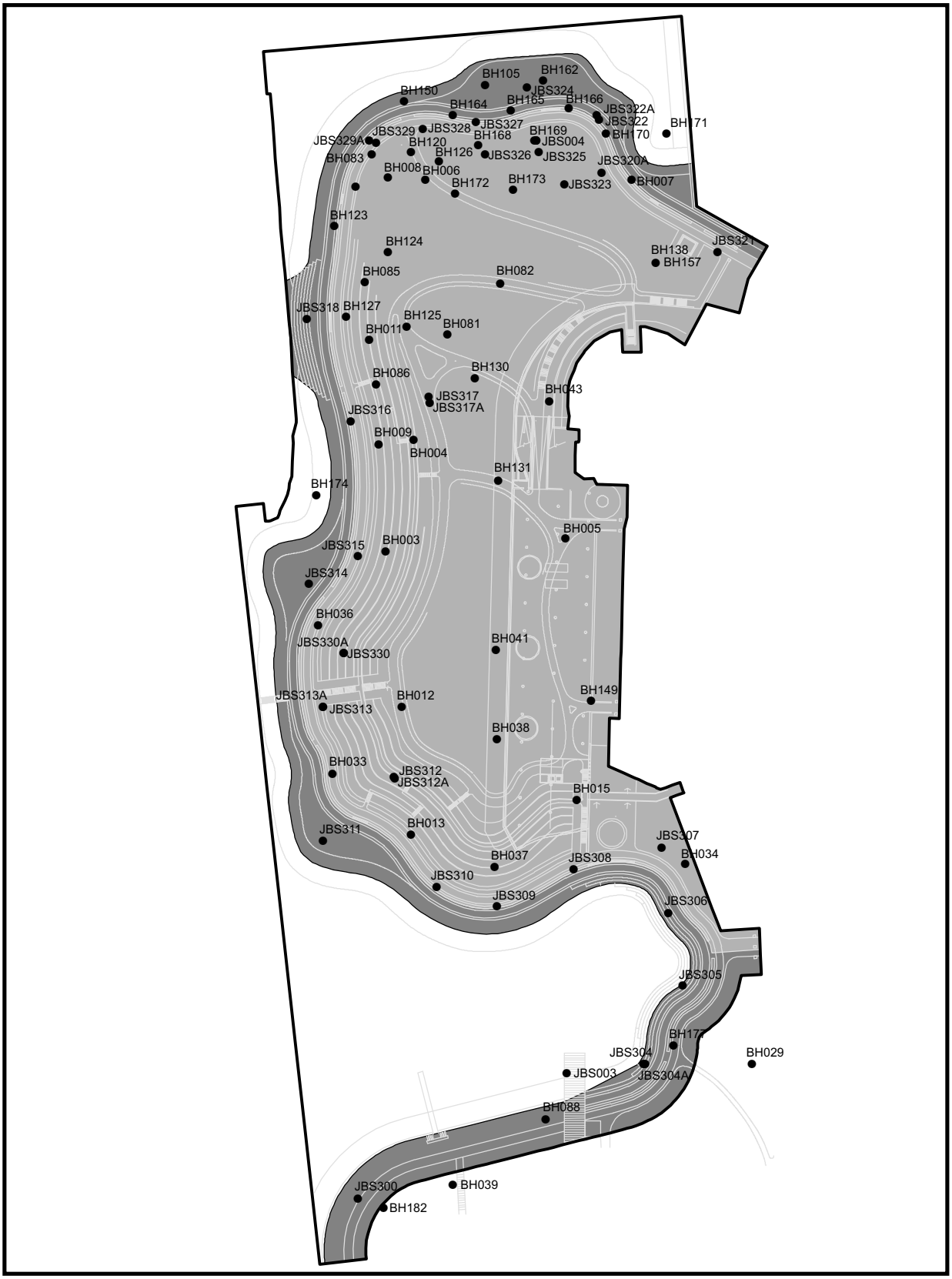
0 100m

Approximate scale

JBS ENVIRONMENTAL

Figure 10 **Plot of Thickness of Natural / Alluvium Soils Overlaid on Proposed Site Dimensions and Soil Sample Locations**

Johnson Pilton Walker (2010) and ERM (2008)
Note- All locations shown are approximate only



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0 25 50 100 m

Scale: 1:2,500 (A4)

Datum: MGA94 Zone 56

A4			
D2	Revision	RF	21-1-2011
D1	Original Issue	RF	20-1-2011
Rev	Description	By	Date

Legend:

- Extent of Clay Layer
- Site Boundary
- Proposed Site Layout
- Sample Location

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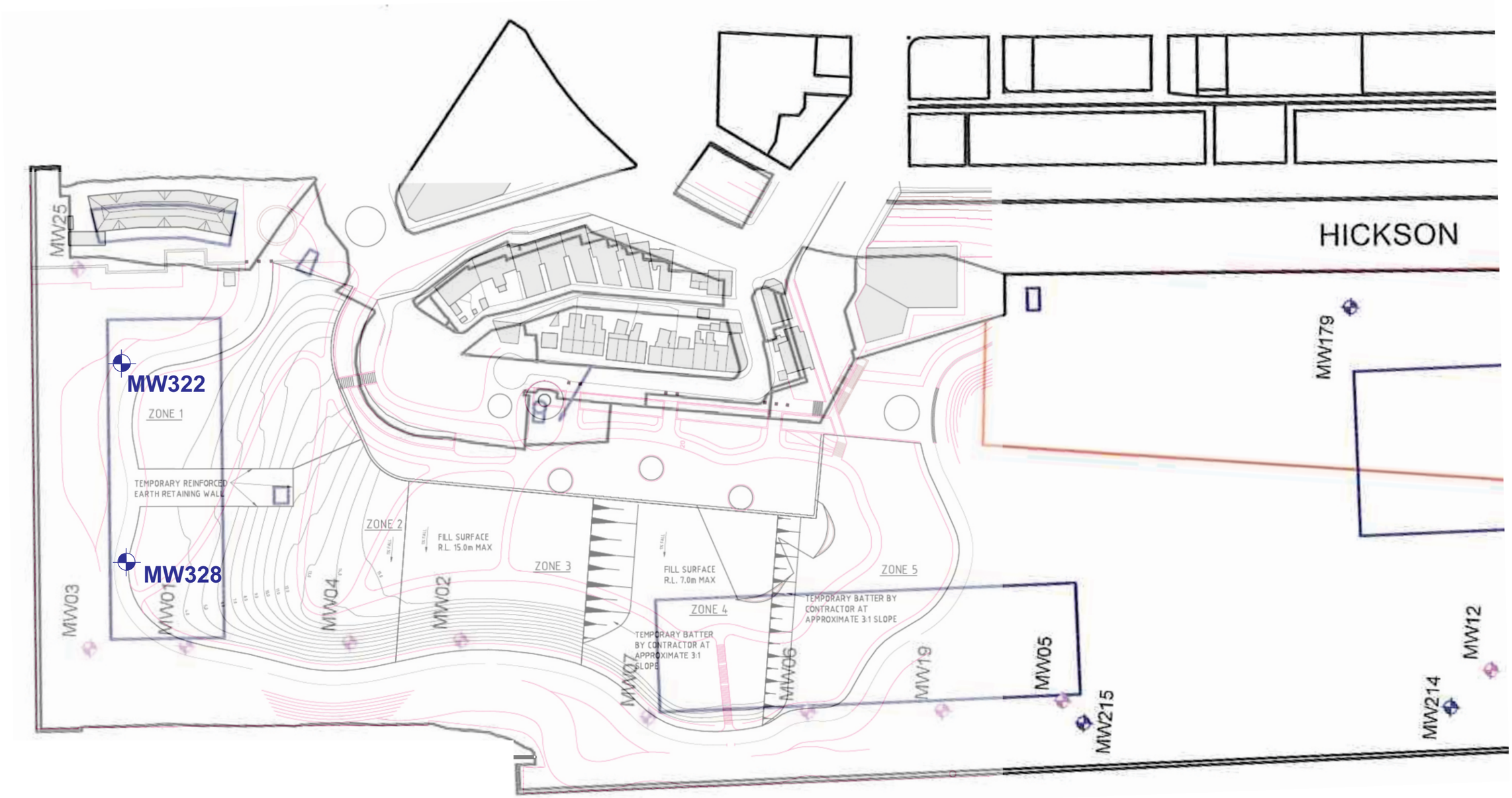
Figure 11: Sample Locations

Client: Barangaroo Delivery Authority

Project: Barangaroo Headland Park

Job No: 41181

File Name: 41181_11a



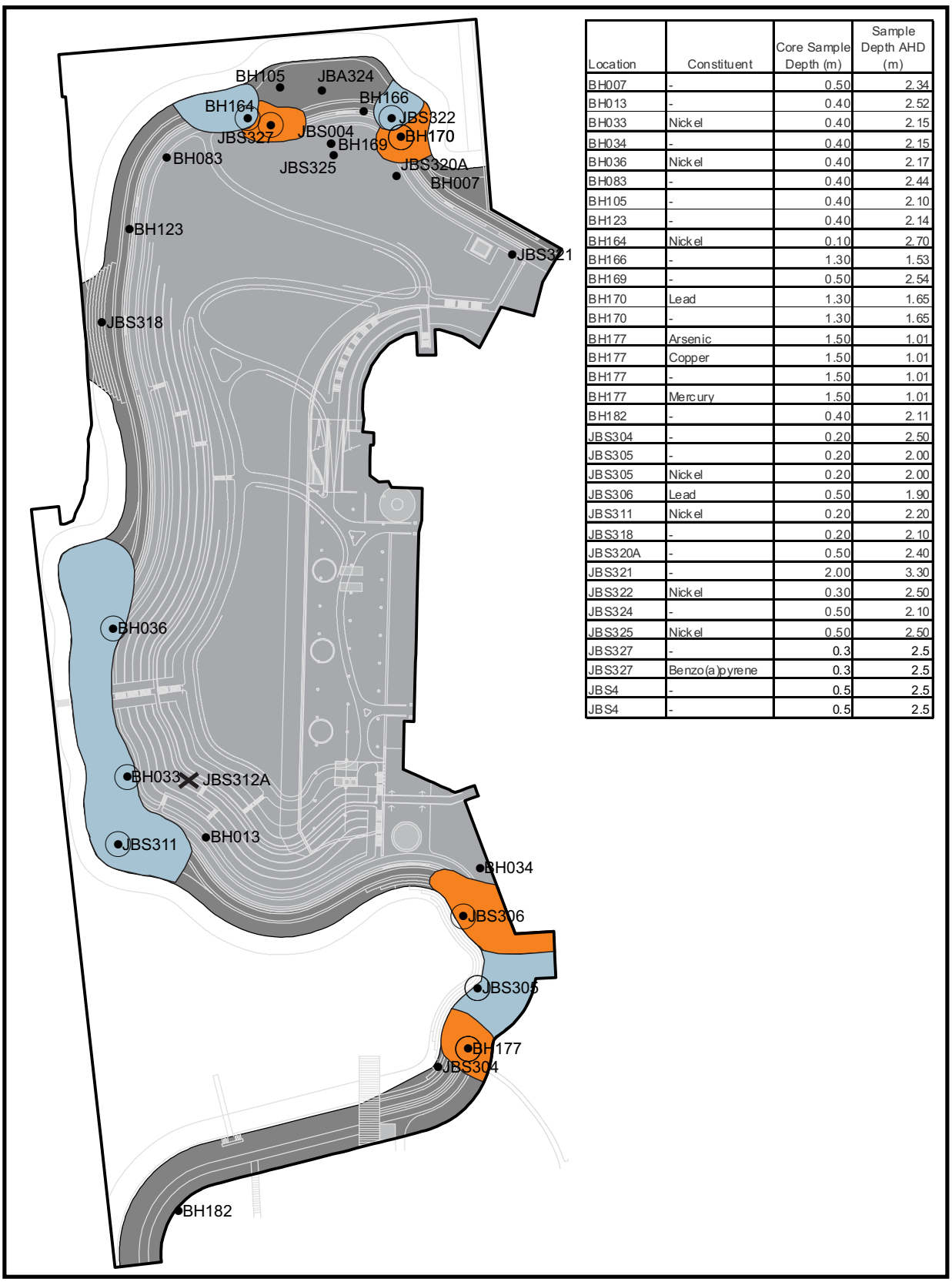
JBS ENVIRONMENTAL

0 200m

Approximate scale

Figure 12 **Groundwater Monitoring Well Locations**

ERM (2008) & Robert Bird Group (2010)
Note- All locations shown are approximate only



Location	Constituent	Core Sample Depth (m)	Sample Depth AHD (m)
BH007	-	0.50	2.34
BH013	-	0.40	2.52
BH033	Nickel	0.40	2.15
BH034	-	0.40	2.15
BH036	Nickel	0.40	2.17
BH083	-	0.40	2.44
BH105	-	0.40	2.10
BH123	-	0.40	2.14
BH164	Nickel	0.10	2.70
BH166	-	1.30	1.53
BH169	-	0.50	2.54
BH170	Lead	1.30	1.65
BH170	-	1.30	1.65
BH177	Arsenic	1.50	1.01
BH177	Copper	1.50	1.01
BH177	-	1.50	1.01
BH177	Mercury	1.50	1.01
BH182	-	0.40	2.11
JBS304	-	0.20	2.50
JBS305	-	0.20	2.00
JBS305	Nickel	0.20	2.00
JBS306	Lead	0.50	1.90
JBS311	Nickel	0.20	2.20
JBS318	-	0.20	2.10
JBS320A	-	0.50	2.40
JBS321	-	2.00	3.30
JBS322	Nickel	0.30	2.50
JBS324	-	0.50	2.10
JBS325	Nickel	0.50	2.50
JBS327	-	0.3	2.5
JBS327	Benzo(a)pyrene	0.3	2.5
JBS4	-	0.5	2.5
JBS4	-	0.5	2.5

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0 25 50 100 m
Scale: 1:2,500 (A4)

Datum: MGA94 Zone 56

A4			
D3	Revision	RF	09-2-2011
D2	Revision	RF	07-2-2011
D1	Original Issue	RF	20-1-2011
Rev	Description	By	Date

Legend:
- Extent of Clay Layer
- Site Boundary
- Material unsuitable to remain in the top 0.5 m of the finished park profile
- Material unsuitable for use as a growing medium
- Tar Impact
- Sample Location
- Exceedance

JBS ENVIRONMENTAL

Figure 13: Areas of Soil Requiring Relocation

Client: Barangaroo Delivery Authority

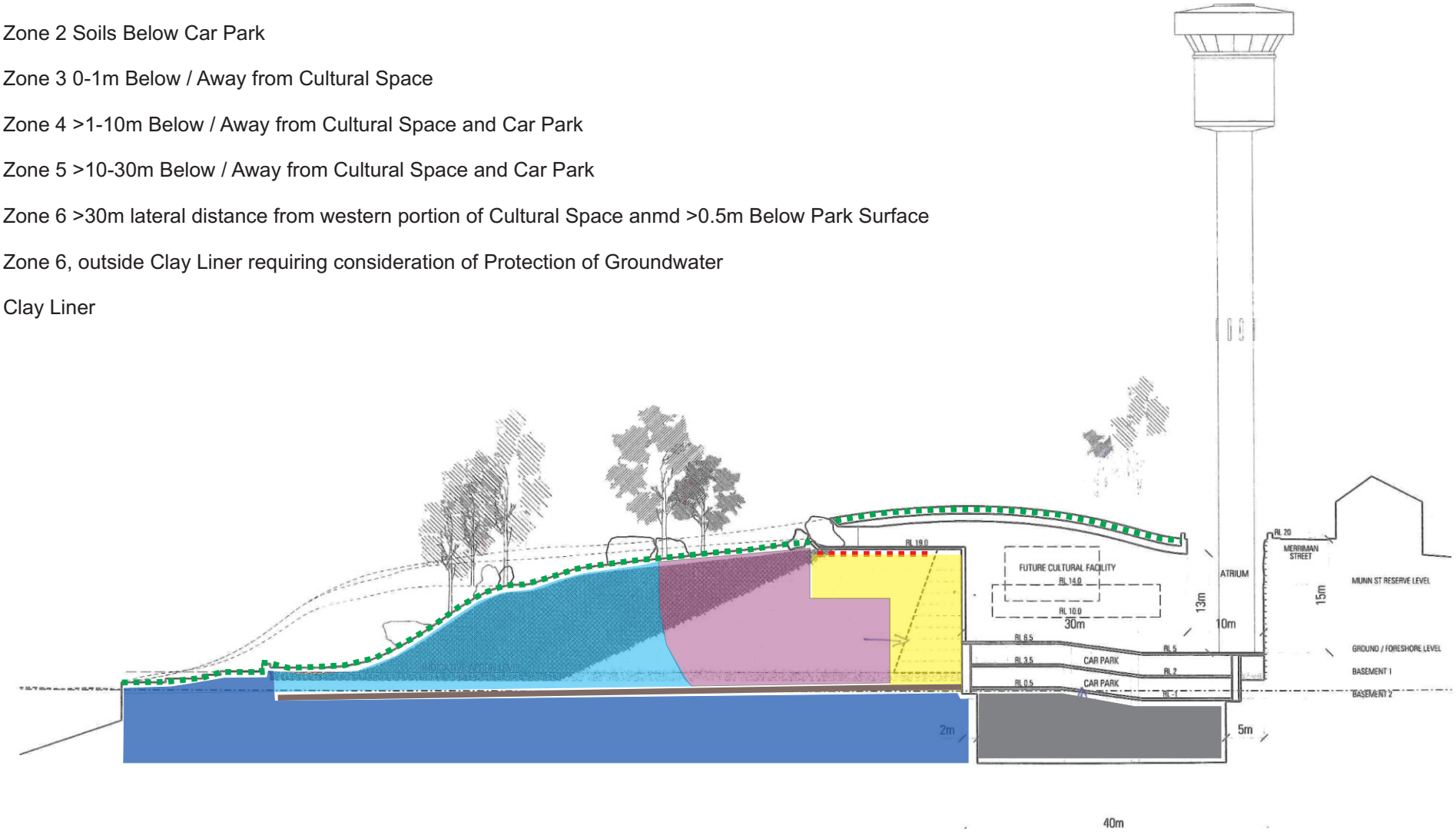
Project: Barangaroo Headland Park

Job No: 41181

File Name: 41181_13 (D3)

LEGEND

- Zone 1 <0.5m below Park Surface (Growing Soils)
- Zone 2 Soils Below Car Park
- Zone 3 0-1m Below / Away from Cultural Space
- Zone 4 >1-10m Below / Away from Cultural Space and Car Park
- Zone 5 >10-30m Below / Away from Cultural Space and Car Park
- Zone 6 >30m lateral distance from western portion of Cultural Space anmd >0.5m Below Park Surface
- Zone 6, outside Clay Liner requiring consideration of Protection of Groundwater
- Clay Liner



JBS ENVIRONMENTAL

0 50m

Approximate scale

Figure 14 **Proposed Complete Park Section and Soil Zones for Derivation of Human Health Risk Based Soil Criteria**

Johnson Pilton Walker (2010)
Note- All locations shown are approximate only

Appendix A – Summary Data Tables

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Table A PAH Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample id	Location	Sampling Depth (m)	Polycyclic Aromatic Hydrocarbons																
			Total PAHs	Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3,cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Assessment criteria [1]								2											
PQL				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	1
BH003	<2010 High Water	1.05	43.7	<0.5	0.8	1.7	2.6	2.5	2.6	1	1.2	2.5	<0.5	9.8	0.9	0.9	0.7	7.8	8.7
BH006	<2010 High Water	1	5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	<0.5	<0.5	<0.5	2.7	1.1
BH006	<2010 High Water	1.7	11	<0.5	<0.5	<0.5	1.1	1	1.3	0.7	<0.5	1.1	<0.5	2.3	<0.5	<0.5	<0.5	1.4	2.1
BH008	<2010 High Water	0.75	42.7	<0.5	0.7	1.6	2.6	3.1	3.4	2.3	1.1	2.5	<0.5	8.5	0.7	1.8	<0.5	6.5	7.9
BH008	<2010 High Water	1.6	3.2	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5	0.6	1
BH009	<2010 High Water	1.7	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5
BH011	<2010 High Water	2.9	8.2	<0.5	<0.5	<0.5	1	0.8	0.9	<0.5	<0.5	0.8	<0.5	2	<0.5	<0.5	<0.5	0.7	2
BH011	<2010 High Water	1.7	125	1.5	<0.5	2.6	12.4	10.2	10.5	4.7	4.1	10.1	1.1	26.5	1	3.9	0.6	9.1	26.7
BH083	<2010 High Water	3.2		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH085	<2010 High Water	1.7	1813	4	12.4	46.9	177	82.4	177	39	46.1	144	13.9	377	18.2	41.1	1.9	340	292
BH086	<2010 High Water	3.2		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH086	<2010 High Water	1.7	15.1	<0.5	<0.5	0.8	0.8	0.9	1	0.7	<0.5	0.6	<0.5	3.5	<0.5	<0.5	<0.5	3.6	3.2
BH105	<2010 High Water	1.7	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5
BH106	<2010 High Water	1.7	10.4	<0.5	<0.5	<0.5	0.6	1.4	1	2.4	0.8	0.6	<0.5	1	<0.5	1.5	<0.5	<0.5	1.1
BH106	<2010 High Water	3.2	10.2	<0.5	<0.5	<0.5	0.9	0.6	0.8		1	0.6	0.8	1.4	<0.5	<0.5	<0.5	<0.5	4.1
BH120	<2010 High Water	1.7	9.1	<0.5	<0.5	<0.5	0.9	0.9	1.1	0.6	<0.5	0.9	<0.5	1.9	<0.5	<0.5	<0.5	0.9	1.9
BH123	<2010 High Water	3.2	2.1	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	<0.5	0.7
BH124	<2010 High Water	1.7	1.8	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	0.6
BH125	<2010 High Water	1.7		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH126	<2010 High Water	5.1	19.6	<0.5	<0.5	0.7	1.6	1.8	2.3	0.8	1	1.6	<0.5	3.8	<0.5	0.7	<0.5	1.9	3.4
BH127	<2010 High Water	3.2		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH162	<2010 High Water	3.5	57.2	1	<0.5	2.2	4	4.1	4.1	2.1	1.8	3.3	<0.5	12.3	1.1	1.8	<0.5	8	11.4
BH162	<2010 High Water	12.3	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5

Table A PAH Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample id	Location	Sampling Depth (m)	Polycyclic Aromatic Hydrocarbons																
			Total PAHs	Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3,cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Assessment criteria [1]								2											
PQL				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	1
BH162	<2010 High Water	13.5	68.3	5.5	<0.5	3.1	4	3.8	4.9	2.7	1.5	3.6	0.6	11	3.9	2.2	0.8	11.6	9.1
BH164	<2010 High Water	5.5	70.9	<0.5	0.8	1	6	8.5	10	6.1	4.4	5	1.2	9.5	<0.5	4.4	<0.5	1.8	12.2
BH165	<2010 High Water	3.5	16.3	<0.5	<0.5	<0.5	1.4	1.7	2	1	0.6	1.3	<0.5	2.9	<0.5	0.8	<0.5	1.6	3
BH165	<2010 High Water	8	9.3	<0.5	<0.5	<0.5	0.8	1	1.2	0.6	<0.5	0.8	<0.5	1.7	<0.5	0.5	<0.5	1	1.7
BH166	<2010 High Water	1.3	30	<0.5	0.5	0.7	2.5	1.7	3.1	2	1.2	1.9	<0.5	6.1	<0.5	1.4	<0.5	2.5	6.4
BH166	<2010 High Water	4	83.9	3.6	0.7	3.8	4.6	4.6	5.6	4.2	2.2	3.7	<0.5	15.1	2.9	2.7	2.7	12.5	15
BH168	<2010 High Water	0.5	17.7	<0.5	<0.5	<0.5	1.7	1.8	1.9	0.8	0.7	1.3	<0.5	3.7	<0.5	0.7	<0.5	1.4	3.7
BH168	<2010 High Water	5	2.3	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	<0.5	1
BH168	<2010 High Water	8.8		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH169	<2010 High Water	0.5	28.6	<0.5	<0.5	0.9	2.4	2.5	2.6	1.2	1	2	<0.5	6.1	<0.5	1	<0.5	2.7	6.2
BH169	<2010 High Water	4.4	25.1	<0.5	0.5	0.7	2.1	1.4	2.5	1.6	1	1.7	<0.5	4.9	<0.5	1.1	0.8	2.4	4.4
BH170	<2010 High Water	1.3	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	0.6
BH170	<2010 High Water	3.7	6.1	<0.5	<0.5	<0.5	0.6	0.7	0.7	0.6	<0.5	<0.5	<0.5	1.3	<0.5	<0.5	<0.5	0.8	1.4
BH170	<2010 High Water	6.1	10.9	<0.5	<0.5	<0.5	1	1.1	1.4	0.6	0.7	0.8	<0.5	1.9	<0.5	<0.5	<0.5	0.7	2.7
BH172	<2010 High Water	1.2	29.4	<0.5	0.7	1.2	2.4	2.2	2.2	0.9	0.9	1.9	<0.5	5.8	<0.5	0.8	0.8	4	5.6
BH172	<2010 High Water	1.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH172	<2010 High Water	3.9	5.7	<0.5	<0.5	<0.5	0.6	0.7	<0.5	<0.5	<0.5	0.6	<0.5	1.6	<0.5	<0.5	<0.5	0.6	1.6
BH173	<2010 High Water	1.8	46.9	<0.5	0.6	1.1	5.1	4.4	4.2	2	2.2	4.5	<0.5	8.8	<0.5	1.7	<0.5	3.9	8.4
BH177	<2010 High Water	1.5	6.8	<0.5	<0.5	<0.5	0.8	0.5	0.9	0.6	<0.5	0.9	<0.5	1.5	<0.5	<0.5	<0.5	<0.5	1.6
BH177	<2010 High Water	4	111.4	<0.5	2.6	4	8.7	8.6	10.4	5.5	3.1	7.3	1.2	18.2	<0.5	4.4	0.8	15	21.6
BH182	<2010 High Water	10.6		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
JBS3	<2010 High Water	1.2	22.4	<0.1	0.2	0.5	1.7	2.3	1.5	1	1.5	1.8	0.2	4.4	<0.1	1	0.1	2	4.2
JBS4	<2010 High Water	2	27.6	<0.1	0.5	0.5	2.4	3	1.9	1.1	1.8	2.3	0.2	5.2	<0.1	1.2	0.2	2	5.3

