Douglas Partners
Geotechnics • Environment • Groundwater

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REPORT
on
PRELIMINARY CONTAMINATION ASSESSMENT

VEHICLE AND PEDESTRIAN SAFTEY (VAPS) PROJECT
SYDNEY OPERA HOUSE BENNELONG POINT

Prepared for
SYDNEY OPERA HOUSE TRUST

Project 71529.01
June 2010

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EXECUTIVE SUMMARY

This report presents the results of a preliminary contamination assessment conducted by Douglas Partners Pty Ltd (DP) at the Sydney Opera House forecourt in support of the Vehicle and Pedestrian Safety (VAPS) project. The work was requested by Marie Khoury of Savills Australia Pty Ltd on behalf of the Sydney Opera House Trust (SOHT).

The site is located with the area currently occupied by the Sydney Opera House and Opera House Forecourt. It is understood that the construction of a new underground loading dock with associated new lifts, a truck turning-bay and an entry/access tunnel to facilitate a central loading dock below the Opera House is proposed. Other aspects of the VAPS project include the diversion of existing high voltage (HV) cables and the historic stormwater channel from beneath the main House building, to an outlet at the Man-O-War steps. For the purpose of this report "the site" is defined as the area in which the subsurface is likely to be disturbed by the VAPS project.

The preliminary contamination assessment was undertaken in conjunction with a preliminary acid sulphate soils assessment (DP Project 71529.01) and subsequent to a geotechnical investigation for the project (DP Project 72529).

The preliminary contamination assessment consisted of a review of the previous reports that relate to the site, a review of site history the drilling of six test bores and the sampling and analysis of representative soil and groundwater samples.

Based on the site history review it appears that the site has been occupied since European settlement. This site was the location of Fort Macquarie until 1901 and was later redeveloped for a tram shed and wharves/jetties between 1901 and 1950. The site was redeveloped for the Sydney Opera House in the 1960s and 1970s. During the course of the European occupation of the site it has been subject to several episodes of filling and reclamation associated with the various uses of the site.

Generally speaking it is considered that the land use would have a low overall contamination potential, although there is a potential for contamination from filling imported to the site from unknown and various sources.

The conditions encountered at the site typically consisted of pavements to depths between 0.2 m to 0.4 underlain by filling to depths ranging between 0.8 m below ground level to 4.95 m below ground level consisting of sand with inclusions of sandstone gravel overlying ballast ("blue metal" gravels and cobbles). The filling was underlain by sandstone. It is noted, however, that the filling was able to be penetrated at all locations.

For the most part the concentrations of the analytes in the soil samples were found to be less than the adopted site assessment criteria (SAC) with the exception of some elevated PAH and TPH.

Based on the results of this preliminary assessment it is considered that the site is suitable (from a contamination standpoint) for the proposed development and that the levels and nature of contamination detected are not likely to pose a significant risk to site users or workers during the construction period of the VAPS works. Furthermore, the final construction outcome will eliminate exposure pathways between general users of the site and the underlying soils with all floors, walls and ceilings being lined.

The filling at the site is provisionally classified as General Solid Waste (non-putrescible), however it is recommended that the waste classification be confirmed via *ex situ* assessment of the excavated spoil prior to final classification and disposal. The underlying natural sandstone is classified as VENM, provided it has not been impacted by odours or staining, however care should be taken in segregating natural and filling materials to avoid cross-contamination and the excavated VENM inspected prior to removal (and additional analysis conducted as/if necessary).

Based on the one test conducted, it is considered that groundwater beneath the site is not likely to present a significant health risk to workers involved in the VAPS project. However, should dewatering be required as part of the VAPS project, it may be necessary to undertake further groundwater assessment, possibly on a regular basis during the works, prior to disposal.

Due to the inherent variability of the filling beneath the site, and the fact that a number of the investigation bores refused within filling material (i.e. deeper filling could not be assessed at some locations) it is recommended that filling excavation works be monitored by an experienced environmental consultant. Furthermore, it is recommended that a Construction Environmental Management Plan be prepared and implemented to control segregation of materials, final waste classification, and management "unexpected finds".

GLOSSARY

AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
AS	Australian Standard
BGL	Below ground level
BTEX	Benzene, Toluene, Ethyl Benzene and Xylenes
C10-C36	long to medium chain hydrocarbons
C6-C9	short chain hydrocarbons
COC	chain of custody
DECCW	Department of Environment, Climate Change and Water
D.P.	Deposited Plan
DP	Douglas Partners
DQI	data quality indicator
DQO	data quality objective
EPA	Environmental Protection Authority
GIL	groundwater investigation level
HIL	human health based investigation level
HV	High voltage
NATA	National Association of Testing Authorities
NEPM	National Environment Protection Measure
NSW DECC	New South Wales Department of Environment and Climate Change
OCP	organochlorine pesticides
OPP	organophosphate pesticides
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PID	photoionisation detector
PPIL	phytotoxicity based investigation level
ppm	parts per million
PQL	practical quantification limit
PRG	primary remediation goal
Pty Ltd	Propriety Limited
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RPD	relative percentage difference
SAC	site acceptance criteria
SAQP	sampling analysis and quality plan
SMF	synthetic mineral fibres
SOPT	Sydney Opera House Trust
TCLP	toxicity characteristic leaching procedure
TOPIC	total photoionisable compounds
TPH	total petroleum hydrocarbons
UCL	upper confidence limit

USEPA	United States Environmental Protection Agency
UST	underground storage tank
VAPS	Vehicle and Pedestrian Safety
VOC	volatile organic compounds

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REPORT ON PRELIMINARY CONTAMINATION ASSESSMENT
VEHICLE AND PEDESTRIAN SAFETY (VAPS) PROJECT
SYDNEY OPERA HOUSE, BENNELONG POINT

1. INTRODUCTION

This report presents the results of a preliminary contamination assessment conducted by Douglas Partners Pty Ltd (DP) at the Sydney Opera House forecourt in support of the Vehicle and Pedestrian Safety (VAPS) project. The work was requested by Marie Khoury of Savills Australia Pty Ltd on behalf of the Sydney Opera House Trust (SOHT).

The investigation area is currently occupied by The Sydney Opera House and Opera House Forecourt. It is understood that the construction of a new underground loading dock with associated new lifts, a truck turning-bay and an entry/access tunnel to facilitate a central loading dock below the Opera House is proposed. Other aspects of the VAPS project include the diversion of existing high voltage (HV) cables and the historic stormwater channel from beneath the main House building, to an outlet at the Man-O-War steps.

The preliminary contamination assessment was undertaken in conjunction with a preliminary acid sulphate soils assessment (DP Project 71529.02) and subsequent to a geotechnical investigation for the project (DP Project 72529) which also included some preliminary contamination testing (the results of which have been incorporated into this report).

The preliminary contamination assessment consists of a review of the previous reports that relate to the site, a review of site history, the drilling of test bores and the sampling and analysis of a limited number of soil and groundwater samples.

2. PROPOSED DEVELOPMENT AND OBJECTIVES

2.1 Proposed Development

The proposed VAPS development involves the construction of a new underground loading and delivery dock below the existing driveway entrance and Monumental Steps. The purpose of the development is to restrict the use of the existing Forecourt area to taxis and VIP vehicles only, thereby enhancing pedestrian safety and improving the aesthetics of the Opera House for patrons arriving and departing. It is understood that two service corridors are to be constructed as tunnels below the main Opera House building, extending to the north from the loading dock area. These service tunnels are to provide storage areas together with access to new internal lifts.

It is understood that the main part of the loading dock will be located underneath the Monumental Steps. The base of the new loading dock will be at RL -10.97 m (AHD) {Level -36 foot} and will be approximately 14.6 m below the Ground Floor Level at RL +3.66 m (AHD) {Level +12 foot}.

The loading dock will be accessed via a new vehicle entry access tunnel located beneath the forecourt area, starting from near the current main gate house and extending in a north-easterly direction towards the Opera House. The architectural drawings indicate that the width of the tunnel will be about 11 m. The southern section of the access tunnel will be located close to the Tarpeian Way cliff line and the alignment of the Sydney Harbour Tunnel.

The dimensions of the main loading dock are about 45 m x 35 m in plan. The main loading dock area will also include a turning bay to accommodate large semi-trailer trucks, extending 20 – 25 m eastwards, towards the Man-O-War Steps. The two service corridors (eastern and western) will extend as tunnels from the base of the loading dock for a length of between 45 – 55 m beneath the main building, towards the central part of the Opera House. The eastern tunnel is shown as approximately 11 m in width in the plan provided, but is intended to be reduced to 8 m and will extend to a proposed new temporary scenery lift located below the set storage area. This corridor may also provide a storage area for containers. The western tunnel is approximately 6 – 7 m in width and will link-up with the existing “Lift 12”. A new

goods lift will also be located midway along the western corridor. All three lift pits are shown to extend locally down to approximately RL -15 m (AHD), about 3 m lower than the proposed floor level of the service tunnels.

The proposed works will also include the diversion of the historic Bennelong Drain beneath the Opera House Forecourt, between the Monumental Steps and the Tarpeian Way to a new outflow point near the Man-O-War Steps. Existing underground HV cables will also be diverted.

It is understood that the proposed works will entail a combination of open excavation in relatively shallow construction areas and tunnelling in deeper areas, such as beneath the main Opera House building.

2.2 Objectives of Investigation

The objectives of the current investigation are as follows;

- To assess the potential for soil contamination at the site and the likely nature and extent of the contamination encountered;
- To assess the potential for groundwater contamination at the site;
- To assess the suitability of the site, from a contamination standpoint, for the proposed development (as detailed in Section 2.1);
- To determine a preliminary waste classification of the soils and bedrock at the site and
- To assess the need for remedial works or management protocols (if required) to render the site suitable for the proposed development

3. SCOPE OF WORKS

The scope of the preliminary contamination assessment included the following:-

- A review the Godden Mackay Logan (updated February 2010) report titled *Archaeological Management Plan & Heritage Impact Assessment*;
- A site history search including a review of historical aerial photos (and other readily available historical photos), a search of the Contaminated Land Register for Notices issued under the Contaminated Land Management Act 1997 and a search of the licensed Groundwater Bore database;
- A walkover inspection to identify current site uses and features as well as any visual or olfactory indicators of potential contamination;
- An underground service location prior to drilling to locate detectable services as a precautionary measure using a professional service tracing company. The underground services search included a review of the service plans made available by SOHT as well as dial-before-you dig records. All drilling locations were checked with an electromagnetic scanning device and ground penetrating radar (GPR) to identify detectable services. In addition, a concrete thickness radar was used in one location (Test Bore 206) to attempt t to detect the underground tension beams beneath the monumental steps;
- Concrete coring in six locations (the limestone pavers were first removed by Sydney Opera House staff to expose the underlying concrete/cement at bores 201-204);
- The drilling of six (6) test bores across the accessible areas of the VAPS works area (i.e. the footprint of the proposed loading dock, access ramp and sewer diversions). It is noted that two test bores (Test Bores 101 and 102) were drilled and sampled during a previous investigation by DP and have been incorporated into the findings of the current assessment. Five of the test bores were drilled with a truck mounted scout rig (Test Bores 201 to 205) and one with a bobcat mounted drilling rig (Test Bore 206). The bores were drilled to a maximum depth of 2.9 m or prior refusal on sandstone or in filling;
- Samples (including 10% field replicates for QA/QC purposes) were collected at regular depth intervals based on field observations, the sub-surface profile encountered and signs of contamination;

- All recovered samples were screened in the field using a field portable photo-ionisation detector (PID);
- Selected samples from the six bores were dispatched to a NATA accredited laboratory for quantitative analysis for the following potential contaminants:

  Soils

  - Heavy Metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc) – 18 samples
  - Monocyclic Aromatic Hydrocarbons (Benzene, Toluene, Ethylbenzene and Xylene – BTEX) – 16 samples;
  - Total Petroleum Hydrocarbons (TPH) – 16 samples;
  - Polycyclic aromatic hydrocarbons (PAHs) – 16 samples;
  - Organochlorine Pesticides (OCP) – 12 samples;
  - Polychlorinated Biphenyls (PCB) – 12 samples;
  - Phenols – 12 samples;
  - Volatile Organic Compounds (VOC) – 6 samples;
  - Asbestos – 12 samples; and
  - TCLP - 6 samples for PAH and 2 samples for lead.

  Groundwater

  - Heavy Metals (8 priority plus manganese and iron)– 1 sample;
  - TPH and BTEX – 1 sample;
  - PAH – 1 sample;
  - pH – 1 sample; and
  - oil and grease – 1sample.

  QA/QC

  - QA/QC samples including 2 intralaboratory duplicates for TPH, BTEX, PAH and heavy metals, 1 interlaboratory duplicate for TPH, BTEX and PAH, 3 trip spikes for BTEX and 3 trip blanks for BTEX.

- Preparation of a preliminary contamination assessment report (this report) which included the following:

  - A preliminary assessment of the contamination status of the site;

- A preliminary assessment of groundwater quality beneath the site;
- A preliminary waste classification of the various material types encountered;
- Recommendations regarding the disposal and/or management of excavated materials;
- Any identified health risks to workers;
- Recommendations for further investigative works or reporting beyond that included in this scope (e.g. a Remedial Action Plan or Soil Management Plan which may be required if contaminated soils are encountered); and;

- Samples not tested were held for a period of one month pending the need for further analysis.

4. SITE IDENTIFICATION AND DESCRIPTION

The Sydney Opera House is located on Bennelong Point on Sydney Harbour. Bennelong Point is bounded by Circular Quay to the west and Farm Cove to the east. The Sydney Opera House and the adjoining forecourt occupy an area of approximately 30,000 m^2. It extends from the vertical rock cutting to the south known as the Tarpeian Way to the northern tip of the Bennelong Point, a distance of approximately 250 m. The width of the Sydney Opera House and forecourt is approximately 120 m in an east-west direction.

The works area for the VAPS project occupies only a portion of the total Opera House and forecourt area, being about 6000 m^2. For the purpose of this report “the site” is defined as the area in which the subsurface is likely to be disturbed by the VAPS project, including the access tunnel, loading dock, stormwater and HV cable diversions. Approximate outlines of these features are shown on Drawing 1, Appendix A. Due to access limitations, no bore drilling or sampling could be undertaken beneath the Opera House itself. However, it is understood that the proposed service corridors beneath the Opera House will be formed through tunnel excavation in the sandstone bedrock.

The site is broadly level with the Opera House forecourt and surrounding boardwalks at approximately 3 m to 5 m above the harbour seawater level, at approximately RL 3.6 m

AHD. The Opera House itself comprises a complex of terraced theatres and halls linked together beneath a roof comprising sets of interlocking vaulted shells surrounded by terrace areas that function as pedestrian concourses.

An underground car-park comprising two concentric cylindrical excavations to depths of approximately 40 m is located to the south of the Opera House and the Tarpeian Way cliffline. The Sydney Harbour Tunnel is located within about 80 m of western seawall of the Sydney Opera House and strikes in an approximately north-north-west orientation.

Selected photos (Photos 1 to 6) of the site and the test bore locations are provided in Appendix B.

5. REGIONAL GEOLOGY, TOPOGRAPHY AND HYDROGEOLOGY

Following is a description of the regional geology, topography and hydrogeology.

Reference to the 1:100,000 Geological Map Sheet for Sydney indicates that the site is underlain by filling and/or a soil layer overlain by Triassic-Aged Hawkesbury Sandstone. The Hawkesbury Sandstone typically comprises medium to coarse-grained quartz sandstone with very minor shale and laminite lenses. Field observations generally confirm the published geological mapping. A more detailed assessment of the local geology is provided in the geotechnical report (DP Project 71529).

The Department of Land and Water Conservation Acid Sulphate Soil Risk Map (1:25,000) for Prospect and Parramatta River (9130N3) indicates that the site is located in an area classed as X2 – disturbed terrain. The Map described disturbed terrain as land that may include "*filled areas which occur during reclamation of low lying swamps for urban development. Other disturbed terrain includes areas which have been mined or dredged or have undergone heavy ground disturbance through general urban development or construction of dams or levees*". The map indicates that "*soil investigations are required to assess these areas for potential acid sulphate soils*". It is noted (as discussed in Section 6) results from the acid sulphate soils assessment conducted in conjunction with this investigation indicated

that the filling/soils within the VAPS works area were not actual or potential acid sulphate soils.

According to the Soil Landscapes of the Sydney 1:100,000 Sheet the site is mapped as being part of the disturbed soil landscape group which includes reclaimed and filled areas. The conditions of the soil group can vary depending of the quality and nature of the fill.

A search of the Department of Environment, Climate Change and Water (DECCW) groundwater bore database was conducted as part of the assessment. The search of registered groundwater bores was conducted within a 1 km radius (refer to the Drawing 3 in Appendix C and accompanying groundwater works records). In total there were 4 registered groundwater bores within the 1 km radius. The registered groundwater bores were all up gradient of the site and had no details. In any case the groundwater at the site would be expect to be highly tidal and influenced by Sydney Harbour.

Surface water runoff drains into stormwater drains in and around the site. These drains exit almost directly into Sydney Harbour.

6. PREVIOUS REPORTS

6.1 Previous Investigations conducted by Douglas Partners

Geotechnical investigations and construction based inspections conducted by DP (for other projects at or near the site) are given in chronological order as follows:

- **1995** – Borehole investigation comprising 28 boreholes for the new boardwalk foundations along the eastern (denoted “DPBHE”) and northern boardwalk (denoted “DPBHN”) for contractors McConnell Dowell (DP Project 20619A). The boreholes were drilled from the boardwalk (deck) level (approximately 3.6 m AHD) to depths of between 7.75 and 11.45 m, below deck level. The subsurface profile encountered in most of the boreholes comprised sand and boulder filling directly overlying sandstone bedrock. The sandstone was generally medium or high strength and slightly fractured.

- **1998** – Borehole drilling for the installation of 6 mini-piles (denoted "MP") for the proposed boardwalk studio located on the western side of the Opera House for contractors Austin Australia (DP Project 24937). The mini-piles were core drilled within sandstone to depths between 8.0 and 9.0 m from the boardwalk (deck) level (approximately 3.6 m AHD).

- **2004** – Inspection of trenching work and reporting on settlement was undertaken during construction of the mechanical bollards for contractors Construction Building Design (DP Project 36814). No borehole information was associated with this project.

6.2 Previous Investigations Conducted by Others

Geotechnical investigations conducted by others (for other projects at or near the site, that DP aware of) are given in chronological order as follows:

- **MacDonald, Wagner and Priddle (1958)** - Twelve hand-drawn boreholes logs (denoted TH) were obtained from a geotechnical investigation undertaken in 1958 for preliminary work on the Opera House when tram sheds existed on the site. Reduced levels at the ground surface and at the top of rock (converted to AHDm) were able to be read from Drawing 7095/1 (1958) with some degree of confidence.
- **Jeffrey and Katauskas (1994)** – Initial borehole investigation comprising seven boreholes (denoted JKBH) for the proposed upgrade to the northern and eastern boardwalk. The boreholes were drilled from the boardwalk (deck) level (approximately 12' Level) to depths of between 7.8 and 9.6 m.
- **ARUP Geotechnics (2004)** – Borehole investigation comprising four boreholes (denoted ARUPBH) drilled to depths of 18.5 m for the proposed Set Storage Area located within the eastern side of the Opera House.

6.3 Previous/Concurrent Investigations undertaken for VAPS Project

DP previously conducted a geotechnical investigation at the site for the VAPS project (DP Project 71529) and also conducted a preliminary acid sulphate soils assessment (DP Project

71529.02) in conjunction with the current preliminary contamination assessment. The report details and a brief summary of the investigations and their findings are presented below.

- *Report on Preliminary Geotechnical Investigation and Waste Classification Assessment, Vehicle and Pedestrian Safety (VAPS) Project, Sydney Opera House*. DP Project 71529, dated 27 January 2010; and

The preliminary geotechnical investigation involved the drilling of two test bores (BH 101 and BH102, shown on Drawing 1, Appendix A). The bores were augered to refusal in sandstone bedrock then, cored using NMLC-coring to depths of 13.48 m (BH101) and 17.11 m (BH102).

Filling was encountered in Test Bore BH101 to a depth of 4.95 m consisting of sands and gravels to a depth of 2.0 m underlain by blue metal gravel and cobbles (ballast) to 4.1 m and loose sand and clayey silt to 4.95 m. Sandstone was encountered at 4.95 m. Test Bore BH102 encountered sand and gravel filling and sandstone filling to 1.4 m underlain by blue metal gravel (ballast filling). Sandstone was encountered at a depth of 1.8 m.

A standpipe was installed into BH101 to measure groundwater levels. This piezometer was developed and sampled during the current contamination assessment.

Based on the results of chemical analysis the filling was preliminary classified as General Solid Waste (non-putrescible). No comment was made on site suitability (from a contamination standpoint) as no such assessment was required at the time.

The results of the contamination and waste classification testing undertaken during the geotechnical investigation have been incorporated into this report and used in combination with recent results to assess the site contamination status and preliminary waste classification.

The test bore logs from the geotechnical investigation are included (along with the logs from the current investigation) in Appendix D. In addition, the laboratory reports have been included in Appendix E.

- *Report on Preliminary Acid Sulphate Soil Assessment, Vehicle and Pedestrian Safety (VAPS) Project, Sydney Opera House*. DP Project 71529.02, dated 7 June 2010.

The acid sulphate soils assessment was conducted in conjunction with the current preliminary contamination assessment. Additional soil samples were collected from the six boreholes drilled for the contamination assessment and the samples subjected to acid sulphate soil screening tests, with selected samples submitted for laboratory analysis for Suspension Peroxide Oxidation Combined Acidity and Sulphate (SPOCAS) testing.

Based on the results of the assessment it was considered that the materials encountered in the test bores did not contain actual acid sulphate soils or potential acid sulphate soils. Therefore based on the findings at this stage no acid sulphate soils management plan was deemed necessary.

It was, however, recommended that the materials be inspected following excavation by a qualified environmental consultant, particularly at and close to bore locations where refusal was encountered in the filling, in areas where deeper filling was encountered (i.e. near the Man-O-War Steps) and in between test bore locations to confirm that the underlying materials are consistent with those observed (and tested) during the investigation. If the materials are inconsistent with those observed during the current investigation or if signs of acid sulphate soils are detected then it was recommended that additional assessment should be conducted to confirm the presence/absence of potential or actual acid sulphate soils.

7. SITE HISTORY INFORMATION

Following is a limited site history assessment including a review of the Hertigate Report prepared by Godden, Mackay Logan, a review of available aerial and historical site photos and a review of DECCW notices and licences database.

7.1 Heritage Report

A review of the Archaeological and Heritage Report entitled *Sydney Opera House, Loading Dock, Archaeological Management Plan and Heritage Impact Assessment* prepared by Godden Mackay Logan Heritage Consultants dated October 2009 was conducted as part of this assessment. The pertinent site history information in the report is summarised below;

- 1788-1802 – early European settlement in Sydney Cove when Bennelong Point was the location of Bennelong brick hut and a saltworks and windmill. Later a redoubt (1789) was constructed which was then replaced by a half moon battery (1788);
- 1810-1843 – work commenced on the construction of a fort on the northern tip of Bennelong Point, while large parts of the point were reserved for public parks and reserves;
- 1817-1901. The fort was present on the site. The fort was augmented with new gun batteries in the 1860s and at the same time an esplanade built around the fort creating an encircling seawall and ferries began operating around the shore. In the late 19th century, the eastern side of Sydney Cove (western shore of Bennelong Point) was converted to use by trading companies for major longshore wool, mail and passenger wharves. In the late 1890s the western rampart of the fort was demolished to make way for the facilities associated with the P&O operation;
- 1901-1958. Bennelong point was used to accommodate a number of jetties for use by the public serviced by a tramline and a tram-car house which became known as “the shed”. The shed was built on the site of Fort Macquarie and was large enough to house 72 trams on 12 parallel tracks. The shed became redundant in the 1950s;
- 1955 to present – period of the conception of the Sydney Opera House which was completed and opened by 1973.

In addition to the general history of the site the report also includes some information on the historical filling and land reclamation at the site. The following key points are noted;

- By 1829 parts of the shoreline along Bennelong Point had been modified and reclaimed. This process continued over the next century with various phases of seawall and wharf construction;

- The shoreline along the south eastern section of the peninsula was the first section to be reclaimed (by 1829) and a boat slip was created in this area by 1845;
- In 1861 an esplanade was created around Fort Macquarie by erecting an encircling seawall and filling the area formerly covered by high tides;
- The western shoreline was used from the 1860s for wharves, jetties and wharve buildings;
- The present shoreline of Bennelong Point which are contained by seawalls are entirely reclaimed land;
- Episodes of reclaimed land have taken place throughout the 19th and 20th centuries;
- The Bennelong Drain (based on historic site photos) is estimated to be located approximately 2 m below the existing surface level suggesting that up to 2 m of fill is present across the site;
- During the construction of the Sydney Opera House (1960s to 1970s) significant earthworks were undertaken including
  - Modification to the shape of Bennelong Point with the construction and/or replacement of seawalls around the entire shoreline;
  - Regularisation of the ground level through the introduction of fill deposits to create level forecourt and boardwalk platforms;
  - Excavation for the construction of the basement levels and other structural elements of the opera house;
  - Construction of infrastructure associated with the opera house;

7.2 Historical Aerial and Site photographs

A review of historical aerial and other photographs was undertaken as part of the assessment. Aerial photographs for the years 1930, 1943, 1951, 1970, 1978, 1986, 1991, 2004, 2005 and 2010 were examined. These were supplemented with historic photos of the site for the 1850s, late 19th century, early 20th century and 1960s. Copies of the aerial and historic site photographs are presented in Appendix C.

1850's and late 19th Century Site Photos

The 1850's site photo shows the north western corner of the former fort (Fort Macquarie) and the exposed top of Bennelong Drain. It addition there is a small single storey house present in the north eastern corner what is now the forecourt area. Sandstone cliff and boulders are visible in the background of the photo to the north of the site and Government House is also visible to the north of the site. A copy of the Photo is presented in Photo 7, Plate 4, Appendix C.

The late 19th century site photo (taken from the eastern side of the site) shows Fort Macquarie. The fort consists of a sandstone wall and tower and several small and medium sized buildings. The photo is presented in Photo 8, Plate 5, Appendix C.

Early 20th Century Photo

The early 20th century photo shows the site after the fort and ancillary structures were demolished and replaced with the tram shed. A number of tram lines are present heading into the tram shed. A number of warehouses are present to the west of the site and the Tar vertical rock cutting to the south of the site known as the Tarpeian Way is present. The photo is presented in Photo 9, Plate 5, Appendix C.

1930 Aerial Photograph

In the 1930 aerial photograph the tram shed and tram line are visible. The northern end of Bennelong Point appears to be a public park. A number of finger wharves are present along the eastern shoreline of Bennelong Point and a warehouse along the western side. The northern end of the western side of Bennelong Point appears to be being used as a docking port for cargo ships. The Royal Botanical Gardens and Government House are visible to the south of the site and Sydney Harbour to the east, north and west. A copy of the photo is presented in Photo 10, Plate 6, Appendix C.

1943 Aerial Photograph

The 1943 aerial photograph is generally similar to the 1930 aerial photograph. It is possible that some minor works have been conducted on the finger wharves, but it is difficult to determine due to the poor quality of the 1930 aerial photograph. The immediate surrounds also appear consistent with the 1930 aerial photograph. A copy of the photo is presented in Photo 11, Plate 7, Appendix C.

1951 Aerial Photograph

The 1951 aerial photograph is generally similar to the 1943 and 1930 aerial photographs. There have been some changes to the finger wharves on the eastern side on Bennelong Point with the two northern most wharves being removed and replaced with a single finger wharve which is connected to the north eastern corner of the point (although this is outside the VAPS works area). The immediate surrounds also appear consistent with the 1943 and 1930 aerial photograph. A copy of the photo is presented in Photo 12, Plate 8, Appendix C.

1960s Historical Site Photos Aerial Photograph

The 1960s historical site photos show the site during the construction of the Sydney Opera House and forecourt. The tram shed and tram lines have been demolished. In addition the Warehouses and docking ports on the western side of Bennelong Point have been removed and the finger wharves along the eastern side of Bennelong Point removed. The only remaining wharf on the eastern side is the Man-O-War Steps. Copies of the photos are presented in Photo 13, 14 and 15, Plate 9, Appendix C.

1970 Aerial Photograph

The 1970 aerial photograph shows the site after the completion of the Sydney Opera House. There appears to be some works on-going in the forecourt area. The immediate surrounds do not appear to have undergone significant change with the exception of increasing number of multi-story office buildings to the south east of the site. A copy of the photo is presented in Photo 16, Plate 10, Appendix C.

1978 Aerial Photograph

The 1978 aerial photograph shows the site following the completion of works in the forecourt. The western side of Bennelong Point appears to have undergone some minor reshaping and the Ma-O-War Steps appear to have been re-designed and possibly small area along the shoreline at the Man-O-War Steps reclaimed to “smooth out” the shoreline. A copy of the photo is presented in Photo 17, Plate 11, Appendix C.

1986 Aerial Photograph

The 1986 aerial photograph does not show any significant change at the site to the 1978 aerial photograph. Similarly there are no significant changes to the surrounding area. A copy of the photo is presented in Photo 18, Plate 12, Appendix C.

1991 Aerial Photograph

The 1991 aerial photograph does not show any significant change ate the site to the 1986 aerial photograph. Similarly there are no significant changes to the surrounding area. A copy of the photo is presented in Photo 19, Plate 13, Appendix C.

2004 Aerial Photograph

The 2004 aerial photograph does not show any significant change at the site to the 1991 aerial photograph. Similarly there are generally significant changes to the surrounding area with the exception of the construction of a new residential apartment block to the south east (“the toaster”). A copy of the photo is presented in Photo 20, Plate 14, Appendix C.

2005 Aerial Photograph

The 2005 aerial photograph does not show any significant change at the site to the 2004 aerial photograph. Similarly there are no significant changes to the surrounding area. A copy of the photo is presented in Photo 21, Plate 15, Appendix C.

2010 Aerial Photograph

The 2010 aerial photograph shows the current site condition and does not show any significant change at the site to the 1986 to 2005 aerial photographs. Similarly, there are no

significant changes to the surrounding area. A copy of the photo is presented in Photo 22, Plate 16, Appendix C.

7.3 EPA Contaminated Land Register

A search was undertaken of the Department of Environmental and Climate Change (DECC) Contaminated Land Register on 7 June 2010.

There were no records, notices or orders to investigate or remediate the site. In addition there were no EPA licences held for the site. A copy of the EPA Licence notices search is provided in Appendix C.

8. POTENTIAL CONTAMINANTS

Based on the previous investigations and past site use it is generally considered that there is a low to moderate potential for contamination at the site. As no specific contamination sources or areas of specific concern were noted, apart from the importation of filling for land reclamation, the investigation was, thus, designed to cover a wide range of commonly occurring contaminants that may be present in the filling which include:

- The priority heavy metals arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc;
- Polycyclic Aromatic Hydrocarbons (PAH);
- Total Recoverable Hydrocarbons (TRH) and benzene, toluene, ethyl benzene and xylenes (BTEX);
- Organochlorine pesticides (OCP);
- Total Phenols;
- Volatile organic compounds (VOC);
- Polychlorinated biphenyls (PCB); and
- Asbestos.

9. FIELD WORK

9.1 Data Quality Objectives

The data quality objectives (DQO) of the Preliminary Contamination Assessment have been developed to define the type and quality of the data to achieve the project objectives and were based broadly in accordance with the seven step data quality objective process, as defined in Australian Standard (AS) *Guide to the Sampling and Investigation of Potentially Contaminated Soil Part 1: Non-volatile and Semi-volatile Compounds* (AS 4482.1 – 2005). The DQO process is outlined in the AS and defined by:

- Stating the Problem;
- Identifying the Decision;
- Identifying Inputs to the Decision;
- Defining the Boundary of the Assessment;
- Developing a Decision Rule;
- Specifying Acceptable Limits on Decision Errors; and
- Optimising the Design for Obtaining Data.

Detailed discussions of the 7 step DQO process is provided in Appendix F and are summarised in Table 1, below.

Table 1 – Data Quality Indicators

Data Quality Objective	Report Section where addressed
State the Problem	S1 Introduction S2 Proposed development and Objectives S4 Site Description
Identify the Decision	S10 Site Acceptance Criteria S12 Discussion of Results S13 Conclusions and Recommendations
Identify Inputs into the Decision	S4 Site Description S5 Regional Geology S6 Previous Reports S7 Site History S8 Potential Contaminants S10 Site Assessment Criteria S11 Results of Assessment S12 Discussion of Results
Define the Boundary of the Assessment	S4 Site Description, Appendix A
Develop a Decision Rule	S10 Site Assessment Criteria
Specify Acceptable Limits on Decision Errors	Appendix E
Optimise the Design for Obtaining Data	S9 Fieldwork

9.2 Sample Rationale

Based on the NSW EPA Sampling Design Guidelines a minimum of 15 Test Bores is recommended for the characterisation of the site (i.e. a plan area of 6,000 m^2). However, due to the limited access restrictions and the linear nature of the proposed tunnel, stormwater and HV cable diversions (to which area based sampling densities in the Sample Design Guidelines do not strictly apply) a “full” phase 2 sampling density based on site area was not considered appropriate. Therefore six test bores were drilled over the accessible areas of the site. In addition two test bores were drilled during the previous geotechnical investigation (a total of eight test bores utilised for the purpose of this assessment). A groundwater sample was also collected from a piezometer installed during the geotechnical investigation.

Based on site observations and the site history review (i.e. identifying no specific target areas other than filling), the sampling locations were placed over the accessible portions of the site with a view to providing a reasonable site coverage. Soil samples were collected at broadly regular intervals, or based on field observations, including changes in strata and signs of contamination. The locations of the test bores are shown in the attached Drawing 1, Appendix A.

9.3 Sampling Procedures

9.3.1 Soil Sampling

All sample locations were cleared for services and pipes using Dial-before-you-dig information and an electro-magnetic sweep by an accredited service locater. A ground penetrating radar survey was completed at each location to attempt to identify deeper services and services not typically detectable by electromagnetic sweeps (such as clay and concrete pipes).

In addition to the electromagnetic and GPR sweeps, an additional concrete thickness radar survey was conducted at Test Bore 206 in an attempt to identify the locations of the underground beam pairs in conjunction with a review of the GBG Report entitled *Investigation using Ground Penetrating Radar of the Subsurface Construction of the Concourse East, Sydney Opera House, Sydney, NSW* dated 4 March 2010. The GBG report was relied upon for the locations of the beam pairs in view of the inconclusive results of the GPR and concrete radar surveys.

The limestone pavement in the forecourt (where Test Bores 201 to 204 were located) was removed by Opera House Staff to expose the underlying cement/concrete. The cement and concrete was then pre-cored using a 150 mm diameter diatube corer with a wetvac to reduce drilling fluids. Test Bore 205 was located on a bitumen pavement and was pre-cored with a 150 mm diatube corer.

Test Bores 201 to 205 were drilled using a truck mounted Scout Rig. The rig was moved into position after the pavement was removed and underlying concrete/bitumen cored. Once in

position barricades were put in place to prevent vehicle and pedestrian access to the works area.

At Test Bore 206 a pilot hole was cored through the asphalt and concrete using a 50 mm diameter diatube corer. Following the completion of the pilot hole demonstrating that the hole was not located over a beam pair a 150 mm core was cored over the top of the pilot hole. Once the concrete core was removed a bobcat mounted drilling rig was moved into position and barricades put in place to prevent vehicle and pedestrian access to the works area.

The recent field investigation comprised the drilling of six test bores (BH201 to BH206) to depths of between 13.5 m and 17.1 m. The borehole locations were set out relative to existing surface features (e.g. walls, staircases and gutters). The locations of test bores are shown in Drawing 1 within Appendix A. Also shown on Drawing 1 are the locations of Test Bores 101 and 102.

Each bore (BH201 to BH206) was drilled using solid, spiral flight augers. Test bores were extended to borehole refusal (on sandstone or in filling) to depths of between 0.9 m and 2.9 m.

All Environmental sampling was performed according to standard operating procedures outlined in the DP *Field Procedures Manual*. All sampling data will be recorded on DP chain of custody sheets. The general soil sampling procedure comprised:-

- Collection of soil samples from auger returns at the surface then at regular intervals or upon signs of contamination, at the observed water table and at test bore completion;
- decontamination of all sampling equipment using a 3% solution of phosphate free detergent (Decon 90) and distilled water prior to collecting each sample;
- transfer of samples into sealable plastic bags. All air was removed from the bags before they were sealed;
- labelling of sample bags with individual and unique identification, including project number, sample location and sample depth; and

- placement of the sample bags into a cooled, insulated and sealed container for transport to DP offices where upon they were placed in a freezer to prevent oxidation and sent to the laboratory in a cooled insulated container (following acid sulphate soil screening).

NATA accredited laboratories were employed to conduct the sample analysis. The laboratories are required to carry out routine in-house QC procedures.

The approximate ground surface level for the boreholes was determined by interpolation between survey makers shown on the drawing prepared by Hard & Forester Consulting Surveyors, 2005 entitled: *Sydney Opera House Survey Control Plan, Ground Floor +12 External, in particular, Sydney Opera House Bench Mark P6-01 (SOHBM – P6-01)*. SOHBM P6-01 was located at the base of the foyer stairs adjacent to the eastern boardwalk, a distance of between 7 m and 17 m from the borehole locations. The Reduced Level (RL) shown on SOHBM – P6-01 is understood to be relative to AHD.

A photoionisation detector (PID) was used to screen the headspace gases of the replicate samples placed in the sealed zip-lock bag. The PID provides an indication of the likely presence of volatile organic compounds in the soil. The PID had a 10.6eV lamp and was calibrated with isobutylene gas prior to commencement of each day's field work.

9.3.2 Piezometer Installation and Groundwater Sampling Methods

The piezometer (installed in Test Bore 101 during the geotechnical investigation) was constructed using 50 mm diameter acid washed class 18 PVC casing and machine slotted well screen. Joints were screw threaded, thereby avoiding the use of glues and solvents which may contaminate the groundwater. The piezometer was completed with a gravel pack extending to 0.1 m above the well screen and a bentonite plug of at least 0.2 m thickness and backfilled with drill returns to the surface. The piezometer was finished with a gatic cover on the ground surface.

Subsequent to installation, the groundwater level in the well was measured and then the well was developed by removing a minimum of 3 bore volumes of water, using a submersible pump.

The well recharged immediately and after a one hour period to allow stabilisation levels re-measured. The well was then micro-purged until field parameters (pH, temperature, dissolved oxygen, conductivity, redox potential and turbidity) stabilised, and sample was collected using a peristaltic pump.

Samples were placed with minimum of disturbance and aeration into appropriately preserved bottles. For heavy metal analysis the relevant sample fraction was filtered using a sterilized 0.45 μm filter. The sample pump and all non disposable sampling equipment was decontaminated between samples via a "triple rinse" procedure i.e. a rinse of all particulates in tap water followed a decontamination using a 3% Decon 90 solution and a final rinse in deionised water. A rinsate sample was collected from the sampling equipment at the completion of sampling to demonstrate that decontamination methodology was adequate.

Sample handling and transport was as set out below:-

- sample containers, supplied by the laboratory (listed below), labelled with individual and unique identification, including project number and sample number;
    - BTEX, C_6-C_9 and VOCs – 2 x 40 ml HCl preserved glass vial;
    - C10-C36 – glass 500 ml;
    - PAH – glass 1000 ml;
    - Phenols – 250 ml H_2SO_4 preserved plastic;
    - PCB/OPP/OCP – 1000 ml glass;
    - Heavy metals and hardness – filtered, 50 ml HNO_3 preserved plastic;
    - VOCs 2 x 40 ml HCL preserved; and
    - pH – 20 ml plastic or glass.
- samples were placed in insulated coolers and maintained at a temperature of approximately 4°C until transported to the analytical laboratory, and
- chain of custody documentation was maintained at all times and countersigned by the receiving laboratory on transfer of samples.

All samples were dispatched to NATA accredited laboratories for analysis.

9.4 Analytical Rationale

The analytical scheme (Table 2) was designed to assess the potential for contamination which may have arisen from current and past use of the site, and more specifically the importation of filling. The analytical scheme also targeted primarily the contaminants commonly associated with old filling around the Sydney Metropolitan area (i.e. Heavy Metals, TPH, BTEX, PAH and Asbestos). A total of 25 (from both the current investigation and previous geotechnical investigation) selected soil samples (including four QA/QC replicates), were analysed for various combinations of the contaminants of concern. In addition, one groundwater sample was also analysed as shown in Table 3.