Table A PAH Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample id	Location	Sampling Depth (m)	Polycyclic Aromatic Hydrocarbons																
			Total PAHs	Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3,cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Assessment criteria [1]								2											
PQL				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	1
JBS300	<2100 High Water	1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS300	<2100 High Water	2	18.5	0.3	<0.1	0.3	1.6	1.9	1.3	1.1	1.2	1.4	0.2	2.9	0.1	1.4	0.2	1.7	2.9
JBS300	<2100 High Water	4	9.6	0.1	<0.1	0.2	0.8	1	0.7	0.5	0.6	0.8	<0.1	1.6	<0.1	0.6	<0.1	1	1.7
JBS300	<2100 High Water	8	9.2	0.1	<0.1	0.1	0.8	1	0.7	0.5	0.6	0.7	<0.1	1.4	<0.1	0.6	0.4	0.8	1.5
JBS300	<2100 High Water	13.5		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS303	<2100 High Water	1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS303	<2100 High Water	4	4.6	<0.1	<0.1	<0.1	0.3	0.5	0.4	0.3	0.3	0.3	<0.1	0.9	<0.1	0.3	<0.1	0.4	0.9
JBS303A	<2100 High Water	5	6.7	<0.1	<0.1	0.2	0.6	0.6	0.4	0.3	0.4	0.6	<0.1	1.1	<0.1	0.3	<0.1	0.6	1.6
JBS303A	<2100 High Water	7	0.16	<0.1	<0.1	<0.1	<0.1	0.06	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
JBS303C	<2100 High Water	12		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS304	<2100 High Water	1	7.4	0.1	<0.1	0.2	0.6	0.6	0.5	0.3	0.4	0.6	<0.1	1.4	<0.1	0.3	<0.1	1.1	1.3
JBS304	<2100 High Water	3	29.1	0.2	0.2	0.7	1.7	3.9	3	2.1	2.9	1.8	0.3	3.3	0.3	2.1	0.3	2.4	3.9
JBS304	<2100 High Water	5	1.9	<0.1	<0.1	<0.1	0.1	0.2	0.2	0.2	0.2	0.1	<0.1	0.2	<0.1	0.2	<0.1	0.2	0.3
JBS304	<2100 High Water	8	2.5	<0.1	<0.1	<0.1	0.2	0.3	0.2	0.2	0.2	0.2	<0.1	0.4	<0.1	0.2	<0.1	0.2	0.4
JBS305	<2100 High Water	2	127.7	4.5	0.6	3.4	10	10	7.5	4.7	7.5	9.5	0.9	23	1.9	5.7	1.5	16	21
JBS305	<2100 High Water	5	189.6	5.6	0.8	4.9	15	18	12	7.1	12	15	1.4	33	1.9	8.2	3.7	20	31
JBS305	<2100 High Water	7	11	0.2	<0.1	0.1	1	1.7	1.1	0.8	1	1.1	0.1	1.2	<0.1	0.8	<0.1	0.3	1.6
JBS306	<2100 High Water	1	0.49	<0.1	<0.1	<0.1	0.1	0.09	<0.1	<0.1	<0.1	0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.1
JBS306	<2100 High Water	2.3	3.2	<0.1	<0.1	<0.1	0.3	0.4	0.3	0.2	0.3	0.3	<0.1	0.5	<0.1	0.2	<0.1	0.2	0.5
JBS306	<2100 High Water	4		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS307	<2100 High Water	1	2.1	<0.1	<0.1	<0.1	0.2	0.2	0.2	0.1	0.1	0.2	<0.1	0.4	<0.1	0.1	<0.1	0.2	0.4
JBS307	<2100 High Water	2	10	<0.1	<0.1	0.3	1.1	0.8	0.7	0.3	0.6	0.9	<0.1	2.2	<0.1	0.4	<0.1	1	1.7
JBS308	<2100 High Water	2	4.4	<0.1	<0.1	0.1	0.4	0.4	0.4	0.2	0.3	0.5	<0.1	0.7	<0.1	0.2	<0.1	0.5	0.7

Table A PAH Results
Historical Soil Sampling
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all units in mg/kg

Sample id	Location	Sampling Depth (m)	Polycyclic Aromatic Hydrocarbons																
			Total PAHs	Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3,cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Assessment criteria [1]								2											
PQL				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	1
JBS309	<2100 High Water	0.5	2.3	<0.1	<0.1	<0.1	0.2	0.3	0.3	0.2	0.2	0.2	<0.1	0.3	<0.1	0.2	<0.1	0.1	0.3
JBS309	<2100 High Water	1	2.4	<0.1	<0.1	<0.1	0.2	0.4	0.3	0.2	0.2	0.2	<0.1	0.3	<0.1	0.2	<0.1	0.1	0.3
JBS309	<2100 High Water	4	6.1	0.1	<0.1	<0.1	0.6	0.7	0.5	0.4	0.5	0.5	<0.1	1	<0.1	0.4	<0.1	0.3	1.1
JBS310	<2100 High Water	1	39.6	0.3	0.3	0.5	3.3	4.6	3.2	2.6	3.2	3.3	0.4	5.8	0.2	3.2	0.2	3	5.5
JBS310	<2100 High Water	2	7.3	<0.1	<0.1	0.1	0.6	0.9	0.6	0.6	0.6	0.6	<0.1	1.1	<0.1	0.6	<0.1	0.5	1.1
JBS310	<2100 High Water	4	1.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	<0.1	0.1	0.1	<0.1	0.2	<0.1	0.1	<0.1	0.1	0.2
JBS310	<2100 High Water	6	1.2	<0.1	<0.1	<0.1	0.1	0.2	0.1	0.1	0.1	0.1	<0.1	0.2	<0.1	0.1	<0.1	<0.1	0.2
JBS311	<2100 High Water	1	5.1	<0.1	<0.1	<0.1	0.4	0.7	0.5	0.5	0.4	0.5	<0.1	0.7	<0.1	0.5	<0.1	0.2	0.7
JBS311	<2100 High Water	3	13.5	0.2	0.1	0.3	1	1.4	1	0.9	0.9	1.1	0.1	2.2	0.1	0.8	<0.1	1.1	2.3
JBS311	<2100 High Water	5	2.8	<0.1	<0.1	<0.1	0.2	0.3	0.2	0.2	0.2	0.2	<0.1	0.5	<0.1	0.2	<0.1	0.3	0.5
JBS311	<2100 High Water	7	9.4	0.1	<0.1	0.3	0.7	1	0.6	0.5	0.6	0.8	<0.1	1.6	<0.1	0.5	<0.1	1	1.7
JBS312	<2100 High Water	1	409	0.4	5.1	10	28	42	24.5	23	24.5	24	2.1	78	3.9	25	0.5	45	73
JBS312A	<2100 High Water	2	0.37	<0.1	<0.1	<0.1	<0.1	0.07	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	0.1	0.1
JBS313	<2100 High Water	1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS313	<2100 High Water	3	33.3	0.4	0.1	0.7	2.7	3.8	2.6	1.6	2.6	2.4	0.2	4.9	0.2	1.8	0.2	2.2	6.9
JBS313	<2100 High Water	4	44.5	0.2	1.5	0.9	3.3	4.1	2.7	1.8	2.6	2.9	0.2	8.4	0.9	2	0.3	4.1	8.6
JBS313A	<2100 High Water	8	28	0.2	4.2	0.8	1.1	1.2	0.8	0.5	0.8	1	0.1	3.1	1.9	0.5	4	5	2.8
JBS314	<2100 High Water	1	31.5	0.5	<0.1	0.6	2.9	3.4	2	1.5	2	2.4	0.2	5.7	0.2	2	0.1	2.1	5.9
JBS314	<2100 High Water	2	9.2	0.1	<0.1	0.2	0.8	1	0.7	0.5	0.6	0.8	<0.1	1.6	<0.1	0.6	<0.1	0.7	1.6
JBS314	<2100 High Water	7	1039	0.8	13	33	84	77	55	28	55	81	8	190	21	41	2.3	210	140
JBS315	<2100 High Water	2	0.6	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	0.2
JBS315	<2100 High Water	4	1.8	<0.1	<0.1	<0.1	0.1	0.2	0.2	0.1	0.1	0.2	<0.1	0.3	<0.1	0.1	<0.1	0.2	0.3
JBS316	<2100 High Water	2	0.28	<0.1	<0.1	<0.1	<0.1	0.08	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.1

Table A PAH Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample id	Location	Sampling Depth (m)	Polycyclic Aromatic Hydrocarbons																
			Total PAHs	Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3,cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Assessment criteria [1]								2											
PQL				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	1
JBS318	<2100 High Water	2	2.6	<0.1	<0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.2	<0.1	0.4	<0.1	0.2	<0.1	0.4	0.4
JBS318	<2100 High Water	3	0.77	<0.1	<0.1	<0.1	<0.1	0.07	<0.1	<0.1	<0.1	0.1	<0.1	0.2	<0.1	<0.1	<0.1	0.2	0.2
JBS319	<2100 High Water	1	0.78	<0.1	<0.1	<0.1	<0.1	0.08	<0.1	<0.1	<0.1	0.2	<0.1	0.1	<0.1	<0.1	<0.1	0.2	0.2
JBS319	<2100 High Water	4	5.3	<0.1	<0.1	0.1	0.6	0.5	0.5	0.2	0.5	0.5	<0.1	0.9	<0.1	0.3	<0.1	0.3	0.9
JBS320A	<2100 High Water	2	5	<0.1	<0.1	0.1	0.5	0.6	0.5	0.3	0.4	0.5	<0.1	0.7	<0.1	0.3	<0.1	0.4	0.7
JBS322	<2100 High Water	1	41.2	0.2	0.1	0.9	4	4.2	3.1	1.6	3.1	3.8	0.4	7.2	0.2	2.1	<0.1	3.9	6.4
JBS322	<2100 High Water	2	20.8	0.3	<0.1	0.4	1.9	1.9	1.4	0.8	1.3	1.6	0.1	3.9	0.2	0.9	<0.1	2.6	3.5
JBS322	<2100 High Water	5	20.4	0.1	<0.1	0.4	2	2	1.4	0.9	1.3	1.8	0.1	4.1	<0.1	1	<0.1	1.6	3.7
JBS323	<2100 High Water	3	34.1	0.3	<0.1	0.4	3.9	3.7	2.5	1.4	2.4	3.3	0.3	6	<0.1	1.7	0.1	1.8	6.3
JBS324	<2100 High Water	1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS324	<2100 High Water	2	9.3	<0.1	<0.1	0.2	0.6	1.1	0.7	0.8	0.7	0.7	0.1	1.5	<0.1	0.7	<0.1	0.6	1.6
JBS324	<2100 High Water	3	42.3	0.2	0.7	1	2.6	4.1	2.7	2.8	2.6	2.7	0.3	6.9	0.7	2.7	1	4.5	6.8
JBS324	<2100 High Water	4	10	0.1	<0.1	0.3	0.8	1	0.7	0.6	0.6	0.8	<0.1	1.7	<0.1	0.5	<0.1	1.1	1.8
JBS324	<2100 High Water	7	22.4	0.2	0.2	0.7	1.7	2	1.3	1	1.2	1.7	0.1	4	0.3	1	0.1	2.8	4.1
JBS324	<2100 High Water	9	5	<0.1	<0.1	0.1	0.4	0.5	0.3	0.3	0.3	0.4	<0.1	0.9	<0.1	0.3	<0.1	0.6	0.9
JBS324	<2100 High Water	10	0.17	<0.1	<0.1	<0.1	<0.1	0.07	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
JBS325	<2100 High Water	2	3.3	<0.1	<0.1	<0.1	0.3	0.4	0.3	0.2	0.3	0.3	<0.1	0.5	<0.1	0.2	<0.1	0.3	0.5
JBS325C	<2100 High Water	3	16.2	0.3	0.1	0.7	1.3	1.4	1	0.5	0.9	1.1	<0.1	2.7	0.4	0.6	0.1	2.2	2.9
JBS326	<2100 High Water	3	1.4	<0.1	<0.1	<0.1	0.1	0.2	0.1	0.1	0.1	0.2	<0.1	0.2	<0.1	0.1	<0.1	0.1	0.2
JBS326	<2100 High Water	4	0.8	<0.1	<0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.2	<0.1	<0.1	<0.1	0.1	0.2
JBS327	<2100 High Water	2	48.7	0.3	0.4	1.4	3.2	4.2	2.7	2.4	2.7	3	0.3	9.3	0.6	2.5	0.3	6.7	8.7
JBS327	<2100 High Water	5	0.8	<0.1	<0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.2	<0.1	<0.1	<0.1	0.1	0.2
JBS327	<2100 High Water	7	0.88	<0.1	<0.1	<0.1	0.1	0.08	<0.1	<0.1	<0.1	0.1	<0.1	0.2	<0.1	<0.1	<0.1	0.2	0.2

Table A PAH Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample id	Location	Sampling Depth (m)	Polycyclic Aromatic Hydrocarbons																
			Total PAHs	Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3,cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Assessment criteria [1]								2											
PQL				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	1
JBS327	<2100 High Water	8	4	<0.1	<0.1	<0.1	0.4	0.4	0.3	0.2	0.3	0.4	<0.1	0.8	<0.1	0.2	<0.1	0.3	0.7
JBS327	<2100 High Water	9	6.8	<0.1	<0.1	0.1	0.5	0.7	0.5	0.4	0.4	0.5	<0.1	1.4	<0.1	0.4	<0.1	0.5	1.4
JBS328	<2100 High Water	1	124.6	0.3	0.8	2.3	8	13	8	9.2	8	7.8	1.1	22	0.8	10	0.3	11	22
JBS328	<2100 High Water	2	177.3	2.8	0.2	2.7	16	21	13	9.6	13	14	2	30	0.8	11	0.9	9.3	31
JBS328	<2100 High Water	4	7.6	0.1	<0.1	0.1	0.7	0.8	0.6	0.4	0.5	0.7	<0.1	1.4	<0.1	0.4	<0.1	0.4	1.5
JBS328	<2100 High Water	6	19.5	0.3	<0.1	0.3	1.9	2	1.4	0.9	1.3	1.7	<0.1	3.7	<0.1	1	0.1	1.2	3.7
JBS328	<2100 High Water	8	0.28	<0.1	<0.1	<0.1	<0.1	0.08	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.1
JBS328	<2100 High Water	9	9.1	0.1	<0.1	0.2	0.9	0.9	0.7	0.4	0.6	0.8	<0.1	1.7	<0.1	0.5	<0.1	0.6	1.7
JBS329	<2100 High Water	1	10.3	0.2	<0.1	0.2	0.9	1	0.7	0.5	0.7	0.9	<0.1	1.9	<0.1	0.5	<0.1	0.8	2
JBS329	<2100 High Water	2	6.4	0.1	<0.1	0.1	0.6	0.6	0.5	0.3	0.4	0.6	<0.1	1.1	<0.1	0.3	<0.1	0.7	1.1
JBS330	<2100 High Water	2	15.1	0.2	<0.1	0.3	1.3	1.6	1.1	1.1	1.1	1.2	0.1	2.3	<0.1	1.2	<0.1	1.1	2.5
JBS330A	<2100 High Water	4	1.4	<0.1	<0.1	<0.1	0.1	0.2	0.1	<0.1	0.1	0.1	<0.1	0.3	<0.1	0.1	<0.1	0.1	0.3
JBS330A	<2100 High Water	6	1.9	<0.1	<0.1	<0.1	0.2	0.2	0.2	<0.1	0.1	0.2	<0.1	0.4	<0.1	0.1	<0.1	0.2	0.3
BH002	Above GW	0.5	6.4	<0.5	<0.5	<0.5	<0.5	0.6	0.8	<0.5	0.5	0.6	<0.5	1.5	<0.5	<0.5	<0.5	0.9	1.5
BH004	Above GW	1.7		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH138	Above GW	0.4	59.7	<0.5	<0.5	1.8	5.6	5.2	6.1	2.8	2.4	5	0.6	12.3	<0.5	2.2	<0.5	4.6	11.1
BH149	Above GW	0.4	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6
BH005	Excavated	0.55		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH007	Excavated	0.5	4.8	<0.5	<0.5	<0.5	0.6	0.6	0.7	<0.5	<0.5	<0.5	<0.5	1.2	<0.5	<0.5	<0.5	0.6	1.1
BH007	Excavated	1	8.1	<0.5	<0.5	<0.5	0.9	0.8	1	0.6	<0.5	0.7	<0.5	1.7	<0.5	<0.5	<0.5	0.8	1.6
BH105	Excavated	0.4	40.3	<0.5	<0.5	1.9	3.3	3.3	2.3	1.9	2.4	2.8	0.6	7.2	0.6	1.6	<0.5	5.2	7.2
BH123	Excavated	0.4	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	0.6
BH150	Excavated	1.7	14.3	<0.5	<0.5	<0.5	1.3	1.4	1.7	0.9	0.7	1.1	<0.5	2.7	<0.5	0.8	<0.5	0.9	2.8

Table A PAH Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample id	Location	Sampling Depth (m)	Polycyclic Aromatic Hydrocarbons																
			Total PAHs	Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3,cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Assessment criteria [1]								2											
PQL				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	1
BH164	Excavated	0.1		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH182	Excavated	0.4	1.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.9	<0.5	<0.5	<0.5	0.9
JBS3	Excavated	0.7	5.3	<0.1	<0.1	<0.1	0.3	0.7	0.4	0.4	0.4	0.4	<0.1	1	<0.1	0.3	0.1	0.3	1
BH015	Excavated	0.6	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5
BH131	Excavated	0.4	18.2	<0.5	<0.5	0.6	1.5	1.7	2	1.3	0.5	1.3	<0.5	3.3	<0.5	1	<0.5	1.9	3.1
BH010	Off-site	0.4	15.5	<0.5	<0.5	<0.5	1.3	1.7	2.2	1.3	0.9	1.4	<0.5	2.4	<0.5	1.1	<0.5	0.8	2.4
BH010	Off-site	1.7	38.4	0.7	<0.5	0.8	3.6	3.7	4.1	2.1	1.7	3.1	<0.5	7	<0.5	1.8	<0.5	2.8	7
BH029	Off-site	0.4	8	<0.5	<0.5	<0.5	0.9	1	0.8	0.7	0.8	0.9	<0.5	1.5	<0.5	0.6	<0.5	0.8	<0.5
BH030	Off-site	1.7	13.5	<0.5	<0.5	0.8	1	0.8	0.6	<0.5	0.7	0.9	<0.5	2.7	0.6	<0.5	<0.5	3.2	2.2
BH031	Off-site	1.7		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH084	Off-site	0.4	1	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
BH121	Off-site	3.2	39.7	0.9	<0.5	1	3.3	3.2	3.9	2	1.6	3	<0.5	7.3	<0.5	1.5	1	4.1	6.9
BH121	Off-site	0.4	3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	1.3	0.6	<0.5
BH121	Off-site	1.7	43.7	1.1	<0.5	1	3.9	4.2	3.2	2.4	2.5	3.4	0.8	7.6	<0.5	2.2	1.2	2.2	8
BH139	Off-site	1.7		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH144	Off-site	3.2	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	0.6
BH163	Off-site	5	16.8	<0.5	<0.5	<0.5	1.1	0.8	1.5	1.4	0.7	0.7	<0.5	4.4	<0.5	0.7	<0.5	1.3	4.2
BH163	Off-site	7	4.6	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.8	<0.5	<0.5	<0.5	0.6	1.6
BH167	Off-site	2.2	9.4	<0.5	<0.5	0.5	1	0.8	0.8	0.5	<0.5	0.7	<0.5	1.7	<0.5	<0.5	<0.5	1.6	1.8
BH167	Off-site	8.6	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
BH167	Off-site	10.7	16.6	<0.5	<0.5	0.6	1.4	1.4	1.4	0.8	0.5	1.2	<0.5	3.3	<0.5	0.6	<0.5	2.1	3.3
BH171	Off-site	1.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH171	Off-site	2.7	22.6	<0.5	<0.5	0.6	<0.5	3.5	4.4	2.7	1.2	<0.5	0.5	2.6	<0.5	1.8	0.7	1.5	3.1

Table A PAH Results
Historical Soil Sampling
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all units in mg/kg

Sample id	Location	Sampling Depth (m)	Polycyclic Aromatic Hydrocarbons																
			Total PAHs	Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3,cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Assessment criteria [1]								2											
PQL				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	1
BH174	Off-site	2.4	15.6	<0.5	<0.5	0.7	1.1	1.2	1	0.8	0.7	0.9	<0.5	3.4	<0.5	0.6	<0.5	1.9	3.3
BH174	Off-site	4.3	10.7	<0.5	<0.5	<0.5	1	1.1	1	0.8	0.6	0.7	<0.5	1.9	<0.5	0.6	<0.5	0.8	2.2
BH175	Off-site	2	6.4	<0.5	<0.5	<0.5	0.8	0.8	0.7	0.6	<0.5	0.6	<0.5	1.1	<0.5	<0.5	<0.5	0.6	1.2
BH175	Off-site	7.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH176	Off-site	2.4	17	<0.5	<0.5	0.6	1.8	1.3	1.6	0.8	0.6	1.2	<0.5	3.4	<0.5	0.6	<0.5	1.7	3.4
BH176	Off-site	3.7	65	<0.5	0.9	1.7	6	6.7	7.7	4.2	3.8	5.1	0.8	9.8	<0.5	3.4	<0.5	4.2	10.7
BH178	Off-site	8.3	3.8	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.9	<0.5	<0.5	<0.5	1.1	1.2
BH181	Off-site	5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH181	Off-site	9.1		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH185	Off-site	4		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH185	Off-site	9.6		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH215	Off-site	2.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH215	Off-site	6.1		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
JBS2	Off-site	1.8	20.3	0.2	1	0.7	1.1	1.7	1.1	1	1.1	1.1	0.2	2.8	0.6	1	1.1	3.2	2.4
JBS2	Off-site	4	13.8	<0.1	0.2	0.3	1.2	1.6	1	0.7	1	1.2	0.1	2.3	<0.1	0.6	<0.1	1.1	2.5
JBS301	off-site	0.5	7.2	<0.1	<0.1	0.1	0.6	1	0.5	0.4	0.5	0.7	<0.1	1.1	<0.1	0.4	<0.1	0.7	1.2
JBS301	off-site	1		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS301	off-site	2	0.5	<0.1	<0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.2
JBS301	off-site	3		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS301	off-site	4		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS301	off-site	5		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS301	off-site	7	2.3	<0.1	<0.1	<0.1	0.2	0.2	0.2	0.1	0.1	0.2	<0.1	0.5	<0.1	0.2	<0.1	0.1	0.5
JBS301	off-site	10	0.56	<0.1	<0.1	<0.1	<0.1	0.06	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	0.1	0.2

Table A PAH Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample id	Location	Sampling Depth (m)	Polycyclic Aromatic Hydrocarbons																
			Total PAHs	Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3,cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Assessment criteria [1]								2											
PQL				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	1
JBS301	off-site	12	2.9	<0.1	<0.1	<0.1	0.3	0.3	0.2	0.1	0.2	0.3	<0.1	0.5	<0.1	0.2	<0.1	0.2	0.6
JBS302	off-site	0.4	6.7	0.1	<0.1	0.1	0.6	0.8	0.6	0.4	0.5	0.6	<0.1	1	<0.1	0.5	<0.1	0.4	1.1
JBS302	off-site	1	1.8	<0.1	<0.1	<0.1	0.2	0.2	0.2	0.1	0.1	0.2	<0.1	0.3	<0.1	0.1	<0.1	0.1	0.3
JBS302	off-site	2		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS302	off-site	6	10.7	0.5	<0.1	0.1	0.9	1.3	0.8	0.5	0.7	0.8	<0.1	1.9	<0.1	0.6	0.3	0.4	1.9
JBS302	off-site	8	0.27	<0.1	<0.1	<0.1	<0.1	0.07	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.1
BH009	Unsaturated	0.4	150.4	<0.5	1.4	4.6	9.2	11.2	11.5	8.2	4	8.2	1.2	32.6	1.5	6.1	0.6	19.8	30.3
BH011	Unsaturated	0.4	4.8	<0.5	<0.5	<0.5	0.5	0.6	<0.5	<0.5	<0.5	0.5	<0.5	1.3	<0.5	<0.5	<0.5	0.6	1.3
BH083	Unsaturated	0.4	4.4	<0.5	<0.5	<0.5	<0.5	0.6	0.7	<0.5	<0.5	<0.5	<0.5	1.2	<0.5	<0.5	<0.5	0.7	1.2
BH085	Unsaturated	0.4	260.5	1.4	2.4	6.6	16.4	25.7	27.6	25.1	10.3	13.8	3	43.8	2.2	16.6	1.1	17	47.5
BH120	Unsaturated	0.4	4.2	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	0.5	<0.5	<0.5	<0.5	1.2	<0.5	<0.5	<0.5	0.8	1.1
BH125	Unsaturated	0.4	44.3	<0.5	<0.5	1.4	2.8	3.5	4.1	2.7	1.5	2.7	<0.5	8.5	0.6	2.2	0.6	5.5	8.2
BH126	Unsaturated	0.4	26.8	<0.5	<0.5	0.6	2	2.4	2.9	2	1	2	<0.5	5.3	<0.5	1.3	<0.5	2.2	5.1
BH127	Unsaturated	0.4	26	<0.5	<0.5	0.6	1.8	2.5	2.9	2.2	1.1	1.8	<0.5	4.9	<0.5	1.4	<0.5	1.8	5
BH130	Unsaturated	0.4	4.9	<0.5	<0.5	<0.5	<0.5	0.6	0.7	<0.5	<0.5	0.5	<0.5	1.2	<0.5	<0.5	<0.5	0.6	1.3
BH157	Unsaturated	0.3		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH158	Unsaturated	0.35		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
JBS3	Unsaturated	0.2	0.4	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.1
JBS4	Unsaturated	0.5	52.4	0.3	0.3	1	3.7	5.6	3.5	2.9	3.4	3.7	0.4	10	0.2	2.7	0.1	4.7	9.9
JBS304	Unsaturated	0.2	8.8	0.1	<0.1	0.1	0.7	1.1	0.8	0.7	0.8	0.8	0.1	1.2	<0.1	0.7	<0.1	0.4	1.3
JBS305	Unsaturated	0.2	11.2	0.1	<0.1	0.1	0.8	1.6	1.3	1.2	1.2	1	0.1	1.1	<0.1	1.3	<0.1	0.2	1.2
JBS306	Unsaturated	0.5	8.9	<0.1	<0.1	0.2	0.7	1	0.7	0.5	0.7	0.8	<0.1	1.3	<0.1	0.7	<0.1	0.9	1.4
JBS308	Unsaturated	0.5	15.3	0.1	<0.1	0.3	1.4	1.3	1.1	0.6	1.1	1.5	0.1	2.7	0.1	0.7	<0.1	2	2.3