Table 2 – Analytical Scheme for Soil Samples

Sample		Heavy Metals	PAH	TPH	BTEX	OCP	PCB	Total Phenols	VOCs	Asbestos	TCLP
101	0.2	✓	✓	✓	✓	✓	-	-	-	✓	✓
101	1.5	✓	✓	✓	✓	✓	-	-	-	✓	✓
102	0.45	✓	✓	✓	✓	✓	-	-	-	✓	✓
102	1	✓	✓	✓	✓	✓	-	-	-	✓	✓
BD 201209		✓	✓	✓	✓	✓	-	-	-	✓	-
201	0.4-0.5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
201	0.8-1	✓	✓	✓	✓	-	-	-	-	-	-
201	1.3-1.5	✓	✓	✓	✓	✓	✓	✓	-	✓	✓
202	0.4-0.5	✓	✓	✓	✓	✓	✓	✓	-	✓	-
202	0.6-0.8	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
202	0.8-0.9	✓	✓	✓	✓	-	-	-	-	-	-
203	0.4-0.5	✓	✓	✓	✓	✓	✓	✓	-	✓	✓
203	0.8-1	✓	✓	✓	✓	-	-	-	✓	✓	-
204	0.4-0.5	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
204	0.8-1	✓	✓	✓	✓	✓	✓	✓	-	✓	-
BD2 170510[5]		✓	✓	✓	✓	-	-	-	-	-	-
204	1.2-1.3	✓	✓	✓	✓	-	-	-	-	-	-
205	0.3-0.5	✓	✓	✓	✓	✓	✓	✓	-	✓	✓
BD4 170510		✓	✓	✓	✓	-	-	-	-	-	✓
205	1.3-1.5	✓	✓	✓	✓	-	-	-	-	✓	-
205	2.3-2.5	✓	✓	✓	✓	✓	✓	✓	✓	-	-
206	0.4-0.5	✓	✓	✓	✓	✓	✓	✓	-	✓	-
BD1 240510[4]		✓	✓	✓	✓	-	-	-	-	-	✓
206	0.8-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
206	1.1-1.2	✓	✓	✓	✓	-	-	-	-	-	✓

Table 3 – Analytical Scheme for Groundwater Sample

Sample ID (Location)	Heavy Metals	TPH/ BTEX	PAH	pH	Oil and Grease	Iron	Manganese
101-GW	✓	✓	✓	✓	✓	✓	✓

10. SITE ASSESSMENT CRITERIA

10.1 Soils

The DECCW's standard, health risk based site assessment settings are defined in the *Guidelines for the NSW Site Auditor Scheme,* 2nd edition, 2006, Appendix I and it includes health based assessment criteria for the following land uses;

- Residential with accessible soil and use of home grown produce. Includes child-care centres, primary schools, pre-schools, town houses and villas (HIL Column 1)
- Residential with minimal access to soil such as high rise apartments and flats (HIL Column 2);
- Parks, recreational open space or [playing fields and including secondary schools (HIL Column 3);
- Commercial or industrial use (HIL Column 4).

In addition, the DECCW also sets provisional phytotoxicity-based investigation levels (PPIL, Column 5) for the protection of plants in the appropriate setting (residential with gardens, areas outside of the building footprint of apartments and flats and open space). The PPIL are not relevant to the current assessment as there are no landscaping areas proposed within the works area.

With regards to the site, the Opera House forecourt is a public open space. While the site will be fully paved upon completion of the project such there will be no direct exposure pathway to the underlying soils a conservative approach had been adopted for the purpose of the current assessment and the threshold values for Parks and recreational open space

[including playing fields and secondary schools] (HIL Column 3) have been used, even though the exposure setting more closely resembles commercial exposure and risk scenarios.

Appendix II of the *Guidelines for the NSW Site Auditor Scheme* and the NSW EPA publication *Guidelines for Assessing Service Station Sites* 1994 provides the health-based investigation levels (HIL) for these settings and the site acceptance criteria (SAC) for the assessment of the site which the soil analytical results have been compared to. The adopted site assessment criteria are shown in Table 4, below.

A contaminant concentration in soil/filling material is considered to be significant if:

i) The concentration of the contaminant is more than 2.5 times the site assessment criteria (SAC). Any location more than 2.5 times the SAC is classified as a 'hotspot', requiring further assessment/ management.

ii) For a data of like material, with respect to the health-based criteria, the calculated 95% Upper Confidence Limit of average concentrations (excluding any 'hotspot' concentrations) exceeds the SAC.

iii) The standard deviation of the results is greater than 50% of the health-based investigation levels (HIL).

Table 4 – Site Assessment Criteria for Soil/ Filling

Contaminant	Adopted Criteria (SAC)	Source
TPH $C_6 – C_9$ $C_{10} – C_{36}$	 65 mg/kg 1000 mg/kg	NSW EPA[1] Contaminated Sites *Guidelines for Assessing Service Station Sites* (1994) threshold concentrations for sensitive land use-soils. Currently there are no other comprehensive EPA endorsed investigation levels for petroleum hydrocarbons.
BTEX Benzene Toluene Ethylbenzene Xylene	 1 mg/kg 1.4 mg/kg 3.1 mg/kg 14 mg/kg	
Metals Arsenic (total) Cadmium Chromium Copper Lead Mercury Nickel Zinc	**HIL-Column 4** 200 mg/kg 40 mg/kg 24% 2000 mg/kg 600 mg/kg 30 mg/kg 600 mg/kg 14000 mg/kg	*Guidelines for the NSW Site Auditor Scheme,* 2nd edition, 2006, Appendix II. Guidelines for Parks and Recreational Open Space (Column 3)
Total Phenols	1700 mg/kg	
PAH Total Benzo(a)Pyrene	 40 mg/kg 2 mg/kg	
PCB	20 mg/kg	
OCP aldrin + dieldrin chlordane DDT (including DDD, DDE, DDT) Heptachlor	 20 100 400 20	
VOC	Not defined	
Asbestos	No asbestos present in soil	No current NSW EPA endorsed guideline levels were available

Providing that the 95% Upper Confidence Limit (UCL) of average concentrations is within the SAC (health-based), and no concentrations of the contaminants are at hotspot level, minor exceedances of the SAC may be considered to pose an insignificant human health risk under the proposed land-use.

It is noted that no SAC has been defined for VOC in soil. Should concentrations exceed the laboratory detection limits, a risk-based assessment of the concentrations detected will be carried out.

[1] NSW EPA and NSW DEC is now part of the NSW Department of Environment and Climate Change (DECC).
[2] Commonwealth Department of Health and Aging. NSW EPA took part in the formulation of the enHealth guidance document.
* Other than a low reliability trigger value of 7µg/L, which is not routinely achievable by NATA accredited laboratories

10.2 Groundwater

The levels of contaminants in groundwater were assessed against Groundwater Investigation Levels (GILs) adopted from applicable guidelines, specifically, the ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. The ANZECC 2000 Guidelines and their source documents are detailed in Table 5. Guidelines for marine waters have been adopted given the proximity of the site to Sydney Harbour.

Table 5 – Groundwater Investigation Levels (GIL)

Contaminant	Adopted Criteria (GIL)	Source
TPH $C_6 – C_9$ $>C_9$	 150 µg/L 600 µg/L	At this stage, there are no high reliability guideline value for TPH* in ANZECC 2000 or endorsed by NSW EPA. For reference purposes, DP has referred to other available Australian guidelines for TPH viz. Airport (Environment Protection) Regulations (1997), Schedule 2 Water Pollution Accepted Limits: Table 1.03 – Accepted limits of contamination. It should be noted however that these have not been endorsed by EPA and are used as 'screening levels' only.
BTEX Benzene Toluene Ethylbenzene Xylene	 500 µg/L 180 µg/L[a] 5 µg/L[a] 425 µg/L[a]	*ANZECC (2000) low to moderate reliability trigger levels, Australian Water Quality Guidelines for the protection of 95% of marine water species* a. low reliability trigger value *ANZECC (2000)*
PAH Total Benzo(a)Pyrene Naphthalene Anthracene Phenanthrene Fluoranthene	 Not Specified 0.2 µg/L[a] 70 µg/L 0.4 µg/L[a] 2.0 µg/L[a] 1.4 µg/L[a]	*ANZECC (2000) Australian Water Quality Guidelines for the protection of 95% of marine water species* a. low reliability trigger value *ANZECC (2000)*
Metals[1] Arsenic (V) Cadmium Chromium (VI) Copper Lead Mercury Nickel Zinc Total Iron Manganese	 2.3 µg/L[a] 5.5 µg/L 27.4 µg/L 1.3 µg/L 4.4 µg/L 0.4 µg/L 70 µg/L 15 µg/L 300 µg/L[a] 80 µg/L[a]	*ANZECC (2000) Australian Water Quality Guidelines for the protection of 95% of marine water species* a. low reliability trigger value *ANZECC (2000)*
Oil and Grease	-	
pH	-	

Notes:
1. Metals GILs in results tables are adjusted for hardness of 100 mg $CaCO_3$/L
a For PAHs, in cases where no high reliability ANZECC trigger values are provided, the low reliability trigger values and the PQLs have been used as screening levels, along with a review of the recorded PAH levels in the soil samples..

10.3 Waste Classification

For the purpose of waste classification the results have been compared to the NSW DECC *Waste Classification Guidelines* 2008 (updated 2009).

11. RESULTS OF SOIL INVESTIGATION

11.1 Field Observations

Details of the sub-surface conditions encountered during the course of the investigation are included in the Test Bore Report Sheets (Appendix D). The bore locations are shown on Drawing 1, Appendix A. The soils were generally free of obvious signs of chemical contamination such as odours or staining. Trace ash was encountered in Test Bores 102, 203 and 205.

The boreholes generally encountered soil and rock filling material over sandstone bedrock. The general sequence of materials encountered in the boreholes is described below:

PAVEMENTS: typically comprised limestone pavers overlying concrete/cement layer or asphaltic concrete (AC) also referred to as bituminous concrete over concrete where present over roadbase gravel with a combined pavement thickness of between 0.2 m to 0.4 m; overlying.

FILLING: Filling was encountered in all test bores to depths ranging between 0.8 m below ground level to 4.95 m below ground level. The depth of filling generally increased to the eastern side of the site (near the Man-O-War Steps), or near service trenches/pits. The filling generally comprised sand with inclusions of sandstone gravel overlying ballast (“blue metal” gravels and cobbles). Trace ash was noted in the filling in Test Bores 201, 203 and 205; overlying.

BEDROCK: the bedrock generally comprised medium and high strength sandstone. Sandstone was not reached in all bores due to refusal in the overlying filling (see Table 6 below).

Table 6 summarises the subsurface profile encountered during the current investigation.

Table 6 - Observed Lithology

Sampling Location	Concrete/ Bitumen	Filling	Sandstone	Completion Depth
101	0-0.13	0.13-4.95	4.95-13.48	13.48
102	0-0.44	0.44-1.8	1.8-17.11	17.11
201	0-0.3	0.3-1.9*	-	1.9
202	0-0.35	0.35-0.8	0.8-0.9	0.9
203	0-0.3	0.3-1.3*	-	1.3
204	0-0.3	0.3-1.1	1.1-1.2	1.2
205	0-0.2	0.2-2.7	2.7-2.9	2.9
206	0-0.4	0.4-1.3*	-	1.3

Note:
* Refusal in filling

11.2 Total Photoionisable Compounds (TOPIC) Results

The replicate soil samples collected in plastic bags were allowed to equilibrate under ambient temperatures before screening for Total Photoionisable Compounds (TOPIC) using a calibrated Photoionisation Detector (PID). Results of sample screening are shown in the Test Bore Reports in Appendix D. All PID readings were less then 1 ppm.

11.3 Groundwater

The condition of the groundwater was generally in the neutral pH range. The Electrical conductivity results were saline (marine) waters. The groundwater field parameters are presented in Table 7.

It is noted that the measured water levels would be expected to vary depending on tide conditions within the surrounding Sydney Harbour and would typically be similar to the water levels in the harbour.

Table 7 – Groundwater Field Parameters

Bore ID	Water Depth (m)	Water Level (m AHD)	Oxygen (ppm)	Conductivity (mS/cm)	pH	Turbidity (NTU)	Temperature (^{o}C)	Redox (Mv)
BH101	3.47	0.13	3.4	18.2	6.7	20	20.7	16.5

11.4 Laboratory Results

The results of laboratory analysis of the soil and groundwater samples are summarised in Tables 8 to 10, with NATA Reports provided in Appendix E.

Table 8 - Soil Results

Bore ID	Sample Depth (m)	Material Type	Heavy Metals								PAH		TPH				BTEX				OCP[3]	PCB[3]	Total Phenols	VOCs[3]	Asbestos	
			As	Cd	Cr[1]	Cu	Pb	Hg	Ni	Zn	B(a)P[2]	Total +ve PAH[3]	C6-C9	C10-C14	C15-C28	C29-C36	Benzene	Toluene	Ethyl-benzene	Total Xylene					In soil	Trace
Previous Geotechnical Investigation December 2009																										
101	0.2		<4	<0.5	9	81	4	<0.1	77	41	<0.05	<0.1	<25	<50	<100	<100	<0.5	<0.5	<1	<3	<0.1	-	-	-	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
101	1.5		<4	<0.5	25	63	54	<0.1	37	82	***3.5***	35.4	<25	<50	120	<100	<0.5	<0.5	<1	<3	<0.1	-	-	-	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
102	0.45		4	<0.5	10	41	70	1.6	11	43	***4.2***	**41.1**	<25	<50	140	<100	<0.5	<0.5	<1	<3	<0.1	-	-	-	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
102	1		<4	<0.5	13	22	25	0.8	7	17	*1.3*	14.7	<25	<50	<100	<100	<0.5	<0.5	<1	<3	<0.1	-	-	-	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
BD 201209			<4	<0.5	12	19	32	0.9	8	18	*1.4*	15.1	<25	<50	<100	<100	<0.5	<0.5	<1	<3	<0.1	-	-	-	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
Current Investigation May 2010																										
201	0.4-0.5		5	<0.5	5	11	7	<0.1	14	12	***2.7***	25.6	<25	<50	<100	<100	<0.5	<0.5	<1	<3	<0.1	<0.1	<5	<1	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
201	0.8-1		<4	<0.5	3	7	3	0.1	8	7	0.1	0.9	<25	<50	<100	<100	<0.5	<0.5	<1	<3	-	-	-	-	-	-
201	1.3-1.5		<4	<0.5	13	19	6	<0.1	22	17	*1.3*	12.4	<25	<50	<100	<100	<0.5	<0.5	<1	<3	<0.1	<0.1	<5	-	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
202	0.4-0.5		<4	<0.5	11	70	12	0.1	77	48	0.8	5.8	<25	<50	<100	<100	<0.5	<0.5	<1	<3	<0.1	<0.1	<5	-	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
202	0.6-0.8		<4	<0.5	14	52	11	0.1	61	41	0.8	6.5	<25	<50	<100	<100	<0.5	<0.5	<1	<3	<0.1	<0.1	<5	<1	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
202	0.8-0.9		<4	<0.5	8	<1	6	<0.1	<1	26	<0.05	<0.1	<25	<50	<100	<100	<0.5	<0.5	<1	<3	-	-	-	-	-	-
203	0.4-0.5		4	1.7	10	66	38	0.2	33	66	0.7	11.1	<25	57	210	200	<0.5	<0.5	<1	<3	<0.1	<0.1	<5	-	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
203	0.8-1		<4	1.8	15	43	*660*	0.2	16	62	*1.6*	16	<25	<50	210	240	<0.5	<0.5	<1	<3	-	-	-	<1	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
204	0.4-0.5		<4	<0.5	16	10	17	<0.1	15	32	0.9	8.8	<25	<50	<100	<100	<0.5	<0.5	<1	<3	<0.1	<0.1	<5	<1	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
204	0.8-1		<4	<0.5	13	6	12	<0.1	6	17	0.1	1.1	<25	<50	<100	<100	<0.5	<0.5	<1	<3	<0.1	<0.1	<5	-	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
BD2 170510[5]			<1	0.2	9	4	10	<0.05	4	21	<0.5	<0.5	<10	<50	<100	<100	<0.2	<0.5	<0.5	<1.5	-	-	-	-	-	-
204	1.2-1.3		<4	<0.5	19	3	11	<0.1	5	28	0.1	0.8	<25	<50	<100	<100	<0.5	<0.5	<1	<3	-	-	-	-	-	-
205	0.3-0.5		<4	<0.5	11	37	45	<0.1	14	58	***16***	**177.7**	<25	<50	**870**	**550**	<0.5	<0.5	<1	<3	<0.1	<0.1	<5	-	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
BD4 170510			<4	<0.5	10	60	43	0.2	31	67	***18***	**222.4**	<25	<50	**890**	**550**	<0.5	<0.5	<1	<3	-	-	-	-	-	-
205	1.3-1.5		<4	<0.5	10	<1	8	<0.1	<1	5	0.5	5.2	<25	<50	<100	<100	<0.5	<0.5	<1	<3	-	-	-	-	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
205	2.3-2.5		<4	<0.5	10	60	43	0.2	31	67	0.07	0.27	<25	<50	<100	<100	<0.5	<0.5	<1	<3	<0.1	<0.1	<5	<1	-	-
206	0.4-0.5		<4	<0.5	7	22	41	0.1	5	31	0.07	0.37	<25	<50	<100	<100	<0.5	<0.5	<1	<3	<0.1	<0.1	<5	-	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
BD1 240510[4]			<4	<0.5	7	38	*130*	0.5	16	110	0.7	7.3	<25	<50	<100	<100	<0.5	<0.5	<1	<3	-	-	-	-	-	-
206	0.8-1		<4	<0.5	8	33	65	0.3	19	78	0.6	6	<25	<50	<100	<100	<0.5	<0.5	<1	<3	<0.1	<0.1	<5	<1	no asbestos found at reporting limit of 0.1 g/kg	respirable fibres not detected
206	1.1-1.2		5	<0.5	32	50	91	0.4	16	100	1	10.9	<25	<50	<100	<100	<0.5	<0.5	<1	<3	-	-	-	-	-	-
Guidelines																										
HIL[7]			200	40	24%	2000	600	30	600	14000	2	40	65 [8]	1000 [8]			1 [8]	1.4/130[8]	3.1/50[8]	14/25[8]	20/1000/400/20 [6]	50	17000	-	None detected	None detected
Waste[10]			100	20	100	-	100	4	40	-	0.8	200	650	10000			10	288	600	1000	<50	<50	288	-	None detected	None detected

Notes	
1	All Chromium are assumed to exist in the stable Cr(III) oxidation state, as Cr(VI) is too reactive and unstable under the normal environment
2	benzo(a)pyrene
3	where results less than practical quantitative limit (PQL), quoted as less than PQL for most individual compounds
4	Intralaboratory Duplicate of sample listed above
5	Interlaboratory duplicate of sample listed above
6	OCP SACs given in order Aldrin+Dieldrin/Chlordane/ DDD+DDE+DDT/Heptachlor
7	NSW DECC Contaminated Sites *Guidelines for the NSW Site Auditor Scheme* 2nd edition (2006) Soil Investigation Levels for Urban Redevelopment Sites in NSW Heath-based investigation levels for Parks, recreational open space, playing fields including secondary schools.
8	NSW EPA Contaminated Sites *Guidelines for Assessing Service Station Sites* (1994)
9	NSW DECC Contaminated Sites *Guidelines for the NSW Site Auditor Scheme* 2nd edition (2006) Provisional Phytotoxicity Based Investigation Levels (PPIL) Waste Classification Guidelines 2008. General Solid Waste
10	Without TCLP
-	not analysed
ND	Not defined
BOLD	Exceeds SAC
Red	Hotspot Concentration
Italics	exceeds General Solid Waste without TCLP

Table 9 - Waste Classification (TCLP) Results

Sample	Total PAH		Benzo(a)Pyrene		Lead		Nickel	
	Total	TCLP[3]	Total	TCLP	Total	TCLP	Total	TCLP
101/0.2	NA	NA	NA	NA	NA	NA	77	0.1
101/1.5	35.4	0.004	3.8	<0.001	NA	NA	NA	NA
102/0.45	41.1	0.004	4.2	<0.001	NA	NA	NA	NA
102/1.0	14.7	0.005	1.3	<0.001	NA	NA	NA	NA
201/0.4-0.5	25.6	0.01	2.7	<0.001	NA	NA	NA	NA
201/1.3-1.5	12.4	0.012	1.3	<0.001	NA	NA	NA	NA
203/0.8-1	16	<0.001	1.6	<0.001	660	0.03	NA	NA
205/0.3-0.5	177.7	0.059	16	<0.001	NA	NA	NA	NA
BD4 170510	222.4	0.01	18	<0.001	NA	NA	NA	NA
206/1-1.2	10.9	<0.001	1	<0.001	NA	NA	NA	NA
BD1 240510	NA	NA	NA	NA	130	0.5	NA	NA
General Solid Waste Guidelines								
Without TCLP	-	-	0.8	-	100	-	40	-
With TCLP	200	-	10	0.04	1500	5	1050	2

Notes	
1	Waste Classification Guidelines 2008. General Solid Waste Without TCLP
2	Waste Classification Guidelines 2008. General Solid Waste With TCLP
3	where results less than practical quantitative limit (PQL), quoted as less than PQL for most individual compounds
NA	Not applicable TCLP test not run for sample/analyte
bold and shading	exceeds General Solid Waste Guidelines with TCLP

Table 10 – Groundwater Results

Sample ID	Heavy Metals											TPH		BTEX					PAH						Oil and Grease (mg/L)	pH
	As	Cd	Ch	Cu	Pb	Hg	Ni	Zn	Fe (total)	Fe (ferrous)	Mn	C6-C9	C10-C36	Benzene	Toluene	Ethyl Benzene	Xylenes	Total[3]	B(a)P	Anthracene	Phenanthrene	Fluoranthene	Naphthalene		
101-GW	<1	<0.1	<1	8	15	<0.5	<1	12	53,000	9100	2900	<10	<250	<1	<1	<1	<3	<1	<1	<1	<1	<1	<1	<5	6.5
Guidelines																									
ANZECC[1]	2.3*	5.5	27.4	1.3	4.4	0.4	70	15	300*	-	80*	1502	6002	500	180*	5*	425*	-	0.2*	0.4*	2*	1.4*	70	-	-

Notes:

1 ANZECC 2000 Trigger levels for marine water moderate reliability for 95% of species unless otherwise indicated.
2 Airport Regulations (1997)
3 Given as sum of PQL of all analytes in list where all analytes below PQL
* Low reliability guideline
Shading Exceeds GIL

12. DISSCUSSION OF RESULTS

Based on the site history review the site appears to have been occupied since European settlement. This site was the location of Fort Macquarie until 1901 and was later redeveloped for a tram shed and wharves/jetties between 1901 and 1950. The site was redeveloped for the Sydney Opera House in the 1960s and 1970s. During the course of the European occupation of the site it has been subject to several episodes of filling and reclamation associated with the various uses of the site.

Generally speaking it is considered that the land use would have a low overall contamination potential, although there is a potential for contamination from filling imported to the site from unknown and various sources.

Details of the sub-surface conditions encountered during the course of the investigation are included in the Test Bore Report Sheets (Appendix D). The bore locations are shown on Drawing 1, Appendix A. The soils were generally free of obvious signs of chemical contamination such as odours or staining, however trace ash was noted in Test Bores 201, 203 and 205.

The conditions encountered typically consisted of pavements to depths between 0.2 m to 0.4 underlain by filling to depths ranging between 0.8 m below ground level to 4.95 m below ground level consisting of sand with inclusions of sandstone gravel overlying ballast (“blue metal” gravels and cobbles). The filling was underlain by sandstone.

12.1 Contaminants in Soil

Soil samples were analysed for a variety of commonly occurring contaminants including heavy metals, TPH, BTEX, PAH, OCP, PCB, phenols, VOCs and asbestos.

12.1.1 Heavy Metals

Soil samples were analysed for the priority heavy metals (i.e. arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc. The concentrations of all heavy metals were within the SAC for all samples tested. It is therefore considered that the site is not likely to be significantly impacted by heavy metals.

12.1.2 TPH, BTEX

Soil samples were tested for total petroleum hydrocarbons (TPH) and BTEX (benzene, toluene, ethyl benzene and xylenes). The concentrations of the volatile fraction TPH (C_6-C_9) and BTEX were below the laboratory detection limits in all samples and therefore within the SAC. It is therefore considered that the site is not likely to be significantly impacted by volatile fraction TPH (C_6-C_9) or BTEX.

The regards to heavy fraction TPH the test results were below detection limits in the majority of the samples tested. The following exceptions were noted;

- Sample 101/1.5 (C_{15}-C_{29} – 120 mg/kg);
- Sample 102/0.45 (C_{15}-C_{29} – 140 mg/kg);
- Sample 203/0.4-0.5 (C_{10}-C_{14} -57 mg/kg, C_{15}-C_{29} – 210 mg/kg and C_{29}-C_{36} – 200 mg/kg);
- Sample 203/0.8-1 (C_{15}-C_{29} – 210 mg/kg and C_{29}-C_{36} – 240 mg/kg);
- Sample 205/0.3-0.5 (C_{15}-C_{29} – 870 mg/kg and C_{29}-C_{36} – 550 mg/kg);
- Sample BD4 170510 (replicate of sample 205/0.3-0.5) (C_{15}-C_{29} – 870 mg/kg and C_{29}-C_{36} – 550 mg/kg).

In the case of samples 101/1.5, 102/0.45, 203/0.4-0.5 and 203/0.8-1 the sum of the C10-C36 fraction was less then the adopted SAC of 1000 mg/kg and therefore not considered significant. In the case of sample 205/0.3-0.5 (and its replicate BD4 170510) the sum of the C10-C36 fraction exceeded the SAC of 1000 mg/kg. This elevated level is however considered to be associated with the PAH levels (discussed further in Section 12.1.4) detected in the samples and given the nature of the site and the thick pavements does not represent a significant risk to site users or construction workers exposed during construction. It is therefore considered that remediation and removal of the impacted soils (outside that which is required for excavation works associated with the VAPS project) is not

necessary and that any residual impacted soils would be effectively capped under the pavement once the works are completed.

12.1.3 VOCs

Six selected soil samples were analysed for volatile organic compounds (VOCs). The concentrations of VOCs were below the laboratory detection limits in all samples It is therefore considered that the site is not likely to be significantly impacted by VOCs.

12.1.4 PAH

Soil samples, including filling and natural soils were analysed for PAH. Generally speaking the concentrations of PAH were low and within the adopted SAC. The following exceedances were detected for PAH;

- Sample 101/1.5 – benzo(a)pyrene 3.5 mg/kg compared to SAC of 2 mg/kg;
- Sample 102/0.45 – benzo(a)pyrene 4.2 mg/kg compared to SAC of 2 mg/kg and total PAH 41.1 mg/kg compared to SAC of 40 mg/kg;
- Sample 201/0.4-0.5 benzo(a)pyrene 2.7 mg/kg compared to SAC of 2 mg/kg;
- Sample 205/0.4-0.5 benzo(a)pyrene 16 mg/kg compared to SAC of 2 mg/kg and total PAH 177.7 mg/kg compared to SAC of 40 mg/kg; and
- Sample BD4 170510 (replicate of 205/0.4-0.5) benzo(a)pyrene 18 mg/kg compared to SAC of 2 mg/kg and total PAH 222.4 mg/kg compared to SAC of 40 mg/kg.

The locations of the PAH exceedances are shown on Drawing 2, Appendix A.

It is noted that the benzo(a)pyrene and total PAH concentrations detected in sample 205/0.4-0.5 and BD4 170510 are at hotspot (2.5 times the guideline level) concentrations.

It is noted that, based on site observations and test bore logs the elevated PAH levels are likely to be associated with trace ash and in the case of sample 205/0.3-0.5 (and its replicate BD4 170510) trace bitumen fragments in the filling. It is therefore considered that there is a limited potential adverse health impact from the elevated levels (i.e. they are generally locked into particulate) and they are therefore not significant unless the particulate is ingested.

Furthermore TCLP results demonstrate that the elevated PAH levels are not leachable and therefore there is not considered to be an off-site migration risk.

It is therefore considered that the elevated PAH levels do not present a significant risk to site users or workers during the VAPS construction works. Therefore it is not necessary to remove (remediate) the PAH impacted at the site beyond that which will be removed as part of the VAPS excavation works and that any residual PAH impacted soils would be effectively capped once the pavement is reinstated.

12.1.5 OCP and PCB

Soil samples were analysed for OCP and PCB. The concentration of OCP and PCB was below the laboratory detection limits and therefore with the site SAC in all samples. On this basis it is considered that the site soils are not likely to be impacted by OCP or PCB.

12.1.6 Phenols

The results of soil samples analysed for phenols were all below the laboratory detection limits and therefore well within the adopted assessment criteria. On this basis it is considered that the site soils are not likely to be impacted by phenols.

12.2 Asbestos

The filling soil samples were analysed for asbestos. Asbestos was not detected at reporting limits in any of samples tested. It is noted however that the site contained uncontrolled filling and therefore at the time of excavation the excavated spoil should be inspected by an experienced environmental consultant to confirm the absence (or otherwise) of asbestos in the filling prior to disposal.

12.3 Preliminary Waste Classification

A Preliminary Waste Classification of the *in situ* fill material was generally conducted in accordance with the six step process as set out in the NSW Department of Environment and Climate Change (DECC) *Waste Classification Guidelines* (2008 Revised July 2009) and summarised in Table 11 below.

Table 11 - Six Step Classification

Step	Classification	Rationale
1. Is it special waste?	No	Waste not considered to be clinical waste, tyre waste. No fibre-cement fragments were observed in the test bores
2. Is it liquid waste?	No	Waste composed of soil matrix (i.e. no liquids)
3. Is the waste "pre-classified"?	No	Waste not observed to contain coal tar, batteries, lead paint or dangerous goods containers.
4. Does the waste have hazardous waste characteristics?	No	Waste not observed to/ or considered at risk to contain explosives, gases, flammable solids, oxidising agents, organic peroxides, toxic substances or corrosive substances
5. Chemical Assessment	Laboratory Analysis conducted to confirm contaminant concentrations were within General Solid Waste Criteria	Waste not observed to/ or considered at risk to contain explosives, gases, flammable solids, oxidising agents, organic peroxides, toxic substances or corrosive substances, waste not observed to contain coal tar, batteries or dangerous goods containers. However, laboratory analysis was carried out to verify the contaminant concentrations
6. Is the waste putrescible?	No	All observed soil / fill are of non-putrescible nature (i.e. soil and gravel)

It is noted that Sample 205/0.3-0.5 had a total benzo(a)pyrene concentration of 16 mg/kg its replicate sample BD4 170510 had a total benzo(a)pyrene concentration of 18 mg/kg which are in excess of the General Soil Waste Guidelines with TCLP. However trace ash and bitumen fragments were noted in the sample and therefore the soil can be classified on the basis of TCLP results only as per the DECCW's general approval of immobilisation of contaminants in waste, Approval Number 1999/05. Taking this into account, based on the low leachability of the sample, the sample is classified as general solid waste.

It is noted that the based on the acid sulphate soils assessment (DP project 43529.01) the soils at the site are not actual or potential acid sulphate soils and therefore do not impact the waste classification. If however actual or potential acid sulphate soils are discovered during the excavation works the materials would need to be assessed and treated prior to disposal.

Based on the results of the assessment the filling at the site is assigned a preliminary classification as **General Solid Waste (non-putrescible)**.

It is noted that the site was filled/reclaimed with uncontrolled filling over an extensive period of time. Extreme care should therefore be exercised in verifying the presence or otherwise of asbestos in the waste material. If detected during excavation works, any waste material containing asbestos must be classified as Asbestos Waste. Furthermore, it is recommended that any filling material that is disposed of off site should be verified *ex situ* (i.e. after excavation in stockpile) to confirm the waste classification.

The underlying natural sandstone (as described in the test bore logs) is classified as virgin excavated natural material (VENM) provided it has not been impacted by odours or staining and it is not cross contaminated with non-VENM material during excavation, stockpiling and disposal.

12.4 Groundwater Results

A groundwater sample was collected from a piezometer installed in Test Bore BH101. The groundwater sample was analysed for a variety of common contaminants including, heavy metals, TPH, BTEX, PAH, iron, manganese, oil and grease and pH.

The results of the organic analysis (TPH, BTEX, PAH and oil and grease) were below the detection limits and therefore well within the adopted GIL. It is noted that elevated levels of some heavy metals were detected (including Cu – 8 µg/L compared to a GIL of 1.3 µg/L, Pb – 15 µg/L compared to a GIL of 4.4 µg/L, iron – 53,000 µg/L compared to a GIL of 300 µg/L and Mn 2900 µg/L compared to a GIL of 80 µg/L).

However the elevated metal concentrations were not considered to be significant due the fact that the waters are highly tidal and likely to be representative of conditions in Sydney Harbour (i.e. background conditions).

It should be noted, however, that the groundwater sample was recovered from one location and one instant in time. Should dewatering be required as part of the VAPS project, it may be necessary to undertake further groundwater assessment, possibly on a regular basis during the works, prior to disposal.

13. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of this preliminary assessment it is considered that the site is suitable (from a contamination standpoint) for the proposed development and that the levels and nature of contamination detected are not likely to pose a significant risk to site users or workers during the construction period of the VAPS works. Furthermore, the final construction outcome will eliminate exposure pathways between general users of the site and the underlying soils with all floors, walls and ceilings being lined.

The filling at the site is provisionally classified as General Solid Waste (non-putrescible), however it is recommended that the waste classification be confirmed via *ex situ* assessment of the excavated spoil prior to final classification and disposal. The underlying natural sandstone is classified as VENM, provided it has not been impacted by odours or staining, however care should be taken in segregating natural and filling materials to avoid cross-contamination and the excavated VENM inspected prior to removal (and additional analysis conducted as/if necessary).

Based on the one test conducted, it is considered that groundwater beneath the site is not likely to present a significant health risk to workers involved in the VAPS project. However, should dewatering be required as part of the VAPS project, it may be necessary to undertake further groundwater assessment, possibly on a regular basis during the works, prior to disposal.

Due to the inherent variability of the filling beneath the site, and the fact that a number of the investigation bores refused within filling material (i.e. deeper filling could not be assessed at some locations) it is recommended that filling excavation works be monitored by an experienced environmental consultant. Furthermore, it is recommended that a Construction Environmental Management Plan be prepared and implemented to control segregation of materials, final waste classification, and management "unexpected finds".

14. LIMITATIONS OF THIS REPORT

The scope of the site assessment activities and consulting services undertaken by DP were limited to those detailed in the proposal dated 29 April 2010 and accepted by The Sydney Opera House Trust.

DP's assessment is necessarily based upon the result of a limited site investigation and the restricted programme of surface and subsurface sampling, screening and chemical testing which was set out in the proposal. DP cannot provide unqualified warranties with regards to site contamination nor does DP assume any liability for site conditions not observed or accessible during the time of the investigations.

Despite all reasonable care and diligence, the ground conditions encountered and concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. In addition, site characteristics may change over time due to activities such as spillages of contaminating substances. These changes may occur subsequent to DP's investigations and assessment.

This report, its associated documentation and the information herein have been prepared solely for the use of the Sydney Opera House trust. Any reliance assumed by third parties on this report shall be at such parties' own risk.