Table A PAH Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample id	Location	Sampling Depth (m)	Polycyclic Aromatic Hydrocarbons																
			Total PAHs	Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3,cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Assessment criteria [1]								2											
PQL				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	1
JBS310	Unsaturated	0.5	6.7	<0.1	<0.1	<0.1	0.5	1	0.7	0.8	0.7	0.5	<0.1	0.7	<0.1	0.8	<0.1	0.2	0.8
JBS311	Unsaturated	0.2		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS316	Unsaturated	0.2	277.7	0.6	2.2	7.4	17	28	17	20	17	17	2.1	49	2.6	19	0.8	30	48
JBS317	Unsaturated	0.5	17.8	<0.1	0.3	0.5	1.1	1.6	1.05	1	1.05	1.2	<0.1	3.1	0.3	1	0.3	2.4	2.9
JBS318	Unsaturated	0.2	7.6	<0.1	0.1	0.2	0.5	0.6	0.5	0.4	0.4	0.5	<0.1	1.3	0.1	0.4	0.2	1.1	1.3
JBS319	Unsaturated	0.2	0.5	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.3	<0.1
JBS320A	Unsaturated	0.5	14.9	0.1	0.1	0.4	1.1	1.5	1	0.9	0.9	1.1	<0.1	2.5	0.1	0.9	0.1	1.7	2.5
JBS320A	Unsaturated	1	8	0.1	<0.1	0.1	0.9	1	0.8	0.3	0.7	0.7	<0.1	1.3	<0.1	0.5	<0.1	0.4	1.2
JBS321	Unsaturated	1	47.5	1	0.4	2.6	2.9	2.6	1.9	0.9	1.8	2.3	0.1	7.5	2.8	1.1	3.6	9.9	6.1
JBS322	Unsaturated	0.3	0.3	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.1	<0.1
JBS323	Unsaturated	1	47.5	0.2	0.9	0.7	3.9	4	2.9	2	2.9	3.6	0.4	8.4	0.5	2.4	1.2	6.2	7.3
JBS324	Unsaturated	0.5	9.4	0.1	<0.1	0.1	0.7	1.1	0.8	0.7	0.8	0.8	<0.1	1.5	<0.1	0.7	<0.1	0.5	1.6
JBS325	Unsaturated	0.5	5.3	<0.1	<0.1	<0.1	0.3	0.5	0.4	0.3	0.4	0.6	<0.1	0.7	<0.1	0.2	0.4	0.8	0.7
JBS325	Unsaturated	1	15.5	0.2	<0.1	0.5	1.4	1.7	1.1	0.5	1.1	1.2	0.1	2.6	0.2	0.7	0.1	1.5	2.6
JBS326	Unsaturated	1	15	0.3	<0.1	0.3	1.3	1.5	1.1	0.7	1.1	1.3	0.1	2.4	<0.1	0.8	0.1	1.6	2.4
JBS327	Unsaturated	0.3	61	0.2	0.4	1.2	4.3	6.1	4.1	4	4	4.2	0.5	11	0.2	4.1	0.2	5.5	11
JBS329	Unsaturated	0.5	5.2	<0.1	<0.1	<0.1	0.4	0.4	0.4	0.2	0.3	0.5	<0.1	0.9	<0.1	0.2	0.2	0.8	0.9
JBS330	Unsaturated	0.2	32.5	0.1	0.4	0.8	2.3	2.9	1.9	1.6	1.8	2	0.2	6	0.4	1.8	0.1	4.5	5.7

Table B Total Petroleum Hydrocarbon Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	TPH				
			C6-C9	C10-C14	C15-C28	C29-C36	ΣC10-C36
Assessment criteria [1]			**65**	**-**			**1000**
PQL			**2**	**50**	**100**	**100**	
BH003	<2010 High Water	1.05	<2	<50	300	<100	300
BH003	<2010 High Water	3.2	<2	<50	<100	<100	-
BH003	<2010 High Water	1.7	<2	<50	<100	<100	-
BH006	<2010 High Water	1	<2	<50	<100	<100	-
BH006	<2010 High Water	1.7	<2	<50	<100	<100	-
BH008	<2010 High Water	0.75	<2	<50	<100	<100	-
BH008	<2010 High Water	1.6	<2	<50	<100	<100	-
BH009	<2010 High Water	1.7	<2	<50	<100	<100	-
BH011	<2010 High Water	2.9	<2	<50	<100	<100	-
BH011	<2010 High Water	1.7	<2	<50	370	260	630
BH013	<2010 High Water	3.2	<2	<50	<100	<100	-
BH013	<2010 High Water	1.7	<2	60	490	270	820
BH036	<2010 High Water	3.2	<2	<50	<100	<100	-
BH036	<2010 High Water	1.7	<2	<50	<100	<100	-
BH083	<2010 High Water	3.2	<2	<50	<100	<100	-
BH085	<2010 High Water	1.7	<2	130	5050	1770	6950
BH086	<2010 High Water	3.2	<2	<50	<100	<100	-
BH086	<2010 High Water	1.7	<2	<50	<100	<100	-
BH106	<2010 High Water	1.7	<2	<50	<100	<100	-
BH106	<2010 High Water	3.2	<2	<50	<100	<100	-
BH123	<2010 High Water	3.2	<2	<50	<100	<100	-
BH124	<2010 High Water	1.7	<2	<50	<100	<100	-
BH125	<2010 High Water	1.7	<2	<50	<100	<100	-
BH126	<2010 High Water	5.1	<2	<50	<100	<100	-
BH127	<2010 High Water	3.2	<2	<50	<100	<100	-

Table B Total Petroleum Hydrocarbon Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	TPH				
			C6-C9	C10-C14	C15-C28	C29-C36	ΣC10-C36
Assessment criteria [1]			**65**	**-**			**1000**
PQL			**2**	**50**	**100**	**100**	
BH162	<2010 High Water	3.5	<2	<50	340	490	830
BH162	<2010 High Water	12.3	<2	<50	<100	<100	-
BH162	<2010 High Water	13.5	<2	<50	<100	<100	-
BH164	<2010 High Water	5.5	<2	<50	630	540	1170
BH165	<2010 High Water	3.5	<2	<50	<100	<100	-
BH165	<2010 High Water	8	<2	<50	<100	<100	-
BH166	<2010 High Water	1.3	<2	<50	<100	<100	-
BH166	<2010 High Water	4	<2	<50	330	320	650
BH168	<2010 High Water	0.5	<2	<50	<100	<100	-
BH168	<2010 High Water	5	<2	<50	<100	<100	-
BH168	<2010 High Water	8.8	<2	<50	<100	<100	-
BH169	<2010 High Water	0.5	<2	<50	130	<100	130
BH169	<2010 High Water	4.4	<2	<50	<100	<100	-
BH170	<2010 High Water	1.3	<2	<50	<100	<100	-
BH170	<2010 High Water	3.7	<2	<50	<100	<100	-
BH170	<2010 High Water	6.1	<2	<50	240	140	380
BH172	<2010 High Water	1.2	<2	<50	110	<100	110
BH172	<2010 High Water	1.5	<2	<50	<100	<100	-
BH172	<2010 High Water	3.9	<2	<50	<100	<100	-
BH173	<2010 High Water	1.8	<2	<50	180	<100	180
BH177	<2010 High Water	1.5	<2	<50	300	160	460
BH177	<2010 High Water	4	<2	<50	400	350	750
BH182	<2010 High Water	10.6	<2	<50	<100	<100	-
JBS3	<2010 High Water	1.2	<25	<50	<100	<100	-
JBS309	<2100 High Water	0.5	<25	<50	<100	<100	<250

Table B Total Petroleum Hydrocarbon Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	TPH				
			C6-C9	C10-C14	C15-C28	C29-C36	ΣC10-C36
Assessment criteria [1]			**65**		**-**		**1000**
PQL			**2**	**50**	**100**	**100**	
JBS314	<2100 High Water	1	<25	<50	150	130	305
BH002	Above GW	0.5	<2	<50	440	630	1070
BH004	Above GW	1.7	<2	<50	<100	<100	-
BH082	Above GW	0.4	<2	<50	<100	<100	-
BH138	Above GW	0.4	<2	<50	340	230	570
BH149	Above GW	0.4	<2	<50	<100	<100	-
BH005	Excavated	0.55	<2	<50	<100	<100	-
BH007	Excavated	0.5	<2	<50	<100	<100	-
BH007	Excavated	1	<2	<50	<100	<100	-
BH088	Excavated	0.4	<2	<50	<100	<100	-
BH105	Excavated	0.4	<2	<50	<100	<100	-
BH123	Excavated	0.4	<2	<50	<100	<100	-
BH150	Excavated	1.7	<2	<50	<100	<100	-
BH164	Excavated	0.1	<2	<50	<100	<100	-
BH182	Excavated	0.4	<2	<50	<100	<100	-
JBS3	Excavated	0.7	<25	<50	<100	<100	-
BH015	Excavated	0.6	<2	60	370	<100	430
BH038	Excavated	0.4	<2	<50	<100	<100	-
BH041	Excavated	0.4	<2	<50	<100	<100	-
BH131	Excavated	0.4	<2	<50	<100	<100	-
BH010	Off-site	0.4	<2	<50	<100	130	130
BH010	Off-site	1.7	<2	<50	170	110	280
BH029	Off-site	0.4	<2	<50	<100	<100	-
BH030	Off-site	1.7	<2	<50	<100	<100	-
BH031	Off-site	1.7	<2	<50	<100	<100	-

Table B Total Petroleum Hydrocarbon Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	TPH				
			C6-C9	C10-C14	C15-C28	C29-C36	ΣC10-C36
Assessment criteria [1]			**65**	**-**			**1000**
PQL			**2**	**50**	**100**	**100**	
BH069	Off-site	0.4	<2	<50	<100	<100	-
BH084	Off-site	0.4	<2	<50	<100	<100	-
BH121	Off-site	3.2	<2	<50	<100	<100	-
BH121	Off-site	0.4	<2	<50	<100	<100	-
BH139	Off-site	1.7	<2	<50	<100	<100	-
BH144	Off-site	3.2	<2	<50	<100	<100	-
BH163	Off-site	5	<2	<50	<100	<100	-
BH163	Off-site	7	<2	<50	<100	<100	-
BH167	Off-site	2.2	<2	<50	<100	<100	-
BH167	Off-site	8.6	<2	<50	<100	<100	-
BH167	Off-site	10.7	<2	<50	<100	<100	-
BH171	Off-site	1.5	<2	<50	<100	<100	-
BH171	Off-site	2.7	<2	180	2240	910	3330
BH174	Off-site	2.4	<2	<50	<100	<100	-
BH174	Off-site	4.3	<2	<50	<100	<100	-
BH175	Off-site	2	<2	<50	<100	<100	-
BH175	Off-site	7.5	<2	<50	<100	<100	-
BH176	Off-site	2.4	<2	<50	<100	<100	-
BH176	Off-site	3.7	<2	<50	1320	460	1780
BH178	Off-site	8.3	<2	<50	<100	<100	-
BH181	Off-site	5	<2	<50	<100	<100	-
BH181	Off-site	9.1	<2	<50	<100	<100	-
BH185	Off-site	4	<2	<50	<100	<100	-
BH185	Off-site	9.6	<2	<50	<100	<100	-
BH215	Off-site	2.5	<2	<50	<100	<100	-

Table B Total Petroleum Hydrocarbon Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	TPH				
			C6-C9	C10-C14	C15-C28	C29-C36	ΣC10-C36
Assessment criteria [1]			**65**		**-**		**1000**
PQL			**2**	**50**	**100**	**100**	
BH215	Off-site	6.1	<2	<50	<100	<100	-
JBS2	Off-site	1.8	<25	<50	<100	<100	-
JBS2	Off-site	4	<25	<50	130	<100	130
BH009	Unsaturated	0.4	<2	<50	<100	130	130
BH011	Unsaturated	0.4	<2	<50	<100	<100	-
BH033	Unsaturated	0.4	<2	<50	<100	<100	-
BH034	Unsaturated	0.4	<2	<50	250	150	400
BH037	Unsaturated	0.4	<2	<50	<100	<100	-
BH037	Unsaturated	0.7	<2	<50	<100	<100	-
BH039	Unsaturated	0.4	<2	<50	<100	<100	-
BH043	Unsaturated	0.4	<2	<50	<100	<100	-
BH083	Unsaturated	0.4	<2	<50	110	<100	110
BH085	Unsaturated	0.4	<2	<50	700	470	1170
BH120	Unsaturated	0.4	7	<50	<100	<100	-
BH125	Unsaturated	0.4	<2	<50	<100	<100	-
BH126	Unsaturated	0.4	<2	<50	<100	<100	-
BH127	Unsaturated	0.4	<2	<50	<100	<100	-
BH130	Unsaturated	0.4	<2	<50	<100	<100	-
BH157	Unsaturated	0.3	3	<50	400	480	880
BH158	Unsaturated	0.35	<2	<50	130	270	400
JBS3	Unsaturated	0.2	<25	<50	580	1600	2180
JBS310	Unsaturated	0.5	<25	<50	100	<100	175
JBS311	Unsaturated	0.2	<25	<50	<100	<100	<250
JBS316	Unsaturated	0.2	<25	<50	510	500	1035
JBS322	Unsaturated	0.3	<25	<50	<100	<100	<250

Table B Total Petroleum Hydrocarbon Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	TPH				
			C6-C9	C10-C14	C15-C28	C29-C36	ΣC10-C36
Assessment criteria [1]			**65**	**-**			**1000**
PQL			**2**	**50**	**100**	**100**	
JBS327	Unsaturated	0.3	<25	<50	100	<100	175
JBS318	Unsaturated	0.2	<25	<50	<100	<100	<250

Table C Monocyclic Aromatic Hydrocarbons Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	Monocyclic Aromatic Hydrocarbons														
			Total MAHs	Benzene	Toluene	Ethylbenzene	meta&para Xylene	ortho Xylene	Styrene	Isopropylbenzene	n-Propylbenzene	1,3,5-Trimethylbenzene	sec-Butylbenzene	1,2,4-Trimethylbenzene	tert-Butylbenzene	p-Isoprpyltoluene	n-Butylbenzene
Assessment criteria				1	1.4	3.1	14		-	-	-	-	-	-	-	-	-
PQL				0.2	0.2	0.2	0.4		1	1	1	1	1	1	1	1	1
BH003	<2010 High Water	1.05		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH003	<2010 High Water	3.2		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH003	<2010 High Water	1.7		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH013	<2010 High Water	3.2		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH013	<2010 High Water	1.7		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH036	<2010 High Water	3.2		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH036	<2010 High Water	1.7		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH083	<2010 High Water	3.2		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH085	<2010 High Water	1.7		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH086	<2010 High Water	3.2		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH086	<2010 High Water	1.7		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH106	<2010 High Water	1.7		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH106	<2010 High Water	3.2		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH123	<2010 High Water	3.2		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH124	<2010 High Water	1.7		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH125	<2010 High Water	1.7		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH126	<2010 High Water	5.1		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH127	<2010 High Water	3.2		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH162	<2010 High Water	3.5		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH162	<2010 High Water	12.3		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH162	<2010 High Water	13.5		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH164	<2010 High Water	5.5		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH165	<2010 High Water	3.5		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH165	<2010 High Water	8		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-

Table C Monocyclic Aromatic Hydrocarbons Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	Monocyclic Aromatic Hydrocarbons														
			Total MAHs	Benzene	Toluene	Ethylbenzene	meta&para Xylene	ortho Xylene	Styrene	Isopropylbenzene	n-Propylbenzene	1,3,5-Trimethylbenzene	sec-Butylbenzene	1,2,4-Trimethylbenzene	tert-Butylbenzene	p-Isoprpyltoluene	n-Butylbenzene
Assessment criteria				1	1.4	3.1	14		-	-	-	-	-	-	-	-	-
PQL				0.2	0.2	0.2	0.4		1	1	1	1	1	1	1	1	1
BH166	<2010 High Water	1.3		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH166	<2010 High Water	4		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH168	<2010 High Water	0.5		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH168	<2010 High Water	5		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH168	<2010 High Water	8.8		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH169	<2010 High Water	0.5		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH169	<2010 High Water	4.4		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH170	<2010 High Water	1.3		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH170	<2010 High Water	3.7		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH170	<2010 High Water	6.1		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH172	<2010 High Water	1.2		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH172	<2010 High Water	1.5		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH172	<2010 High Water	3.9		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH173	<2010 High Water	1.8		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH177	<2010 High Water	1.5		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH177	<2010 High Water	4		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH182	<2010 High Water	10.6		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
JBS309	<2100 High Water	0.5		<0.5	<0.5	<1	<2	<1									
JBS314	<2100 High Water	1		<0.5	<0.5	<1	<2	<1									
BH002	Above GW	0.5		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH004	Above GW	1.7		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH082	Above GW	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH138	Above GW	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH149	Above GW	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-

Table C Monocyclic Aromatic Hydrocarbons Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	Monocyclic Aromatic Hydrocarbons														
			Total MAHs	Benzene	Toluene	Ethylbenzene	meta&para Xylene	ortho Xylene	Styrene	Isopropylbenzene	n-Propylbenzene	1,3,5-Trimethylbenzene	sec-Butylbenzene	1,2,4-Trimethylbenzene	tert-Butylbenzene	p-Isoprpyltoluene	n-Butylbenzene
Assessment criteria				1	1.4	3.1	14		-	-	-	-	-	-	-	-	-
PQL				0.2	0.2	0.2	0.4		1	1	1	1	1	1	1	1	1
BH005	Excavated	0.55		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH038	Excavated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH041	Excavated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH088	Excavated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH105	Excavated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH123	Excavated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH131	Excavated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH150	Excavated	1.7		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH164	Excavated	0.1		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH182	Excavated	0.4		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH069	Off-site	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH084	Off-site	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH121	Off-site	3.2		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH121	Off-site	0.4		<0.2	<0.2	<0.2	<0.3		-	-	-	-	-	-	-	-	-
BH139	Off-site	1.7		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH144	Off-site	3.2		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH163	Off-site	5		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH163	Off-site	7		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH167	Off-site	2.2		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH167	Off-site	8.6		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH167	Off-site	10.7		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH171	Off-site	1.5		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH171	Off-site	2.7		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH174	Off-site	2.4		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-

Table C Monocyclic Aromatic Hydrocarbons Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	Monocyclic Aromatic Hydrocarbons														
			Total MAHs	Benzene	Toluene	Ethylbenzene	meta&para Xylene	ortho Xylene	Styrene	Isopropylbenzene	n-Propylbenzene	1,3,5-Trimethylbenzene	sec-Butylbenzene	1,2,4-Trimethylbenzene	tert-Butylbenzene	p-Isoprpyltoluene	n-Butylbenzene
Assessment criteria				1	1.4	3.1	14		-	-	-	-	-	-	-	-	-
PQL				0.2	0.2	0.2	0.4		1	1	1	1	1	1	1	1	1
BH174	Off-site	4.3		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH175	Off-site	2		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH175	Off-site	7.5		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH176	Off-site	2.4		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH176	Off-site	3.7		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH178	Off-site	8.3		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH181	Off-site	5		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH181	Off-site	9.1		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH185	Off-site	4		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH185	Off-site	9.6		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH215	Off-site	2.5		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH215	Off-site	6.1		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH033	Unsaturated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH034	Unsaturated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH037	Unsaturated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH037	Unsaturated	0.7		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH039	Unsaturated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH043	Unsaturated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH083	Unsaturated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH085	Unsaturated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH120	Unsaturated	0.4		<0.2	0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH125	Unsaturated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH126	Unsaturated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH127	Unsaturated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-

Table C Monocyclic Aromatic Hydrocarbons Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	Monocyclic Aromatic Hydrocarbons														
			Total MAHs	Benzene	Toluene	Ethylbenzene	meta&para Xylene	ortho Xylene	Styrene	Isopropylbenzene	n-Propylbenzene	1,3,5-Trimethylbenzene	sec-Butylbenzene	1,2,4-Trimethylbenzene	tert-Butylbenzene	p-Isoprpyltoluene	n-Butylbenzene
Assessment criteria				1	1.4	3.1	14		-	-	-	-	-	-	-	-	-
PQL				0.2	0.2	0.2	0.4		1	1	1	1	1	1	1	1	1
BH130	Unsaturated	0.4		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH157	Unsaturated	0.3		<0.2	<0.2	<0.2	<0.3		-	-	-	-	-	-	-	-	-
BH158	Unsaturated	0.35		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
JBS310	Unsaturated	0.5		<0.5	<0.5	<1	<2	<1	-	-	-	-	-	-	-	-	-
JBS311	Unsaturated	0.2		<0.5	<0.5	<1	<2	<1	-	-	-	-	-	-	-	-	-
JBS316	Unsaturated	0.2		<0.5	<0.5	<1	<2	<1	-	-	-	-	-	-	-	-	-
JBS322	Unsaturated	0.3		<0.5	<0.5	<1	<2	<1	-	-	-	-	-	-	-	-	-
JBS327	Unsaturated	0.3		<0.5	<0.5	<1	<2	<1	-	-	-	-	-	-	-	-	-
JBS318	Unsaturated	0.2		<0.5	<0.5	<1	<2	<1	-	-	-	-	-	-	-	-	-

Table D Heavy Metals and Inorganics Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	Heavy Metals								Sulphate	Cyanide (total)	Ammonia
			As	Cd	Cr	Cu	Pb	Hg	Ni	Zn			
PQL			**5**	**1**	**1**	**1**	**1**	**0.1**	**2**	**1**	**100**	**1**	**0.5**
Assessment Criteria											**2000**		
BH003	<2010 High Water	1.05	<5	<1	20	123	183	0.2	61	114	-	-	-
BH003	<2010 High Water	3.2	<5	<1	18	62	124	<0.1	2	39	-	-	-
BH003	<2010 High Water	1.7	<5	<1	18	42	266	0.3	2	92	-	-	-
BH006	<2010 High Water	1	<5	<1	18	180	195	2.6	5	155	-	-	-
BH006	<2010 High Water	1.7	<5	<1	12	59	207	0.5	10	210	-	-	-
BH008	<2010 High Water	0.75	<5	<1	22	30	111	0.2	20	152	-	-	-
BH008	<2010 High Water	1.6	<5	<1	12	12	34	<0.1	9	81	-	-	-
BH009	<2010 High Water	1.7	<5	<1	14	53	301	<0.1	12	49	-	-	-
BH011	<2010 High Water	2.9	<5	<1	19	20	83	0.1	4	58	-	-	-
BH011	<2010 High Water	1.7	7	<1	10	74	290	0.7	18	154	-	-	-
BH012	<2010 High Water	1.7	<5	<1	2	23	70	0.4	<2	126	-	-	-
BH013	<2010 High Water	3.2	<5	<1	44	82	125	<0.1	10	102	-	-	-
BH013	<2010 High Water	1.7	<5	<1	6	80	181	0.4	17	348	-	-	-
BH033	<2010 High Water	3.2	<5	<1	6	61	77	0.1	4	85	-	-	-
BH033	<2010 High Water	1.7	6	<1	141	31	72	0.1	19	308	-	-	-
BH034	<2010 High Water	1.7	<5	<1	5	5	5	<0.1	<2	<5	-	-	-
BH036	<2010 High Water	3.2	<5	<1	10	24	182	0.2	3	28	-	-	-
BH036	<2010 High Water	1.7	<5	<1	7	28	64	0.1	<2	43	-	-	-
BH037	<2010 High Water	2.85	<5	<1	14	5	11	<0.1	<2	<5	-	-	-
BH039	<2010 High Water	2.25	<5	<1	12	18	22	0.1	19	32	-	-	-
BH083	<2010 High Water	3.2	<5	<1	12	16	45	0.1	8	62	420	<1	-
BH085	<2010 High Water	1.7	<5	<1	9	293	157	0.2	6	22	500	<1	-
BH086	<2010 High Water	3.2	<5	<1	8	5	5	<0.1	<2	<5	320	<1	-
BH086	<2010 High Water	1.7	<5	<1	13	6	21	0.1	<2	8	210	<1	-
BH088	<2010 High Water	3.2	<5	<1	8	5	12	<0.1	<2	18	-	-	-
BH105	<2010 High Water	1.7	<5	<1	11	6	21	<0.1	<2	20	-	-	-
BH106	<2010 High Water	1.7	6	<1	5	5	14	<0.1	<2	19	-	-	-
BH106	<2010 High Water	3.2	<5	<1	7	9	27	<0.1	3	61	-	-	-
BH120	<2010 High Water	1.7	12	<1	37	34	168	0.2	21	106	-	-	-
BH123	<2010 High Water	3.2	<5	<1	9	9	165	<0.1	<2	38	850	<1	-
BH124	<2010 High Water	1.7	<5	<1	11	36	210	0.4	6	38	510	<1	-
BH125	<2010 High Water	1.7	<5	1	10	7	24	<0.1	<2	12	-	-	-
BH126	<2010 High Water	5.1	<5	<1	9	40	101	0.2	8	63	-	-	-
BH126	<2010 High Water	1.7	77	<1	22	79	538	1.7	31	328	-	-	-
BH127	<2010 High Water	3.2	<5	<1	4	12	19	<0.1	<2	6	-	-	-
BH150	<2010 High Water	9.7	18	2	41	83	208	1.2	15	369	-	-	-
BH150	<2010 High Water	3.2	<5	<1	13	30	117	0.3	6	126	-	-	-
BH162	<2010 High Water	3.5	<5	<1	8	17	69	<0.1	3	59	230	<1	-
BH162	<2010 High Water	12.3	<5	<1	6	<5	14	<0.1	<2	21	100	<1	-
BH162	<2010 High Water	13.5	5	<1	9	16	28	<0.1	4	50	1490	<1	-
BH164	<2010 High Water	5.5	11	<1	16	82	383	2.7	6	291	2290	<1	-