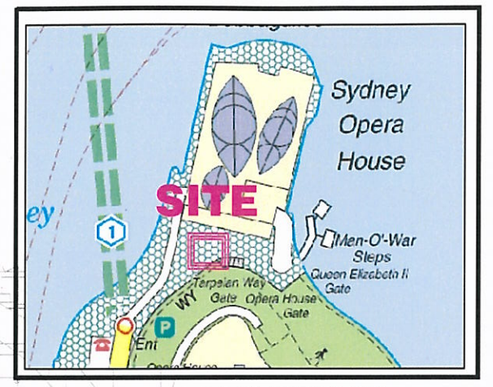
DOUGLAS PARTNERS PTY LTD

Kurt Plambeck
Environmental Scientist

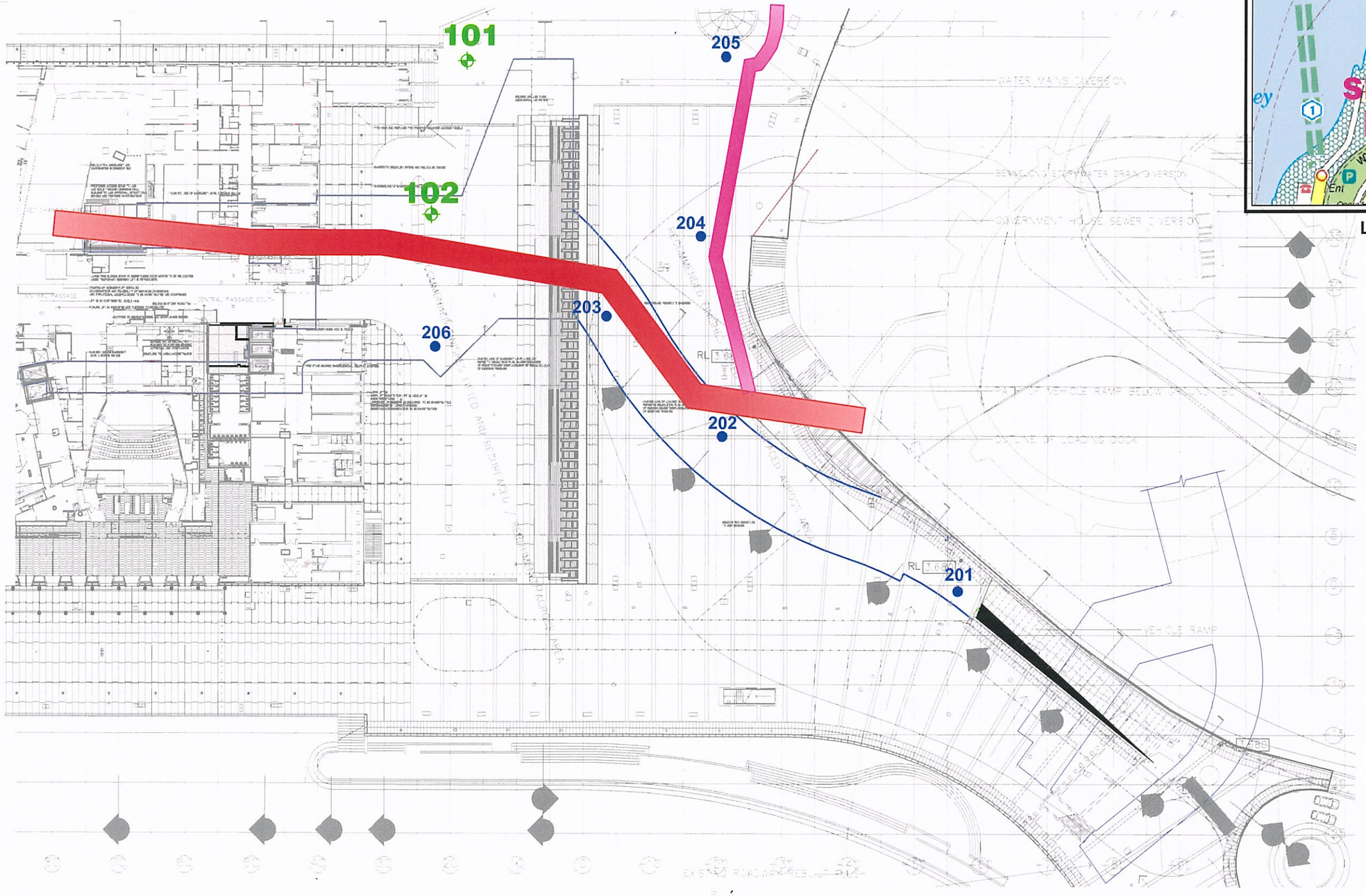
Reviewed by

Paul Gorman
Manager, Environmental Services

APPENDIX A
Site Drawings



LOCALITY PLAN



SCALE
0 10 20 30 40 50m
1:800

LEGEND

- PREVIOUS DP TEST BORE
- CURRENT DP TEST BORE
- NEW TUNNEL & LOADING DOCK
- PROPOSED STORMWATER DIVERSION
- EXISTING BENNELONG DRAIN

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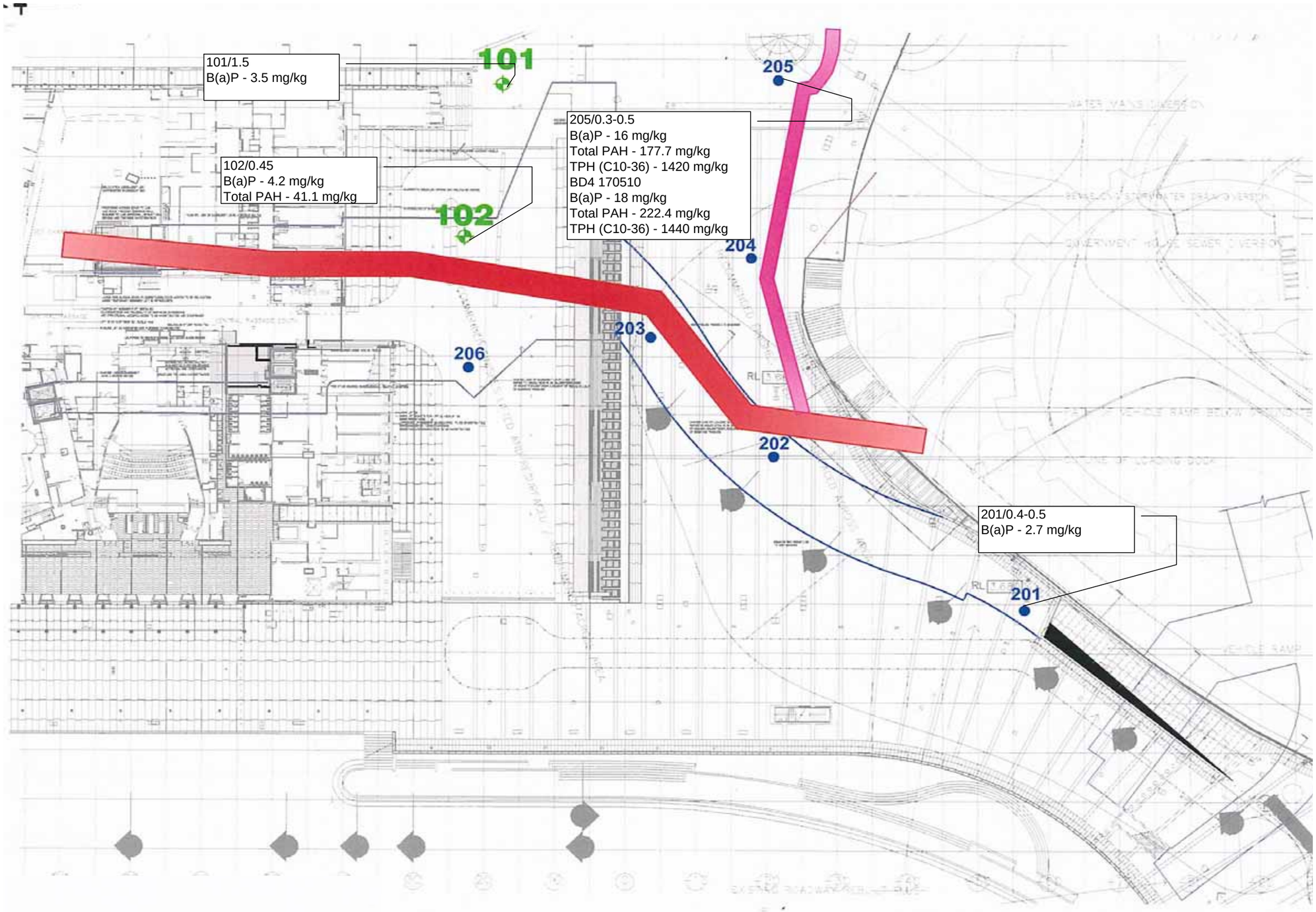
CLIENT: Sydney Opera House Trust		
DRAWN BY: PSCH	SCALE: As shown	OFFICE: Sydney
APPROVED BY:		DATE: 3.6.2010

TITLE: **Location of Test Bores,Vehicle & Pedestrian Safety (VAPS) Project, Contamination Assessment Sydney Opera House, BENNELONG POINT**

PROJECT No:	71529.01
DRAWING No:	1
REVISION:	A



Douglas Partners Geotechnics · Environment · Groundwater	CLIENT: Sydney Opera House Trust			TITLE: **Location of Exceedances** **VAPS Contamination Assessment** **Sydney Opera House, Bennelong Point**	Project No: 71529.01
	DRAWN BY: FW	SCALE: NTS	OFFICE: Sydney		Drawing No: 2
	APPROVED BY: KP		DATE: 08.03.2010		Revision: A

APPENDIX B
Site Photographs

Photo 1: Test Bore 201

Photo 2: Test Bore 204 and 202 looking west

Preliminary Contamination Assessment **Vehicle and Pedestrian Safety (VAPS) Project** **Sydney Opera House, Bennelong Point**	**Project** **71529.01**	**June** **2010**	**Plate** **1**

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Photo 3: Test Bores 202 and 204 looking south towards Tarpeian Way

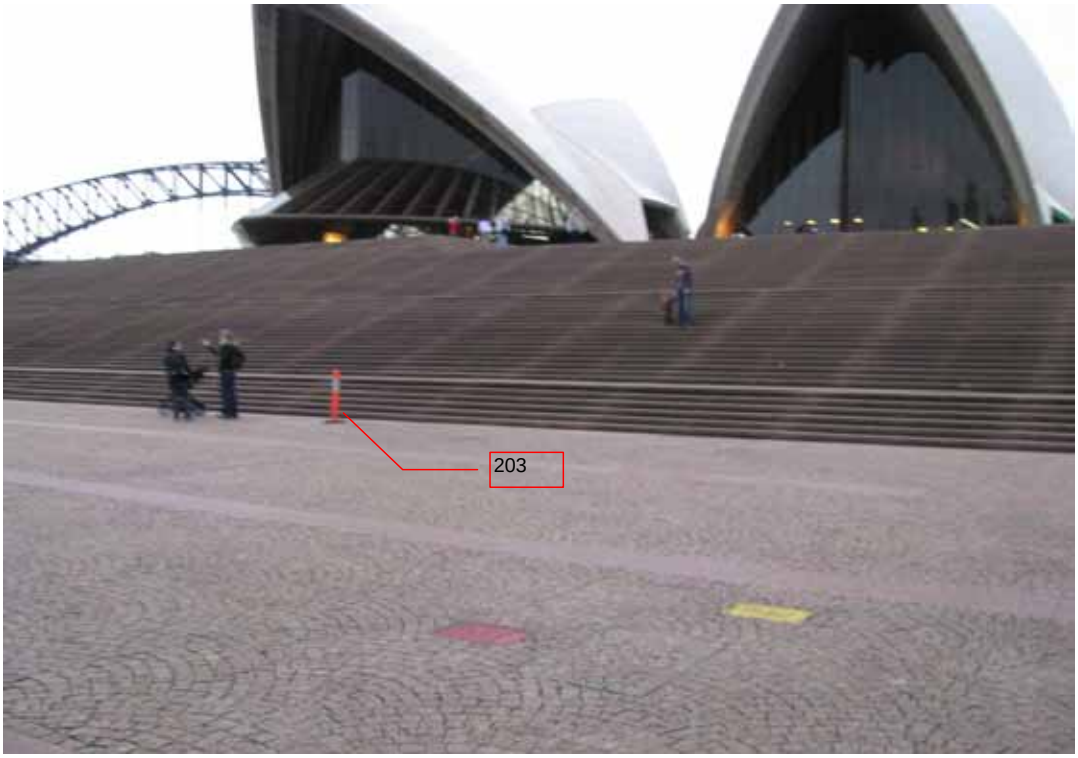

Photo 4: Test Bore 203 looking north west

Preliminary Contamination Assessment Vehicle and Pedestrian Safety (VAPS) Project Sydney Opera House, Bennelong Point	**Project 71529.01**	**June 2010**	**Plate 2**

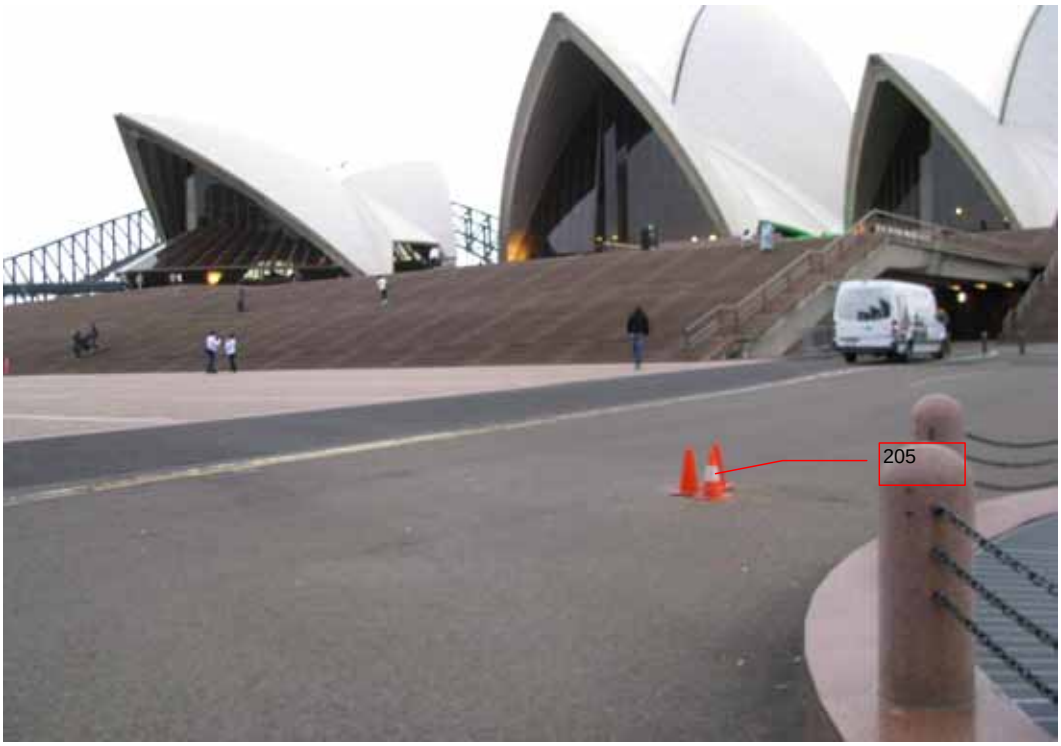

Photo 5: Test Bore 205 looking south west

Photo 6: Test Bore 206

Preliminary Contamination Assessment **Vehicle and Pedestrian Safety (VAPS) Project** **Sydney Opera House, Bennelong Point**	**Project** **71529.01**	**June** **2010**	**Plate** **3**

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APPENDIX C
Site History Information

Photo 7: Top of Bennelong Drain adjacent to Fort Macquarie circa 1850s

Source: (reproduced in) Godden Mackay Logan 2009

Photo 8: Fort Macquarie, 19th Century Source: http://www.sydneyarchitecture.com

Photo 9: Early 20th Century. Tramshed that replaced Fort Macquarie
Source: http://www.sydneyarchitecture.com

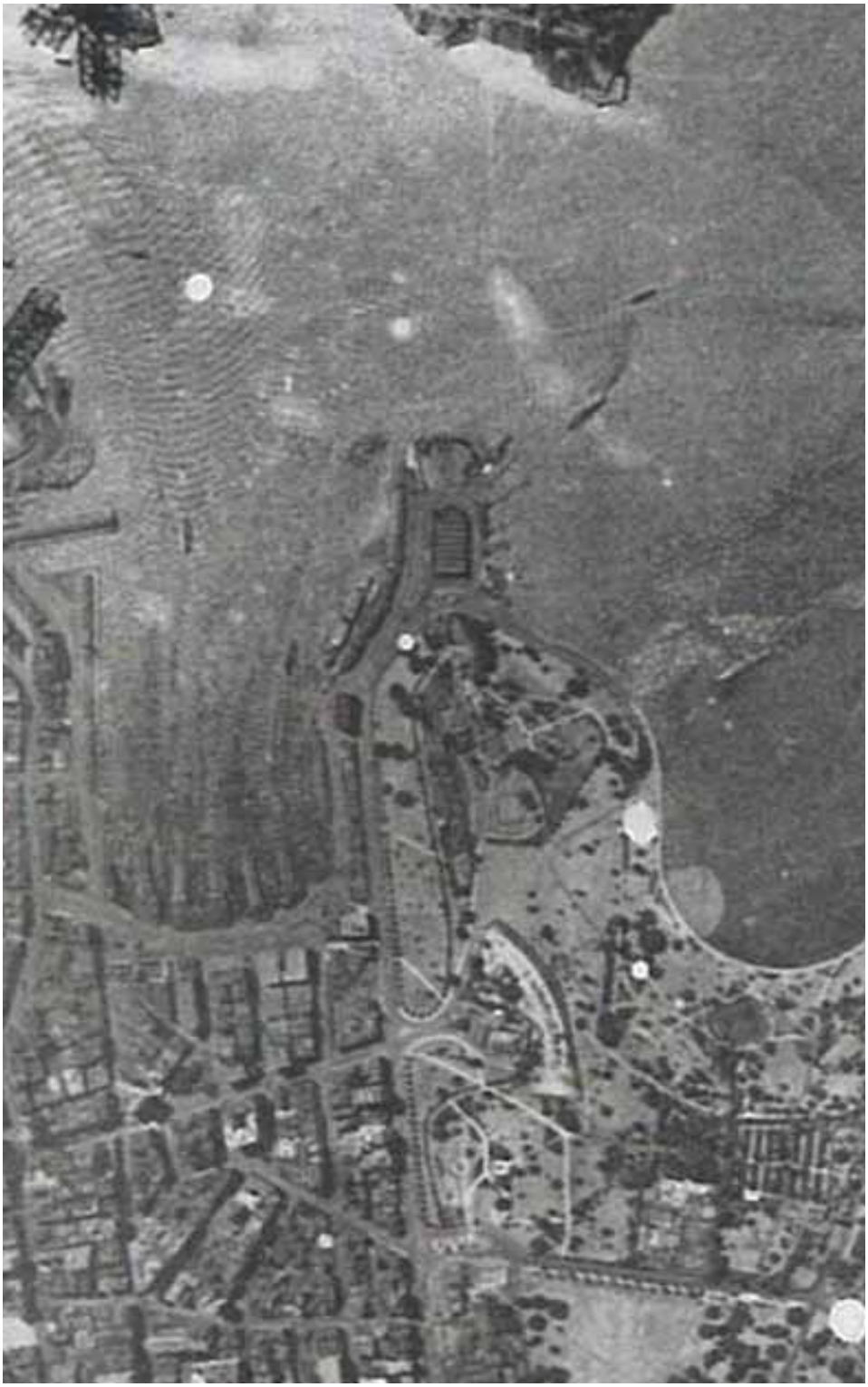

Photo 10: 1930 Aerial Photograph

Preliminary Contamination Assessment **Vehicle and Pedestrian Safety (VAPS) Project** **Sydney Opera House, Bennelong Point**	**Project** **71529.01**	**June** **2010**	**Plate** **6**

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Photo 11: 1943 Aerial Photograph

Preliminary Contamination Assessment **Vehicle and Pedestrian Safety (VAPS) Project** **Sydney Opera House, Bennelong Point**	**Project** **71529.01**	**June** **2010**	**Plate** **7**

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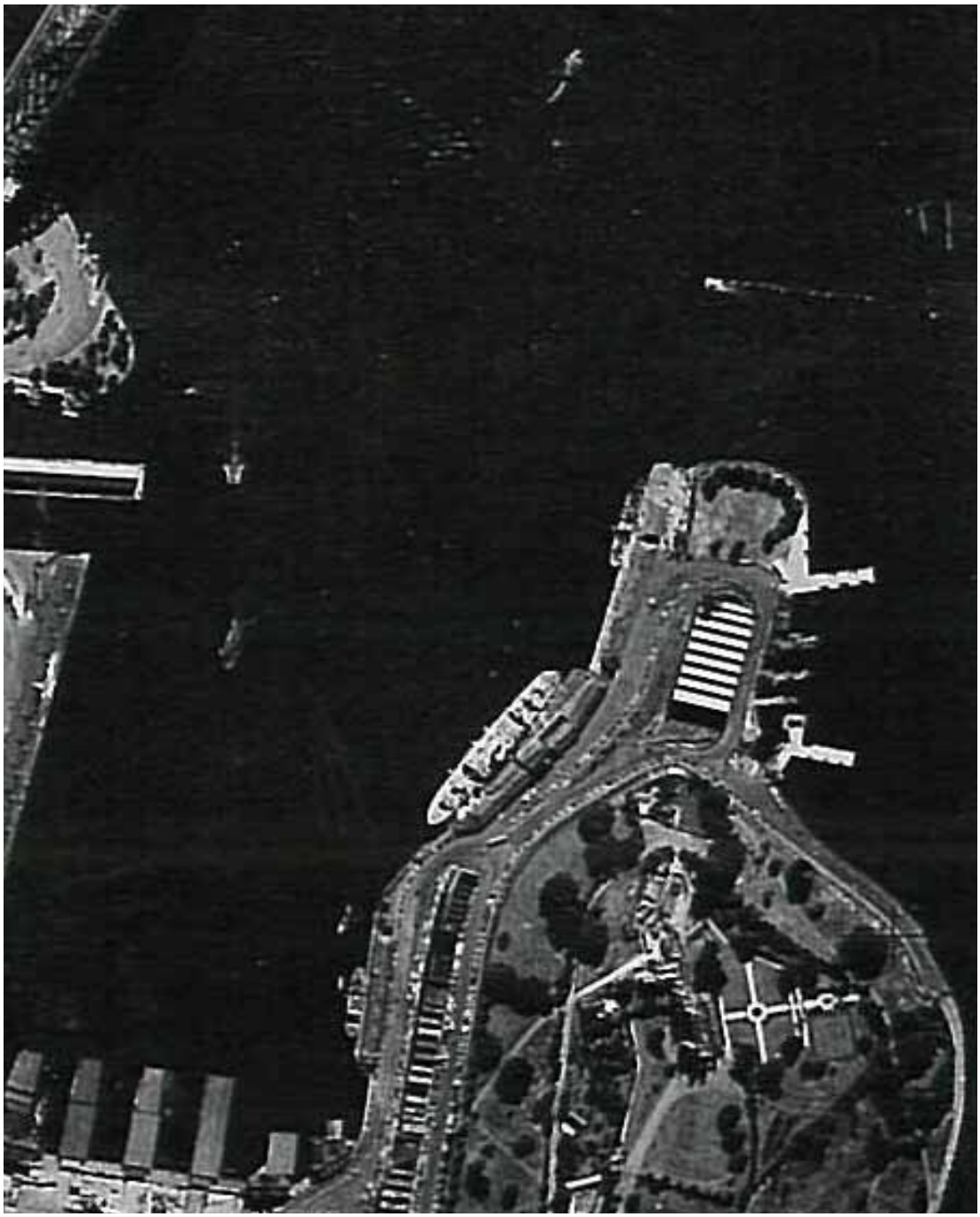

Photo 12: 1951 Aerial Photograph

Preliminary Contamination Assessment **Vehicle and Pedestrian Safety (VAPS) Project** **Sydney Opera House, Bennelong Point**	**Project** **71529.01**	**June** **2010**	**Plate** **8**

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Photo 13: Opera House During Construction 1960s
Source: (reproduced in) Godden Mackay Logan 2009)

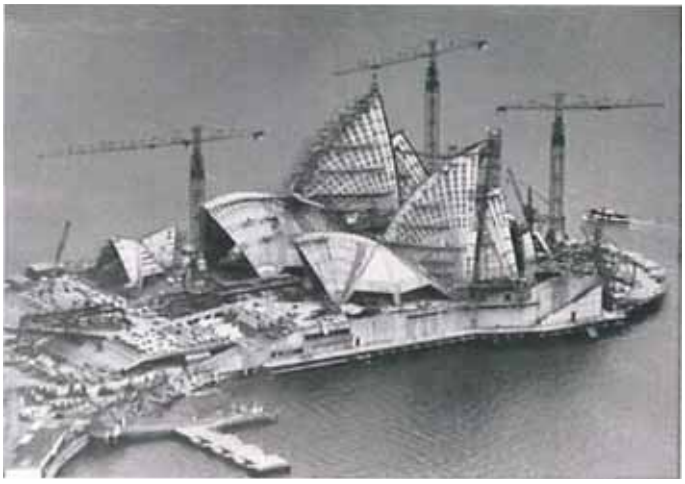

Photo 14: Opera House During Construction 1960s
Source: (reproduced in) Godden Mackay Logan 2009)

Photo 15: Opera House During Construction
Source: http://www.sydneyarchitecture.com

Photo 16: 1970 Aerial Photograph

Preliminary Contamination Assessment **Vehicle and Pedestrian Safety (VAPS) Project** **Sydney Opera House, Bennelong Point**	**Project** **71529.01**	**June** **2010**	**Plate** **10**

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Photo 17: 1978 Aerial Photograph

Preliminary Contamination Assessment Vehicle and Pedestrian Safety (VAPS) Project Sydney Opera House, Bennelong Point	Project 71529.01	June 2010	Plate 11

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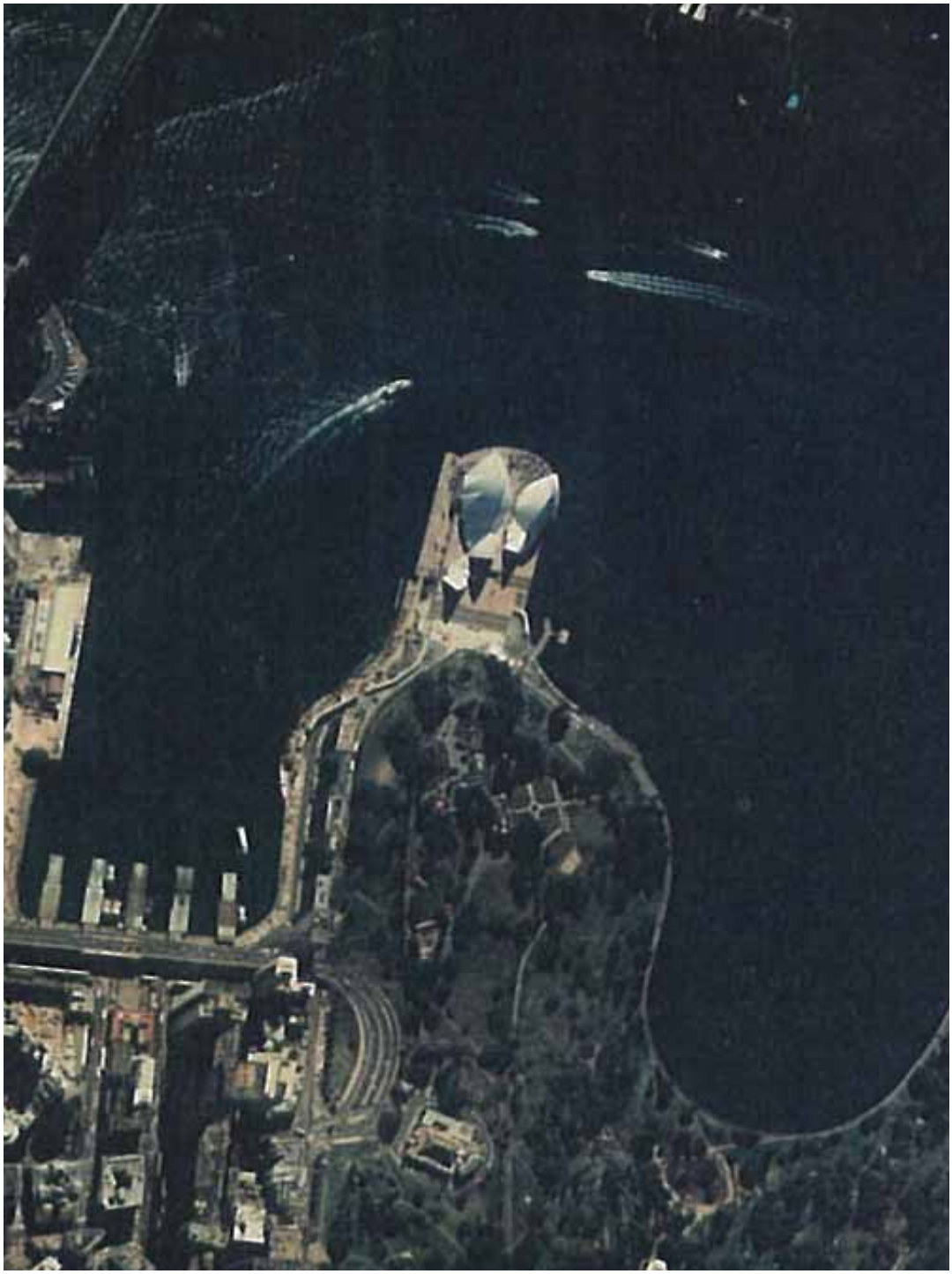

Photo 18: 1986 Aerial Photograph

Preliminary Contamination Assessment **Vehicle and Pedestrian Safety (VAPS) Project** **Sydney Opera House, Bennelong Point**	**Project** **71529.01**	**June** **2010**	**Plate** **12**

Photo 19: 1991 Aerial Photograph

Preliminary Contamination Assessment **Vehicle and Pedestrian Safety (VAPS) Project** **Sydney Opera House, Bennelong Point**	**Project** **71529.01**	**June** **2010**	**Plate** **13**

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Photo 20: 2004 Aerial Photograph

Preliminary Contamination Assessment **Vehicle and Pedestrian Safety (VAPS) Project** **Sydney Opera House, Bennelong Point**	**Project** **71529.01**	**June** **2010**	**Plate** **14**

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Photo 21: 2005 Aerial Photograph

Preliminary Contamination Assessment **Vehicle and Pedestrian Safety (VAPS) Project** **Sydney Opera House, Bennelong Point**	**Project** **71529.01**	**June** **2010**	**Plate** **15**

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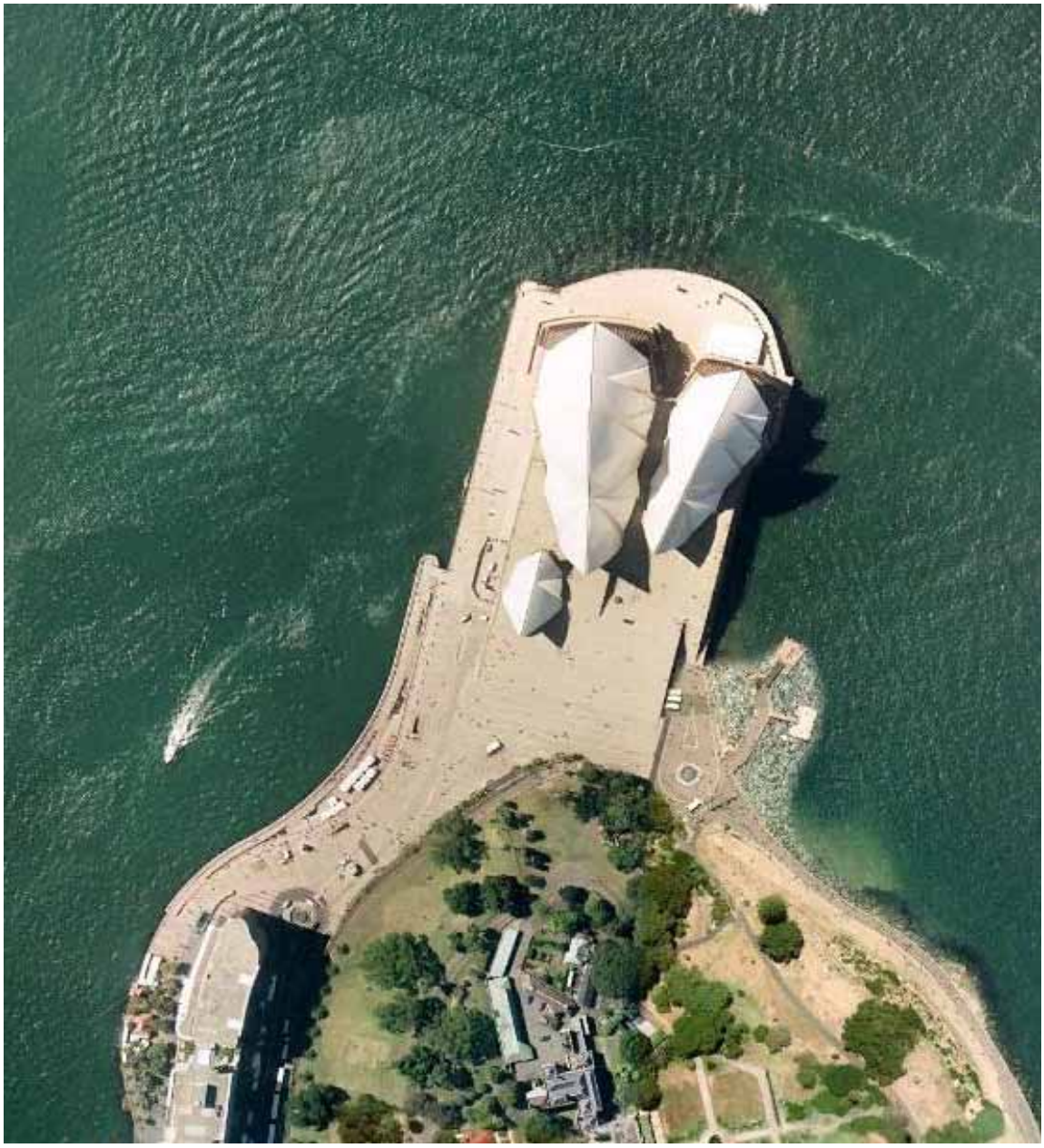

Photo 22: 2010 Aerial Photograph

Preliminary Contamination Assessment **Vehicle and Pedestrian Safety (VAPS) Project** **Sydney Opera House, Bennelong Point**	**Project** **71529.01**	**June** **2010**	**Plate** **16**

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Douglas Partners Geotechnics • Environment • Groundwater	CLIENT: Sydney Opera House Trust		TITLE:	**Registered Groundwater Wells**	Project No: 71529.01
	DRAWN BY: FW	SCALE: NTS	OFFICE: Sydney	**VAPS Contamination Assessment**	Drawing No: 3
	APPROVED BY: KP		DATE: 08.03.2010	**Sydney Opera House, Bennelong Point**	Revision: A

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, June 7, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW109085

Works Details (top)

GROUNDWATER NUMBER GW109085
LIC-NUM
AUTHORISED-PURPOSES
INTENDED-PURPOSES
WORK-TYPE
WORK-STATUS
CONSTRUCTION-METHOD
OWNER-TYPE
COMMENCE-DATE
COMPLETION-DATE
FINAL-DEPTH (metres)
DRILLED-DEPTH (metres)
CONTRACTOR-NAME
DRILLER-NAME
PROPERTY
GWMA
GW-ZONE
STANDING-WATER-LEVEL
SALINITY
YIELD

Site Details (top)

REGION
RIVER-BASIN
AREA-DISTRICT
CMA-MAP
GRID-ZONE
SCALE
ELEVATION
ELEVATION-SOURCE
NORTHING
EASTING
LATITUDE
LONGITUDE
GS-MAP

AMG-ZONE
COORD-SOURCE
REMARK

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, June 7, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW109086

Works Details (top)

GROUNDWATER NUMBER GW109086
LIC-NUM
AUTHORISED-PURPOSES
INTENDED-PURPOSES
WORK-TYPE
WORK-STATUS
CONSTRUCTION-METHOD
OWNER-TYPE
COMMENCE-DATE
COMPLETION-DATE
FINAL-DEPTH (metres)
DRILLED-DEPTH (metres)
CONTRACTOR-NAME
DRILLER-NAME
PROPERTY
GWMA
GW-ZONE
STANDING-WATER-LEVEL
SALINITY
YIELD

Site Details (top)

REGION
RIVER-BASIN
AREA-DISTRICT
CMA-MAP
GRID-ZONE
SCALE
ELEVATION
ELEVATION-SOURCE
NORTHING
EASTING
LATITUDE
LONGITUDE
GS-MAP

AMG-ZONE
COORD-SOURCE
REMARK

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Monday, June 7, 2010

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW109087

Works Details (top)

GROUNDWATER NUMBER GW109087
LIC-NUM
AUTHORISED-PURPOSES
INTENDED-PURPOSES
WORK-TYPE
WORK-STATUS
CONSTRUCTION-METHOD
OWNER-TYPE
COMMENCE-DATE
COMPLETION-DATE
FINAL-DEPTH (metres)
DRILLED-DEPTH (metres)
CONTRACTOR-NAME
DRILLER-NAME
PROPERTY
GWMA
GW-ZONE
STANDING-WATER-LEVEL
SALINITY
YIELD

Site Details (top)

REGION
RIVER-BASIN
AREA-DISTRICT
CMA-MAP
GRID-ZONE
SCALE
ELEVATION
ELEVATION-SOURCE
NORTHING
EASTING
LATITUDE
LONGITUDE
GS-MAP

AMG-ZONE
COORD-SOURCE
REMARK

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Environment, Climate Change & Water

Search results

Your search for: LGA: Sydney City Council

Matched 27 notices relating to 14 sites.

Search Again | Refine Search

Suburb	Address	Site Name	Notices related to this site
Alexandria	Off Huntley Street	Alexandra Canal	2 current
Alexandria	49-59 O'Riordan Street	Cadbury Schweppes Site	1 former
Erskineville	Off Burren Street	Macdonaldtown Triangle	2 former
Millers Point	36 Hickson Road	Millers Point Gasworks	2 former
Millers Point	Wharves 5 and 7, Hickson Road	Millers Point Gasworks	1 current and 2 former
Millers Point	Hickson Road	Millers Point Gasworks	1 current and 2 former
Newtown	81 Wilson Street	MBL Service Station	4 former
Newtown	79 Wilson Street	Property Adjacent to MBL Service Station	3 former
Pyrmont	Pyrmont Road	Pyrmont Power Station	7 former
Waterloo	903-921 Bourke Street	Affected by Lawrence Dry Cleaners	4 current and 1 former
Waterloo	901 Bourke Street	Affected by Lawrence Dry Cleaners	4 current and 1 former
Waterloo	895-899 Bourke Street	Affected by Lawrence Dry Cleaners	4 current and 1 former
Waterloo	207-229 Young Street	Affected by Lawrence Dry Cleaners	4 current and 1 former
Waterloo	887-893 Bourke Street	Lawrence Dry Cleaners	4 current and 1 former

Page 1 of 1

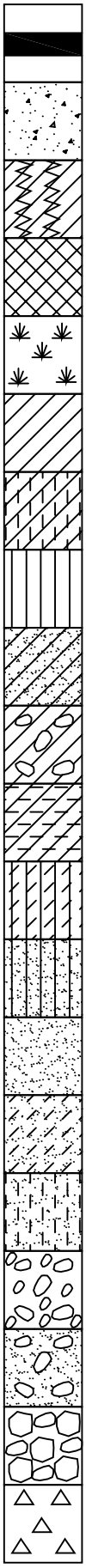
7 June 2010

APPENDIX D

Test Bore report results and Notes Relating to this Report

GRAPHIC SYMBOLS FOR SOIL & ROCK

SOIL



BITUMINOUS CONCRETE

CONCRETE

TOPSOIL

FILLING

PEAT

CLAY

SILTY CLAY

SILT

SANDY CLAY

GRAVELLY CLAY

SHALY CLAY

CLAYEY SILT

SANDY SILT

SAND

CLAYEY SAND

SILTY SAND

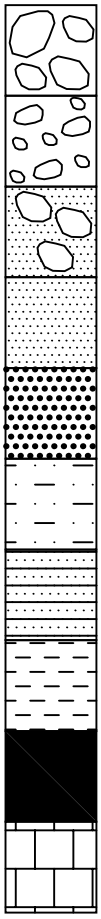
GRAVEL

SANDY GRAVEL

COBBLES/BOULDER

TALUS

SEDIMENTARY ROCK



BOULDER CONGLOMERATE

CONGLOMERATE

CONGLOMERATIC SANDSTONE

SANDSTONE FINE GRAINED

SANDSTONE COARSE GRAINED

SILTSTONE

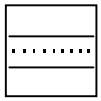
LAMINITE

MUDSTONE, CLAYSTONE, SHALE

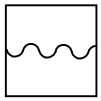
COAL

LIMESTONE

SEAMS

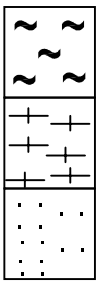


SEAM >10mm



SEAM <10mm

METAMORPHIC ROCK

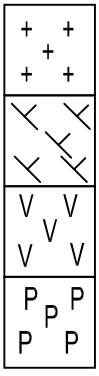


SLATE, PHYLLITE, SCHIST

GNEISS

QUARTZITE

IGNEOUS ROCK



GRANITE

DOLERITE, BASALT

TUFF

PORPHYRY

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BOREHOLE LOG

CLIENT: Sydney Opera House Trust
PROJECT: Vehicle & Pedestrian Safety (VAPS) Project
LOCATION: Bennelong Point

SURFACE LEVEL: 3.5 m AHD* **BORE No:** 101
EASTING: **PROJECT No:** 71529
NORTHING: **DATE:** 17 Dec 09
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.13	ASPHALT - 130mm thick										
	0.2	ROADBASE - blue metal gravel and some sand							A			
		FILLING - grey sand filling, with some sandstone gravel, dry							A			PID<1ppm
									S			3,3,3 N = 6
	1.5	FILLING - grey sand filling, with some sandstone gravel and blue metal gravel and cobbles (ballast)							A			30/150mm refusal PID<1ppm
	2.0	FILLING - bluemetal gravel and cobbles (ballast)										Water level measured on 9/1/10 at 2.48m
												Water level measured on 12/1/10 at 3.15m
	4.1	FILLING - loose, black, medium grained sand filling with some clayey silt, wet				17-12-09			A			PID<1ppm
	4.95	SANDSTONE - high strength, fresh, slightly fractured and unbroken, light grey with yellow coating, medium to coarse grained sandstone						Note: Unless otherwise stated, bedding planes are planar and rough	C	100	100	
	5.8	5.8-7.63m: fine to medium grained sandstone						5.61m: B2°, clay veneer				PL(A) = 1.2MPa
								6.15m: B2°				
								6.38m: B2°				PL(A) = 1.4MPa
								6.55m: D				
								6.82m: D				
								7.15m: B2°				
								7.25m: B2°	C	100	100	
	7.63							7.49m: B3°				
								7.62m: B2°				PL(A) = 1.3MPa UCS=17.1MPa
								9m: B4°				PL(A) = 1.4MPa
								9.28m: B2°	C	100	100	
	9.6 9.68	9.6-9.68m: very high strength siltstone band						9.68m: B4°, ironstained 9.75m: B3°, clay smear				PL(A) = 3.2MPa PL(A) = 1.2MPa

RIG: Multi-Drill **DRILLER:** Traccess **LOGGED:** PGH **CASING:** HW to 5.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 4.5m; Rotary to 4.95m; NMLC-Coring to 13.48m

WATER OBSERVATIONS: Free groundwater observed at 4.1m whilst augering (possibly sea water level). 80% water loss from approx 6.0m depth

REMARKS: Standpipe installed: Solid PVC 0.0-7.5m; Screen 7.5-13.5m. *Borehole surface level (approximate only) measured from SOBM-P601 and interpolated from survey plan (Sydney Opera House Survey Control Plan, Ground Floor + 12' External) by Hard & Forester

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: BJM
Date: 18/2/10

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BOREHOLE LOG

CLIENT: Sydney Opera House Trust
PROJECT: Vehicle & Pedestrian Safety (VAPS) Project
LOCATION: Bennelong Point

SURFACE LEVEL: 3.5 m AHD* **BORE No:** 101
EASTING: **PROJECT No:** 71529
NORTHING: **DATE:** 17 Dec 09
DIP/AZIMUTH: 90°/-- **SHEET** 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SANDSTONE - high strength, fresh, slightly fractured and unbroken, pale grey with yellow coating, medium to coarse grained sandstone *(continued)*						10.37m: D				PL(A) = 1.5MPa
	11								C	100	100	
	12	- indistinct cross-beds at 12.20m						11.95m: D				PL(A) = 1.5MPa
	13	- low strength siltstone band						12.94m: D	C	100	100	PL(A) = 1.3MPa
	13.48	Bore discontinued at 13.48m										PL(A) = 1.3MPa
	14											
	15											
	16											
	17											
	18											
	19											

RIG: Multi-Drill **DRILLER:** Traccess **LOGGED:** PGH **CASING:** HW to 5.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 4.5m; Rotary to 4.95m; NMLC-Coring to 13.48m

WATER OBSERVATIONS: Free groundwater observed at 4.1m whilst augering (possibly sea water level). 80% water loss from approx 6.0m depth

REMARKS: Standpipe installed: Solid PVC 0.0-7.5m; Screen 7.5-13.5m.*Borehole surface level (approximate only) measured from SOBM-P601 and interpolated from survey plan (Sydney Opera House Survey Control Plan, Ground Floor + 12' External) by Hard & Forester

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: BTM
Date: 18/2/10

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BOREHOLE LOG

CLIENT: Sydney Opera House Trust
PROJECT: Vehicle & Pedestrian Safety (VAPS) Project
LOCATION: Bennelong Point

SURFACE LEVEL: 3.6 m AHD* **BORE No:** 102
EASTING: **PROJECT No:** 71529
NORTHING: **DATE:** 20 Dec 09
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.075	ASPHALT - 70mm thick										
		CONCRETE - 370mm thick										
	0.44	FILLING - sand filling with sandstone and blue metal gravel (ballast), dry							A			PID<1ppm
									S			17,15,15 N = 30
	1.0	FILLING - sandstone filling, dry							A			PID<1ppm
	1.4	FILLING - blue metal gravel filling (ballast)							(S)			10/40mm refusal
	1.8	SANDSTONE - medium strength, slightly to moderately weathered, white grey, medium grained sandstone						Note: Unless otherwise stated, all bedding planes are planar and rough				
	2.2	SANDSTONE - high strength, fresh then slightly weathered, slightly fractured and unbroken, light grey, medium to coarse grained sandstone						2.5m: D	C	100	100	PL(A) = 1.7MPa
								2.9m: D				
								3.3m: B10° 3.34m: B10° 3.52m: B10°				PL(A) = 2MPa
								3.76m: B2°, clay				
								4.03m: B5° 4.19m: D 4.2m: B2° 4.38m: B2° 4.59m: crushed zone, 2°, 60mm thick 4.78m: B2° 4.84m: B, ironstained 5.07m: B2°, 2mm clay 5.17m: B2° 5.41m: B0° 5.5m: B0°, carbonaceous laminations 5.85m: B6° 6.05m: B0°	C	100	91	
		4.25-4.95m: moderately weathered, fractured zone, 700mm										PL(A) = 1.2MPa
	4.95	4.95-5.2m: high strength, laminite band, fresh										PL(A) = 1.1MPa
	5.2	SANDSTONE - high strength, fresh, slightly fractured and unbroken, light grey with yellow coating, medium grained sandstone, medium bedded										
		7.0-9.1m: possible 'yellow block' sandstone						6.75m: D 6.92m: D 7.15m: B1°	C	100	100	PL(A) = 1.9MPa
												PL(A) = 1.5MPa
								8.55m: B10°	C	100	96	PL(A) = 1.6MPa
								8.94m: B1° 8.95m: B1°, smooth 9.3m: B1° 9.44m: B2° 9.52m: B2°				PL(A) = 1.9MPa
		9.45-9.55m: carbonaceous laminations						9.73m: B3°, carbonaceous infill	C	100	96	

RIG: Multi-Drill **DRILLER:** Traccess **LOGGED:** PGH **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger to 2.2m; NMLC-Coring to 17.11m

WATER OBSERVATIONS: No free groundwtaer observed whilst augering

REMARKS: (S) Indicates no SPT sample recovered. *Borehole surface level (approximate only) measured from SOBM-P601 and interpolated from survey plan (Sydney Opera House Survey Control Plan, Ground Floor + 12' External) by Hard & Forester

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: BJM
Date: 18/2/10

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Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Sydney Opera House Trust
PROJECT: Vehicle & Pedestrian Safety (VAPS) Project
LOCATION: Bennelong Point

SURFACE LEVEL: 3.6 m AHD* **BORE No:** 102
EASTING: **PROJECT No:** 71529
NORTHING: **DATE:** 20 Dec 09
DIP/AZIMUTH: 90°/-- **SHEET** 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-7	11	SANDSTONE - high strength, fresh, slightly fractured and unbroken, light grey with yellow coating, medium grained sandstone, medium bedded *(continued)*						10.41m: B5°, clay infill, 30mm thick 10.5m: D 10.74m: B2° 10.87m: B2° 11.1m: B2° 11.28m: D 11.45m: B5° 11.62m: B2° 11.7m: D1° 11.8-11.90m: (x3) B1°	C	100	96	
-8	12							12.15m: B1°	C	100	97	PL(A) = 1.6MPa PL(A) = 1.3MPa
-9	13							12.62-12.70m: clay 80mm thick on possible thrust fault, 20°	C	100	87	PL(A) = 1.2MPa
-10	14							13.52m: B5°, clay veneer 13.57m: B5°, clay veneer 14.05m: D 14.31m: D 14.58m: D	C	100	97	PL(A) = 1.1MPa PL(A) = 1.8MPa UCS=18.8MPa
-11	15	15.28-17.11m: core undersized with numerous drill breaks (possible bent drill rod)						14.85m: D 15.15m: D 15.28-17.11m: D (x33)	C	100	100	PL(A) = 1.6MPa
-12	16							16.58m: B4°	C	100	100	PL(A) = 1.3MPa
-13	17											
-14	17.11	Bore discontinued at 17.11m										
-15	18											
-16	19											

RIG: Multi-Drill **DRILLER:** Traccess **LOGGED:** PGH **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger to 2.2m; NMLC-Coring to 17.11m

WATER OBSERVATIONS: No free groundwtaer observed whilst augering

REMARKS: (S) Indicates no SPT sample recovered. *Borehole surface level (approximate only) measured from SOBM-P601 and interpolated from survey plan (Sydney Opera House Survey Control Plan, Ground Floor + 12' External) by Hard & Forester

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: BTM
Date: 18/2/10

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BOREHOLE LOG

CLIENT: Sydney Opera House Trust
PROJECT: Vehicle & Pedestrial Safety (VAPS) Project
LOCATION: Bennelong Point

SURFACE LEVEL: 3.6 AHD
EASTING: 334801
NORTHING: 6252104
DIP/AZIMUTH 90°/--

BORE No: 201
PROJECT No: 71529.01
DATE: 17/05/2010
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.07	PAVERS							
		CONCRETE							
	0.3	FILLING - yellow brown, medium grained sand filling with trace ash, dry		A	0.4				
				ASS	0.5		PID<1ppm		
				A	0.8		PID<1ppm		
				ASS	1.0				
	1.27	FILLING - brown, gravelly sand filling with concrete rubble and blue metal, dry		A	1.3		PID<1ppm		
				ASS	1.5				
	1.6	FILLING - gravel and cobble filling (ballast) - no sample recovery							
	1.9	Bore discontinued at 1.9m							

RIG: Scout **DRILLER:** K Ennis **LOGGED:** KP **CASING:** Uncased
TYPE OF BORING: Diatube to 0.3m; Solid flight auger to 1.9m. Auger snapped, 1.5m left in ground
WATER OBSERVATIONS: No free groundwater observed
REMARKS: ASS = Acid sulphate soil sample

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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BOREHOLE LOG

CLIENT: Sydney Opera House Trust
PROJECT: Vehicle & Pedestrial Safety (VAPS) Project
LOCATION: Bennelong Point

SURFACE LEVEL: 3.6 AHD
EASTING: 334834
NORTHING: 6252133
DIP/AZIMUTH: 90°/--

BORE No: 202
PROJECT No: 71529.01
DATE: 17/05/2010
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.08	PAVERS							
		CONCRETE							
	0.35	FILLING - brown, gravelly sand filling with roadbase gravel inclusions, dry		A*	0.4		PID<1ppm		
				ASS	0.5				
	0.6	FILLING - brown, gravelly sand filling with cobbles (ballast), dry		A	0.6				
	0.8				0.8				
	0.9	SANDSTONE - grey, fine to medium grained sandstone, dry		A	0.9		PID<1ppm		
		Bore discontinued at 0.9m - refusal on sandstone							

RIG: Scout **DRILLER:** K Ennis **LOGGED:** KP **CASING:** Uncased

TYPE OF BORING: Diatube to 0.35m; Solid flight auger to 0.9m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: ASS = Acid sulphate soil sample. *Denotes field duplicate sample BD3/150510 collected

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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BOREHOLE LOG

CLIENT: Sydney Opera House Trust
PROJECT: Vehicle & Pedestrial Safety (VAPS) Project
LOCATION: Bennelong Point

SURFACE LEVEL: 3.7 AHD
EASTING: 334864
NORTHING: 6252156
DIP/AZIMUTH: 90°/--

BORE No: 203
PROJECT No: 71529.01
DATE: 17/05/2010
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.07	LIMESTONE PAVERS							
		CEMENT							
	0.3	CONCRETE							
	0.4	FILLING - dark brown, gravelly sand filling with blue metal, crushed sandstone and sandstone fragments and trace ash, dry		A	0.4		PID<1ppm		
				ASS	0.5				
				A	0.81				
				ASS	1.0		PID<1ppm		
	1.2	FILLING - grey, sand filling with concrete, dry		A	1.2		PID<1ppm		
	1.3	Bore discontinued at 1.3m - refusal on concrete in filling			1.3				

RIG: Scout **DRILLER:** K Ennis **LOGGED:** KP **CASING:** Uncased
TYPE OF BORING: Diatube to 0.4m; Solid flight auger to 1.3m
WATER OBSERVATIONS: No free groundwater observed
REMARKS: ASS = Acid sulphate soil sample

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo Ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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BOREHOLE LOG

CLIENT: Sydney Opera House Trust
PROJECT: Vehicle & Pedestrial Safety (VAPS) Project
LOCATION: Bennelong Point

SURFACE LEVEL: 3.7 AHD
EASTING: 334872
NORTHING: 6252134
DIP/AZIMUTH: 90°/--

BORE No: 204
PROJECT No: 71529.01
DATE: 17/05/2010
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.08	PAVERS							
		CONCRETE							
	0.3	ROADBASE - blue metal and gravel roadbase							
	0.4	FILLING - orange brown, crushed sandstone filling with some roadbase inclusions, dry		A	0.4				
				ASS	0.5		PID<1ppm		
					0.8				
				A*			PID<1ppm		
				ASS	1.0		PID<1ppm		
	1.1	SANDSTONE - orange sandstone, dry							
	1.2	Bore discontinued at 1.2m - refusal on sandstone		A	1.2				

RIG: Scout **DRILLER:** K Ennis **LOGGED:** KP **CASING:** Uncased

TYPE OF BORING: Diatube to 0.3m; Solid flight auger to 1.2m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: ASS = Acid sulphate soil sample. *Denotes field duplicate sample BD2/150510 collected

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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BOREHOLE LOG

CLIENT: Sydney Opera House Trust
PROJECT: Vehicle & Pedestrial Safety (VAPS) Project
LOCATION: Bennelong Point

SURFACE LEVEL: 3.5 AHD
EASTING: 334909
NORTHING: 6252125
DIP/AZIMUTH: 90°/--

BORE No: 205
PROJECT No: 71529.01
DATE: 17/05/2010
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		BITUMINOUS CONCRETE							
	0.2	FILLING - brown, gravelly sand filling with roadbase gravel with bitumen fragments and trace ash		A*	0.3		PID<1ppm		
	0.5	FILLING - brown, crushed sandstone filling, damp		ASS	0.5				
				A	0.8		PID<1ppm		
	1			ASS	1.0				1
	1.1	FILLING - orange brown, sandy clay filling (crushed sandstone), damp		A	1.3		PID<1ppm		
					1.5				
	1.7	FILLING - brown, medium grained sand filling, moist		A	1.8		PID<1ppm		
	1.9	FILLING - yellow brown, medium grained sand filling		ASS	2.0				2
	2	2.0 FILLING - orange and grey, sandy clay filling, wet		A	2.3		PID<1ppm		
				ASS	2.5				
	2.7	SANDSTONE - yellow orange, sandstone		ASS	2.7		PID<1ppm		
	2.9	Bore discontinued at 2.9m - refusal on sandstone			2.9				3
	3								4

RIG: Scout **DRILLER:** K Ennis **LOGGED:** KP **CASING:** Uncased

TYPE OF BORING: Solid flight auger to 2.9m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: ASS = Acid sulphate soil sample. *Denotes field duplicate sample BD4/150510 collected

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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BOREHOLE LOG

CLIENT: Sydney Opera House Trust
PROJECT: Vehicle & Pedestrial Safety (VAPS) Project
LOCATION: Bennelong Point

SURFACE LEVEL: 3.6 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 206
PROJECT No: 71529.01
DATE: 24/05/2010
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.07	BITUMINOUS CONCRETE							
		CONCRETE							
	0.23	CONCRETE							
	0.4	FILLING - light grey, crushed sandstone filling		A	0.4				
				ASS	0.5		PID<1ppm		
	0.8	FILLING - brown, gravelly sand filling with concrete rubble and cobbles (ballast)			0.8				
				A*			PID<1ppm		
				ASS	1.0				
				A	1.1		PID<1ppm		
				ASS	1.2				
	1.3	Bore discontinued at 1.3m - refusal on possible concrete or ballast filling (ballast)							

RIG: Bobcat **DRILLER:** S Salib **LOGGED:** KP **CASING:** Uncased

TYPE OF BORING: Diatube to 0.4m; Solid flight auger to 1.3m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: ASS = Acid sulphate soil sample
*Denotes field duplicate samples BD1/150510 and BD2/240510 collected

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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DESCRIPTION AND CLASSIFICATION OF ROCKS FOR ENGINEERING PURPOSES

DEGREE OF WEATHERING

Term	Symbol	Definition
Extremely Weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly Weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered	MW	Rock substance affected by weathering to the extent that staining or discolouration of the rock substance usually by limonite has taken place. The colour of the fresh rock is no longer recognisable.
Slightly Weathered	SW	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable.
Fresh Stained	Fs	Rock substance unaffected by weathering, but showing limonite staining along joints.
Fresh	Fr	Rock substance unaffected by weathering.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index ($I_{S(50)}$) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by Australian Standard 4133.4.1 - 1993.

Term	Symbol	Field Guide*	Point Load Index $I_{S(50)}$ MPa	Approx Unconfined Compressive Strength q_u ** MPa
Extremely low	EL	Easily remoulded by hand to a material with soil properties	<0.03	< 0.6
Very low	VL	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; too hard to cut a triaxial sample by hand. SPT will refuse. Pieces up to 3 cm thick can be broken by finger pressure.	0.03-0.1	0.6-2
Low	L	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long 40 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	0.1-0.3	2-6
Medium	M	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.	0.3-1.0	6-20
High	H	Can be slightly scratched with a knife. A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow, rock rings under hammer.	1 - 3	20-60
Very high	VH	Cannot be scratched with a knife. Hand specimen breaks with pick after more than one blow, rock rings under hammer.	3 - 10	60-200
Extremely high	EH	Specimen requires many blows with geological pick to break through intact material, rock rings under hammer.	>10	> 200

Note that these terms refer to strength of rock material and not to the strength of the rock mass, which may be considerably weaker due to rock defects.

* The field guide assessment of rock strength may be used for preliminary assessment or when point load testing is not able to be done.

** The approximate unconfined compressive strength (q_u) shown in the table is based on an assumed ratio to the point load index of 20:1. This ratio may vary widely.

STRATIFICATION SPACING

Term	Separation of Stratification Planes
Thinly laminated	<6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	>2 m

DEGREE OF FRACTURING

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks. The orientation of rock defects is measured as an angle relative to a plane perpendicular to the core axis. Note that where possible, recordings of the actual defect spacing or range of spacings is preferred to the general terms given below.

Term	Description
Fragmented	The core consists mainly of fragments with dimensions less than 20 mm.
Highly Fractured	Core lengths are generally less than 20 mm - 40 mm with occasional fragments.
Fractured	Core lengths are mainly 40 mm - 200 mm with occasional shorter and longer sections.
Slightly Fractured	Core lengths are generally 200 mm - 1000 mm with occasional shorter and longer sections.
Unbroken	The core does not contain any fracture.

ROCK QUALITY DESIGNATION (RQD)

This is defined as the ratio of sound (i.e. low strength or better) core in lengths of greater than 100 mm to the total length of the core, expressed in percent. If the core is broken by handling or by the drilling process (i.e. the fracture surfaces are fresh, irregular breaks rather than joint surfaces) the fresh broken pieces are fitted together and counted as one piece.

SEDIMENTARY ROCK TYPES

This classification system provides a standardised terminology for the engineering description of sandstone and shales, particularly in the Sydney area, but the terms and definitions may be used elsewhere when applicable.

Rock Type	Definition
Conglomerate	More than 50% of the rock consists of gravel-sized (greater than 2 mm) fragments
Sandstone:	More than 50% of the rock consists of sand-sized (0.06 to 2 mm) grains
Siltstone:	More than 50% of the rock consists of silt-sized (less than 0.06 mm) granular particles and the rock is not laminated.
Claystone:	More than 50% of the rock consists of clay or sericitic material and the rock is not laminated.
Shale:	More than 50% of the rock consists of silt or clay-sized particles and the rock is laminated.

Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, eg. clayey sandstone, sandy shale.

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NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigations Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00 mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12—25
Firm	25—50
Stiff	50—100
Very stiff	100—200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300 mm)	CPT Cone Value (q_c — MPa)
Very loose	less than 5	less than 2
Loose	5—10	2—5
Medium dense	10—30	5—15
Dense	30—50	15—25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing with a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

Drilling Methods.

The following is a brief summary of drilling methods currently adopted by the Company and some comments on their use and application.

Test Pits — these are excavated with a backhoe or a tracked excavator, allowing close examination of the in-situ soils if it is safe to descent into the pit. The depth of penetration is limited to about 3 m for a backhoe and up to 6 m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) — the hole is advanced by a rotating plate or short spiral auger, generally 300 mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling — the hole is advanced by pushing a 100 mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling in soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers — the hole is advanced using 90—115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow

sampling or in-situ testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling — the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling — similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. from SPT).

Continuous Core Drilling — a continuous core sample is obtained using a diamond-tipped core barrel, usually 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" — Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of say 4, 6 and 7

  as 4, 6, 7
  N = 13

- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm

  as 15, 30/40 mm.

The results of the tests can be related empirically to the engineering properties of the soil.

Occasionally, the test method is used to obtain samples in 50 mm diameter thin walled sample tubes in clays. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch cone — abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australian Standard 1289, Test 6.4.1.

In the tests, a 35 mm diameter rod with a cone-tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130 mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20 mm per second) the information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: —

- Cone resistance — the actual end bearing force divided by the cross sectional area of the cone — expressed in MPa.
- Sleeve friction — the frictional force on the sleeve divided by the surface area — expressed in kPa.
- Friction ratio — the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0—5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0—50 MPa) is less sensitive and is shown as a full line.

The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1%—2% are commonly encountered in sands and very soft clays rising to 4%—10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:—

q_c (MPa) = (0.4 to 0.6) N (blows per 300 mm)

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range:—

q_c = (12 to 18) c_u

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculation of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on

soil classification is required, direct drilling and sampling may be preferable.

Hand Penetrometers

Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150 mm increments of penetration. Normally, there is a depth limitation of 1.2 m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer — a 16 mm diameter flat-ended rod is driven with a 9 kg hammer, dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as the Scala Penetrometer) — a 16 mm rod with a 20 mm diameter cone end is driven with a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). The test was developed initially for pavement subgrade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms.

Bore Logs

The bore logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify on economic grounds. In any case, the boreholes represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes, the frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Ground Water

Where ground water levels are measured in boreholes, there are several potential problems;

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions — the potential for this will depend partly on bore spacing and sampling frequency
- changes in policy or interpretation of policy by statutory authorities
- the actions of contractors responding to commercial pressures.

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers,

Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

APPENDIX E
Laboratory Reports and Chain of Custody Documentation

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 41144

Client:
Douglas Partners
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Kurt Plambeck

Sample log in details:

Your Reference:	**71529.01, Opera House VAPS Project**
No. of samples:	21 Soils
Date samples received:	18/05/10
Date completed instructions received:	18/05/10

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	27/05/10
Date of Preliminary Report:	Not Issued
Issue Date:	26/05/10

NATA accreditation number 2901. This document shall not be reproduced except in full.
This document is issued in accordance with NATA's accreditation requirements.
Accredited for compliance with ISO/IEC 17025.
Tests not covered by NATA are denoted with *.

Results Approved By:

Rhian Morgan
Metals Supervisor

Jacinta Hurst
Laboratory Manager

Matt Mansfield
Approved Signatory

Envirolab Reference: 41144
Revision No: R 00

ACCREDITED FOR TECHNICAL COMPETENCE

VOCs in soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ---------- 	41144-1 201/0.4-0.5 17/05/2010 Soil	41144-5 202/0.6-0.8 17/05/2010 Soil	41144-8 203/0.8-1 17/05/2010 Soil	41144-9 204/0.4-0.5 17/05/2010 Soil	41144-13 205/2.3-2.5 17/05/2010 Soil
Date extracted	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
Date analysed	-	21/05/2010	21/05/2010	21/05/2010	21/05/2010	21/05/2010
Dichlorodifluoromethane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Vinyl Chloride	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
trans-1,2-dichloroethene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-dichloroethane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
cis-1,2-dichloroethene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
bromochloromethane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
chloroform	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
2,2-dichloropropane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-dichloroethane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-trichloroethane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-dichloropropene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Cyclohexane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
carbon tetrachloride	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Benzene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
dibromomethane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-dichloropropane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
trichloroethene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
bromodichloromethane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
trans-1,3-dichloropropene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
cis-1,3-dichloropropene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2-trichloroethane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-dichloropropane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
dibromochloromethane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-dibromoethane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
tetrachloroethene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1,2-tetrachloroethane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
chlorobenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Ethylbenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
bromoform	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
m+p-xylene	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
styrene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-tetrachloroethane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0

VOCs in soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41144-1 201/0.4-0.5 17/05/2010 Soil	41144-5 202/0.6-0.8 17/05/2010 Soil	41144-8 203/0.8-1 17/05/2010 Soil	41144-9 204/0.4-0.5 17/05/2010 Soil	41144-13 205/2.3-2.5 17/05/2010 Soil
o-Xylene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,3-trichloropropane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
isopropylbenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
bromobenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
n-propyl benzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
2-chlorotoluene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
4-chlorotoluene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,3,5-trimethyl benzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
tert-butyl benzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,4-trimethyl benzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-dichlorobenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
sec-butyl benzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,4-dichlorobenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
4-isopropyl toluene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-dichlorobenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
n-butyl benzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-dibromo-3-chloropropane	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,4-trichlorobenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
hexachlorobutadiene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,3-trichlorobenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Surrogate Dibromofluorometha	%	85	87	84	84	80
Surrogate aaa-Trifluorotoluene	%	131	140	129	126	125
Surrogate Toluene-d_8	%	109	112	108	107	105
Surrogate 4-Bromofluorobenzene	%	101	99	101	101	101

vTPH & BTEX in Soil						
Our Reference:	UNITS	41144-1	41144-2	41144-3	41144-4	41144-5
Your Reference	----------	201/0.4-0.5	201/0.8-1	201/1.3-1.5	202/0.4-0.5	202/0.6-0.8
Date Sampled	----------	17/05/2010	17/05/2010	17/05/2010	17/05/2010	17/05/2010
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
Date analysed	-	21/05/2010	21/05/2010	21/05/2010	21/05/2010	21/05/2010
vTPH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
m+p-xylene	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
o-Xylene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Surrogate aaa-Trifluorotoluene	%	131	99	107	109	140

vTPH & BTEX in Soil						
Our Reference:	UNITS	41144-6	41144-7	41144-8	41144-9	41144-10
Your Reference	----------	202/0.8-0.9	203/0.4-0.5	203/0.8-1	204/0.4-0.5	204/0.8-1
Date Sampled	----------	17/05/2010	17/05/2010	17/05/2010	17/05/2010	17/05/2010
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
Date analysed	-	21/05/2010	21/05/2010	21/05/2010	21/05/2010	21/05/2010
vTPH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
m+p-xylene	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
o-Xylene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Surrogate aaa-Trifluorotoluene	%	104	108	129	126	104

vTPH & BTEX in Soil						
Our Reference:	UNITS	41144-11	41144-12	41144-13	41144-15	41144-16
Your Reference	----------	205/0.3-0.5	205/1.3-1.5	205/2.3-2.5	BD4/170510	Trip Spike
Date Sampled	----------	17/05/2010	17/05/2010	17/05/2010	17/05/2010	17/05/2010
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
Date analysed	-	21/05/2010	21/05/2010	21/05/2010	21/05/2010	21/05/2010
vTPH C_6 - C_9	mg/kg	<25	<25	<25	<25	[NA]
Benzene	mg/kg	<0.5	<0.5	<0.5	<0.5	94%
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	97%
Ethylbenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	95%
m+p-xylene	mg/kg	<2.0	<2.0	<2.0	<2.0	96%
o-Xylene	mg/kg	<1.0	<1.0	<1.0	<1.0	95%
Surrogate aaa-Trifluorotoluene	%	110	110	125	109	92

vTPH & BTEX in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41144-17 Trip Blank 17/05/2010 Soil	41144-18 204/1.2-1.3 17/05/2010 Soil
Date extracted	-	20/05/2010	20/05/2010
Date analysed	-	21/05/2010	21/05/2010
vTPH C_6 - C_9	mg/kg	<25	<25
Benzene	mg/kg	<0.5	<0.5
Toluene	mg/kg	<0.5	<0.5
Ethylbenzene	mg/kg	<1.0	<1.0
m+p-xylene	mg/kg	<2.0	<2.0
o-Xylene	mg/kg	<1.0	<1.0
Surrogate aaa-Trifluorotoluene	%	114	105

sTPH in Soil (C10-C36)						
Our Reference:	UNITS	41144-1	41144-2	41144-3	41144-4	41144-5
Your Reference	----------	201/0.4-0.5	201/0.8-1	201/1.3-1.5	202/0.4-0.5	202/0.6-0.8
Date Sampled	----------	17/05/2010	17/05/2010	17/05/2010	17/05/2010	17/05/2010
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
Date analysed	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
TPH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TPH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TPH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	100	95	92	98	95

sTPH in Soil (C10-C36)						
Our Reference:	UNITS	41144-6	41144-7	41144-8	41144-9	41144-10
Your Reference	----------	202/0.8-0.9	203/0.4-0.5	203/0.8-1	204/0.4-0.5	204/0.8-1
Date Sampled	----------	17/05/2010	17/05/2010	17/05/2010	17/05/2010	17/05/2010
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
Date analysed	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
TPH C_{10} - C_{14}	mg/kg	<50	57	<50	<50	<50
TPH C_{15} - C_{28}	mg/kg	<100	210	210	<100	<100
TPH C_{29} - C_{36}	mg/kg	<100	200	240	<100	<100
Surrogate o-Terphenyl	%	95	105	111	97	92

sTPH in Soil (C10-C36)						
Our Reference:	UNITS	41144-11	41144-12	41144-13	41144-15	41144-18
Your Reference	----------	205/0.3-0.5	205/1.3-1.5	205/2.3-2.5	BD4/170510	204/1.2-1.3
Date Sampled	----------	17/05/2010	17/05/2010	17/05/2010	17/05/2010	17/05/2010
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
Date analysed	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
TPH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TPH C_{15} - C_{28}	mg/kg	870	<100	<100	890	<100
TPH C_{29} - C_{36}	mg/kg	550	<100	<100	550	<100
Surrogate o-Terphenyl	%	#	97	90	#	88

PAHs in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41144-1 201/0.4-0.5 17/05/2010 Soil	41144-2 201/0.8-1 17/05/2010 Soil	41144-3 201/1.3-1.5 17/05/2010 Soil	41144-4 202/0.4-0.5 17/05/2010 Soil	41144-5 202/0.6-0.8 17/05/2010 Soil
Date extracted	-	20/5/10	20/5/10	20/5/10	20/5/10	20/5/10
Date analysed	-	21/5/10	21/5/10	21/5/10	21/5/10	21/5/10
Naphthalene	mg/kg	0.3	<0.1	0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.7	<0.1	0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	0.3	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	2.3	0.2	1.0	0.2	0.4
Anthracene	mg/kg	0.5	<0.1	0.3	<0.1	0.1
Fluoranthene	mg/kg	3.6	0.2	2.1	0.7	0.9
Pyrene	mg/kg	4.8	0.2	2.2	0.9	1.0
Benzo(a)anthracene	mg/kg	2.1	0.1	1.0	0.5	0.6
Chrysene	mg/kg	2.2	0.1	1.1	0.6	0.6
Benzo(b+k)fluoranthene	mg/kg	3.3	<0.2	1.7	1.1	1.1
Benzo(a)pyrene	mg/kg	2.7	0.1	1.3	0.8	0.8
Indeno(1,2,3-c,d)pyrene	mg/kg	1.4	<0.1	0.8	0.5	0.5
Dibenzo(a,h)anthracene	mg/kg	0.2	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	1.2	<0.1	0.7	0.5	0.5
Surrogate p-Terphenyl-d_{14}	%	112	104	104	106	105

PAHs in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41144-6 202/0.8-0.9 17/05/2010 Soil	41144-7 203/0.4-0.5 17/05/2010 Soil	41144-8 203/0.8-1 17/05/2010 Soil	41144-9 204/0.4-0.5 17/05/2010 Soil	41144-10 204/0.8-1 17/05/2010 Soil
Date extracted	-	20/5/10	20/5/10	20/5/10	20/5/10	20/5/10
Date analysed	-	21/5/10	21/5/10	21/5/10	22/5/10	22/5/10
Naphthalene	mg/kg	<0.1	0.2	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	0.4	0.2	0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	1.8	1.4	0.9	<0.1
Anthracene	mg/kg	<0.1	1.8	0.3	0.2	<0.1
Fluoranthene	mg/kg	<0.1	1.9	2.6	1.6	0.2
Pyrene	mg/kg	<0.1	1.8	2.7	1.7	0.2
Benzo(a)anthracene	mg/kg	<0.1	0.7	1.3	0.7	0.1
Chrysene	mg/kg	<0.1	0.7	1.4	0.8	0.1
Benzo(b+k)fluoranthene	mg/kg	<0.2	0.3	2.3	1.1	0.2
Benzo(a)pyrene	mg/kg	<0.05	0.7	1.6	0.9	0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	0.4	1.1	0.4	0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	0.4	1.0	0.4	0.1
Surrogate p-Terphenyl-d_{14}	%	107	99	102	112	113

PAHs in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41144-11 205/0.3-0.5 17/05/2010 Soil	41144-12 205/1.3-1.5 17/05/2010 Soil	41144-13 205/2.3-2.5 17/05/2010 Soil	41144-15 BD4/170510 17/05/2010 Soil	41144-18 204/1.2-1.3 17/05/2010 Soil
Date extracted	-	20/5/10	20/5/10	20/5/10	20/5/10	20/5/10
Date analysed	-	22/5/10	22/5/10	22/5/10	22/5/10	22/5/10
Naphthalene	mg/kg	0.7	<0.1	<0.1	0.9	<0.1
Acenaphthylene	mg/kg	2.2	<0.1	<0.1	2.0	<0.1
Acenaphthene	mg/kg	1.5	<0.1	<0.1	2.2	<0.1
Fluorene	mg/kg	2.4	<0.1	<0.1	2.3	<0.1
Phenanthrene	mg/kg	24	0.7	<0.1	35	<0.1
Anthracene	mg/kg	6.4	0.2	<0.1	9.2	<0.1
Fluoranthene	mg/kg	31	0.9	0.1	40	0.2
Pyrene	mg/kg	28	0.9	0.1	35	0.2
Benzo(a)anthracene	mg/kg	13	0.4	<0.1	16	0.1
Chrysene	mg/kg	13	0.4	<0.1	16	<0.1
Benzo(b+k)fluoranthene	mg/kg	21	0.7	<0.2	25	<0.2
Benzo(a)pyrene	mg/kg	16	0.5	0.07	18	0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	8.9	0.3	<0.1	10	0.1
Dibenzo(a,h)anthracene	mg/kg	1.4	<0.1	<0.1	1.6	<0.1
Benzo(g,h,i)perylene	mg/kg	8.2	0.2	<0.1	9.2	0.1
Surrogate p-Terphenyl-d_{14}	%	110	112	115	106	112

Organochlorine Pesticides in soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41144-1 201/0.4-0.5 17/05/2010 Soil	41144-3 201/1.3-1.5 17/05/2010 Soil	41144-4 202/0.4-0.5 17/05/2010 Soil	41144-5 202/0.6-0.8 17/05/2010 Soil	41144-7 203/0.4-0.5 17/05/2010 Soil
Date extracted	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
Date analysed	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	99	98	99	101	100

Organochlorine Pesticides in soil						
Our Reference:	UNITS	41144-8	41144-9	41144-10	41144-11	41144-13
Your Reference	----------	203/0.8-1	204/0.4-0.5	204/0.8-1	205/0.3-0.5	205/2.3-2.5
Date Sampled	----------	17/05/2010	17/05/2010	17/05/2010	17/05/2010	17/05/2010
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
Date analysed	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	103	100	103	99	98

PCBs in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41144-1 201/0.4-0.5 17/05/2010 Soil	41144-3 201/1.3-1.5 17/05/2010 Soil	41144-4 202/0.4-0.5 17/05/2010 Soil	41144-5 202/0.6-0.8 17/05/2010 Soil	41144-7 203/0.4-0.5 17/05/2010 Soil
Date extracted	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
Date analysed	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
Arochlor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1221*	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	99	98	99	101	100

PCBs in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41144-8 203/0.8-1 17/05/2010 Soil	41144-9 204/0.4-0.5 17/05/2010 Soil	41144-10 204/0.8-1 17/05/2010 Soil	41144-11 205/0.3-0.5 17/05/2010 Soil	41144-13 205/2.3-2.5 17/05/2010 Soil
Date extracted	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
Date analysed	-	20/05/2010	20/05/2010	20/05/2010	20/05/2010	20/05/2010
Arochlor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1221*	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	103	100	103	99	98

Total Phenolics in Soil						
Our Reference:	UNITS	41144-1	41144-3	41144-4	41144-5	41144-7
Your Reference	----------	201/0.4-0.5	201/1.3-1.5	202/0.4-0.5	202/0.6-0.8	203/0.4-0.5
Date Sampled	----------	17/05/2010	17/05/2010	17/05/2010	17/05/2010	17/05/2010
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/5/2010	20/5/2010	20/5/2010	20/5/2010	20/5/2010
Date analysed	-	20/5/2010	20/5/2010	20/5/2010	20/5/2010	20/5/2010
Total Phenolics (as Phenol)	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0

Total Phenolics in Soil						
Our Reference:	UNITS	41144-8	41144-9	41144-10	41144-11	41144-13
Your Reference	----------	203/0.8-1	204/0.4-0.5	204/0.8-1	205/0.3-0.5	205/2.3-2.5
Date Sampled	----------	17/05/2010	17/05/2010	17/05/2010	17/05/2010	17/05/2010
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/5/2010	20/5/2010	20/5/2010	20/5/2010	20/5/2010
Date analysed	-	20/5/2010	20/5/2010	20/5/2010	20/5/2010	20/5/2010
Total Phenolics (as Phenol)	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0

Acid Extractable metals in soil						
Our Reference:	UNITS	41144-1	41144-2	41144-3	41144-4	41144-5
Your Reference	----------	201/0.4-0.5	201/0.8-1	201/1.3-1.5	202/0.4-0.5	202/0.6-0.8
Date Sampled	----------	17/05/2010	17/05/2010	17/05/2010	17/05/2010	17/05/2010
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	20/05/10	20/05/10	20/05/10	20/05/10	20/05/10
Date analysed	-	21/05/10	21/05/10	21/05/10	21/05/10	21/05/10
Arsenic	mg/kg	5	<4	<4	<4	<4
Cadmium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	5	3	13	11	14
Copper	mg/kg	11	7	19	70	52
Lead	mg/kg	7	3	6	12	11
Mercury	mg/kg	<0.1	0.1	<0.1	0.1	0.1
Nickel	mg/kg	14	8	22	77	61
Zinc	mg/kg	12	7	17	48	41

Acid Extractable metals in soil						
Our Reference:	UNITS	41144-6	41144-7	41144-8	41144-9	41144-10
Your Reference	----------	202/0.8-0.9	203/0.4-0.5	203/0.8-1	204/0.4-0.5	204/0.8-1
Date Sampled	----------	17/05/2010	17/05/2010	17/05/2010	17/05/2010	17/05/2010
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	20/05/10	20/05/10	20/05/10	20/05/10	20/05/10
Date analysed	-	21/05/10	21/05/10	21/05/10	21/05/10	21/05/10
Arsenic	mg/kg	<4	4	<4	<4	<4
Cadmium	mg/kg	<0.5	1.7	1.8	<0.5	<0.5
Chromium	mg/kg	8	10	15	16	13
Copper	mg/kg	<1	66	43	10	6
Lead	mg/kg	6	38	660	17	12
Mercury	mg/kg	<0.1	0.2	0.2	<0.1	<0.1
Nickel	mg/kg	<1	33	16	15	6
Zinc	mg/kg	26	66	62	32	17

Acid Extractable metals in soil						
Our Reference:	UNITS	41144-11	41144-12	41144-13	41144-15	41144-18
Your Reference	----------	205/0.3-0.5	205/1.3-1.5	205/2.3-2.5	BD4/170510	204/1.2-1.3
Date Sampled	----------	17/05/2010	17/05/2010	17/05/2010	17/05/2010	17/05/2010
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	20/05/10	20/05/10	20/05/10	20/05/10	20/05/10
Date analysed	-	21/05/10	21/05/10	21/05/10	21/05/10	21/05/10
Arsenic	mg/kg	<4	<4	<4	<4	<4
Cadmium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	11	10	1	10	19
Copper	mg/kg	37	<1	<1	60	3
Lead	mg/kg	45	8	2	43	11
Mercury	mg/kg	<0.1	<0.1	<0.1	0.2	<0.1
Nickel	mg/kg	14	<1	<1	31	5
Zinc	mg/kg	58	5	1	67	28

sPOCAS Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41144-19 204/1.0 17/05/2010 Soil	41144-20 205/2.5 17/05/2010 Soil	41144-21 201/1.0 17/05/2010 Soil
Date prepared	-	20/5/10	20/5/10	20/5/10
Date analysed	-	20/5/10	20/5/10	20/5/10
pH kcl	pH units	8.8	7.7	10.0
TAA pH 6.5	moles H^+/t	<5	<5	<5
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01
pH ox	pH units	6.4	4.3	7.3
TPA pH 6.5	moles H^+/t	<5.0	<5.0	<5.0
s-TPA pH 6.5	%w/w S	<0.01	<0.01	<0.01
TSA pH 6.5	moles H^+/t	<5.0	<5.0	<5.0
s-TSA pH 6.5	%w/w S	<0.01	<0.01	<0.01
ANCE	% $CaCO_3$	<0.05	<0.05	0.63
a-ANCE	moles H^+/t	<5	<5	125
s-ANCE	%w/w S	<0.05	<0.05	0.20
SKCl	%w/w S	0.006	<0.005	<0.005
SP	%w/w	0.007	0.025	0.005
SPOS	%w/w	<0.005	0.021	<0.005
a-SPOS	moles H^+/t	<5.0	13	<5.0
CaKCl	%w/w	0.058	0.051	0.11
CaP	%w/w	0.055	0.058	0.42
CaA	%w/w	<0.005	0.007	0.32
MgKCl	%w/w	0.014	0.008	<0.005
MgP	%w/w	0.020	0.009	0.016
MgA	%w/w	0.006	<0.005	0.013
SRAS	%w/w	<0.005	<0.005	<0.005
SHCl	%w/w S	0.006	<0.005	0.005
SNAS	%w/w S	<0.005	<0.005	<0.005
a-SNAS	moles H^+/t	<5	<5	<5
s-SNAS	%w/w S	<0.01	<0.01	<0.01
a-Net Acidity	moles H^+/t	<10	13	<10
Liming rate	kg $CaCO_3$/t	<0.75	0.99	<0.75
a-Net Acidity without ANCE	moles H^+/t	NA	NA	<10
Liming rate without ANCE	kg $CaCO_3$/t	NA	NA	<0.75

Moisture Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41144-1 201/0.4-0.5 17/05/2010 Soil	41144-2 201/0.8-1 17/05/2010 Soil	41144-3 201/1.3-1.5 17/05/2010 Soil	41144-4 202/0.4-0.5 17/05/2010 Soil	41144-5 202/0.6-0.8 17/05/2010 Soil
Date prepared	-	20/5/10	20/5/10	20/5/10	20/5/10	20/5/10
Date analysed	-	20/5/10	20/5/10	20/5/10	20/5/10	20/5/10
Moisture	%	15	19	16	6.8	8.1

Moisture Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41144-6 202/0.8-0.9 17/05/2010 Soil	41144-7 203/0.4-0.5 17/05/2010 Soil	41144-8 203/0.8-1 17/05/2010 Soil	41144-9 204/0.4-0.5 17/05/2010 Soil	41144-10 204/0.8-1 17/05/2010 Soil
Date prepared	-	20/5/10	20/5/10	20/5/10	20/5/10	20/5/10
Date analysed	-	20/5/10	20/5/10	20/5/10	20/5/10	20/5/10
Moisture	%	17	7.6	10	20	11

Moisture Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41144-11 205/0.3-0.5 17/05/2010 Soil	41144-12 205/1.3-1.5 17/05/2010 Soil	41144-13 205/2.3-2.5 17/05/2010 Soil	41144-15 BD4/170510 17/05/2010 Soil	41144-17 Trip Blank 17/05/2010 Soil
Date prepared	-	20/5/10	20/5/10	20/5/10	20/5/10	20/5/10
Date analysed	-	20/5/10	20/5/10	20/5/10	20/5/10	20/5/10
Moisture	%	5.7	12	20	9.4	0.10

Moisture Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41144-18 204/1.2-1.3 17/05/2010 Soil
Date prepared	-	20/5/10
Date analysed	-	20/5/10
Moisture	%	7.7

Asbestos ID - soils						
Our Reference:	UNITS	41144-1	41144-3	41144-4	41144-5	41144-7
Your Reference	----------	201/0.4-0.5	201/1.3-1.5	202/0.4-0.5	202/0.6-0.8	203/0.4-0.5
Date Sampled	----------	17/05/2010	17/05/2010	17/05/2010	17/05/2010	17/05/2010
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	21/5/10	21/5/10	21/5/10	21/5/10	21/5/10
Sample Description	-	Approx 30g Sandy Soil	Approx 40g Sandy Soil & Rocks	Approx 40g Sandy Soil & Rocks	Approx 40g Sandy Soil & Rocks	Approx 40g Sandy Soil & Rocks
Asbestos ID in soil	-	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg
Trace Analysis	-	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected

Asbestos ID - soils						
Our Reference:	UNITS	41144-8	41144-9	41144-10	41144-11	41144-12
Your Reference	----------	203/0.8-1	204/0.4-0.5	204/0.8-1	205/0.3-0.5	205/1.3-1.5
Date Sampled	----------	17/05/2010	17/05/2010	17/05/2010	17/05/2010	17/05/2010
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	21/5/10	21/5/10	21/5/10	21/5/10	21/5/10
Sample Description	-	Approx 40g Sandy Soil & Rocks	Approx 40g Sandy Soil & Rocks	Approx 40g Sandy Soil & Rocks	Approx 40g Sandy Soil & Rocks	Approx 40g Sandy Soil & Rocks
Asbestos ID in soil	-	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg
Trace Analysis	-	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected

Method ID	Methodology Summary
GC.14	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
GC.16	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS.
GC.3	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID.
GC.12 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
GC-5	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
GC-6	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
LAB.30	Total Phenolics - determined colorimetrically following disitillation.
Metals.20 ICP-AES	Determination of various metals by ICP-AES.
Metals.21 CV-AAS	Determination of Mercury by Cold Vapour AAS.
LAB.64	sPOCAS determined using titrimetric and ICP-AES techniques. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.
LAB.8	Moisture content determined by heating at 105 deg C for a minimum of 4 hours.
AS4964-2004	Asbestos ID - Qualitative identification of asbestos type fibres in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques.