Table D Heavy Metals and Inorganics Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	Heavy Metals								Sulphate	Cyanide (total)	Ammonia
			As	Cd	Cr	Cu	Pb	Hg	Ni	Zn			
PQL			**5**	**1**	**1**	**1**	**1**	**0.1**	**2**	**1**	**100**	**1**	**0.5**
Assessment Criteria											**2000**		
BH165	<2010 High Water	3.5	<5	<1	33	33	42	<0.1	4	43	600	<1	-
BH165	<2010 High Water	8	5	<1	13	32	106	0.2	9	94	650	<1	-
BH166	<2010 High Water	1.3	6	<1	19	47	216	0.3	6	144	490	<1	-
BH166	<2010 High Water	4	6	<1	21	52	111	0.2	15	189	1530	<1	-
BH168	<2010 High Water	0.5	<5	<1	18	32	110	0.2	23	450	470	<1	-
BH168	<2010 High Water	5	6	<1	9	24	149	0.2	4	70	630	<1	-
BH168	<2010 High Water	8.8	11	<1	14	<5	9	<0.1	10	41	1040	<1	-
BH169	<2010 High Water	0.5	6	<1	12	58	177	1	12	155	640	<1	-
BH169	<2010 High Water	4.4	26	<1	20	30	237	0.5	19	116	1320	<1	-
BH170	<2010 High Water	1.3	6	<1	12	53	304	0.6	6	309	490	2	-
BH170	<2010 High Water	3.7	7	<1	14	36	433	1.1	5	139	1730	<1	-
BH170	<2010 High Water	6.1	6	<1	11	51	207	0.4	8	66	1790	<1	-
BH172	<2010 High Water	1.2	<5	<1	12	27	120	0.7	7	67	450	<1	-
BH172	<2010 High Water	1.5	<5	<1	7	<5	<5	<0.1	<2	<5	220	<1	-
BH172	<2010 High Water	3.9	<5	<1	6	9	15	<0.1	<2	13	220	<1	-
BH173	<2010 High Water	1.8	10	<1	11	157	1250	1	12	163	3640	<1	-
BH177	<2010 High Water	1.5	36	<1	47	1480	131	8	12	221	11600	<1	-
BH177	<2010 High Water	4	<5	<1	22	85	58	0.4	19	114	640	<1	-
BH182	<2010 High Water	10.6	<5	<1	9	8	8	<0.1	6	47	1180	1	-
JBS3	<2010 High Water	1.2	<4	<0.5	10	150	120	0.7	11	72	-	-	-
JBS4	<2010 High Water	2	11	<0.5	11	76	170	0.2	3	62	-	-	-
JBS4	<2010 High Water	7.5	5	<0.5	10	72	230	0.9	9	70	-	-	-
JBS300	<2100 High Water	1	<4	<0.5	6	<1	5	<0.1	<1	<1	-	-	-
JBS300	<2100 High Water	2	<4	<0.5	23	24	110	0.1	9	70	-	-	-
JBS300	<2100 High Water	4	<4	<0.5	20	26	120	<0.1	15	77	-	-	-
JBS300	<2100 High Water	8	<4	<0.5	11	13	83	<0.1	5	66	-	-	-
JBS300	<2100 High Water	13.5	<4	<0.5	5	7	34	<0.1	3	27	-	-	-
JBS303	<2100 High Water	1	<4	<0.5	7	5	15	<0.1	1	6	-	-	-
JBS303	<2100 High Water	4	<4	<0.5	13	42	41	0.3	3	38	-	-	-
JBS303A	<2100 High Water	5	<4	<0.5	12	43	55	0.4	3	47	-	-	-
JBS303A	<2100 High Water	7	<4	<0.5	48	20	19	<0.1	10	36	-	-	-
JBS303C	<2100 High Water	12	<4	<0.5	7	2	6	<0.1	5	14	-	-	-
JBS304	<2100 High Water	1	<4	<0.5	6	4	79	<0.1	1	30	-	-	-
JBS304	<2100 High Water	3	36	0.6	59	3200	260	16	31	440	-	-	-
JBS304	<2100 High Water	5	4	<0.5	14	330	46	1.7	7	51	-	-	-
JBS304	<2100 High Water	8	<4	<0.5	8	130	21	0.4	5	51	-	-	-
JBS305	<2100 High Water	2	<4	<0.5	18	26	220	<0.1	11	60	-	-	-
JBS305	<2100 High Water	5	4	<0.5	14	37	89	0.5	8	150	-	-	-
JBS305	<2100 High Water	7	<4	<0.5	9	10	43	0.2	2	39	-	-	-
JBS306	<2100 High Water	1	<4	<0.5	13	280	300	1.2	8	100	-	-	-

Table D Heavy Metals and Inorganics Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	Heavy Metals								Sulphate	Cyanide (total)	Ammonia
			As	Cd	Cr	Cu	Pb	Hg	Ni	Zn			
PQL			**5**	**1**	**1**	**1**	**1**	**0.1**	**2**	**1**	**100**	**1**	**0.5**
Assessment Criteria											**2000**		
JBS306	<2100 High Water	2.3	<4	1.5	26	180	330	0.9	6	420	-	-	-
JBS306	<2100 High Water	4	17	<0.5	7	6	13	<0.1	3	10	-	-	-
JBS307	<2100 High Water	1	<4	<0.5	12	29	98	0.1	9	68	-	-	-
JBS307	<2100 High Water	2	<4	<0.5	23	18	65	0.2	6	34	-	-	-
JBS308	<2100 High Water	2	<4	<0.5	18	36	52	<0.1	27	40	-	-	-
JBS309	<2100 High Water	0.5	<4	<0.5	9	43	31	<0.1	56	46	-	-	-
JBS309	<2100 High Water	1	5	<0.5	6	15	40	0.1	6	50	-	-	-
JBS309	<2100 High Water	4	<4	<0.5	7	14	45	0.1	5	51	-	-	-
JBS310	<2100 High Water	1	<4	<0.5	8	48	310	0.3	5	110	-	-	-
JBS310	<2100 High Water	2	<4	<0.5	7	19	53	0.2	3	57	-	-	-
JBS310	<2100 High Water	4	<4	<0.5	9	11	27	<0.1	2	27	-	-	-
JBS310	<2100 High Water	6	<4	<0.5	12	12	38	0.1	3	39	-	-	-
JBS311	<2100 High Water	1	<4	<0.5	6	17	52	0.2	4	46	-	-	-
JBS311	<2100 High Water	3	<4	<0.5	9	85	110	0.1	34	120	-	-	-
JBS311	<2100 High Water	5	<4	<0.5	4	13	14	<0.1	4	19	-	-	-
JBS311	<2100 High Water	7	<4	<0.5	6	27	21	<0.1	8	41	-	-	-
JBS312	<2100 High Water	1	<4	<0.5	6	31	260	0.2	3	48	-	-	-
JBS312A	<2100 High Water	2	<4	<0.5	5	2	3	<0.1	<1	2	-	-	-
JBS313	<2100 High Water	1	7	<0.5	3	1	4	<0.1	1	4	-	-	-
JBS313	<2100 High Water	3	16	<0.5	9	34	140	0.2	7	180	-	-	-
JBS313	<2100 High Water	4	15	<0.5	16	22	140	0.2	9	140	-	-	-
JBS313A	<2100 High Water	8	<4	<0.5	25	33	8	<0.1	10	21	-	-	-
JBS314	<2100 High Water	1	7	<0.5	9	18	69	0.1	3	61	-	-	-
JBS314	<2100 High Water	2	<4	<0.5	8	18	52	<0.1	5	30	-	-	-
JBS314	<2100 High Water	7	<4	<0.5	5	49	57	0.2	3	41	-	-	-
JBS315	<2100 High Water	2	<4	<0.5	9	24	180	0.2	3	39	-	-	-
JBS315	<2100 High Water	4	<4	<0.5	8	15	45	<0.1	4	42	-	-	-
JBS316	<2100 High Water	2	<4	<0.5	10	4	16	<0.1	<1	7	-	-	-
JBS318	<2100 High Water	2	10	<0.5	26	24	56	0.1	15	87	-	-	-
JBS318	<2100 High Water	3	4	<0.5	16	19	52	<0.1	9	55	-	-	-
JBS319	<2100 High Water	1	<4	<0.5	13	35	260	0.8	8	96	-	-	-
JBS319	<2100 High Water	4	18	<0.5	9	220	190	0.4	14	340	-	-	-
JBS320A	<2100 High Water	2	12	<0.5	10	180	58	0.1	3	31	-	-	<0.5
JBS322	<2100 High Water	1	<4	<0.5	12	63	420	0.3	37	160	-	-	<0.5
JBS322	<2100 High Water	2	<4	<0.5	9	35	170	0.2	5	97	-	-	<0.5
JBS322	<2100 High Water	5	<4	<0.5	12	33	190	0.8	7	120	-	-	<0.5
JBS323	<2100 High Water	3	17	<0.5	13	160	480	2	34	180	-	-	2.4
JBS324	<2100 High Water	1	<4	<0.5	8	3	14	<0.1	4	31	-	-	-
JBS324	<2100 High Water	2	<4	<0.5	8	16	88	0.1	4	61	-	-	-
JBS324	<2100 High Water	3	4	<0.5	10	38	120	0.2	8	83	-	-	-

Table D Heavy Metals and Inorganics Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	Heavy Metals								Sulphate	Cyanide (total)	Ammonia
			As	Cd	Cr	Cu	Pb	Hg	Ni	Zn			
PQL			**5**	**1**	**1**	**1**	**1**	**0.1**	**2**	**1**	**100**	**1**	**0.5**
Assessment Criteria											**2000**		
JBS324	<2100 High Water	4	<4	<0.5	8	21	100	0.2	3	63	-	-	-
JBS324	<2100 High Water	7	<4	<0.5	10	12	74	<0.1	3	66	-	-	-
JBS324	<2100 High Water	9	<4	<0.5	11	6	28	<0.1	4	32	-	-	-
JBS324	<2100 High Water	10	<4	<0.5	8	5	34	0.1	3	29	-	-	-
JBS325	<2100 High Water	2	4	<0.5	21	15	320	<0.1	5	79	-	-	-
JBS325C	<2100 High Water	3	<4	<0.5	14	32	130	0.4	6	87	-	-	-
JBS326	<2100 High Water	3	<4	<0.5	13	9	37	<0.1	4	44	-	-	-
JBS326	<2100 High Water	4	11	<0.5	9	25	48	<0.1	3	38	-	-	-
JBS327	<2100 High Water	2	9	<0.5	23	54	200	0.4	15	140	-	-	-
JBS327	<2100 High Water	5	6	<0.5	7	18	94	0.3	3	72	-	-	-
JBS327	<2100 High Water	7	<4	<0.5	7	14	49	<0.1	5	48	-	-	-
JBS327	<2100 High Water	8	<4	<0.5	3	25	90	0.1	3	58	-	-	-
JBS327	<2100 High Water	9	<4	<0.5	6	5	25	<0.1	1	10	-	-	-
JBS328	<2100 High Water	1	13	<0.5	11	48	2300	0.5	10	120	-	-	-
JBS328	<2100 High Water	2	<4	<0.5	9	67	180	0.3	11	89	-	-	-
JBS328	<2100 High Water	4	<4	<0.5	8	18	64	0.1	3	54	-	-	-
JBS328	<2100 High Water	6	<4	<0.5	9	39	81	1.2	5	57	-	-	-
JBS328	<2100 High Water	8	<4	<0.5	10	4	11	<0.1	1	13	-	-	-
JBS328	<2100 High Water	9	<4	<0.5	11	23	57	0.2	5	42	-	-	-
JBS329	<2100 High Water	1	5	<0.5	15	13	74	0.3	4	70	-	-	-
JBS329	<2100 High Water	2	11	<0.5	12	58	210	0.2	6	170	-	-	-
JBS330	<2100 High Water	2	<4	<0.5	12	30	86	0.2	4	100	-	-	-
JBS330A	<2100 High Water	4	<4	<0.5	7	25	72	0.1	8	84	-	-	-
JBS330A	<2100 High Water	6	<4	<0.5	8	12	53	0.2	5	47	-	-	-
BH002	Above GW	0.5	<5	<1	67	58	40	0.2	77	66	-	-	-
BH004	Above GW	1.7	<5	<1	7	5	16	<0.1	<2	5	-	-	-
BH082	Above GW	0.4	<5	<1	30	19	41	<0.1	30	59	-	-	-
BH138	Above GW	0.4	<5	<1	32	36	54	0.4	33	67	-	-	-
BH149	Above GW	0.4	<5	<1	8	33	27	<0.1	48	27	-	-	-
BH005	Excavated	0.55	<5	<1	10	40	39	<0.1	62	63	-	-	-
BH007	Excavated	0.5	<5	<1	17	36	116	0.2	18	94	-	-	-
BH007	Excavated	1	<5	<1	20	33	273	0.4	15	130	-	-	-
BH088	Excavated	0.4	<5	<1	11	18	15	<0.1	41	34	-	-	-
BH088	Excavated	1.7	<5	<1	8	14	48	<0.1	7	52	-	-	-
BH105	Excavated	0.4	<5	<1	21	62	129	0.4	38	92	-	-	-
BH123	Excavated	0.4	<5	<1	16	16	38	<0.1	16	48	520	<1	-
BH150	Excavated	1.7	<5	<1	15	34	130	0.2	8	126	-	-	-
BH164	Excavated	0.1	<5	<1	114	35	<5	<0.1	122	59	580	<1	-
BH182	Excavated	0.4	<5	<1	18	21	38	<0.1	27	54	450	<1	-
BH015	Excavated	0.6	<5	<1	7	15	37	<0.1	18	42	-	-	-

Table D Heavy Metals and Inorganics Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	Heavy Metals								Sulphate	Cyanide (total)	Ammonia
			As	Cd	Cr	Cu	Pb	Hg	Ni	Zn			
PQL			**5**	**1**	**1**	**1**	**1**	**0.1**	**2**	**1**	**100**	**1**	**0.5**
Assessment Criteria											**2000**		
BH038	Excavated	0.4	<5	<1	5	60	9	<0.1	115	42	-	-	-
BH041	Excavated	0.4	<5	<1	6	55	20	<0.1	90	43	-	-	-
BH131	Excavated	0.4	<5	<1	8	20	110	<0.1	15	103	-	-	-
BH010	Off-site	0.4	<5	<1	10	79	108	0.1	15	77	-	-	-
BH010	Off-site	1.7	<5	<1	8	30	132	0.3	4	84	-	-	-
BH014	Off-site	6.75	<5	<1	78	16	51	0.1	5	60	-	-	-
BH014	Off-site	0.4	<5	<1	9	56	25	<0.1	96	50	-	-	-
BH016	Off-site	0.4	<5	<1	8	42	99	0.3	36	73	-	-	-
BH016	Off-site	1.7	5	<1	4	14	31	0.1	<2	14	-	-	-
BH029	Off-site	3.2	5	<1	9	67	215	0.5	<2	43	-	-	-
BH029	Off-site	0.4	<5	<1	10	43	116	0.2	40	88	-	-	-
BH030	Off-site	3.2	<5	<1	10	14	64	0.8	7	71	-	-	-
BH030	Off-site	0.4	<5	<1	7	24	51	<0.1	29	41	-	-	-
BH030	Off-site	1.7	<5	<1	10	14	38	<0.1	5	23	-	-	-
BH031	Off-site	1.7	7	<1	7	8	8	<0.1	5	11	-	-	-
BH069	Off-site	0.4	<5	<1	12	44	54	<0.1	54	61	-	-	-
BH069	Off-site	1.7	<5	<1	7	6	10	<0.1	<2	<5	-	-	-
BH084	Off-site	0.4	<5	<1	6	13	15	<0.1	14	14	-	-	-
BH084	Off-site	1.7	<5	<1	4	5	25	<0.1	<2	12	-	-	-
BH121	Off-site	3.2	<5	<1	42	26	66	0.2	9	48	-	-	-
BH121	Off-site	0.4	<5	<1	8	19	32	<0.1	10	219	-	-	-
BH139	Off-site	1.7	<5	<1	8	5	8	<0.1	<2	<5	-	-	-
BH144	Off-site	3.2	<5	<1	40	13	25	<0.1	22	47	-	-	-
BH163	Off-site	5	<5	<1	7	6	51	0.2	<2	38	230	<1	-
BH163	Off-site	7	<5	<1	13	30	101	<0.1	<2	57	210	<1	-
BH167	Off-site	2.2	<5	<1	7	13	47	<0.1	3	39	260	<1	-
BH167	Off-site	8.6	<5	<1	7	42	48	<0.1	8	54	220	<1	-
BH167	Off-site	10.7	<5	<1	7	15	196	0.4	4	104	200	<1	-
BH171	Off-site	1.5	<5	<1	3	<5	<5	<0.1	<2	<5	150	<1	-
BH171	Off-site	2.7	<5	<1	6	24	192	0.2	4	101	1650	2	-
BH174	Off-site	2.4	<5	<1	18	17	74	<0.1	4	46	1460	<1	-
BH174	Off-site	4.3	-	-	-	-	-	-	-	-	940	<1	-
BH175	Off-site	2	<5	<1	9	11	11	0.2	3	39	1720	<1	-
BH175	Off-site	7.5	<5	<1	5	<5	7	<0.1	<2	10	300	<1	-
BH176	Off-site	2.4	<5	<1	<2	<5	14	<0.1	<2	21	400	<1	-
BH176	Off-site	3.7	8	<1	8	94	227	5.7	4	152	1550	<1	-
BH178	Off-site	8.3	<5	<1	18	21	109	0.3	7	284	2360	<1	-
BH181	Off-site	5	<5	<1	7	<5	18	<0.1	<2	19	120	<1	-
BH181	Off-site	9.1	<5	<1	6	<5	16	<0.1	2	19	390	1	-
BH185	Off-site	4	<5	<1	7	7	32	<0.1	5	34	930	<1	-

Table D Heavy Metals and Inorganics Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	Heavy Metals								Sulphate	Cyanide (total)	Ammonia
			As	Cd	Cr	Cu	Pb	Hg	Ni	Zn			
PQL			**5**	**1**	**1**	**1**	**1**	**0.1**	**2**	**1**	**100**	**1**	**0.5**
Assessment Criteria											**2000**		
BH185	Off-site	9.6	<5	<1	4	<5	12	<0.1	<2	45	520	<1	-
BH215	Off-site	2.5	<5	<1	7	<5	16	<0.1	<2	9	430	<1	-
BH215	Off-site	6.1	<5	<1	11	11	483	<0.1	4	311	860	<1	-
JBS2	Off-site	1.8	<4	<0.5	11	38	210	<0.1	24	290	-	-	-
JBS301	off-site	0.5	<4	<0.5	7	15	37	<0.1	8	29	-	-	-
JBS301	off-site	1	<4	<0.5	9	11	14	<0.1	4	25	-	-	-
JBS301	off-site	2	<4	<0.5	6	2	18	<0.1	2	21	-	-	-
JBS301	off-site	3	<4	<0.5	7	2	10	<0.1	2	17	-	-	-
JBS301	off-site	4	<4	<0.5	13	3	19	<0.1	4	24	-	-	1.8
JBS301	off-site	5	<4	<0.5	12	3	16	<0.1	3	24	-	-	1.6
JBS301	off-site	7	<4	<0.5	13	6	43	0.3	3	30	-	-	-
JBS301	off-site	10	<4	<0.5	11	4	22	0.1	2	28	-	-	-
JBS301	off-site	12	<4	<0.5	14	5	26	0.1	3	27	-	-	-
JBS302	off-site	0.4	<4	<0.5	9	310	48	0.1	9	210	-	-	-
JBS302	off-site	1	<4	<0.5	6	39	68	0.2	2	44	-	-	-
JBS302	off-site	2	<4	<0.5	7	4	17	<0.1	1	16	-	-	-
JBS302	off-site	6	<4	<0.5	11	14	39	0.1	7	54	-	-	-
JBS302	off-site	8	<4	<0.5	22	7	18	<0.1	5	26	-	-	-
BH009	Unsaturated	0.4	<5	<1	12	46	280	<0.1	20	97	-	-	-
BH011	Unsaturated	0.4	6	<1	17	50	78	0.1	49	141	-	-	-
BH012	Unsaturated	0.4	<5	<1	12	63	41	<0.1	130	63	-	-	-
BH013	Unsaturated	0.4	<5	<1	8	41	72	<0.1	30	62	-	-	-
BH033	Unsaturated	0.4	<5	<1	41	50	34	<0.1	69	45	-	-	-
BH034	Unsaturated	0.4	<5	<1	7	36	93	0.2	25	76	-	-	-
BH036	Unsaturated	0.4	<5	<1	8	66	5	<0.1	128	38	-	-	-
BH037	Unsaturated	0.4	<5	<1	7	42	84	0.2	59	87	-	-	-
BH037	Unsaturated	0.7	<5	<1	7	5	11	<0.1	<2	<5	-	-	-
BH039	Unsaturated	0.4	<5	<1	7	26	27	0.1	39	31	-	-	-
BH043	Unsaturated	0.4	<5	<1	9	32	21	<0.1	56	41	-	-	-
BH083	Unsaturated	0.4	<5	<1	27	83	57	0.4	52	92	710	<1	-
BH085	Unsaturated	0.4	<5	<1	9	18	37	<0.1	11	41	260	<1	-
BH120	Unsaturated	0.4	<5	<1	66	32	42	0.1	70	84	-	-	-
BH125	Unsaturated	0.4	<5	<1	10	68	210	1.3	32	140	-	-	-
BH126	Unsaturated	0.4	<5	<1	22	35	108	0.4	20	145	-	-	-
BH127	Unsaturated	0.4	<5	<1	10	42	71	0.4	30	70	-	-	-
BH130	Unsaturated	0.4	<5	<1	8	16	46	<0.1	11	51	-	-	-
BH157	Unsaturated	0.3	-	-	-	-	-	-	-	-	520	1	-
JBS4	Unsaturated	0.5	<4	<0.5	15	37	110	0.3	15	100	-	-	-
JBS304	Unsaturated	0.2	<4	<0.5	7	35	60	0.2	15	40	-	-	-
JBS305	Unsaturated	0.2	<4	<0.5	12	52	100	0.2	68	92	-	-	-

Table D Heavy Metals and Inorganics Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Fill Based Soils

all units in mg/kg

Sample ID	Location	Sampling Depth (m)	Heavy Metals								Sulphate	Cyanide (total)	Ammonia
			As	Cd	Cr	Cu	Pb	Hg	Ni	Zn			
PQL			**5**	**1**	**1**	**1**	**1**	**0.1**	**2**	**1**	**100**	**1**	**0.5**
Assessment Criteria											**2000**		
JBS306	Unsaturated	0.5	<4	<0.5	14	94	270	0.4	37	120	-	-	-
JBS308	Unsaturated	0.5	5	<0.5	12	25	63	0.1	10	36	-	-	-
JBS310	Unsaturated	0.5	<4	<0.5	10	37	48	<0.1	44	46	-	-	-
JBS311	Unsaturated	0.2	<4	<0.5	7	52	3	<0.1	91	35	-	-	-
JBS316	Unsaturated	0.2	5	<0.5	8	57	120	0.1	39	91	-	-	-
JBS317	Unsaturated	0.5	<4	<0.5	11	55	90	<0.1	47	65	-	-	-
JBS318	Unsaturated	0.2	<4	<0.5	15	54	72	0.3	50	100	-	-	-
JBS319	Unsaturated	0.2	<4	0.6	110	34	9	<0.1	120	61	-	-	-
JBS320A	Unsaturated	0.5	<4	<0.5	50	40	73	0.5	57	87	-	-	<0.5
JBS320A	Unsaturated	1	4	<0.5	9	830	34	<0.1	2	15	-	-	-
JBS321	Unsaturated	1	<4	<0.5	8	19	29	0.3	7	31	-	-	-
JBS322	Unsaturated	0.3	<4	<0.5	100	31	6	<0.1	94	53	-	-	-
JBS323	Unsaturated	1	5	<0.5	29	42	66	0.1	29	110	-	-	0.7
JBS324	Unsaturated	0.5	<4	<0.5	11	62	100	0.7	21	86	-	-	-
JBS325	Unsaturated	0.5	<4	<0.5	78	44	31	<0.1	82	67	-	-	-
JBS325	Unsaturated	1	<4	<0.5	5	14	51	<0.1	3	52	-	-	-
JBS326	Unsaturated	1	450	1.5	12	100	240	<0.1	23	1100	-	-	-
JBS327	Unsaturated	0.3	5	<0.5	28	42	140	0.9	24	120	-	-	-
JBS329	Unsaturated	0.5	<4	<0.5	100	38	19	<0.1	110	68	-	-	-
JBS330	Unsaturated	0.2	<4	<0.5	14	56	64	0.2	10	96	-	-	-

Table E Polycyclic Aromatic Hydrocarbon Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Natural Soils

all units in mg/kg

Sample id	Sampling Depth (m)	Soil Type / description	Polycyclic Aromatic Hydrocarbons																
			Total PAHs	Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3,cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Assessment criteria [1]			40					2											
PQL				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	1
BH014	11.7 (1.2)	Sandy clay, orange brown		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH016	5.8 (2.7)	Silty sand, dark grey		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	0.6
BH029	9.25 (4.25)	Clayey sand, brown		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH083	7.2 (1.0)	Sandy clay, brown		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH144	15.2 (1.7)	Sandy clay, orange brown		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH163	15 (0.5)	Clay, red/orange		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH164	8.3 (1.1)	Sand, grey/brown	25.1	<0.5	<0.5	0.8	2.1	2.2	2.8	1.5	1.1	1.6	<0.5	5.1	<0.5	1.1	<0.5	1.6	5.2
BH165	10.5 (0.5)	Sandstone, orange/yellow		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH166	7 (1.2)	Sand, yellow/brown/grey	1.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	<0.5	0.9
BH169	7.5 (1.7)	Sandy clay, grey	204.4	2	1.9	8.8	19.1	13.5	18.4	8.1	8.9	14.6	2.3	38.9	3.5	6.3	<0.5	27.4	30.7
BH169	9 (3.2)	Sandy clay, light grey		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH171	4.8 (1.3)	Sandstone, yellow/brown/white		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH173	3.7 (0.1)	Sand, grey/brown		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH174	8 (0.2)	Clayey sand, yellow/brown/white		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH175	11 (0.25)	Clayey sand, yellow/brown		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH176	9.2 (1.6)	Clayey sand, yellow/brown		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH177	12.2 (0)	Clayey sand, yellow/brown		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH178	12 (0)	Clayey sand, red/brown/grey		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH178	17 (5)	Sandstone, light grey		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH181	22 (8.5)	Sandstone, yellow/brown		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH182	22.9 (7.9)	Sandy silty clay, brown		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH185	14.6 (0.1)	Sandy clay, dark grey	2.5	<0.5	<0.5	<0.5	<0.5	0.6	0.7	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	0.6
BH215	18 (0)	Sandy clay, dark grey	18.1	<0.5	<0.5	<0.5	1.8	1.8	2.2	1.3	1.1	1.4	<0.5	3	<0.5	1	<0.5	1.2	3.3
JBS300	15.5 (0.5)	Clay, dark grey	1.6	<0.1	<0.1	<0.1	0.2	0.1	0.1	<0.1	0.1	0.2	<0.1	0.3	<0.1	0.1	<0.1	0.2	0.3
JBS301	14 (0.2)	Clay, black	5.4	0.1	<0.1	0.1	0.5	0.6	0.5	0.3	0.4	0.4	<0.1	0.8	<0.1	0.4	<0.1	0.3	1
JBS302	14 (0.2)	Clay, black	12	0.3	<0.1	0.2	1	1.5	1	0.6	0.9	0.9	<0.1	1.8	0.1	0.8	0.1	0.7	2.1
JBS304A	13 (0.3)	Clayey silt, black, trace shells	3.7	<0.1	<0.1	<0.1	0.3	0.5	0.4	0.2	0.3	0.3	<0.1	0.5	<0.1	0.3	<0.1	0.2	0.7
JBS305	8 (0.1)	Sandstone, grey mottled yellow	2.4	<0.1	<0.1	<0.1	0.2	0.3	0.3	0.2	0.2	0.2	<0.1	0.3	<0.1	0.2	<0.1	0.2	0.3
JBS305	9 (1.1)	Sandstone, grey mottled yellow	0.05	<0.1	<0.1	<0.1	<0.1	0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Table E Polycyclic Aromatic Hydrocarbon Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Natural Soils

all units in mg/kg

Sample id	Sampling Depth (m)	Soil Type / description	Polycyclic Aromatic Hydrocarbons																
			Total PAHs	Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3,cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Assessment criteria [1]			40					2											
PQL				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	1
JBS306	5 (0.2)	Clayey sand, green yellow		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS307	4 (1)	Sandstone, yellow brown		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS308	3 (0.3)	Sandstone	0.46	<0.1	<0.1	<0.1	<0.1	0.06	<0.1	<0.1	<0.1	0.1	<0.1	0.1	<0.1	<0.1	<0.1	0.1	0.1
JBS309	6 (0.5)	Silty clay, red brown to brown	5.3	<0.1	<0.1	0.1	0.5	0.5	0.4	0.2	0.3	0.4	<0.1	1	<0.1	0.3	<0.1	0.7	0.9
JBS309	8 (2.5)	Sandstone, yellow to orange	0.48	<0.1	<0.1	<0.1	<0.1	0.08	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	0.2
JBS310	8 (0.2)	Sandstone, white to grey and brown	2.6	<0.1	<0.1	<0.1	0.3	0.2	0.2	0.1	0.2	0.2	<0.1	0.5	<0.1	0.1	<0.1	0.3	0.5
JBS310	10 (2.2)	Sandstone, white to grey and brown	5.7	0.1	<0.1	0.3	0.5	0.4	0.3	0.1	0.2	0.4	<0.1	1.1	0.1	0.2	<0.1	0.9	1.1
JBS311	7.25 (0.15)	Sandstone, yellow		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS312A	4 (0.1)	Sandstone, yellow to orange		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS312A	4.55 (0.65)	Sandstone, yellow to orange	1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.3	<0.1	<0.1	<0.1	0.2	0.3
JBS313A	12 (0.3)	Sandstone, grey mottled brown		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS314	11 (0.1)	Clayey silt, black	12.1	0.1	<0.1	0.3	1.2	1.5	0.9	0.6	0.9	1	<0.1	2	<0.1	0.9	0.1	0.5	2.1
JBS315	6 (1.3)	Sandy clay, dark grey to black	3.9	<0.1	<0.1	<0.1	0.4	0.4	0.3	0.2	0.3	0.4	<0.1	0.7	<0.1	0.2	<0.1	0.3	0.7
JBS315	6.5 (1.8)	Sandstone, grey	1140	0.2	11	52	110	90	70	32	70	99	16	220	14	45	0.3	130	180
JBS316	6 (0.1)	Clayey silt, dark grey to black	1	<0.1	<0.1	<0.1	0.1	0.1	0.1	<0.1	0.1	0.1	<0.1	0.2	<0.1	<0.1	<0.1	0.1	0.2
JBS316	8 (2.1)	Sandstone, brown mottled red		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS317	2 (0.5)	Sandstone, grey		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS318	4.9 (0)	Clayey Sand, brown	2	<0.1	<0.1	<0.1	0.2	0.2	0.2	<0.1	0.1	0.2	<0.1	0.4	<0.1	0.1	<0.1	0.2	0.4
JBS320A	3 (0.9)	Sandstone, yellow orange		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS321	2 (0.4)	Sandstone, white mottled red	0.2	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	0.1	<0.1
JBS322A	7 (0.2)	Clayey silt, dark grey	4.3	<0.1	<0.1	0.1	0.4	0.4	0.3	0.2	0.3	0.3	<0.1	0.7	<0.1	0.2	<0.1	0.5	0.9
JBS323	5 (0.9)	Sandstone, yellow	0.68	<0.1	<0.1	<0.1	0.1	0.08	<0.1	<0.1	<0.1	0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	0.2
JBS324	11 (0.3)	Silty clay, dark grey to black	15	0.2	<0.1	0.2	1	2.3	1.6	1.3	1.6	1.1	0.2	1.7	<0.1	1.3	<0.1	0.6	1.9
JBS324	13 (2.3)	Sandstone, brown	1.9	<0.1	<0.1	<0.1	0.2	0.2	0.2	0.1	0.1	0.2	<0.1	0.3	<0.1	0.1	<0.1	0.1	0.4
JBS325C	5 (0.2)	Sandy silt, grey	36.7	0.8	0.2	1.5	2.8	3.3	2.1	1.4	2	2.4	0.2	6.1	0.9	1.7	0.7	4.4	6.2
JBS325C	6 (1.2)	Sandy silt, grey	27.9	0.4	0.1	0.9	2.4	2.7	1.8	1.1	1.7	2.1	0.2	4.8	0.4	1.4	0.2	2.6	5.1
JBS326	7.3 (0.3)	Sandstone, yellow orange		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS327	10.5 (0.1)	Sandstone		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS328	10 (0.1)	Sandstone, brown and grey	0.2	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.1

Table E Polycyclic Aromatic Hydrocarbon Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Natural Soils

all units in mg/kg

Sample id	Sampling Depth (m)	Soil Type / description	Polycyclic Aromatic Hydrocarbons																
			Total PAHs	Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3,cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Assessment criteria [1]			40					2											
PQL				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	1
JBS329A	9 (0.1)	Sandstone, red brown and grey		<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
JBS330A	8 (0.2)	Clayey silt, black	41.2	0.3	0.3	1.2	3.7	4.2	2.9	1.4	2.9	3.3	0.3	6.7	0.6	1.8	0.3	4	7.3

Note: value in brackets is depth of sample below fill / natural soil interface

Table F Total Petroleum Hydrocarbon Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Natural Soils

all units in mg/kg

Sample ID	Sampling Depth (m)	Soil Type / Description	TPH				
			C6-C9	C10-C14	C15-C28	C29-C36	ΣC10-C36
Assessment criteria [1]			**65**	**-**			**1000**
PQL			**2**	**50**	**100**	**100**	
BH014	11.7 (1.2)	Sandy clay, orange brown	<2	<50	<100	<100	-
BH016	5.8 (2.7)	Silty sand, dark grey	<2	<50	<100	<100	-
BH029	9.25 (4.25)	Clayey sand, brown	<2	<50	<100	<100	-
BH034	2.7 (0.2)	Clayey sand, dark grey	<2	<50	<100	<100	-
BH083	7.2 (1.0)	Sandy clay, brown	<2	<50	<100	<100	-
BH123	7.7 (5.5)	Sandstone, light grey	<2	<50	<100	<100	-
BH144	15.2 (1.7)	Sandy clay, orange brown	<2	<50	<100	<100	-
BH163	15 (0.5)	Clay, red/orange	<2	<50	<100	<100	-
BH164	8.3 (1.1)	Sand, grey/brown	<2	<50	<100	<100	-
BH165	10.5 (0.5)	Sandstone, orange/yellow	<2	<50	<100	<100	-
BH166	7 (1.2)	Sand, yellow/brown/grey	<2	<50	<100	<100	-
BH169	7.5 (1.7)	Sandy clay, grey	15	<50	820	520	1340
BH169	9 (3.2)	Sandy clay, light grey	<2	<50	<100	<100	-
BH171	4.8 (1.3)	Sandstone, yellow/brown/white	<2	<50	<100	<100	-
BH173	3.7 (0.1)	Sand, grey/brown	<2	<50	<100	<100	-
BH174	8 (0.2)	Clayey sand, yellow/brown/white	<2	<50	<100	<100	-
BH175	11 (0.25)	Clayey sand, yellow/brown	<2	<50	<100	<100	-
BH176	9.2 (1.6)	Clayey sand, yellow/brown	<2	<50	<100	<100	-
BH177	12.2 (0)	Clayey sand, yellow/brown	<2	<50	<100	<100	-
BH178	12 (0)	Clayey sand, red/brown/grey	<2	<50	<100	<100	-
BH178	17 (5)	Sandstone, light grey	<2	<50	<100	<100	-
BH181	22 (8.5)	Sandstone, yellow/brown	<2	<50	<100	<100	-
BH182	22.9 (7.9)	Sandy silty clay, brown	<2	<50	<100	<100	-
BH185	14.6 (0.1)	Sandy clay, dark grey	<2	<50	<100	<100	-
BH215	18 (0)	Sandy clay, dark grey	<2	<50	550	440	990

Note: value in brackets is depth of sample below fill / natural soil interface

Table G Monocyclic Aromatic Hydrocarbons Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Natural Soils

all units in mg/kg

Sample ID	Sampling Depth (m)	Soil Type / Description	Monocyclic Aromatic Hydrocarbons														
			Total MAHs	Benzene	Toluene	Ethylbenzene	meta&para Xylene	ortho Xylene	Styrene	Isopropylbenzene	n-Propylbenzene	1,3,5-Trimethylbenzene	sec-Butylbenzene	1,2,4-Trimethylbenzene	tert-Butylbenzene	p-Isoprpyltoluene	n-Butylbenzene
Assessment criteria				1	1.4	3.1	14		-	-	-	-	-	-	-	-	-
PQL				0.2	0.2	0.2	0.4		1	1	1	1	1	1	1	1	1
BH034	2.7 (0.2)	Clayey sand, dark grey		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH083	7.2 (1.0)	Sandy clay, brown		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH123	7.7 (5.5)	Sandstone, light grey		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH144	15.2 (1.7)	Sandy clay, orange brown		<0.2	<0.2	<0.2	<0.4		-	-	-	-	-	-	-	-	-
BH163	15 (0.5)	Clay, red/orange		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH164	8.3 (1.1)	Sand, grey/brown		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH165	10.5 (0.5)	Sandstone, orange/yellow		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH166	7 (1.2)	Sand, yellow/brown/grey		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH169	7.5 (1.7)	Sandy clay, grey		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH169	9 (3.2)	Sandy clay, light grey		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH171	4.8 (1.3)	Sandstone, yellow/brown/white		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH173	3.7 (0.1)	Sand, grey/brown		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH174	8 (0.2)	Clayey sand, yellow/brown/white		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH175	11 (0.25)	Clayey sand, yellow/brown		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH176	9.2 (1.6)	Clayey sand, yellow/brown		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH177	12.2 (0)	Clayey sand, yellow/brown		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH178	12 (0)	Clayey sand, red/brown/grey		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH178	17 (5)	Sandstone, light grey		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH181	22 (8.5)	Sandstone, yellow/brown		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH182	22.9 (7.9)	Sandy silty clay, brown		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH185	14.6 (0.1)	Sandy clay, dark grey		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-
BH215	18 (0)	Sandy clay, dark grey		<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-

Note: value in brackets is depth of sample below fill / natural soil interface

Table H Heavy Metals and Inorganics Results
Historical Soil Sampling
Barangaroo Headland Park and Northern Cove, Natural Soils

all units in mg/kg

Sample ID	Sampling Depth (m)	Soil Type / Description	Heavy Metals								Sulphate	Cyanide (total)
			As	Cd	Cr	Cu	Pb	Hg	Ni	Zn		
PQL			**5**	**1**	**1**	**1**	**1**	**0.1**	**2**	**1**	**100**	**1**
Assessment Criteria											**2000**	
BH014	11.7 (1.2)	Sandy clay, orange brown	6	<1	18	5	23	0.2	<2	25	-	-
BH016	5.8 (2.7)	Silty sand, dark grey	<5	<1	3	17	57	<0.1	<2	45	-	-
BH029	9.25 (4.25)	Clayey sand, brown	<5	<1	13	8	18	<0.1	3	8	-	-
BH034	2.7 (0.2)	Clayey sand, dark grey	<5	<1	6	186	39	<0.1	<2	12	-	-
BH083	7.2 (1.0)	Sandy clay, brown	<5	<1	17	5	306	<0.1	<2	7	570	<1
BH123	7.7 (5.5)	Sandstone, light grey	<5	<1	56	5	7	<0.1	4	21	-	-
BH144	15.2 (1.7)	Sandy clay, orange brown	<5	<1	14	10	59	0.1	4	37	-	-
BH163	15 (0.5)	Clay, red/orange	3	<1	20	12	77	0.8	<2	25	2090	<1
BH164	8.3 (1.1)	Sand, grey/brown	18	<1	15	19	48	0.4	<2	80	1630	<1
BH165	10.5 (0.5)	Sandstone, orange/yellow	<5	<1	10	<5	11	<0.1	<2	15	650	<1
BH166	7 (1.2)	Sand, yellow/brown/grey	11	<1	12	<5	<5	<0.1	<2	<5	480	<1
BH169	7.5 (1.7)	Sandy clay, grey	7	<1	9	148	247	0.8	4	35	2070	<1
BH169	9 (3.2)	Sandy clay, light grey	5	<1	5	<5	<5	<0.1	<2	<5	2010	<1
BH171	4.8 (1.3)	Sandstone, yellow/brown/white	<5	<1	6	<5	<5	<0.1	<2	<5	410	<1
BH173	3.7 (0.1)	Sand, grey/brown	11	<1	10	<5	7	<0.1	3	13	1430	<1
BH174	8 (0.2)	Clayey sand, yellow/brown/white	<5	<1	8	10	68	<0.1	<2	699	590	<1
BH175	11 (0.25)	Clayey sand, yellow/brown	<5	<1	15	<5	5	<0.1	<2	<5	520	<1
BH176	9.2 (1.6)	Clayey sand, yellow/brown	<5	<1	2	<5	9	1.2	<2	<5	300	<1
BH177	12.2 (0)	Clayey sand, yellow/brown	<5	<1	19	10	<5	0.5	<2	16	160	<1
BH178	12 (0)	Clayey sand, red/brown/grey	7	<1	14	<5	<5	0.7	<2	7	880	<1
BH178	17 (5)	Sandstone, light grey	<5	<1	23	<5	7	<0.1	<2	<5	430	<1
BH181	22 (8.5)	Sandstone, yellow/brown	5	<1	17	<5	11	0.7	<2	13	280	<1
BH182	22.9 (7.9)	Sandy silty clay, brown	<5	<1	8	<5	18	<0.1	<2	<5	480	<1
BH185	14.6 (0.1)	Sandy clay, dark grey	6	<1	14	19	78	0.3	4	101	440	<1
BH215	18 (0)	Sandy clay, dark grey	15	<1	30	104	255	1.5	14	326	850	<1
JBS4	10.5 (6.5)	Sandstone, grey	<4	<0.5	15	14	75	0.2	3	39	-	-
JBS300	15.5 (0.5)	Clay, dark grey	<4	<0.5	13	17	110	<0.1	13	110	-	-
JBS301	14 (0.2)	Clay, black	11	<0.5	28	58	180	0.8	13	240	-	-
JBS302	14 (0.2)	Clay, black	21	0.8	31	170	290	3	10	470	-	-
JBS304A	13 (0.3)	Clayey silt, black, trace shells	11	<0.5	22	80	230	2.8	7	290	-	-
JBS305	8 (0.1)	Sandstone, grey mottled yellow	<4	<0.5	15	7	46	<0.1	1	13	-	-
JBS305	9 (1.1)	Sandstone, grey mottled yellow	<4	<0.5	5	4	8	<0.1	<1	6	-	-
JBS306	5 (0.2)	Clayey sand, green yellow	6	<0.5	11	2	8	<0.1	2	10	-	-
JBS307	4 (1)	Sandstone, yellow brown	<4	<0.5	13	10	44	<0.1	1	1	-	-
JBS308	3 (0.3)	Sandstone	<4	<0.5	26	8	12	<0.1	4	11	-	-
JBS309	6 (0.5)	Silty clay, red brown to brown	<4	<0.5	13	9	60	0.1	2	48	-	-
JBS309	8 (2.5)	Sandstone, yellow to orange	<4	<0.5	10	9	25	<0.1	2	15	-	-
JBS310	8 (0.2)	Sandstone, white to grey and brown	<4	<0.5	11	10	33	<0.1	5	48	-	-
JBS310	10 (2.2)	Sandstone, white to grey and brown	<4	<0.5	11	23	22	<0.1	4	31	-	-
JBS311	7.25 (0.15)	Sandstone, yellow	<4	<0.5	4	8	15	<0.1	3	15	-	-
JBS312A	4 (0.1)	Sandstone, yellow to orange	<4	<0.5	7	2	6	<0.1	3	8	-	-
JBS312A	4.55 (0.65)	Sandstone, yellow to orange	<4	<0.5	7	14	17	<0.1	6	12	-	-
JBS313A	12 (0.3)	Sandstone, grey mottled brown	<4	<0.5	8	<1	12	<0.1	<1	<1	-	-
JBS314	11 (0.1)	Clayey silt, black	10	<0.5	19	42	220	1.5	6	150	-	-
JBS315	6 (1.3)	Sandy clay, dark grey to black	<4	<0.5	9	41	110	0.3	7	54	-	-
JBS315	6.5 (1.8)	Sandstone, grey	7	<0.5	10	370	300	0.9	6	28	-	-
JBS316	6 (0.1)	Clayey silt, dark grey to black	5	<0.5	8	15	22	0.1	2	9	-	-
JBS316	8 (2.1)	Sandstone, brown mottled red	<4	0.8	33	6	15	<0.1	2	19	-	-
JBS317	2 (0.5)	Sandstone, grey	<4	<0.5	18	3	14	<0.1	6	15	-	-
JBS318	4.9 (0)	Clayey Sand, brown	<4	<0.5	10	14	42	<0.1	3	26	-	-
JBS320A	3 (0.9)	Sandstone, yellow orange	<4	<0.5	5	8	20	<0.1	1	25	-	-
JBS321	2 (0.4)	Sandstone, white mottled red	<4	<0.5	6	3	6	<0.1	<1	2	-	-
JBS322A	7 (0.2)	Clayey silt, dark grey	<4	<0.5	15	18	110	0.2	4	140	-	-
JBS323	5 (0.9)	Sandstone, yellow	<4	<0.5	49	5	15	<0.1	4	19	-	-
JBS324	11 (0.3)	Silty clay, dark grey to black	53	2.7	22	99	2500	2.7	7	600	-	-
JBS324	13 (2.3)	Sandstone, brown	<4	<0.5	9	3	21	0.3	1	15	-	-
JBS325C	5 (0.2)	Sandy silt, grey	4	<0.5	10	32	130	0.4	7	100	-	-
JBS325C	6 (1.2)	Sandy silt, grey	5	<0.5	12	40	130	0.5	9	110	-	-
JBS326	7.3 (0.3)	Sandstone, yellow orange	<4	1.2	11	11	16	<0.1	3	12	-	-
JBS327	10.5 (0.1)	Sandstone	<4	<0.5	8	3	9	<0.1	1	9	-	-
JBS328	10 (0.1)	Sandstone, brown and grey	<4	<0.5	6	1	7	<0.1	2	10	-	-
JBS329A	9 (0.1)	Sandstone, red brown and grey	4	<0.5	12	21	31	0.1	2	24	-	-
JBS330A	8 (0.2)	Clayey silt, black	10	<0.5	13	260	380	2.1	8	230	-	-

Note: value in brackets is depth of sample below fill / natural soil interface

Table I Groundwater Sample Register
Historical Groundwater Sampling and Analysis
Barangaroo Headland Park and Northern Cove

Monitoring Well ID	Sample Date	Location	Analytes
MW01	14/07/2006	Adjoiniong proposed north-western site boundary	Heavy metals, PAHs, TPH and PCBs
	5/05/2008		Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	3/12/2010		Heavy metals, ammonia (as N), PAHs, BTEX, VOCs
MW02	14/07/2006 & 17/07/2006	Proposed western boundary	Heavy metals, PAHs, TPH and PCBs
	14/08/2007		Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	5/06/2008		Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	3/12/2010		Heavy metals, ammonia (as N), PAHs, BTEX, VOCs
MW03	14/07/2006	Adjoining north-west of proposed north-western site boundary	Cu, Pb and Zn
	5/05/2008		Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	6/12/2010		
MW04	14/07/2006	Proposed western boundary	Heavy metals, PAHs, TPH and PCBs
	13/08/2007		Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	5/06/2008		Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	3/12/2010		Heavy metals, ammonia (as N), PAHs, BTEX, VOCs

Table I Groundwater Sample Register
Historical Groundwater Sampling and Analysis
Barangaroo Headland Park and Northern Cove

Monitoring Well ID	Sample Date	Location	Analytes
MW05	18/07/2006	Within inundated area of proposed Northern Cove (off-site)	Cu, Pb and Zn
	16/08/2007		Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	5/09/2008		Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	6/12/2010		Heavy metals, ammonia (as N), PAHs, BTEX, VOCs
MW06	18/07/2006	Proposed south-western boundary	Cu, Pb and Zn
	16/08/2007		Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	5/08/2008		Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	6/12/2010		Heavy metals, ammonia (as N), PAHs, BTEX, VOCs
MW07	17/07/2006	Proposed western boundary	Cu, Pb and Zn
	15/08/2007		Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	5/06/2008		Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	6/12/2010		Heavy metals, ammonia (as N), PAHs, BTEX, VOCs
MW19	18/07/2006	Within inundated area of proposed Northern Cove (off-site)	Cu, Pb and Zn
	16/08/2007		Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	5/09/2008		Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	9/12/2010		Heavy metals, ammonia (as N), PAHs, BTEX, VOCs

Table I Groundwater Sample Register
Historical Groundwater Sampling and Analysis
Barangaroo Headland Park and Northern Cove

Monitoring Well ID	Sample Date	Location	Analytes
MW25	25/07/2006	Within ununddated area to north-east of site (off-site)	Cu, Pb and Zn
	13/08/2007		Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	5/12/2008		Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	9/12/2010		Heavy metals, ammonia (as N), PAHs, BTEX, VOCs
MW179	5/06/2008	To east of southern portion of Headland Park site (upgradient / background)	Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	9/12/2010		Heavy metals, ammonia (as N), PAHs, BTEX, VOCs
MW215	5/08/2008	Within inundated area of proposed Northern Cove (off-site)	Heavy metals, anions, cations, cyanide, ammonia (as N), phenols, PAHs, BTEX, TPH and PCBs
	6/12/2010		Heavy metals, ammonia (as N), PAHs, BTEX, VOCs
MW328	2/12/2010	Western side of proposed northern boundary of site	Heavy metals, ammonia (as N), PAHs, BTEX, VOCs
MW322A	9/12/2010	Eastern side of proposed northern boundary of site	Heavy metals, ammonia (as N), PAHs, BTEX, VOCs

Table J Polycyclic Aromatic Hydrocarbons Results - Groundwater
Historical Groundwater Sampling and Analysis
Barangaroo Headland Park and Northern Cove

all units in ug/l

Sample id	Location	Date sampled	Polycyclic Aromatic Hydrocarbons														
			Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b&k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3,cd)pyrene	Dibenz(a,h)anthracene	Benzo(g,h,i)perylene
Assessment criteria [1]			50	-	-	-	2	0.1	1.4	0.24	0.5	0.2	0.05	0.2	0.05	-	0.05
PQL			1	1	1	1	1	1	1	1	1	1	2	0.5	1	1	1
MW01	Boundary	14/07/2006	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.5	<1	<1	<1
MW01		5/05/2008	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.5	<1	<1	<1
MW01		3/12/2010	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
MW02	Boundary	14 & 17/07/2006	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.5	<1	<1	<1
MW02		14/08/2007	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.5	<1	<1	<1
MW02		5/06/2008	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.5	<1	<1	<1
MW02		3/12/2010	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
MW03	Boundary	5/05/2008	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.5	<1	<1	<1
MW03		6/12/2010	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
MW04	Boundary	14/07/2006	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.5	<1	<1	<1
MW04		13/08/2007	<1	<1	<1	<1	1.3	<1	**2.2**	**2**	<1	<1	<2	0.9	<1	<1	<1
MW04		5/06/2008	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.5	<1	<1	<1
MW04		3/12/2010	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
MW06	Boundary	16/08/2007	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.5	<1	<1	<1
MW06		5/08/2008	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.5	<1	<1	<1
MW06		6/12/2010	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
MW07	Boundary	15/08/2007	<1	<1	<1	<1	1.7	<1	**5.4**	**6.1**	**2.2**	**2.1**	**4**	**2.7**	**1.4**	<1	**1.6**
MW07		5/06/2008	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.5	<1	<1	<1
MW07		6/12/2010	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1

Table J Polycyclic Aromatic Hydrocarbons Results - Groundwater
Historical Groundwater Sampling and Analysis
Barangaroo Headland Park and Northern Cove

all units in ug/l

Sample id	Location	Date sampled	Polycyclic Aromatic Hydrocarbons														
			Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b&k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3,cd)pyrene	Dibenz(a,h)anthracene	Benzo(g,h,i)perylene
Assessment criteria [1]			50	-	-	-	2	0.1	1.4	0.24	0.5	0.2	0.05	0.2	0.05	-	0.05
PQL			1	1	1	1	1	1	1	1	1	1	2	0.5	1	1	1
328	Boundary	2/12/2010	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
BD1/021210	328	2/12/2010	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
BH322A	Boundary	9/12/2010	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
MW05	Off-site	16/08/2007	7.7	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.5	<1	<1	<1
MW05		5/09/2008	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.5	<1	<1	<1
MW05		6/12/2010	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
MW19	Off-site	16/08/2007	6.6	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.5	<1	<1	<1
MW19		5/09/2008	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
MW19		9/12/2010	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
MW25	Off-site	13/08/2007	<1	<1	<1	<1	**2.5**	**1.1**	**5.5**	**6.5**	**2.4**	**2.4**	**4.4**	**3**	**1.8**	<1	**2**
MW25		5/12/2008	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.5	<1	<1	<1
MW25		9/12/2010	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
MW215	Off-site	5/08/2008	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
MW215		6/12/2010	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.1	<0.2	<0.1	<0.1	<0.1	<0.1
MW179	Background	5/06/2008	<1	<1	<1	<1	<1	<1	**1.4**	**1.3**	<1	<1	<2	**0.7**	<1	<1	<1
MW179		9/12/2010	3.4	0.4	0.3	0.9	0.7	**0.5**	**1.5**	**1.3**	0.3	**0.2**	<0.2	**<0.1**	<0.1	<0.1	<0.1

Table K TPH Results - Groundwater
Historical Groundwater Sampling and Analysis
Barangaroo Headland Park and Northern Cove

all units in ug/l

Sample ID	Location	Date sampled	TPH				
			C6-C9	C10-C14	C15-C28	C29-C36	ΣC6-C36
Assessment criteria [1]			--	-			**600**
PQL			**20**	**50**	**100**	**50**	
MW01	Boundary	14/07/2006	<20	<50	<100	<50	-
MW01		5/05/2008	<20	<50	<100	<50	-
MW02	Boundary	14 & 17/07/2006	<20	<50	<100	<50	-
MW02		14/08/2007	<20	<50	<100	<50	-
MW02		5/06/2008	<20	<50	<100	<50	-
MW03	Boundary	5/05/2008	<20	<50	<100	<50	-
MW04	Boundary	14/07/2006	<20	<50	<100	<50	-
MW04		13/08/2007	<20	<50	<100	<50	-
MW04		5/06/2008	<20	<50	<100	<50	-
MW06	Boundary	16/08/2007	<20	<50	<100	<50	-
MW06		5/08/2008	<20	<50	<100	<50	-
MW07	Boundary	15/08/2007	<20	<50	300	160	460
MW07		5/06/2008	<20	<50	<100	<50	-
MW05	Off-site	16/08/2007	<20	<50	<100	<50	-
MW05		5/09/2008	<20	<50	<100	<50	-
MW19	Off-site	16/08/2007	<20	<50	<100	<50	-
MW19		5/09/2008	<20	<50	<100	<50	-
MW25	Off-site	13/08/2007	<20	<50	400	200	600
MW25		5/12/2008	<20	<50	100	50	150
MW215	Off-site	5/08/2008	<20	<50	<100	<50	-
MW179	Background	5/06/2008	<20	<50	200	820	**1020**