QUALITY CONTROL VOCs in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			20/05/2010	41144-1	20/05/2010 || 20/05/2010	LCS-4	20/05/2010
Date analysed	-			21/05/2010	41144-1	21/05/2010 || 21/05/2010	LCS-4	21/05/2010
Dichlorodifluoromethane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
Chloromethane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
Vinyl Chloride	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
Bromomethane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
Chloroethane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
Trichlorofluoromethane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
1,1-Dichloroethene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
trans-1,2-dichloroethene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
1,1-dichloroethane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	LCS-4	90%
cis-1,2-dichloroethene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
bromochloromethane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
chloroform	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	LCS-4	83%
2,2-dichloropropane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
1,2-dichloroethane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	LCS-4	82%
1,1,1-trichloroethane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	LCS-4	79%
1,1-dichloropropene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
Cyclohexane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
carbon tetrachloride	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
Benzene	mg/kg	0.5	GC.14	<0.5	41144-1	<0.5 || <0.5	[NR]	[NR]
dibromomethane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
1,2-dichloropropane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
trichloroethene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	LCS-4	83%
bromodichloromethane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	LCS-4	84%
trans-1,3-dichloropropene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
cis-1,3-dichloropropene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
1,1,2-trichloroethane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
Toluene	mg/kg	0.5	GC.14	<0.5	41144-1	<0.5 || <0.5	[NR]	[NR]
1,3-dichloropropane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
dibromochloromethane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	LCS-4	81%
1,2-dibromoethane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
tetrachloroethene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	LCS-4	85%
1,1,1,2-tetrachloroethane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
chlorobenzene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
Ethylbenzene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
bromoform	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
m+p-xylene	mg/kg	2	GC.14	<2.0	41144-1	<2.0 || <2.0	[NR]	[NR]
styrene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
1,1,2,2-tetrachloroethane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]

QUALITY CONTROL VOCs in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
o-Xylene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
1,2,3-trichloropropane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
isopropylbenzene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
bromobenzene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
n-propyl benzene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
2-chlorotoluene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
4-chlorotoluene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
1,3,5-trimethyl benzene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
tert-butyl benzene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
1,2,4-trimethyl benzene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
1,3-dichlorobenzene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
sec-butyl benzene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
1,4-dichlorobenzene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
4-isopropyl toluene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
1,2-dichlorobenzene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
n-butyl benzene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
1,2-dibromo-3-chloropropane	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
1,2,4-trichlorobenzene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
hexachlorobutadiene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
1,2,3-trichlorobenzene	mg/kg	1	GC.14	<1.0	41144-1	<1.0 || <1.0	[NR]	[NR]
Surrogate Dibromofluorometha	%		GC.14	95	41144-1	85 || 82 || RPD: 4	LCS-4	92%
Surrogate aaa-Trifluorotoluene	%		GC.14	118	41144-1	131 || 120 || RPD: 9	LCS-4	106%
Surrogate Toluene-d8	%		GC.14	100	41144-1	109 || 111 || RPD: 2	LCS-4	99%
Surrogate 4-Bromofluorobenzene	%		GC.14	99	41144-1	101 || 101 || RPD: 0	LCS-4	102%

QUALITY CONTROL vTPH & BTEX in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			20/05/2010	41144-11	20/05/2010 || 20/05/2010	LCS-1	20/05/2010
Date analysed	-			21/05/2010	41144-11	21/05/2010 || 21/05/2010	LCS-1	21/05/2010
vTPH C_6 - C_9	mg/kg	25	GC.16	<25	41144-11	<25 || <25	LCS-1	96%
Benzene	mg/kg	0.5	GC.16	<0.5	41144-11	<0.5 || <0.5	LCS-1	98%
Toluene	mg/kg	0.5	GC.16	<0.5	41144-11	<0.5 || <0.5	LCS-1	93%
Ethylbenzene	mg/kg	1	GC.16	<1.0	41144-11	<1.0 || <1.0	LCS-1	95%
m+p-xylene	mg/kg	2	GC.16	<2.0	41144-11	<2.0 || <2.0	LCS-1	96%
o-Xylene	mg/kg	1	GC.16	<1.0	41144-11	<1.0 || <1.0	LCS-1	100%
Surrogate aaa-Trifluorotoluene	%		GC.16	100	41144-11	110 || 110 || RPD: 0	LCS-1	107%

QUALITY CONTROL sTPH in Soil (C10-C36)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			20/05/2010	41144-1	20/05/2010 || 20/05/2010	LCS-1	20/05/2010
Date analysed	-			20/05/2010	41144-1	20/05/2010 || 20/05/2010	LCS-1	20/05/2010
TPH C_{10} - C_{14}	mg/kg	50	GC.3	<50	41144-1	<50 || <50	LCS-1	88%
TPH C_{15} - C_{28}	mg/kg	100	GC.3	<100	41144-1	<100 || <100	LCS-1	103%
TPH C_{29} - C_{36}	mg/kg	100	GC.3	<100	41144-1	<100 || <100	LCS-1	102%
Surrogate o-Terphenyl	%		GC.3	92	41144-1	100 || 101 || RPD: 1	LCS-1	87%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			20/5/10	41144-1	20/5/10 || 20/5/10	LCS-1	20/5/10
Date analysed	-			21/5/10	41144-1	21/5/10 || 21/5/10	LCS-1	21/5/10
Naphthalene	mg/kg	0.1	GC.12 subset	<0.1	41144-1	0.3 || 0.4 || RPD: 29	LCS-1	94%
Acenaphthylene	mg/kg	0.1	GC.12 subset	<0.1	41144-1	0.7 || 1.8 || RPD: 88	[NR]	[NR]
Acenaphthene	mg/kg	0.1	GC.12 subset	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	GC.12 subset	<0.1	41144-1	0.3 || 0.4 || RPD: 29	LCS-1	95%
Phenanthrene	mg/kg	0.1	GC.12 subset	<0.1	41144-1	2.3 || 2.5 || RPD: 8	LCS-1	97%
Anthracene	mg/kg	0.1	GC.12 subset	<0.1	41144-1	0.5 || 0.8 || RPD: 46	[NR]	[NR]
Fluoranthene	mg/kg	0.1	GC.12 subset	<0.1	41144-1	3.6 || 7.0 || RPD: 64	LCS-1	89%
Pyrene	mg/kg	0.1	GC.12 subset	<0.1	41144-1	4.8 || 10 || RPD: 70	LCS-1	99%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Benzo(a)anthracene	mg/kg	0.1	GC.12 subset	<0.1	41144-1	2.1 || 5.1 || RPD: 83	[NR]	[NR]
Chrysene	mg/kg	0.1	GC.12 subset	<0.1	41144-1	2.2 || 4.9 || RPD: 76	LCS-1	103%
Benzo(b+k)fluoranthene	mg/kg	0.2	GC.12 subset	<0.2	41144-1	3.3 || 8.0 || RPD: 83	[NR]	[NR]
Benzo(a)pyrene	mg/kg	0.05	GC.12 subset	<0.05	41144-1	2.7 || 6.8 || RPD: 86	LCS-1	114%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	GC.12 subset	<0.1	41144-1	1.4 || 3.4 || RPD: 83	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	GC.12 subset	<0.1	41144-1	0.2 || 0.5 || RPD: 86	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	GC.12 subset	<0.1	41144-1	1.2 || 3.3 || RPD: 93	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%		GC.12 subset	113	41144-1	112 || 101 || RPD: 10	LCS-1	113%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			20/05/2010	41144-1	20/05/2010 || 20/05/2010	LCS-1	20/05/2010
Date analysed	-			20/05/2010	41144-1	20/05/2010 || 20/05/2010	LCS-1	20/05/2010
HCB	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	LCS-1	104%
gamma-BHC	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	LCS-1	104%
Heptachlor	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	LCS-1	93%
delta-BHC	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	LCS-1	103%
Heptachlor Epoxide	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	LCS-1	107%
gamma-Chlordane	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	LCS-1	106%
Dieldrin	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	LCS-1	111%
Endrin	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	LCS-1	104%
pp-DDD	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	LCS-1	111%
Endosulfan II	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	LCS-1	101%
Methoxychlor	mg/kg	0.1	GC-5	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		GC-5	98	41144-1	99 || 100 || RPD: 1	LCS-1	100%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			20/05/2010	41144-1	20/05/2010 || 20/05/2010	LCS-1	20/05/2010
Date analysed	-			20/05/2010	41144-1	20/05/2010 || 20/05/2010	LCS-1	20/05/2010
Arochlor 1016	mg/kg	0.1	GC-6	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1221*	mg/kg	0.1	GC-6	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	0.1	GC-6	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	0.1	GC-6	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	0.1	GC-6	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	0.1	GC-6	<0.1	41144-1	<0.1 || <0.1	LCS-1	110%
Arochlor 1260	mg/kg	0.1	GC-6	<0.1	41144-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		GC-6	98	41144-1	99 || 100 || RPD: 1	LCS-1	99%

QUALITY CONTROL Total Phenolics in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			20/5/2010	41144-1	20/5/2010 || 20/5/2010	LCS-1	20/5/2010
Date analysed	-			20/5/2010	41144-1	20/5/2010 || 20/5/2010	LCS-1	20/5/2010
Total Phenolics (as Phenol)	mg/kg	5	LAB.30	<5.0	41144-1	<5.0 || <5.0	LCS-1	90%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date digested	-			20/05/10	41144-1	20/05/10 || 20/05/10	LCS-1	20/05/10
Date analysed	-			21/05/10	41144-1	21/05/10 || 21/05/10	LCS-1	21/05/10
Arsenic	mg/kg	4	Metals.20 ICP-AES	<4	41144-1	5 || 4 || RPD: 22	LCS-1	106%
Cadmium	mg/kg	0.5	Metals.20 ICP-AES	<0.5	41144-1	<0.5 || <0.5	LCS-1	108%
Chromium	mg/kg	1	Metals.20 ICP-AES	<1	41144-1	5 || 4 || RPD: 22	LCS-1	107%
Copper	mg/kg	1	Metals.20 ICP-AES	<1	41144-1	11 || 11 || RPD: 0	LCS-1	108%
Lead	mg/kg	1	Metals.20 ICP-AES	<1	41144-1	7 || 6 || RPD: 15	LCS-1	107%
Mercury	mg/kg	0.1	Metals.21 CV-AAS	<0.1	41144-1	<0.1 || <0.1	LCS-1	100%
Nickel	mg/kg	1	Metals.20 ICP-AES	<1	41144-1	14 || 14 || RPD: 0	LCS-1	110%
Zinc	mg/kg	1	Metals.20 ICP-AES	<1	41144-1	12 || 12 || RPD: 0	LCS-1	110%

QUALITY CONTROL sPOCAS	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			20/5/10	41144-21	20/5/10 || 20/5/10	LCS	20/5/10
Date analysed	-			20/5/10	41144-21	20/5/10 || 20/5/10	LCS	20/5/10
pH kcl	pH units		LAB.64	5.2	41144-21	10.0 || 10.0 || RPD: 0	LCS	101%
TAA pH 6.5	moles H^+/t	5	LAB.64	<5	41144-21	<5 || <5	LCS	110%
s-TAA pH 6.5	%w/w S	0.01	LAB.64	<0.01	41144-21	<0.01 || <0.01	LCS	107%
pH ox	pH units		LAB.64	4.3	41144-21	7.3 || 7.4 || RPD: 1	LCS	104%
TPA pH 6.5	moles H^+/t	5	LAB.64	<5.0	41144-21	<5.0 || <5.0	LCS	75%
s-TPA pH 6.5	%w/w S	0.01	LAB.64	<0.01	41144-21	<0.01 || <0.01	LCS	75%
TSA pH 6.5	moles H^+/t	5	LAB.64	<5.0	41144-21	<5.0 || <5.0	LCS	70%
s-TSA pH 6.5	%w/w S	0.01	LAB.64	<0.01	41144-21	<0.01 || <0.01	LCS	69%
ANCe	% $CaCO_3$	0.05	LAB.64	<0.05	41144-21	0.63 || 0.63 || RPD: 0	[NR]	[NR]
a-ANCe	moles H^+/t	5	LAB.64	<5	41144-21	125 || 125 || RPD: 0	[NR]	[NR]
s-ANCe	%w/w S	0.05	LAB.64	<0.05	41144-21	0.20 || 0.20 || RPD: 0	[NR]	[NR]
SKCl	%w/w S	0.005	LAB.64	<0.005	41144-21	<0.005 || <0.005	LCS	122%
SP	%w/w	0.005	LAB.64	<0.005	41144-21	0.005 || <0.005	LCS	110%
SPOS	%w/w	0.005	LAB.64	<0.005	41144-21	<0.005 || <0.005	LCS	107%
a-SPOS	moles H^+/t	5	LAB.64	<5.0	41144-21	<5.0 || <5.0	LCS	108%
CaKCl	%w/w	0.005	LAB.64	<0.005	41144-21	0.11 || 0.11 || RPD: 0	LCS	91%
CaP	%w/w	0.005	LAB.64	<0.005	41144-21	0.42 || 0.34 || RPD: 21	LCS	85%
CaA	%w/w	0.005	LAB.64	<0.005	41144-21	0.32 || 0.23 || RPD: 33	[NR]	[NR]
MgKCl	%w/w	0.005	LAB.64	<0.005	41144-21	<0.005 || <0.005	LCS	90%
MgP	%w/w	0.005	LAB.64	<0.005	41144-21	0.016 || 0.013 || RPD: 21	LCS	102%
MgA	%w/w	0.005	LAB.64	<0.005	41144-21	0.013 || 0.011 || RPD: 17	[NR]	[NR]
SRAS	%w/w	0.005	LAB.64	<0.005	41144-21	<0.005 || <0.005	[NR]	[NR]
SHCl	%w/w S	0.005	LAB.64	<0.005	41144-21	0.005 || 0.005 || RPD: 0	LCS	88%
SNAS	%w/w S	0.005	LAB.64	<0.005	41144-21	<0.005 || <0.005	[NR]	[NR]
a-SNAS	moles H^+/t	5	LAB.64	<5	41144-21	<5 || <5	[NR]	[NR]
s-SNAS	%w/w S	0.01	LAB.64	<0.01	41144-21	<0.01 || <0.01	[NR]	[NR]
a-Net Acidity	moles H^+/t	10	LAB.64	<10	41144-21	<10 || <10	LCS	106%
Liming rate	kg $CaCO_3$/t	0.75	LAB.64	<0.75	41144-21	<0.75 || <0.75	LCS	106%

QUALITY CONTROL sPOCAS	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
a-Net Acidity without ANCE	moles H^+/t	10	LAB.64	<10	41144-21	<10 || <10	[NR]	[NR]
Liming rate without ANCE	kg $CaCO_3$/t	0.75	LAB.64	<0.75	41144-21	<0.75 || <0.75	[NR]	[NR]

QUALITY CONTROL Moisture	UNITS	PQL	METHOD	Blank
Date prepared	-			20/5/10
Date analysed	-			20/5/10
Moisture	%	0.1	LAB.8	<0.10

QUALITY CONTROL Asbestos ID - soils	UNITS	PQL	METHOD	Blank
Date analysed	-			[NT]

QUALITY CONTROL sTPH in Soil (C10-C36)	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	41144-11	20/05/2010 || 20/05/2010	41144-5	20/05/2010
Date analysed	-	41144-11	20/05/2010 || 20/05/2010	41144-5	20/05/2010
TPH C_{10} - C_{14}	mg/kg	41144-11	<50 || <50	41144-5	88%
TPH C_{15} - C_{28}	mg/kg	41144-11	870 || 850 || RPD: 2	41144-5	107%
TPH C_{29} - C_{36}	mg/kg	41144-11	550 || 560 || RPD: 2	41144-5	110%
Surrogate o-Terphenyl	%	41144-11	# || #	41144-5	91%
QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	41144-11	20/5/10 || 20/5/10	41144-5	20/5/10
Date analysed	-	41144-11	22/5/10 || 22/5/10	41144-5	21/5/10
Naphthalene	mg/kg	41144-11	0.7 || 0.7 || RPD: 0	41144-5	92%
Acenaphthylene	mg/kg	41144-11	2.2 || 2.3 || RPD: 4	[NR]	[NR]
Acenaphthene	mg/kg	41144-11	1.5 || 1.4 || RPD: 7	[NR]	[NR]
Fluorene	mg/kg	41144-11	2.4 || 2.4 || RPD: 0	41144-5	97%
Phenanthrene	mg/kg	41144-11	24 || 22 || RPD: 9	41144-5	93%
Anthracene	mg/kg	41144-11	6.4 || 6.1 || RPD: 5	[NR]	[NR]
Fluoranthene	mg/kg	41144-11	31 || 29 || RPD: 7	41144-5	90%
Pyrene	mg/kg	41144-11	28 || 26 || RPD: 7	41144-5	100%
Benzo(a)anthracene	mg/kg	41144-11	13 || 12 || RPD: 8	[NR]	[NR]
Chrysene	mg/kg	41144-11	13 || 13 || RPD: 0	41144-5	94%
Benzo(b+k)fluoranthene	mg/kg	41144-11	21 || 21 || RPD: 0	[NR]	[NR]
Benzo(a)pyrene	mg/kg	41144-11	16 || 16 || RPD: 0	41144-5	102%
Indeno(1,2,3-c,d)pyrene	mg/kg	41144-11	8.9 || 8.5 || RPD: 5	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	41144-11	1.4 || 1.5 || RPD: 7	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	41144-11	8.2 || 7.4 || RPD: 10	[NR]	[NR]

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Surrogate p-Terphenyl-d14	%	41144-11	110 || 114 || RPD: 4	41144-5	103%
QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	41144-11	20/05/2010 || 20/05/2010	41144-5	20/05/2010
Date analysed	-	41144-11	20/05/2010 || 20/05/2010	41144-5	20/05/2010
HCB	mg/kg	41144-11	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	41144-11	<0.1 || <0.1	41144-5	102%
gamma-BHC	mg/kg	41144-11	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	41144-11	<0.1 || <0.1	41144-5	104%
Heptachlor	mg/kg	41144-11	<0.1 || <0.1	41144-5	104%
delta-BHC	mg/kg	41144-11	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	41144-11	<0.1 || <0.1	41144-5	101%
Heptachlor Epoxide	mg/kg	41144-11	<0.1 || <0.1	41144-5	106%
gamma-Chlordane	mg/kg	41144-11	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	41144-11	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	41144-11	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	41144-11	<0.1 || <0.1	41144-5	105%
Dieldrin	mg/kg	41144-11	<0.1 || <0.1	41144-5	110%
Endrin	mg/kg	41144-11	<0.1 || <0.1	41144-5	106%
pp-DDD	mg/kg	41144-11	<0.1 || <0.1	41144-5	112%
Endosulfan II	mg/kg	41144-11	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	41144-11	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	41144-11	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	41144-11	<0.1 || <0.1	41144-5	103%
Methoxychlor	mg/kg	41144-11	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%	41144-11	99 || 100 || RPD: 1	41144-5	100%

QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	41144-11	20/05/2010 || 20/05/2010	41144-5	20/05/2010
Date analysed	-	41144-11	20/05/2010 || 20/05/2010	41144-5	20/05/2010
Arochlor 1016	mg/kg	41144-11	<0.1 || <0.1	[NR]	[NR]
Arochlor 1221*	mg/kg	41144-11	<0.1 || <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	41144-11	<0.1 || <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	41144-11	<0.1 || <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	41144-11	<0.1 || <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	41144-11	<0.1 || <0.1	41144-5	106%
Arochlor 1260	mg/kg	41144-11	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%	41144-11	99 || 100 || RPD: 1	41144-5	104%
QUALITY CONTROL Total Phenolics in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	41144-11	20/5/2010 || 20/5/2010	41144-3	20/5/2010
Date analysed	-	41144-11	20/5/2010 || 20/5/2010	41144-3	20/5/2010
Total Phenolics (as Phenol)	mg/kg	41144-11	<5.0 || <5.0	41144-3	92%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date digested	-	41144-11	20/05/10 || 20/05/10	41144-5	20/05/10
Date analysed	-	41144-11	21/05/10 || 21/05/10	41144-5	21/05/10
Arsenic	mg/kg	41144-11	<4 || <4	41144-5	101%
Cadmium	mg/kg	41144-11	<0.5 || <0.5	41144-5	92%
Chromium	mg/kg	41144-11	11 || 9 || RPD: 20	41144-5	105%
Copper	mg/kg	41144-11	37 || 35 || RPD: 6	41144-5	119%
Lead	mg/kg	41144-11	45 || 43 || RPD: 5	41144-5	94%
Mercury	mg/kg	41144-11	<0.1 || <0.1	41144-5	110%
Nickel	mg/kg	41144-11	14 || 14 || RPD: 0	41144-5	98%
Zinc	mg/kg	41144-11	58 || 57 || RPD: 2	41144-5	99%

Report Comments:

Total Petroleum Hydrocarbons in soil (semivol):The RPD for duplicate results is accepted due to the non homogenous nature of the sample/s.# Percent recovery is not possible to report as the high concentration of analytes in the sample/s have caused interference.

PAH's in soil: The RPD for duplicate results is accepted due to the non homogenous nature of the sample/s.

Asbestos was analysed by Approved Identifier: Matt Mansfield

Asbestos was authorised by Approved Signatory: Matt Mansfield

INS: Insufficient sample for this test NT: Not tested PQL: Practical Quantitation Limit <: Less than >: Greater than

RPD: Relative Percent Difference NA: Test not required LCS: Laboratory Control Sample NR: Not requested

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria:

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the sample batch were within laboratory acceptance criteria.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable. Surrogates: 60-140% is acceptable for general organics and 10-140% for

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

SAMPLE RECEIPT ADVICE

Client:

Douglas Partners
96 Hermitage Rd
West Ryde NSW 2114

ph: 02 9809 0666
Fax: 02 9809 4095

Attention: Kurt Plambeck

Sample log in details:

Your reference:	**71529.01, Opera House VAPS Project**
Envirolab Reference:	**41144**
Date received:	18/05/10
Date results expected to be reported:	**27/05/10**

Samples received in appropriate condition for analysis:	YES
No. of samples provided	21 Soils
Turnaround time requested:	Standard
Temperature on receipt	Cool
Cooling Method:	Ice

Comments:

Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples.

Contact details:

Please direct any queries to Aileen Hie or Jacinta Hurst
ph: 02 9910 6200 fax: 02 9910 6201
email: ahie@envirolabservices.com.au or jhurst@envirolabservices.com.au

Douglas Partners
Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY

Project Name: Opera House VAPS Project
Project No: ...71529.01..... Sampler: ...KDP.....
Project Mgr: ...KP.....Mob. Phone: 0402 057 147
Email: kurt.plambeck@douglaspartners.com.au
Date Required: ...standard ..... Lab Quote No. .....

To: Envirolab Services
12 Ashley Street, Chatswood NSW 2068
Attn: Tania Notaras
Phone: 02 9910 6200 Fax: 02 9910 6201
Email: tnotaras@envirolabservices.com.au

Sample ID	Sample Depth	Lab ID	Sampling Date	Sample Type S - soil W – water	Container type	Analytes: Heavy metals	TRH BTEX	PAH	OCP PCB	Phenols	Asbestos	VOC			Notes
201	0.4-0.5	1	17/5	S	G	T	T	T	✓	✓	✓	✓			
201	0.8-1	2													
201	1.3-1.5	3							✓	✓	✓				
202	0.4-0.5	4							✓	✓	✓				
202	0.6-0.8	5							✓	✓	✓	✓			
202	0.8-0.9	6													
203	0.4-0.5	7							✓	✓	✓				
203	0.8-1	8							✓	✓	✓	✓			
204	0.4-0.5	9							✓	✓	✓	✓			
204	0.8-1	10							✓	✓	✓				
205	0.3-0.5	11							✓	✓	✓				
205	1.3-1.5	12				⊥	⊥	⊥			✓				

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: 9910 6200

Job No: 41144
Date received: 18/5/10
Time received: 4pm
Received by: Z.L.
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Lab Report No.: .....
Send Results to: Douglas Partners Address: 96 Hermitage Road, West Ryde 2114
Phone: (02) 9809 0666
Fax: (02) 9809 4095

Relinquished by:	Signed:	Date & Time:	Received By: Z.L.	Date & Time: 18/5/10 4pm
Relinquished by:	Signed:	Date & Time:	Received By:	Date & Time:

Douglas Partners
Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY

Project Name: Opera House VAPS Project
Project No: ...71529.01..... Sampler: ...KDP.....
Project Mgr: ...KP.....Mob. Phone: 0402 057 147
Email: kurt.plambeck@douglaspartners.com.au
Date Required: ...standard ..... Lab Quote No. .....

To: Envirolab Services
12 Ashley Street, Chatswood NSW 2068
Attn: Tania Notaras
Phone: 02 9910 6200 Fax: 02 9910 6201
Email: tnotaras@envirolabservices.com.au

Sample ID	Sample Depth	Lab ID	Sampling Date	Sample Type S - soil W – water	Container type	Analytes: Heavy metals	TRH BTEX	PAH	OCP PCB	Phenols	Asbestos	VOC	BTEX	SPOCAS	Notes
205/	1.3-2.5	13	17/5	S	G	✓	✓	✓	✓	✓		✓			
BD2	70510	14				✓	✓	✓							interlab
BD4	70510	15				✓	✓	✓							intralab
trip sp ike		16					✓						✓		
Trip blank		17					✓								
204/	1.2-1.3	18				✓	✓	✓						✓	
204/	1.0	19												✓	
205/	2.5	20												✓	
201/	1.0	21													

Lab Report No. .....
Send Results to: Douglas Partners Address: 96 Hermitage Road, West Ryde 2114
Phone: (02) 9809 0666
Fax: (02) 9809 4095

Relinquished by:	Signed:	Date & Time:	Received By: Z.L.	Date & Time: 18/5/10 4pm
Relinquished by:	Signed:	Date & Time:	Received By:	Date & Time:

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 41366

Client:
Douglas Partners
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Kurt Plambeck

Sample log in details:

Your Reference:	**71529.01, VAPs Opera House**
No. of samples:	7 Soils
Date samples received:	24/05/10
Date completed instructions received:	24/05/10

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	31/05/10
Date of Preliminary Report:	Not Issued
Issue Date:	29/05/10

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Accredited for compliance with ISO/IEC 17025.
Tests not covered by NATA are denoted with *.

Results Approved By:

Rhian Morgan
Metals Supervisor

Jacinta Hurst
Laboratory Manager

Matt Mansfield
Approved Signatory

VOCs in soil		
Our Reference:	UNITS	41366-2
Your Reference	----------	206/0.8-1.0
Date Sampled	----------	24/05/2010
Type of sample		Soil
Date extracted	-	25/05/2010
Date analysed	-	26/05/2010
Dichlorodifluoromethane	mg/kg	<1.0
Chloromethane	mg/kg	<1.0
Vinyl Chloride	mg/kg	<1.0
Bromomethane	mg/kg	<1.0
Chloroethane	mg/kg	<1.0
Trichlorofluoromethane	mg/kg	<1.0
1,1-Dichloroethene	mg/kg	<1.0
trans-1,2-dichloroethene	mg/kg	<1.0
1,1-dichloroethane	mg/kg	<1.0
cis-1,2-dichloroethene	mg/kg	<1.0
bromochloromethane	mg/kg	<1.0
chloroform	mg/kg	<1.0
2,2-dichloropropane	mg/kg	<1.0
1,2-dichloroethane	mg/kg	<1.0
1,1,1-trichloroethane	mg/kg	<1.0
1,1-dichloropropene	mg/kg	<1.0
Cyclohexane	mg/kg	<1.0
carbon tetrachloride	mg/kg	<1.0
Benzene	mg/kg	<0.5
dibromomethane	mg/kg	<1.0
1,2-dichloropropane	mg/kg	<1.0
trichloroethene	mg/kg	<1.0
bromodichloromethane	mg/kg	<1.0
trans-1,3-dichloropropene	mg/kg	<1.0
cis-1,3-dichloropropene	mg/kg	<1.0
1,1,2-trichloroethane	mg/kg	<1.0
Toluene	mg/kg	<0.5
1,3-dichloropropane	mg/kg	<1.0
dibromochloromethane	mg/kg	<1.0
1,2-dibromoethane	mg/kg	<1.0
tetrachloroethene	mg/kg	<1.0
1,1,1,2-tetrachloroethane	mg/kg	<1.0
chlorobenzene	mg/kg	<1.0
Ethylbenzene	mg/kg	<1.0
bromoform	mg/kg	<1.0
m+p-xylene	mg/kg	<2.0
styrene	mg/kg	<1.0
1,1,2,2-tetrachloroethane	mg/kg	<1.0

VOCs in soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ---------- 	41366-2 206/0.8-1.0 24/05/2010 Soil
o-Xylene	mg/kg	<1.0
1,2,3-trichloropropane	mg/kg	<1.0
isopropylbenzene	mg/kg	<1.0
bromobenzene	mg/kg	<1.0
n-propyl benzene	mg/kg	<1.0
2-chlorotoluene	mg/kg	<1.0
4-chlorotoluene	mg/kg	<1.0
1,3,5-trimethyl benzene	mg/kg	<1.0
tert-butyl benzene	mg/kg	<1.0
1,2,4-trimethyl benzene	mg/kg	<1.0
1,3-dichlorobenzene	mg/kg	<1.0
sec-butyl benzene	mg/kg	<1.0
1,4-dichlorobenzene	mg/kg	<1.0
4-isopropyl toluene	mg/kg	<1.0
1,2-dichlorobenzene	mg/kg	<1.0
n-butyl benzene	mg/kg	<1.0
1,2-dibromo-3-chloropropane	mg/kg	<1.0
1,2,4-trichlorobenzene	mg/kg	<1.0
hexachlorobutadiene	mg/kg	<1.0
1,2,3-trichlorobenzene	mg/kg	<1.0
Surrogate Dibromofluorometha	%	96
Surrogate aaa-Trifluorotoluene	%	119
Surrogate Toluene-d_8	%	119
Surrogate 4-Bromofluorobenzene	%	98

vTPH & BTEX in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41366-1 206/0.4-0.5 24/05/2010 Soil	41366-2 206/0.8-1.0 24/05/2010 Soil	41366-3 206/1.1-1.2 24/05/2010 Soil	41366-4 BD1240510 24/05/2010 Soil	41366-6 Trip Spike 24/05/2010 Soil
Date extracted	-	25/5/10	25/5/10	25/5/10	25/5/10	25/5/10
Date analysed	-	26/5/10	26/5/10	26/5/10	26/5/10	26/5/10
vTPH C_6 - C_9	mg/kg	<25	<25	<25	<25	[NA]
Benzene	mg/kg	<0.5	<0.5	<0.5	<0.5	100%
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	122%
Ethylbenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	104%
m+p-xylene	mg/kg	<2.0	<2.0	<2.0	<2.0	104%
o-Xylene	mg/kg	<1.0	<1.0	<1.0	<1.0	104%
Surrogate aaa-Trifluorotoluene	%	100	119	101	99	109

vTPH & BTEX in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41366-7 Trip Blank 24/05/2010 Soil
Date extracted	-	25/5/10
Date analysed	-	26/5/10
Benzene	mg/kg	<0.5
Toluene	mg/kg	<0.5
Ethylbenzene	mg/kg	<1.0
m+p-xylene	mg/kg	<2.0
o-Xylene	mg/kg	<1.0
Surrogate aaa-Trifluorotoluene	%	86

sTPH in Soil (C10-C36) Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ---------- 	41366-1 206/0.4-0.5 24/05/2010 Soil	41366-2 206/0.8-1.0 24/05/2010 Soil	41366-3 206/1.1-1.2 24/05/2010 Soil	41366-4 BD1240510 24/05/2010 Soil
Date extracted	-	25/05/2010	25/05/2010	25/05/2010	25/05/2010
Date analysed	-	25/05/2010	25/05/2010	25/05/2010	25/05/2010
TPH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50
TPH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100
TPH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100
Surrogate o-Terphenyl	%	92	101	103	105

PAHs in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41366-1 206/0.4-0.5 24/05/2010 Soil	41366-2 206/0.8-1.0 24/05/2010 Soil	41366-3 206/1.1-1.2 24/05/2010 Soil	41366-4 BD1240510 24/05/2010 Soil
Date extracted	-	25/5/10	25/5/10	25/5/10	25/5/10
Date analysed	-	26/5/10	26/5/10	26/5/10	26/5/10
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	0.7	1.5	0.7
Anthracene	mg/kg	<0.1	0.1	0.3	0.1
Fluoranthene	mg/kg	0.1	1.0	1.9	1.3
Pyrene	mg/kg	0.1	1.1	1.9	1.3
Benzo(a)anthracene	mg/kg	<0.1	0.5	0.9	0.6
Chrysene	mg/kg	0.1	0.6	1.0	0.7
Benzo(b+k)fluoranthene	mg/kg	<0.2	0.8	1.4	1.1
Benzo(a)pyrene	mg/kg	0.07	0.6	1	0.7
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	0.3	0.5	0.4
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	0.3	0.5	0.4
Surrogate p-Terphenyl-d_{14}	%	77	79	80	86

Organochlorine Pesticides in soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ---------- 	41366-1 206/0.4-0.5 24/05/2010 Soil	41366-2 206/0.8-1.0 24/05/2010 Soil
Date extracted	-	24/05/2010	24/05/2010
Date analysed	-	26/05/2010	26/05/2010
HCB	mg/kg	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1
Surrogate TCLMX	%	104	100

PCBs in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ---------- 	41366-1 206/0.4-0.5 24/05/2010 Soil	41366-2 206/0.8-1.0 24/05/2010 Soil
Date extracted	-	24/05/2010	24/05/2010
Date analysed	-	26/05/2010	26/05/2010
Arochlor 1016	mg/kg	<0.1	<0.1
Arochlor 1221*	mg/kg	<0.1	<0.1
Arochlor 1232	mg/kg	<0.1	<0.1
Arochlor 1242	mg/kg	<0.1	<0.1
Arochlor 1248	mg/kg	<0.1	<0.1
Arochlor 1254	mg/kg	<0.1	<0.1
Arochlor 1260	mg/kg	<0.1	<0.1
Surrogate TCLMX	%	104	100

Total Phenolics in Soil			
Our Reference:	UNITS	41366-1	41366-2
Your Reference	----------	206/0.4-0.5	206/0.8-1.0
Date Sampled	----------	24/05/2010	24/05/2010
Type of sample		Soil	Soil
Date extracted	-	25/5/2010	25/5/2010
Date analysed	-	25/5/2010	25/5/2010
Total Phenolics (as Phenol)	mg/kg	<5.0	<5.0

sPOCAS Our Reference: Your Reference Date Sampled Type of sample	 UNITS ---------- ---------- 	 41366-5 206/1.0 24/05/2010 Soil
Date prepared	-	25/5/10
Date analysed	-	25/5/10
pH kcl	pH units	9.2
TAA pH 6.5	moles H^+/t	<5
s-TAA pH 6.5	%w/w S	<0.01
pH ox	pH units	7.2
TPA pH 6.5	moles H^+/t	<5.0
s-TPA pH 6.5	%w/w S	<0.01
TSA pH 6.5	moles H^+/t	<5.0
s-TSA pH 6.5	%w/w S	<0.01
ANCE	% $CaCO_3$	0.4
a-ANCE	moles H^+/t	80
s-ANCE	%w/w S	0.13
SKCl	%w/w S	0.014
SP	%w/w	0.014
SPOS	%w/w	<0.005
a-SPOS	moles H^+/t	<5.0
CaKCl	%w/w	0.13
CaP	%w/w	0.16
CaA	%w/w	0.038
MgKCl	%w/w	0.022
MgP	%w/w	0.036
MgA	%w/w	0.013
SRAS	%w/w	<0.005
SHCl	%w/w S	0.008
SNAS	%w/w S	<0.005
a-SNAS	moles H^+/t	<5
s-SNAS	%w/w S	<0.01
a-Net Acidity	moles H^+/t	<10
Liming rate	kg $CaCO_3$/t	<0.75
a-Net Acidity without ANCE	moles H^+/t	<10
Liming rate without ANCE	kg $CaCO_3$/t	<0.75

Acid Extractable metals in soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41366-1 206/0.4-0.5 24/05/2010 Soil	41366-2 206/0.8-1.0 24/05/2010 Soil	41366-3 206/1.1-1.2 24/05/2010 Soil	41366-4 BD1240510 24/05/2010 Soil
Date digested	-	26/05/10	26/05/10	26/05/10	26/05/10
Date analysed	-	26/05/10	26/05/10	26/05/10	26/05/10
Arsenic	mg/kg	<4	<4	5	<4
Cadmium	mg/kg	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	7	8	32	7
Copper	mg/kg	22	33	50	38
Lead	mg/kg	41	65	91	130
Mercury	mg/kg	0.1	0.3	0.4	0.5
Nickel	mg/kg	5	19	16	16
Zinc	mg/kg	31	78	100	110

Moisture Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41366-1 206/0.4-0.5 24/05/2010 Soil	41366-2 206/0.8-1.0 24/05/2010 Soil	41366-3 206/1.1-1.2 24/05/2010 Soil	41366-4 BD1240510 24/05/2010 Soil	41366-7 Trip Blank 24/05/2010 Soil
Date prepared	-	25/5/10	25/5/10	25/5/10	25/5/10	25/5/10
Date analysed	-	25/5/10	25/5/10	25/5/10	25/5/10	25/5/10
Moisture	%	7.1	9.3	8.7	8.6	21

Asbestos ID - soils Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41366-1 206/0.4-0.5 24/05/2010 Soil	41366-2 206/0.8-1.0 24/05/2010 Soil
Date analysed	-	27/5/10	27/5/10
Sample Description	-	Approx 20g Sandy Soil	Approx 40g Soil & Rocks
Asbestos ID in soil	-	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg
Trace Analysis	-	Respirable fibres not detected	Respirable fibres not detected

Method ID	Methodology Summary
GC.14	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
GC.16	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS.
GC.3	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID.
GC.12 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
GC-5	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
GC-6	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
LAB.30	Total Phenolics - determined colorimetrically following disitillation.
LAB.64	sPOCAS determined using titrimetric and ICP-AES techniques. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.
Metals.20 ICP-AES	Determination of various metals by ICP-AES.
Metals.21 CV-AAS	Determination of Mercury by Cold Vapour AAS.
LAB.8	Moisture content determined by heating at 105 deg C for a minimum of 4 hours.
AS4964-2004	Asbestos ID - Qualitative identification of asbestos type fibres in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques.