Table L Monocyclic Aromatic Hydrocarbons Results - Groundwater
Historical Groundwater Sampling and Analysis
Barangaroo Headland Park and Northern Cove

all units in ug/l

Sample ID	Location	Date sampled	Monocyclic Aromatic Hydrocarbons													
			Benzene	Toluene	Ethylbenzene	meta&para Xylene	Styrene	ortho Xylene	Isopropylbenzene	n-Propylbenzene	1,3,5-Trimethylbenzene	sec-Butylbenzene	1,2,4-Trimethylbenzene	tert-Butylbenzene	p-Isoprpyltoluene	n-Butylbenzene
Assessment criteria			500	180	5	75	30	75	-	-	-	-	-	-	-	-
PQL			1	1	1	2	1	1	1	1	1	1	1	1	1	1
MW01		14/07/2006	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW01		5/05/2008	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW01	Boundary	3/12/2010	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW02		14 & 17/07/2006	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW02		14/08/2007	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW02		5/06/2008	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW02	Boundary	3/12/2010	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW03		5/05/2008	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW03	Boundary	6/12/2010	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW04		14/07/2006	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW04		13/08/2007	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW04		5/06/2008	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW04	Boundary	3/12/2010	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW06		16/08/2007	<1	<1	<1	2	-	<1	-	-	-	-	-	-	-	-
MW06		5/08/2008	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW06	Boundary	6/12/2010	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW07		15/08/2007	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW07		5/06/2008	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW07	Boundary	6/12/2010	<10	<10	<10	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
328	Background	2/12/2010	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Table L Monocyclic Aromatic Hydrocarbons Results - Groundwater
Historical Groundwater Sampling and Analysis
Barangaroo Headland Park and Northern Cove

all units in ug/l

Sample ID	Location	Date sampled	Monocyclic Aromatic Hydrocarbons													
			Benzene	Toluene	Ethylbenzene	meta&para Xylene	Styrene	ortho Xylene	Isopropylbenzene	n-Propylbenzene	1,3,5-Trimethylbenzene	sec-Butylbenzene	1,2,4-Trimethylbenzene	tert-Butylbenzene	p-Isoprpyltoluene	n-Butylbenzene
Assessment criteria			500	180	5	75	30	75	-	-	-	-	-	-	-	-
PQL			1	1	1	2	1	1	1	1	1	1	1	1	1	1
BH322A	Background	9/12/2010	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW05	Off-site	16/08/2007	1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW05		5/09/2008	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW05		6/12/2010	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW19	Off-site	16/08/2007	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW19		5/09/2008	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW19		9/12/2010	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW25	Off-site	13/08/2007	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW25		5/12/2008	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW25		9/12/2010	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW215	Off-site	5/08/2008	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW215		6/12/2010	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW179	Background	5/06/2008	<1	<1	<1	<2	-	<1	-	-	-	-	-	-	-	-
MW179		9/12/2010	1	<1	<1	<2	<1	<1	<1	<1	<1	<1	1.2	<1	<1	<1

Table M Phenols Results - Groundwater
Historical Groundwater Sampling and Analysis
Barangaroo Headland Park and Northern Cove

all units in ug/l

Sample ID	Date sampled	Phenols																
		Total	Phenol	2-Chlorophenol	2-Methylphenol	3- & 4-Methylphenol	2,4-Dimethylphenol	2-Nitrophenol	2,4-Dichlorphenol	2,4,6-Trichlorophenol	2,4,5-Trichlorophenol	2,4-Dinitrophenol	4-Nitrophenol	4-Chloro-3-methylphenol	2-methyl-4,6-dinitrophenol	Pentachlorophenol	3-methylphenol	2,6-Dichlorophenol	2,3,4,6-Tetrachlorophenol
PQL			1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1
MW01	5/05/2008		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW02	14/08/2007		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW02	5/06/2008		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW03	5/05/2008		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW04	13/08/2007		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW04	5/06/2008		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW05	16/08/2007		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW05	5/09/2008		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW06	16/08/2007		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW06	5/08/2008		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW07	15/08/2007		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW07	5/06/2008		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW19	16/08/2007		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW19	5/09/2008		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW25	13/08/2007		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW25	5/12/2008		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW179	5/06/2008		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-
MW215	5/08/2008		-	-	-	-	-	<1	-	<1	-	-	-	<1	-	<2	-	<1	-

Table N Heavy Metals and Inorganics Results - Groundwater
Historical Groundwater Sampling and Analysis
Barangaroo Headland Park and Northern Cove

all units in ug/l

Sample ID	Location	Date sampled	Metals												Total Dissolved Solids (TDS)	pH	Cyanide (total)	Ammonia (as N)
			As	Cd	Cr	Cu	Fe total	Fe	Pb	Mn total	Mn	Hg	Ni	Zn				
PQL			**1**	**0.1**	**1**	**1**			**1**			**0.1**	**1**	**1**			**4**	**100**
Assessment Criteria			**2.3**	**0.7**	**4.4**	**1.3**			**4.4**			**0.1**	**7**	**15**	**-**	**-**	**4**	**910**
MW01	Boundary	14/07/2006	<10	<1	<10	**2**	**-**	**-**	0.2	-	-	<0.1	<10	**22**	30030	7.34	-	-
MW01		5/05/2008	<0.5	0.6	<0.5	**2**	**-**	**-**	<0.2	-	-	<0.1	**186**	**26**	30095	5.91	<4	204
MW01		3/12/2010	1	0.2	<1	<1	1900	1900	<1	410	410	<0.4	<1	5	32000	6.98	-	200
MW02	Boundary	14 & 17/07/2006	<10	<1	<10	<1	**-**	**-**	2.5	-	-	<0.1	<10	**41**	30160	7.14-7.53	-	-
MW02		14/08/2007	<10	**1.4**	<10	**144**	**-**	**-**	<10	-	-	<0.1	**228**	**156**	-	-	<4	**1000**
MW02		5/06/2008	2.2	0.3	<0.5	<1	**-**	**-**	0.5	-	-	<0.1	**116**	7	31655	7.09	<4	<15
MW02		3/12/2010	2	0.2	<1	1	30	26	<1	<5	<5	<0.4	<1	3	33500	7.54	-	<5
MW03	Boundary	14/07/2006	-	-	-	**3**	**-**	**-**	0.7	-	-	-	-	**17**	30745	7.83	-	-
MW03		5/05/2008	1	**5.5**	<0.5	<1	**-**	**-**	<0.2	-	-	<0.1	**46.3**	12	30420	7.44	<4	130
MW03		6/12/2010	2	0.5	2	1	380	64	<1	<5	<5	<0.4	2	**32**	21400	7.91	-	<5
MW04	Boundary	14/07/2006	<10	<1	<10	1	**-**	**-**	1.2	-	-	<0.1	**10**	**22**	32045	7.24	-	-
MW04		13/08/2007	13	**18.8**	<10	**96**	**-**	**-**	**65**	-	-	<0.1	**241**	**392**	-	-	<4	<100
MW04		5/06/2008	1.3	0.4	<0.5	**11**	**-**	**-**	1.3	-	-	<0.1	**303**	**31**	20280	5.87	<4	119
MW04		3/12/2010	2	0.3	<1	<1	30	26	<1	<5	<5	<0.4	<1	**20**	35000	7.1	-	<5
MW06	Boundary	18/07/2006	-	-	-	**2**	**-**	**-**	1.6	-	-	-	-	**40**	23530	7.73	-	-
MW06		16/08/2007	**11**	**1.1**	<1	**153**	**-**	**-**	**19**	-	-	<0.1	**46**	**127**	-	-	<4	<10
MW06		5/08/2008	1.6	<0.2	<0.5	<1	**-**	**-**	<0.2	-	-	<0.1	<0.5	**12**	31070	7.76	<4	214
MW06		6/12/2010	2	0.5	<1	**6**	30	20	<1	<5	<5	<0.4	4	**17**	34000	7.99	-	5
MW07	Boundary	17/07/2006	-	-	-	1	**-**	**-**	**5**	-	-	-	-	**95**	30160	7.53	-	-
MW07		15/08/2007	**12**	**4.2**	<10	**25**	**-**	**-**	<10	-	-	<0.1	**29**	**86**	-	-	<4	<100
MW07		5/06/2008	1.6	0.2	<0.5	<1	**-**	**-**	<0.2	-	-	<0.1	**12.2**	10	31135	7.36	<4	581
MW07		6/12/2010	2	0.2	<1	1	120	60	<1	920	100	<0.4	<1	3	33700	7.61	-	200
328	Boundary	2/12/2010	2	0.1	<1	<1	27	<10	1	<5	<5	<0.4	<1	14	35300	7.98	-	<5
BD1/021210	328	2/12/2010	2	0.2	<1	<1	-	-	2	-	-	<0.4	<1	12			-	**-**
BH322A	Boundary	9/12/2010	1	0.1	<1	1	500	27	4	10	<5	<0.4	<1	20	35000	7.69	-	80
MW05	Off-site	18/07/2006	-	-	-	1	**-**	**-**	0.8	-	-	-	-	**45**	23855	7.49	-	-
MW05		16/08/2007	<6	**1.7**	<5	**76**	**-**	**-**	<1	-	-	<0.1	**56**	**299**	-	-	<4	<10
MW05		5/09/2008	0.8	0.2	1.9	<1	**-**	**-**	<0.2	-	-	<0.1	0.8	**19**	21775	6.56	<4	<15
MW05		6/12/2010	1	0.4	3	<1	170	55	<1	940	47	<0.4	5	**33**	26000	6.68	-	8
MW19	Off-site	18/07/2006	-	-	-	**2**	**-**	**-**	7	-	-	-	-	**45**	20540	7.43	-	-
MW19		16/08/2007	<10	**3.2**	<10	**45**	**-**	**-**	<10	-	-	<0.1	<10	<50	-	-	<4	<100
MW19		5/09/2008	1.4	0.4	1.6	2	**-**	**-**	3.8	-	-	<0.1	0.7	**29**	30615	7.67	<4	<15
MW19		9/12/2010	1	0.6	<1	<1	260	28	**6**	10	5	<0.4	<1	**42**	21500	7.98	-	9
MW25	Off-site	25/07/2006	-	-	-	2	**-**	**-**	**24.8**	-	-	-	-	**203**	21190	6.92	-	-
MW25		13/08/2007	<10	**43.2**	<10	**36**	**-**	**-**	**62**	-	-	0.1	**74**	**290**	-	-	<4	**3610**
MW25		5/12/2008	1.4	<0.2	<0.5	<1	**-**	**-**	<0.2	-	-	<0.1	4	6	14625	6.6	11.8	**4320**
MW25		9/12/2010	2	<0.1	<1	<1	30000	23000	<1	2800	2800	<0.4	3	11	11200	6.94	-	**3000**
MW215	Off-site	5/08/2008	1	0.3	<0.5	1	-	-	<0.2	-	-	<0.1	1.7	**18**	31005	7.5	<4	78
MW215		6/12/2010	2	0.3	1	<1	3000	130	<1	60	<5	<0.4	<1	5	33100	7.94	-	5
MW179	Background	5/06/2008	1.1	0.4	<0.5	<1	-	-	0.6	-	-	<0.1	**86.8**	**36**	31070	7.5	<4	218
MW179		9/12/2010	<1	<0.1	<1	<1	160	110	<1	10	10	<0.4	<1	6	152000	6.52	-	10

Table O Volatile Organic Compounds - Groundwater
Historical Groundwater Sampling and Analysis
Barangaroo Headland Park and Northern Cove

| Sample ID | Location | Date sampled | VOCs (other than MAHs) | | |

Appendix B – Data Tables used for Assessment against Criteria

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DATA SET 1

Sample id	Location	Sampling Depth (m)	Current Ground level m AHD	Finished Park ground level m AHD	Sample depth mAHD	Depth below finished surface	Where soils are <1.9 m AHD	TPH												Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(e)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthrene	Fluorene	Indeno(1,2,3,cd)pyrene	Naphthalene	Phenanthrene	Pyrene	Benzene	Toluene	Ethylbenzene	Xylene	Heavy Metals								Sulphate	Cyanide (total)	Ammonia
								C6-C9	C6-C9 aliphatic	C6-C8 aliphatic	C10-C14	C10-C14 aliphatic	C10-C14 aromatic	C8-C16 aliphatic	C8-C16 aromatic	C15-C28	C29-C36	>16 aliphatic	>16 aromatic	ΣC10-C36																																		
PQL								2			50					100	100				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	0.2	0.2	0.2											
Criteria									65			2308	23						1429		5	70	42							35	2.4		208	17	12	1.3	0.7	<LOR	<LOR	23			31	157	0.2	1061	99		<LOR	
Max								15	15	15	130	65	65	65.5	33	5050	1770	3410	3410	6951	5.6	13	52	177	90	177	39	70	144	16	377	21	45	4	340	292	0.25	0.25	0.5	1.5	77	2.7	141	3200	2500	16	115	699	11600	2	10
BH003	<2010 High Water	1.05	2.432	6.5	1.382	5.118	1	1	1	1	25	12.5	12.5	13	6.75	300	50	175	175	376	0.25	0.8	1.7	2.6	2.5	2.6	1	1.2	2.5	0.25	9.8	0.9	0.9	0.7	7.8	8.7	0.1	0.1	0.1	0.2	2.5	0.5	20	123	183	0.2	61	114	-	-	-
BH003	<2010 High Water	1.7	2.432	6.5	0.732	5.768	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-																0.1	0.1	0.1	0.2	2.5	0.5	18	42	266	0.3	2	92	-	-	-
BH003	<2010 High Water	3.2	2.432	6.5	-0.768	7.268	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-																0.1	0.1	0.1	0.2	2.5	0.5	18	62	124	0.05	2	39	-	-	-
BH004	Above GW	1.7	2.88	9	1.18	7.82	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.1	0.1	0.2	2.5	0.5	7	5	16	0.05	1	5	-	-	-
BH006	<2010 High Water	1.7	3.01	4.8	1.31	3.49	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	1.1	1	1.3	0.7	0.25	1.1	0.25	2.3	0.25	0.25	1.4	2.1					2.5	0.5	12	59	207	0.5	10	210	-	-	-
BH007	Excavated	1	2.844	2	1.844	0.156	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.9	0.8	1	0.6	0.25	0.7	0.25	1.7	0.25	0.25	0.25	0.8	1.6					2.5	0.5	20	33	273	0.4	15	130	-	-	-
BH008	<2010 High Water	0.75	2.619	3	1.869	1.131	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.7	1.6	2.6	3.1	3.4	2.3	1.1	2.5	0.25	8.5	0.7	1.8	0.25	6.5	7.9					2.5	0.5	22	30	111	0.2	20	152	-	-	-
BH008	<2010 High Water	1.6	2.619	3	1.019	1.981	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.25	1	0.25	0.25	0.6	1					2.5	0.5	12	12	34	0.05	9	81	-	-	-
BH009	<2010 High Water	1.7	2.584	5.5	0.884	4.616	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.5	0.25					2.5	0.5	14	53	301	0.05	12	49	-	-	-
BH011	<2010 High Water	1.7	2.651	7	0.951	6.049	1	1	1	1	25	12.5	12.5	13	6.75	370	260	315	315	656	1.5	0.25	2.6	12.4	10.2	10.5	4.7	4.1	10.1	1.1	26.5	1	3.9	0.6	9.1	**26.7**					7	0.5	10	74	290	0.7	18	154	-	-	-
BH011	<2010 High Water	2.9	2.651	7	-0.249	7.249	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	1	0.8	0.9	0.25	0.25	0.8	0.25	2	0.25	0.25	0.25	0.7	2					2.5	0.5	19	20	83	0.1	4	58	-	-	-
BH012	<2010 High Water	1.7	2.937	20	1.237	18.763	1																																		2.5	0.5	2	23	70	0.4	1	126	-	-	-
BH013	<2010 High Water	1.7	2.921	3	1.221	1.779	1	1	1	1	60	30	**30**	30.5	15.5	490	270	380	380	821																0.1	0.1	0.1	0.2	2.5	0.5	6	80	181	0.4	17	348	-	-	-
BH013	<2010 High Water	3.2	2.921	3	-0.279	3.279	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-																0.1	0.1	0.1	0.2	2.5	0.5	44	82	125	0.05	10	102	-	-	-
BH029	9.25 (4.25)	9.25	2.553	6.5	-6.697	13.197	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25					2.5	0.5	13	8	18	0.05	3	8	-	-	-
BH033	<2010 High Water	1.7	2.547	2	0.847	1.153	1																																		6	0.5	141	31	72	0.1	19	308	-	-	-
BH033	<2010 High Water	3.2	2.547	2	-0.653	2.653	1																																		2.5	0.5	6	61	77	0.1	4	85	-	-	-
BH034	<2010 High Water	1.7	2.549	3	0.849	2.151	1																																		2.5	0.5	5	5	5	0.05	1	2.5	-	-	-
BH034	2.7 (0.2)	2.7	2.549	3	-0.151	3.151	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-																0.1	0.1	0.1	0.2	2.5	0.5	6	186	39	0.05	1	12	-	-	-
BH036	<2010 High Water	1.7	2.573	2	-	2	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-																0.1	0.1	0.1	0.2	2.5	0.5	7	28	64	0.1	1	43	-	-	-
BH036	<2010 High Water	3.2	2.573	2	-0.627	2.627	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-																0.1	0.1	0.1	0.2	2.5	0.5	10	24	182	0.2	3	28	-	-	-
BH037	Unsaturated	0.7	2.35	6	1.65	4.35	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-																0.1	0.1	0.1	0.2	2.5	0.5	7	5	11	0.05	1	2.5	-	-	-
BH037	<2010 High Water	2.85	2.35	6	-0.5	6.5	1																																		2.5	0.5	14	5	11	0.05	1	2.5	-	-	-
BH038	Excavated	0.4	2.173	20	1.773	18.227	1																														0.1	0.1	0.1	0.2											
BH038	Excavated	0.4	2.173	20	1.773	18.227	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-																				2.5	0.5	5	60	9	0.05	115	42	-	-	-
BH039	Unsaturated	0.4	2.225	3	1.825	1.175	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-																0.1	0.1	0.1	0.2	2.5	0.5	7	26	27	0.1	39	31	-	-	-
BH039	<2010 High Water	2.25	2.225	3	-0.025	3.025	1																																		2.5	0.5	12	18	22	0.1	19	32	-	-	-
BH083	<2010 High Water	3.2	2.835	3	-0.365	3.365	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.1	0.1	0.2	2.5	0.5	12	16	45	0.1	8	62	420	0.5	-
BH083	7.2 (1.0)	7.2	2.835	3	-4.365	7.365	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.1	0.1	0.2	2.5	0.5	17	5	306	0.05	1	7	570	0.5	-
BH085	<2010 High Water	1.7	2.697	7	0.997	6.003	1	1	1	1	130	65	**65**	65.5	33	5050	1770	3410	3410	6951	4	12.4	46.9	177	82.4	177	39	46.1	144	13.9	377	18.2	41.1	1.9	340	292	0.1	0.1	0.1	0.2	2.5	0.5	9	293	157	0.2	6	22	500	0.5	-
BH086	<2010 High Water	1.7	2.701	6.5	1.001	5.499	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.8	0.8	0.9	1	0.7	0.25	0.6	0.25	3.5	0.25	0.25	3.2	0.1	0.1	0.1	0.2	2.5	0.5	13	6	21	0.1	1	8	210	0.5	-
BH086	<2010 High Water	3.2	2.701	6.5	-0.499	6.999	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.1	0.1	0.2	2.5	0.5	8	5	5	0.05	1	2.5	320	0.5	-
BH088	Excavated	0.4	2.246	3.65	1.846	1.804	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-																0.1	0.1	0.1	0.2	2.5	0.5	11	18	15	0.05	41	34			
BH088	Excavated	1.7	2.246	3.65	0.546	3.104	1																																		2.5	0.5	8	14	48	0.05	7	52	-	-	-
BH088	<2010 High Water	3.2	2.246	3.65	-0.954	4.604	1																																		2.5	0.5	8	5	12	0.05	1	18	-	-	-
BH105	<2010 High Water	1.7	2.496	2.7	0.796	1.904	1														0.25	0.25	0.25	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.25	0.25						2.5	0.5	11	6	21	0.05	1	20	-	-	-
BH120	<2010 High Water	1.7	3.017	4	1.317	2.683	1														0.25	0.25	0.25	0.9	0.9	1.1	0.6	0.25	0.9	0.25	1.9	0.25	0.25	0.25	0.9	1.9						12	0.5	37	34	168	0.2	21	106	-	-	-
BH123	<2010 High Water	3.2	2.539	2	-0.661	2.661	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.25	0.8	0.25	0.25	0.25	0.25	0.7	0.1	0.1	0.1	0.2	2.5	0.5	9	9	165	0.05	1	38	850	0.5	-
BH123	7.7 (5.5)	7.7	2.539	2	-5.161	7.161	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-																0.1	0.1	0.1	0.2	2.5	0.5	56	5	7	0.05	4	21	-	-	-
BH124	<2010 High Water	1.7	2.732	10	1.032	8.968	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.6	0.1	0.1	0.1	0.2	2.5	0.5	11	36	210	0.4	6	38	510	0.5	-
BH125	<2010 High Water	1.7	2.922	13	1.222	11.778	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.1	0.1	0.2	2.5	1	10	7	24	0.05	1	12	-	-	-
BH126	<2010 High Water	1.7	3.067	4.5	1.367	3.133	1																																		77	0.5	22	79	538	1.7	31	328	-	-	-
BH126	<2010 High Water	5.1	3.067	4.5	-2.033	6.533	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.7	1.6	1.8	2.3	0.8	1	1.6	0.25	3.8	0.25	0.7	0.25	1.9	3.4	0.1	0.1	0.1	0.2	2.5	0.5	9	40	101	0.2	8	63	-	-	-
BH127	<2010 High Water	3.2	2.573	4	-0.627	4.627	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.1	0.1	0.2	2.5	0.5	4	12	19	0.05	1	6	-	-	-
BH150	Excavated	1.7	2.604	3.15	0.904	2.246	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	1.3	1.4	1.7	0.9	0.7	1.1	0.25	2.7	0.25	0.8	0.25	0.9	2.8	0.1	0.1	0.1	0.2	2.5	0.5	15	34	130	0.2	8	126	-	-	-
BH150	<2010 High Water	3.2	2.604	3.15	-0.596	3.746	1																																		2.5	0.5	13	30	117	0.3	6	126	-	-	-
BH150	<2010 High Water	9.7	2.604	3.15	-7.096	10.246	1																																		18	2	41	83	208	1.2	15	369	-	-	-
BH162	<2010 High Water	3.5	2.563	2.7	-0.937	3.637	1	1	1	1	25	12.5	12.5	13	6.75	340	490	415	415	856	1	0.25	2.2	4	4.1	4.1	2.1	1.8	3.3	0.25	12.3	1.1	1.8	0.25	8	11.4	0.1	0.25	0.25	0.5	2.5	0.5	8	17	69	0.05	3	59	230	0.5	-
BH162	<2010 High Water	12.3	2.563	2.7	-9.737	12.437	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.25	0.5	0.1	0.25	0.25	0.5	2.5	0.5	6	2.5	14	0.05	1	21	100	0.5	-
BH162	<2010 High Water	13.5	2.563	2.7	-10.937	13.637	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	**5.5**	0.25	3.1	4	3.8	4.9	2.7	1.5	3.6	0.6	11	**3.9**	2.2	0.8	11.6	9.1	0.1	0.25	0.25	0.5	5	0.5	9	16	28	0.05	4	50	1490	0.5	-
BH164	<2010 High Water	5.5	2.795	2	-2.705	4.705	1	1	1	1	25	12.5	12.5	13	6.75	630	540	585	585	1196	0.25	0.8	1	6	8.5	10	6.1	4.4	5	1.2	9.5	0.25	4.4	0.25	1.8	12.2	0.1	0.25	0.25	0.5	11	0.5	16	82	383	2.7	6	291	2290	0.5	-
BH164	8.3 (1.1)	8.3	2.795	2	-5.505	7.505	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.8	2.1	2.2	2.8	1.5	1.1	1.6	0.25	5.1	0.25	1.1	0.25	1.6	5.2	0.1	0.25	0.25	0.5	18	0.5	15	19	48	0.4	1	80	1630	0.5	-
BH165	<2010 High Water	3.5	2.807	2	-0.693	2.693	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	1.4	1.7	2	1	0.6	1.3	0.25	2.9	0.25	0.8	0.25	1.6	3	0.1	0.25	0.25	0.5	2.5	0.5	33	33	42	0.05	4	43	600	0.5	-
BH165	<2010 High Water	8	2.807	2	-5.193	7.193	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.8	1	1.2	0.6	0.25	0.8	0.25	2	0.25	0.5	0.25	1	1.7	0.1	0.25	0.25	0.5	5	0.5	13	32	106	0.2	9	94	650	0.5	-
BH165	10.5 (0.5)	10.5	2.807	2	-7.693	9.693	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.1	0.1	0.2	2.5	0.5	10	2.5	11	0.05	1	15	650	0.5	-
BH166	<2010 High Water	1.3	2.833	2	1.533	0.467	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.5	0.7	2.5	1.7	3.1	2	1.2	1.9	0.25	6.1	0.25	1.4	0.25	2.5	6.4	0.1	0.25	0.25	0.5	6	0.5	19	47	216	0.3	6	144	490	0.5	-
BH166	<2010 High Water	4	2.833	2	-1.167	3.167	1	1	1	1	25	12.5	12.5	13	6.75	330	320	325	325	676	3.6	0.7	3.8	4.6	4.6	5.6	4.2	2.2	3.7	0.25	15.1	**2.9**	2.7	2.7	12.5	15	0.1	0.25	0.25	0.5	6	0.5	21	52	111	0.2	15	189	1530	0.5	-
BH166	7 (1.2)	7	2.833	2	-4.167	6.167	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.8	0.25	0.25	0.25	0.9	0.1	0.25	0.25	0.5	11	0.5	12	2.5	2.5	0.05	1	2.5	480	0.5	-
BH168	<2010 High Water	5	3.015	4	-1.985	5.985	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.5	0.25	0.25	0.25	0.25	0.8	0.25	0.25	0.25	0.25	1	0.1	0.25	0.25	0.5	6	0.5	9	24	149	0.2	4	70	630	0.5	-
BH168	<2010 High Water	8.8	3.015	4	-5.785	9.785	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.25	0.25	0.5	11	0.5	14	2.5	9	0.05	10	41	1040	0.5	-
BH169	<2010 High Water	4.4	3.035	3.5	-1.365	4.865	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.5	0.7	2.1	1.4	2.5	1.6	1	1.7	0.25	4.9	0.25	1.1	0.8	2.4	4.4	0.1	0.25	0.25	0.5	26	0.5	20	30	237	0.5	19	116	1320	0.5	-
BH169	7.5 (1.7)	7.5	3.035	3.5	-4.465	7.965	1	15	15	15	25	12.5	12.5	20	13.75	820	520	670	670	1380	2	1.9	8.8	19.1	13.5	18.4	8.1	8.9	14.6	2.3	**38.9**	**3.5**	6.3	0.25	**27.4**	**30.7**	0.1	0.25	0.25		7	0.5	9	148	247	0.8	4	35	2070	0.5	-
BH169	9 (3.2)	9	3.035	3.5	-5.965	9.465	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.25	0.25		5	0.5	5	2.5	2	0.05	1	2.5	2010	0.5	-
BH170	<2010 High Water	1.3	2.951	3.15	1.651	1.499	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.25	0.6	0.1	0.25	0.25	0.5	6	0.5	12	53	304	0.6	6	309	490	2	-
BH170	<2010 High Water	3.7	2.951	3.15	-0.749	3.899	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.6	0.7	0.7	0.6	0.25	0.25	0.25	1.3	0.25	0.25	0.8	1.4	0.1	0.25	0.25	0.5	7	0.5	14	36	433	1.1	5	139	1730	0.5	-
BH170	<2010 High Water	6.1	2.951	3.15	-3.149	6.299	1	1	1	1	25	12.5	12.5	13	6.75	240	140	190	190	406	0.25	0.25	0.25	1	1.1	1.4	0.6	0.7	0.8	0.25	1.9	0.25	0.25	0.25	0.7	2.7	0.1	0.25	0.25	0.5	6	0.5	11	51	207	0.4	8	66	1790	0.5	-
BH171	4.8 (1.9)	4.8	2.719	-4	-2.081	1.919	1	1	1	1	25	12.5	12.5	13	6.75	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.25	0.25		2.5	0.5	6	2.5	2.5

DATA SET 1

Sample id	Location	Sampling Depth (m)	Current Ground level m AHD	Finished Park ground level m AHD	Sample depth mAHD	Depth below finished surface	Where soils are <1.9 m AHD	TPH											Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthrene	Fluorene	Indeno(1,2,3,cd)pyrene	Naphthalene	Phenanthrene	Pyrene	Benzene	Toluene	Ethylbenzene	Xylene	Heavy Metals								Sulphate	Cyanide (total)	Ammonia
								C6-C9	C6-C9 aliphatic	C6-C8 aliphatic	C10-C14	C10-C14 aliphatic	C10-C14 aromatic	C8-C16 aliphatic	C8-C16 aromatic	C15-C28	C29-C36	>16 aliphatic	>16 aromatic	ΣC10-C36																																		
PQL								2			50					100	100				1	1	1	1	0.5	2	1		1	1	1	1	1	1	0.2	0.2	0.2											
Criteria									65			2308	23							1429		5	70	42					35	2.4		208	17	12	1.3	0.7	<LOR	<LOR	23			31	157	0.2	1061	99		<LOR	
Max								15	15	15	130	65	65	65.5	33	5050	1770	3410	3410	6951	5.6	13	52	177	90	177	39	70	144	16	377	21	45	4	340	292	0.25	0.25	0.5	1.5	77	2.7	141	3200	2500	16	115	699	11600	2	10
JBS312A	<2100 High Water	2	3	13	1	12	1												0.05	0.05	0.05	0.05	0.07	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.1	0.1					2	0.25	5	2	3	0.05	0.5	2	-	-	-
JBS312A	4 (0.1)	4	3	13	-1	14	1												0.05	0.05	0.05	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05					2	0.25	7	2	6	0.05	3	8	-	-	-
JBS312A	4.55 (0.65)	4.55	3	13	-1.55	14.55	1												0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.1	0.05	0.3	0.05	0.05	0.05	0.2	0.3					2	0.25	7	14	17	0.05	6	12	-	-	-
JBS313	<2100 High Water	1	2.5	4.5	1.5	3	1												0.05	0.05	0.05	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05					7	0.25	3	1	4	0.05	1	4	-	-	-
JBS313	<2100 High Water	3	2.5	4.5	-0.5	5	1												0.4	0.1	0.7	2.7	3.8	2.6	1.6	2.6	2.4	0.2	4.9	0.2	1.8	0.2	2.2	6.9					16	0.25	9	34	140	0.2	7	180	-	-	-
JBS313	<2100 High Water	4	2.5	4.5	-1.5	6	1												0.2	1.5	0.9	3.3	4.1	2.7	1.8	2.6	2.9	0.2	8.4	0.9	2	0.3	4.1	8.6					15	0.25	16	22	140	0.2	9	140	-	-	-
JBS313A	<2100 High Water	8	2.5	4.5	-5.5	10	1												0.2	4.2	0.8	1.1	1.2	0.8	0.5	0.8	1	0.1	3.1	1.9	0.5	4	5	2.8					2	0.25	25	33	8	0.05	10	21	-	-	-
JBS313A	12 (0.3)	12	2.5	4.5	-9.5	14	1												0.05	0.05	0.05	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05					2	0.25	8	0.5	12	0.05	0.5	0.5	-	-	-
JBS314	<2100 High Water	1	2.5	2.9	1.5	1.4	1	15	15	15	25	12.5	12.5	20	13.75	150	130	140	140	320	0.5	0.05	0.6	2.9	3.4	2	1.5	2	2.4	0.2	5.7	0.2	2	0.1	2.1	5.9	0.25	0.25	0.5	1.5	7	0.25	9	18	69	0.1	3	61	-	-	-
JBS314	<2100 High Water	2	2.5	2.9	0.5	2.4	1												0.1	0.05	0.2	1.2	1	1	0.5	1	0.8	0.05	2	0.05	0.6	0.05	1.2	1.9					4	0.25	8	18	61	0.05	5	30	-	-	-
JBS314	<2100 High Water	7	2.5	2.9	-4.5	7.4	1												0.8	13	33	84	77	55	28	55	81	8	190	21	41	2.3	210	140					2	0.25	5	49	57	0.2	3	41	-	-	-
JBS314	11 (0.1)	11	2.5	2.9	-8.5	11.4	1												0.1	0.05	0.3	1.2	1.5	0.9	0.6	0.9	1	0.05	2	0.05	0.9	0.1	0.5	2.1					10	0.25	19	42	220	1.5	6	150	-	-	-
JBS315	<2100 High Water	2	2.3	3.65	0.3	3.35	1												0.05	0.05	0.05	0.05	0.1	0.1	0.05	0.1	0.1	0.05	0.2	0.05	0.05	0.05	0.05	0.2					2	0.25	9	24	180	0.2	3	39	-	-	-
JBS315	<2100 High Water	4	2.3	3.65	-1.7	5.35	1												0.05	0.05	0.05	0.1	0.2	0.2	0.1	0.1	0.2	0.05	0.3	0.05	0.1	0.05	0.2	0.3					2	0.25	8	15	45	0.05	4	42	-	-	-
JBS315	6 (1.3)	6	2.3	3.65	-3.7	7.35	1												0.05	0.05	0.05	0.4	0.4	0.3	0.2	0.3	0.4	0.05	0.7	0.05	0.2	0.05	0.3	0.7					2	0.25	9	41	110	0.3	7	54	-	-	-
JBS315	6.5 (1.8)	6.5	2.3	3.65	-4.2	7.85	1												0.2	11	52	110	90	70	32	70	99	16	220	14	45	0.3	130	180					7	0.25	10	370	300	0.9	6	28	-	-	-
JBS316	<2100 High Water	2	2.5	3.65	0.5	3.15	1												0.05	0.05	0.05	0.05	0.08	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.1					2	0.25	10	4	16	0.05	0.5	7	-	-	-
JBS316	6 (0.1)	6	2.5	3.65	-3.5	7.15	1												0.05	0.05	0.05	0.1	0.1	0.1	0.05	0.1	0.1	0.05	0.2	0.05	0.05	0.05	0.1	0.2					5	0.25	8	15	22	0.1	2	9	-	-	-
JBS316	8 (2.1)	8	2.5	3.65	-5.5	9.15	1												0.05	0.05	0.05	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05					2	0.8	33	6	15	0.05	2	19	-	-	-
JBS317	2 (0.5)	2	2.7	16.3	0.7	15.6	1												0.05	0.05	0.05	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05					2	0.25	18	3	14	0.05	6	20	-	-	-
JBS318	<2100 High Water	2	2.3	2.9	0.3	2.6	1												0.05	0.05	0.1	0.2	0.2	0.2	0.2	0.1	0.2	0.05	0.4	0.05	0.2	0.05	0.4	0.4					10	0.25	26	24	56	0.1	15	87	-	-	-
JBS318	<2100 High Water	3	2.3	2.9	-0.7	3.6	1												0.05	0.05	0.05	0.05	0.07	0.05	0.05	0.05	0.1	0.05	0.2	0.05	0.05	0.05	0.2	0.2					4	0.25	16	19	52	0.05	9	55	-	-	-
JBS318	4.9 (0)	4.9	2.3	2.9	-2.6	5.5	1												0.05	0.05	0.05	0.2	0.2	0.2	0.05	0.1	0.2	0.05	0.4	0.05	0.1	0.05	0.2	0.4					2	0.25	10	14	42	0.05	3	26	-	-	-
JBS319	<2100 High Water	1	2.8	4.1	1.8	2.3	1												0.05	0.05	0.05	0.05	0.08	0.05	0.05	0.05	0.2	0.05	0.1	0.05	0.05	0.05	0.2	0.2					2	0.25	13	35	260	0.8	8	96	-	-	-
JBS319	<2100 High Water	4	2.8	4.1	-1.2	5.3	1												0.05	0.05	0.1	0.6	0.5	0.5	0.2	0.5	0.5	0.05	0.9	0.05	0.3	0.05	0.9						18	0.25	9	220	190	0.4	14	340	-	-	-
JBS320A	<2100 High Water	2	2.9	2.9	0.9	2	1												0.05	0.05	0.1	0.5	0.6	0.5	0.3	0.4	0.5	0.05	0.7	0.05	0.3	0.05	0.4	0.7					12	0.25	10	180	58	0.1	3	31	-	-	0.25
JBS320A	3 (0.9)	3	2.9	2.9	-0.1	3	1												0.05	0.05	0.05	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05					2	0.25	5	8	20	0.05	1	25	-	-	0.25
JBS322	<2100 High Water	1	2.8	3.15	1.8	1.35	1												0.2	0.1	0.9	4	4.2	3.1	1.6	3.1	3.8	0.4	7.2	0.2	2.1	0.05	3.9	6.4					2	0.25	12	63	420	0.3	37	160	-	-	0.25
JBS322	<2100 High Water	2	2.8	3.15	0.8	2.35	1												0.3	0.05	0.4	1.9	1.9	1.4	0.8	1.3	1.6	0.1	3.9	0.2	0.9	0.05	2.6	3.5					2	0.25	9	35	170	0.2	5	97	-	-	0.25
JBS322	<2100 High Water	5	2.8	3.15	-2.2	5.35	1												0.1	0.05	0.4	2	2	1.4	0.9	1.3	1.8	0.1	4.1	0.05	1	0.05	1.6	3.7					2	0.25	12	33	190	0.8	7	120	-	-	0.25
JBS322A	7 (0.2)	7	2.8	3.15	-4.2	7.35	1												0.05	0.05	0.1	0.4	0.4	0.3	0.2	0.3	0.3	0.05	0.7	0.05	0.2	0.05	0.5	0.9					2	0.25	15	18	110	0.2	4	140	-	-	10
JBS323	<2100 High Water	3	2.9	4	-0.1	4.1	1												0.3	0.05	0.4	3.9	3.7	2.5	1.4	2.4	3.3	0.3	6	0.05	1.7	0.1	1.8	6.3					17	0.25	13	160	480	2	34	180	-	-	2.4
JBS323	5 (0.9)	5	2.9	4	-2.1	6.1	1												0.05	0.05	0.05	0.1	0.08	0.05	0.05	0.05	0.1	0.05	0.2	0.05	0.05	0.05	0.05	0.2					2	0.25	49	5	15	0.05	4	19	-	-	0.25
JBS324	<2100 High Water	1	2.6	2.9	1.6	1.3	1												0.05	0.05	0.05	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05					2	0.25	8	3	14	0.05	4	31	-	-	-
JBS324	<2100 High Water	2	2.6	2.9	0.6	2.3	1												0.05	0.05	0.2	0.6	1.1	0.7	0.8	0.7	0.7	0.1	1.5	0.05	0.7	0.05	0.6	1.6					2	0.25	8	16	88	0.1	4	61	-	-	-
JBS324	<2100 High Water	3	2.6	2.9	-0.4	3.3	1												0.2	0.7	1	2.6	4.1	2.7	2.8	2.6	2.7	0.3	6.9	0.7	2.7	1	4.5	6.8					4	0.25	10	38	120	0.2	8	83	-	-	-
JBS324	<2100 High Water	4	2.6	2.9	-1.4	4.3	1												0.1	0.05	0.3	0.8	1	0.7	0.6	0.6	0.8	0.05	1.7	0.05	0.5	0.05	1.1	1.8					2	0.25	8	21	100	0.2	3	63	-	-	-
JBS324	<2100 High Water	7	2.6	2.9	-4.4	7.3	1												0.2	0.2	0.7	1.7	2	1.3	1	1.2	1.7	0.1	4	0.3	1	0.1	2.8	4.1					2	0.25	10	12	74	0.05	3	66	-	-	-
JBS324	<2100 High Water	9	2.6	2.9	-6.4	9.3	1												0.05	0.05	0.1	0.4	0.5	0.3	0.3	0.3	0.4	0.05	0.9	0.05	0.3	0.05	0.6	0.9					2	0.25	11	6	28	0.05	4	32	-	-	-
JBS324	<2100 High Water	10	2.6	2.9	-7.4	10.3	1												0.05	0.05	0.05	0.05	0.07	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1					2	0.25	8	5	34	0.1	3	29	-	-	-
JBS324	11 (0.3)	11	2.6	2.9	-8.4	11.3	1												0.2	0.05	0.2	1	2.3	1.6	1.3	1.6	1.1	0.2	1.7	0.05	1.3	0.05	0.6	1.9					53	2.7	22	99	2500	2.7	7	600	-	-	-
JBS324	13 (2.3)	13	2.6	2.9	-10.4	13.3	1												0.05	0.05	0.05	0.2	0.2	0.2	0.1	0.1	0.2	0.05	0.3	0.05	0.1	0.05	0.1	0.4					2	0.25	9	3	21	0.3	1	15	-	-	-
JBS325	<2100 High Water	2	3	2.95	1	1.95	1												0.05	0.05	0.05	0.4	0.5	0.4	0.3	0.4	0.4	0.05	0.7	0.05	0.3	0.05	0.4	0.8					6	0.25	24	22	490	0.3	6	110	-	-	-
JBS325C	<2100 High Water	3	3	2.95	0	2.95	1												0.3	0.1	0.7	1.3	1.4	1	0.5	0.9	1.1	0.05	2.7	0.4	0.6	0.1	2.2	2.9					2	0.25	14	32	130	0.4	6	87	-	-	-
JBS325C	5 (0.2)	5	3	2.95	-2	4.95	1												0.8	0.2	1.5	2.8	3.3	2.1	1.4	2	2.4	0.2	6.1	0.9	1.7	0.7	4.4	6.2					4	0.25	10	32	130	0.4	7	100	-	-	-
JBS325C	6 (1.2)	6	3	2.95	-3	5.95	1												0.4	0.1	0.9	2.4	2.7	1.8	1.1	1.7	2.1	0.2	4.8	0.4	1.4	0.2	2.6	5.1					5	0.25	12	40	130	0.5	9	110	-	-	-
JBS326	<2100 High Water	3	3	4	0	4	1												0.05	0.05	0.05	0.1	0.2	0.1	0.1	0.1	0.2	0.05	0.2	0.05	0.1	0.05	0.2	0.4					2	0.25	13	37	0.05	4	44	-	-	-
JBS326	<2100 High Water	4	3	4	-1	5	1												0.05	0.05	0.05	0.1	0.1	0.05	0.05	0.05	0.1	0.05	0.2	0.05	0.05	0.05	0.1	0.2					11	0.25	9	25	48	0.05	3	38	-	-	-
JBS326	7.3 (0.3)	7.3	3	4	-4.3	8.3	1												0.05	0.05	0.05	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05					2	1.2	11	11	16	0.05	3	12	-	-	-
JBS327	<2100 High Water	2	2.8	3.15	0.8	2.35	1												0.3	0.8	2.3	5	6.9	4.4	4	4.4	4.8	0.5	15	0.8	4.2	0.3	10	15					9	0.25	23	54	590	0.7	15	140	-	-	-
JBS327	<2100 High Water	5	2.8	3.15	-2.2	5.35	1												0.05	0.05	0.05	0.1	0.1	0.05	0.05	0.05	0.1	0.05	0.2	0.05	0.05	0.05	0.1	0.2					6	0.25	7	18	94	0.3	3	72	-	-	-
JBS327	<2100 High Water	7	2.8	3.15	-4.2	7.35	1												0.05	0.05	0.05	0.1	0.08	0.05	0.05	0.05	0.1	0.05	0.2	0.05	0.05	0.05	0.2	0.2					2	0.25	11	14	49	0.05	5	48	-	-	-
JBS327	<2100 High Water	8	2.8	3.15	-5.2	8.35	1												0.05	0.05	0.05	0.4	0.4	0.3	0.2	0.3	0.4	0.05	0.8	0.05	0.2	0.05	0.3	0.7					2	0.25	3	25	90	0.1	3	58	-	-	-
JBS327	<2100 High Water	9	2.8	3.15	-6.2	9.35	1												0.05	0.05	0.1	0.5	0.7	0.5	0.4	0.4	0.5	0.05	1.4	0.05	0.4	0.05	0.5	1.4					2	0.25	6	5	25	0.05	1	10	-	-	-
JBS327	10.5 (0.1)	10.5	2.8	3.15	-7.7	10.85	1												0.05	0.05	0.05	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05					2	0.25	8	3	9	0.05	1	9	-	-	-
JBS327	<2100 High Water	2	2.8	3.15	0.8	2.35	1												0.3	0.8	2.3	5	6.9	4.4	4	4.4	4.8	0.5	15	0.8	4.2	0.3	10	15					9	0.25	23	54	590	0.7	15	140	-	-	-
JBS327	<2100 High Water	5	2.8	3.15	-2.2	5.35	1												0.05	0.05	0.05	0.1	0.1	0.05	0.05	0.05	0.1	0.05	0.2	0.05	0.05	0.05	0.1	0.2					6	0.25	7	18	94	0.3	3	72	-	-	-
JBS327	<2100 High Water	7	2.8	3.15	-4.2	7.35	1												0.05	0.05	0.05	0.1	0.08	0.05	0.05	0.05	0.1	0.05	0.2	0.05	0.05	0.05	0.2	0.2					2	0.25	11	14	49	0.05	5	48	-	-	-
JBS327	<2100 High Water	8	2.8	3.15	-5.2	8.35	1												0.05	0.05	0.05	0.4	0.4	0.3	0.2	0.3	0.4	0.05	0.8	0.05	0.2	0.05	0.3	0.7					2	0.25	3	25	90	0.1	3	58	-	-	-
JBS327	<2100 High Water	9	2.8	3.15	-6.2	9.35	1												0.05	0.05	0.1	0.5	0.7	0.5	0.4	0.4	0.5	0.05	1.4	0.05	0.4	0.05	0.5	1.4					2	0.25	6	5	25	0.05	1	10	-	-	-
JBS327	10.5 (0.1)	10.5	2.8	3.15	-7.7	10.85	1												0.05	0.05	0.05	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05					2	0.25	8	3	9	0.05	1	9	-	-	-
JBS328	<2100 High Water	1	2.8	3.65	1.8	1.85	1												0.3	0.8	2.3	8	13	8	9.2	8	7.8	1.1	22	0.8	10	0.3	11	22					13	0.25	11	48	2300	0.5	10	120	-	-	-
JBS328	<2100 High Water	2	2.8	3.65	0.8	2.85	1												3.8	0.4	4.4	21	28	17.5	12	17.5	19	2.7	42	1.3	15	1.1	15	41					2	0.25	9	67	180	0.3	11	89	-	-	-
JBS328	<2100 High Water	4	2.8	3.65	-1.2	4.85	1												0.1	0.05	0.1	0.7	0.8	0.6	0.4	0.5	0.7	0.05	1.4	0.05	0.4	0.05	0.4	1.5					2	0.25	8	18	64	0.1	3	54	-	-	-
JBS328	<2100 High Water	6	2.8	3.65	-3.2	6.85	1												0.3	0.05	0.3	1.9	2	1.4	0.9	1.3	1.7	0.05	3.7	0.05	1	0.1	1.2	3.7					2	0.25	9	39	81	1.2	5	57	-	-	-
JBS328	<2100 High Water	8	2.8	3.65	-5.2	8.85	1												0.05	0.05	0.05	0.05	0.08	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.1					2	0.25	10	4	11	0.05	1	13	-	-	-
JBS328	<2100 High Water	9	2.8	3.65	-6.2	9.85	1												0.1	0.05	0.2	0.9	0.9	0.7	0.4	0.6	0.8	0.05	1.7	0.05	0.5	0.05	0.6	1.7					2	0.25	11	23	57	0.2	5	42	-	-	-
JBS328	10 (0.1)	10	2.8	3.65	-7.2	10.85	1												0.05	0.05	0.05	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.1					2	0.25	6	1	7	0.05	2	10	-	-	-
JBS329	<2100 High Water	1	2.8	3.65	1.8	1.85	1												0.2	0.05	0.2	0.9	1	0.7	0.5	0.7	0.9	0.05	1.9	0.05	0.5	0.05	0.8	2					5	0.25	15	13	74	0.3	4	70	-	-	-
JBS329	<2100 High Water	2	2.8	3.65	0.8	2.85	1												0.1	0.05	0.1	0.6	0.6	0.5	0.3	0.4	0.6	0.05	1.1	0.05	0.3	0.05	0.7	1.1					11	0.25	12	58	210	0.2	6	170	-	-	-
JBS329A	9 (0.1)	9	2.8	3.56	-6.2	9.76	1												0.05	0.05	0.05	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05					4	0.25	12	21	31	0.1	2	24	-	-	-
JBS330	<2100 High Water	2	2.8	11	0.8	10.2	1												0.2	0.05	0.3	1.3	1.6	1.1	1.1	1.1	1.2	0.1	2.3	0.05	1.2	0.05	1.1	2.5					2	0.25	12	31	86	0.2	4	100	-	-	-
JBS330A	<2100 High Water	4	2.8	11	-1.2	12.2	1												0.05	0.05	0.05	0.1	0.2	0.1	0.05	0.1	0.1	0.05	0.3	0.05	0.1	0.05	0.1	0.3					2	0.25	7	25	72	0.1	8	84	-	-	-
JBS330A	<2100 High Water	6	2.8	11	-3.2	14.2	1												0.05	0.05	0.05	0.2	0.2	0.2	0.05	0.1	0.2	0.05	0.4	0.05	0.1	0.05	0.2	0.3					2	0.25	8	12	53	0.2	5	47	-	-	-
JBS330A	8 (0.2)	8	2.8	11	-5.2	16.2	1												0.3	0.3	1.2	3.7	4.2	2.9	1.4	2.9	3.3	0.3	6.7	0.6	1.8	0.3	4	7.3					10	0.25	13	260

DATA SET 2

Sample id	Location	Sampling Depth (m)	Current Ground level m AHD	Finished Park ground level m AHD	Sample depth mAHD	Depth below finished surface	Where soils are >1.9 m AHD		Where soils located at thzn	TPH													Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	BTEX				Heavy Metals										
										C6-C9	C6-C9 aliphatic	C6-C8 aliphatic	C10-C14	C10-C14 aliphatic	C10-C14 aromatic	C8-C16 aliphatic	C8-C16 aromatic	C15-C28	C29-C36	>16 aliphatic	>16 aromatic	ΣC10-C36												