QUALITY CONTROL VOCs in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			25/05/2010	41366-2	25/05/2010 || 25/05/2010	LCS-4	25/05/2010
Date analysed	-			26/05/2010	41366-2	26/05/2010 || 26/05/2010	LCS-4	26/05/2010
Dichlorodifluoromethane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
Chloromethane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
Vinyl Chloride	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
Bromomethane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
Chloroethane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
Trichlorofluoromethane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
1,1-Dichloroethene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
trans-1,2-dichloroethene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
1,1-dichloroethane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	LCS-4	91%
cis-1,2-dichloroethene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
bromochloromethane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
chloroform	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	LCS-4	87%
2,2-dichloropropane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
1,2-dichloroethane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	LCS-4	87%
1,1,1-trichloroethane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	LCS-4	86%
1,1-dichloropropene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
Cyclohexane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
carbon tetrachloride	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
Benzene	mg/kg	0.5	GC.14	<0.5	41366-2	<0.5 || <0.5	[NR]	[NR]
dibromomethane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
1,2-dichloropropane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
trichloroethene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	LCS-4	77%
bromodichloromethane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	LCS-4	77%
trans-1,3-dichloropropene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
cis-1,3-dichloropropene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
1,1,2-trichloroethane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
Toluene	mg/kg	0.5	GC.14	<0.5	41366-2	<0.5 || <0.5	[NR]	[NR]
1,3-dichloropropane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
dibromochloromethane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	LCS-4	74%
1,2-dibromoethane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
tetrachloroethene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	LCS-4	80%
1,1,1,2-tetrachloroethane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
chlorobenzene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
Ethylbenzene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
bromoform	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
m+p-xylene	mg/kg	2	GC.14	<2.0	41366-2	<2.0 || <2.0	[NR]	[NR]
styrene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
1,1,2,2-tetrachloroethane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]

QUALITY CONTROL VOCs in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
o-Xylene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
1,2,3-trichloropropane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
isopropylbenzene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
bromobenzene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
n-propyl benzene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
2-chlorotoluene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
4-chlorotoluene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
1,3,5-trimethyl benzene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
tert-butyl benzene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
1,2,4-trimethyl benzene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
1,3-dichlorobenzene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
sec-butyl benzene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
1,4-dichlorobenzene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
4-isopropyl toluene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
1,2-dichlorobenzene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
n-butyl benzene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
1,2-dibromo-3-chloropropane	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
1,2,4-trichlorobenzene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
hexachlorobutadiene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
1,2,3-trichlorobenzene	mg/kg	1	GC.14	<1.0	41366-2	<1.0 || <1.0	[NR]	[NR]
Surrogate Dibromofluorometha	%		GC.14	88	41366-2	96 || 88 || RPD: 9	LCS-4	89%
Surrogate aaa-Trifluorotoluene	%		GC.14	93	41366-2	119 || 112 || RPD: 6	LCS-4	98%
Surrogate Toluene-d_8	%		GC.14	90	41366-2	119 || 112 || RPD: 6	LCS-4	91%
Surrogate 4-Bromofluorobenzene	%		GC.14	98	41366-2	98 || 97 || RPD: 1	LCS-4	97%

QUALITY CONTROL vTPH & BTEX in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			25/5/10	41366-2	25/5/10 || 25/5/10	LCS-4	26/5/10
Date analysed	-			26/5/10	41366-2	26/5/10 || 26/5/10	LCS-4	26/5/10
vTPH C_6 - C_9	mg/kg	25	GC.16	<25	41366-2	<25 || <25	LCS-4	98%
Benzene	mg/kg	0.5	GC.16	<0.5	41366-2	<0.5 || <0.5	LCS-4	96%
Toluene	mg/kg	0.5	GC.16	<0.5	41366-2	<0.5 || <0.5	LCS-4	101%
Ethylbenzene	mg/kg	1	GC.16	<1.0	41366-2	<1.0 || <1.0	LCS-4	96%
m+p-xylene	mg/kg	2	GC.16	<2.0	41366-2	<2.0 || <2.0	LCS-4	98%
o-Xylene	mg/kg	1	GC.16	<1.0	41366-2	<1.0 || <1.0	LCS-4	102%
Surrogate aaa-Trifluorotoluene	%		GC.16	93	41366-2	119 || 112 || RPD: 6	LCS-4	111%

QUALITY CONTROL sTPH in Soil (C10-C36)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			25/05/2010	41366-2	25/05/2010 || 25/05/2010	LCS-4	25/05/2010
Date analysed	-			25/05/2010	41366-2	25/05/2010 || 25/05/2010	LCS-4	25/05/2010
TPH C_{10} - C_{14}	mg/kg	50	GC.3	<50	41366-2	<50 || <50	LCS-4	89%
TPH C_{15} - C_{28}	mg/kg	100	GC.3	<100	41366-2	<100 || <100	LCS-4	99%
TPH C_{29} - C_{36}	mg/kg	100	GC.3	<100	41366-2	<100 || <100	LCS-4	97%
Surrogate o-Terphenyl	%		GC.3	94	41366-2	101 || 100 || RPD: 1	LCS-4	103%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			25/5/10	41366-2	25/5/10 || 25/5/10	LCS-5	25/5/10
Date analysed	-			26/5/10	41366-2	26/5/10 || 26/5/10	LCS-5	26/5/10
Naphthalene	mg/kg	0.1	GC.12 subset	<0.1	41366-2	<0.1 || <0.1	LCS-5	87%
Acenaphthylene	mg/kg	0.1	GC.12 subset	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	GC.12 subset	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	GC.12 subset	<0.1	41366-2	<0.1 || <0.1	LCS-5	95%
Phenanthrene	mg/kg	0.1	GC.12 subset	<0.1	41366-2	0.7 || 0.6 || RPD: 15	LCS-5	95%
Anthracene	mg/kg	0.1	GC.12 subset	<0.1	41366-2	0.1 || 0.1 || RPD: 0	[NR]	[NR]
Fluoranthene	mg/kg	0.1	GC.12 subset	<0.1	41366-2	1.0 || 1.0 || RPD: 0	LCS-5	88%
Pyrene	mg/kg	0.1	GC.12 subset	<0.1	41366-2	1.1 || 1.1 || RPD: 0	LCS-5	99%
Benzo(a)anthracene	mg/kg	0.1	GC.12 subset	<0.1	41366-2	0.5 || 0.6 || RPD: 18	[NR]	[NR]

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Chrysene	mg/kg	0.1	GC.12 subset	<0.1	41366-2	0.6 || 0.6 || RPD: 0	LCS-5	102%
Benzo(b+k)fluoranthene	mg/kg	0.2	GC.12 subset	<0.2	41366-2	0.8 || 0.9 || RPD: 12	[NR]	[NR]
Benzo(a)pyrene	mg/kg	0.05	GC.12 subset	<0.05	41366-2	0.6 || 0.7 || RPD: 15	LCS-5	105%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	GC.12 subset	<0.1	41366-2	0.3 || 0.4 || RPD: 29	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	GC.12 subset	<0.1	41366-2	<0.1 || 0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	GC.12 subset	<0.1	41366-2	0.3 || 0.5 || RPD: 50	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%		GC.12 subset	96	41366-2	79 || 83 || RPD: 5	LCS-5	100%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			24/05/2010	41366-2	24/05/2010 || 24/05/2010	LCS-1	24/05/2010
Date analysed	-			26/05/2010	41366-2	26/05/2010 || 26/05/2010	LCS-1	26/05/2010
HCB	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	LCS-1	107%
gamma-BHC	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	LCS-1	100%
Heptachlor	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	LCS-1	92%
delta-BHC	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	LCS-1	105%
Heptachlor Epoxide	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	LCS-1	104%
gamma-Chlordane	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	LCS-1	99%
Dieldrin	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	LCS-1	104%
Endrin	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	LCS-1	94%
pp-DDD	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	LCS-1	95%
Endosulfan II	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	LCS-1	94%
Methoxychlor	mg/kg	0.1	GC-5	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		GC-5	97	41366-2	100 || 98 || RPD: 2	LCS-1	99%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			24/05/2010	41366-2	24/05/2010 || 24/05/2010	LCS-1	24/05/2010
Date analysed	-			26/05/2010	41366-2	26/05/2010 || 26/05/2010	LCS-1	26/05/2010
Arochlor 1016	mg/kg	0.1	GC-6	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
Arochlor 1221*	mg/kg	0.1	GC-6	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	0.1	GC-6	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	0.1	GC-6	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	0.1	GC-6	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	0.1	GC-6	<0.1	41366-2	<0.1 || <0.1	LCS-1	99%
Arochlor 1260	mg/kg	0.1	GC-6	<0.1	41366-2	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		GC-6	97	41366-2	100 || 98 || RPD: 2	LCS-1	99%

QUALITY CONTROL Total Phenolics in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			25/5/2010	41366-1	25/5/2010 || 25/5/2010	LCS-2	25/5/2010
Date analysed	-			25/5/2010	41366-1	25/5/2010 || 25/5/2010	LCS-2	25/5/2010
Total Phenolics (as Phenol)	mg/kg	5	LAB.30	<5.0	41366-1	<5.0 || <5.0	LCS-2	95%

QUALITY CONTROL sPOCAS	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			25/5/10	[NT]	[NT]	LCS	25/5/10
Date analysed	-			25/5/10	[NT]	[NT]	LCS	25/5/10
pH $_{kcl}$	pH units		LAB.64	5.3	[NT]	[NT]	LCS	101%
TAA pH 6.5	moles H^+/t	5	LAB.64	<5	[NT]	[NT]	LCS	99%
s-TAA pH 6.5	%w/w S	0.01	LAB.64	<0.01	[NT]	[NT]	LCS	97%
pH $_{ox}$	pH units		LAB.64	4.2	[NT]	[NT]	LCS	107%
TPA pH 6.5	moles H^+/t	5	LAB.64	<5.0	[NT]	[NT]	LCS	95%
s-TPA pH 6.5	%w/w S	0.01	LAB.64	<0.01	[NT]	[NT]	LCS	95%
TSA pH 6.5	moles H^+/t	5	LAB.64	<5.0	[NT]	[NT]	LCS	94%
s-TSA pH 6.5	%w/w S	0.01	LAB.64	<0.01	[NT]	[NT]	LCS	93%
ANCe	% $CaCO_3$	0.05	LAB.64	<0.05	[NT]	[NT]	[NR]	[NR]
a-ANCe	moles H^+/t	5	LAB.64	<5	[NT]	[NT]	[NR]	[NR]

QUALITY CONTROL sPOCAS	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
s-ANCe	%w/w S	0.05	LAB.64	<0.05	[NT]	[NT]	[NR]	[NR]
Skcl	%w/w S	0.005	LAB.64	<0.005	[NT]	[NT]	LCS	111%
Sp	%w/w	0.005	LAB.64	<0.005	[NT]	[NT]	LCS	100%
Spos	%w/w	0.005	LAB.64	<0.005	[NT]	[NT]	LCS	97%
a-Spos	moles H^+/t	5	LAB.64	<5.0	[NT]	[NT]	LCS	98%
Cakcl	%w/w	0.005	LAB.64	<0.005	[NT]	[NT]	LCS	93%
Cap	%w/w	0.005	LAB.64	<0.005	[NT]	[NT]	LCS	78%
Caa	%w/w	0.005	LAB.64	<0.005	[NT]	[NT]	[NR]	[NR]
Mgkcl	%w/w	0.005	LAB.64	<0.005	[NT]	[NT]	LCS	91%
Mgp	%w/w	0.005	LAB.64	<0.005	[NT]	[NT]	LCS	95%
Mga	%w/w	0.005	LAB.64	<0.005	[NT]	[NT]	[NR]	[NR]
SRAS	%w/w	0.005	LAB.64	<0.005	[NT]	[NT]	[NR]	[NR]
Shcl	%w/w S	0.005	LAB.64	<0.005	[NT]	[NT]	LCS	89%
Snas	%w/w S	0.005	LAB.64	<0.005	[NT]	[NT]	[NR]	[NR]
a-Snas	moles H^+/t	5	LAB.64	<5	[NT]	[NT]	[NR]	[NR]
s-Snas	%w/w S	0.01	LAB.64	<0.01	[NT]	[NT]	[NR]	[NR]
a-Net Acidity	moles H^+/t	10	LAB.64	<10	[NT]	[NT]	LCS	96%
Liming rate	kg $CaCO_3$/t	0.75	LAB.64	<0.75	[NT]	[NT]	LCS	96%
a-Net Acidity without ANCE	moles H^+/t	10	LAB.64	<10	[NT]	[NT]	[NR]	[NR]
Liming rate without ANCE	kg $CaCO_3$/t	0.75	LAB.64	<0.75	[NT]	[NT]	[NR]	[NR]

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date digested	-			26/05/10	41366-2	26/05/10 || 26/05/10	LCS-1	26/05/10
Date analysed	-			26/05/10	41366-2	26/05/10 || 26/05/10	LCS-1	26/05/10
Arsenic	mg/kg	4	Metals.20 ICP-AES	<4	41366-2	<4 || <4	LCS-1	100%
Cadmium	mg/kg	0.5	Metals.20 ICP-AES	<0.5	41366-2	<0.5 || <0.5	LCS-1	105%
Chromium	mg/kg	1	Metals.20 ICP-AES	<1	41366-2	8 || 8 || RPD: 0	LCS-1	106%
Copper	mg/kg	1	Metals.20 ICP-AES	<1	41366-2	33 || 31 || RPD: 6	LCS-1	110%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Lead	mg/kg	1	Metals.20 ICP-AES	<1	41366-2	65 || 69 || RPD: 6	LCS-1	101%
Mercury	mg/kg	0.1	Metals.21 CV-AAS	<0.1	41366-2	0.3 || 0.3 || RPD: 0	LCS-1	91%
Nickel	mg/kg	1	Metals.20 ICP-AES	<1	41366-2	19 || 12 || RPD: 45	LCS-1	108%
Zinc	mg/kg	1	Metals.20 ICP-AES	<1	41366-2	78 || 83 || RPD: 6	LCS-1	106%

QUALITY CONTROL Moisture	UNITS	PQL	METHOD	Blank
Date prepared	-			25/5/10
Date analysed	-			25/5/10
Moisture	%	0.1	LAB.8	<0.10

QUALITY CONTROL Asbestos ID - soils	UNITS	PQL	METHOD	Blank
Date analysed	-			[NT]

QUALITY CONTROL sTPH in Soil (C10-C36)	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	41366-1	25/05/2010
Date analysed	-	[NT]	[NT]	41366-1	25/05/2010
TPH C_{10} - C_{14}	mg/kg	[NT]	[NT]	41366-1	82%
TPH C_{15} - C_{28}	mg/kg	[NT]	[NT]	41366-1	102%
TPH C_{29} - C_{36}	mg/kg	[NT]	[NT]	41366-1	97%
Surrogate o-Terphenyl	%	[NT]	[NT]	41366-1	106%
QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	41366-1	25/5/10
Date analysed	-	[NT]	[NT]	41366-1	26/5/10
Naphthalene	mg/kg	[NT]	[NT]	41366-1	86%
Acenaphthylene	mg/kg	[NT]	[NT]	[NR]	[NR]
Acenaphthene	mg/kg	[NT]	[NT]	[NR]	[NR]
Fluorene	mg/kg	[NT]	[NT]	41366-1	91%
Phenanthrene	mg/kg	[NT]	[NT]	41366-1	90%
Anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Fluoranthene	mg/kg	[NT]	[NT]	41366-1	92%
Pyrene	mg/kg	[NT]	[NT]	41366-1	100%
Benzo(a)anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Chrysene	mg/kg	[NT]	[NT]	41366-1	97%
Benzo(b+k)fluoranthene	mg/kg	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	mg/kg	[NT]	[NT]	41366-1	101%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Indeno(1,2,3-c,d)pyrene	mg/kg	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%	[NT]	[NT]	41366-1	79%
QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	41366-1	24/05/2010
Date analysed	-	[NT]	[NT]	41366-1	26/05/2010
HCB	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-BHC	mg/kg	[NT]	[NT]	41366-1	111%
gamma-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
beta-BHC	mg/kg	[NT]	[NT]	41366-1	99%
Heptachlor	mg/kg	[NT]	[NT]	41366-1	86%
delta-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
Aldrin	mg/kg	[NT]	[NT]	41366-1	106%
Heptachlor Epoxide	mg/kg	[NT]	[NT]	41366-1	103%
gamma-Chlordane	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-chlordane	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan I	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDE	mg/kg	[NT]	[NT]	41366-1	96%
Dieldrin	mg/kg	[NT]	[NT]	41366-1	103%
Endrin	mg/kg	[NT]	[NT]	41366-1	86%
pp-DDD	mg/kg	[NT]	[NT]	41366-1	91%
Endosulfan II	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDT	mg/kg	[NT]	[NT]	[NR]	[NR]
Endrin Aldehyde	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan Sulphate	mg/kg	[NT]	[NT]	41366-1	90%
Methoxychlor	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%	[NT]	[NT]	41366-1	100%

QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	41366-1	24/05/2010
Date analysed	-	[NT]	[NT]	41366-1	26/05/2010
Arochlor 1016	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1221*	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1232	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1242	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1248	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1254	mg/kg	[NT]	[NT]	41366-1	101%
Arochlor 1260	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%	[NT]	[NT]	41366-1	110%

Report Comments:

Asbestos was analysed by Approved Identifier: Matt Mansfield
Asbestos was authorised by Approved Signatory: Matt Mansfield
INS: Insufficient sample for this test NT: Not tested PQL: Practical Quantitation Limit <: Less than >: Greater than
RPD: Relative Percent Difference NA: Test not required LCS: Laboratory Control Sample NR: Not requested

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria:

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the sample batch were within laboratory acceptance criteria.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable. Surrogates: 60-140% is acceptable for general organics and 10-140% for

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

SAMPLE RECEIPT ADVICE

Client:

Douglas Partners
96 Hermitage Rd
West Ryde NSW 2114

ph: 02 9809 0666
Fax: 02 9809 4095

Attention: Kurt Plambeck

Sample log in details:

Your reference:	**71529.01, VAPs Opera House**
Envirolab Reference:	**41366**
Date received:	24/05/10
Date results expected to be reported:	**31/05/10**

Samples received in appropriate condition for analysis:	YES
No. of samples provided	7 Soils
Turnaround time requested:	Standard
Temperature on receipt	Cool
Cooling Method:	Ice

Comments:

Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples.

Contact details:

Please direct any queries to Aileen Hie or Jacinta Hurst
ph: 02 9910 6200 fax: 02 9910 6201
email: ahie@envirolabservices.com.au or jhurst@envirolabservices.com.au

Douglas Partners
Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY

Project Name: VAPs Opera House
Project No: ...71529.01..... Sampler: ...KDP.....
Project Mgr: ...KP.....Mob. Phone: 0402 057 147
Email: kurt.plambeck@douglaspartners.com.au
Date Required: ...standard ..... Lab Quote No. .....

To: Envirolab Services
12 Ashley Street, Chatswood NSW 2068
Attn: Tania Notaras
Phone: 02 9910 6200 Fax: 02 9910 6201
Email: tnotaras@envirolabservices.com.au

	Sample ID	Sample Depth	Lab ID	Sampling Date	Sample Type S - soil W – water	Container type	Analytes: Heavy metals	TRH BTEX	PAH	OCP PCB	Phenols	Asbestos	SPOCAS	BTEX	VOC	Notes
1	206/0.4-0.5			24/5	S	G	T	T	T	✓	✓	✓				
2	206/0.8-1.0									✓	✓	✓			✓	
3	206/1.1-1.2															
4	BD1240510					↓										
5	206/1.0					B							✓			
6	trip spike					A								✓		
7	trip blank			↓	↓	A								✓		

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: 9910 6200

Job No: 41366
Date received: 24/05/10
Time received: 4pm HM
Received by:
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Lab Report No. .....
Send Results to: Douglas Partners Address: 96 Hermitage Road, West Ryde 2114
Phone: (02) 9809 0666
Fax: (02) 9809 4095

Relinquished by: KP	Signed: KP	Date & Time: 24/5 12pm	Received By: Hindo	Date & Time:	
Relinquished by:	Signed:	Date & Time:	Received By:	Date & Time:	

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 41144-A

Client:
Douglas Partners
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Kurt Plambeck

Sample log in details:

Your Reference:	**71529.01, Opera House VAPS Project**
No. of samples:	Additional Testing on 5 Soils
Date samples received:	18/05/10
Date completed instructions received:	28/05/10

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	4/06/10
Date of Preliminary Report:	Not Issued
Issue Date:	3/06/10

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Tests not covered by NATA are denoted with *.

Results Approved By:

Jacinta Hurst
Laboratory Manager

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Metals in TCLP USEPA1311 Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ---------- 	41144-A-1 201/0.4-0.5 17/05/2010 Soil	41144-A-3 201/1.3-1.5 17/05/2010 Soil	41144-A-8 203/0.8-1 17/05/2010 Soil	41144-A-11 205/0.3-0.5 17/05/2010 Soil	41144-A-15 BD4/170510 17/05/2010 Soil
Date extracted	-	31/05/2010	31/05/2010	31/05/2010	31/05/2010	31/05/2010
Date analysed	-	[NA]	[NA]	01/06/2010	[NA]	[NA]
pH of soil for fluid# determ.	pH units	9.40	9.20	9.40	9.20	9.40
pH of soil for fluid # determ. (acid)	pH units	1.20	1.30	1.20	1.10	1.20
Extraction fluid used	-	1	1	1	1	1
pH of final Leachate	pH units	5.50	6.10	5.90	5.20	5.20
Lead in TCLP	mg/L	[NA]	[NA]	0.03	[NA]	[NA]

PAHs in TCLP (USEPA 1311) Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41144-A-1 201/0.4-0.5 17/05/2010 Soil	41144-A-3 201/1.3-1.5 17/05/2010 Soil	41144-A-8 203/0.8-1 17/05/2010 Soil	41144-A-11 205/0.3-0.5 17/05/2010 Soil	41144-A-15 BD4/170510 17/05/2010 Soil
Date extracted	-	01/06/2010	01/06/2010	01/06/2010	01/06/2010	01/06/2010
Date analysed	-	01/06/2010	01/06/2010	01/06/2010	01/06/2010	01/06/2010
Naphthalene in TCLP	mg/L	0.003	0.002	<0.001	0.009	0.001
Acenaphthylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Acenaphthene in TCLP	mg/L	<0.001	<0.001	<0.001	0.007	0.002
Fluorene in TCLP	mg/L	0.002	0.001	<0.001	0.008	0.001
Phenanthrene in TCLP	mg/L	0.005	0.006	<0.001	0.024	0.006
Anthracene in TCLP	mg/L	<0.001	0.001	<0.001	0.004	<0.001
Fluoranthene in TCLP	mg/L	<0.001	0.001	<0.001	0.004	<0.001
Pyrene in TCLP	mg/L	<0.001	0.001	<0.001	0.003	<0.001
Benzo(a)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chrysene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(b+k)fluoranthene in TCLP	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Benzo(a)pyrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Dibenzo(a,h)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(g,h,i)perylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Surrogate p-Terphenyl-d_{14}	%	116	124	115	109	111

Method ID	Methodology Summary
LAB.4	Toxicity Characteristic Leaching Procedure (TCLP).
EXTRACT.7	Toxicity Characteristic Leaching Procedure (TCLP).
LAB.1	pH - Measured using pH meter and electrode in accordance with APHA 20th ED, 4500-H+.
Metals.20 ICP-AES	Determination of various metals by ICP-AES.
GC.12 subset	Leachates are extracted with Dichloromethane and analysed by GC-MS.
GC.12 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
GC.12	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.

QUALITY CONTROL Metals in TCLP USEPA1311	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			31/05/2010	[NT]	[NT]	LCS-W1	31/05/2010
Date analysed	-			01/06/2010	[NT]	[NT]	LCS-W1	01/06/2010
Lead in TCLP	mg/L	0.03	Metals.20 ICP-AES	<0.03	[NT]	[NT]	LCS-W1	92%

QUALITY CONTROL PAHs in TCLP (USEPA 1311)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			01/06/2010	[NT]	[NT]	LCS-W1	01/06/2010
Date analysed	-			01/06/2010	[NT]	[NT]	LCS-W1	01/06/2010
Naphthalene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	89%
Acenaphthylene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Acenaphthene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Fluorene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	91%
Phenanthrene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	89%
Anthracene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Fluoranthene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	80%
Pyrene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	87%
Benzo(a)anthracene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Chrysene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	97%
Benzo(b+k)fluoranthene in TCLP	mg/L	0.002	GC.12 subset	<0.002	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	116%
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%		GC.12	114	[NT]	[NT]	LCS-W1	113%

Report Comments:

Asbestos was analysed by Approved Identifier: Not applicable for this job
Asbestos was authorised by Approved Signatory: Not applicable for this job
INS: Insufficient sample for this test NT: Not tested PQL: Practical Quantitation Limit <: Less than >: Greater than
RPD: Relative Percent Difference NA: Test not required LCS: Laboratory Control Sample NR: Not requested

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria:

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the sample batch were within laboratory acceptance criteria.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable. Surrogates: 60-140% is acceptable for general organics and 10-140% for

Aileen Hie

From: Kurt Plambeck [kurt.plambeck@douglaspartners.com.au]
Sent: Friday, 28 May 2010 01:09 PM
To: Jacinta Hurst
Cc: Aileen Hie
Subject: RE: Results for registration '41144 - 71529.01, Opera House VAPS Project'

Jacinta,

-1 -3 -8 -11 -15

can you please run samples 201/0.4-0.5, 201/1.3-1.5, 203/0.8-1, 205/0.3-0.5 and BD4 170510 for TCLP PAH and
Sample 203/0.8-1 for TCLP lead

-8

Regards

Kurt Plambeck

From: Jacinta Hurst [mailto:JHurst@envirolabservices.com.au]
Sent: Wednesday, 26 May 2010 3:35 PM
To: Kurt Plambeck
Subject: Results for registration '41144 - 71529.01, Opera House VAPS Project'

Please refer to attached for:
a copy of the Certificate of Analysis
a copy of the COC
an excel file containing the results

Please note that a hard copy will not be posted.

Enquiries should be made directly to:
Jacinta Hurst on jhurst@envirolabservices.com.au
or
David Springer on dspringer@envirolabservices.com.au
or
Tania Notaras on tnotaras@envirolabservices.com.au

Envirolab Ref: 41144A
Due: 4/6/10
std TA

Regards

Envirolab Services
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
www.envirolabservices.com.au

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 36506-A

Client:
Douglas Partners
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Peter Hartcliff

Sample log in details:

Your Reference:	**71529, Sydney Opera House (VAPS)**
No. of samples:	Additional Testing on 4 Soils
Date samples received:	22/12/09
Date completed instructions received:	08/01/10

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	11/01/10
Date of Preliminary Report:	Not Issued
Issue Date:	11/01/10

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Tests not covered by NATA are denoted with *.

Results Approved By:

Joshua Lim
Chemist

Metals in TCLP USEPA1311 Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	36506-A-1 BH101/0.2 17/12/2009 Soil	36506-A-2 BH101/1.5 17/12/2009 Soil	36506-A-3 BH102/0.45 20/12/2009 Soil	36506-A-4 BH102/1.0 20/12/2009 Soil
Date extracted	-	8/01/2010	8/01/2010	8/01/2010	8/01/2010
Date analysed	-	11/01/2010	[NA]	[NA]	[NA]
pH of soil for fluid# determ.	pH units	9.70	9.50	9.90	9.60
pH of soil for fluid # determ. (acid)	pH units	0.900	0.900	1.00	0.900
Extraction fluid used	-	1	1	1	1
pH of final Leachate	pH units	5.20	5.30	6.30	5.10
Nickel in TCLP	mg/L	0.1	[NA]	[NA]	[NA]

PAHs in TCLP (USEPA 1311) Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	36506-A-2 BH101/1.5 17/12/2009 Soil	36506-A-3 BH102/0.45 20/12/2009 Soil	36506-A-4 BH102/1.0 20/12/2009 Soil
Date extracted	-	11/01/2010	11/01/2010	11/01/2010
Date analysed	-	11/01/2010	11/01/2010	11/01/2010
Naphthalene in TCLP	mg/L	0.001	<0.001	0.002
Acenaphthylene in TCLP	mg/L	<0.001	<0.001	<0.001
Acenaphthene in TCLP	mg/L	<0.001	<0.001	<0.001
Fluorene in TCLP	mg/L	<0.001	<0.001	<0.001
Phenanthrene in TCLP	mg/L	0.003	0.004	0.003
Anthracene in TCLP	mg/L	<0.001	<0.001	<0.001
Fluoranthene in TCLP	mg/L	<0.001	<0.001	<0.001
Pyrene in TCLP	mg/L	<0.001	<0.001	<0.001
Benzo(a)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001
Chrysene in TCLP	mg/L	<0.001	<0.001	<0.001
Benzo(b+k)fluoranthene in TCLP	mg/L	<0.002	<0.002	<0.002
Benzo(a)pyrene in TCLP	mg/L	<0.001	<0.001	<0.001
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	<0.001	<0.001	<0.001
Dibenzo(a,h)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001
Benzo(g,h,i)perylene in TCLP	mg/L	<0.001	<0.001	<0.001
Surrogate p-Terphenyl-d_{14}	%	116	122	119

Method ID	Methodology Summary
LAB.4	Toxicity Characteristic Leaching Procedure (TCLP).
EXTRACT.7	Toxicity Characteristic Leaching Procedure (TCLP).
LAB.1	pH - Measured using pH meter and electrode in accordance with APHA 20th ED, 4500-H+.
Metals.20 ICP-AES	Determination of various metals by ICP-AES.
GC.12 subset	Leachates are extracted with Dichloromethane and analysed by GC-MS.
GC.12 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
GC.12	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.

QUALITY CONTROL Metals in TCLP USEPA1311	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			08/01/10	[NT]	[NT]	LCS-W1	08/01/10
Date analysed	-			11/01/10	[NT]	[NT]	LCS-W1	11/01/10
Nickel in TCLP	mg/L	0.02	Metals.20 ICP-AES	<0.02	[NT]	[NT]	LCS-W1	93%

QUALITY CONTROL PAHs in TCLP (USEPA 1311)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			11/01/2010	[NT]	[NT]	LCS-W1	11/01/2010
Date analysed	-			11/01/2010	[NT]	[NT]	LCS-W1	11/01/2010
Naphthalene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	98%
Acenaphthylene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Acenaphthene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Fluorene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	94%
Phenanthrene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	101%
Anthracene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Fluoranthene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	90%
Pyrene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	94%
Benzo(a)anthracene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Chrysene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	109%
Benzo(b+k)fluoranthene in TCLP	mg/L	0.002	GC.12 subset	<0.002	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	117%
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%		GC.12	117	[NT]	[NT]	LCS-W1	113%

Report Comments:

Asbestos was analysed by Approved Identifier: Not applicable for this job
INS: Insufficient sample for this test NT: Not tested PQL: Practical Quantitation Limit <: Less than >: Greater than
RPD: Relative Percent Difference NA: Test not required LCS: Laboratory Control Sample NR: Not requested

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria:

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the sample batch were within laboratory acceptance criteria.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable. Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and speciated phenols.

Aileen Hie

From: Jacinta Hurst
Sent: Friday, 8 January 2010 02:20 PM
To: Aileen Hie
Subject: FW: Results for registration '36506 - 71529, Sydney Opera House (VAPS)'

Envirolab Ref: 36506A
Due: 11/1/10
24hr TAT.

Regards,

Jacinta Hurst
Envirolab Services Pty Ltd
12 Ashley St Chatswood NSW 2067
T 02 9910 6200 F 02 9910 6201
D 02 9910 6220 M 0407 00 3037
jhurst@envirolabservices.com.au | www.envirolabservices.com.au

From: Peter Hartcliff [mailto:Peter.Hartcliff@douglaspartners.com.au]
Sent: Friday, 8 January 2010 02:20
To: Jacinta Hurst
Subject: RE: Results for registration '36506 - 71529, Sydney Opera House (VAPS)'

Jacinta,

Can I please get you guys to conduct TCLP (ASAP) on samples 1, 2, 3 and 4 (for PAH analysis for samples 2, 3 and 4 and for Nickel for sample 1).

Thanks

Peter Hartcliff | Engineering Geologist
Douglas Partners Pty Ltd | ABN 75 053 980 117 | www.douglaspartners.com.au
96 Hermitage Road West Ryde NSW 2114 | PO Box 472 West Ryde NSW 1685
P: 02 8878 0616 | F: 02 9809 4095 | M: 0423 564 775 | E: Peter.Hartcliff@douglaspartners.com.au

From: Jacinta Hurst [mailto:JHurst@envirolabservices.com.au]
Sent: Wednesday, 30 December 2009 1:10 PM
To: Peter Hartcliff
Subject: Results for registration '36506 - 71529, Sydney Opera House (VAPS)'

Please refer to attached for:
a copy of the Certificate of Analysis
a copy of the COC
an excel file containing the results

Please note that a hard copy will not be posted.

Enquiries should be made directly to:
Jacinta Hurst on jhurst@envirolabservices.com.au

or
Joshua Lim on jlim@envirolabservices.com.au
or
David Springer on dspringer@envirolabservices.com.au
or
Tania Notaras on tnotaras@envirolabservices.com.au

Regards

Envirolab Services
12 Ashley St Chatswood NSW 2067
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Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 36506

Client:
Douglas Partners
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Peter Hartcliff

Sample log in details:

Your Reference:	**71529, Sydney Opera House (VAPS)**
No. of samples:	5 Soils
Date samples received:	22/12/09
Date completed instructions received:	22/12/09

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	6/01/10
Date of Preliminary Report:	Not Issued
Issue Date:	30/12/09

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Tests not covered by NATA are denoted with *.

Results Approved By:

Jacinta Hurst
Operations Manager

Joshua Lim
Chemist

Envirolab Reference: 36506
Revision No: R 00

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

vTPH & BTEX in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	36506-1 BH101/0.2 17/12/2009 Soil	36506-2 BH101/1.5 17/12/2009 Soil	36506-3 BH102/0.45 20/12/2009 Soil	36506-4 BH102/1.0 20/12/2009 Soil	36506-5 BD/201 209 17/12/2009 Soil
Date extracted	-	23/12/2009	23/12/2009	23/12/2009	23/12/2009	23/12/2009
Date analysed	-	23/12/2009	23/12/2009	23/12/2009	23/12/2009	23/12/2009
vTPH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
m+p-xylene	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
o-Xylene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Surrogate aaa-Trifluorotoluene	%	88	89	81	89	86

sTPH in Soil (C10-C36) Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ---------- 	36506-1 BH101/0.2 17/12/2009 Soil	36506-2 BH101/1.5 17/12/2009 Soil	36506-3 BH102/0.45 20/12/2009 Soil	36506-4 BH102/1.0 20/12/2009 Soil	36506-5 BD/201 209 17/12/2009 Soil
Date extracted	-	23/12/2009	23/12/2009	23/12/2009	23/12/2009	23/12/2009
Date analysed	-	24/12/2009	24/12/2009	24/12/2009	24/12/2009	24/12/2009
TPH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TPH C_{15} - C_{28}	mg/kg	<100	120	140	<100	<100
TPH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	90	97	96	93	92

PAHs in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	36506-1 BH101/0.2 17/12/2009 Soil	36506-2 BH101/1.5 17/12/2009 Soil	36506-3 BH102/0.45 20/12/2009 Soil	36506-4 BH102/1.0 20/12/2009 Soil	36506-5 BD/201 209 17/12/2009 Soil
Date extracted	-	23/12/2009	23/12/2009	23/12/2009	23/12/2009	23/12/2009
Date analysed	-	23/12/2009	23/12/2009	23/12/2009	24/12/2009	24/12/2009
Naphthalene	mg/kg	<0.1	0.1	0.1	0.1	0.1
Acenaphthylene	mg/kg	<0.1	0.3	0.4	0.1	0.1
Acenaphthene	mg/kg	<0.1	0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	0.2	0.1	0.1	0.1
Phenanthrene	mg/kg	<0.1	3.5	4.0	2.1	2.1
Anthracene	mg/kg	<0.1	0.9	0.9	0.4	0.4
Fluoranthene	mg/kg	<0.1	6.1	7.0	2.5	2.6
Pyrene	mg/kg	<0.1	6.1	7.3	2.7	2.7
Benzo(a)anthracene	mg/kg	<0.1	2.9	3.3	1.1	1.2
Chrysene	mg/kg	<0.1	3.0	3.3	1.2	1.2
Benzo(b+k)fluoranthene	mg/kg	<0.2	4.7	5.4	1.7	1.8
Benzo(a)pyrene	mg/kg	<0.05	3.5	4.2	1.3	1.4
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	2.0	2.6	0.7	0.7
Dibenzo(a,h)anthracene	mg/kg	<0.1	0.2	0.2	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	1.8	2.3	0.7	0.7
Surrogate p-Terphenyl-d_{14}	%	90	88	91	92	90

Organochlorine Pesticides in soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	36506-1 BH101/0.2 17/12/2009 Soil	36506-2 BH101/1.5 17/12/2009 Soil	36506-3 BH102/0.45 20/12/2009 Soil	36506-4 BH102/1.0 20/12/2009 Soil	36506-5 BD/201 209 17/12/2009 Soil
Date extracted	-	23/12/2009	23/12/2009	23/12/2009	23/12/2009	23/12/2009
Date analysed	-	23/12/2009	23/12/2009	23/12/2009	23/12/2009	23/12/2009
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	97	99	101	101	102

Acid Extractable metals in soil						
Our Reference:	UNITS	36506-1	36506-2	36506-3	36506-4	36506-5
Your Reference	----------	BH101/0.2	BH101/1.5	BH102/0.45	BH102/1.0	BD/201 209
Date Sampled	----------	17/12/2009	17/12/2009	20/12/2009	20/12/2009	17/12/2009
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	23/12/2009	23/12/2009	23/12/2009	23/12/2009	23/12/2009
Date analysed	-	29/12/2009	29/12/2009	29/12/2009	29/12/2009	29/12/2009
Arsenic	mg/kg	<4	<4	4	<4	<4
Cadmium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	9	25	10	13	12
Copper	mg/kg	81	63	41	22	19
Lead	mg/kg	4	54	70	25	32
Mercury	mg/kg	<0.1	<0.1	1.6	0.8	0.9
Nickel	mg/kg	77	37	11	7	8
Zinc	mg/kg	41	82	43	17	18

Moisture Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	36506-1 BH101/0.2 17/12/2009 Soil	36506-2 BH101/1.5 17/12/2009 Soil	36506-3 BH102/0.45 20/12/2009 Soil	36506-4 BH102/1.0 20/12/2009 Soil	36506-5 BD/201 209 17/12/2009 Soil
Date prepared	-	23/12/2009	23/12/2009	23/12/2009	23/12/2009	23/12/2009
Date analysed	-	23/12/2009	23/12/2009	23/12/2009	23/12/2009	23/12/2009
Moisture	%	7.3	6.9	16	5.3	5.5

Asbestos ID - soils						
Our Reference:	UNITS	36506-1	36506-2	36506-3	36506-4	36506-5
Your Reference	----------	BH101/0.2	BH101/1.5	BH102/0.45	BH102/1.0	BD/201 209
Date Sampled	----------	17/12/2009	17/12/2009	20/12/2009	20/12/2009	17/12/2009
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	24/12/2009	24/12/2009	24/12/2009	24/12/2009	24/12/2009
Sample Description	-	Approx 30g Soil	Approx 30g Soil	Approx 30g Soil	Approx 30g Soil	Approx 40g Soil
Asbestos ID in soil	-	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg
Trace Analysis	-	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected

Method ID	Methodology Summary
GC.16	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS.
GC.3	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID.
GC.12 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
GC-5	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Metals.20 ICP-AES	Determination of various metals by ICP-AES.
Metals.21 CV-AAS	Determination of Mercury by Cold Vapour AAS.
LAB.8	Moisture content determined by heating at 105 deg C for a minimum of 4 hours.
ASB.1	Qualitative identification of asbestos type fibres in bulk using Polarised Light Microscopy and Dispersion Staining Techniques.

QUALITY CONTROL vTPH & BTEX in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/12/09	36506-4	23/12/2009 || 23/12/2009	LCS-3	23/12/09
Date analysed	-			23/12/09	36506-4	23/12/2009 || 23/12/2009	LCS-3	23/12/09
vTPH C_6 - C_9	mg/kg	25	GC.16	<25	36506-4	<25 || <25	LCS-3	114%
Benzene	mg/kg	0.5	GC.16	<0.5	36506-4	<0.5 || <0.5	LCS-3	85%
Toluene	mg/kg	0.5	GC.16	<0.5	36506-4	<0.5 || <0.5	LCS-3	108%
Ethylbenzene	mg/kg	1	GC.16	<1.0	36506-4	<1.0 || <1.0	LCS-3	122%
m+p-xylene	mg/kg	2	GC.16	<2.0	36506-4	<2.0 || <2.0	LCS-3	127%
o-Xylene	mg/kg	1	GC.16	<1.0	36506-4	<1.0 || <1.0	LCS-3	132%
Surrogate aaa-Trifluorotoluene	%		GC.16	90	36506-4	89 || 93 || RPD: 4	LCS-3	94%

QUALITY CONTROL sTPH in Soil (C10-C36)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/12/09	36506-4	23/12/2009 || 23/12/2009	LCS-3	23/12/09
Date analysed	-			24/12/09	36506-4	24/12/2009 || 24/12/2009	LCS-3	24/12/09
TPH C_{10} - C_{14}	mg/kg	50	GC.3	<50	36506-4	<50 || <50	LCS-3	104%
TPH C_{15} - C_{28}	mg/kg	100	GC.3	<100	36506-4	<100 || <100	LCS-3	123%
TPH C_{29} - C_{36}	mg/kg	100	GC.3	<100	36506-4	<100 || <100	LCS-3	126%
Surrogate o-Terphenyl	%		GC.3	98	36506-4	93 || 92 || RPD: 1	LCS-3	95%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/12/09	36506-4	23/12/2009 || 23/12/2009	LCS-3	23/12/09
Date analysed	-			23/12/09	36506-4	24/12/2009 || 24/12/2009	LCS-3	23/12/09
Naphthalene	mg/kg	0.1	GC.12 subset	<0.1	36506-4	0.1 || 0.1 || RPD: 0	LCS-3	93%
Acenaphthylene	mg/kg	0.1	GC.12 subset	<0.1	36506-4	0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	GC.12 subset	<0.1	36506-4	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	GC.12 subset	<0.1	36506-4	0.1 || 0.1 || RPD: 0	LCS-3	95%
Phenanthrene	mg/kg	0.1	GC.12 subset	<0.1	36506-4	2.1 || 1.9 || RPD: 10	LCS-3	94%
Anthracene	mg/kg	0.1	GC.12 subset	<0.1	36506-4	0.4 || 0.4 || RPD: 0	[NR]	[NR]
Fluoranthene	mg/kg	0.1	GC.12 subset	<0.1	36506-4	2.5 || 2.2 || RPD: 13	LCS-3	84%
Pyrene	mg/kg	0.1	GC.12 subset	<0.1	36506-4	2.7 || 2.3 || RPD: 16	LCS-3	96%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Benzo(a)anthracene	mg/kg	0.1	GC.12 subset	<0.1	36506-4	1.1 || 1.0 || RPD: 10	[NR]	[NR]
Chrysene	mg/kg	0.1	GC.12 subset	<0.1	36506-4	1.2 || 1.0 || RPD: 18	LCS-3	101%
Benzo(b+k)fluoranthene	mg/kg	0.2	GC.12 subset	<0.2	36506-4	1.7 || 1.5 || RPD: 12	[NR]	[NR]
Benzo(a)pyrene	mg/kg	0.05	GC.12 subset	<0.05	36506-4	1.3 || 1.2 || RPD: 8	LCS-3	104%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	GC.12 subset	<0.1	36506-4	0.7 || 0.6 || RPD: 15	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	GC.12 subset	<0.1	36506-4	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	GC.12 subset	<0.1	36506-4	0.7 || 0.6 || RPD: 15	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%		GC.12 subset	93	36506-4	92 || 89 || RPD: 3	LCS-3	93%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/12/09	36506-4	23/12/2009 || 23/12/2009	LCS-1	23/12/09
Date analysed	-			23/12/09	36506-4	23/12/2009 || 23/12/2009	LCS-1	23/12/09
HCB	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	LCS-1	103%
gamma-BHC	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	LCS-1	120%
Heptachlor	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	LCS-1	98%
delta-BHC	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	LCS-1	100%
Heptachlor Epoxide	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	LCS-1	93%
gamma-Chlordane	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	LCS-1	119%
Dieldrin	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	LCS-1	104%
Endrin	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	LCS-1	109%
pp-DDD	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	LCS-1	114%
Endosulfan II	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	LCS-1	110%
Methoxychlor	mg/kg	0.1	GC-5	<0.1	36506-4	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		GC-5	93	36506-4	101 || 97 || RPD: 4	LCS-1	94%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date digested	-			23/12/09	36506-4	23/12/2009 || 23/12/2009	LCS-6	23/12/09
Date analysed	-			29/12/09	36506-4	29/12/2009 || 29/12/2009	LCS-6	29/12/09
Arsenic	mg/kg	4	Metals.20 ICP-AES	<4	36506-4	<4 || <4	LCS-6	105%
Cadmium	mg/kg	0.5	Metals.20 ICP-AES	<0.5	36506-4	<0.5 || <0.5	LCS-6	107%
Chromium	mg/kg	1	Metals.20 ICP-AES	<1	36506-4	13 || 16 || RPD: 21	LCS-6	108%
Copper	mg/kg	1	Metals.20 ICP-AES	<1	36506-4	22 || 22 || RPD: 0	LCS-6	111%
Lead	mg/kg	1	Metals.20 ICP-AES	<1	36506-4	25 || 22 || RPD: 13	LCS-6	106%
Mercury	mg/kg	0.1	Metals.21 CV-AAS	<0.1	36506-4	0.8 || 0.7 || RPD: 13	LCS-6	100%
Nickel	mg/kg	1	Metals.20 ICP-AES	<1	36506-4	7 || 9 || RPD: 25	LCS-6	110%
Zinc	mg/kg	1	Metals.20 ICP-AES	<1	36506-4	17 || 13 || RPD: 27	LCS-6	107%

QUALITY CONTROL Moisture	UNITS	PQL	METHOD	Blank
Date prepared	-			23/12/09
Date analysed	-			23/12/09
Moisture	%	0.1	LAB.8	<0.10

QUALITY CONTROL Asbestos ID - soils	UNITS	PQL	METHOD	Blank
Date analysed	-			[NT]

Report Comments:

Asbestos: A portion of the supplied sample was sub-sampled for asbestos according to Envirolab procedures. We cannot guarantee that this sub-sample is indicative of the entire sample.
Envirolab recommends supplying 30-40g of sample in it's own container.
Asbestos was analysed by Approved Identifier: Joshua Lim
INS: Insufficient sample for this test NT: Not tested PQL: Practical Quantitation Limit <: Less than >: Greater than
RPD: Relative Percent Difference NA: Test not required LCS: Laboratory Control Sample NR: Not requested

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria:

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the sample batch were within laboratory acceptance criteria.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable. Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and speciated phenols.

Douglas Partners
Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY

Project Name: **Sydney Opera House (VAPS)**
Project No: **71529** Sampler: **PGH**
Project Mgr: **BJM** Mob. Phone: **0423 564 775**
Email: peter.hartcliff@douglaspartners.com.au
Date Required: ..... Lab Quote No. .....

To: Envirolab Services
12 Ashley Street, Chatswood NSW 2068
Attn: Tania Notaras
Phone: 02 9910 6200 Fax: 02 9910 6201
Email: tnotaras@envirolabservices.com.au

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: 9910 6200

Job No: 36506
Date received: 22·12·09
Time received: 1000hrs
Received by: PE
Temp: Cool/Ambient
Cooling: Ice/Ice Pack
Security: Intact/Broken/None

Sample ID	Sample Depth	Lab ID	Sampling Date	Sample Type S - soil W – water	Container type	Analytes														Notes
						As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	BTEX/ TPH	OPs/ PCBs	PAH	Phenols	VOCs	Other- OCP's and Asbestos	
BH101	0.2	1	17th Dec	S	Jar	X	X	X	X	X	X	X	X	X		X			X	See note (1) below
BH101	1.5	2	17th Dec	S	Jar	X	X	X	X	X	X	X	X	X		X			X	See note (1) below
BH102	0.45	3	20th Dec	S	Jar	X	X	X	X	X	X	X	X	X		X			X	See note (1) below
BH102	1.0	4	20th Dec	S	Jar	X	X	X	X	X	X	X	X	X		X			X	See note (1) below
BD/201 209		5				X	X	X	X	X	X	X	X	X		X			X	See note (1) below

Lab Report No. .....
Send Results to: Douglas Partners Address: 96 Hermitage Road, West Ryde 2114
Phone: (02) 9809 0666
Fax: (02) 9809 4095

Relinquished by:	Signed:	Date & Time:	Received By:	Date & Time: 22·12·09 1000hrs
Relinquished by:	Signed:	Date & Time:	Received By:	Date & Time:

Note (1) - Please extract all samples prior to the Christmas shutdown

LabMark
ENVIRONMENTAL LABORATORIES

CUSTOMER CENTRIC - ANALYTICAL CHEMISTS

FINAL CERTIFICATE OF ANALYSIS - ENVIRONMENTAL DIVISION

Laboratory Report No:	E048260	Cover Page 1 of 4
Client Name:	Douglas Partners	plus Sample Results
Client Reference:	Opera House VAPS Project	
Contact Name:	Kurt Plambeck	
Chain of Custody No:	na	Date Received: 19/05/2010
Sample Matrix:	SOIL	Date Reported: 27/05/2010

This Final Certificate of Analysis consists of sample results, DQI's, method descriptions, laboratory definitions, and internationally recognised NATA accreditation and endorsement. The DQO compliance relates specifically to QA/QC results as performed as part of the sample analysis, and may provide an indication of sample result quality. Transfer of report ownership from Labmark to the client shall only occur once full & final payment has been settled and verified. All report copies may be retracted where full payment has not occured within the agreed settlement period.

QUALITY ASSURANCE CRITERIA

Accuracy:	matrix spike:	1 in first 5-20, then 1 every 20 samples
	lcs, crm, method:	1 per analytical batch
	surrogate spike:	addition per target organic method
Precision:	laboratory duplicate:	1 in first 5-10, then 1 every 10 samples
	laboratory triplicate:	re-extracted & reported when duplicate RPD values exceed acceptance criteria
Holding Times:	soils, waters:	Refer to LabMark Preservation & THT table VOC's 14 days water / soil VAC's 7 days water or 14 days acidified VAC's 14 days soil SVOC's 7 days water, 14 days soil Pesticides 7 days water, 14 days soil Metals 6 months general elements Mercury 28 days
Confirmation:	target organic analysis:	GC/MS, or confirmatory column
Sensitivity:	EQL:	Typically 2-5 x Method Detection Limit (MDL)

QUALITY CONTROL GLOBAL ACCEPTANCE CRITERIA (GAC)

Accuracy:	spike, lcs, crm surrogate:	general analytes 70% - 130% recovery phenol analytes 50% - 130% recovery organophosphorous pesticide analytes 60% - 130% recovery phenoxy acid herbicides, organotin 50% - 130% recovery
	anion/cation bal:	+/- 10% (0-3 meq/l), +/- 5% (>3 meq/l)
Precision:	method blank:	not detected >95% of the reported EQL
	duplicate lab RPD (metals):	0-30% (>10xEQL), 0-75% (5-10xEQL) 0-100% (<5xEQL)
	duplicate lab RPD:	0-50% (>10xEQL), 0-75% (5-10xEQL) 0-100% (<5xEQL)

QUALITY CONTROL ANALYTE SPECIFIC ACCEPTANCE CRITERIA (ASAC)

Accuracy:	spike, lcs, crm surrogate:	analyte specific recovery data <3xsd of historical mean
Uncertainty:	spike, lcs:	measurement calculated from historical analyte specific control charts

RESULT ANNOTATION

Data Quality Objective	s:	matrix spike recovery	p:	pending	bcs: batch specific lcs
Data Quality Indicator	d:	laboratory duplicate	lcs:	laboratory control sample	bmb: batch specific mb
Estimated Quantitation Limit	t:	laboratory triplicate	crm:	certified reference material	
not applicable	r:	RPD relative % difference	mb:	method blank	

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NEPC GUIDELINE COMPLIANCE - DQO

1. GENERAL

A. Results relate specifically to samples as received. Sample results are not corrected for matrix spike, lcs, or surrogate recovery data.

B. EQL's are matrix dependant and may be increased due to sample dilution or matrix interference.

C. Laboratory QA/QC samples are specific to this project.

D. Inter-laboratory proficiency results are available upon request. NATA accreditation details available at www.nata.asn.au.

E. VOC spikes & surrogates added to samples during extraction, SVOC spikes & surrogates added prior to extraction.

F. Recovery data outside GAC limits shall be investigated and compared to ASAC (historical mean +/- 3sd). If recovery data <20%, then the relevant results for that compound are considered not reliable.

G. Recovery data (ms, surrogate, crm, lcs) outside ASAC limits shall initiate an investigative action. Anomolous QC data is examined in conjunction with other QC samples and a final decision whether to accept or reject results is provided by the professional judgement of the senior analyst. The USEPA-CLP National Functional Guidelines are referred to for specific recommendations.

H. Extraction (preparation) date refers to the date that sample preparation was initiated. Note that certain methods not requiring sample preparation (eg. VOCs in water, etc) may report a common extraction and analysis date.

I. LabMark shall maintain an official copy of this Certificate of Analysis for all tracable reference purposes.

2. CHAIN OF CUSTODY (COC) & SAMPLE RECEIPT NOTICE (SRN) REQUIREMENTS

A. SRN issued to client upon sample receipt & login verification.

B. Preservation & sampling date details specified on COC and SRN, unless noted.

C. Sample Integrity & Validated Time of Sample Receipt (VTSR) Holding Times verified (preservation may extend holding time, refer to preservation chart).

3. NATA ACCREDITED METHODS

A. NATA accreditation held for each in-house method and sample matrix type reported, unless noted below (Refer to subcontracted test reports for NATA accreditation status).

B. NATA accredited in-house laboratory methods are referenced from NEPC, ASTM, modified USEPA / APHA documents. Corporate Accreditation No. 13542.

C. Subcontracted analyses: Refer to Sample Receipt Notice and additional DQO comments.

4. QA/QC FREQUENCY COMPLIANCE TABLE SPECIFIC TO THIS REPORT

Matrix: **SOIL**

Page:	Method:	Totals:	#d	%d-ratio	#t	#s	%s-ratio
1	BTEX by P&T	1	0	0%	0	0	0%
1	Volatile TPH by P&T (vTPH)	1	0	0%	0	0	0%
2	Petroleum Hydrocarbons (TPH)	1	0	0%	0	0	0%
3	Polyaromatic Hydrocarbons (PAH)	1	0	0%	0	0	0%
4	Acid extractable metals (M7)	1	0	0%	0	0	0%
5	Acid extractable metals - mercury	1	0	0%	0	0	0%
6	Moisture	1	--	--	--	--	--

GLOSSARY:

#d	number of discrete duplicate extractions/analyses performed.
%d-ratio	NEPC guideline for laboratory duplicates is 1 in 10 samples (min 10%).
#t	number of triplicate extractions/analyses performed.
#s	number of spiked samples analysed.
%s-ratio	USEPA guideline for laboratory matrix spikes is 1 in 20 samples (min 5%).

5. ADDITIONAL COMMENTS SPECIFIC TO THIS REPORT

A. All tests were conducted by LabMark Environmental Sydney, NATA accreditation No. 13542, unless indicated below.

LabMark

ENVIRONMENTAL LABORATORIES

CUSTOMER CENTRIC - ANALYTICAL CHEMISTS

Environmental Laboratory Industry Group

Foundation Member

Laboratory Report: E048260

Cover Page 4 of 4

Laboratory QA/QC data shall relate specifically to this report, and may provide an indication of site specific sample result quality. LabMark DOES NOT report NON-RELEVANT BATCH QA/QC data. Acceptance of this self assessment certificate does not preclude any requirement for a QA/QC review by a accredited contaminated site EPA auditor, when and wherever necessary. Laboratory QA/QC self assessment references available upon request.

LabMark Environmental Laboratories ABN 30 008 127 802
* SYDNEY: Unit 1, 8 Leighton Place Asquith NSW 2077
* Telephone: (02) 9476 6533 * Fax: (02) 9476 8219
* MELBOURNE: 1868 Dandenong Road, Clayton VIC 3168
* Telephone: (03) 9538 2277 * Fax: (03) 9538 2278

LabMark
ENVIRONMENTAL LABORATORIES

Laboratory Report No: E048260 **Page:** 1 of 6 Final

Client Name: Douglas Partners plus cover page **Certificate**

Contact Name: Kurt Plambeck **Date:** 27/05/10 of Analysis

Client Reference: Opera House VAPS Project 71529.01 This report supercedes reports issued on: N/A

Laboratory Identification		**262777**	**lcs**	**mb**							
Sample Identification		BD2 150510	QC	QC							
Depth (m)		--	--	--							
Sampling Date recorded on COC		15/5/10	--	--							
Laboratory Extraction (Preparation) Date		21/5/10	21/5/10	21/5/10							
Laboratory Analysis Date		24/5/10	21/5/10	21/5/10							
Method : E029.2/E016.2											
BTEX by P&T	**EQL**										
Benzene	0.2	<0.2	97%	<0.2							
Toluene	0.5	<0.5	97%	<0.5							
Ethylbenzene	0.5	<0.5	90%	<0.5							
meta- and para-Xylene	1	<1	93%	<1							
ortho-Xylene	0.5	<0.5	94%	<0.5							
Total Xylene	--	--	--	--							
CDFB (Surr @ 4 mg/kg)	--	*103%*	*107%*	*104%*							
Method : E029.2/E016.2											
Volatile TPH by P&T (vTPH)	**EQL**										
C6 - C9 Fraction	10	<10	104%	<10							

Results expressed in mg/kg dry weight unless otherwise specified

Comments:

E029.2/E016.2: 8-10g soil extracted with 20ml methanol. Analysis by P&T/GC/FID/MSD.
E029.2/E016.2: 8-10g soil extracted with 20ml methanol. Analysis by P&T/GC/MSD.

Laboratory Identification		**262777**	**lcs**	**mb**							
Sample Identification		BD2 150510	QC	QC							
Depth (m)		--	--	--							
Sampling Date recorded on COC		15/5/10	--	--							
Laboratory Extraction (Preparation) Date		21/5/10	21/5/10	21/5/10							
Laboratory Analysis Date		22/5/10	21/5/10	21/5/10							
Method : E006.2											
Petroleum Hydrocarbons (TPH)	**EQL**										
C10 - C14 Fraction	50	<50	--	<50							
C15 - C28 Fraction	100	<100	80%	<100							
C29 - C36 Fraction	100	<100	--	<100							
Sum of TPH C10 - C36	--	--	--	--							

Results expressed in mg/kg dry weight unless otherwise specified

Comments:

E006.2: 8-10g soil extracted with 20ml DCM/Acetone/Hexane (10:45:45). Analysis by GC/FID.

Laboratory Identification		262777	lcs	mb							
Sample Identification		BD2 150510	QC	QC							
Depth (m)		--	--	--							
Sampling Date recorded on COC		15/5/10	--	--							
Laboratory Extraction (Preparation) Date		21/5/10	21/5/10	21/5/10							
Laboratory Analysis Date		21/5/10	21/5/10	21/5/10							
Method : E007.2											
Polyaromatic Hydrocarbons (PAH)	**EQL**										
Naphthalene	0.5	<0.5	95%	<0.5							
Acenaphthylene	0.5	<0.5	96%	<0.5							
Acenaphthene	0.5	<0.5	92%	<0.5							
Fluorene	0.5	<0.5	90%	<0.5							
Phenanthrene	0.5	<0.5	105%	<0.5							
Anthracene	0.5	<0.5	106%	<0.5							
Fluoranthene	0.5	<0.5	90%	<0.5							
Pyrene	0.5	<0.5	89%	<0.5							
Benz(a)anthracene	0.5	<0.5	75%	<0.5							
Chrysene	0.5	<0.5	101%	<0.5							
Benzo(b)&(k)fluoranthene	1	<1	88%	<1							
Benzo(a) pyrene	0.5	<0.5	90%	<0.5							
Indeno(1,2,3-c,d)pyrene	0.5	<0.5	90%	<0.5							
Dibenz(a,h)anthracene	0.5	<0.5	108%	<0.5							
Benzo(g,h,i)perylene	0.5	<0.5	97%	<0.5							
Sum of reported PAHs	--	--	--	--							
2-FBP (Surr @ 5mg/kg)	--	*84%*	*86%*	*88%*							
TP-d14 (Surr @ 5mg/kg)	--	*79%*	*77%*	*79%*							

Results expressed in mg/kg dry weight unless otherwise specified

Comments:

E007.2: 8-10g soil extracted with 20ml DCM/Acetone/Hexane (10:45:45). Analysis by GC/MS.

Laboratory Identification		**262777**	**crm**	**lcs**	**mb**						
Sample Identification		BD2 150510	QC	QC	QC						
Depth (m)		--	--	--	--						
Sampling Date recorded on COC		15/5/10	--	--	--						
Laboratory Extraction (Preparation) Date		21/5/10	21/5/10	21/5/10	21/5/10						
Laboratory Analysis Date		25/5/10	22/5/10	22/5/10	22/5/10						
Method : E022.2											
Acid extractable metals (M7)	**EQL**										
Arsenic	1	<1	109%	115%	<1						
Cadmium	0.1	0.2	97%	103%	<0.1						
Chromium	1	9	116%	129%	<1						
Copper	2	4	115%	109%	<2						
Nickel	1	4	103%	112%	<1						
Lead	2	10	99%	103%	<2						
Zinc	5	21	116%	118%	<5						

Results expressed in mg/kg dry weight unless otherwise specified

Comments:

E022.2: 0.5g digested in nitric/hydrochloric acid. Analysis by ICP-MS.

LabMark
ENVIRONMENTAL LABORATORIES

Laboratory Report No: E048260 **Page:** 5 of 6 Final
Client Name: Douglas Partners plus cover page **Certificate**
Contact Name: Kurt Plambeck **Date:** 27/05/10 of Analysis
Client Reference: Opera House VAPS Project 71529.01 This report supercedes reports issued on: N/A

Laboratory Identification		**262777**	**crm**	**lcs**	**mb**						
Sample Identification		BD2 150510	QC	QC	QC						
Depth (m)		--	--	--	--						
Sampling Date recorded on COC		15/5/10	--	--	--						
Laboratory Extraction (Preparation) Date		21/5/10	21/5/10	21/5/10	21/5/10						
Laboratory Analysis Date		24/5/10	21/5/10	21/5/10	21/5/10						
Method : E026.2											
Acid extractable metals - mercury	**EQL**										
Mercury	0.05	<0.05	97%	97%	<0.05						

Results expressed in mg/kg dry weight unless otherwise specified

Comments:

E026.2: 0.5g digested with nitric/hydrochloric acid. Analysis by CV-ICP-MS or FIMS.

Laboratory Identification		**262777**									
Sample Identification		BD2									
Depth (m)		150510 --									
Sampling Date recorded on COC		15/5/10									
Laboratory Extraction (Preparation) Date		21/5/10									
Laboratory Analysis Date		24/5/10									
Method : E005.2											
Moisture	**EQL**										
Moisture	--	7									

Results expressed in % w/w unless otherwise specified

Comments:

E005.2: Moisture by gravimetric analysis. Results are in % w/w.

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Quality, Service, Support

Report Date : 20/05/2010
Report Time : 10:31:51AM

Sample Receipt Notice (SRN) for E048260

Client Details		Laboratory Reference Information	
		Please have this information ready when contacting Labmark.	
Client Name:	Douglas Partners	Laboratory Report:	E048260
Client Phone:	02 9809 0666	Quotation Number:	- Not provided, standard prices apply
Client Fax:	02 98094095	Laboratory Address:	Unit 1, 8 Leighton Pl. Asquith NSW 2077
Contact Name:	Kurt Plambeck		
Contact Email:	kurt.plambeck@douglaspartners.com.au	Phone:	61 2 9476 6533
Client Address:	96 Hermitage Road West Ryde NSW 2114	Fax:	61 2 9476 8219
Project Name:	Opera House VAPS Project	Sample Receipt Contact:	Ros Schacht
Project Number:	71529.01	Email:	Ros.Schacht@labmark.com.au
CoC Serial Number:	- Not provided -	Reporting Contact:	Leanne Boag
Purchase Order:	- Not provided -	Email:	leanne.boag@labmark.com.au
Surcharge:	No surcharge applied (results by 6:30pm on due date)		
Sample Matrix:	SOIL		

Date Sampled (earliest date):	15/05/2010	NATA Accreditation:	13542
Date Samples Received:	19/05/2010	TGA GMP License:	185-336 (Sydney)
Date Sample Receipt Notice issued:	20/05/2010	APVMA License:	6105 (Sydney)
Date Preliminary Report Due:	27/05/2010	AQIS Approval:	NO356 (Sydney)
Client TAT Request Date:	27/05/2010	AQIS Entry Permit:	200521534 (Sydney)

Reporting Requirements: Electronic Data Download required: No

Invoice Number: 10EA9581

Sample Condition: COC received with samples. Report number and lab ID's defined on COC.
Samples received in good order .
Samples received with cooling media: Ice bricks .
Samples received chilled.
Security seals not used .
Sample container & chemical preservation suitable .

Comments: Sample ID/Sampling date as labelled, unless otherwise instructed | TRH as TPH C6-C36 & Heavy metals as M8 (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg) unless otherwise instructed

Holding Times: Date received allows for sufficient time to meet Technical Holding Times.

Preservation: Chemical preservation of samples satisfactory for requested analytes.

Important Notes:
LabMark shall responsibly dispose of spent customer soil and water samples which includes the disintegration of the sample label. A sample disposal fee of $1.00 is applicable on all samples received by the laboratory regardless of whether they have undergone analytical testing. Sample disposal of environmental samples shall be 31 days (water) and 3 months (soil, HN03 preserved samples) after laboratory receipt, unless otherwise requested in writing by the client. Samples requested to be held in non-refrigerated storage shall incur $5.00/ sample/ 3 months. Additional refrigerated storage shall incur $30/ sample/ 3 months. Combination prices apply only if requested. Transfer of report ownership from LabMark to the client shall occur once full and final payment has been settled and verified. All report copies may be retracted where full payment does not occur within the agreed settlement period.

Analysis comments:

Subcontracted Analyses:

Thank you for choosing Labmark to analyse your project samples.
Additional information on www.labmark.com.au

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Quality, Service, Support

Report Date : 20/05/2010
Report Time : 10:31:51AM

Sample Receipt Notice (SRN) for E048260

The table below represents LabMark's understanding and interpretation of the customer supplied sample COC request (refer to SRN comments section on first page for external subcontracting method details). Please confirm that your COC request has been entered correctly. Due to THT and TAT requirements, testing shall commence immediately as per this table, unless the customer intervenes with a correction prior to testing.

GRID REVIEW TABLE

No.	Date	Depth	Client Sample ID	Requested Analysis: BTEX by P&T	Acid extractable metals - mercury	Acid extractable metals (M7)	Moisture	Polyaromatic Hydrocarbons (PAH)	PREP Not Reported	Petroleum Hydrocarbons (TPH)	Volatile TPH by P&T (VTPH)
262777	15/05		BD2 150510	●	●	●	●	●	●	●	●
			Totals:	1	1	1	1	1	1	1	1

'PREP Not Reported' refers to an internal laboratory instruction - client confirmation of this parameter is not required.

Thank you for choosing Labmark to analyse your project samples.
Additional information on www.labmark.com.au

LabMark
ENVIRONMENTAL LABORATORIES

Quality, Service, Support

Report Date : 20/05/2010
Report Time : 10:31:51AM

Sample **Receipt** Notice (SRN) for **E048260**

No.	Date	Depth	Client Sample ID	Requested Analysis: M8 - M7-T_S																			
262777	15/05		BD2 150510	●																			
			Totals:	1																			

Thank you for choosing Labmark to analyse your project samples.
Additional information on www.labmark.com.au

Douglas Partners
Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY

Project Name: Opera House VAPS Project
Project No: ...71529.01..... Sampler: ...KDP..... .....
Project Mgr: ...KP.....Mob. Phone: 0402 057 147 .....
Email: kurt.plambeck@douglaspartners.com.au .....
Date Required: ...standard ..... Lab Quote No. .....

To: Envirolab Services
12 Ashley Street, Chatswood NSW 2068
Attn: Tania Notaras
Phone: 02 9910 6200 Fax: 02 9910 6201
Email: tnotaras@envirolabservices.com.au

Sample ID	Sample Depth	Lab ID	Sampling Date	Sample Type S - soil W - water	Container type	Analytes: Heavy metals	TRH BTEX	PAH	OCP PCB	Phenols	Asbestos	VOC	BTEX	SPOCAS	Notes
205/	2.3-2.5	13	17/5	S	G	✓	✓	✓	✓	✓		✓			
BD2	70510	14	15/5	S	G	✓	✓	✓		262777					interlab Labelled BD2 150510
BD4	70510	15	~~15/5~~	~~S~~	~~G~~ glass	✓	✓	✓							intralab ~~Lab~~ glass
trip spike		16					✓						✓		
trip blank		17					✓								
204/	1.2-1.3	18				✓	✓	✓						✓	
204/	1.0	19												✓	
205/	2.5	20												✓	
201/	1.0	21													

Lab Report No. E048260
Send Results to: Douglas Partners Address: 96 Hermitage Road, West Ryde 2114
Phone: (02) 9809 0666
Fax: (02) 9809 4095

Relinquished by:	Signed:	Date & Time:	Received By: Z.L.	Date & Time: 18/5/10 4pm	
Relinquished by:	Signed:	Date & Time:	Received By: SR	Date & Time: 19/5/10 4:50pm	

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 41366-A

Client:
Douglas Partners
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Kurt Plambeck

Sample log in details:

Your Reference:	**71529.01, VAPs Opera House**
No. of samples:	Additional Testing on 2 Soils
Date samples received:	24/05/10
Date completed instructions received:	02/06/10

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	9/06/10
Date of Preliminary Report:	Not Issued
Issue Date:	9/06/10

NATA accreditation number 2901. This document shall not be reproduced except in full.
This document is issued in accordance with NATA's accreditation requirements.
Accredited for compliance with ISO/IEC 17025.
Tests not covered by NATA are denoted with *.

Results Approved By:

Jacinta Hurst
Laboratory Manager

Envirolab Reference: 41366-A
Revision No: R 00

ACCREDITED FOR TECHNICAL COMPETENCE

Metals in TCLP USEPA1311 Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ---------- 	41366-A-3 206/1.1-1.2 24/05/2010 Soil	41366-A-4 BD1240510 24/05/2010 Soil
Date extracted	-	03/06/2010	03/06/2010
Date analysed	-	[NA]	04/06/2010
pH of soil for fluid# determ.	pH units	9.20	9.30
pH of soil for fluid # determ. (acid)	pH units	1.40	1.30
Extraction fluid used	-	1	1
pH of final Leachate	pH units	5.10	5.10
Lead in TCLP	mg/L	[NA]	0.5

PAHs in TCLP (USEPA 1311) Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ---------- 	41366-A-3 206/1.1-1.2 24/05/2010 Soil
Date extracted	-	03/06/2010
Date analysed	-	03/06/2010
Naphthalene in TCLP	mg/L	<0.001
Acenaphthylene in TCLP	mg/L	<0.001
Acenaphthene in TCLP	mg/L	<0.001
Fluorene in TCLP	mg/L	<0.001
Phenanthrene in TCLP	mg/L	<0.001
Anthracene in TCLP	mg/L	<0.001
Fluoranthene in TCLP	mg/L	<0.001
Pyrene in TCLP	mg/L	<0.001
Benzo(a)anthracene in TCLP	mg/L	<0.001
Chrysene in TCLP	mg/L	<0.001
Benzo(b+k)fluoranthene in TCLP	mg/L	<0.002
Benzo(a)pyrene in TCLP	mg/L	<0.001
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	<0.001
Dibenzo(a,h)anthracene in TCLP	mg/L	<0.001
Benzo(g,h,i)perylene in TCLP	mg/L	<0.001
Surrogate p-Terphenyl-d_{14}	%	106

Method ID	Methodology Summary
LAB.4	Toxicity Characteristic Leaching Procedure (TCLP).
EXTRACT.7	Toxicity Characteristic Leaching Procedure (TCLP).
LAB.1	pH - Measured using pH meter and electrode in accordance with APHA 20th ED, 4500-H+.
Metals.20 ICP-AES	Determination of various metals by ICP-AES.
GC.12 subset	Leachates are extracted with Dichloromethane and analysed by GC-MS.
GC.12 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
GC.12	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.

QUALITY CONTROL Metals in TCLP USEPA1311	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			03/06/2010	[NT]	[NT]	LCS-W2	03/04/2010
Date analysed	-			04/06/2010	[NT]	[NT]	LCS-W2	04/06/2010
Lead in TCLP	mg/L	0.03	Metals.20 ICP-AES	<0.03	[NT]	[NT]	LCS-W2	80%

QUALITY CONTROL PAHs in TCLP (USEPA 1311)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			03/06/2010	[NT]	[NT]	LCS-W1	03/06/2010
Date analysed	-			03/06/2010	[NT]	[NT]	LCS-W1	03/06/2010
Naphthalene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	94%
Acenaphthylene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Acenaphthene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Fluorene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	109%
Phenanthrene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	105%
Anthracene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Fluoranthene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	98%
Pyrene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	110%
Benzo(a)anthracene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Chrysene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	112%
Benzo(b+k)fluoranthene in TCLP	mg/L	0.002	GC.12 subset	<0.002	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	LCS-W1	105%
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene in TCLP	mg/L	0.001	GC.12 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%		GC.12	109	[NT]	[NT]	LCS-W1	106%

Report Comments:

Asbestos was analysed by Approved Identifier: Not applicable for this job
Asbestos was authorised by Approved Signatory: Not applicable for this job
INS: Insufficient sample for this test NT: Not tested PQL: Practical Quantitation Limit <: Less than >: Greater than
RPD: Relative Percent Difference NA: Test not required LCS: Laboratory Control Sample NR: Not requested

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria:

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the sample batch were within laboratory acceptance criteria.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable. Surrogates: 60-140% is acceptable for general organics and 10-140% for

Aileen Hie

From: Kurt Plambeck [kurt.plambeck@douglaspartners.com.au]
Sent: Wednesday, 2 June 2010 11:31 AM
To: Jacinta Hurst
Cc: Aileen Hie
Subject: RE: Results for registration '41366 - 71529.01, VAPs Opera House'

Jacinta,

Can you please run TCLP on the following samples
3 206/1-1.2 for PAH
4 BD1 240510 for lead

Envirolab Ref. 41366A
Due: 9/6/10
std TAT.

Regards

Kurt Plambeck

From: Jacinta Hurst [mailto:JHurst@envirolabservices.com.au]
Sent: Saturday, 29 May 2010 12:15 PM
To: Kurt Plambeck
Subject: Results for registration '41366 - 71529.01, VAPs Opera House'

Please refer to attached for:
a copy of the Certificate of Analysis
a copy of the COC
an excel file containing the results

Please note that a hard copy will not be posted.

Enquiries should be made directly to:
Jacinta Hurst on jhurst@envirolabservices.com.au
or
David Springer on dspringer@envirolabservices.com.au
or
Tania Notaras on tnotaras@envirolabservices.com.au

Regards

Envirolab Services
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
www.envirolabservices.com.au

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 41145

Client:
Douglas Partners
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Kurt Plambeck

Sample log in details:

Your Reference:	**71529.01, Opera House VAPS**
No. of samples:	6 Waters
Date samples received:	18/05/10
Date completed instructions received:	18/05/10

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	25/05/10
Date of Preliminary Report:	Not issued
Issue Date:	24/05/10

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Results Approved By:

Rhian Morgan
Metals Supervisor

Jacinta Hurst
Laboratory Manager

Envirolab Reference: 41145
Revision No: R 00

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

vTPH & BTEX in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	41145-1 101-GW 17/05/2010 Water	41145-5 TB 17/05/2010 Water	41145-6 TS 17/05/2010 Water
Date extracted	-	20/5/10	20/5/10	20/5/10
Date analysed	-	20/5/10	20/5/10	20/5/10
TPH C_6 - C_9	µg/L	<10	<10	[NA]
Benzene	µg/L	<1.0	<1.0	73%
Toluene	µg/L	<1.0	<1.0	77%
Ethylbenzene	µg/L	<1.0	<1.0	76%
m+p-xylene	µg/L	<2.0	<2.0	75%
o-xylene	µg/L	<1.0	<1.0	76%
Surrogate Dibromofluoromethane	%	101	100	100
Surrogate toluene-d8	%	100	98	100
Surrogate 4-BFB	%	98	99	100

sTPH in Water (C10-C36)		
Our Reference:	UNITS	41145-1
Your Reference	----------	101-GW
Date Sampled	----------	17/05/2010
Type of sample		Water
Date extracted	-	21/5/10
Date analysed	-	21/5/10
TPH C_{10} - C_{14}	µg/L	<50
TPH C_{15} - C_{28}	µg/L	<100
TPH C_{29} - C_{36}	µg/L	<100
Surrogate o-Terphenyl	%	95

PAHs in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ---------- 	41145-1 101-GW 17/05/2010 Water
Date extracted	-	21/05/2010
Date analysed	-	21/05/2010
Naphthalene	µg/L	<1
Acenaphthylene	µg/L	<1
Acenaphthene	µg/L	<1
Fluorene	µg/L	<1
Phenanthrene	µg/L	<1
Anthracene	µg/L	<1
Fluoranthene	µg/L	<1
Pyrene	µg/L	<1
Benzo(a)anthracene	µg/L	<1
Chrysene	µg/L	<1
Benzo(b+k)fluoranthene	µg/L	<2
Benzo(a)pyrene	µg/L	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1
Dibenzo(a,h)anthracene	µg/L	<1
Benzo(g,h,i)perylene	µg/L	<1
Surrogate p-Terphenyl-d_{14}	%	81

HM in water - dissolved		
Our Reference:	UNITS	41145-1
Your Reference	----------	101-GW
Date Sampled	----------	17/05/2010
Type of sample		Water
Date prepared	-	20/5/10
Date analysed	-	20/5/10
Arsenic-Dissolved	µg/L	<1
Cadmium-Dissolved	µg/L	<0.1
Chromium-Dissolved	µg/L	<1
Copper-Dissolved	µg/L	8
Lead-Dissolved	µg/L	15
Mercury-Dissolved	µg/L	<0.5
Nickel-Dissolved	µg/L	<1
Zinc-Dissolved	µg/L	12

Metals in Waters - Acid extractable		
Our Reference:	UNITS	41145-1
Your Reference	----------	101-GW
Date Sampled	----------	17/05/2010
Type of sample		Water
Date prepared	-	21/05/10
Date analysed	-	21/05/10
Iron - Total	mg/L	53
Manganese - Total	mg/L	2.9

Miscellaneous Inorganics		
Our Reference:	UNITS	41145-1
Your Reference	----------	101-GW
Date Sampled	----------	17/05/2010
Type of sample		Water
Date prepared	-	19/5/2010
Date analysed	-	24/5/2010
pH	pH Units	6.5
Oil & Grease (LLE)	mg/L	<5
Ferrous Iron	mg/L	9.1

Method ID	Methodology Summary
GC.16	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS.
GC.3	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID.
GC.12 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
Metals.22 ICP-MS	Determination of various metals by ICP-MS.
Metals.21 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Metals.20 ICP-AES	Determination of various metals by ICP-AES.
LAB.1	pH - Measured using pH meter and electrode in accordance with APHA 20th ED, 4500-H+.
LAB.3	Oil & Grease - determine gravimetrically following extraction with Hexane/tert-Methyl Butyl Ether, in accordance with APHA 20th ED, 5220-B.
LAB.76	A sample is determined colourimetrically by discrete analyser.