DATA SET 3

Sample id	Location	Sampling Depth (m)	Current Ground level m AHD	Finished Park ground level m AHD		Sample depth mAHD	TPH												PAH																			BTEX				Heavy Metals								Sulphate	Cyanide (total)	Ammonia
							C6-C9	C6-C9 aliphatic	C6-C8 aliphatic	C10-C14	C10-C14 aliphatic	C10-C14 aromatic	C8-C16 aliphatic	C8-C16 aromatic	C15-C28	C29-C36	>16 aliphatic	>16 aromatic	ΣC10-C36	Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benze(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3,cd)pyrene	Naphthalene	Phenanthrene	Pyrene	Benzene	Toluene	Ethylbenzene	Xylene	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn			
PQL							2			50					100	100				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	1	0.2	0.2	0.2										2000		
Criteria							65		5100				4600	2400			130000	1900	1000		10		31	3.1	31		31	310	3.1	670	30	31	880		14	1	1.4	3.1	14	27	7.7	415	152	89	2.9	67	430		0.5	5100
Max							**15**	**15**	**15**	**25**	**12.5**	**12.5**	**20**	**20**	**300**	**160**	**230**	**230**	**486**	**0.3**	**0.5**	**1.9**	**4.3**	**6.1**	**4.1**	**4**	**4**	**4.2**	**0.6**	**11**	**0.9**	**4.1**	**0.4**	**5.5**	**11**	**0.25**	**0.25**	**0.5**	**1.5**	**36**	**0.5**	**114**	**1480**	**304**	**8**	**128**	**309**	**11600**	**2**	**0.25**
BH007	Excavated	0.5	2.844	3.15	0.306	2.344	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.6	0.6	0.7	0.25	0.25	0.25	1.2	0.25	0.25	0.25	0.6	1.1					2.5	0.5	17	36	116	0.2	18	94	-	-	-
BH013	Unsaturated	0.4	2.921	3	0.079	2.521																																		2.5	0.5	8	41	72	0.05	30	62	-	-	-
BH033	Unsaturated	0.4	2.547	2	-0.547	2.147	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																	0.1	0.1	0.1	0.2	2.5	0.5	41	50	34	0.05	69	45	-	-	-
BH034	Unsaturated	0.4	2.549	3	0.451	2.149	1	1	1	25	12.5	12.5	13	13	250	150	200	200	426																	0.1	0.1	0.1	0.2	2.5	0.5	7	36	93	0.2	25	76	-	-	-
BH036	Unsaturated	0.4	2.573	2	-0.573	2.173																																		2.5	0.5	8	66	5	0.05	128	38	-	-	-
BH083	Unsaturated	0.4	2.835	3	0.165	2.435	1	1	1	25	12.5	12.5	13	13	110	50	80	80	186	0.25	0.25	0.25	0.25	0.6	0.7	0.25	0.25	0.25	0.25	1.2	0.25	0.25	0.25	0.7	1.2	0.1	0.1	0.1	0.2	2.5	0.5	27	83	57	0.4	52	92	710	0.5	-
BH105	Excavated	0.4	2.496	2.7	0.204	2.096	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	1.9	3.3	3.3	2.3	1.9	2.4	2.8	0.6	7.2	0.6	1.6	0.25	5.2	7.2	0.1	0.1	0.1	0.2	2.5	0.5	21	62	129	0.4	38	92	-	-	-
BH123	Excavated	0.4	2.539	2	-0.539	2.139	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.25	0.6	0.1	0.1	0.1	0.2	2.5	0.5	16	16	38	0.05	16	48	520	0.5	-
BH164	Excavated	0.1	2.795	2	-0.795	2.695	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.25	0.25	0.5	2.5	0.5	114	35	2.5	0.05	122	59	580	0.5	-
BH166	<2010 High Water	1.3	2.833	2	-0.833	1.533	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.5	0.7	2.5	1.7	3.1	2	1.2	1.9	0.25	6.1	0.25	1.4	0.25	2.5	6.4	0.1	0.25	0.25	0.5	6	0.5	19	47	216	0.3	6	144	490	0.5	-
BH169	<2010 High Water	0.5	3.035	3.5	0.465	2.535	1	1	1	25	12.5	12.5	13	13	130	50	90	90	206	0.25	0.25	0.9	2.4	2.5	2.6	1.2	1	2	0.25	6.1	0.25	1	0.25	2.7	6.2	0.1	0.25	0.25	0.5	6	0.5	12	58	177	1	12	155	640	0.5	-
BH170	<2010 High Water	1.3	2.951	3.15	0.199	1.651	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.25	0.6	0.1	0.25	0.25	0.5	6	0.5	12	53	304	0.6	6	309	490	**2**	-
BH177	<2010 High Water	1.5	2.507	2	-0.507	1.007	1	1	1	25	12.5	12.5	13	13	300	160	230	230	486	0.25	0.25	0.25	0.8	0.5	0.9	0.6	0.25	0.9	0.25	1.5	0.25	0.25	0.25	0.25	1.6	0.1	0.25	0.25	0.5	36	0.5	47	1480	131	8	12	221	11600	0.5	-
BH182	Excavated	0.4	2.508	1.5	-1.008	2.108	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.9	0.25	0.25	0.25	0.25	0.9	0.1	0.25	0.25	0.5	2.5	0.5	18	21	38	0.05	27	54	450	0.5	-
JBS304	Unsaturated	0.2	2.7	3.15	0.45	2.5														0.1	0.05	0.1	0.7	1.1	0.8	0.7	0.8	0.8	0.1	1.2	0.05	0.7	0.05	0.4	1.3					2	0.25	7	35	60	0.2	15	40	-	-	-
JBS305	Unsaturated	0.2	2.2	2.65	0.45	2														0.1	0.05	0.1	0.8	1.6	1.3	1.2	1.2	1	0.1	1.1	0.05	1.3	0.05	0.2	1.2					2	0.25	12	52	100	0.2	68	92	-	-	-
JBS306	Unsaturated	0.5	2.4	2.6	0.2	1.9														0.05	0.05	0.2	0.7	1	0.7	0.5	0.7	0.8	0.05	1.3	0.05	0.7	0.05	0.9	1.4					2	0.25	14	94	270	0.4	37	120	-	-	-
JBS311	Unsaturated	0.2	2.4	2.8	0.4	2.2	15	15	15	25	12.5	12.5	20	20	50	50	50	50	140	0.05	0.05	0.05	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.25	0.25	0.5	1.5	2	0.25	7	52	3	0.05	91	35	-	-	-
JBS318	Unsaturated	0.2	2.3	2.9	0.6	2.1	15	15	15	25	12.5	12.5	20	20	50	50	50	50	140	0.05	0.1	0.2	0.5	0.6	0.5	0.4	0.4	0.5	0.05	1.3	0.1	0.4	0.2	1.1	1.3	0.25	0.25	0.5	1.5	2	0.25	15	54	72	0.3	50	100	-	-	-
JBS320A	Unsaturated	0.5	2.9	2.9	0	2.4														0.1	0.1	0.4	1.1	1.5	1	0.9	0.9	1.1	0.05	2.5	0.1	0.9	0.1	1.7	2.5					2	0.25	50	40	73	0.5	57	87	-	-	0.25
JBS321	2 (0.4)	2	5.3	3.65	-1.65	3.3														0.05	0.05	0.05	0.05	2.3	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.1	0.05					2	0.25	12	21	12	0.05	3	15	-	-	-
JBS322	Unsaturated	0.3	2.8	3.15	0.35	2.5	15	15	15	25	12.5	12.5	20	20	50	50	50	50	140	0.05	0.05	0.05	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.2	0.1	0.05	0.25	0.25	0.5	1.5	2	0.25	100	31	6	0.05	94	53	-	-	-
JBS324	Unsaturated	0.5	2.6	2.9	0.3	2.1														0.1	0.05	0.1	0.7	1.1	0.8	0.7	0.8	0.8	0.05	1.5	0.05	0.7	0.05	0.5	1.6					2	0.25	11	62	100	0.7	21	86	-	-	-
JBS325	Unsaturated	0.5	3	2.95	-0.05	2.5														0.05	0.05	0.05	0.3	0.5	0.4	0.3	0.4	0.6	0.05	0.7	0.05	0.2	0.4	0.8	0.7					2	0.25	78	44	31	0.05	82	67	-	-	-
JBS327	Unsaturated	0.3	2.8	3.15	0.35	2.5	15	15	15	25	12.5	12.5	20	20	100	50	75	75	190	0.2	0.4	1.2	4.3	6.1	4.1	4	4	4.2	0.5	11	0.2	4.1	0.2	5.5	11	0.25	0.25	0.5	1.5	5	0.25	28	42	140	0.9	24	120	-	-	-
JBS4	Unsaturated	0.5	3	3.15	0.15	2.5														0.3	0.3	1	3.7	5.6	3.5	2.9	3.4	3.7	0.4	10	0.2	2.7	0.1	4.7	9.9					2	0.25	15	37	110	0.3	15	100	-	-	-
Average							4.5	4.5	4.5	25.0	12.5	12.5	14.8	14.8	90.0	63.1	76.6	76.6	239.3	0.2	0.2	0.4	1.1	1.4	1.1	0.9	0.9	1.0	0.2	2.5	0.2	0.8	0.2	1.3	2.6	0.1	0.2	0.3	0.7	4.1	0.4	27.5	101.8	91.9	0.7	43.0	92.5	1935.0	0.7	0.3
95% UCL for health based criteria									11				16	16			148	148					1.4	1.7	1.4		0.9	1.2	0.3	3.2		0.84	0.3		3.3	0.17			1.3	1	0.4	45		133	67					

All data compared to Zone 6 criteria

Sample id	Location	Sampling Depth (m)	Current Ground level m AHD	Finished Park ground level m AHD	TPH											PAH																						BTEX				Heavy Metals								Sulphate	Cyanide (total)	Ammonia
					C6-C9	C6-C9 aliphatic	C6-C8 aliphatic	C10-C14	C10-C14 aliphatic	C10-C14 aromatic	C8-C16 aliphatic	C8-C16 aromatic	C15-C28	C29-C36	>16 aliphatic	>16 aromatic	ΣC10-C36	Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	Benzene	Toluene	Ethylbenzene	Xylene	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn			
PQL					2			50					100	100				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	0.2	0.2	0.2												2000		
Criteria							3500				2700	4900																					2.3	690	80	180											3400		
Max					**15**	**15**	**15**	**130**	**65**	**65**	**65.5**	**65.5**	**5050**	**1770**	**3410**	**3410**	**6951**	**5.6**	**13**	**52**	**177**	**90**	**177**	**39**	**70**	**144**	**16**	**377**	**21**	**45**	**4**	**340**	**292**	**0.25**	**0.25**	**0.5**	**1.5**	**450**	**2.7**	**141**	**3200**	**2500**	**16**	**130**	**1100**	**11600**	**2**	**10**
BH002	Above GW	0.5	2.657	11	1	1	1	25	12.5	12.5	13	13	440	630	535	535	1096	0.25	0.25	0.25	0.25	0.6	0.8	0.25	0.5	0.6	0.25	1.5	0.25	0.25	0.25	0.9	1.5	0.1	0.1	0.1	0.2	2.5	0.5	67	58	40	0.2	77	66	-	-	-
BH003	<2010 High Water	1.05	2.432	6.5	1	1	1	25	12.5	12.5	13	13	300	50	175	175	376	0.25	0.8	1.7	2.6	2.5	2.6	1	1.2	2.5	0.25	9.8	0.9	0.9	0.7	7.8	8.7	0.1	0.1	0.1	0.2	2.5	0.5	20	123	183	0.2	61	114	-	-	-
BH003	<2010 High Water	1.7	2.432	6.5	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																	0.1	0.1	0.1	0.2	2.5	0.5	18	42	266	0.3	2	92	-	-	-
BH003	<2010 High Water	3.2	2.432	6.5	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																	0.1	0.1	0.1	0.2	2.5	0.5	18	62	124	0.05	2	39	-	-	-
BH004	Above GW	1.7	2.88	9	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.1	0.1	0.2	2.5	0.5	7	5	16	0.05	1	5	-	-	-
BH005	Excavated	0.55	2.97	20	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.1	0.1	0.2	2.5	0.5	10	40	39	0.05	62	63	-	-	-
BH006	<2010 High Water	1	3.01	4.8	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	1.2	0.25	0.25	0.25	2.7	1.1					2.5	0.5	18	180	195	2.6	5	155	-	-	-
BH006	<2010 High Water	1.7	3.01	4.8	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	1.1	1	1.3	0.7	0.25	1.1	0.25	2.3	0.25	0.25	0.25	1.4	2.1					2.5	0.5	12	59	207	0.5	10	210	-	-	-
BH007	Excavated	0.5	2.844	2	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.6	0.6	0.7	0.25	0.25	0.25	0.25	1.2	0.25	0.25	0.25	0.6	1.1					2.5	0.5	17	36	116	0.2	18	94	-	-	-
BH007	Excavated	1	2.844	2	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.9	0.8	1	0.6	0.25	0.7	0.25	1.7	0.25	0.25	0.25	0.8	1.6					2.5	0.5	20	33	273	0.4	15	130	-	-	-
BH008	<2010 High Water	0.75	2.619	3	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.7	1.6	2.6	3.1	3.4	2.3	1.1	2.5	0.25	8.5	0.7	1.8	0.25	6.5	7.9					2.5	0.5	22	30	111	0.2	20	152	-	-	-
BH008	<2010 High Water	1.6	2.619	3	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.25	1	0.25	0.25	0.25	0.6	1					2.5	0.5	12	12	34	0.05	9	81	-	-	-
BH009	Unsaturated	0.4	2.584	5.5	1	1	1	25	12.5	12.5	13	13	50	130	90	90	206	0.25	1.4	4.6	9.2	11.2	11.5	8.2	4	8.2	1.2	32.6	1.5	6.1	0.6	19.8	30.3					2.5	0.5	12	46	280	0.05	20	97	-	-	-
BH009	<2010 High Water	1.7	2.584	5.5	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.5	0.25					2.5	0.5	14	53	301	0.05	12	49	-	-	-
BH011	Unsaturated	0.4	2.651	7	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.5	0.6	0.25	0.25	0.25	0.5	0.25	1.3	0.25	0.25	0.25	0.6	1.3					6	0.5	17	50	78	0.1	49	141	-	-	-
BH011	<2010 High Water	1.7	2.651	7	1	1	1	25	12.5	12.5	13	13	370	260	315	315	656	1.5	0.25	2.6	12.4	10.2	10.5	4.7	4.1	10.1	1.1	26.5	1	3.9	0.6	9.1	26.7					7	0.5	10	74	290	0.7	18	154	1	-	-
BH011	<2010 High Water	2.9	2.651	7	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	1	0.8	0.9	0.25	0.25	0.8	0.25	2	0.25	0.25	0.25	0.7	2					2.5	0.5	19	20	83	0.1	4	58	-	-	-
BH012	Unsaturated	0.4	2.937	20																																	2.5	0.5	12	63	41	0.05	130	63	-	-	-
BH012	<2010 High Water	1.7	2.937	20																																	2.5	0.5	2	23	70	0.4	1	126	-	-	-
BH013	Unsaturated	0.4	2.921	3																																	2.5	0.5	8	41	72	0.05	30	62	-	-	-
BH013	<2010 High Water	1.7	2.921	3	1	1	1	60	30	30	30.5	30.5	490	270	380	380	821																	0.1	0.1	0.1	0.2	2.5	0.5	6	80	181	0.4	17	348	-	-	-
BH013	<2010 High Water	3.2	2.921	3	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																	0.1	0.1	0.1	0.2	2.5	0.5	44	82	125	0.05	10	102	-	-	-
BH015	Excavated	0.6	2.825	16	1	1	1	60	30	30	30.5	30.5	370	50	210	210	481	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.5	0.25					2.5	0.5	7	15	37	0.05	18	42	-	-	-
BH029	9.25 (4.25)	9.25	2.553	6.5	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25					2.5	0.5	13	8	18	0.05	3	8	-	-	-
BH033	Unsaturated	0.4	2.547	2	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																	0.1	0.1	0.1	0.2	2.5	0.5	41	50	34	0.05	69	45	-	-	-
BH033	<2010 High Water	1.7	2.547	2																																	6	0.5	141	31	72	0.1	19	308	-	-	-
BH033	<2010 High Water	3.2	2.547	2																																	2.5	0.5	6	61	77	0.1	4	85	-	-	-
BH034	Unsaturated	0.4	2.549	3	1	1	1	25	12.5	12.5	13	13	250	150	200	200	426																	0.1	0.1	0.1	0.2	2.5	0.5	7	36	93	0.2	25	76	-	-	-
BH034	<2010 High Water	1.7	2.549	3																																	2.5	0.5	5	5	5	0.05	1	2.5	-	-	-
BH034	2.7 (0.2)	2.7	2.549	3	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																	0.1	0.1	0.1	0.2	2.5	0.5	6	186	39	0.05	1	12	-	-	-
BH036	Unsaturated	0.4	2.573	2																																	2.5	0.5	8	66	5	0.05	128	38	-	-	-
BH036	<2010 High Water	1.7	2.573	2	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																	0.1	0.1	0.1	0.2	2.5	0.5	7	28	64	0.1	1	43	-	-	-
BH036	<2010 High Water	3.2	2.573	2	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																	0.1	0.1	0.1	0.2	2.5	0.5	10	24	182	0.2	3	28	-	-	-
BH037	Unsaturated	0.4	2.35	6	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																	0.1	0.1	0.1	0.2	2.5	0.5	7	42	84	0.2	59	87	-	-	-
BH037	Unsaturated	0.7	2.35	6	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																	0.1	0.1	0.1	0.2	2.5	0.5	7	5	11	0.05	1	2.5	-	-	-
BH037	<2010 High Water	2.85	2.35	6																																	2.5	0.5	14	5	11	0.05	1	2.5	-	-	-
BH038	Excavated	0.4	2.173	20																														0.1	0.1	0.1	0.2													
BH038	Excavated	0.4	2.173	20	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																					2.5	0.5	5	60	9	0.05	115	42	-	-	-
BH039	Unsaturated	0.4	2.225	3	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																	0.1	0.1	0.1	0.2	2.5	0.5	7	26	27	0.1	39	31	-	-	-
BH039	<2010 High Water	2.25	2.225	3																																	2.5	0.5	12	18	22	0.1	19	32	-	-	-
BH041	Excavated	0.4	2.394	20																														0.1	0.1	0.1	0.2													
BH041	Excavated	0.4	2.394	20	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																					2.5	0.5	6	55	20	0.05	90	43	-	-	-
BH043	Unsaturated	0.4	2.684	17.2	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																	0.1	0.1	0.1	0.2	2.5	0.5	9	32	21	0.05	56	41	-	-	-
BH082	Above GW	0.4	2.86	12.5	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																	0.1	0.1	0.1	0.2	2.5	0.5	30	19	41	0.05	30	59	-	-	-
BH083	Unsaturated	0.4	2.835	3	1	1	1	25	12.5	12.5	13	13	110	50	80	80	186	0.25	0.25	0.25	0.25	0.6	0.7	0.25	0.25	0.25	0.25	1.2	0.25	0.25	0.25	0.7	1.2	0.1	0.1	0.1	0.2	2.5	0.5	27	83	57	0.4	52	92	710	0.5	-
BH083	<2010 High Water	3.2	2.835	3	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.1	0.1	0.2	2.5	0.5	12	16	45	0.1	8	62	420	0.5	-
BH083	7.2 (1.0)	7.2	2.835	3	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.1	0.1	0.2	2.5	0.5	17	5	306	0.05	1	7	570	0.5	-
BH085	Unsaturated	0.4	2.697	7	1	1	1	25	12.5	12.5	13	13	700	470	585	585	1196	1.4	2.4	6.6	16.4	25.7	27.6	25.1	10.3	13.8	3	43.8	2.2	16.6	1.1	17	47.5	0.1	0.1	0.1	0.2	2.5	0.5	9	18	37	0.05	11	41	260	0.5	-
BH085	<2010 High Water	1.7	2.697	7	1	1	1	130	65	65	65.5	65.5	5050	1770	3410	3410	6951	4	12.4	46.9	177	82.4	177	39	46.1	144	13.9	377	18.2	41.1	1.9	340	292	0.1	0.1	0.1	0.2	2.5	0.5	9	293	157	0.2	6	22	500	0.5	-
BH086	<2010 High Water	1.7	2.701	6.5	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.8	0.8	0.9	1	0.7	0.25	0.6	0.25	3.5	0.25	0.25	0.25	3.6	3.2	0.1	0.1	0.1	0.2	2.5	0.5	13	6	21	0.1	1	8	210	0.5	-
BH086	<2010 High Water	3.2	2.701	6.5	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.1	0.1	0.2	2.5	0.5	8	5	5	0.05	1	2.5	320	0.5	-
BH088	Excavated	0.4	2.246	3.65	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																	0.1	0.1	0.1	0.2	2.5	0.5	11	18	15	0.05	41	34	-	-	-
BH088	Excavated	1.7	2.246	3.65																																	2.5	0.5	8	14	48	0.05	7	52	-	-	-
BH088	<2010 High Water	3.2	2.246	3.65																																	2.5	0.5	8	5	12	0.05	1	18	-	-	-
BH105	Excavated	0.4	2.496	2.7	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	1.9	3.3	3.3	2.3	1.9	2.4	2.8	0.6	7.2	0.6	1.6	0.25	5.2	7.2	0.1	0.1	0.1	0.2	2.5	0.5	21	62	129	0.4	38	92	-	-	-
BH105	<2010 High Water	1.7	2.496	2.7														0.25	0.25	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.25	0.25					2.5	0.5	11	6	21	0.05	1	20	-	-	-
BH120	Unsaturated	0.4	3.017	4	7	7	7	25	12.5	12.5	16	16	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.6	0.5	0.25	0.25	0.25	1.2	0.25	0.25	0.25	0.8	1.1	0.1	0.2	0.1	0.2	2.5	0.5	66	32	42	0.1	70	84	-	-	-
BH120	<2010 High Water	1.7	3.017	4														0.25	0.25	0.25	0.25	0.9	1.9	0.25	0.25	0.25	0.25	0.9	1.9									12	0.5	37	34	168	0.2	21	106	-	-	-
BH123	Excavated	0.4	2.539	2	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.25	0.6	0.1	0.1	0.1	0.2	2.5	0.5	16	16	38	0.05	16	48	520	0.5	-
BH123	<2010 High Water	3.2	2.539	2	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.25	0.8	0.25	0.25	0.25	0.25	0.7	0.1	0.1	0.1	0.2	2.5	0.5	9	9	165	0.05	1	38	850	0.5	-
BH123	7.7 (5.5)	7.7	2.539	2	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-																	0.1	0.1	0.1	0.2	2.5	0.5	56	5	7	0.05	4	21			
BH124	<2010 High Water	1.7	2.732	10	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.25	0.6	0.25	0.25	0.25	0.6	0.1	0.1	0.1	0.1	0.2	2.5	0.5	11	36	210	0.4	6	38	510	0.5	-
BH125	Unsaturated	0.4	2.922	13	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	1.4	2.8	3.5	4.1	2.7	1.5	2.7	0.25	8.5	0.6	2.2	0.6	5.5	8.2	0.1	0.1	0.1	0.2	2.5	0.5	10	68	210	1.3	32	140	-	-	-
BH125	<2010 High Water	1.7	2.922	13	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.1	0.1	0.2	2.5	1	10	7	24	0.05	1	12	-	-	-
BH126	Unsaturated	0.4	3.067	4.5	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.6	2	2.4	2.9	2	1	2	0.25	5.3	0.25	1.3	0.25	2.2	5.1	0.1	0.1	0.1	0.2	2.5	0.5	22	35	108	0.4	20	145	-	-	-
BH126	<2010 High Water	1.7	3.067	4.5																																	77	0.5	22	79	538	1.7	31	328	-	-	-
BH126	<2010 High Water	5.1	3.067	4.5	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.7	1.6	1.8	2.3	0.8	1	1.6	0.25	3.8	0.25	0.7	0.25	1.9	3.4	0.1	0.1	0.1	0.2	2.5	0.5	9	40	101	0.2	8	63	-	-	-
BH127	Unsaturated	0.4	2.573	4	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.6	1.8	2.5	2.9	2.2	1.1	1.8	0.25	4.9	0.25	1.4	0.25	1.8	5	0.1	0.1	0.1	0.2	2.5	0.5	10	42	71	0.4	30	70	-	-	-
BH127	<2010 High Water	3.2	2.573	4	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.1	0.1	0.1	0.2	2.5	0.5	4	12	19	0.05	1	6	-	-	-
BH130	Unsaturated	0.4	2.784	16	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.6	0.7	0.25	0.25	0.5	0.25	1.2	0.25	0.25	0.25	0.6	1.3	0.1	0.1	0.1	0.2	2.5	0.5	8	16	46	0.05	11	51	-	-	-
BH131	Excavated	0.4	2.79	18																														0.1	0.1	0.1	0.2													
BH131	Excavated	0.4	2.79	18	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.6	1.5	1.7	2	1.3	0.5	1.3	0.25	3.3	0.25	1	0.25	1.9	3.1					2.5	0.5	8	20	110	0.05	15	103	-	-	-
BH138	Above GW	0.4	2.907	7	1	1	1	25	12.5	12.5	13	13	340	230	285	285	596	0.25	0.25	1.8	5.6	5.2	6.1	2.8	2.4	5	0.6	12.3	0.25	2.2	0.25	4.6	11.1	0.1	0.1	0.1	0.2	2.5	0.5	32	36	54	0.4	33	67	-	-	-
BH149	Above GW	0.4	2.87	19	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.6	0.1	0.1	0.1	0.2	2.5	0.5	8	33	27	0.05	48	27	-	-	-
BH150	Excavated	1.7	2.604	3.15	1	1	1	25	12.5	12.5	13	13	50	50	50	50	-	0.25	0.25	0.25	1.3	1.4	1.7	0.9	0.7	1.1	0.25	2.7	0.25	0.8	0.25	0.9	2.8	0.1	0.1	0.1	0.2	2.5	0.5	15	34	130	0.2	8	126	-	-	-
BH150	<2010 High Water	3.2	2.604	3.15																																	2.5	0.5	13	30	117	0.3	6	126	-	-	-
BH150	<2010 High Water	9.7	2.604	3.15																																	18	2	41	83	208	1.2	15	369	-	-	-
BH157	Unsaturated	0.3	2.907	7	3	3	3	25	12.5	12.5	14	14	400	480	440	440	908	0.25	0.25	0.25	0.25	0.25	0.25

All data compared to Zone 6 criteria

| Sample id | Location | Sampling Depth (m) | Current Ground level m AHD | Finished Park ground level m AHD | TPH | | |

All data compared to Zone 6 criteria

Sample id	Location	Sampling Depth (m)	Current Ground level m AHD	Finished Park ground level m AHD	TPH													PAH																	VOC				Heavy Metals								Sulphate	Cyanide (total)	Ammonia
					C6-C9	C6-C9 aliphatic	C6-C8 aliphatic	C10-C14	C10-C14 aliphatic	C10-C14 aromatic	C8-C16 aliphatic	C8-C16 aromatic	C15-C28	C29-C36	>16 aliphatic	>16 aromatic	ΣC10-C36	Acenaphthylene	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	Benzene	Toluene	Ethylbenzene	Xylene	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn			
PQL					2			50					100	100				1	1	1	1	0.5	2	1		1	1	1	1	1	1	1	0.2	0.2	0.2										2000		
Criteria							3500				2700	4900																					2.3	690	80	180										3400	
Max					**15**	**15**	**15**	**130**	**65**	**65**	**65.5**	**65.5**	**5050**	**1770**	**3410**	**3410**	**6951**	**5.6**	**13**	**52**	**177**	**90**	**177**	**39**	**70**	**144**	**16**	**377**	**21**	**45**	**4**	**340**	**292**	**0.25**	**0.25**	**0.5**	**1.5**	**450**	**2.7**	**141**	**3200**	**2500**	**16**	**130**	**1100**	**11600**	**2**	**10**
JBS4	10.5 (6.5)	10.5	3	3.15																																	2	0.25	15	14	75	0.2	3	39	-	-	-
Average					3	3	3	27	13	13	15	15	168	129	149	149	790	0.3	0.4	1.2	3.4	3.1	3.0	1.6	2.0	3.0	0.4	7.5	0.6	1.7	0.3	5.3	6.6	0.1	0.2	0.2	0.4	6	0	16	62	120	0	16	84	1082	1	1

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Document Status

Rev No.	Author(s)	Reviewer	Approved for Issue		
		Name	Name	Signature	Date
A	Matthew Parkinson Andrew Lau	Charlie Furr Andrew Lau	Draft for Site Auditor Review	-	2/08/2010
B	Matthew Parkinson Andrew Lau	Andrew Lau	Draft for Client Review	-	16/08/2010
C	Matthew Parkinson	Andrew Lau	Draft for Client Review		7/10/2010
D	Matthew Parkinson	Andrew Lau	Draft for Client Review		7/10/2010
E	Matthew Bennett	Andrew Lau	Draft for Client Review		21/01/2011
F	Matthew Bennett Sumi Dorairaj	Sumi Dorairaj	Draft for Client Review		09/02/2011

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