QUALITY CONTROL vTPH & BTEX in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			20/5/10	[NT]	[NT]	LCS-W1	20/5/10
Date analysed	-			20/5/10	[NT]	[NT]	LCS-W1	20/5/10
TPH C_6 - C_9	µg/L	10	GC.16	<10	[NT]	[NT]	LCS-W1	94%
Benzene	µg/L	1	GC.16	<1.0	[NT]	[NT]	LCS-W1	94%
Toluene	µg/L	1	GC.16	<1.0	[NT]	[NT]	LCS-W1	93%
Ethylbenzene	µg/L	1	GC.16	<1.0	[NT]	[NT]	LCS-W1	93%
m+p-xylene	µg/L	2	GC.16	<2.0	[NT]	[NT]	LCS-W1	95%
o-xylene	µg/L	1	GC.16	<1.0	[NT]	[NT]	LCS-W1	93%
Surrogate Dibromofluoromethane	%		GC.16	100	[NT]	[NT]	LCS-W1	100%
Surrogate toluene-d8	%		GC.16	98	[NT]	[NT]	LCS-W1	99%
Surrogate 4-BFB	%		GC.16	97	[NT]	[NT]	LCS-W1	100%

QUALITY CONTROL sTPH in Water (C10-C36)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			21/5/10	[NT]	[NT]	LCS-W2	21/5/10
Date analysed	-			21/5/10	[NT]	[NT]	LCS-W2	21/5/10
TPH C_{10} - C_{14}	µg/L	50	GC.3	<50	[NT]	[NT]	LCS-W2	77%
TPH C_{15} - C_{28}	µg/L	100	GC.3	<100	[NT]	[NT]	LCS-W2	128%
TPH C_{29} - C_{36}	µg/L	100	GC.3	<100	[NT]	[NT]	LCS-W2	97%
Surrogate o-Terphenyl	%		GC.3	109	[NT]	[NT]	LCS-W2	102%

QUALITY CONTROL PAHs in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			21/05/2010	[NT]	[NT]	LCS-W1	21/05/2010
Date analysed	-			21/05/2010	[NT]	[NT]	LCS-W1	21/05/2010
Naphthalene	µg/L	1	GC.12 subset	<1	[NT]	[NT]	LCS-W1	83%
Acenaphthylene	µg/L	1	GC.12 subset	<1	[NT]	[NT]	[NR]	[NR]
Acenaphthene	µg/L	1	GC.12 subset	<1	[NT]	[NT]	[NR]	[NR]
Fluorene	µg/L	1	GC.12 subset	<1	[NT]	[NT]	LCS-W1	91%
Phenanthrene	µg/L	1	GC.12 subset	<1	[NT]	[NT]	LCS-W1	91%
Anthracene	µg/L	1	GC.12 subset	<1	[NT]	[NT]	[NR]	[NR]
Fluoranthene	µg/L	1	GC.12 subset	<1	[NT]	[NT]	LCS-W1	84%
Pyrene	µg/L	1	GC.12 subset	<1	[NT]	[NT]	LCS-W1	95%

QUALITY CONTROL PAHs in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Benzo(a)anthracene	µg/L	1	GC.12 subset	<1	[NT]	[NT]	[NR]	[NR]
Chrysene	µg/L	1	GC.12 subset	<1	[NT]	[NT]	LCS-W1	99%
Benzo(b+k)fluoranthene	µg/L	2	GC.12 subset	<2	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	µg/L	1	GC.12 subset	<1	[NT]	[NT]	LCS-W1	98%
Indeno(1,2,3-c,d)pyrene	µg/L	1	GC.12 subset	<1	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	µg/L	1	GC.12 subset	<1	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	µg/L	1	GC.12 subset	<1	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%		GC.12 subset	74	[NT]	[NT]	LCS-W1	85%

QUALITY CONTROL HM in water - dissolved	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD
Date prepared	-			20/5/10	41145-1	20/5/10 || 20/5/10
Date analysed	-			20/5/10	41145-1	20/5/10 || 20/5/10
Arsenic-Dissolved	µg/L	1	Metals.22 ICP-MS	<1	41145-1	<1 || <1
Cadmium-Dissolved	µg/L	0.1	Metals.22 ICP-MS	<0.1	41145-1	<0.1 || <0.1
Chromium-Dissolved	µg/L	1	Metals.22 ICP-MS	<1	41145-1	<1 || <1
Copper-Dissolved	µg/L	1	Metals.22 ICP-MS	<1	41145-1	8 || 8 || RPD: 0
Lead-Dissolved	µg/L	1	Metals.22 ICP-MS	<1	41145-1	15 || 16 || RPD: 6
Mercury-Dissolved	µg/L	0.5	Metals.21 CV-AAS	<0.5	41145-1	<0.5 || <0.5
Nickel-Dissolved	µg/L	1	Metals.22 ICP-MS	<1	41145-1	<1 || <1
Zinc-Dissolved	µg/L	1	Metals.22 ICP-MS	<1	41145-1	12 || 9 || RPD: 29

QUALITY CONTROL Metals in Waters - Acid extractable	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			21/05/10	[NT]	[NT]	LCS-W1	21/05/10
Date analysed	-			21/05/10	[NT]	[NT]	LCS-W1	21/05/10
Iron - Total	mg/L	0.02	Metals.20 ICP-AES	<0.02	[NT]	[NT]	LCS-W1	106%
Manganese - Total	mg/L	0.01	Metals.20 ICP-AES	<0.01	[NT]	[NT]	LCS-W1	107%

QUALITY CONTROL Miscellaneous Inorganics	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			19/5/2010	41145-1	19/5/2010 || 19/5/2010	LCS-W1	19/5/2010
Date analysed	-			24/5/2010	41145-1	24/5/2010 || 24/5/2010	LCS-W1	24/5/2010
pH	pH Units		LAB.1	[NT]	41145-1	6.5 || [N/T]	LCS-W1	100%
Oil & Grease (LLE)	mg/L	5	LAB.3	<5	41145-1	<5 || [N/T]	LCS-W1	93%
Ferrous Iron	mg/L	0.10	LAB.76	<0.10	41145-1	9.1 || 9.3 || RPD: 2	LCS-W1	96%

QUALITY CONTROL HM in water - dissolved	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	LCS-W1	20/5/10
Date analysed	-	[NT]	[NT]	LCS-W1	20/5/10
Arsenic-Dissolved	µg/L	[NT]	[NT]	LCS-W1	103%
Cadmium-Dissolved	µg/L	[NT]	[NT]	LCS-W1	105%
Chromium-Dissolved	µg/L	[NT]	[NT]	LCS-W1	102%
Copper-Dissolved	µg/L	[NT]	[NT]	LCS-W1	97%
Lead-Dissolved	µg/L	[NT]	[NT]	LCS-W1	101%
Mercury-Dissolved	µg/L	[NT]	[NT]	LCS-W1	120%
Nickel-Dissolved	µg/L	[NT]	[NT]	LCS-W1	98%
Zinc-Dissolved	µg/L	[NT]	[NT]	LCS-W1	99%

Report Comments:

Asbestos was analysed by Approved Identifier: Not applicable for this job
Asbestos was authorised by Approved Signatory: Not applicable for this job
INS: Insufficient sample for this test NT: Not tested PQL: Practical Quantitation Limit <: Less than >: Greater than
RPD: Relative Percent Difference NA: Test not required LCS: Laboratory Control Sample NR: Not requested

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria:

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the sample batch were within laboratory acceptance criteria.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable. Surrogates: 60-140% is acceptable for general organics and 10-140% for

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

SAMPLE RECEIPT ADVICE

Client:

Douglas Partners
96 Hermitage Rd
West Ryde NSW 2114

ph: 02 9809 0666
Fax: 02 9809 4095

Attention: Kurt Plambeck

Sample log in details:

Your reference:	**71529.01, Opera House VAPS**
Envirolab Reference:	**41145**
Date received:	18/05/10
Date results expected to be reported:	**25/05/10**

Samples received in appropriate condition for analysis:	YES
No. of samples provided	6 Waters
Turnaround time requested:	Standard
Temperature on receipt	Cool
Cooling Method:	Ice

Comments:

Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples.

Contact details:

Please direct any queries to Aileen Hie or Jacinta Hurst
ph: 02 9910 6200 fax: 02 9910 6201
email: ahie@envirolabservices.com.au or jhurst@envirolabservices.com.au

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BD6

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Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY

Project Name: Opera House VAPS Project.....
Project No: ...71529.01..... Sampler: ...KDP..... .....
Project Mgr: ...KP.....Mob. Phone: 0402 057 147 .....
Email: kurt.plambeck@douglaspartners.com.au .....
Date Required: ...standard ..... Lab Quote No. .....

To: Envirolab Services
12 Ashley Street, Chatswood NSW 2068
Attn: Tania Notaras
Phone: 02 9910 6200 Fax: 02 9910 6201
Email: tnotaras@envirolabservices.com.au

Sample ID	Sample Depth	Lab ID	Sampling Date	Sample Type S - soil W – water	Container type	Analytes: Heavy metals	TRH BTEX	PAH	Oil and grease	pH	Mn, Fe (total and Ferrous)				Notes
101-GW		1	17/5	S	G	✓	✓	✓	✓	✓	✓				
FB		2													
BD5		3													
BD6		4													
TB		5					✓								
TS		6					✓								

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: 9910 6200

Job No: 41145
Date received: 18/5/10
Time received: 4pm
Received by: Z.L.
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Lab Report No. .....
Send Results to: Douglas Partners Address: 96 Hermitage Road, West Ryde 2114
Phone: (02) 9809 0666
Fax: (02) 9809 4095

Relinquished by:	Signed:	Date & Time:	Received By: Z.L.	Date & Time: 18/5/10 4pm
Relinquished by:	Signed:	Date & Time:	Received By:	Date & Time:

APPENDIX F
Quality Assurance/Quality Control Procedures and Results

QA/QC PROCEDURES AND RESULTS

Data Quality Objectives

The scope of the Preliminary Contamination Assessment has been devised broadly in accordance with the seven step data quality objective process, as defined in Australian Standard "*Guide to the Sampling and Investigation of Potentially Contaminated Soil Part 1: Non-volatile and semi-volatile compounds* (AS 4482.1 – 1997). The DQO process is outlined as follows:

(1) State the Problem

The "problem" is to characterise the nature and extent of contamination, if any in in the works area for the VAPS project, and to determine if the site is suitable for the proposed development.

(2) Identify the Decision

The suitability of the site for redevelopment and the scope of the required remedial works will be assessed against the SAC and GIL provided in Section 9.

(3) Identify Inputs to the Decision

The primary inputs in assessing the requirements for assessing the suitability of the site for the proposed development will be:

- Available site Information regarding activities undertaken on the site and the surrounding area;
- Results of previous investigations;
- Results from the current round of investigation as detailed in the scope of works;
- The local geology, topography and hydrology;
- Potential contaminants;
- Published guidelines for assessing soil and groundwater quality;
- Field observations/measurements, field mapping and analytical results.

(4) Define the Boundary of the Assessment

The site is identified as the works areas for the VAPS project within the forecourt of the Sydney Opera House Described in Section 4. The site is presented in the Drawing 1, Appendix A

(5) Develop a Decision Rule

The decision rule is the comparison of the analytical results against relevant published guideline criteria including:

i) NSW DECC *Guidelines for the NSW Site Auditor Scheme 2nd edition* (2006);

ii) NSW DECC *Guidelines for Assessing Service Station Sites (1994);*

iii) ANZECC *Guidelines for Fresh and Marine Water Quality* ANZECC (2000) for the protection of 95% of species; and

iv) Other screening references including Commonwealth legislation – the *Airports Act* (1997), *Airport (Environment Protection) Schedule 2 Water Pollution Accepted Limits: Table 1.03*; Dutch Intervention Value (Dutch IV) from the *Environmental Quality Standards in the Netherlands* 1999 and USEPA *Region IX modified Preliminary Remediation Goals* (PRG).

These assessment criteria will be used to evaluate whether the site is compatible with the current and intended land use from a contamination standpoint.

(6) Specify Acceptable Limits on Decision Errors

In order to ensure the quality of the soil and groundwater data, appropriate and adequate quality assurance and quality control (QA/QC) measures and evaluations should be incorporated into the validation sampling and testing regime.

A field and laboratory QA/QC regime, comprising the collection and analysis of Inter-laboratory duplicate / replicate samples, Intra-laboratory duplicate / replicate samples will be implemented to meet the requirements associated with the following data quality indicators (DQIs).

- conformance with specified holding times;
- accuracy of spiked samples within the laboratory's acceptable range (typically 70-130% for inorganic contaminants and greater for some organic contaminants);
- field and laboratory duplicates and replicates samples will have a precision average of +/- 30% relative percent difference (RPD) for inorganic analytes and +/- 50% RPD for organic analytes;
- field replicates will be collected at a frequency of 10% of all samples; and
- no evidence of significant cross contamination during sampling or handling activities

(7) Optimise the Design for Obtaining Data

The purpose of the current investigation is to provide representative information within the VAPS works area, subject to current site access restrictions. The sampling programme has a targeted approach within the VAPS works area (rather then across the entire Opera House Site) in accessible locations. The proposed sampling locations are provided in Drawing 1, Appendix A.

Procedures for the collection of environmental samples, as described in Section 8, were developed prior to undertaking the assessment phase of works, which were in line with NSW EPA guidelines and current industry practice. DP employs NATA-accredited analytical laboratories to conduct sample analysis. Envirolab Services Pty Ltd was employed to conduct primary sample analysis and Labmark Pty Ltd was employed to conduct interlaboratory sample analysis.

It is therefore considered that the data quality of assessment was of a satisfactory standard.

Quality assurance and control formed an integral part of this assessment. The results of the QA/QC assessments are detailed below.

The Data Quality Indicators (DQI's) have been addressed as follows in Table F1.

Table F1 – DQIs and Evaluation Procedures

DQI	Evaluation Procedure
Documentation completeness	Completion of field and laboratory documentation including chain of custody, test bore reports.
Data completeness	Sampling at an appropriate density as per the requirements of the *Sampling Design Guidelines*, analysis of appropriate contaminants, analysis of appropriate soil horizons, analysis of appropriate QA samples etc
Data comparability	Use of NATA accredited analytical methods, use of consistent sampling technique, commitment to equipment decontamination, field sample storage techniques etc.
Data representativeness	Sampling from targeted areas and a broad grid pattern across the site in order to obtain samples representative of contamination present.
Precision and accuracy for sampling and analysis	Use of NATA accredited analytical methods, achievement of 30-50% RPD for replicate analysis (as appropriate) and achievement of laboratory QC criteria.

As indicated above, the DQIs for sampling and analysis were achieved and the quality of the data satisfactorily meets the objectives of the current assessment.

Q1 - FIELD QUALITY ASSURANCE AND QUALITY CONTROL

The field QC procedures for sampling as prescribed in Douglas Partners *Field Procedures Manual* were followed at all times during the assessment.

Q1.1 Sampling Team

Field sampling was undertaken by DP Environmental Scientist Kurt Plambeck. Soil samples were collected from test bores on 17 and 24 May 2010. The piezometer (201) was installed on 17 December 2009 during a previous geotechnical investigation. The piezometer was developed and sampled on 17 May 2010. Sampling was undertaken during fine or slightly overcast weather conditions.

Q1.2 Sample Collection

Sample collection procedures and dispatch for soil and groundwater are reported in Section 5.3.

Q1.3 Logs

Logs for each sampling location were recorded in the field. The individual samples were recorded on the field logs along with the sample identity, location, depth, initials of sampler, duplicate locations, duplicate type, site observations. Analysis to be performed on each sample and the dispatch courier were recorded on the COC, Appendix E. Logs are presented in Appendix D. Groundwater field sheets are presented in Appendix G.

Q1.4 Chain of Custody

Chain of custody information was recorded on the Chain of Custody (COC) sheets and accompanied samples to the analytical laboratory. Signed copies of COCs are presented in Appendix E, following the laboratory reports.

Q1.5 Sample Splitting Techniques

Replicate samples were collected in the field as a measure of accuracy, precision and repeatability of the results. Field replicate samples for soil were collected from the same location and an identical depth to the primary sample. Equal portions of

the primary sample were placed into the sampling jars and sealed. The sample was not homogenised in a bowl and then split to prevent the loss of volatiles from the soil. Replicate samples were labelled with a DP identification number, recorded on DP bore logs, so as to conceal their relationship to their primary sample from the analysing laboratory. Groundwater replicate collection involved filling two sample containers by decanting approximately equal portions of the primary sample.

Q1.6 Duplicate Frequency

Field sampling comprised replicate sampling, at a rate of approximately one duplicate sample for every ten original samples for intra-laboratory analysis, one duplicate/triplicate sample for every 10 samples for inter-laboratory analysis, trip spikes, trip blanks and a rinsate sample from the groundwater pump during groundwater sampling.

Q1.7 Field Blank Results

A field blank is a sample taken as an indication to demonstrate correct field handling. A rinsate sample was collected as the field blank to demonstrate correct decontamination procedures were undertaken during groundwater sampling. This is further discussed in Section Q1.9.

Q1.8 Background Sample

A background sample is representative of natural background soil conditions. Background samples were not applicable as part of this assessment as the land at the site and in the surrounding area have been developed over a significant period of time and not in a natural state.

Q1.9 Rinsate Samples

Decontamination was carried out between groundwater and soil sampling events and on augurs between test bores. New tubing was used to sample the groundwater. No rinsate sample was collected, but sample results were examined for signs if cross contamination between sample events. There was no evidence that cross contamination had occurred. It is therefore considered that suitable decontamination techniques were employed.

Q1.10 Trip Spikes

According to *the NSW EPA Guidelines for Consultants Reporting on Contaminated Sites (1997)*, laboratory prepared trip spikes are to be taken into the field, subjected to the same preservation methods as the field samples, then analysed, for the purposes of determining the losses in volatile organics incurred prior to reaching the laboratory.

The practicalities of trip spikes are currently being debated and a detailed procedure is yet to be finalised. Discussions with the laboratory indicated that trip spikes are generally prepared as aqueous solutions. The laboratory prepared an aqueous trip spike and a soil trip spike which were preserved in the standard manner and taken into the field unopened. The volatile organic recovery rates are shown below. At this stage, the laboratory has no standard acceptance limits in recovery rates as results from in-house laboratory controls often vary. Results (Table Q1) indicate that the percentage loss for BTEX during the trip was minimal and therefore appropriate preservation techniques were employed.

Table Q1 – Trip Spike Results

Sample ID	Matrix	Recovery (%)				
		Benzene	Toluene	Ethyl Benzene	m+p xylene	o xylene
Trip Spike 170510	soil	94	97	95	96	95
Trip Spike 170510	water	73	77	76	75	76
Trip Spike 240510	soil	100	122	104	104	104

Q1.11 Trip Blanks

Laboratory prepared soil and water trip blanks were taken out to the field unopened, subjected to the same preservation methods as the field samples, then analysed for the purposes of determining the transfer of contaminants into the blank sample incurred prior to reaching the laboratory. The result of the laboratory analysis for the trip blanks is shown in Table Q2.

Table Q2 Trip Blank Results – TPH/BTEX mg/kg (water µg/L)

Sample ID	Matrix	TPH	BTEX			
		C6-C9	Benzene	Toluene	Ethyl Benzene	Xylenes
Trip Blank 170510	soil	<25	<0.5	<0.5	<1	<3
Trip Blank 170510	water	<10	<1	<1	<1	<3
Trip Blank 240510	soil	-	<0.5	<0.5	<1	<3

Levels of analytes were all below detection limits indicating that cross contamination had not occurred during the course of the round trip from the site to the laboratory.

Q1.12 Field Instrument Calibration

The groundwater parameters were measured with a 90FL-T water quality meter. The water quality meter was calibrated at Enviroequip on 17/12/09 and the pH meter was calibrated prior to use in the field with pH buffer solutions of 4 and 10. The calibration certificate can be found in Appendix G.

All soil samples were screened for the presence of Total Photo-Ionisable Compounds (TOPIC) using a calibrated Photo-Ionisation Detector (PID). The PID was calibrated at Enviroequip and in the field with Isobutylene gas. The calibration certificate and daily calibration records can be found in Appendix G.

Q1.13 Relative Percentage Difference

A measure of the consistency of results for field samples is derived by the calculation of relative percentage differences (RPDs) for duplicate samples. A RPD of ± 30% is generally considered typically acceptable for inorganic analytes by EPA, although in general a wider RPD range (50%) may be acceptable for organic analytes.

Q1.13.1 Intra-Laboratory Analysis

Intra-laboratory duplicates were conducted as an internal check of the reproductively within the primary laboratory (Envirolab Pty Ltd) and as a measure of consistency of

sampling techniques. Replicate samples were collected at a rate of approximately one replicate sample for every ten original samples collected and also analysed at a rate of 5% of primary samples analysed.

The comparative results of analysis between original and duplicate samples are summarised in the tables below.

Table Q3 – Intra-laboratory Results Heavy Metals

	As	Cd	Cr[1]	Cu	Pb	Hg	Ni	Zn
102/1.0	<4	<0.5	13	22	25	0.8	7	17
BD/201209	<4	<0.5	12	19	32	0.9	8	18
Difference	0	0	1	3	7	0.1	1	1
RPD (%)	**0**	**0**	**8**	**17**	**25**	**12**	**13**	**6**
205/0.3-0.5	<4	<0.5	11	37	45	<0.1	14	58
BD4 170510	<4	<0.5	10	60	43	0.2	31	67
Difference	0	0	1	23	2	0.1	17	9
RPD (%)	**0**	**0**	**10**	**47**	**5**	**67**	**76**	**14**
206/0.4-0.5	<4	<0.5	7	22	41	0.1	5	31
BD1 240510	<4	<0.5	7	38	130	0.5	16	110
Difference	0	0	0	16	89	0.4	9	79
RPD (%)	**0**	**0**	**0**	**53**	**104**	**133**	**86**	**112**

Table Q4 – Intra-laboratory Results PAH, TPH and BTEX

	B(a)P[2]	Total +ve PAH[3]	C6-C9	C10-C36	Benzene	Toluene	Ethylbenzene	Total Xylene
102/1.0	1.3	14.7	<25	<250	<0.5	<0.5	<1	<3
BD/201209	1.4	15.1	<25	<250	<0.5	<0.5	<1	<3
Difference	0.1	0.4	0	0	0	0	0	0
RPD (%)	**7**	**3**	**0**	**0**	**0**	**0**	**0**	**0**
205/0.3-0.5	16	177.7	<25	1420	<0.5	<0.5	<1	<3
BD4 170510	18	222.4	<25	1440	<0.5	<0.5	<1	<3
Difference	2	44.7	0	0	0	0	0	0
RPD (%)	**12**	**22**	**0**	**0**	**0**	**0**	**0**	**0**
206/0.4-0.5	0.07	0.37	<25	<250	<0.5	<0.5	<1	<3
BD1 240510	0.7	5.5	<25	<250	<0.5	<0.5	<1	<3
Difference	0.63	5.13	0	0	0	0	0	0
RPD (%)	**164**	**175**	**0**	**0**	**0**	**0**	**0**	**0**

Table Q5 – Intra-laboratory Results – OCP and Asbestos

	OCP	Asbestos
102/1.0	<0.1	Nil detected
BD/201209	<0.1	Nil detected
Difference	0	0
RPD (%)	**0**	**0**

Most of calculated RPD values were within the acceptable range of ± 30 for inorganic analytes (± 50% for organic) for the sample and its duplicates with the exception of those shaded. However, this is not considered to be of concern due to:

- The low actual differences in the concentrations of the replicate pairs;
- Replicates, rather than homogenised duplicates were used to avoid volatile loss;
- Some of the duplicate samples being collected in filling material which is heterogeneous in nature, therefore differences are representative of the material and not the result inconsistencies in the sampling technique or laboratory precision; and
- Most of the recorded concentrations being at/ close to the practical quantitation limit.
- All other QA/QC parameters met the DQI's

It is therefore considered that the results indicate an acceptable consistency between the samples and their duplicates and indicate that suitable field sampling methodology was adopted and laboratory precision was achieved.

Q1.13.2 Inter-Laboratory Analysis

Inter-laboratory duplicates were conducted as a check of the reproductively of results between the primary laboratory (Envirolab Pty Ltd) and a secondary laboratory (Labmark Pty Ltd) and as a measure of consistency of sampling techniques. Inter-laboratory duplicates were collected at a rate at least one replicate sample for every 5 original samples collected and also analysed at a rate of 5% of primary samples analysed. Primary chemicals of concern were analysed at a higher frequency to other chemicals.

The comparative results of analysis between original and inter-laboratory duplicates are summarised in the tables below. Note that where the laboratory PQL are different and both samples are below PQL (or one sample is below PQL and other has a recorded detection below the other lab PQL) the difference and RPD has been given as zero (0).

Table Q6 Inter-laboratory Results Heavy Metals

	As	Cd	Cr[1]	Cu	Pb	Hg	Ni	Zn
204/0.8-1.0	<4	<0.5	13	6	12	<0.1	6	17
BD2 170510	<1	0.2	9	4	10	<0.05	4	21
Difference	0	0	4	2	2	0	2	4
RPD (%)	**0**	**0**	**36**	**40**	**18**	**0**	**40**	**21**

Table Q7 Inter-laboratory Results PAH, TPH and BTEX

	B(a)P[2]	Total +ve PAH[3]	C6-C9	C10-C36	Benzene	Toluene	Ethylbenzene	Total Xylene
204/0.8-1.0	0.1	1.1	<25	<250	<0.5	<0.5	<1	<3
BD2 170510	<0.5	<0.5	<10	<250	<0.2	<0.5	<0.5	<1.5
Difference	0	0	0	0	0	0	0	0
RPD (%)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Most of calculated RPD values were within the acceptable range of ± 30 for inorganic analytes (± 50% for organic) for the sample and its duplicates with the exception of those shaded. However, this is not considered to be of concern due to:

- The low actual differences in the concentrations of the replicate pairs;
- Replicates, rather than homogenised duplicates were used to avoid volatile loss;
- The duplicate samples being collected in filling material which is heterogeneous in nature, therefore differences are representative of the material and not the result inconsistencies in the sampling technique or laboratory precision; and
- Most of the recorded concentrations being at/ close to the practical quantitation limit.
- All other QA/QC parameters met the DQI's

It is therefore considered that the results indicate an acceptable consistency between the samples and their duplicates and indicate that suitable field sampling methodology was adopted and laboratory precision was achieved.

Q2 - LABORATORY QUALITY ASSURANCE AND QUALITY CONTROL

Q2.1 Chain of Custody

Chain of custody information was recorded on the Chain of Custody (COC) sheets and accompanied samples to the analytical laboratory. COCs contained receipt date and time and the identity of samples. Signed copies of COCs are presented in Appendix E, following the laboratory reports.

Q2.2 Holding Times

A review of the laboratory report sheets and chain-of-custody documentation indicated that holding times were met, as summarised in the table below.

Table Q8 - Holding Times

Matrix	Analyte	Recommended maximum holding time	Holding time met
Soil	Heavy Metals: As, Cd, Cr, Cu, Pb, Hg, Ni, Zn	6 months	Yes
	TPH C_6-C_9	14 days	Yes
	TPH C_{10}-C_{36}	14 days	Yes
	VOC	14 days	Yes
	BTEX	14 days	Yes
	PAH	14 days	Yes
	OCP	14 days	Yes
	OPP	14 days	Yes
	PCB	14 days	Yes
	Phenols	14 days	Yes
	pH	7 days	Yes
	Asbestos	Nil	yes
Water	Metals	6 months	yes
	TPH C_6-C_9	14 days	yes
	TPH C_{10}-C_{36}	7 days	yes
	BTEX	14 days	yes
	PAH	7 days	yes

Q2.3 Analytical Laboratory

Samples were submitted to the following laboratories for analysis:

- Primary Laboratory: Envirolab Services Pty Ltd (Chatswood);
- Secondary Laboratory: Labmark Environmental Laboratories (Asquith)

Both laboratories are NATA accredited. Envirolab's accreditation number is 2901 and is accredited for compliance with ISO/IEC 17025. Envirolab tests comply with NATA and NEPM. In house procedures are employed by Envirolab in the absence of documented standards.

Labmark's NATA accreditation number is: 13542. NATA accredited in-house laboratory methods are referenced from NEPC, ASTM, modified USEPA/ APHA documents.

Q2.4 Analytical Methods

The laboratory analytical methods are provided on the laboratory certificates in Appendix H and summarised below in Tables Q9 and Q10:

Table Q9 - Soil Analysis

Analyte	Limit of Reporting (mg/kg) Envirolab/labmark	Envirolab Reference Method	Labmark Reference Method
Heavy Metals Cd, Cr, Cu, Pb, Ni, Zn	1.0/0.1-5.0	Metals.20 ICP-AES	E022.2 digested in nitric/hydrochloric acid, analysis by ICP-MS
Arsenic (As)	4.0/1.0	Metals.20 ICP-AES	E022.2 digested in nitric/hydrochloric acid, analysis by ICP-MS
Mercury (Hg)	0.10/0.05	Metals.21 ICP-AAS	E026.2 digested in nitric/hydrochloric acid, analysis by CV-ICP-MS or FIMS
VOC	0.5-10/0.5-5.0	GC.14	E016.2 methanol extraction, analysis by P&T/GC/MS
TPH C_6-C_9	25/10	GC.16	E029.2/E016.2 methanol extraction, analysis by P&T/GC/FID/MSD
TPH C_{10}-C_{36}	250/250	GC.3	E006.2 DCM/Acetone/Hexane (10:45:45) extraction, analysis by GC/FID
BTEX	0.5-2/0.2-1.0	GC.14	E002.2 methanol extraction, analysis by P&T/GC/PID/MSD
OCP	0.1/0.05	GC-5	E013.2 DCM/Acetone/Hexane (10:45:45) extraction, analysis by GC/dual ECD
OPP	0.1/0.5-1.0	GC.8	E014.2 DCM/Acetone/Hexane (10:45:45) extraction, analysis by GC/MSD
PCB	0.1/0.5	GC-6	E013.2 DCM/Acetone/Hexane (10:45:45) extraction, analysis by GC/dual ECD
PAH	0.05-0.1/0.5-1.0	GC.12 subset	E007.2 DCM/Acetone/Hexane (10:45:45) extraction, analysis by GC/MS
Phenols	1-10/0.5-1.0	GC.12	E008.2 DCM/Acetone/Hexane (10:45:45) extraction, analysis by GC/MS
Asbestos	qualitative identification	AS4964-2004, qualitative identification using Polarised Light Microscopy and Dispersion Staining Techniques.	Not analysed
VOC	1-10	P&T and GC/MS	-

Table Q10 - Groundwater Analysis

Analyte	Limit of Reporting (µg/L) Envirolab/labmark	Envirolab Reference Method	Labmark Reference Method
Heavy Metals, As, Cd, Cr, Cu, Pb, Ni, Zn	0.1-1.0/0.5-5.0	Metals.22 ICP-MS	E022.1 digested in nitric/hydrochloric acid, analysis by ICP-MS
Mercury (Hg)	0.5-0.1	Metals.21 CV-AAS	E026.1 digested with nitric/hydrochloric acid, analysis by CV-ICP-MS or FIMS
VOC	1-10/5-50	GC.13	E016.1 direct analysis by P&T/GC/MS
BTEX	1-2/5-10	GC.13	E016.1 direct analysis by P&T/GC/MS
TPH C_6-C_9	10/50	GC.16	E003.1 direct injection into P&T/GC/FID
TPH C_{10}-C_{36}	250/250	GC.3	E004.1 triple extraction with DCM, analysis by GC/FID
PAH	0.1-0.2	GC.12 subset	E007.1: triple extraction with DCM, analysis by GC/MS
PCB	0.01	Ext-020	E013.2 DCM/Acetone/Hexane (10:45:45) extraction, analysis by GC/dual ECD
pH	0.1	LAB.1	Not analysed
OCP	0.001	Ext-020	E014.2 DCM/Acetone/Hexane (10:45:45) extraction, analysis by GC/MSD

The following QA/QC procedures were conducted by the laboratory. The results are included in the laboratory reports in Appendix E.

Q2.5 Surrogate Spike

This sample is prepared by adding a known amount of surrogate, which behaves similarly to the analyte, prior to analysis to each sample. The recovery result indicates the proportion of the known concentration of the surrogate that is detected during analysis. These results are within acceptance limits as specified in Envirolab Services, indicating that the extraction technique was effective.

The laboratory acceptance criteria for surrogate samples is generally 60-140% for organics; and 10-140% for SVOC and speciated phenols.

Q2.6 Practical Quantitation Limits - PQLs

The PQL is the lowest quantity of an analyte which can be detected during the analysis. PQLs at different analytical laboratories can differ based on the analytical techniques.

Q2.7 Reference and Daily Check Sample Results - Laboratory Control Sample (LCS)

This sample comprises spiking either a standard reference material or a control matrix (such as a blank of sand or water) with a known concentration of specific analytes. The LCS is then analysed and results compared against each other to determine how the laboratory has performed with regard to sample preparation and analytical procedure. LCSs are analysed at a frequency of 1 in 20, with a minimum of one analysed per batch.

The laboratory acceptance criteria for LCS samples is generally 70-130% for inorganics/ metals; and 60-140% for organics; and 10-140% for SVOC and speciated phenols.

Q2.8 Laboratory Duplicate Results

These are additional portions of a sample which are analysed in exactly the same manner as all other samples. The laboratory acceptance criteria for duplicate samples is: in cases where the level is <5xPQL – any RPD is acceptable; and in cases where the level is >5xPQL – 0-50% RPD is acceptable.

Q2.9 Laboratory Blank Results

The laboratory blank, sometimes referred to as the method blank or reagent blank is the sample prepared and analysed at the beginning of every analytical run, following calibration of the analytical apparatus. This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, it can be determined by processing solvents and reagents in exactly the same manner as for samples. Laboratory blanks are analysed at a frequency of 1 in 20, with a minimum of one per batch.

Q2.10 Matrix Spike

This is a sample duplicate prepared by adding a known amount of analyte prior to analysis, and then treated exactly the same as all other samples. The recovery result indicates the proportion of the known concentration of the analyte that is detected during analysis. The laboratory acceptance criteria for matrix spike samples is generally 70-130% for inorganics/metals; and 60-140% for organics; and 10-140% for SVOC and speciated phenols.

Q2.11 Results of Laboratory QA

The laboratory QA for surrogate spikes, LCS, laboratory duplicate results, method blanks and matrix spikes were generally within the acceptance standards. There were, however a few comments made in the laboratory reports which are summarised in Table Q11 below.

Table Q11 - Laboratory QA Comments

Laboratory Report	Comment
ELS 36506	No comment
ELS 35506-A	No comment
ELS 41144	TPH RPD accepted due to non-homogeneous nature of sample. % recovery mo possible due to high concentration in samples causing interference
ELS 41144A	No comment
ELS 41145	No comment
ELS 41366	No comment
ELS 41366A	No comment
LM E048260	No comment

It was therefore considered that an acceptable level of laboratory precision and consistency was achieved and that surrogate spikes, LCS, laboratory duplicate results, method blanks and matrix spike results were of an acceptable level.

APPENDIX G
Calibration Certificates

ThermoFisher SCIENTIFIC

SERVICE OR REPAIR: 90-FLT

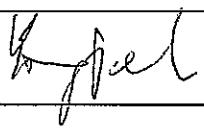
COMPANY	Douglas Partners Pty Ltd				
CONTACT	Wen Fei Yuan				
SERIAL NO.	S1753	CALL NO.	69420	RECEIVED	17/12/2009

REQUEST/PROBLEM DESCRIPTION
1. Add Redox parameter. 2. Check Turbidity sensor. 3. Service and calibration.

This equipment has been calibrated to the manufacturer's specifications, using the standards shown below:

PARAMETER	STANDARD	TRACEABILITY LOT NO.	PRE CALIBRATION READING	POST CALIBRATION READING
TEMPERATURE	24.1°C	-	23.6°C	24.1°C
pH	7.00		7.05	7.00
	4.00		3.98	4.00
CONDUCTIVITY	0.0µS/cm	-	-0.2µS/cm	0.0µS/cm
	2.76mS/cm		2.77mS/cm	2.76mS/cm
TDS	0.0ppm	-	0.0ppm	0.0ppm
	36.0ppk		35.7ppk	36.0ppk
DISSOLVED OXYGEN	0.00ppm		-0.10ppm	0.00ppm
	Air	-	9.04ppm	8.50ppm
TURBIDITY	0 NTU	-	-4NTU	0NTU
	360 NTU		349NTU	360NTU

COMMENTS/ADDITIONAL REPAIRS/SERVICES PERFORMED
1. Clean/decon the meter. 2. Sent to manufacturer TPS for assessment and repair. 3. Input connectors replaced. 4. pH sensor replaced due to noise. 5. DO membrane replaced. 6. Faulty charger replaced. 7. Tested/calibrated OK. 8. This older version 90FLT meter cannot be fitted with Redox range.

SERVICED BY	Yingjie Liu	COMPLETED	04/02/2010
SIGNATURE			

Phone: (Free Call) 1300 735 295 | Environmental Assessment Technologies | Fax: (Free Call) 1800 657 123

Melbourne Branch, 5 Caribbean Drive, Scoresby 3179, Email: RentalsEnviroVIC@thermofisher.com
Sydney Branch, Level 1, 4 Talavera Road, North Ryde 2113, Email: RentalsEnviroNSW@thermofisher.com
Adelaide Branch, 27 Beulah Road, Norwood, South Australia 5067, Email: RentalsEnviroSA@thermofisher.com
Brisbane Branch, Unit 2/5 Ross St, Newstead 4006, Email: RentalsEnviroQLD@thermofisher.com
Perth Branch, 121 Beringarra Ave, Malaga WA 6090, Email: RentalsEnviroWA@thermofisher.com

ACTIVE ENVIRONMENTAL **SOLUTIONS**

Alemir International Pty Ltd, trading as Active Environmental Solutions

Calibration and Service Report

Company:	Douglas Partners Pty Ltd	**Manufacturer:**	RAE Systems	**Serial #:**	590-000221
Contact:	Wenfei Yuan	**Instrument:**	MiniRAE Lite	**Part #:**	059-A110-000
Address:	96 Hermitage Road	**Model:**	PGM 7300	**Date Sold:**	3 July 2008
Suburb:	WEST RYDE NSW 2114	**Cal spec:**	STD	**Last Cal:**	27 August 2009
Phone:	(02) 9809 0666	**Configuration:**	VOC	**Job #:**	100-11304
Fax:	(02) 9809 4095	**Details:**	Pump	**Order #:**	87039
Email:	wenfei.yuan@douglaspartners.com.au				

Item	Test	Pass	Fail	Comments	Qty	Part code	Cost
Battery	NiCd, NiMH, Dry cell, Li Ion	✓		Li Ion SN: 167J2W0104			
	Charger, Power supply	✓		240VAC			
Pump	Flow	✓		>500ml/min			
Filter	Filter, fitting, etc	✓					
Alarms	Audible, visual, external	✓					
	Alarm code	✓					
Display	Operation	✓					
Switches	Operation	✓					
PCB	Operation	✓					
Connectors	Condition	✓					
Firmware	Version	✓		V1.05			
Datalogger	Operation	✓					
Case	Condition	✓					
Sensors							
Oxygen	Lo/Hi						
Toxic 1	Inst/STEL/TWA						
Toxic 2	Inst/STEL/TWA						
Toxic 3	Inst/STEL/TWA						
LEL	Alarm 1, Alarm 2						
%vol	Alarm 1, Alarm 2						
PID, IR, other	Alarm 1, Alarm 2	✓		10.6eV			
Other tests	PID Sensor		x	Moisture sensitive, replaced	1	023-3010-000	$290.00

Engineer's Report

PID sensor replaced
Pump checked; Lamp cleaned
Unit calibrated, unit serviceable

Parts Total	$290.00
Labour	
Calibration	$90.00
GST	$38.00
Total	$418.00

Calibration Certificate

Sensor	Type	Serial# Date Code	Span Gas	Concentration	Traceability Lot #	CF	Reading	
							Zero	Span
Oxygen			Air Nitrogen	20.9% 99.9%				
Toxic 1				ppm				
Toxic 2				ppm				
Toxic 3				ppm				
% LEL				% LEL				
% VOL				% VOL				
PID	10.6	106GA20365	Isobutylene	100ppm	28459-1-1		0	100

Calibrated/Repaired by: *Peter Donnellan*

Calibration/repair date: 29 January 2010

Next due: 29 July 2010

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FIELD PID CALIBRATION RECORD

Unit ID.....DP401.....

Date of Calibration.....17/5/10.....

Calibration Gas.....Isobutylene.....

Concentration Recorded.....98ppm.....

Calibrated by.....KP.....

Battery Charged (Yes)/No.....

Lamp OK (Yes)/No).....

Operated by.....KP.....

Signed.....KP.....

Douglas Partners
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FIELD PID CALIBRATION RECORD

Unit ID.....DP401.....

Date of Calibration.....24/5/10.....

Calibration Gas.....Isobutylene.....

Concentration Recorded.....101 ppm.....

Calibrated by.....KP.....

Battery Charged (Yes)/No.....

Lamp OK (Yes/No).....

Operated by.....KP.....

Signed.....